Managing the infrastructure gap: perceptions, challenges and strategies in Calgary and Edmonton

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Since the 1980's, concerns over the municipal 'infrastructure gap' or 'deficit' have been frequently raised by local governments in Canada and around the world. In response to the limited number of in-depth case studies on this topic, this thesis undertook a comparative analysis of the Cities of Calgary and Edmonton focusing on how these two municipalities understand, view the causes of, and are working to address, their local infrastructure gaps. Municipal councillors and administrators, as well as developer and community representatives, were interviewed to discuss their views on their respective city's infrastructure gap. Document analysis and descriptive statistics were employed to triangulate findings.

This thesis finds that both cities treat their infrastructure gap figures as high-level estimates subject to significant uncertainty and produced, at least in part, to assist with advocacy for increased intergovernmental capital transfers. Participants in both cities identified the following as contributing to their infrastructure gaps: growth and urban form, asset management challenges, political factors, and inadequate revenues. Participants frequently described infrastructure, particularly maintenance and renewal, as being "not sexy" politically and therefore difficult to adequately prioritize. Both cities exclusively report funding gaps for tax-supported (e.g., roads, public transit) infrastructure; neither city reports funding gaps for user fee-funded infrastructure (e.g., water utilities, waste and recycling). Despite this, no participant identified (the absence of) pricing as contributing to infrastructure gaps.

This thesis also finds that both case cities have, particularly in the last two decades, exerted substantial effort to improve their capital budgeting and asset management processes to optimize limited funding. Both cities' strategies correspond with understood causes of infrastructure gaps and include improved asset and growth management practices (particularly related to cost modeling), development of capital prioritization methods, cultivation of dedicated revenue streams (including

earmarked property tax increases and development charges), and advocacy for increased intergovernmental transfers.

In response to the above, the following recommendations are made: a national framework should be developed to monitor municipal service levels and associated service costs; municipalities should continue to improve their understanding of capital costs associated with urban growth and proper asset management; municipalities should improve the transparency of their capital budgeting and prioritization decisions; provinces should provide large, urban municipalities with additional own-source revenue tools to better respond to their infrastructure needs; and municipalities should seriously assess the feasibility of introducing pricing (e.g. road tolling) to fund needed infrastructure.

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Dedication

For Nina Sedorova (1925-2021).

Rest in peace, Grandma.

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Chapter 1: Introduction

Physical infrastructure underpins almost every aspect of contemporary life. This is particularly the case in urban areas around the world where roadways, transit systems, and other transportation facilities undergird most economic activity, and where energy and water networks deliver services vital to citizens' health and quality of life (Aschauer, 1990; Felbinger, 1995; Neuman & Smith, 2010; Srithongrung et al., 2019). Services such as electricity, clean drinking water, and transportation flow from these systems of wires, pipes, roads, public transport vehicles. In many parts of the world these services may easily be taken for granted, however, their importance comes into sharp relief when they are interrupted through dramatic failures, such as bridge collapses (Caron, 2018) or waterborne illness outbreaks (Woo & Vicente, 2003). These 'core local services' (and associated infrastructure systems) are provided by local governments in most countries (Dahlby & McMillan, 2019a; Kitchen, McMillan, et al., 2019a; Statistics Canada, 2019).

The state of Canada's municipal infrastructure has become a serious policy issue, especially where infrastructure has been badly affected by the local impacts of climate change. The growing threat of disasters is increasingly straining Canadian communities, with threats to infrastructure being identified as one of the country's most pressing climate risks (Council of Canadian Academies, 2019). Floods, hurricanes, wildfires, and other disasters that disrupt or destroy infrastructure are becoming increasingly common. Disruptions due to these climate events may in turn become more frequent, threatening the services that Canadians rely on to protect their health, safety, and economic wellbeing. Strengthening local infrastructure

networks to withstand these events is expected to cost several billions of dollars per year (FCM, 2020), on top of any pre-existing investment requirements.

Apart from climate concerns, many worry that the publicly owned capital assets Canadians rely on for a multitude of essential local services, such as transportation and clean drinking water, may not be fit for purpose over the medium-to-long term (Boadway & Kitchen, 2018; Mirza, 2007). Since the 1980's, these concerns have given rise to many attempts to assess Canadian municipalities' infrastructure 'deficits', 'debts' and 'gaps' (BCG Canada, 2017; Kitchen, 2003; Mintz & Roberts, 2004; Mirza & Ali, 2017). Though these terms are often used interchangeably in the literature, in this thesis an 'infrastructure gap' refers to an expected future shortfall between required capital expenditures and available resources, whereas an infrastructure 'deficit' or 'debt' refers to such shortfalls in the past. See Section 1.2 for additional discussion of definitions. The 'infrastructure gap', that is, future shortfalls, is the primary focus of this thesis as this is the figure most commonly published and discussed by municipalities.

This thesis focuses on the drivers behind Canada's 'municipal infrastructure gap' phenomenon, namely: how municipalities determine infrastructure investment needs, and what resources are available to support them. Three broad questions are posed. First, how do municipal stakeholders and decisionmakers understand their infrastructure gaps? Second, what do municipalities perceive to be the larger cause(s) of their infrastructure gaps? And third, how are municipalities addressing their infrastructure gaps?

1.1 Context

The COVID-19 pandemic has brought the importance of municipal infrastructure into sharp relief. At no other time in recent decades have citizens relied more on the provision of electricity, water and wastewater services, and public spaces than when sheltering in place. This underlines pre-existing concerns over Canada's municipal 'infrastructure gap', an idea which suggests that current investment in local infrastructure is not sufficient, and has not been for some time, to the detriment of Canadians' quality of life and economic productivity (Boadway & Kitchen, 2018; Hilton, 2007; Kitchen, 2003; Mintz & Roberts, 2004). The sufficiency of municipal infrastructure spending can be assessed in many ways (each with its own limitations), typically with reference to how well or poorly infrastructure is supporting service provision. For example, spending sufficiency can be measured through physical asset conditions, the frequency of infrastructure failures, periods of reduced service quality (for example traffic congestion) or, less directly, through figures such as net book values. See Chapter 2 for additional details.

Motivated in part by the above concerns (but also by economic stimulus objectives), Canadian governments writ large have increased spending on municipal and other infrastructure in recent decades (C4SE, 2017; CESD Canada, 2016; Stoney & Krawchenko, 2012). Until recently, these spending plans have rarely been supported, however, by the kinds of rigorous, evidence-based needs assessments increasingly conducted by other jurisdictions (Oughton et al., 2018; Wahba, 2011; Wegrich et al., 2017). In March 2021 the Government of Canada announced plans to conduct a National Infrastructure Assessment (NIA), an exercise

that would “identify needs and priorities for [Canada’s] infrastructure, and plan for a net-zero emissions future by 2050.” (Canada, 2021, p. 6).

As suggested above, the NIA’s announcement follows a decades-long period of steadily increasing public concern over infrastructure policy (Adams & Heinke, 1987; Mackenzie, 2013; Mirza & Ali, 2017; C. G. Vander Ploeg, 2013). Much of this concern has been fueled by debates over the existence of a structural municipal fiscal gap in Canada, whereby local governments are incapable of providing all necessary facilities due to limited own-source revenues and intergovernmental grants in light of expenditure pressures such as downloaded responsibilities from other orders of government (Hilton, 2007; Leung, 1998; Slack & Tassonyi, 2017).

There is broad agreement that in recent decades, public investment in Canada’s roadways, wastewater treatment systems, and mass transit systems (most of which are owned by municipal governments) has been inadequate (Boadway & Kitchen, 2018; Kitchen, McMillan, et al., 2019b; Mirza, 2007; Slack & Tassonyi, 2017). In this way, ‘adequacy’ can in general be understood as the degree to which an infrastructure system is able to serve its purpose(s), which may evolve over time (Boadway & Kitchen, 2018).

Beyond agreement over the existence of unmet municipal infrastructure needs, fault lines have emerged over how to properly measure and evaluate these unmet needs, and what exact policy solutions might help to address them (Kitchen, McMillan, et al., 2019b). Many authors blame the emergence of these unmet infrastructure needs on reduced federal and provincial capital spending beginning in the 1980’s and stretching through to the mid-2000’s (Mackenzie, 2013; Mirza, 2007), coupled with Canadian municipalities’ lack of fiscal capacity

(Sancton & Young, 2009). Other factors, such as urbanization, population growth, and climate change, are often cited as exacerbating factors.

Planners, with their generalist skillsets, experience in political mediation and facilitation of complex interdisciplinary processes, are uniquely well-equipped to address the complex problem of addressing Canada's municipal infrastructure challenges. Though planning's historic interest in physical infrastructure has weakened over time, emerging trends provide opportunities for re-engagement (Neuman & Smith, 2010; Todes, 2012). As this thesis will demonstrate, coordinating infrastructure investment requires extensive collaboration across disciplinary boundaries, in addition to public engagement and political mediation. These are only some of the ways in which planners could support improvements in local infrastructure management.

1.2 Key definitions

The terms 'infrastructure gap', 'debt', and 'deficit' are used interchangeably in this thesis, with limited exceptions, to reflect these terms' prevailing usage within the literature and among research participants. This being said, 'infrastructure gap' is the most frequently provided figure by large urban municipalities within publicly available documentation, and these estimates do often reflect previously unmet infrastructure needs (deficits/debts) such as deferred maintenance in addition to expected future needs (Félio, 2007). For these reasons, 'infrastructure gap' will be the term primarily used throughout the remainder of this thesis.

It is acknowledged that, in addition to municipal documentation, certain authors (see for example Van Der Ploeg 2003a, 2003b, 2004) use more precise definitions of the above

terms (see Table 1). These more precise definitions distinguish between the three terms in reference to capital funding shortfalls within specified periods of time. These more restrictive definitions are used where context requires, namely in section 5.1 where formal 'infrastructure gap' estimates produced by the case study cities are discussed.

In addition, the term 'infrastructure shortfall' is at times used to refer to the general phenomenon described by all three terms.

The underlying drivers of infrastructure gaps (debts, deficits) overlap substantially with those of municipalities' overall capital expenditures. For example, there may be discrete funding gaps related to maintaining and renewing existing infrastructure, and/or to expanding infrastructure systems in order to service population, economic, and urban growth. There may also be funding gaps related to enhancing the quality and availability of municipal services. This includes addressing inequities in service provision, for example a lack of recreation facilities in low-income communities and increases to service levels writ large.

Table 1: Key Definitions

Term	**Definition**
Infrastructure deficit	A negative difference, in a single fiscal year, between available funds and required infrastructure investment.
Infrastructure debt	An accumulation of annual 'infrastructure deficits' over many fiscal years.
Infrastructure gap	A forward-looking projection of a negative difference between available funds and required infrastructure investment.

Source: adapted from Vander Ploeg (2003, p. 5)

The remainder of this introduction comprises a summary of key theoretical and background relevant to infrastructure policy and, more specifically, to the two essential components of the 'infrastructure gap': municipal capital expenditures and revenues.

First, infrastructure is defined in terms of tangible capital assets belonging to local public authorities. Second, key concepts related to infrastructure management and governance are introduced. Third, the 'political' nature of infrastructure decision-making is discussed in terms of its complexity, ambiguity, and uncertainty, and the role of competing interests and priorities in decision-making. Finally, we briefly review the context for municipal infrastructure in Canada, including its growth as a share of total public capital stocks.

1.3 Defining 'infrastructure'

'Infrastructure' is an expansive term, which at its broadest could include any system of engineered physical assets, among other components. In this sense, infrastructure may be publicly, or privately owned, and could include roads and highways, telecommunications networks, military bases, offices buildings, and private dwellings.

The Government of Canada has broadly suggested that "Infrastructure is the set of basic facilities and systems required for a country, city or community to function." (Government of Canada, 2018). While a useful starting point, this definition begs certain questions: what does it mean to 'function'? for what purposes? for whom? in what manner? let alone how to identify 'basic' and presumably crucial facilities, and matters of ownership and governance (i.e., private or public). This hints at another important aspect of infrastructure: services flowing from networks of physical assets, and that these services are essential in that they enable a host of additional human activities to occur.

More specifically, Statistics Canada (2019) has identified 'core public infrastructure' to mean "bridges and tunnels; culture, recreation and sports facilities; potable water, stormwater, and wastewater management facilities and assets; public transit assets; roads and streets; public social and affordable housing facilities; and solid waste management facilities". In the Canadian context, most of these assets are maintained by local governments.

Effective in 2009, Canada's Public Sector Accounting Board (PSAB) established a universal definition of publicly owned infrastructure, referred to as 'tangible capital assets', for Canadian governments (CPA Canada, 2007, p. 1):

> *Tangible capital assets are non-financial assets having physical substance that: (i) are held for use in the production or supply of goods and services, for rental to others, for administrative purposes or for the development, construction, maintenance or repair of other tangible capital assets; (ii) have useful economic lives extending beyond an accounting period; (iii) are to be used on a continuing basis; and (iv) are not for sale in the ordinary course of operations.*

Tassonyi and Conger (2015, p. 1) note that, in the case of municipalities, the PSAB's definition of infrastructure "... includes items such as the development and purchase of land and buildings, rolling stock including vehicles and machinery, water and sewage systems, roadways, bridges, sidewalks, traffic lights and street lighting, landfill sites, furniture and office equipment and information technology." The PSAB definition of TCAs, or 'infrastructure', will be used in this thesis, as Canadian local governments are required by provincial legislation to report on their financial activities in accordance with the PSAB's accounting guidelines.

For greater clarity, references in this thesis to 'infrastructure' do not include Tangible Capital Assets associated with either provincial (for example education and healthcare) or federal public services. However, per the above definition, this thesis' discussions of

'infrastructure' do encompass assets such as social housing buildings, if these are owned by a municipal government.

1.4 Infrastructure governance and management

Modern academic and policy understandings of public infrastructure draw on a variety of disciplines, including economics, engineering, planning, public health, public policy, and political science (Sancton, 2015; Vanier et al., 2006). For example, the concepts of "public goods" and "positive externalities" from economics provide rationales for the public provision of infrastructure and associated services, while the subdiscipline of civil engineering has generated substantial bodies of knowledge of the construction and maintenance of physical assets in long-term service of these goals. In addition, analyses of local government by political scientists help us to explain some of the challenges associated with achieving optimal levels of infrastructure investment. This section provides a brief overview of key concepts that assist with understanding infrastructure governance and management.

1.4.1 The economic nature of municipal services

As previously stated, infrastructure exists to support the delivery of one or more services. For example, road networks and mass transit provide the related services of goods and people movement. It is therefore crucial to understand the characteristics of the services provided by local governments in order to appreciate the challenges associated with providing (and funding) related infrastructure. One important characteristic of 'core local services' (Dahlby & McMillan, 2019a; Kitchen, McMillan, et al., 2019a) is that they are often inherently

capital-intensive and, flowing from this, do not easily fit the classic distinction between public and private goods.

A ‘public good’ is a good or service whose consumption is both non-excludable, and non-rivalrous (OpenStax Economics, 2016). A good is non-excludable (and hence, prices cannot be easily charged) if it is difficult or impossible to prevent someone who did not pay for the good from consuming (or benefitting from) it, and non-rivalrous if one person’s consumption of the good does not interfere with the ability of another to consume it.

Not all goods and services provided by governments, municipal or otherwise, and financed by public dollars are considered public goods. Many goods, such as parks, roads, sewage, potable water, healthcare, and education are to some extent excludable and rivalrous. In these cases, the rationale for publicly providing these goods (and by extension, associated infrastructures) is partly associated with ‘positive externalities’ and their status as ‘toll goods’ (Sancton, 2015).

A ‘toll good’ refers to goods or services which may be prone to provision by natural monopolies due to their simultaneously excludable nature and the fact that their benefits are enjoyed ‘in common’ by consumers (Feiock et al., 2007; Ostrom & Ostrom, 2019; Sancton, 2015; Stein, 1993). These goods are further prone to natural monopolies because of strong barriers to entry by competing firms, such as high capital costs (i.e., costs of building associated infrastructure) and community disruptions posed by construction (Sancton, 2015). These services may, in theory, be provided by either the public or private sector (Ostrom & Ostrom, 2019), however private monopolies’ strong incentives to maximize profits at consumers’

expense creates a rationale for their public provision or regulation (Feiock et al., 2007; Ostrom & Ostrom, 2019; Sancton, 2015).

It is important to note that most municipal services such as roads, public transit, and water utilities, are considered toll goods due largely to their extensive capital requirements (Ostrom & Ostrom, 2019; Sancton, 2015). Accordingly, many suggest that the lack of full-cost pricing (user fees) for these services may be a substantial contributor to municipal infrastructure gaps in Canada (Bazel & Mintz, 2014; Dachis, 2018; Kitchen, McMillan, et al., 2019b).

1.4.2 Subsidiarity and fiscal federalism

The level(s) of government that construct and maintain what capital assets in support of which public services has important implications (Boadway & Kitchen, 2018; Gérard & Granelli, 2010; Hebb, 2021). The related concepts of subsidiarity and fiscal federalism provide some guidance in these matters.

The principle of subsidiarity is a heuristic that can aid citizens and decision-makers in identifying what level(s) of government are best suited to fulfilling certain responsibilities (and by extension, providing services and therefore infrastructure). Lazar and Leuprecht (2007, p. 5) state that "... the principle of subsidiarity normatively posits delegation of decision-making responsibility to the sphere of government that is closest to the citizen and is best positioned to carry out a particular task; thus, to local government, other things being equal." In keeping with subsidiarity, academics generally recognize local governments in Canada and elsewhere as being best suited to provide services with limited geographic extent, for example local roads

and sewage systems (Hebb, 2021; Hulten & Schwab, 1997). In contrast, national defense, given its nature as a resource-intensive public good, would be nearly impossible for provincial (let alone municipal) governments to provide.

Even if expenditure responsibilities are distributed between orders of government per subsidiarity, the capacities of those governments to fulfill said responsibilities is a separate matter (Boadway & Kitchen, 2018; Simeon & Papillon, 2005). The study and theory of 'fiscal federalism' addresses the horizontal and vertical gaps between governments, in terms of their capacity to finance services and infrastructure, and what optimal arrangements might be (Boadway & Kitchen, 2018; Hulten & Schwab, 1997). Canada's federal and provincial governments have widely varying taxation and borrowing capabilities, which impact their ability to construct and maintain public infrastructure (Simeon & Papillon, 2005). Similarly, Canadian municipalities' fiscal capacities can vary as a result of the strict taxation and borrowing regimes established by their respective provinces (Boadway & Kitchen, 2018). As suggested previously, these limitations are partly blamed for contributing to municipalities' infrastructure gaps.

Fiscal federalism theory also attempts to identify under what circumstances a service or infrastructure should be financed through that government's own taxes, or when grants from senior levels of government should be utilized. In general, it is suggested that intergovernmental transfers only be used when infrastructure(s) are utilized by and benefit the residents of more than one jurisdiction (Boadway & Kitchen, 2018; Hulten & Schwab, 1997). For example, a province should provide transfers to a municipality when its infrastructure is used by (and benefits) residents of a greater metropolitan area (Boadway & Kitchen, 2018). This

point is highly relevant to Canada, given rising levels of intergovernmental capital transfers to Canadian municipalities in recent decades.

1.4.3 Asset management

"Asset management" is the practice of maintaining municipal infrastructure for long-term use (Vanier et al., 2006). This process integrates data collection activities (about specific infrastructure types or 'asset classes'), evaluating asset conditions, forecasting needs, and exercises in prioritization. This work is highly relevant to municipal infrastructure investment, in part because the presence or absence of proactive maintenance and repair is one determining factor of a municipality's future infrastructure costs.

Asset management is more broadly understood as: "A business process and decision-support framework that (1) covers the extended service life of an asset; (2) draws from engineering as well as economics; and (3) considers a diverse range of assets." (Vanier et al., 2006, p. 1). It is important to emphasize the 'decision-support' aspect of Vanier et al's definition. Municipal councils, through their budget approval processes, ultimately decide to what degree a local government invests in maintaining its infrastructure (Sancton, 2015).

The engineering, economics, and accounting disciplines provide asset management with its key concepts. Definitions in Table 2 will be used in this thesis to ensure consistency and clarity.

Table 2: Terminology

Term	Definition
Asset	A physical component of a facility that has value, enable services to be provided, and has an economic service life of greater than 12 months.
Capital Costs	Costs incurred to acquire, construct, or improve assets including the directly related planning, engineering, legal, or borrowing costs.
Capital Renewal	The replacement of an asset at the end of its service life or because of economic, obsolescence, modernization or compatibility issues.
Current Replacement Value	The cost of replacing an asset in current dollars.
Deterioration	A process by which there is a loss of asset performance due to loss of strength, effects of usage, environmental exposure or passage of time.
Deferred Maintenance	The cost of maintenance (and not capital renewal) to bring the asset to its original potential that has been postponed or phased.
Level of Service	A qualitative or quantitative measure of how well or poorly a service is provided.
Life Cycle Cost	The total cost, in present value or annual value, required to maintain an asset in full performance for its service life. This can include the operating, capital and operating leases, maintenance, user, and socio-economic costs.
Maintenance	A broad range of planned or unplanned activities for preserving the asset in its original condition and for the purpose for which it was originally intended. Maintenance generally consists of: (1) inspections, (2) preventive maintenance, (3) repairs, and (4) rehabilitation.

Source: adapted from Vanier & Rahman (2004)

"Levels of Service" is a crucial concept in infrastructure planning and delivery. All infrastructure is constructed for the purpose of providing or supporting one or more services. Determining the 'level' at which the service is provided involves quantifying infrastructure's performance, for example in units of a good provided (e.g., potable water), adherence to safety or regulatory standards, or number of hours-of-service availability (e.g., transit hours).

Identifying Levels of Service helps municipal officials to evaluate needs, and to make complex decisions relating to capital and operating costs. Service levels are not necessarily fixed, however, and may change for a variety of reasons including those not under the direct control of local decisionmakers (Félio, 2007). For example, federal and provincial water treatment regulations may change resulting in additional costs to municipalities (and their citizens), commuters may face congested roadways, and so on.

Municipalities must account for "depreciation" (or loss of financial value over time) of infrastructure (CPA Canada, 2007), as physical assets slowly break down following their creation, notwithstanding catastrophic events. Thus, over time, they become less useful and less able to provide or support the services intended. (There are many methods of calculating asset depreciation, however a full discussion of them is beyond the scope of this thesis.) Depreciation, in general, can be addressed through ongoing investment in repairs and maintenance.

"Recommended investment levels" are guidelines for how much should be spent on preventative and other forms of maintenance, for optimal asset performance in light of depreciation. These levels vary by asset type (e.g., diesel buses, sewage pipes, bridges), but in general are estimated at 2-4% of asset value per year (Vanier et al., 2006).

1.4.4 Infrastructure decision-making

Decision-making surrounding publicly owned infrastructure is inherently 'political', insofar as it is characterized by conditions of complexity, uncertainty, and ambiguity over an extended time scale and within a wider context of competing priorities and interests (Anand,

2015; Blainey & Preston, 2019; von Hirschhausen et al., 2004; Wegrich & Hammerschmid, 2017). Infrastructure as a policy field is not unique in this regard, however, these factors hold particular implications for how public authorities choose to construct and maintain their capital assets.

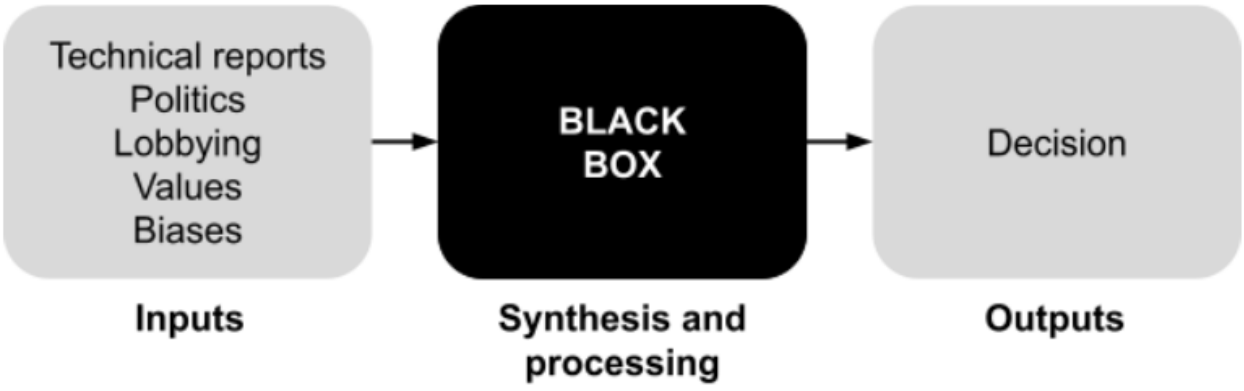
Infrastructure policy is complex because it involves many types of diverse physical assets, involves many actors, and draws on the knowledge of many disciplines (such as accounting, economics, engineering, architecture, planning, political science, and public policy) (Neuman & Smith, 2010; Vanier & Rahman, 2004). Uncertainty characterizes infrastructure policy in that decisions are typically made based on forecasts, which in turn are informed by assumptions and incomplete information about an unknowable future (Blainey & Preston, 2019; Wegrich et al., 2017). These forecasts are also limited by decision-makers 'bounded rationality' due to inevitably limited information processing capabilities, which typically manifests in selective perception of costs and benefits and the potential intrusion of arbitrary biases (Flyvbjerg, 1998; Heuton & Strate, 2020; Wegrich & Hammerschmid, 2017). Decision-makers and involved parties are furthermore numerous, oftentimes with interests lying in only select aspects of particular infrastructure projects (Kitchen, McMillan, et al., 2019b). Public infrastructure decision-making must also grapple with ambiguity, in that any one piece of information can often be plausibly interpreted in multiple ways, and thereby mobilized differently by numerous stakeholders (Wegrich et al., 2017).

Given the nature of public decision-making, a variety of geographic, social, economic, and cultural interests come to vie for limited public resources (Dollery et al., 2020). For example, over the course of the twentieth century infrastructure policy in North America

gradually came to emphasize economic and security benefits over health and social ones (Aschauer, 1990; Felbinger, 1995; Leung, 1998). In this way, job creation and productivity enhancement came to dominate explicit rationales for infrastructure investment, whereas public health and quality of life broadly may be treated as secondary considerations, despite the fact that such public spending may provide benefits across all these domains (Aschauer, 1990).

Figure 1 presents one interpretation of decision-making processes that are often opaque due to complexity, uncertainty, ambiguity, competing interests and priorities, among other factors.

Figure 1: The Decision-making 'Black Box'



Source: adapted from Seasons (2021)

1.5 Municipal government and infrastructure in Canada

Canadian municipalities exist as 'creatures of the provinces', meaning they lack any constitutional status of their own and fall under the exclusive legislative authority of their respective provincial government (Simeon & Papillon, 2005). Municipalities must perform the duties assigned to them by provincial legislation and, corresponding to this, only have the

revenue-raising and law enforcement capabilities they are delegated by their respective province.

The services municipalities provide, either by custom or law, are often inherently capital intensive. Together, transportation (roads, mass transit) and water (water treatment and distribution, stormwater, and wastewater) infrastructure together often form a plurality of local government capital expenditures in a single province (Tassonyi & Conger, 2015).

Under Canada's Constitution (1982), all orders of government hold responsibility for constructing and maintaining various types of infrastructure (Boadway & Kitchen, 2018). Despite this legal reality, the balance of expenditure responsibilities for constructing and maintaining much of the country's core public infrastructure has come to rest on municipalities. In 2013, it was estimated that Canadian municipalities owned 56.8% of the country's net stocks of public capital (Standing Committee on Transport, Infrastructure, and Communities., 2015). This is impressive, as in 1955 the corresponding figure was just over 20% (Ditta, 2015). Driving this trend was post-WWII suburbanization, encouraged by all orders of governments and substantially enabled by federal mortgage and other policies (Foran, 2009; Harris, 2004). It appears then, that new capital construction, as opposed to transfers in asset ownership, may be the primary source of this growth.

Additional and successive provincial and federal policies have also contributed to long-term growth in municipal infrastructure ownership over time. These include permissive provincial planning regimes and capital grants, and specifically federal infrastructure loans and grants to municipalities during the 1960's and 1970's. The trends towards greater municipal

infrastructure ownership, when placed in context, demonstrates the 'intermingling' of roles and responsibilities between all orders of government in Canada (Masson & LeSage, 1994).

1.6 Summary

This chapter provided contextual and background information to shed light on concerns over the adequacy of local infrastructure in Canada. Since the 1980's, it has been frequently suggested that municipalities do not possess the revenue raising capabilities to meet their infrastructure needs. In support of this, infrastructure 'debt', 'deficit', and 'gap' figures have been produced, primarily at the national scale (see for example Adams & Heinke, 1987; FCM et al, 2012; Mirza, 2007), estimating unfunded investments in the hundreds of billions of dollars. These concerns have taken on added urgency in light of the COVID-19 pandemic, the increasing frequency and intensity of climate disasters, and the fact that local authorities have come to own the majority of Canada's infrastructure.

The infrastructure shortfall problem contains two essential components, namely expenditures and revenues. Accordingly, the remainder of this chapter discussed concepts which may aid in understanding municipal infrastructure spending responsibilities and revenue-raising capacities.

The economic nature of municipal services, which in turn dictates the type(s) of infrastructure needed, provides some guidance on how capital assets can or should be funded. 'Core local services' such as roads, public transport, water distribution, sewers, parks and recreation, and others, tend to be 'toll goods' (Sancton, 2015; Stein, 1993). These services are

typically excludable (i.e., user fees may theoretically be charged) in that beneficiaries and non-beneficiaries may be distinguished, albeit with varying degrees of ease and technological requirements. 'Core local services' may also become rival at times when congested, however this does not occur beneath a certain threshold. Common rationales for municipal provision of toll goods include their potential for positive externalities, and/or that their private provision tends to result in natural monopolies.

The related concepts of subsidiarity and fiscal federalism provide a framework for understanding the 'ideal' allocation of expenditure requirements and revenue-raising capabilities among orders of government. In general, per the subsidiarity principle, service responsibilities should be delegated to the lowest order of government that can effectively provide said services (Boadway & Kitchen, 2018; Gérard & Granelli, 2010; Hebb, 2021). Therefore, it is reasonable for sewers and local roads to be provided by municipal authorities given their local scope, while education and social services are best provided by provincial governments to take advantage of scale and other benefits. Fiscal federalism suggests that each order of government should have access to sufficient revenues to fulfill their expenditure responsibilities independently (Boadway & Kitchen, 2018). However, when local infrastructure results in externalities or 'spillover benefits,' it is appropriate for higher orders of government to provide related fiscal transfers (ibid).

Asset Management, a relatively new discipline arising from engineering and economics (Vanier & Rahman, 2004), provides useful concepts illustrating the connections between municipal services and related infrastructure, particularly as it relates to cost. These concepts

include “Levels of Service”, which assists with assessing the infrastructure costs of providing services to varying extents.

Finally, understanding the political nature of public infrastructure decision-making helps to understand the broader context of these decisions, specifically how costs are assessed and how funds are deployed. Public decision-making with regards to infrastructure investment is subject to many challenges, namely uncertainty, complexity, and ambiguity (Anand, 2015; Wegrich et al., 2017). Capital decisions are uncertain in that they are long-term investments that rely on forecasts underpinned by assumptions about the future; are complex in that they involve a large array of stakeholders and physical components; and are ambiguous in that relevant information may be subject to a variety of plausible interpretations by stakeholders.

1.7 Thesis Structure

The remainder of this thesis is structured as follows. Chapter Two reviews the literature on municipal infrastructure deficits, debts, and gaps in Canada. Studies quantifying these infrastructure needs are identified and discussed, as well as literature commenting on and critiquing these studies. Also reviewed are the literatures discussing the two essential components at the core of these issues: first, local government capital budgeting, including how needs are assessed for municipal infrastructure projects; and second, capital funding tools available to Canadian municipalities.

Chapter Three discusses this thesis’ research methodology, detailing its qualitative mixed-methods and case study approach. Chapter Four presents background information on

the two case study cities (Calgary and Edmonton). Chapter Five presents and discusses the study's overall findings in response to each research question. Chapter Five summarizes this thesis' findings and presents recommendations for policy and future research.

Chapter 2: Literature Review

This literature review includes both academic and 'grey' sources, such as reports produced by governments, think tanks, and municipal and industry associations. First, studies discussing Canada's municipal infrastructure shortfalls will be summarised, with attention to areas of consensus and disagreement. Second, research discussing municipal capital budgeting, planning, and spending in Canada will be surveyed, supplemented by international literature. Third, literature focusing on the sources of (capital) funding available to Canadian local governments will be discussed.

It should be noted at the outset that the Canadian literature on municipal finance and infrastructure in Canada is limited in many respects. First, a substantial amount of the literature appears in the form of 'grey' sources, as opposed to peer-reviewed academic sources. Second, over the last three decades contributions to the literature by academic authors have been dominated by a very small number of relatively prolific economists (and their students) which frequently co-publish together. These include Enid Slack, Richard Bird, Harry Kitchen, Melville McMillan, Almos Tassonyi, and Bev Dahlby. Third, a substantial amount of the literature, in particular regarding infrastructure needs, comprises publications either sponsored, or directly authored, by associations whose memberships' have a direct interest in increased levels of public capital spending. Fourth, both grey and academic sources almost exclusively focus on Canada's large urban municipalities.

2.1 Literature gap and research questions

Most research on municipal infrastructure gaps in Canada focuses on the national or provincial scales, and draws conclusions mainly based on quantitative methods such as analyses of aggregated survey or financial data. Published studies tend to focus on topics such as quantifying infrastructure shortfalls, critiquing these estimates, and examining revenue and expenditure patterns to assess municipalities' capacity to fund capital projects. In contrast, there is little academic research examining various stakeholders' perspectives on municipal infrastructure gaps, their policymaking significance, or how municipal and other orders of government have responded, or should respond, to them. There are also very few studies that review the situations of particular municipalities, in particular attempts to quantify and address local infrastructure gaps. Studies of particular municipalities tend to place greater focus on revenue issues, as opposed to matters relating to capital expenditures, such as how infrastructure needs are identified (see for example Harris, 2011; Peterson, 2021). In general, most research appears to favour particular causes (and corresponding solutions) of municipal infrastructure gaps, namely inadequate pricing or vertical fiscal gaps.

In light of the above literature gap, this thesis explores in-depth the infrastructure challenges facing two large Canadian cities, Calgary and Edmonton. This study poses the following questions: how do municipal stakeholders and decisionmakers understand their infrastructure gaps? what do municipalities perceive to be the larger cause(s) of their infrastructure debt, deficits, and gaps? And, how are municipalities addressing their infrastructure debt, deficits, and gaps?

2.2 Quantifying Canada's municipal infrastructure shortfalls

Since the 1980's, many studies have attempted to quantify the shortfall between municipal infrastructure needs and available funding. Many more attempts have been made to quantify shortfalls in provincially- and nationally-owned infrastructure, however these are beyond the scope of this literature review.

Some studies have taken a national perspective (FCM, 1985, 1992; FCM et al, 2016; Mirza, 2007) covering many asset classes, while others have focused on the general municipal infrastructure needs within particular provinces or groups of provinces (Ontario et al., 2008; UMQ & CBoC, 2003; C. Vander Ploeg, 2004). Still others have focused on particular asset classes, such as those related to public transit (CUTA, 2019) or water and wastewater infrastructure (CWWA, 1997). These works vary greatly in terms of the asset classes included but focus generally on water utility and transportation infrastructure. In terms of methods, studies typically rely on surveys (FCM, 1985; see for example FCM et al, 2016; Mirza, 2007), historical spending patterns (see for example UMQ & CBoC, 2003), or unfunded capital project figures published by municipal governments (see for example C. Vander Ploeg, 2003). Some recent studies draw on predictive models that integrate population, historical capital expenditures, and other data (CUTA, 2019; Ontario et al., 2008). See Tables 3, 4, and 5 below for a summary of select studies.

Table 3: Select Estimates of Overall Municipal Infrastructure Needs (National)

Year	Figure	Description	Source
1985	$12 billion	Estimated cost for needed municipal infrastructure “upgrades”, from a survey of municipalities.	FCM (1985)
1992	$20 billion	Estimated cost for needed municipal infrastructure “upgrades”, from a survey of municipalities.	FCM (1992)
1995	$44 billion	Estimated cost to bring all municipal infrastructure into an “acceptable” physical condition, from a survey of municipalities.	McGill-FCM (1996)
2002	$57 billion	Estimated municipal infrastructure “deficit” (cost of accumulated deferred maintenance, rehabilitation, and replacement), from a survey of municipalities.	CSCE (2004)
2007	$123 billion	Estimated municipal infrastructure “deficit” (cost of accumulated deferred maintenance, rehabilitation, and replacement), from a survey of municipalities.	Mirza (2007) for FCM
2012	$50.7 billion	Estimated replacement value for select municipal assets (roads and water utility assets) in “poor” and “very poor” condition, from a survey of municipalities.	FCM et al (2012)
2016	$141 billion	Estimated replacement value for select municipal assets (roads, bridges, buildings, water utilities, public transit, sport and recreation facilities) in “poor” and “very poor” condition, from a survey of municipalities.	FCM et al (2012)

Source: adapted from Mirza and Ali (2017), Table 1

Table 4: Select Estimates of Municipal Infrastructure Needs (Regional)

Year	Figure	Description	Source
2003	$15-$17.5 billion	Estimated municipal infrastructure "gap" for roads, sewers, and aqueducts in Quebec. Figures based on comparing historical investment rates.	UMQ & CBoC (2003)
2003	$564 million	Estimated combined infrastructure "deficit" for the 2003 fiscal year, for Vancouver, Edmonton, Calgary, Regina, Saskatoon, and Winnipeg. Figure is based on the value of unfunded projects within capital budgets.	Vander Ploeg (2003)
2008	$60 billion	Estimated 10-year infrastructure "gap" for Ontario municipalities, including both growth and replacement capital (for roads, bridges, transit, water, wastewater, stormwater, and Conservation Authorities only). Figure is based on a model of municipal capital costs.	Ontario et al. (2008)

Sources: Kitchen (2003)

Table 5: Select Estimates of Municipal Infrastructure Needs (Sectoral)

Year	Figure	Description	Source
1997	$88.45 billion	Estimated required investment (1997-2012) in municipal water and wastewater infrastructure (includes replacement, improvement, and growth-related investments). Figure based on various survey, government, and other data.	CWWA (1997)
2019	$74.8 billion	Estimated value of unfunded transit infrastructure projects for 2018-2028, encompassing investments required for maintenance/rehabilitation, to serve growth, and to meet service level targets. Figure based on member surveys and a predictive model.	CUTA (2019)

Sources: Kitchen (2003)

2.2.1 Criticisms of infrastructure shortfall estimates

Commentators have expressed several concerns with the above infrastructure shortfall and needs assessment figures. Kitchen (Boadway & Kitchen, 2018; Fenn & Kitchen, 2016; Kitchen, McMillan, et al., 2019b; Kitchen, 2003) is the author with the most extensive record of

publications criticizing infrastructure shortfall and investment needs estimates, with many others echoing broadly similar concerns over the years (Bazel & Mintz, 2014; Dachis, 2018; Mintz, 2006; Mintz & Roberts, 2004; Slack, 2006; Slack & Tassonyi, 2017). Concerns typically centre around potential conflicts of interest by sponsoring organisations, poor quality data, and inattention to economic issues such as pricing. These criticisms seem to have remained largely unchanged over the last two decades since Kitchen's (2003) review of infrastructure shortfall studies, which appears to be one of the earliest such commentaries. Furthermore, criticisms tend to be presented tentatively and on a conceptual as opposed to an empirical level, in that few published commentaries cite specific examples from infrastructure gap studies to illustrate the concerns presented. This lack of specificity may be, at least in part, due to the commonly held ideas that infrastructure gap figures are not necessarily helpful in determining 'optimal' levels of public capital investment, and also may be impossible to accurately calculate (Bazel & Mintz, 2015; Kitchen, 2003; Kitchen et al, 2019).

Many suggest that infrastructure shortfall estimates (especially those arising from reports sponsored by municipal associations themselves) may serve mainly as advocacy tools aimed at increasing federal and provincial transfers to municipalities (Hilton, 2007; Kitchen, 2003; Slack & Tassonyi, 2017; Boadway & Kitchen, 2018), as this is "politically more expedient and acceptable" to local politicians' constituents than "raising taxes or user fees" (Fenn & Kitchen 2016, p. 61). Some allege that most municipalities already "have the capacity to pay for their infrastructure" (ibid). For example, it is argued that local authorities could in theory introduce new road tolls or other user fees to generate funding for infrastructure renewal and growth expenditures, but they have not done so (Bazel & Mintz, 2014; Slack & Tassonyi, 2017)

largely for political reasons namely the unpopularity of such fees (Slack & Tassonyi, 2017). Similar arguments are made regarding property taxes, with some suggesting that municipalities could further increase property taxes (Dahlby & McMillan, 2019a; Tassonyi et al., 2015), at least somewhat, to fund some proportion of needed expenditures. See Section 2.4.1 (Property Taxes) for further discussion of this issue. Some also point out that many municipalities could take out more debt to finance needed infrastructure, while remaining within borrowing limits prescribed by provincial governments (Bazel & Mintz, 2014; Tassonyi & Conger, 2015).

Many authors (Kitchen, 2003; Hilton, 2007; Kitchen et al, 2019) also express concern over the absence of "consistency or clarity in the way in which infrastructure need and, hence, deficit is estimated" (Fenn & Kitchen 2016, p. 63). Vander Ploeg (2003b, p. 6) notes that "…there is a strong subjective element to the notion of an infrastructure deficit or debt, particularly as it relates to measuring infrastructure requirements – it is difficult, if not impossible to separate 'wants' and 'desires' from actual 'needs'".

In addition, when assessments are conducted in relation to an external standard of need, some authors caution that such standards are often created by the same associations (of municipal asset owners) who have incentives to "inflate the size of the deficit" (Slack and Tassonyi, 2017 p. 3) by "set[ing] high standards or benchmarks if there is a possibility that it could lead to increased grants and investment" (Kitchen et al 2019, p. 217). It should be noted that these above authors do not single out for scrutiny any particular infrastructure gap estimates, or otherwise provide detailed information to support claims of bias.

The overall implication of the above concerns is that municipalities and their associations may potentially be 'inflating' infrastructure gap figures. These issues of 'needs

versus wants' points towards the idea of Levels of Service, which seek to measure the amount and/or quality of municipal services provided to the public, arrived at while balancing citizens' "perceptions of the acceptability of existing levels of service and user willingness to pay" (InfraGuide, 2002 p. 6). Poor quality data may limit the usefulness of infrastructure shortfall estimates. This includes survey data, where individual respondents (municipalities) are often left to determine both what investments are needed to achieve a given 'acceptable' standard, and potentially said standards as well (Fenn & Kitchen, 2016; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). Even engineering assessments are alleged to contain certain 'subjective' elements, such as differing opinions as to what exact activities or investments may be needed to bring an asset up to technical standards (Fenn & Kitchen, 2016). Some authors also argue that data on public capital stocks, as well as municipal capital expenditures and assets, are often limited in scope and quality (Fenn & Kitchen, 2016; Kitchen, 2003). As well, financial data is limited in that it, on its own, does not assist with determining whether infrastructure is meeting service levels such as safety or environmental protection (Tassonyi & Conger, 2015). When historical financial data is used to estimate future investment needs, results often depend on which year(s) are selected as a baseline (Fenn & Kitchen, 2016; Slack & Tassonyi, 2017).

Finally, many are concerned that infrastructure shortfall estimates may fail to account for economic considerations. More specifically, certain authors suggest these studies often tacitly assume the continuation of current, allegedly inefficient infrastructure funding policies (namely the absence of 'well-designed' user fees for capital-intensive services such as roads)

(Fenn & Kitchen, 2016; Kitchen, McMillan, et al., 2019b; Kitchen, 2003; Mintz, 2006; Slack, 2006).

Ultimately, some authors suggest it may not be possible to arrive at conclusive estimates of infrastructure shortfalls however (Kitchen, McMillan, et al., 2019b). In addition, others point out that these estimates likely provide little assistance with determining optimal levels of municipal capital investment (Bazel & Mintz, 2015; Gramlich, 1994; Kitchen, 2003).

Despite methodological critiques of infrastructure shortfall estimates, there nevertheless seems to be broad agreement that municipal capital investment has been suboptimal in recent decades (Bazel & Mintz, 2014; Boadway & Kitchen, 2018; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). Declining net book values of municipally owned infrastructure (that is, assets' acquisition costs after depreciation) (Slack & Tassonyi, 2017; Tassonyi & Conger, 2015), congested transportation systems (Bazel & Mintz, 2015; Dachis, 2018), and similar trends across many other countries (Kitchen, McMillan, et al., 2019b; Mirza & Ali, 2017) are cited as evidence of systemic municipal infrastructure funding challenges. Disagreement arises, however, over the causes of these shortfalls, what must be done (and by whom) to address them.

Lack of full-cost user pricing, specifically for roads and other transportation infrastructure, is frequently cited as a likely cause of municipal infrastructure funding challenges (Bazel & Mintz, 2014; Dachis, 2018; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017; Tassonyi & Conger, 2015). Less frequently discussed, but nevertheless acknowledged, is the issue of poor asset management (including adequate maintenance planning and investment, as well as asset tracking) as a contributor to inadequate infrastructure

investment levels (Kitchen, McMillan, et al., 2019b; Kitchen, 2003; Mirza & Ali, 2017). Finally, some (including the Federation of Canadian Municipalities) suggest that infrastructure shortfalls may be a symptom of a broader vertical fiscal gap between municipalities and other orders of government, or in other words, that municipalities' expenditure responsibilities exceed their revenue-raising capacity (Calgary, 2013a; FCM, 2006; McMillan, 2006; Slack, 2006; Vander Ploeg, 2004). Balanced budget and other requirements imposed on municipalities mean that any vertical fiscal gaps are most likely to show up in terms of inadequate service delivery and poor infrastructure conditions, which are both difficult to measure consistently (Slack, 2006).

2.3 Capital budgeting and expenditures

Perhaps surprisingly, given its importance, the global literature on municipal/local government capital budgeting (let alone in the Canadian context) is limited (Ermasova, 2020; Khalid et al., 2017). What little published literature that does exist tends to focus on the overall municipal budgeting process, with capital budgeting as one component (Kitchen, McMillan, et al., 2019b; Schaeffer, 2000; Tassonyi, 2002). Furthermore, published works on the subject are primarily descriptive and normative (Khalid et al., 2017; Srithongrung et al., 2019). What follows is a review of the literature on capital budgeting with a focus on Canadian local governments, supplemented where needed by international literature (drawn primarily from the United States). Essential elements of capital budgets are first reviewed, followed by the general process that municipal authorities' follow when preparing their capital budgets.

2.3.1 Capital budget components

Municipal budgets are important tools for monitoring and managing expenditures, operational planning, and (re)assessing local taxation policies (Dollery et al., 2020; Kitchen, Slack, et al., 2019; Tassonyi, 2002). Local governments' budgets are often, in effect, two separate documents: one for operating (recurring) expenses such as wages, and one for capital expenditures (Dollery et al., 2020; Tassonyi, 2002). These budgets are linked by reserve contributions, Pay-As-You-Go funding streams, debt servicing payments, and, ideally, a fulsome understanding of new capital assets' operating and maintenance costs (Dollery et al., 2020; Kitchen, McMillan, et al., 2019b; Sancton, 2015).

Broadly speaking, capital budgets list the expenditures and associated funding arrangements required to facilitate the acquisition or rehabilitation of long-term tangible assets (Dollery et al., 2020; Kitchen, 2006; Srithongrung et al., 2019; Wendorf, 2005). In municipal contexts around the world, these capital expenditures primarily relate to infrastructures that facilitate 'core local services' such as roads, mass transport vehicles, sewers, and buildings (Dahlby & McMillan, 2019a; Dollery et al., 2020; Kitchen, Slack, et al., 2019). The exact definition of a municipal 'capital' expenditure, as differentiated from an 'operating' expenditure, may vary considerably both within and between countries (Forrester, 1993; Kitchen, McMillan, et al., 2019b).

In most countries, municipal budgeting occurs in the context of 'hard' legislative constraints imposed by other orders of government, including balanced budgeting requirements, borrowing limitations, annual audit requirements, and other prescriptions (R. Bird, 2001; R. M. Bird & Tassonyi, 2003; Dollery et al., 2020; Sancton, 2015). These frameworks

systematically shape municipal decision making, including the allocation of resources for capital expenditures.

There is general consensus that a municipal capital budgeting process should include three basic components: an asset inventory, a Capital Investment Plan (CIP), and a financing plan (Dollery et al., 2020; Schaeffer, 2000; Spearman, 2007; Srithongrung et al., 2019; Tassonyi, 2002; Tassonyi & Conger, 2015; Wendorf, 2005).

An inventory of existing assets (infrastructure) provides foundational information for any capital budget. This includes information on assets' age and condition, which assists in determining the timing and cost of necessary rehabilitation and/or replacement, as well as the relative urgency of associated spending (Cooper et al., 2020; Schaeffer, 2000; Tassonyi, 2002).

CIPs should include projects and associated expenditure timetables over (at least) the next 5 years, with longer term projections as practicable (i.e., if project construction periods extend beyond 5 years), and should be aligned with applicable municipal land use and strategic plans (Dollery et al., 2020; Tassonyi, 2002; Tassonyi & Conger, 2015). Projects included in CIPs should support attainment of defined performance measures or Levels of Service metrics (Cooper et al., 2020; Schaeffer, 2000). Capital financing plans allocate available funds, per established priorities, to projects included in the CIP and should include long-term debt and revenue projections specific to taxes, user fees, and grants (Kitchen, McMillan, et al., 2019b; Srithongrung et al., 2019).

2.3.2 Capital budgeting process

In general, the preparation of a municipal budget (especially in council-manager systems) is primarily led by civic administrations, albeit within overall parameters established by elected officials (Dollery et al., 2020; Heuton & Strate, 2020; Sancton, 2015; Tassonyi, 2002). These 'parameters may change year-over-year, but often include a target property taxation rate and focus on particular services/asset classes (Dollery et al., 2020; Heuton & Strate, 2020). The exact process a municipality follows to develop its capital budget varies substantially, and typically does so according to size, legislative context, decisionmakers' personalities, legislative the relative importance of certain funding streams, and so on (Dollery et al., 2020; Sancton, 2015).

There is general agreement within the literature that the formal budgeting process usually encompasses four broad stages or groups of activities (Dollery et al., 2020; Kitchen, 2002; Sancton, 2015; Srithongrung et al., 2019; Tassonyi, 2002). First, a 'planning' stage whereby departments prepare and submit funding requests to a central financial office or official. Second, an 'integration and prioritisation' stage where funding requests are analysed relative to one another and formed into (a) coherent budgetary document(s). Third, an 'approval' stage where the budget is debated and approved by the relevant body (i.e., the municipal council). And fourth, an 'implementation' stage involving capital project management and ongoing financial monitoring activities.

Regardless of the exact process a municipality follows, it should be emphasised that capital budgeting choices are ultimately seen as short-term political decisions about long-term resource allocations (Forrester, 1993; Tassonyi & Conger, 2015). In other words, municipal

capital investment decisions are informed by value-based judgments in addition to purely technical factors (Forrester, 1993; Millar, 1988; Sancton, 2015; Tassonyi, 2002; Tassonyi & Conger, 2015).

Budget planning

Most municipal capital projects, whether to rehabilitate existing or construct new assets, are usually identified by the operating department responsible for the related service(s) the asset(s) will support (Chan, 2004; Dollery et al., 2020; Sancton, 2015; Tassonyi, 2002). Initial capital budget should be, and are to varying extents, formed on the basis of an existing asset inventory (including age, condition, replacement value etc.), degree of urgency, forecasts of service demand, and expected urban growth (Berechman, 2018; Dollery et al., 2020; Schaeffer, 2000; Srithongrung et al., 2019; Tassonyi, 2002; Tassonyi & Conger, 2015). Requests should furthermore align to approved land use and strategic plans (Cooper et al., 2020; Mathur, 2019; Srithongrung et al., 2019; Wendorf, 2005), reflect relevant metrics for measuring actual versus desired Levels of Service (Dollery et al., 2020; Schaeffer, 2000; Tassonyi, 2002), and include a comprehensive assessment of costs and benefits over assets' entire life cycles (Berechman, 2018; Dollery et al., 2020; Kitchen, McMillan, et al., 2019b). Projects related to different asset classes should also be coordinated with one another, for example roadway reconstruction and water utility pipe maintenance projects located in close proximity (Abu-Samra et al., 2020; Dollery et al., 2020; Kitchen, 2006).

It is generally recognized, however, that local governments face many challenges in preparing capital budgets. Certain costs and benefits associated with municipal infrastructure

may be difficult to quantify and thus account for (Berechman, 2018; Chan, 2004; Kitchen, McMillan, et al., 2019b), and that the accuracy of forecasted capital costs will necessarily improve as project designs evolve (Love & Ahiaga-Dagbui, 2018; Spearman, 2007). Fully accurate asset inventories are difficult to compile, and municipalities' asset management capacity often varies by their size (Dollery et al., 2020; Kitchen, McMillan, et al., 2019b; Schaeffer, 2000). In addition, identified needs may not necessarily translate into budget requests for political reasons, such as cases where administrators perceive politicians' as unwilling to increase taxes (Sancton, 2015). Reducing capital expenditures (particularly on maintenance) is also a common municipal response to revenue constraints (Afonso, 2014; Heuton & Strate, 2020). Finally, accurately forecasting future service demands and capital project costs is often very difficult due to data limitations and other constraints (Berechman, 2018; Dollery et al., 2020; Love et al., 2016; Siemiatycki, 2009).

In recent decades, the persistent phenomenon of capital project cost overruns in the public sector has attracted substantial scholarly attention (see for example Flyvbjerg, 2007; Love et al., 2016; Siemiatycki, 2015). Project cost estimation practises within the public sector, among other aspects of capital budgeting, have been singled out for criticism. Concerns have been expressed over both the technical methods used to estimate costs as well as institutional issues such as over-optimism and strategic misrepresentation (lying), however authors differ in what factors they emphasise as explanations (Berechman, 2018; Love & Ahiaga-Dagbui, 2018; Siemiatycki, 2009).

Budget integration and prioritisation

Once developed by departments, initial capital spending requests are typically submitted to a central financial office or official for review and integration, with varying involvement by elected officials (Dollery et al., 2020; Sancton, 2015; Schaeffer, 2000; Tassonyi, 2002). As municipalities rarely possess the resources to complete all projects identified within their Capital Investment Plans at any given time, spending requests must be prioritised in relation to one another (Forrester, 1993; Kitchen, McMillan, et al., 2019b; Schaeffer, 2000; Srithongrung et al., 2019).

Capital projects should ideally be compared on the basis of rigorous cost-benefit analyses, for example net present value (NPV), cost-benefit ratio, internal rate of return, and payback period assessments (Berechman, 2018; Kitchen, McMillan, et al., 2019b; Sekwat, 1999; Srithongrung et al., 2019). The NPV approach is generally viewed as superior as it considers the time value of money and can be applied to capital projects of various sizes (Chan, 2004; Kitchen, McMillan, et al., 2019b; Srithongrung et al., 2019). In theory, projects with the greatest benefits in proportion to costs should be funded first (Kitchen, McMillan, et al., 2019b). As discussed above, it is often challenging however for municipalities to quantify all benefits and costs associated with a given project. Multi-criteria prioritisation systems are often recommended in light of these issues, whereby projects are scored against a series of ordinal, value-based criteria for example economic development, legislative compliance, and risks of non-funding (Chan, 2004; Marcelo et al., 2016; Srithongrung et al., 2019).

In theory, funding decisions are a linear process of comparing the future flows of costs and benefits associated with various projects, and then, beginning with projects with the

greatest benefit, allocating available resources accordingly until they are exhausted (Kitchen, McMillan, et al., 2019b; Schaeffer, 2000). In practice however, capital prioritisation processes tend to be iterative, partly because municipalities are able to adjust revenues at least marginally, for example to cover urgently needed capital expenditures that would otherwise go unfunded (Schaeffer, 2000).

Earmarking

Further complicating matters are the existence of dedicated or 'earmarked' revenue streams such as development charges, intergovernmental grants, user fees, and capital levies (included as part of a broader property tax levy), which must be spent on particular projects, but which may or may not cover all associated project costs (Kitchen, 2006; Kitchen, McMillan, et al., 2019b; Schaeffer, 2000; Slack & Tassonyi, 2017). Municipal revenue earmarking may be driven by several factors including external legislation and efforts to improve the political acceptability of tax increases (Bird & Jun, 2005; Kitchen & Slack, 2016). The literature generally encourages earmarking where there is a strong 'benefit' link between revenues and services received, for example in the case of water utility fees charged based on marginal cost pricing (Bird, 2001; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017; Tassonyi, 2002). User fees are not the only potential source of earmarked revenues however, as "well-designed earmarked benefit taxes" may be viewed as "surrogate prices" (Bird, 2001, p. 126). In practice, however, earmarking is implemented with widely varying connections between revenues and expenditures (Bird & Jun, 2005; Kitchen, McMillan, et al., 2019b). Dedicating revenue streams

may be criticized for introducing rigidities into local budgets; however, these concerns are often dismissed as exaggerated and surmountable (Bird & Jun, 2005; Kitchen & Slack, 2016).

For the above and other reasons, the literature emphasises funding mechanisms' influence over capital funding decisions and thus the importance of appropriately matching expenditures with revenues through a municipality's capital Financing Plan. For example, it is frequently suggested that tax and intergovernmental grant funding for infrastructure may encourage over-consumption of capital-intensive municipal services (such as roads), whereas 'well-designed' user fees may facilitate more efficient capital allocations (Dollery et al., 2020; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). See below for further discussion of these issues.

Budget approval/implementation

Once a municipality's draft capital budget, typically containing both a Capital Improvement Plan and a Financing Plan, is completed it is presented to either a committee or the entire municipal council (Dollery et al., 2020; Sancton, 2015; Tassonyi, 2002). Public hearings may occur at this stage; prior to approval, slight amendments may be made, though these are usually minor (Dollery et al., 2020; Sancton, 2015). Capital project management, expenditure monitoring, and audit activities occur after capital budgets are approved.

2.4 Funding and financing municipal infrastructure

Canadian municipalities fund their capital expenditures through a combination of current revenues (property taxes, and user fees primarily) in the form of reserves and Pay-As-

You-Go funding, development charges, intergovernmental grants, and debt serviced through current revenues (Slack, 2005; Slack & Tassonyi, 2017). Property taxes and user fees respectively accounted for approximately 48.1% and 22.2% of total Canadian municipal revenues in 2016; in Alberta, corresponding figures are 41.4% and 19.6% (Slack & Bird, 2019a).

In general, and on average, since the mid-twentieth century Canadian local governments have become more dependent on user fees and transfers (primarily from provincial governments) and less dependent on property tax revenues (Bazel & Mintz, 2014). Since the 1980's (a period of high interest rates), municipalities have borrowed much less to facilitate infrastructure spending, and in turn have financed more capital spending on a pay-as-you-go basis (Bazel & Mintz, 2014; Kitchen, 2006). These broad trends are also observed in Alberta municipalities (Bazel & Mintz, 2014).

Economists generally agree that current revenues should be used to fund capital maintenance expenses and assets with short lifespans and should be used to service debt obtained to facilitate construction of long-lived infrastructure (Dachis, 2018; Kitchen, 2006; Kitchen & Tassonyi, 2012; Slack & Tassonyi, 2017). Property tax revenues should be allocated towards services without easily identifiable beneficiaries; otherwise 'properly-designed' user fees should be utilised (Dachis, 2018; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). Furthermore, intergovernmental grants should be utilised less than they currently are, and only when benefit 'spillovers' are present or there is a clear national/provincial interest in the project(s) being funded (Bazel & Mintz, 2014; Dachis, 2018; Dahlby & Jackson, 2015; Kitchen, McMillan, et al., 2019b). Finally, development charges are generally supported within the literature as long as they vary by the marginal costs and reflect the total costs of associated

infrastructure (Found, 2019; Kitchen, McMillan, et al., 2019b; Slack & Bird, 2019b; Slack & Tassonyi, 2017).

2.4.1 Funding sources

Property taxes

Property taxes are Canadian municipalities' primary own-source revenue tool, as is the case in many countries (Bird, 2001; Kitchen, McMillan, et al., 2019b; Slack & Bird, 2019b). As such, whether or not these tax bases have the capacity to yield additional revenues for needed-yet-unfunded capital spending is an essential question when examining the phenomenon of infrastructure gaps (debts, deficits) among local governments in Canada (Vander Ploeg, 2004).

Property taxes as a municipal revenue source are generally viewed positively by economists, given their ability to generate stable revenues in support of core local services while ensuring a degree of fairness, that is, alignment between those who pay and those who benefit (Dachis, 2018; B. Dahlby & McMillan, 2019a; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). The property tax is further argued to be an appropriate and effective tax for local governments in particular, given its relative ease of administration, its high visibility to taxpayers (engendering accountability for local fiscal decisions), the nature of property as an immovable asset, among other reasons (Dachis, 2018; Dahlby & McMillan, 2019a; Slack & Bird, 2015). However, it is also generally believed that when services are funded through property taxes (and taxes generally), as opposed to user fees, this tends to result in overconsumption and thus over-provision of infrastructure (Bazel & Mintz, 2014; Slack & Tassonyi, 2017; Tassonyi & Conger, 2015).

The Canadian property tax literature, especially in recent decades, seems to have substantially developed in response to what authors view as common criticisms of this tax primarily from municipal officials and taxpayers (Bazel & Mintz, 2014; Dahlby & McMillan, 2019b; Kitchen, Slack, et al., 2019). These include adequacy of revenues, regressivity, and impacts on urban form, among other concerns.

Are property tax revenues adequate?

Consensus does not exist within the literature on whether property taxes are adequate to fund all municipal (capital) expenditures or, in other words, whether these taxes' limitations warrant the extension of new revenue sources to local governments. Some suggest that property taxes can indeed provide Canadian municipalities with adequate revenues (Dahlby & McMillan, 2019a; McMillan & Dahlby, 2014) but may be simply underutilised (Dahlby & McMillan, 2019a; Tassonyi et al., 2015). It is also suggested that, despite widespread belief otherwise (see for example Vander Ploeg, 2004), property taxes are not inelastic or unresponsive to economic growth. Rather, in multiple provinces, property tax revenues as a percentage of household incomes have remained relatively stable since the mid-twentieth century (Dahlby & McMillan, 2019a; McMillan & Dahlby, 2014). Shorter-term concerns remain, however, as infrastructure expenditures required to support economic and population growth are often required well in advance of any increases in property tax revenue resulting from that growth (Slack, 2005; Vander Ploeg, 2004).

While supporting the property tax as a main municipal revenue source, some have come to believe that more taxation powers may be warranted for Canada's large urban municipalities

(Boadway & Kitchen, 2018; Kitchen, McMillan, et al., 2019b; Kitchen & Slack, 2016; Mintz, 2006). This support is rationalised in light of international practises, the benefits of diversifying municipal revenues, as well as current and emerging challenges facing Canadian cities including ageing populations, climate change, and deteriorating infrastructure systems (Boadway & Kitchen, 2018; Kitchen & Slack, 2016; Mintz, 2006).

Some acknowledge the difficulties of obtaining increased revenues from the property tax, given its high visibility (important for accountability) and status as a deeply unpopular tax with both politicians and citizens (Bird, 2001; Dachis, 2018; Kitchen, McMillan, et al., 2019b; Slack, 2005). Certain aspects of the property tax make it difficult to increase relative to other taxes, namely lump-sum invoicing (whereas sales and income taxes are withheld at source) and public 'misunderstandings' of what services the tax funds (Dachis, 2018; Kitchen, McMillan, et al., 2019b; Slack & Bird, 2015).

Whether or not tax competition among Canadian municipalities serves as a real barrier to increasing property tax rates (and resulting revenues) remains somewhat open to debate. Despite finding evidence of tax competition, Tassonyi et al (2015) concluded that most Greater Toronto Area municipalities may indeed be able to raise property taxes rates at least marginally without shrinking their assessment bases (and therefore revenues), similar to findings from New Brunswick (Brett & Tardif, 2008). Less certain are findings from Alberta, where Conger et al found evidence of "increasing competition among [Edmonton and Calgary region] municipalities for the non-residential tax bases" but that the same data might also suggest "collusion" (2016, p. 16). Similar ambiguous findings resulted from Brett and Pinkse's 2000 study of British Columbia municipal tax rates: "we find some evidence that municipalities react

to increases in the tax rates of their neighbours" but "it is not obvious that this implies widespread destructive competition for capital." (2000, p. 712).

Are property taxes regressive?

Assertions that property taxation is regressive are disputed within the literature (Kitchen, Slack, et al., 2019; Kitchen & Tassonyi, 2012), and are in general dismissed as arising from a "limited and short-term perspective" (McMillan & Dahlby, 2014, p. 1). Indeed, 'perspective' is an important issue when it comes to regressivity concerns, as empirical investigations of the incidence of property tax are said to largely turn on assumptions about the tax itself (Dahlby, 1985; Kitchen, McMillan, et al., 2019b; Kitchen, Slack, et al., 2019). More specifically, most authors seem to suggest that the property tax is regressive if it is considered an excise tax, progressive if it is viewed as a wealth tax, and neither if it is presumed to be a benefit tax (Kitchen, McMillan, et al., 2019b; Kitchen, Slack, et al., 2019; Slack & Bird, 2014). There is general support, however, for targeted property tax relief for those in need, for example low-income seniors who may be 'asset-rich' but 'cash-poor' (Kitchen, McMillan, et al., 2019b; McMillan & Dahlby, 2014).

Spatial implications of property taxation

Finally, it is generally understood that property taxes tend to encourage less dense (and more costly, from an infrastructure point of view) urban development patterns (Blais, 2011; Conger et al., 2016; Kitchen, McMillan, et al., 2019b; Slack, 2002). Because property taxes payable (particularly in the Canadian context (Dachis, 2018) where market value assessments are widespread) increase as property values increase, these taxes serve as a "disincentive to

intensify the use of land and as an incentive to sprawl" thereby "leading to lower densities than would otherwise exist without the influence of the property tax" (Blais, 2011, p. 102).

User fees

It has been suggested that Canada's municipal infrastructure gap (deficit, debt) may be, at least partly, caused by the absence of adequate pricing mechanisms (Bazel & Mintz, 2014; Dachis, 2018; Kitchen, McMillan, et al., 2019b). Accordingly, many suggest expanded and improved use of user fees as a strategy for addressing these issues, specifically in the context of road and transportation infrastructure (Bazel & Mintz, 2014; Boadway & Kitchen, 2018; Dachis, 2018; Kitchen, 2006; Mintz, 2006; Slack & Tassonyi, 2017).

Indeed, economists generally favour 'properly designed' user fees for municipal services "whenever and wherever possible" (Kitchen, McMillan, et al., 2019b, p. 364), given their potential as a mechanism for revealing demand, encouraging efficiencies and conformity to the 'benefit model' of municipal finance (Bird, 2001; Dachis, 2018; Slack & Tassonyi, 2017; Tedds & Althaus, 2016). In municipal contexts, this means new and better user fees for services where beneficiaries may be identified, such as major roads, mass transit, water, wastewater, sewage, waste disposal, recreation, and libraries (Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). With the exception of major roads, most of these services are already fully or partially funded through user fees in most Canadian provinces, despite whatever imperfections may be found in their design.

Marginal cost pricing

The view that "few Canadian municipal governments price services correctly" is common within the literature (Slack & Tassonyi, 2017, p. 9). As suggested, criticisms primarily focus on the extent to which existing municipal user fees fail to conform to the 'benefit model' of municipal finance. These criticisms typically stem from concerns over efficiency, equity, and accountability (Dachis, 2018; Kitchen, McMillan, et al., 2019b; Kitchen & Tassonyi, 2012; Slack, 2016).

For example, water and sewer user charges are frequently criticized because, where they are present, they are often not calculated using marginal cost pricing. Prevailing methods (including 'constant unit rates') are accused of failing to comprehensively account for capital replacement costs, opportunity costs, as well as differences in service costs arising from peak-versus-off-peak demand and distances between supply and consumer (Kitchen & Tassonyi, 2012; Slack & Tassonyi, 2017). These pricing issues represent inefficiencies that, it is suggested, tend to result in inflated demand for and investment in related infrastructure (Bird, 2001; Kitchen, McMillan, et al., 2019b).

Many authors furthermore contend that municipalities tend to set user fee rates based on revenue goals, as opposed to the (marginal) costs of providing services, posing equity concerns (Kitchen, McMillan, et al., 2019b). It is argued that this practice creates the potential for perverse subsidies (Bird & Tsiopoulos, 1997; Slack & Tassonyi, 2017). Furthermore, 'properly designed' user fees are viewed as meeting the accountability criteria as payers are likely to understand fees' purposes as well as the uses of resulting revenues (Tassonyi & Kitchen, 2021). Finally, this failure to appropriately set user fees has also been shown to distort urban

development by lowering the costs of lower-density development relative to more efficient land use patterns (Blais, 2011; Slack, 2002).

It is generally recognized that user fees are indeed regressive in that they may fall more heavily on those with lower incomes (R. Bird, 2001; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017), though such concerns are often dismissed as "about as relevant as the claim that milk prices and movie tickets are regressive" (Kitchen, McMillan, et al., 2019b, p. 399). Accordingly, the literature suggests managing this concern through greater redistributive transfers funded by provincial and federal income and other tax revenues (Dachis, 2018; Tassonyi & Kitchen, 2021), as opposed to "changing or distorting prices" of municipal services (Kitchen, McMillan, et al., 2019b, p. 365).

Intergovernmental transfers

In recent decades Canada's local governments have successfully advocated for increased intergovernmental capital transfers, at least in part by mobilising concern over municipal infrastructure shortfalls (Bazel & Mintz, 2014; Dahlby & Jackson, 2015; Hilton, 2007; Kitchen, McMillan, et al., 2019b; Tassonyi & Conger, 2015). The literature suggests, however, that intergovernmental grants are often an inappropriate method for funding municipal infrastructure.

Virtually the only circumstance in which grants are warranted are situations wherein one municipality constructs and maintains infrastructure that benefits neighbouring jurisdictions in some way (Boadway & Kitchen, 2018; Hulten & Schwab, 1997; Slack & Tassonyi, 2017). Even then, grants should only be in amounts proportional to these positive externalities

(Dahlby & Jackson, 2015; Slack & Tassonyi, 2017). This 'spillover' principle may be interpreted more-or-less expansively, however, in support of nationally/provincially significant environmental protection, productivity-enhancement, economic stimulus, and other policy goals (Dahlby & Jackson, 2015; Kitchen, McMillan, et al., 2019b).

Canadian economists have many concerns over the general (and, in recent decades, increasing) use of intergovernmental grants to fund municipal infrastructure. Specific criticisms of this funding tool focus on how such transfers are unpredictable and may distort local decision-making, reduce political accountability, and disincentivize certain economic and public policy choices.

Grants from other orders of government are fundamentally unpredictable revenue sources for local authorities (Bird, 2001; Schaeffer, 2000; Slack, 2005; Tassonyi, 2002). As the level and nature of these transfers fluctuate with other governments' priorities, recipient municipalities often find themselves in situations where they must reduce expenditures and/or increase property tax or user fee revenues to make up for reduced grant revenues (Bird, 2001; Slack, 2005).

Many intergovernmental capital grants require matching funds as well as other conditions, resulting in concerns that these transfers will lead local officials to pursue projects that may be misaligned with local priorities (Bird, 2001; Kitchen, 2006; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). This occurs because grants reduce the cost of certain municipal capital projects, per other governments' priorities (Slack, 2005; Slack & Tassonyi, 2017).

It is furthermore argued that intergovernmental transfers reduce political accountability, as funding from more than one order of government makes it difficult for

citizens to identify which public officials to hold responsible for real or perceived public policy failures (Bird, 2001; Kitchen, 2006; Kitchen, McMillan, et al., 2019b; Slack, 2005; Slack & Tassonyi, 2017).

Finally, intergovernmental capital grants are alleged to reduce local governments' incentives to make certain public choices such as the adoption of effective asset management strategies and the introduction of expanded and/or improved user fees (Kitchen, 2006, 2017; Kitchen, McMillan, et al., 2019b; Slack, 2005; Slack & Tassonyi, 2017). For example, Vander Ploeg (2004) notes how, in the early 2000's, certain federal-municipal capital grants for water and wastewater infrastructure effectively rewarded municipalities for not adopting utility rates aimed at comprehensive cost-recovery.

As a result of the above concerns, many in the Canadian context have subsequently called for reduced inter-governmental grants, and instead greater use of municipal own-source revenues (such as user fees), debt financing, as well as the extension of new revenue tools to local authorities (Boadway & Kitchen, 2018; Dachis, 2018; Kitchen & Slack, 2016; Mintz, 2006; Slack & Tassonyi, 2017).

Development charges

Development charges (DCs; also known as Off-site Levies in Alberta, Development Cost Charges in British Columbia, and impact fees among other names across the United States) are a common tool for funding growth-related infrastructure in North America and, increasingly, around the world (Found, 2019; Sancton, 2021; Slack, 2005; Slack & Bird, 2019b). DCs are one-time, per unit (hectare, dwelling) fees levied on new developments to offset capital costs of

required off-site infrastructure borne by municipalities (Kitchen, McMillan, et al., 2019b). These charges are intended to cover an amount of capital costs proportional to infrastructure benefits received by new developments' residents/occupants (Found, 2019; Slack & Bird, 2019b). Given DCs application to new growth-related capital only, their potential for addressing municipal infrastructure shortfall is necessarily limited to such expenditures. However, well-designed DCs may serve to encourage more efficient and less-capital intensive development, thereby reducing operating and capital replacement costs over the long term (Slack, 2002; Vander Ploeg, 2004).

A significant concern within the development charges literature is their calculation based on average costs as opposed to marginal costs (Blais, 2011; Kitchen, McMillan, et al., 2019b; Slack & Bird, 2019b; Tomalty & Skaburskis, 2003). For DCs to be fair and efficient, and to avoid perverse subsidies, they must vary according to a development's density and location among other variables (Blais, 2011; Slack, 2002; Slack & Bird, 2019b). It is generally recognized, however, that implementing true marginal cost pricing for DCs is likely beyond the administrative capacities of most municipalities. Thus, charges based on average costs within a given area (e.g., neighbourhood) are often recommended as a compromise (Slack & Bird, 2019b; Tomalty & Skaburskis, 2003).

Less prominent within the broader municipal finance literature, but important nonetheless, are ongoing debates over the appropriateness of development charges in light of their impacts on housing affordability and practical ability to align costs and benefits, and foundational questions such as the degree to which infrastructure benefits are truly separable, among others. A full treatment of these concerns is, however, beyond the scope of this thesis.

See Found (2019) and Sancton (2021) for contrasting viewpoints on these issues within the Canadian context.

2.4.2. Financing mechanisms

Pay-As-You-Go and Reserves

A substantial portion of Canadian municipalities' capital expenditures are presently funded directly through current revenues (property taxes and user fees) on a Pay-As-You-Go (PAYG) basis or by accumulating over time in reserves (Slack & Tassonyi, 2017; Tassonyi & Conger, 2015). These practices seem to be more prevalent in smaller municipalities, where borrowing costs may be higher due to perceived risk by lenders (Kitchen, 2006; Sancton, 2015; Slack, 2005).

Economists support PAYG funding for short-lived assets such as vehicles, as well as for ongoing expenses like routine asset maintenance (Kitchen, McMillan, et al., 2019b; Mintz, 2006; Slack & Tassonyi, 2017). PAYG is not supported for assets with long useful lives as this is viewed as disrupting alignment between costs and revenues, violating intergenerational equity, and, in practical terms, as generally insufficient to support large capital expenses (Kitchen, 2006; Kitchen, McMillan, et al., 2019b; Slack, 2005; Slack & Tassonyi, 2017).

Reserves are often described as the opposite of borrowing, whereby current revenues accumulate in dedicated accounts (which may be interest-bearing) to support future capital expenditures (Kitchen, McMillan, et al., 2019b; Sancton, 2015; Slack & Tassonyi, 2017). These accounts may be discretionary or required by legislation, may be funded through "a 'capital levy' — usually a few percentage points of the local property tax" (Kitchen, 2006, p. 4), and may be either dedicated to a particular initiative or in support of a municipality's overall capital

expenditures. Similar to PAYG funding, reserves are also criticized for violating intergenerational equity and misaligning costs and revenues (Dachis, 2018; Kitchen, 2006; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). Despite these concerns, the use of reserves is observed to be common and growing (Kitchen, McMillan, et al., 2019b; Sancton, 2015; Slack & Tassonyi, 2017).

Borrowing

Debt itself is not a source of funding, rather it is a tool to facilitate timely asset construction that may also help facilitate alignment between costs and beneficiaries (Hanniman, 2015; Tassonyi & Conger, 2015). Debt must be repaid with a funding source, which, in the case of Canadian local governments, is primarily property taxes and user fees. Debt is perceived to be one important strategy, among many, that municipalities should utilise, and have been utilising, to address their infrastructure gaps (Bazel & Mintz, 2014; Hanniman, 2015; Tassonyi & Conger, 2015; Vander Ploeg, 2004).

Among economists, there is broad agreement that debt should be used to facilitate municipal infrastructure projects with long-term benefits, so as to ensure intergenerational equity as well as avoid large year-over-year tax increases (Hanniman, 2015; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). However, some skepticism exists over intergenerational equity's (the extent to which present-day capital expenditures benefits future users) strength as a rationale for borrowing (Dahlby & Smart, 2015), leaving 'tax smoothing' as a primary area of agreement in terms of borrowing justifications. There is further agreement that capital debt should in turn be serviced by the appropriate stream of current revenues: user fees where

infrastructure has identifiable beneficiaries, and property taxes where beneficiaries cannot be easily identified (Hanniman, 2015; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017).

Finally, there is some evidence that municipalities have excess capacity to obtain additional debt (Bazel & Mintz, 2014; LeSage & McMillan, 2008; Tassonyi & Conger, 2015). Beginning in the 1980's, due to high interest rates prevailing during that period, Canadian municipalities shifted en masse towards reduced borrowing and increased pay-as-you-go capital financing (Bazel & Mintz, 2014; Kitchen, 2006). There are few studies that indicate whether or not municipalities' existing property tax bases could accommodate new debt servicing costs resulting from enhanced borrowing (Tassonyi & Conger, 2015). What little research that has occurred seems to suggest that, in certain places, municipal property tax bases could bear rate increases to some extent (Brett & Tardif, 2008; Tassonyi et al., 2015).

2.5 Summary

Over the past three decades there have been numerous attempts to quantify Canadian municipalities' infrastructure shortfalls and outstanding investment needs. Invariably, these figures have run into the billions of dollars. These estimates, however, have been subject to many criticisms including their production by municipal associations (resulting in potential conflicts of interest), their basis on poor quality data, and their inattention to economic issues namely the need to establish/improve pricing mechanisms for capital-intensive municipal services. Nevertheless, there exists broad consensus that municipal infrastructure spending has

been suboptimal in recent decades, due inadequate pricing, vertical fiscal gaps, and/or asset management challenges.

Municipal capital budgeting is, at a high level, a matter of prioritising various expenditure requests in light of numerous political, legal, fiscal, operational, and other considerations. These include regulations from other orders of government (such as those requiring balanced budgets), the public acceptability of taxation levels, earmarked revenue sources (such as user fees and grants), and the balance between maintaining existing versus constructing new assets. In general, municipal capital budgets should reflect a comprehensive inventory of assets and include Capital Improvement Plan listing expenditures and projects integrated with a Financing Plan identifying funding sources.

In the Canadian context, municipal revenue sources leveraged for capital expenditures are in general limited to property taxes, user fees, and intergovernmental transfers. Debt must be repaid using one or more funding streams and may help to smooth taxation increases over time while ensuring a degree of intergenerational equity. The literature emphasises the relationship between funding mechanisms and expenditures, often suggesting that the absence of pricing mechanisms may result in over-consumption and over-provision of infrastructure.

Chapter 3: Methods

3.1 Research philosophy

The broad 'philosophy' employed by researchers has important implications on what approaches and methods they utilise and should therefore be made explicit (Creswell & Creswell, 2017). Creswell and Creswell (2017) identify four common research philosophies: postpositivist, constructivist, transformative, and pragmatic. Post positivism is characterised by deterministic views on causality, the use of the scientific method (e.g., hypothesis testing), and lends itself to the quantitative observations of phenomena. Constructivism is characterised by a focus on subjective meanings and experiences generated by individuals, and the ways in which these are shaped by culture and history. This philosophy thus lends itself towards more qualitative research approaches. Transformative philosophies are broadly characterised by concern over issues of power and oppression, the experiences of marginalised peoples, and the need for research to contribute positively to social, political, and economic change. Pragmatic philosophies focus on problem-solving, leverage mixed-method approaches, and tend to eschew abstract concerns such as the nature of reality.

This study reflects a broadly pragmatic research philosophy, albeit with constructivist leanings. Pragmatism creates room to explore a 'problem' such as the phenomenon of infrastructure shortfalls through a variety of avenues and approaches, a helpful framework for examining an issue both highly political and technical and one that implicates a variety of disciplines (including economics, accounting, and civil engineering). A constructivist orientation flows from certain research questions, which include a focus on the perceptions of municipal

stakeholders (i.e., with regards to infrastructure shortfalls' causes). Postpositive and transformative philosophies are less suited to this thesis, given its guiding research questions.

3.2 Research approach

This thesis utilises a broadly qualitative approach to address its research questions, in the context of a comparative case study of The City of Calgary and The City of Edmonton. It is recognized however, that distinctions between "qualitative" or "quantitative" research are relative and occur along a continuum (Bhattacherjee, 2012; Creswell & Creswell, 2017). A qualitative approach was selected given the exploratory, open-ended nature of the research questions and their focus on exploring meanings associated with infrastructure shortfalls in both case study cities (Lune & Berg, 2017). An overall quantitative approach was not selected given its relative incompatibility with the research questions, as this approach entails efforts to examine relationships among phenomena through hypothesis testing, numeric data, and statistical methods.

As with quantitative and mixed method approaches, qualitative research has its benefits and limitations. qualitative research may be criticized in terms of validity and reliability (Brinkmann et al., 2020; Ritchie et al., 2013). The former refers to the extent to which methods produce findings that accurately reflect the phenomenon under scrutiny, while the latter refers to their consistent employment (Creswell & Creswell, 2017). Though some researchers reject the application of (post)positivist conceptions of validity and reliability to qualitative research in favour of other criteria (Brinkmann et al., 2020; Denzin & Lincoln, 2011; Hammersley, 2007),

others adopt a more moderate approach that seeks to reform these ideas for best use in qualitative research (Creswell & Creswell, 2017; Lune & Berg, 2017). Accordingly, qualitative researchers may improve the reliability and validity of their findings by applying certain procedures, for example triangulation using multiple methods, use of detailed descriptions, and documentation of data collection and analysis (Bhattacherjee, 2012; Creswell & Creswell, 2017; Lune & Berg, 2017).

3.3 Methods selection

3.3.1 Comparative case study approach

Comparative case studies provide the framework for this thesis' methods. For the purposes of this thesis, case study research is defined generally as (Creswell & Creswell, 2017, p. 290):

> *… a qualitative design in which the researcher explores in depth a program, event, activity, process, or one or more individuals. The case(s) are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time.*

At minimum, case studies may help facilitate exploration of complex, under-researched topics through in-depth and contextualised description of one or more instances of a phenomenon (Bhattacherjee, 2012; Lune & Berg, 2017; Marginson, 2004). Case studies may also assist with generating hypotheses for subsequent quantitative testing (Bhattacherjee, 2012; Marginson, 2004). Case studies are often criticized for failing to produce generalizable findings (Creswell & Creswell, 2017; Lune & Berg, 2017) (that is, conclusions that are representative of and/or applicable to a wider class of cases) due to the wide variety of

uncontrolled variables and contextual factors at play (Bhattacherjee, 2012). However, this view is not undisputed. Some counter that while a researcher may not necessarily be able to generalise findings from any given case study, others may be able to generalise from a multitude of completed case studies (Flyvbjerg, 2006; Ruddin, 2006). In addition, single case studies may enable generalisation through falsification of hypotheses (Bhattacherjee, 2012; Flyvbjerg, 2006; Ruddin, 2006).

A case study approach was selected given this thesis' exploratory research questions in the context of the research topic's complexity. As noted in the preceding chapter, the literature lacks in-depth case studies that relate how specific municipalities assess, perceive the causes of, and address local infrastructure shortfalls. Further, infrastructure shortfalls as a phenomenon are demonstrably complex as it implicates a variety of disciplines, occurs in the context of large and diverse organisations (municipalities), and as its causes appear ambiguous. To mitigate the limitations of case study research, as well as this thesis' qualitative approach generally, the following procedures were adopted: use of two case study municipalities, multiple research methods to allow triangulation (see below), provision of detailed methodological descriptions, and inclusion of direct interview and document quotations to support rich descriptions.

3.3.2 Case study selection

The City of Calgary and The City of Edmonton were chosen as case studies, providing an overall framework for this thesis. Given this thesis' exploratory nature, case study selection was informed mainly by a concern for choosing broadly comparable jurisdictions, availability of data, as well as convenience. These two municipalities are Canada's largest pair of similarly

sized urban municipalities within a single province. In addition, both cities have, albeit to varying extents, consistently reported on both their infrastructure shortfalls as well as the condition of their asset portfolios over the last two decades. Given the author's prior familiarity with the Alberta municipal context, case study selection was also informed by convenience.

The case study cities, and thus this thesis' findings, may not necessarily be representative of the broader experience of large urban municipalities in Canada. First, Calgary and Edmonton contain the vast majority of their regional populations and have done so since the mid-twentieth century, usually with support from provincial annexation policy (Foran, 2009). This contrasts with many other urban regions such as Toronto, Montreal, Ottawa, and Halifax which remained relatively fragmented with many contiguous municipal governments existing until the late-1990's and early 2000s. Other urban regions such as Victoria and Vancouver continue to this day to contain a multitude of smaller urban municipalities within the context of strong regional governing entities such as Metro Vancouver and the Capital Regional District, each with distinct responsibilities for water utilities and waste management among other capital-intensive municipal services. Second, Calgary and Edmonton have been subject to periods of rapid population and economic growth owing to Alberta's cyclical economy. These structural factors, among others, together with provincial differences in municipal legislation, could limit comparison to other Canadian jurisdictions. Additional in-depth case studies are needed to better understand how these factors and other factors may impact municipal infrastructure shortfalls.

3.3.3 Methods selection

This study relied on three research methods: semi-structured key informant interviews; municipal documentary sources; and descriptive statistics for both case study cities. These three methods were chosen to allow for adequate 'triangulation' in research findings within the case studies (Bhattacherjee, 2012; Creswell & Creswell, 2017; Lune & Berg, 2017).

Interviews were chosen as they provide relatively easy access to the understandings, perceptions, and opinions of individuals, a key focus of the research questions (Lune & Berg, 2017). Semi-structured interviews are well-suited to exploratory research as they can assist with unearthing previously undocumented information (Marginson, 2004) and create time and space for participants to explain complex or seemingly contradictory ideas (Horton et al., 2004). Interviews are limited in that individual participants' understandings and recollections are always partial to some extent and may be biased or otherwise one-sided (Bhattacherjee, 2012; Ritchie et al., 2013). Interviews may also be challenging to conduct when research participants are situated within 'guarded' or 'secretive' organisations (Monahan & Fisher, 2015).

Document analysis was selected primarily as a means of validating (or otherwise) findings from interviews, more specifically the claims of research participants, as well as providing overall context for findings (Bowen, 2009; Lune & Berg, 2017; Prior, 2020). Document analysis' strengths are that it is a relatively efficient, cost effective, and non-intrusive method, providing access to stable materials that do not react to observation by researchers (unlike, for example, research participants in interviews) (Bowen, 2009; Lune & Berg, 2017). As with any method, document analysis has its own methodological limitations. Recognizing that documents are typically produced for purposes other than research, they should not necessarily

be assumed to be complete or accurate; in addition, documents may not include enough detail to address research objectives (Bowen, 2009). Documents, particularly those publicly available, may also reflect organisational or other biases against revealing embarrassing or otherwise sensitive information (Lune & Berg, 2017). These issues underscore the need for adequate triangulation (Bowen, 2009; Creswell & Creswell, 2017; Lune & Berg, 2017).

Descriptive statistics, for example aggregate per capita capital spending figures, long-term debt figures, and population growth, was chosen to identify long-term trends and provide overall context for each case study city, within which to situate interview and documentary data.

3.4 Methods application

3.4.1 Interviews

Twenty (20) interviews were conducted between July 2020 and January 2021. Interviews lasted between thirty (30) and ninety (90) minutes and followed a semi-structured interview guide with between four (4) and six (6) substantive questions, depending on participants' category. Per institutional policy in place due to the COVID-19 pandemic, all interviews occurred via telephone or electronic conferencing platforms. Eighteen (18) interviews were recorded (with participants' consent) and transcribed for analysis. The remaining two (2) participants did not consent to their interviews being recorded and therefore notes were taken instead.

Participants included city councillors and current or former administrators at The City of Calgary and The City of Edmonton. Professionally speaking, administrators were either planners or engineers directly engaged with infrastructure matters; no municipal employees in budget or financial administration roles were interviewed. In terms of role, administrators were either senior managers or subject matter experts. Others interviewed included: representatives from community organizations whose mandate includes facilitating public participation in municipal planning, one in Calgary and one in Edmonton; a development association representative in Calgary; and an employee of a provincial municipal association. See Appendices for a full list of participants.

Research participants were identified through a mixed purposive and snowball sampling approach. To begin, all sitting municipal councillors in Calgary and Edmonton were contacted, as well as one community organisation with expertise in urban planning, and one association of residential land developers in each city, as well as a provincial municipal association. Furthermore, at the end of each interview participants were asked to identify what other individuals, if any, they would suggest be interviewed as part of this research. Participants were asked to contact such individuals and request their permission, prior to sharing said individuals' contact information with the researcher.

A semi-structured interview format was employed to allow a degree of flexibility, whereby the interview guide could be supplemented with additional questions that arose per participants' comments and areas of expertise (Creswell & Creswell, 2017; Lune & Berg, 2017). The term infrastructure 'gap' (referring to forward looking, projected differences between

required capital expenditures and available funds) was intentionally used within the first interview question as this is the figure published consistently by the case study cities.

Questions' exact phrasing varied somewhat between participant categories (e.g., councillors versus community representatives), however they focused on participants' understandings of local infrastructure gaps, perceived contributing factors, and mitigation strategies employed by both municipalities. See Table 6 for an overview of interview questions and their alignment with this thesis' overall research questions. See Appendices for exact interview guides by participant type.

Table 6: Interview Questions

Research Questions	Interview Questions	Rationale
#1 How do municipal stakeholders and decisionmakers understand their local infrastructure gap estimates?	#1 The City of [NAME] projected a 10-year infrastructure funding gap of [AMOUNT] dollars in [YEAR]. How was this figure calculated? What kinds of information was considered?	This question solicits a general overview of how their municipality estimates its infrastructure 'gap' figure. Participants' understandings of how infrastructure gap figures are estimated was solicited to contextualize their answers to later questions' (councillors answers to question #1 primarily assisted with this), and also to make up for information gaps about methods in municipal reports (administrators answers to question #1 primarily assisted with this).
	#4 How does The City of [NAME] determine the need for new infrastructure projects?	The literature emphasises the cost component of infrastructure shortfall estimates as warranting scrutiny; this question seeks information on how 'needs' are established.
#2 What do municipalities perceive to be the larger cause(s) of their infrastructure debt, deficits, and gaps?	#2 What factors have contributed to this accumulated infrastructure deficit?	This question asks participants to identify what, in their opinion, is resulting in infrastructure shortfalls in their local context.
	#5 What factors impede [CITY]'s capacity to build infrastructure projects?	These questions were designed to provide participants with additional opportunities to discuss participants' factors contributing towards municipal infrastructure shortfalls, including their relative importance.
	#6 What factors enhance The City of Calgary's capacity to build infrastructure projects?	
#3 How are municipalities addressing their infrastructure debt, deficits, and gaps?	#3 What strategies has The City of [NAME] utilised to address its infrastructure deficit?	This question seeks information on what policy responses municipalities have mounted in response to their infrastructure shortfalls .

3.4.2 Document analysis

Documents selected for review were chosen due to frequent references by research participants in interviews, within budget documents or infrastructure gap source documents, and relevance to this thesis' overall research questions. All documents were obtained from the public websites of each municipality. These documents included current and previous Municipal Development Plans, current asset management/infrastructure strategies and associated policies, and policies related to debt and other financial matters. See Appendices for a list of municipal documents reviewed in-depth. For documents where the topic was not solely related to such matters, the key words "infrastructure" and "capital" were used to locate relevant information.

In certain cases, documents and reports not explicitly referenced either by participants or within budget/infrastructure documents were sought out to provide additional context to issues discussed or to facilitate comparison between the two case study municipalities. For example, additional documents and reports were sought regarding The City of Edmonton's Neighbourhood Renewal Program given frequent reference by research participants, though participants themselves did not refer to any documents in particular. These documents were not subject to in-depth review and are not listed within the Appendices.

3.4.3 Municipal financial and other data

Descriptive statistics, specifically financial and other data produced by The City of Calgary and The City of Edmonton, were used to illustrate trends and overall context for the two case cities. Data includes historical capital spending, capital budgeting allocation figures,

debt levels, asset condition figures, and population growth figures. These data are primarily drawn from each municipality's annual financial reports. Specific datasets were chosen with considering reference by research participants in interviews and/or within budget documents or infrastructure gap source documents, and relevance to research questions.

3.5 Analysis

In keeping with this thesis' broadly qualitative nature, data analysis followed an inductive, grounded theory approach (Creswell & Creswell, 2017). As such, analysis began with open coding of interview transcripts and documents to identify themes raised by interview participants and within documents (Bhattacherjee, 2012; Lune & Berg, 2017).

Interview recordings were listened to once for comprehension, then a second time for transcription. Transcripts were reviewed and coded to identify common themes. Sub-codes were established as needed. Codes were then organised by city and by interview question which, per Table 6, broadly align with this thesis' three guiding research questions. Following initial coding, themes were grouped as needed into larger categories within each research question. Documents were coded in the same manner, with content being reviewed for themes in alignment with the overall research questions. Such themes were then grouped into larger categories, and then compared to those generated from interview transcripts in keeping with document analysis' use as a validation method.

In parallel with open coding of interview and documentary data, axial coding was undertaken to explore relationships between the broader categories identified (Bhattacherjee,

2012; Strauss & Corbin, 1990). Through axial coding, potential inter-relationships (causal and otherwise) and interactions between categories were explored to develop explanatory hypotheses to address the research questions.

Municipal financial and other data was compiled from budgetary documents and annual financial statements while open and axial coding was being undertaken. Population growth figures, annexation data, annual capital spending figures, intergovernmental grant revenues, and long-term (capital) debt figures were compiled to illustrate each case municipalities' larger contexts. Population figures were assembled from each municipality's civic census. Annual capital expenditures were inflation adjusted per the non-residential construction prices indices for Calgary and Edmonton respectively, published by Statistics Canada. Other financial figures, including long-term debt and capital budgets allocations, are not inflation adjusted unless otherwise stated. These figures and associated trends further aided with triangulation throughout the coding process.

Finally, selective coding was undertaken to "explicate a story from the interconnection of [the] categories" (Creswell & Creswell, 2017, p. 246) first identified through open coding and then further explored through axial coding.

3.6 Limitations

This thesis faces several limitations. These include both general factors and considerations specific to the research design and methods chosen.

First and foremost, given this thesis' broadly qualitative research design, its findings are neither exhaustive nor are they comprehensive, despite measures taken to safeguard validity (triangulation, documentation of methods, etc.). Rather, this thesis presents certain tentative hypotheses that could be tested and then supported or contradicted through future research. It must also be emphasized that given this thesis' qualitative nature, conclusions cannot be drawn about either the existence of infrastructure gaps themselves, or the appropriateness of the methods used by municipalities to estimate these figures. Findings are furthermore specific to the case study cities and are not necessarily generalizable to other large urban municipalities in Canada. In addition, statements by participants reflect their opinions and perspective. Though placed in the context of documentary and other evidence, participants' statements should not necessarily be taken at face value as this thesis does not seek to, and cannot given its research design, prove or disprove them.

As well, given the expansive subject matter and limits posed by time and resources, this thesis generally prioritised *breadth* over *depth* of inquiry. This trade-off occurred given the identified literature gap and resulting research questions, and that the phenomenon of municipal infrastructure shortfalls implicates several discrete bodies of knowledge and substantive topics. Though a practical necessity, this trade-off almost certainly means that certain, specific details and nuances associated with various subjects touched on within this thesis are elided in favour of attempting to illustrate broader trends and connections. Though this was deemed acceptable, given this thesis' research objectives, it nevertheless remains a limitation. To provide a concrete example, many research participants perceived urban growth as a cause of infrastructure shortfalls, and accordingly described various policy responses to this

issue by their municipality. Municipal subject matter experts for each policy response were not necessarily interviewed; to compensate somewhat, documents related to topics raised were reviewed.

Research participants were primarily municipal councillors and administrators. Municipal administrators interviewed were primarily engineers and planners. Interviews occurred with other participants including: one community representative in both case cities, and a provincial municipal association representative, and a Calgary-based development industry representative. Despite best efforts, no development industry representative in Edmonton was recruited. Given the above, this thesis' findings primarily reflect the perspectives of municipal stakeholders.

In addition, it is important to stress the fact that no interviews were secured with municipal finance administrators, despite referrals through the snowball sampling approach. For both case municipalities, prospective participants did not refuse interview requests per se. In one case, a prospective participant seemed to indicate their preference for a more structured interview format, while another became unresponsive after a seemingly positive initial response. Regardless of the reason, the fact that no finance administrators were interviewed means that findings could omit certain important details. More specifically, descriptive information about how capital budgeting works in practice at the city (as opposed to simply per policy or as described in reports), may be lacking. Thus, the absence of these research participants makes it difficult to adequately triangulate findings here/to assemble relevant context.

The primary methodological limitation related to this thesis' use of document analysis relates to selection. As documents were selected for review primarily as a result of being referenced by research participants and/or cited within capital budget documents, this could in theory introduce an element of confirmation bias into this research. As well, the fact that only publicly available documents were reviewed presents a further limitation, as information relevant to this thesis' findings are very likely to be contained within internal documentation not publicly available.

Most quantitative data sources included in this thesis are generated locally by The City of Calgary and The City of Edmonton, posing varying degrees of comparison challenges. As both Calgary and Edmonton are required to prepare their annual financial statements per Canada's Public Sector Accounting Standards (PSAS), in theory, figures such as both cities' long-term debt and capital expenditure figures should be broadly comparable. Notably, changes to PSAS in 2009 resulted in stricter requirements for tracking and depreciation of Tangible Capital Assets (infrastructure) (CPA Canada, 2007), meaning that associated annual municipal financial data may not be strictly comparable before and after that year.

Not all municipal data referenced in this thesis are subject to external standards, however. Infrastructure condition assessments and capital budget figures specifically, due to their locally generated nature, may not be directly comparable due to differing municipal definitions, policies, practices, and standards related to their preparation. In addition, similar data from both municipalities was sometimes obtained in different ways. Historical annexation data, for example, was easily accessible in a compiled format for The City of Edmonton, however this data had to be compiled manually from archival sources for The City of Calgary.

Due to this, some caution is warranted when comparing certain figures from the case cities. Nevertheless, broad observations of trends in both cities are made and discussed in relation to one another, aligning with this study's overall qualitative approach.

Finally, the results of this thesis must be understood as reflecting a particular point in time. Interviews were conducted primarily over the summer of 2020, during the COVID-19 pandemic. Documents reflect the most recent available information at that time.

3.7 Ethical considerations

The thesis received ethics approval (ORE#41685) from the University of Waterloo, in accordance with its institutional policies and practices. A researcher's ethical obligations, however, extend beyond formal reviews of data collection procedures and into analysis and publication.

In order to preserve participants' anonymity, at most their location (municipality), category (e.g., Councillor, Administrator) are provided. Given the highly specific nature of the study's topic, a reasonably well-informed reader of this thesis may be able to accurately ascertain the identity of informants based on quotations from interviews if additional information such as profession (e.g., planner, engineer) or role (e.g., senior manager, subject matter expert) was provided.

Finally, it is important to acknowledge how the researcher's own bias and positionality may impact the findings of this research. Specifically, it is important to disclose that, since September 2020, the author has been employed by two separate municipal councillors in

Calgary. The resulting closeness to one of the case study cities may impact this research by reducing critical distance. However, simultaneously, this has resulted in greater understanding of certain general aspects of municipal government in Alberta which may have benefited the findings through improved contextual awareness.

Chapter 4: Context

This chapter discusses the overall context for the two case study municipalities, focusing on drivers of local capital expenditures. A brief overview of the two cities and their recent infrastructure projects is first provided. Major trends and features of Calgary's and Edmonton's population growth, urban form, and metropolitan structure are then highlighted to illustrate the influences on their historical capital allocation decisions. Next, direct and related measures of capital expenditures are discussed. These include total long-term debt, intergovernmental transfers, capital expenditures, and asset portfolio figures. Historical background information is briefly summarised where relevant.

4.1 Overview

The Cities of Calgary and Edmonton are Alberta's two largest cities, with 2021 populations of 1,306,784 and 1,010,899, representing about 88% and 71% of their respective Census Metropolitan Area populations (Statistics Canada, 2021). Together, the two cities contain just over half of the province of Alberta's total population. See Figure 2 for maps of both cities.

In recent decades, particularly since the early 2000's (see Figure 6), both Calgary and Edmonton have rapidly increased their capital expenditures in both absolute and per capita terms, adjusted for inflation. During this period, major tax-funded (as opposed to utility projects funded by user fees) infrastructure projects in both cities have included LRT system extensions, roadway projects, recreation facilities, and new libraries. To illustrate the scale and

timing of these recent and future investments, examples of LRT and recreation projects in both cities are discussed below.

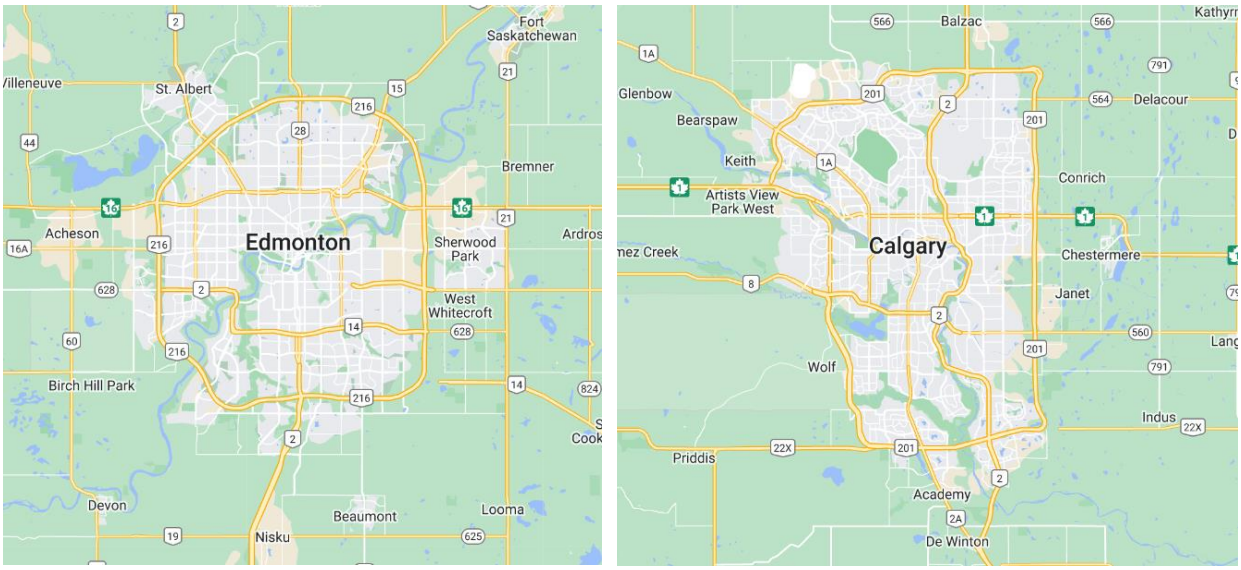
Calgary and Edmonton have followed somewhat different historical trajectories in developing their respective LRT systems, which in turn accounts for timing differences in associated expenditures. Edmonton's original Capital Line opened in 1978, with incremental expansions from the 1980's to the mid-2000's (Edmonton, 2009a). Following adoption of its 2009 Long-term LRT Network Plan, Edmonton embarked on a period of rapid system expansion, including: the Metro Line (opened 2015, cost $665 million), Valley Line Southeast (planned opening 2022, $1.8 billion budget), the Valley Line West (construction commenced 2021, $2.7 billion budget), and Capital Line south extension (construction commencing 2023, $1.1 billion budget) (Alberta, 2022a, 2022b, 2022c; Edmonton, 2021, 2022).

Calgary, meanwhile, built the core of its LRT system (South, Northeast, and Northwest lines) during the 1980's, with both major and incremental expansions from the 1990's to the early 2010's, including the $1.3 billion West Line (Calgary, 2017b; OCA, Calgary, 2013). Presently however, Calgary is in the midst of its own large-scale LRT expansion in the form of the $4.9 billion-dollar Green Line project (Calgary, 2021a).

Both Calgary and Edmonton have invested substantial own-source resources in building new recreation facilities in recent years. Examples in Calgary include the following facilities (now operated by third parties): Quarry Park (opened 2016, cost $63 million), Great Plains (opened 2016, cost $33 million), Rocky Ridge (opened 2018, cost $192 million), and Seton (opened 2019, cost $193 million) (Calgary, 2022c). Examples in Edmonton include the following recreation centre and/or library facilities: Terwillegar (opened 2011, $86 million CRV), The

Meadows (opened 2014, $71 million CRV), Clareview (opened 2014, $61 million CRV), and Lewis Farms (planned opening 2026, $311 million budget) (Edmonton, 2018d, 2020b).

Figure 2: Maps, Calgary and Edmonton



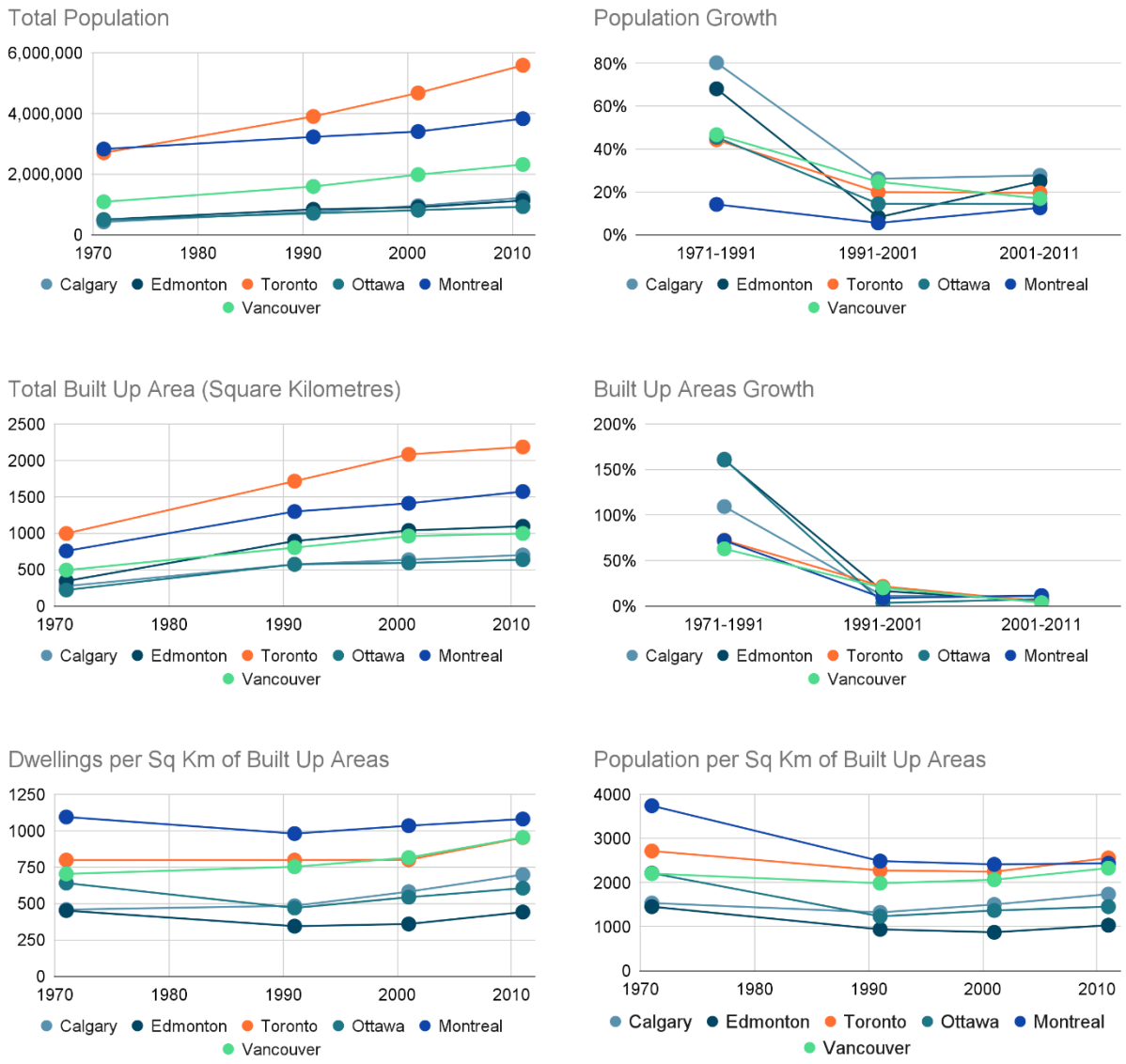
Source: Google Maps (2022)

4.2 Population and built-up area growth trends

Figure 4.2 places Calgary and Edmonton's population and built-up areas growth within the broader context of Canada's largest Census Metropolitan Areas (CMAs). From 1971 to 2011, Calgary and Edmonton's CMA populations grew at faster rates than other CMAs. High population growth, together with rapid growth in built-up areas, translated into large capital expenditures for these region's core cities. The Calgary and Edmonton CMAs are also substantially less dense than their counterparts elsewhere in Canada, on both a per capita and per dwelling basis, again, likely influencing overall municipal capital spending. As with all CMAs,

metropolitan densities in Calgary and Edmonton decreased between 1971 and 1991, but then increased somewhat between 1991 and 2011.

Figure 3: Population Growth, Built-Up Area, and Density for Select CMAs, 1971-2011

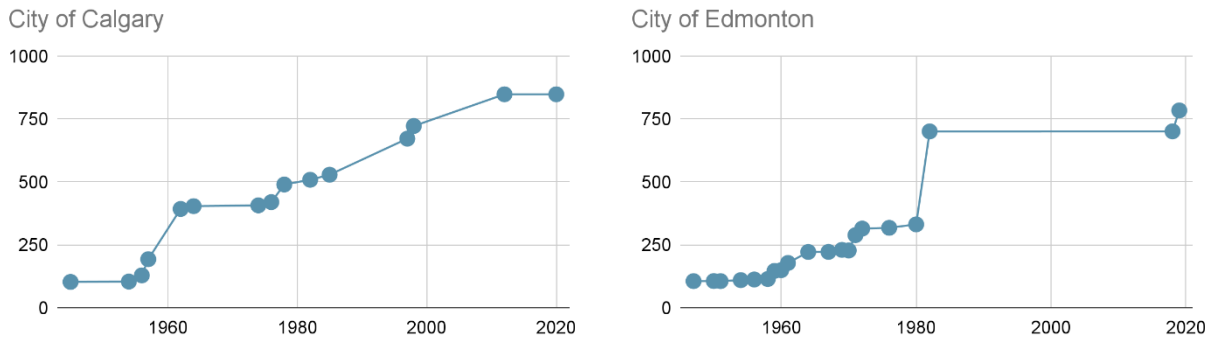


Source: Statistics Canada (2016)

Notes: 'Built Up Areas' includes roads; figures reflect 2011 CMA boundaries for each year

In contrast to most Canadian metropolitan areas, the Cities of Calgary and Edmonton have contained the vast majority of their regional populations since the mid-twentieth century, though Edmonton to a lesser degree. This 'uni-city' approach was affirmed in 1956 by the Royal Commission on the Metropolitan development of Calgary and Edmonton as a principle to guide the development of both urban regions (Foran, 2009). The provincial government would, over the following decades, largely follow this policy in approving the annexation requests of both cities. One notable exception is the province's rejection of The City of Edmonton's 1980 proposal to annex the neighbouring urban communities of St. Albert and Sherwood Park (Hulchanski & Gordon, 1985), while approving annexations of adjacent rural areas. Figure 4 depicts both cities' growth in municipal area over time through annexations from, and of, surrounding municipalities.

Figure 4: Municipal Area (Square Kilometres), 1945-2020



Source: City of Calgary, City of Edmonton

Notes: municipal area does not equal built-up areas, as municipal area includes undeveloped lands

4.3 Capital expenditure, funding, and financing trends

As in most Canadian urban regions, the 1950's through the 1970's were an intense period of infrastructure building in both Calgary and Edmonton (Calgary, 2004b; Edmonton,

2006). Crucially, however, this period pre-dates the development of comprehensive asset management practices and systems among local governments in Canada (Ontario et al., 2008).

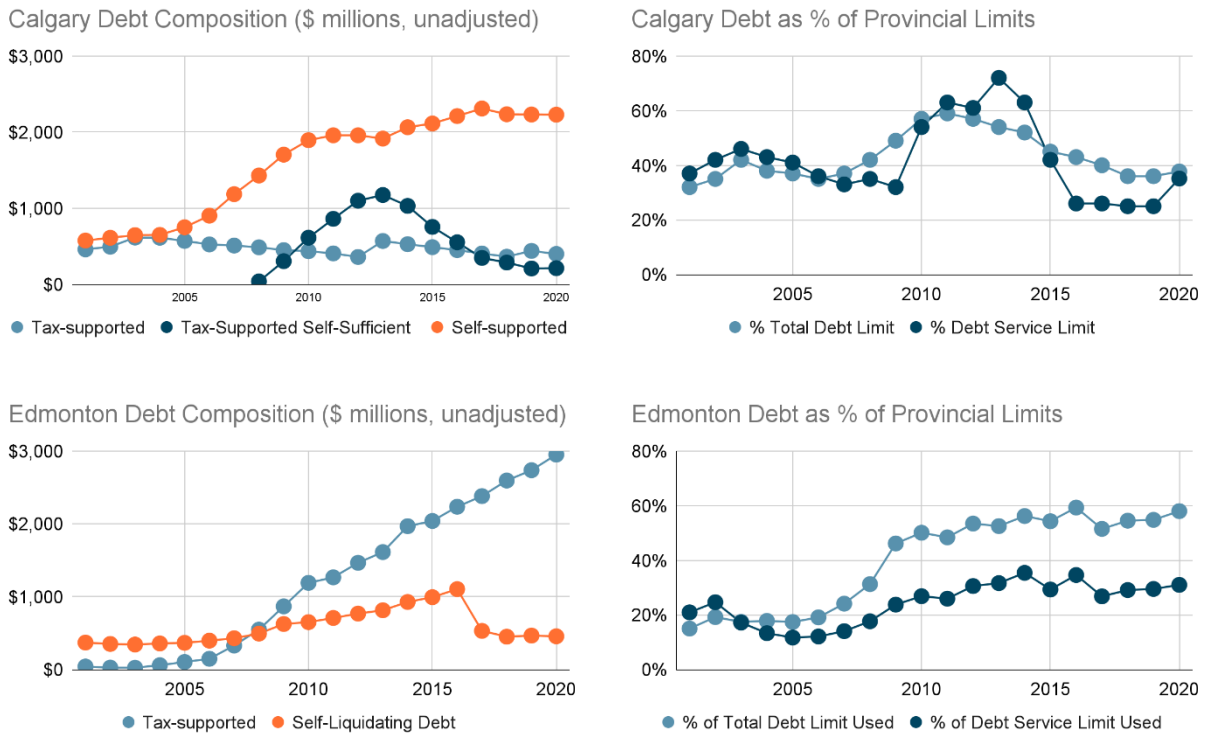
In Alberta, municipal capital expenditures during this period were primarily funded through debentures, with municipal long-term (capital) debt reaching a high of 20% of personal income by the late 1950's, remaining elevated through the 1960's, and then declining during the 1970's (McMillan & Dahlby, 2014). The next two decades would represent a period of relatively low capital expenditures among Alberta municipalities generally (McMillan & Dahlby, 2014). During the 1980's, debt servicing costs peaked at 20% of Alberta municipalities' total expenditures (ibid), prompting the introduction of debt reduction measures in both Calgary and Edmonton.

In the 1990's The City of Calgary, among other measures, reduced its borrowing terms to between 10 and 15 years, while foregoing new tax-supported borrowing in certain fiscal years (Calgary, 2002). The City of Edmonton took a more aggressive approach by prohibiting new tax-supported borrowing altogether throughout the 1990's (Edmonton, 2014). Both cities had returned to tax-supported borrowing by the early 2000's, however, while also adopting internal debt limits stricter than those imposed by provincial legislation. These stricter debt limits have remained following the creation of the Calgary and Edmonton City Charters in 2018 which, among other things, enables both cities to independently determine their debt ceilings.

Since 2001, the composition of municipal long-term debt in Calgary and Edmonton has diverged. By 2020, the City of Calgary's debt burden primarily relates to water utility infrastructure, largely driven by growth pressures (Calgary, 2019). The City of Edmonton's debt, meanwhile, largely arises from tax-supported borrowing for public transit (including LRT

network expansion), recreation and culture, and roads infrastructure (Edmonton, 2020c). This divergence is also partly attributable to Edmonton's 2017 transfer of storm and sanitary sewer infrastructure (and related debt) to EPCOR, a wholly owned subsidiary (Edmonton, 2017a).

Figure 5: Debt Composition and Limits, Calgary and Edmonton, 2001-2020



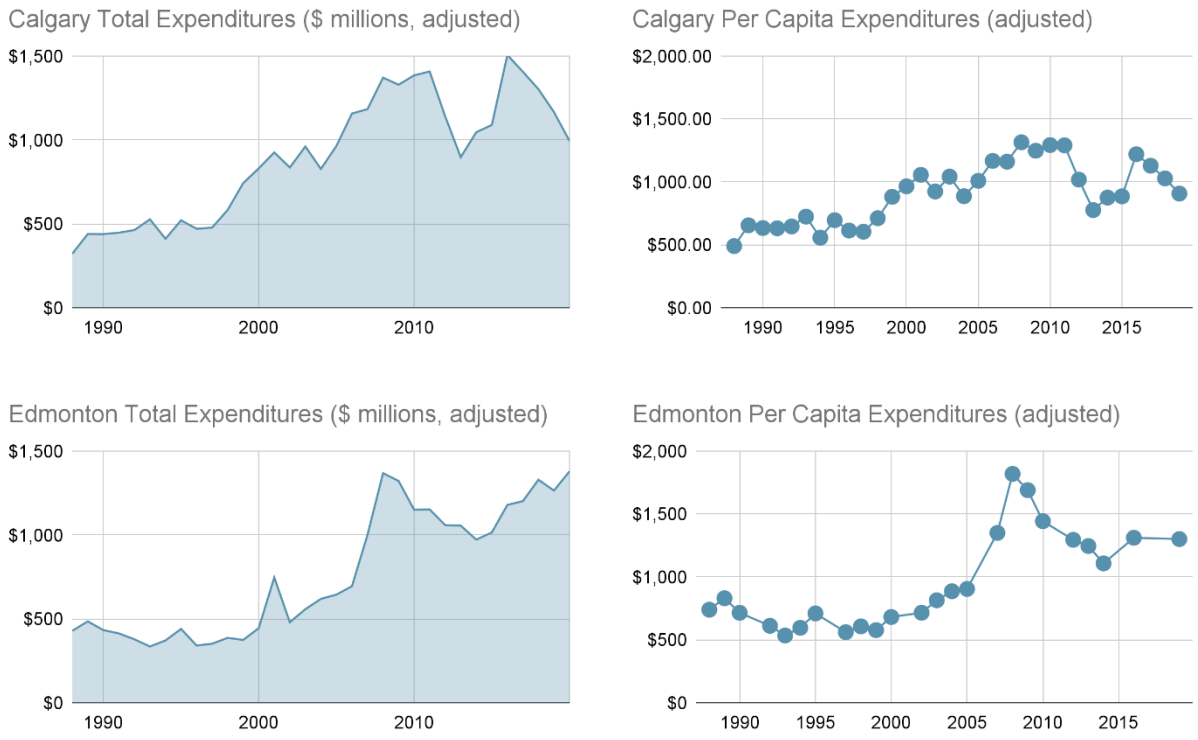
Source: City of Calgary and City of Edmonton annual financial statements

Notes: "Tax-Supported" debt refers to debt repaid through property taxes; "Self-Supported"/ "Self-Liquidating" debt refers to debt repaid through utility rates. Calgary's "Tax-Supported Self-Sufficient" debt refers to debt repaid using dedicated tax amounts, including Community Revitalization Levies (CRL; a form of Tax Increment Financing); Edmonton Tax-Supported debt figures include CRL debt.

As illustrated by Figure 6, annual capital expenditures for both Calgary and Edmonton have grown in absolute terms and per capita terms since the mid-2000's. This growth in spending has corresponded with growth in intergovernmental grant funding (Figure 7). Much of

these increases in grants may be explained by the federal Gas Tax Fund (renamed the Canada Community Building Fund in 2021) in 2005, and the provincial Municipal Sustainability Initiative in 2007.

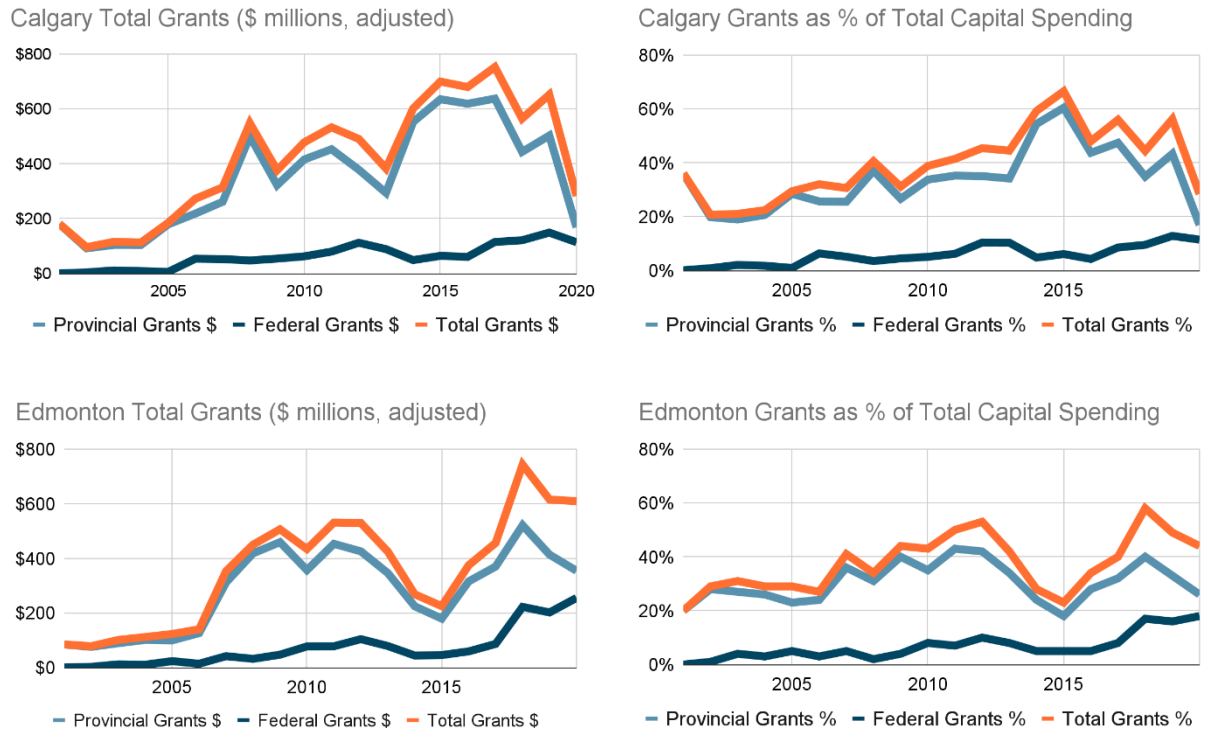
Figure 6: Capital Expenditures, Calgary and Edmonton, 1988-2020



Source: City of Calgary and City of Edmonton annual financial statements and Vander Ploeg (2004)

Notes: per capita expenditures calculated using civic censuses; expenditures adjusted to 2020 constant dollars per Statistics Canada Non-Residential Construction Price Indices for the respective city.

Figure 7: Intergovernmental Grants, Calgary and Edmonton, 2001-2020



Source: City of Calgary and City of Edmonton annual financial statements

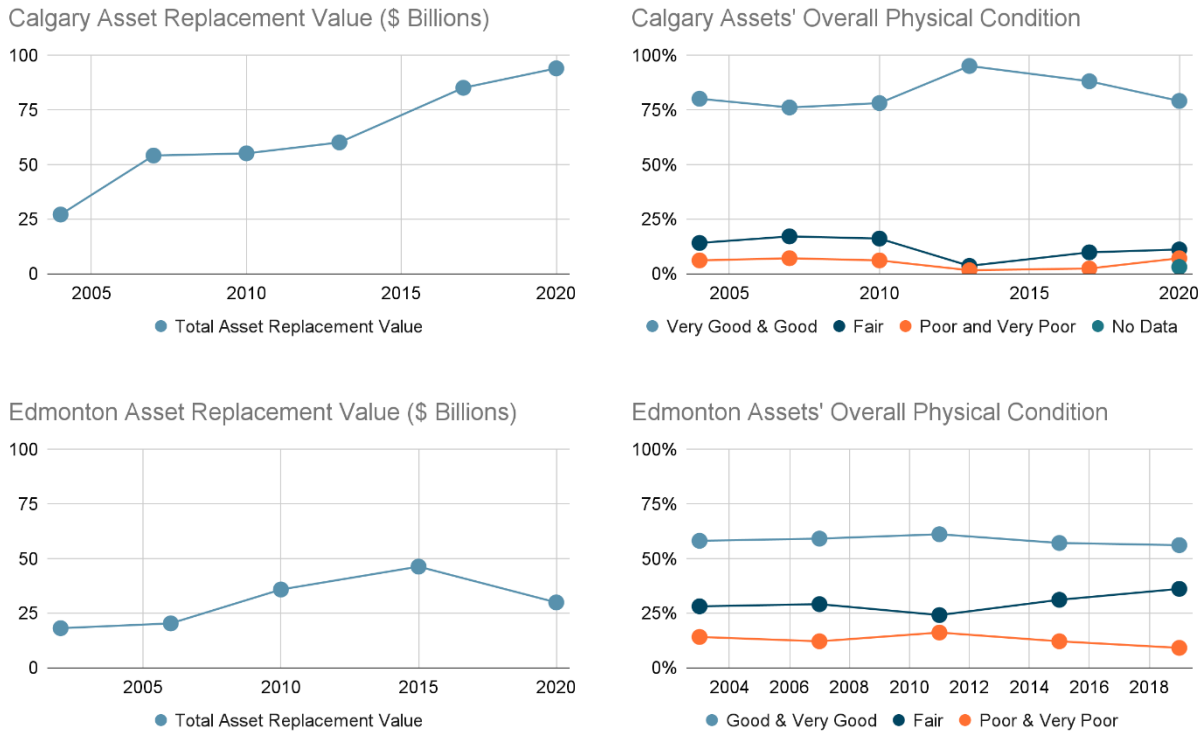
Notes: Intergovernmental grant funds are recognized as municipal revenues when the conditions of the grant are fulfilled, i.e., when funds are spent; expenditures are adjusted to 2020 constant dollars per Statistics Canada Non-Residential Construction Price Indices for the respective city.

Finally, since the early 2000's, Calgary and Edmonton have reported on their overall asset portfolio, including physical conditions, average age, and replacement value. The two cities' figures are difficult to compare directly, given assumed differences in infrastructure assessment procedures resulting from the absence of overarching external standards for these activities. For example, the seemingly poorer overall condition of Edmonton's infrastructure assets relative to Calgary's could be due to more rigorous inspection protocols in Edmonton.

In addition, potable water distribution assets are not reflected in Edmonton's figures for 2001-2020 as this infrastructure was transferred to EPCOR in the 1990's; in 2017 storm and sanitary sewer assets were also transferred to EPCOR, accounting for most of the drop in replacement value between 2015 and 2020. All three forms of water utility infrastructure are, meanwhile, included in Calgary's figures. The fact that Calgary's physical condition figures include self-supported (user-fee funded) water utility assets that have very high capital replacement values, and also tend to be in better condition than tax supported assets (such as roads) where data is available, further limits comparison. Unfortunately, due to differences in how each city publicly reports on its asset portfolios, it was not possible to present asset inventory data in a more comparable way. Finally, 'continuous improvement' and other changes in asset inventory reporting methodologies over time reported by both cities, further limits comparison even between each municipality (see Figure 7).

With the above in mind, it is nevertheless interesting to note how trends in both city's overall asset conditions seem to correspond with municipal capital investment decisions over the last decade. During its most recent (2019-2023+) budget cycle, Calgary has placed greater emphasis on growth-related, as opposed to capital maintenance, investments (Calgary, 2018c). This corresponds with increases in assets in Poor and Very Poor condition and a growing infrastructure maintenance gap (see Figure 8). It seems Edmonton, meanwhile, has since 2011 pursued a more "balanced approach" between Growth and Renewal investments (Edmonton, 2020a, p. 15), corresponding with a steady decline in assets in Poor and Very Poor condition.

Figure 8: Municipal Asset Portfolio Figures, Calgary and Edmonton, 2001-2020



Sources: City of Calgary (2021b), City of Edmonton (2020a)

Notes: figures reflect the Capital Replacement Values and Physical Conditions for the entire asset portfolios of The City of Calgary and The City of Edmonton, as reported by these municipalities.

4.4 Summary

In the context of Canada's large urban regions, Calgary and Edmonton are relatively unique. Both exist as 'uni-cities' that contain a large majority of their respective regional populations; both cities, and their surrounding regions, are substantially less dense than their counterparts elsewhere in Canada; finally, both have undergone periods of elevated population growth, relative to other regions, since the mid-twentieth century due to Alberta's famously cyclical economy. These characteristics, among other factors, influence these municipalities' capital expenditures.

Since the 1990's, municipal capital expenditures in Calgary and Edmonton have grown rapidly in both absolute and per capita terms. Much of this increased capital spending has been in support of population and economic growth, for example new LRT extensions and recreational facilities. Historically, periods of increased capital expenditures in both cities (particularly tax-supported/non-utility capital, e.g., roads, recreation centres, libraries, public transit, etc.) seem to have been primarily debt-financed. In contrast, capital expenditures in recent decades appear to be financed to a much greater extent through intergovernmental grants. Though both cities have adopted relatively conservative borrowing policies, Edmonton appears to be engaged in greater tax-supported borrowing than Calgary, whose borrowing focuses largely on utilities-related debt.

Chapter 5: Findings

This chapter presents this thesis' findings in response to its research questions, namely: how do municipal stakeholders and decisionmakers understand their local infrastructure gap estimates? what do municipalities perceive to be the larger cause(s) of their infrastructure debt, deficits, and gaps? And how are municipalities addressing their infrastructure debt, deficits, and gaps?

Section 5.1 answers the first research question, providing an overview of each city's infrastructure gap and how each city calculates this figure in general terms per municipal reports, with focus on how needed capital expenditures are estimated. The historical emergence of infrastructure gap figures, as well as criticisms of these figures voiced by certain councillors and administrators are also discussed.

Section 5.2 answers the second research question, outlining what research participants perceive to be the causes of each city's infrastructure gap. Participants in both cities identified four primary contributors of municipal infrastructure names, namely: growth and urban form, asset management challenges, political factors (especially as they relate to capital priority-setting), and inadequate revenues (including criticisms of property taxes and grants, and the perceived overall fiscal gap).

Section 5.3 answers the third research question, describing what strategies each city has pursued to address its infrastructure gap. Strategies aligned with contributing factors identified by municipalities, and included: improved growth management, improved asset management practices, development of capital prioritisation frameworks, cultivating earmarked (dedicated)

revenue sources for certain capital expenditures, and intergovernmental advocacy for increased transfers.

Finally, Section 5.4 summarises this thesis' findings in anticipation of Chapter 6: Conclusions and Recommendations.

It must be emphasized that, given its research design, this thesis does not seek to prove or disprove statements made by research participants. Rather, participants' opinions and perspectives are presented in the context of documentary and other evidence in order to identify themes and patterns that in turn hold implications for municipal infrastructure decision making.

5.1 Infrastructure gaps in Calgary and Edmonton

This section presents a high-level overview of Calgary and Edmonton's infrastructure gaps, as perceived by local stakeholders (municipal councillors and administrators primarily) and within relevant municipal reports. A brief historical discussion of how these municipalities came to prepare infrastructure gap figures is presented, followed by an overview of recent figures and how they are currently prepared by both cities. Municipal reports are the primary sources for these sections. Research participants' perceptions of the general methodologies for determining infrastructure gap figures are then discussed. Finally, criticisms of the infrastructure gap concept voiced by participants are outlined. As mentioned earlier in this thesis, the definition of 'infrastructure gap' found in Table 1 above is used throughout this section.

5.1.1 Historical background

It appears that Calgary and Edmonton began publishing municipal infrastructure gap estimates in 2004 and 1998, respectively (Calgary, 2004b; Edmonton, 2004). In both cases, the preparation of these estimates was closely related to financial concerns associated with asset and growth management. In Edmonton, municipal infrastructure gap estimates seem to have been originally prepared as part of a long-term financial planning exercise, which then appears to have spurred prioritisation of asset management as an organizational activity. In Calgary, the preparation of infrastructure gap estimates appears to have resulted from Council identifying the need for a coordinated asset management program, in response to concerns over rising maintenance and growth pressures.

In Edmonton's case, the infrastructure gap was uncovered in its 1998 Long-Range Financial Plan and this, in turn, led to the adoption of an Infrastructure Strategy as well as the creation of a specialised Office of Infrastructure in 2000 (Edmonton, 2004, 2006).

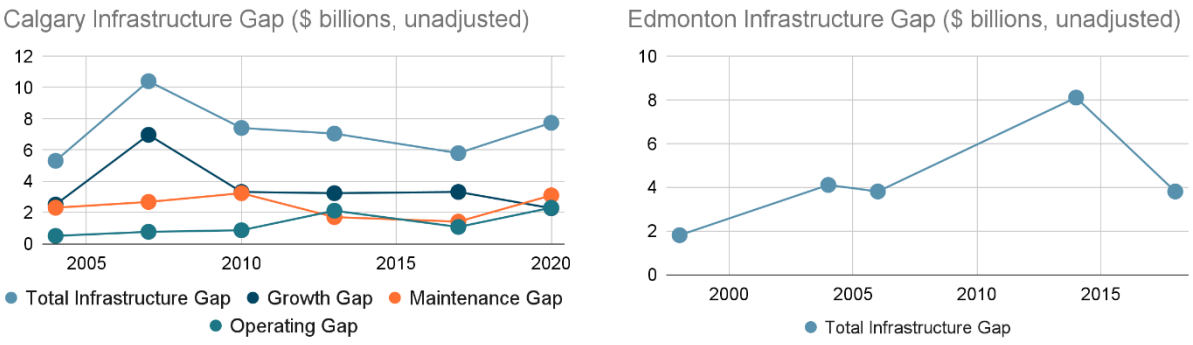
In Calgary, the infrastructure gap seems to have surfaced through civic administrators' response to council direction, in September 2003, to prepare a "Corporate Asset Management Strategy and Program" as well as a "Corporate Infrastructure Status Report" (Calgary, 2004c, p. 1). (However, infrastructure gap figures do not appear in the 2004 Infrastructure Status Report, though figures for 2004 have been published in subsequent reports. Instead, these figures make what seems to be their first appearance in the ISR's 2007 edition (Calgary, 2004b, 2007).) This September 2003 direction was itself in response to a successful Notice of Motion proposed by then-Alderman Ric McIver in December 2002 (McIver, 2002). This motion expressed concern over Calgary's infrastructure "maintenance deficit" and "fast pace" of

growth, requesting a report from Administration "addressing the need for a common set of standards for life cycle maintenance of public domain assets which will help ensure the financial sustainability of our city as it grows" (McIver, 2002, p. 1). It appears however that by this time City of Calgary administrators had long been concerned about the state of municipal infrastructure, as a series of similar reports had been produced during the 1990's (Calgary, 2004b).

5.1.2 Overview of municipal infrastructure gaps

Over the past two decades, the cities of Calgary and Edmonton have consistently reported multi-billion-dollar infrastructure gap estimates. In the case of both cities, these estimates represent the projected total value of unfunded infrastructure projects over a ten-year period. Figure 9 depicts infrastructure ten-year gap estimates released by both cities.

Figure 9: 10-year Infrastructure Gaps, Calgary and Edmonton, 1998-2020



Sources: The City of Calgary (2021b), The City of Edmonton (various)

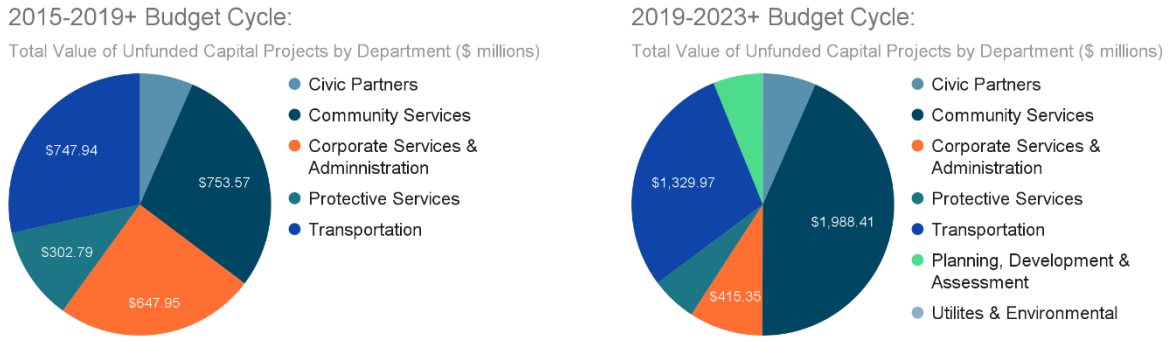
In Calgary, infrastructure gap estimates are included as part of the Infrastructure Status Report ISR), which is prepared in advance of each four-year budget cycle. The ISR also reports on the condition of municipally owned assets. In Edmonton, infrastructure gap estimates are included within the ten-year Capital Investment Outlook (CIO), which projects required capital expenditures against anticipated funding levels, likewise in advance of each four-year budget cycle. The City of Edmonton produces a separate Infrastructure State & Condition Report. Calgary's infrastructure gap estimate is broken down by growth, maintenance, and operating gaps, while only total figures are available for Edmonton.

A complementary way to explore municipal infrastructure gaps is through unfunded capital project lists (Vander Ploeg, 2003), which both Calgary and Edmonton include in their four-year budgets. As these lists only cover a four-year period, they differ from the formal ten-year infrastructure gap estimates. Due to differences in municipal reporting (specifically with regards to level of disaggregation), both infrastructure gap estimates and unfunded capital projects are leveraged to explore the components of each city's infrastructure gap.

Based on ten-year estimates, as well as the total value of four-year unfunded capital projects (see Figures 5.8 and 5.9), it appears that asset classes associated with tax-supported services (for example: roads, public transit, recreation facilities, and parks) make up the vast majority of both Calgary and Edmonton's infrastructure gaps. Noticeably absent from Calgary's ten-year infrastructure gap estimates, as well as both Calgary and Edmonton's unfunded capital lists, are infrastructure related to user fee-funded services, such as waste and recycling and water utilities.

Furthermore, these figures suggest significant unfunded growth as well as maintenance and renewal expenditures, with the balance between these two categories appearing to vary by city and over time. Growth-related infrastructure seems to comprise the bulk of Edmonton's 2019-2023+ unfunded capital lists, however the lack of corresponding detail for unfunded 2019-2023+ Renewal projects makes it difficult to determine this conclusively. In contrast, for the first time since reporting began, estimates for Calgary's 'capital growth gap' in 2020 were lower than both its maintenance and operating gaps. Direct comparison between the two cities is not possible in this regard, however, for multiple reasons including that Calgary does not disaggregate its unfunded capital lists by growth/maintenance/etc. status, and similarly Edmonton does not disaggregate its ten-year infrastructure gap by such classifications. Differences in exact definitions of services, as well as differing definitions of expenditure (such as growth, renewal) classifications, further challenge comparison.

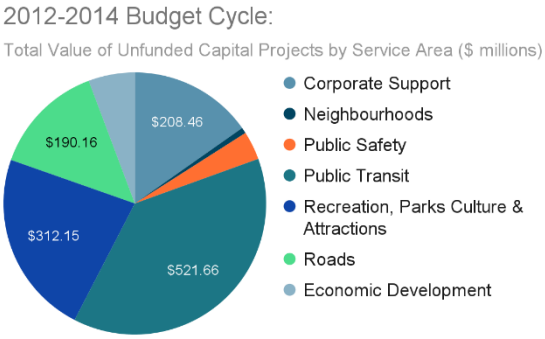
Figure 10: Unfunded capital by department, Calgary, select budget cycles

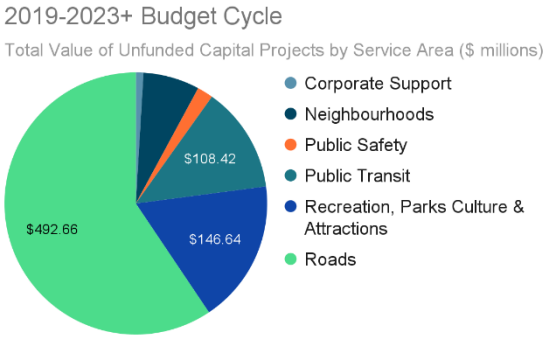


Source: City of Calgary

Notes: includes investments classified as Growth, Maintenance, Upgrade, and New Service; 2019-2023+ figures presented on the basis of 2015-2018 departments for ease of comparison: 'Community Services' includes service lines such as Recreation, Parks, etc. and 'Transportation' includes service lines such as: Streets, Sidewalks & Pathways, Public Transit, etc.

Figure 11: Unfunded Growth capital by service area, Edmonton, select budget cycles





Source: City of Edmonton

Notes: above does not include investments classified as Renewal (2019-2023+ Renewal investments were funded at 90-100% of recommended allocations, 2012-2014 unfunded Renewal investments totaled $1.01 billion); total unfunded growth capital for 2015-2019+ budget cycle not available; 2012-2014 unfunded Growth projects were re-categorized per 2019-2023+ service areas.

5.1.3 Determining infrastructure gaps

Both Calgary's Infrastructure Status Report (ISR) and Edmonton's Capital Investment Outlook (CIO) contain high-level descriptions of how each city's ten-year infrastructure gaps are calculated. In addition, research participants were asked how, to their knowledge, these figures were determined as well as how each municipality determines the need for new infrastructure projects generally. The below findings do not exhaustively or conclusively review the methods used by the case municipalities to estimate their infrastructure gaps. Rather, the below presents a general overview of these methods as described in relevant municipal reports, and also as understood by research participants, as necessary context for later sections.

In general, per municipal reports and research participants' understandings, both cities calculate their infrastructure gap figures simply by projecting both expected capital investment

needs (including both growth, renewal/maintenance, and other) and anticipated available funding (including Pay-As-You-Go, reserves, intergovernmental grants, etc.), over a ten-year period. The projected difference between required expenditures and available funds over this ten-year period is referred to as the infrastructure gap. Crucially, one Calgary administrator (INT-02) noted that "audit rigour" is not "applied to our infrastructure gap calculations".

In both Calgary and Edmonton, projected available funding appears to be largely determined by extrapolating current trends in intergovernmental grants, Pay-As-You-Go and reserve funding, developer contributions, and other sources of capital funding. Exact methodologies for identifying necessary capital investments and estimating their costs may vary by asset class (e.g., roads, transit vehicles, recreation centres) and also by expenditure classification (e.g., Growth, Renewal). Documents and participants from both municipalities identified approved municipal strategic documents, Council direction, and service level metrics are key inputs that assist with identifying all types of capital investments. Data such as asset condition is specifically leveraged to identify required maintenance and renewal investments.

Capital expenditure estimates

Municipal reports and research participants suggest that the two cities use broadly similar methods to identify capital projects relating to maintenance/renewal versus growth. The City of Edmonton uses its RIMS (Risk-Based Infrastructure Management System) model to "predict the optimal funding for the renewal of existing infrastructure", integrating information such as an asset's current condition and "expected lifecycle deterioration curve" (Edmonton, 2018c, p. 14). The RIMS model illustrates the critical role that asset management activities play

in helping a municipality understand infrastructure investment requirements, in particular as they relate to maintenance and renewal.

An Edmonton administrator (INT-09) provided additional details surrounding the RIMS model, saying that while departments may "evaluate their infrastructure differently" efforts are made to "to normalise it into… [RIMS]". By "inputting and accounting for all of the existing condition[s]" through RIMS, The City is "able to project based on the different risk-based methodologies – the cost it would take to restore our infrastructure to a 'good' or 'fair' condition" (INT-09). The same administrator (INT-09) offered a caveat to estimates produced by the RIMS model: "It's not exactly perfect but it gives us a really good snapshot of our overall infrastructure."

Edmonton's Capital Investment Outlook (CIO) describes, in general terms, how Growth-related infrastructure projects were identified (Edmonton, 2018c, p. 48): Services Areas identify "what growth projects they anticipate as *possible* needs over the 10 years" (emphasis added) with individual projects being "typically generated from master plans, anticipated growth of the city, and previous Council or Committee direction."

Accordingly, Edmonton's CIO contains brief descriptions of capital submissions by Services Area that help to shed light on how Growth-related infrastructure needs are determined by each Service Area. These descriptions include reference to the above-mentioned internal planning documents (e.g., Edmonton Police Services' Strategic Facilities Plan) and related Council-approved strategies (e.g., Affordable Housing Strategy), and often list considerations that influence the need for new Growth-related investments such as crime trends (Service Area 4: Public Safety) and income inequality (Service Area 5: Housing).

Noticeably absent from the CIO (as well as Edmonton's 2019-2023+ capital budget) is discussion of how these investments relate to achieving specified levels of service (though service levels are mentioned as a concept throughout).

The CIO goes on to state that: "The projects identified as part of the CIO have not gone through a formal prioritisation review process and therefore result in more projects being identified than there is funding available over the next 10 years.", resulting in the infrastructure gap (Edmonton, 2018c, p. 48). Crucially, the CIO also states that many of the Growth projects it includes "are also at the early stages of development. As such, funding calculations are based on high level project estimates" that may not be fully accurate (Edmonton, 2018a, p. 48). An Edmonton administrator (INT-09) stated that "the growth list is different" from Renewal, and that "there's less of a science around modelling the growth impacts" on infrastructure. Exact methodologies for estimating the costs of identified Growth infrastructure projects are not discussed within the CIO, however these figures are presumably developed per the project cost estimation guidelines of Edmonton's *Project Management Reference Guide* (an internal resource document not publicly available).

Perhaps surprisingly, it seems Edmonton did not possess adequate (as determined by its City Auditor) internal guidelines for capital project management, including for estimating capital costs, until the early 2010's (OCA, Edmonton, 2014). Such guidelines were created following internal audits of certain municipal capital projects from the late 1990's to the early 2010's (OCA, Edmonton, 2008, 2011).

Calgary's 2020 Infrastructure Status Report (ISR) contains limited details on both how needed projects are identified and how costs are estimated. In general, Business Units are

contacted for their asset data which is then consolidated for the purposes of corporate reporting. The ISR (Calgary, 2021b, p. 7) does note however that while “there are many commonalities across the Corporation in terms of how different areas manage their assets and record asset data and transactions” but “there are also many differences”, suggesting a decentralised approach to managing infrastructure.

An administrator (INT-01) provided a succinct overview of how, in their view, The City of Calgary estimates its infrastructure gap: “It all starts with knowing what services we provide, what's required to provide that service, and whether we have enough money to provide that service by maintaining the assets that are required.” They went on to state that the infrastructure gap contains different components, including both growth and varying levels of maintenance and lifecycle replacement. The same administrator then discussed their understanding of growth-related infrastructure planning:

> *… there's also new infrastructure, and that is typically tied to growth. At the City of Calgary… over the last couple of decades… we've been faced with extraordinary growth, and so a deficit can also be comprised of assets we feel are required to support that growth. Whether it's new roadways, sewers, wastewater treatment, Transit, new interchanges, road widening -- it could be anything that would support growth.*

The administrator also reported that asset maintenance/replacement costs are estimated based on asset inventories, condition assessments of individual assets, replacement values, service levels, and other variables (INT-01). With this information (similar to Edmonton’s RIMS model), administrators in Calgary “calculate what the required investment is with different assumptions in mind, whether it's current service levels, or future plan[ned] service level[s]”.

Another Calgary administrator (INT-02) perceived that "even with very solid, rational, and engineered base information" related to existing asset conditions, estimating "the infrastructure gap at any one time… is quite often a best guess". In addition to cost uncertainty, this was also partly attributed to difficulties associated with forecasting with available funding, for example due to unpredictable intergovernmental grant revenues.

One administrator (INT-02) alleged that not all departments at the City of Calgary are able to assemble "solid, rational, and engineered base information" about their assets, however. Many, due to their small size, lack the "staff resource[s] or consultant resource[s] to do very solid condition assessments" (INT-02). In these situations, it was reported that the City relies on financial data, specifically historical Tangible Capital Asset (TCA) figures. Though this information is "not based on actual, in-the-day physical condition assessment, engineering assessments" it nevertheless "gives you a proxy of what the valuation of the asset might be from a financial perspective" (INT-02).

According to the same participant, the City of Calgary's practice is to identify necessary infrastructure investments, regardless of expenditure classification (Growth, Maintenance, etc.), in relation to the relevant 'existing' and/or 'preferred' level of service measures (INT-02): "we calculate what exactly [are] the service requirements. What is that service standard - what is [the] existing service standard and what's the preferred service standard…" For example, in the case of LRT service: "on a weekday, you want to have an LRT available every 5 minutes… That could be a service level statement. Coming every 2 kilometres is a station. And you want to see a train running down every 5 minutes. You can actually calculate the density of the train you require."

An internal guidance document exists (INT-02) to assist departments in determining service level statements which, in turn, inform decisions about needed investments. Using service level measures to assist with identifying capital investments can, in practice, make it challenging to classify capital expenditures as solely Growth, Maintenance, etc. An investment might partly relate to Maintenance, but it may also contain Growth or New Service components. Continuing with the above transit example, the same administrator explained (INT-02):

> *… when Council [sees] that our transit folks [want] to buy 40 more new [LRT] cars, there [is] actually logic behind that calculation. One [is] an increase in… the desired level of service, as well as the replacing of our old, aged assets, which were… purchased back in 1980-81 when we [built] the first LRT [line]. It's a combination of expansion of service desire plus the lifecycle maintenance obligation of older assets.*

As with the City of Edmonton, the City of Calgary maintains a comprehensive series of standards and related guidance resources for capital projects within its *Corporate Project Management Framework* (Calgary, 2017a) which are made publicly available. Guidelines for estimating project costs are contained within the 'Estimation, Contingency and Schedule' Standard and Guidance documents. Cost estimates are developed using five standard classes, ranging from Class 5 (costs expected to be accurate within a range of -50% to +100%) to Class 1 (costs expected to be accurate within -10% to +10%) (ibid). In general, three approaches are used to generate cost estimates: comparative, elemental, and trade based. The comparative approach relies on data from recent, similar projects, accounting for "obvious differences such as size, time, location, inflation, etc." (Calgary, 2017a, p. 3), and are generally used to produce Class 5 or 4 estimates. The elemental approach quantifies various project components (e.g., wall area) and then applies unit cost figures, and is used to produce Class 4 or 3 estimates.

Trade-based estimates are used when project designs are sufficiently advanced and detailed technical specifications are available, and result in Class 1 or 2 estimates.

Similar to Edmonton, Calgary did not possess adequate (as determined by its City Auditor) capital project management guidelines, including for estimating capital costs, until the early 2010's (OCA, Calgary, 2013). Likewise, it seems the City of Calgary's *Corporate Project Management Framework* was developed in response to internal audits of certain capital projects in the late 2000's (OCA, Calgary, 2011a, 2011b).

5.1.4 Internal criticisms of the infrastructure gap

Interview questions were phrased so as to assume the existence of infrastructure gaps in both cities, as such figures have been consistently included within official reports produced by both municipalities. However, some participants in both cities expressed varying degrees of ambivalence, if not outright scepticism, about the overall concept.

Participants in Edmonton tended to express varying degrees of ambivalence about infrastructure gaps. One Edmonton administrator (INT-20) suggested that infrastructure gaps were more useful as an "advocacy tool", than a "management tool". Along similar lines, an Edmonton councillor (INT-16) felt that, to some extent, managing the infrastructure gap was a matter of:

> *… accepting reality, that we have a certain amount of spending capacity, and living within our means, accepting that for what it is, and trying to find a way to provide the level of service we would like to provide, but in the most cost-efficient way possible. We need to keep those choices in mind. I think it's just not enough discipline, quite frankly, on those spending decisions and on those priority conversations. I really, quite frankly, believe it's all within the control of city administration and city council.*

However, the same councillor then went on to highlight the need, in their opinion, to better align municipalities' fiscal capacities with their service provision responsibilities:

> *… only 8% of every tax dollar goes to cities and they have a disproportionate responsibility compared to that tax dollar – so if there was a way to create a more equitable distribution of resources, I think that would be very much welcome…*

The above comments may shed light on the fact that The City of Edmonton does not appear to publicly report detailed infrastructure gap figures; instead, aggregate figures have been periodically included in reports such as its 2006 Infrastructure Strategy, and in its periodic Capital Investment Outlooks (Edmonton, 2006, 2018c). In contrast, The City of Calgary has consistently produced detailed infrastructure gap estimates disaggregated by classification (growth, maintenance, operating) and asset class (roads, recreation centres, etc.) (see for example Calgary, 2021b).

Echoing their Edmonton colleague's comment above, a Calgary administrator (INT-02) perceived that intergovernmental advocacy was a major reason for producing infrastructure gap figures:

> *We are trying to produce [infrastructure gap] valuations because we're in competition with [other municipalities] to access scarce resources, to access those funds that come from either [the] federal government or provincial governments… That is part of why we calculate those [infrastructure gap] numbers. We're putting it out there that we have needs…*

Two Calgary councillors expressed outright scepticism about their municipal infrastructure gap figures. The first councillor's (INT-06) comments focused on the relationship between service levels and citizen expectations, in the context of citizens' willingness to pay, on Calgary's infrastructure gap. When asked about Calgary's reported 2017 infrastructure gap of $5.7 billion dollars, the councillor stated that:

> *I think the municipalities typically high ball their infrastructure funding gaps, and they put all sorts of things into various wish lists, so I believe that that number is inflated to begin with. It comes down to, at the end of the day, we have to respond to what Calgarians' needs and wants are, but also their tolerance to pay…*

Towards the end of their interview this councillor went on to state that, from their perspective, "this infrastructure gap is imaginary. It's a function of citizens' expectations." The second councillor's (INT-10) comments focused on The City of Calgary's overall process for planning growth-related infrastructure, which they perceived to be "not necessarily innovative" resulting in "inflated" figures. Describing their understanding of the process for estimating the broader infrastructure gap, they raised many concerns including the role of certain municipal policies and standards in "inflating" these figures:

> *I imagine [administration] figured 'well we anticipate that we will grow in these areas, and therefore we will need this much more pipe in the ground, and this much more road infrastructure, and we anticipate it's going to cost this much money'... I think when it comes to being creative, there's a real limitation because it's policy that drives decisions… So [administration] makes these decisions based on jurisdiction, based on moving goods and people quickly, and not on building good communities. So, I think sometimes that infrastructure number is inflated because they're going by their own little 'planning by numbers' exercises.*

Views of individual councillors do not indicate whether or not infrastructure gaps exist in Calgary or in Edmonton. They do, however, underscore the crucial role that Levels of Service play in conversations surrounding infrastructure gaps. Félio (2007, p. 69) observes this issue is central to "the debate over the infrastructure gap", which may be framed disagreements over one fundamental question: "Do we have the necessary quantity and quality of infrastructure to provide the level of service Canadians are willing to pay for?"

When participants (councillors in particular) comment that their municipality should "live within its means", or that capital project "wish lists" and certain policies may result in

"inflated" infrastructure gap figures, what they are speaking to is their view of how citizens' desires for certain levels of service should be balanced with their willingness to pay. Put differently, these councillors are suggesting that, in their opinion, citizens are uninterested in paying for heightened Levels of Service through increased taxes and user fees. As local councils ultimately determine levels of service as well as property tax and utility rates, individual councillors' opinions about the appropriate balance between costs and levels of service is key to understanding how municipalities respond to infrastructure gap concerns.

These matters point to an often-cited concern within the literature: that in the absence of full-cost marginal pricing for many municipal services, whereby citizens could signal their willingness to pay through their revealed preferences, local elected officials are left to gauge citizens' willingness to pay through political processes. Such processes, it is alleged, tend to favour lower taxation and the deferral of needed capital projects (Bazel & Mintz, 2015).

5.2 Factors contributing to local infrastructure gaps

This section reviews factors identified by research participants as contributing to their respective city's infrastructure gap. Issues discussed by participants are summarised and contextualised with financial and other data where relevant, as well as through municipal reports referenced in interviews and/or within budget documents. Most participants identified growth and urban form as a significant, if not the most significant, factor impacting infrastructure gaps. Specifically discussed was the nature, location, and timing/pace of development. Participants in both cities also discussed political factors (in particular as their

impact capital prioritisation), matters of asset management and budgetary process, and adequacy of existing revenues sources, as factors contributing to infrastructure gaps.

5.2.1 Growth and urban form

Within their 2019-2023+ budgets, approximately 47% and 66%, respectively, of new municipal capital investment in Calgary and Edmonton was allocated to projects broadly categorised as 'growth'. These top-level figures are skewed somewhat, as they include water utilities (in Calgary's case) and LRT construction (in Edmonton's case). Growth investments also tend to comprise the single largest portion of each city's infrastructure gaps. In 2021, The City of Calgary reported that $2.27 billion of its 10-year ($7.73 billion) infrastructure gap was related to growth (Calgary, 2021b). Similarly, The City of Edmonton reported $0.829 billion in unfunded growth projects in its 2019-2023+ capital budget (Burge & Laughlin, personal communication, November 27, 2018).

Research participants in Calgary and Edmonton consistently stated that they perceived growth as an important contributor to their municipal infrastructure gaps. This was true across all participant categories, including both councillors and administrators.

Although each city defines 'growth' capital expenditures slightly differently within their respective budgetary documents (see Appendices for definitions), these classifications capture expenditures both related and unrelated to suburban development. Despite the breadth of each municipality's budgetary definitions, research participants overwhelmingly discussed growth in terms of current and historical patterns of urban development, particularly in

peripheral areas of each city. In addition, participants' comments were often related to development's nature, as well as pace as it relates to building infrastructure.

While most participants identified the infrastructure impacts of growth in general, the exact asset classes discussed varied between the two cities. Participants in Calgary frequently discussed off-site growth impacts on water, storm, and sewage infrastructure when asked about that City's overall infrastructure gap, despite the fact that technically these assets are excluded from that city's official infrastructure figures given they are "self-supported" through utility rates (Calgary, 2021b). Participants in Edmonton were more likely to discuss infrastructure such as fire stations and recreation centres. These asset classes are examples of growth-related infrastructure that, until very recently, have been entirely tax-supported in that city.

These observations should be considered in the context of differences in service organisation, in growth-related funding mechanisms between the two cities, and simply with what issues have been active on each council's agendas in recent years. Water utility services (including water, storm, and sewers) are managed by a municipal department in Calgary, whereas in Edmonton these same services are managed by a wholly owned subsidiary, EPCOR.

Calgary uses an expansive Off-Site Levy (development charge) system that requires developers to contribute capital funds for growth-related roads, buses, water utilities, police and fire stations, recreation centres, and libraries. Depending on the asset type, levy revenues may not fully cover a project's cost however (due to benefits not entirely accruing to new development). Thus, in addition to managing construction of these assets The City of Calgary often must also identify additional funding sources for certain growth-related assets. In

Edmonton, initial subdivision developers must 'front-end' certain off-site infrastructure and are then repaid through an inter-developer cost-sharing system facilitated by the municipality. Currently, such cost-sharing systems exist only for arterial roadways and storm and sewage infrastructure, though an off-site levy for new fire stations in outlying communities began to be collected in 2022. These foundational differences in how growth-related infrastructures are funded and built between the two cities appear to underpin much of either city's contemporary challenges.

Nature and location of development

Some participants discussed how the location, density, form (e.g., multi-residential, single detached dwellings), and layout of new development impacts municipal capital costs and by extension the infrastructure gap. Implicitly, new residential development, particularly on the periphery of both cities, was the focus of many participants' comments, however redevelopment of established communities was also discussed.

A Calgary administrator (INT-01) stated that, in their opinion, "... something that we've struggled with [in Calgary] is sprawl. Sprawl is very decentralised. A sprawling City form is a less efficient way of growing than a more compact form." And further, that "Growth does not typically pay for itself from a municipal perspective." One Calgary councillor (INT-10) agreed, saying that: "the single biggest contributor to the infrastructure gap is the fact that the North American post-war city… has more infrastructure requirements than there is tax-paying structure to support it."

Another Calgary councillor (INT-06) felt differently however, suggesting that many newer residential areas on that city's periphery were, by virtue of their composition and density, likely generating municipal revenues that cover their costs in terms of both tax-supported and rate-support (by user fees) municipal services. They suggested that in certain "new suburbs… the density is quite extreme. I believe modern municipalities including Calgary are building *some* neighbourhoods that are actually cashflow positive… Or at least breaks even…" (emphasized added). It should be noted that this quotation, as well as those above and below, represents one participant's view, and that this research has not been designed to prove or disprove such opinions.

As context to the above, among the fourteen growth areas Calgary City Council approved in 2018 estimated revenues (utility fees, property taxes, transit fares, etc.) exceeded operating costs in three[1] (Calgary, 2018e). These estimates reflected only 'direct incremental' operating costs, that is those costs attributable to a specific growth area, such as roads and parks maintenance, fire station operations, and waste and recycling. Data on actual costs and revenues associated with these growth areas is not available.

Similar to their Calgary colleague (INT-10), one Edmonton councillor (INT-17) perceived that "unabated suburban growth absent an infrastructure management strategy", specifically over the course of the 1980's and 1990's, was partly to blame for that city's "enormous" infrastructure "deficit". Similar comments were made by another Edmonton councillor (INT-16):

[1] Estimated revenues exceeded operating costs in Rangeview (representing two areas or "new communities", encompassing 652 hectares) and Providence (one area or "new community", 223 hectares). In 2018, revenues associated with these three areas or "new communities" were projected to exceed direct incremental operating costs both during and after the 2019-2022 budget cycle. This is likely due to the relatively higher proportion of commercial lands included within these areas, which under existing property tax rates generate a disproportionate amount of tax revenues.

“as the population increases there’s a need to add to the asset family to service the population... That contributes to the deficit in that it – we can’t keep up with the spending, so we accumulate things that need to be done.”

A community representative (INT-12) felt that “Edmonton [being] such a sprawling city” contributed to its infrastructure gap. Their counterpart (INT-03) in Calgary echoed similar sentiments, suggesting that they believed “rapid growth during boom times” and the “city expanding so far out and so quickly” were primary factors exacerbating the infrastructure gap.

In both Calgary and Edmonton, participants acknowledged that developers “... build all of the initial capital investment associated with a new subdivision…” (INT-09), including roads and water, sewage, and storm pipes internal to that subdivision, with off-site infrastructure impacts being managed differently in the two cities. Some participants then highlighted the fact that associated “operational costs [of developer-build infrastructure] eventually get transferred to” (INT-03) municipalities, who must then “figure out how they’re going to - using… traditional tax powers - support [those] ongoing costs” (INT-09). It is crucial to note that both cities require, as a condition of planning approval, developers to build subdivision infrastructure in accordance with municipal specifications and standards (Calgary, 2022a; Edmonton, n.d.).

Infrastructure planning to support redevelopment within built-up areas was cited as a challenging endeavour in both cities, potentially thwarting efforts to make better use of existing infrastructure capacity as directed by both cities’ Municipal Development Plans. An Edmonton administrator (INT-14) commented that: “redevelopment [is] a little trickier” than suburban development, “insofar as there's more demand than there is supply” of funds for new growth-related infrastructure. One Calgary Councillor (INT-10) suggested that water utility

infrastructure in established areas, given its status as 'leading' infrastructure required to enable development, is "one of the single biggest barriers we face in terms of" meeting densification targets.

Financial impacts of development timing

Temporal gaps between revenues generated by new subdivisions (both in terms of up-front off-site levies, or property taxes/user fees later on), and the costs of municipal service provision were noted by many participants. One Edmonton administrator (INT-9) emphasised that, in their view,"the pace of development is often a huge variable", thereby challenging infrastructure planning efforts: "We might suggest that you need a fire station within ten years, but it could actually be twenty." A Calgary administrator similarly observed that: "When we get into these situations of more and more suburbs springing up and services being required, we do our best to catch up, but I would say [there] is probably [a] mismatch between revenue growth and municipal growth…"

One Calgary councillor (INT-09) stated that, in their opinion, Calgary's off-site levy system "doesn't work from a cashflow perspective", specifically with regard to water utility infrastructure. This is given The City's use of self-supported debt to finance this infrastructure, combined with delays in development (and in turn, payment of levies by developers to The City). The same councillor continued: "when the market declines, or a developer decides not to execute on [their] plan[ned subdivision], The City has already put the infrastructure in the ground, but [is] not getting paid back from the levies because those developments haven't happened yet." Another Calgary administrator (INT-05) elaborated further: "the way principal

and interest works are that… if the pace of development slowed a bit like it has now, those payments from levies tend to lag a bit and so we have to backstop them through the utility rate, which is what we do."

These contemporary cash flow challenges came after the 2001-2015 period when The City of Calgary saw massive increases in self-supported debt levels related to construction of growth-related water utility infrastructure. These debt increases were driven primarily by the complete lack of off-site levies for water utilities from 2001 to 2011, and their partial reintroduction (on a 50% cost recovery basis) from 2011 to 2016 (Calgary, 2016).

Given differences in funding mechanisms, Calgary's challenges with growth-related water infrastructure are not applicable to Edmonton. In the early 1970's, The City of Edmonton established its Permanent Area Contributions (PAC) system, whereby greenfield developers are required to construct, and then share costs among themselves, applicable on- and off-site storm and sewer infrastructure (Edmonton, 2020f). By removing the municipality from both construction and financing roles, the PAC system seems to hugely reduce the likelihood that Edmonton would face similar circumstances as Calgary.

5.2.2 Asset management challenges

Research participants in both cities, but to a much greater degree in Edmonton, highlighted historical (and, in some cases, present) deficiencies with asset management processes as contributors to their infrastructure gaps. In Edmonton, these comments came from both administrators and councillors, where in Calgary they came from a development

industry representative. (Though participants in Calgary, administrators primarily, did discuss asset management matters, as well as the importance of these activities, they did not specifically identify historical issues as specific contributors to that city's infrastructure gap.) Comments related primarily to planning for the costs of operating, maintaining, and eventually replacing infrastructure over its entire lifecycle, as well as asset inventory and condition data. Comments were often made in relation to historical spending patterns.

Many participants in Edmonton discussed historical asset management issues in the context of the 1990's, which many described as a "fairly significant period of austerity" (INT-18) among all orders of government. One councillor (INT-17) suggested that The City of Edmonton lacked "an asset management plan and subsequent investment strategy through basically all of the 80's and 90's" while, at the same time, its overall "financial strategy that [did not] prioritise investment in existing infrastructure". When asked about factors contributing to Edmonton's infrastructure gap, a third councillor (INT-11) stated of this time period: "there was so little being invested in infrastructure renewal that that created a large amount of our [infrastructure] deficit". As well, during the 1990's Council approved "a string of zero percent increases", corresponding with observable reductions in capital expenditures during that time period.

A development industry representative in Calgary (INT-04) commented on a lack of sufficiently detailed and accurate asset inventory information, in particular as it relates to water utilities infrastructure impacting new development. They suggested that "There is a real deficit of accuracy as it relates to what infrastructure is out there. Below grade infrastructure especially… it's a huge problem that that data doesn't exist." and furthermore, "when you don't really understand what you have, it's really hard to figure out what you're supposed to do".

Although no Calgary councillors or administrators specifically discussed deficiencies with asset management processes as contributing to that city's infrastructure gap, one participant did state that, in their view, "a lot of that infrastructure gap" results from "where we've deferred maintenance" (INT-02). This corresponds to the persistence of a 'maintenance gap' within The City of Calgary's infrastructure gap figures which, for the first time since figures began to be reported in 2004, was estimated as greater than the 'growth gap' in 2020. As well, between 1996 and 2004 no "compilation[s] of the overall assets and condition of City infrastructure" (Calgary, 2004c, p. 1) were prepared at the City of Calgary, "due to organisational restructuring, staff availability and pressures of growth" (Calgary, 2004b, p. 10).

5.2.3 Political factors

Many research participants in both Calgary and Edmonton felt that certain 'political' factors contribute to the infrastructure gap of both cities, in terms of capital budget prioritisation. These included comments on the perceived attractiveness to citizens of infrastructure maintenance and renewal spending, overall citizen expectations, the intrusion of potentially irrelevant considerations into decision-making, and the relative openness of the municipal (capital) budget approval process. Some participants also commented on political considerations in the context of intergovernmental grants, however those are discussed in the following section.

The perceived political unattractiveness of infrastructure maintenance and replacement spending was often commented on during interviews. One Edmonton administrator (INT-09)

felt that infrastructure renewal "[isn't] exactly sexy politically… It's just something citizens often come to expect, that infrastructure is kept in good repair, but there's a significant cost to it" which then "creates some tension between whether or not you need to invest in renewal or invest in growth." An Edmonton councillor (INT-16) felt similarly, but nevertheless emphasised the importance of maintenance investments:

> *… [maintaining assets is] not the most fun thing to do I suppose, or the most high-profile thing to do, to cut the ribbon on a pothole repair, but it's the most critical thing we can do. I think it tends to lead to a need to have to do enough shiny new stuff that frankly keeps people happy. I guess part of that is politics… People want to see what they're getting for their [tax] contributions. Not everybody is satisfied with maintenance of what is, they're looking for additional amenities.*

A Calgary administrator (INT-02) echoed these sentiments, emphasising the importance of infrastructure maintenance, and also highlighting deferred maintenance as a component of the infrastructure gap:

> *… the inevitable truth of infrastructure maintenance [is] it's inconvenient [to the public] and it's not sexy. But it has to be done, and if you don't do it… actually we have seen cases where disaster does result, where you know a bridge may fail because it wasn't adequately inspected or there wasn't the necessary preventative maintenance put into it. So, a lot of that infrastructure gap is that calculated portion of where we've deferred maintenance.*

A development industry representative in Calgary (INT-04) made similar comments, stating that in their opinion:

> *… even though the City [of Calgary] maybe knows it has an infrastructure deficit, it actually has the money to pay for it, [but] it allocates the money somewhere else that's more interesting to the general public, in the short term… Infrastructure isn't sexy, at all.*

These comments underline the perceived political nature of capital prioritization exercises, whereby 'needed' expenditures may be contested on a variety of grounds. As the City of Calgary does not appear to release its prioritization criteria (which are separate from its

capital investment principles), let alone the scorings of individual projects, it is difficult to adequately contextualize these perceptions.

One Councillor (INT-17) discussed a recent vote by Edmonton's City Council to expand its South LRT line as an example of how, in their view, less relevant considerations may come to inform decisions, especially in relation to new Growth infrastructure:

> *South Edmonton's growth is exponentially more than the north. But then you get into this 'it's the north's turn' argument. The vote was 8-to-5 for the south so it wasn't like a slam dunk, by any means. One south-side Councillor said his reason [for his vote] was [that] he felt sorry for the north-side… For new projects you get this mix of data-driven recommendations from administration, and the political colouring of the decision is very relevant as well.*

Later, the same Councillor (INT-17) observed that: "Politics always creates risks that you're going to make bad decisions. I don't know a better system, so we just live with the risks. We just put up with it."

The openness of municipal budget approval processes was commented on by certain participants, for example as a means by which funding is allocated for certain projects. Such comments highlighted the fact that during budget deliberations individual councillors are empowered to propose amendments on items, which are successful if a majority of councillors vote in favour. Speaking in the context of Growth-related investments, one Edmonton Councillor (INT-11) commented:

> *… our administration tries to take a very objective viewpoint [on] new infrastructure needs [however] members of council can still introduce new projects to the debate. They might not get funded, but that is one other way that new projects can move forward… thankfully it's not a very big element. Most of the time, if that happens, councillors will say, 'well how does this fit within the overall prioritisation?' and we try to defer to that.*

A Calgary administrator (INT-01) similarly felt that often "... a councillor will get a number of calls saying 'we're not happy about this', and it'll be brought up in council

chambers…" and, later on, highlighted the uncertainty of what issues may arise: "I guess you never really know what is going to crop up as an issue, and that's just the nature of municipal government and politics..." The administrator provided an example, discussing how, when the issue of gaps within Calgary's pathway system was identified by "one small group of councillors" during a recent round of annual budget adjustments "some money was found or reallocated from somewhere else to at least address some of the key gaps in the pathway network."

5.2.4 Inadequate revenue sources

Most participants highlighted municipalities' fiscal limitations as either a direct contributing factor to their local infrastructure gap, or as an overall impediment to building needed infrastructure. Comments reflected a mix of concerns over the limited number of capital funding sources available to the Cities of Calgary and Edmonton, as well as concerns over existing revenue sources' capacity to raise sufficient revenues without posing unreasonable burdens on taxpayers. Finally, some participants felt their municipal infrastructure gaps are caused by what they view as structural imbalances between municipalities' expenditures responsibilities and revenue-raising tools, as compared to other orders of government.

Property tax revenues

Several participants, primarily Councillors, in both Calgary (INT-06, INT-08) and Edmonton (INT-17, INT-16) criticized the property tax for both being a 'regressive' and inadequate revenue tool, particularly for large infrastructure projects. One Calgary councillor emphasised their view that the property tax "hits hardest those with the least ability to pay", and then expressed concern over the weak connection between property tax revenues and municipal expenditures: "there's not a clear line of sight between those who pay and those who benefit. It's not aligned in terms of, say, user fees..." (INT-06). Another Calgary councillor went so far as to state that the property tax is "the most regressive form of taxation".

One Edmonton councillor (INT-17) stated that, in their opinion, the property tax is both "unfair" and that "you can't finance a modern functioning city of a million people with just the property tax". Property taxes were also criticized by Edmonton councillors as being particularly inadequate as a "tool to pay for… massive infrastructure projects", resulting in municipalities being "completely dependent on other orders of government" (INT-11) for large projects such as transit infrastructure. Another Edmonton Councillor (INT-16) criticized property taxation as "backward-looking" without "consider[ing] capacity to pay".

A Calgary administrator (INT-05) outlined their view of the competitiveness considerations surrounding property taxes: "We can't simply double our property tax rate on say business – non-residential – property taxpayers and expect to be competitive from an economic development standpoint as well." Another (INT-02) identified the need to identify alternative capital funding sources to property taxes, for example public-private partnerships, other forms of taxation, or initiatives such as the Infrastructure Bank of Canada.

Intergovernmental transfers

Research participants expressed two primary concerns with intergovernmental capital grants. First, the priorities of other orders of government (as indicated in granting conditions) may not reflect local needs. And second, grant funds are often unpredictable. An Edmonton administrator (INT-09) observed that grants "often aren't reliable… they fluctuate up and down, there's lots of conditions… [and] infrastructure that a city might think is very important and they want to invest in, may not align with the criteria the grant is providing." Similarly, a Calgary councillor (INT-06) described fluctuations in grants funding as creating a "feast or famine situation" whereby funding is not necessarily available for projects "best driven by data or evidence", as municipal infrastructure needs "are rarely… matched up with what the provincial or the federal political parties are willing to commit to."

An Edmonton councillor (INT-11) underscored (provincial) capital grants' unpredictable nature saying that, in their opinion, with recent reductions in provincial-municipal transfers it may "take twenty plus years just to reach the previous levels from a few years ago in terms of ongoing infrastructure funding" for Alberta municipalities.

A Calgary councillor (INT-10) provided a vivid example of how, in the context of an LRT project, provincial decisions to delay release of grant funding impacted The City of Calgary's financial position. The participant stated that in recent years "the single biggest piece of debt that the City of Calgary was holding, was interest costs on paying off the West LRT" which resulted from the province "reneging" in 2009 on a previously agreed Municipal Sustainability Initiative (MSI) grant payment schedule. This change was attributed to a decline in energy

prices (and thus provincial royalty revenue), resulting in $108 million in unbudgeted interest costs for the municipality (OCA, Calgary, 2013).

Structural fiscal imbalances

Certain councillors in both Calgary and Edmonton believed that in general, their municipalities' expenditure responsibilities are poorly aligned with their revenue-raising capabilities. Illustrating this, some (specifically Edmonton) elected officials pointed to the proportion of tax revenues received by municipalities writ large across Canada, as compared to those received by federal and provincial governments. For example, two Edmonton councillors (INT-11, INT-16) emphasised that that municipalities receive only “8 cents” (INT-11) for every tax dollar in Canada, and in their opinion resulting in municipalities possessing “a disproportionate [expenditure] responsibility compared to” (INT-16) their available resources, resulting in their being “reliant on the other two orders of government for large infrastructure projects” (INT-11).

Expressing similar concern as their Edmonton colleagues, one Calgary Councillor (INT-10) stated that, in their view, “we send way more tax dollars to Edmonton and Ottawa than we get back” and that “our tax dollars, for capital projects, trickle back to us in a very haphazard and mercurial way” through intergovernmental grants. Touching also on issues of jurisdiction, another Calgary councillor (INT-07) stated that The City of Calgary has “taken [on] more and more… responsibilities” such as affordable housing, without necessarily receiving corresponding funding. When asked about factors contributing to Calgary’s infrastructure gap, the same councillor (INT-07) similarly remarked on the “challenges” of “trying to align their

[other orders of government] mandate[s] with our needs" without being "empowered to be able to have the resources available to just make those decisions" around infrastructure.

A Calgary administrator (INT-05) agreed, suggesting municipalities faced challenges when they are "responsible for delivering a service" without being "the level of government that collects the capital funding to build" related infrastructure: "you're the operator but you're not the primary funder of the capital, that really is an impediment".

5.3 Responses to local infrastructure gaps

Research participants identified a range of actions taken by The City of Edmonton and The City of Calgary to address their respective infrastructure funding challenges, both in terms of managing expenditures and increasing revenues. These included efforts to better manage urban growth, improve asset management and associated budgeting processes, prioritise capital expenditures, cultivate dedicated revenue streams for certain infrastructure, in addition to intergovernmental advocacy.

5.3.1 Managing growth and urban form

Participants at The City of Calgary and The City of Edmonton recognized the impacts of growth and urban form on their respective infrastructure gaps, and discussed strategies being pursued to address these challenges. These strategies include adopting Municipal Development Plan policies to promote efficient use of existing infrastructure through intensification, developing new methods for understanding the capital (as well as operating) impacts of new

growth and developing new funding mechanisms, particularly to support redevelopment of already built-up areas to make efficient use of existing infrastructure.

One administrator (INT-05) in Calgary commented: “If you design your city and build your city a certain way, it can be more or less infrastructure-heavy.”, underscoring their view that urban form “has a lot to do with how [a city] can manage its own infrastructure deficit”. They confirmed that “part of The City’s growth strategy is… to try and shift the ratio of greenfield growth to more established area growth where there’s existing capacity of infrastructure.”, referring to long-term targets contained within that city’s Municipal Development Plan (MDP). In addition to intensification targets, Calgary’s MDP recognizes the linkages between municipal finance and growth-related infrastructure through several policy statements supporting the ‘optimization’ of ‘existing infrastructure’ and the prioritisation of municipal capital investments that support redevelopment of existing areas. Related to this, a 2009 study commissioned during the preparation of Calgary’s MDP estimated that the plan’s preferred growth scenario could result in cumulative capital savings of approximately $11.2 billion dollars over 60 years (IBI Group, 2009).

Progress to implement these directions has occurred but has fallen short of achieving associated targets. The intensification targets mentioned above include the percentage of cumulative population growth accommodated within the Developed Areas (communities generally built-up by the 1990’s). As reported in 2018, during the plan’s first decade “progress towards the target was not as significant as intended” with only 9.7% of cumulative new population growth occurring in these areas, likely jeopardising attainment of the longer-term target of 50% of cumulative population growth (since 2006), by 2076 (Calgary, 2018a, p. 11).

For context, it should be noted that 26.8% of cumulative new dwelling units constructed between 2006 and 2017 were located in the Developed Areas. Though the rationale for this target includes "reduc[ing] the cost of City services" (ibid), presumably including infrastructure costs, The City of Calgary does not appear to track the actual, incremental savings achieved through shifting the ratio of development in favour of existing built-up areas.

Efforts seem to be underway however, to enable greater established area (re)development so as to achieve desired capital efficiencies. One councillor (INT-10) stated that "saying we need to achieve a level of redevelopment is one level of planning" and that "actually being able to get there" is another. They continued saying that, per their understanding, "the conversation about how much infrastructure overhaul do we need with regard to sewage, water delivery… and stormwater management… that work is underway".

Perhaps in connection to their colleagues' comments above, another Calgary councillor (INT-08) described the Off-Site Levy bylaw's limited application to established neighbourhoods as "our biggest downfall", in that storm sewer, sanitary sewer, and water distribution levies, among others, are not applied into these areas. As levies must be spent on infrastructure benefitting the area(s) from which they were collected, this situation limits capital available for infrastructure needed to support growth in already built-up areas. The councillor added that they were "very happy to see that we are working on fixing [this] inequity" however, likely referring to the new Off-Site Levy Bylaw to be approved in 2023.

Similar to their colleague in Calgary, one Edmonton councillor (INT-17) stressed the need for funds to "invest in infrastructure to catalyse private development in core city [neighbourhoods]". Accordingly, Edmonton's (2018e) Infill Roadmap identified the need to

better assess infrastructure capacity in established areas (Action 2) and to identify cost-sharing mechanisms for upgrades needed to support redevelopment (Action 16). Edmonton's current MDP, known as "CityPlan" (Edmonton, 2020d), underpins these directions through policies supporting infrastructure capacity expansion in specified areas, as well as optimization of existing capacity. Edmonton's prior MDP, known as "The Way We Grow" (Edmonton, 2009b), included similar policies. As part of the CityPlan's development, a study compared the costs of 'business as usual' growth patterns, versus more compact growth patterns promoted by CityPlan. The study estimated that the CityPlan growth scenario would generate over $3 billion dollars in capital savings by 2065, in addition to approximately 2% higher total property assessment (Hemson, 2020).

Similar to its southern neighbour, The City of Edmonton has experienced challenges in meeting target levels of intensification that have been set, at least in part to "making better use of land and infrastructure" (Edmonton, 2018g, p. 13). The "Ways" strategic documents (including The Way We Grow), identified a target of 25% of net new annual residential units occurring in Mature Areas (generally neighbourhoods built out by 1970). Between 2010 and 2017 these figures ranged from 13% to 24%, with an average of 16.75% over the eight-year reporting period (Edmonton, 2018g). Also like The City of Calgary, The City of Edmonton does not seem to track the actual, ongoing infrastructure savings realised as a result of intensification.

Evaluating costs of peripheral growth

For reasons suggested above, the challenges of managing growth-related infrastructure costs in peripheral areas contrast to those experienced in existing communities within both cities. Over the last decade or so, Calgary and Edmonton have worked to better assess infrastructure costs within peripheral growth areas through their respective Growth Management Overlay (GMO) removal process (Calgary), and Integrated Infrastructure Management Planning (IIMP) framework (Edmonton). These exercises seek to estimate infrastructure costs related to these new (primarily residential) development areas, as well as related operating costs, in alignment with policies in both cities' MDPs.

Edmonton's CityPlan seeks to "Ensure that growth is managed with regard to long term fiscal impacts and full lifecycle costs of infrastructure and services" (Edmonton, 2020d, p. 58). Calgary's MDP seeks to "accommodate growth while avoiding premature investment in municipal infrastructure" (Calgary, 2020a, p. 27) while "linking growth decisions to municipal financial and infrastructure capacity" (Calgary, 2020a, p. 133).

Edmonton's IIMP framework, established in 2012, comprises "a high-level analysis that provides information about the infrastructure required for development" and "a general indication of future cost implications and revenue potential" associated with new greenfield development (Edmonton, 2016b, p. 2). Cost estimates are established for developer and municipal/provincial capital, as well as municipal renewal and operating costs related to applicable services; key inputs are cost data from developers and municipal departments. Property tax, user fee, capital grant, and other revenues are estimated using average assessed values for relevant property classes and similar figures. The IIMP study area is Edmonton's

remaining three undeveloped (as of 2015) Urban Growth Areas and for this reason, “does not comprehensively address all growth-related costs and revenues” (Edmonton, 2016b). Full build-out is assumed to occur between 30-39 years, estimates public, developer, and other costs over a 50-year timeframe. More detailed IIMP estimates are prepared for each Area Structure Plan and Neighbourhood Structure Plan as part of their approval processes.

As part of the IIMP exercise, a $1.4 billion-dollar expenditure-revenue shortfall was identified over a 50-year horizon. This was described as “typical for residentially focused areas” (Edmonton, 2016b, p. 1) and that in response the City would be required to further densify, make more efficient use of existing infrastructure, and grow its industrial/commercial tax bases, otherwise service levels may have to be reduced or residential property taxes may have to be increased. The $1.4 billion dollar figure “does not comprehensively address all growth-related costs and revenues” (Edmonton, 2017b, p. 2) however, given the IIMP’s limited scope.

Furthermore, it is stressed that property taxes generated by one neighbourhood “[do] not exclusively pay for municipal programs and services associated with that neighbourhood”, but rather collectively fund “shared resources, infrastructure and services provided by the municipality” (Edmonton, 2016b, p. 1).

Calgary’s Growth Management Overlay (GMO) was adopted, in principle, in 2013 “to direct development… strategically to lands determined to be ready for development” (Calgary, 2013b, p. 8) on the city’s periphery, with emphasis on infrastructure servicing. When a new Area Structure Plan is approved, the GMO is applied to all subject lands, and new developments cannot be approved on these lands until the GMO is lifted. Subsequently, developers may apply to The City to have the GMO removed from certain lands once necessary infrastructure and

servicing has been arranged for, as well as when other matters have been addressed. This GMO removal process includes analysis of infrastructure costs associated with approving new subdivisions, including both 'leading' infrastructure (water utilities, roads, transit, fire protection) and 'lagging' infrastructure (libraries, recreation, and other facilities), as well as associated operating costs (Calgary, 2013b), with emphasis on the former.

The GMO removal analysis includes the initial capital costs related to up-front infrastructure construction. It is unclear whether lifecycle replacement costs for this infrastructure have previously been considered within GMO removal analysis. In 2018, unfunded capital was estimated at $1.65 billion, including costs related to the 27 peripheral communities 'actively developing' at that time, and the 13-15 communities within 'future investment areas' (Calgary, 2018b).

Prior to 2022, only 'direct incremental' operating costs were considered as part of the GMO removal process, that is, those costs directly attributable to the build-out of that community. This includes certain costs related to roads, transit, parks, police, fire protection, bylaw enforcement, waste and recycling, bylaw enforcement, and community association support (Calgary, 2018b). These figures do not include costs to provide certain city-wide services, for example neighbourhood services or internal administrative functions such as the City's law department.

Challenges with forecast models

Both the IIMP framework and GMO removal process demonstrate many of the forecasting and related challenges municipalities face when working to better understand the

costs of growth. For a variety of reasons, these figures are limited and non-exhaustive estimates of growth-related infrastructure costs. As with all such exercises, usefulness depends largely on input data and assumptions. Even with high quality information and reasonable assumptions however, actual costs and revenues may differ significantly from forecasts due to the number and nature of variables involved in determining these outcomes. For example, as discussed by research participants, the pace at which development actually occurs (determined largely by market factors) is very difficult to predict, potentially resulting in fluctuations in cost and/or revenues over a set time period. In addition, reliance on city-wide averages as data inputs further reduces accuracy.

In the context of improved understandings of growth costs, one Calgary councillor doubted the ability for peripheral growth to ever fully cover its own costs, whether related to up-front capital or ongoing operations. They stated that, in their opinion, "as much as we [want] growth to cover its own costs, there's no way for that to actually happen" as developers "[do] not have deep enough pockets to front-end growth"-related infrastructure.

Instead, they stated that the City is moving towards understanding "what public investments do we have to make to create the smartest amount of growth so we can get to a point of payback as soon as possible" in terms of municipal services' operating costs. This, however "does not… address the capital replacement costs – the infrastructure deficit... That's a whole other political battle…"

5.3.1 Improved asset management practices

Improvements to asset management practices, in connection with capital budgeting processes, was an important infrastructure gap management strategy identified by several participants in Calgary and in Edmonton, as well as within relevant municipal reports. This includes efforts to improve inventory and condition assessment processes, as well as to quantify levels of service. The overall goal of these activities has been to "provide… accurate and detailed information" about municipal assets, (Edmonton, 2006, p. 12) so that relevant parties may "make consistent, effective and informed infrastructure decisions" (Calgary, 2004a, p. 9) including the optimal allocation of limited resources. For discussion of capital prioritisation practices, which are closely related to asset management in both municipalities, see the following section.

The early 2000's marked a period of transition at both municipalities, moving from a relatively disconnected series of infrastructure maintenance activities towards a coordinated Asset Management approach aimed at maximising value for service provision. One Edmonton Councillor (INT-18) remarked that, in their view, asset management "work was just not being done" in "any systemic [sic] way prior" to the late 1990's and early 2000's. Administrators in Calgary (INT-01, INT-02) discussed similar timelines for the shift towards more coordinated asset management practices in that city.

During this period, both municipal councils adopted asset management strategies and accordingly, Calgary and Edmonton have been regularly reporting on their respective asset inventories since 2004 and 2000, respectively (Calgary, 2021b; Edmonton, 2020a). In addition, these early strategies identified actions such as developing related processes to support asset

inventory data collection, implementation of full infrastructure lifecycle costing, and creating risk assessment methodologies to inform investment decisions (Calgary, 2004a; Edmonton, 2006). These early asset management strategies in both cities made explicit reference to the infrastructure gap.

Edmonton's 2006 Infrastructure Strategy, building on the prior 1998 strategy, also included actions aimed at "[ensuring] adequate fiscal tools and resources to fund infrastructure assets" (Edmonton, 2006, p. 10). Such elements addressing the revenue aspect of the infrastructure gap are absent from Calgary's 2004 Asset Management Strategy, which identified other actions such as the need to establish governance frameworks to assist with asset management decision making. Over the following fifteen years, both municipalities refined their overall approaches while also adopting policies that define roles and responsibilities, ensure strategic alignment across each municipality, establish general asset management principles, and provide for a series of Asset Management Plans organised by asset class. Examples include Edmonton's council-approved Infrastructure Asset Management Policy (2018), and Calgary's administration-approved Asset Management Policy (2010).

It appears that adoption of improved asset management practices has been, at times, met with internal resistance within both cities' municipal administrations. One Calgary administrator (INT-02) remarked that, in their view, prior to 2009 it was "often difficult" to get certain Business Units "to calculate their infrastructure gap, or even actually estimate… the current valuation of their assets" because many did not see the benefit of doing so. It seems that such resistance largely disappeared following changes to public sector accounting standards in 2009, which now require municipalities to report more rigorously on their Tangible

Capital Assets. The same administrator commented that these changes "took our whole asset management practice to the next level". More recently, an Edmonton administrator (INT-20) observed that some areas of The City's administration were initially sceptical of adopting Level of Service measures, seemingly out of concern that resources to meet associated targets were not available.

The overall reported Physical Condition of municipally owned assets in Calgary and Edmonton have fluctuated over the last two decades, for a variety of reasons. Some general patterns are evident, however, in the proportion of assets deemed to be in 'Poor' and 'Very Poor' condition by both cities. In Calgary, conditions seem to have improved by this measure from 2004 to 2013 but worsened between 2013 and 2020. In Edmonton, overall asset conditions worsened slightly between 2003 and 2011, but improved from 2011 to 2020.

Ongoing challenges with asset management practices

For many reasons, however, it is difficult to measure improvements in either city over time or to compare the two cities with any certainty. First, user fee-funded water utilities infrastructure is managed differently between the two municipalities. The City of Edmonton's 2017 transfer of storm and sanitary sewer assets (its then-largest asset class by value) to EPCOR almost certainly impacted the proportion of municipal assets in various condition categories. Likewise, the presence of water utility infrastructure within Calgary's figures (making up nearly two thirds of municipal CRV, with often high percentages of assets in 'Very Good' and 'Good' condition) furthermore skews these numbers. Very generally however, as of 2019 and 2020 respectively, Edmonton and Calgary appear to view the Physical Condition of their tax-

supported asset classes (such as roads, transit, parks, and recreation/other facilities) similarly in terms of Physical Condition (Calgary, 2021b; Edmonton, 2020a).

Second, continuous refinement in asset management over the last two decades has meant that municipal practices have evolved substantially from the early 2000's, making any assessment of progress from a 'baseline' nearly impossible (Calgary, 2021b; Edmonton, 2020a). This is particularly the case when it comes to data collection for each city's asset inventories.

Recently, Edmonton reported that "some gaps in the data" remain as certain "assets have never been accounted for" as part of past reporting and that for some assets, inventory "information does not yet exist" (Edmonton, 2020a, p. 6). Likewise, in Calgary a small portion of assets had not had their condition assessed as of 2020 (Calgary, 2021b); in addition, increases to The City of Calgary's total asset Capital Replacement Value were attributed to ongoing 'maturation' of asset management practices.

Lastly, assumed differences in exact asset condition assessment procedures and practices between the two municipalities further challenge direct comparison, despite use of similar terminology. In 2015, The City of Calgary moved towards service-based budgeting with quantified levels of service across almost all classes. The City of Edmonton has established such metrics for certain asset classes (specifically asset condition targets for neighbourhood streets, alleys, and arterial roadways), however its current 2019-2022 budget does not appear to establish such metrics across asset classes and service areas. However, development of a "documented suite of [Level of Service] measures" (Edmonton, 2018f, p. 25) was identified as a priority within that city's 2018 Infrastructure Strategy.

Both cities' efforts at establishing quantifiable service levels also appear to be linked to parallel changes in their capital budgeting processes. In Edmonton, administrators have reportedly worked to better "link the lifecycle costs" to growth-related capital budget requests put to Council, so that municipal elected officials "have a really good appreciation of what the operating costs are, as well as future capital liability associated with rehabilitating" facilities in the future (INT-09). Likewise, in Calgary, efforts have reportedly been made to better link capital budget submissions to quantified "service requirements" identified in light of both "existing service standard[s]" and "preferred versus standard[s]" (INT-02). Finally, participants in both Calgary (INT-01) and Edmonton (INT-20) reported adoption of 'value management' processes whereby certain capital projects are reviewed in-depth by subject matter experts to ensure value for money, at resulting in "reduc[ing] projects [costs]... by significant amounts" (INT-01).

5.3.2 Capital prioritisation decisions

The development of prioritisation, or 'ranking', systems and processes to assist with funding allocation decisions was discussed by participants in both Calgary and Edmonton as important strategies undertaken to address their respective infrastructure gaps. The nature of these exercises may vary by expenditure classification (Growth versus Renewal/Maintenance). For example, asset condition figures are primary inputs for estimating Renewal/Maintenance spending needs, whereas Growth-related projects may be identified on the basis of a variety of considerations such as forecasted population growth and desired service levels. Managing risk,

broadly speaking, is an overriding concern for both municipalities when making capital budget allocations.

Two Edmonton councillors remarked that, in their opinion, a primary strategy employed to manage their municipality's infrastructure gap has been developing "a way of prioritising what needed to be done" (INT-18) in order to "[serve] the most critical needs" first (INT-16). Accordingly, this city seems to have pursued a relatively formalised approach to capital prioritisation.

In Edmonton, capital budget recommendations for infrastructure renewal projects are determined through the Risk-based Infrastructure Management System (RIMS), described by one councillor (INT-18) as a "vigilant scoring system" integrating both "risk" and "lifecycle" considerations. Developed in 2011, RIMS is an "analytical tool designed to predict the optimal funding for the renewal of existing infrastructure" using "assets' current physical condition, its target physical condition, renewal investment options/costs, and expected life cycle deterioration curve" (Edmonton, 2018a, p. 30). Funding recommendations are then based on the severity of risks posed by assets' failure as well as funding necessary to "maximise the life of the asset at a minimised cost" (ibid). Recommended funding levels are not necessarily determinative of ultimate allocations, however, for example within Edmonton's 2019-2022 capital budget asset classes with higher risk tolerance thresholds and lacking dedicated resources saw their renewal funding reduced to about 90% of ideal RIMS recommendations "given [then-]current funding constraints" (ibid).

Growth-related capital projects are assessed separately. Beginning in 2015, a weighted criteria scoring system was introduced reflecting both strategic (council priority areas) and

operational (legislative compliance, services levels, etc.) factors (Edmonton, 2018b). Tax-supported capital spending proposals are evaluated against these criteria, to inform the allocation of unconstrained funding sources such as Pay-As-You-Go amounts. One councillor (INT-18) felt that the process of assigning scores to individual capital proposals based on certain criteria can "get perilously close to subjective", however efforts are made to "as much as possible, at least at the recommendation level" minimise this. According to capital budget documents, a handful of both Growth and Renewal projects in Edmonton's recent budget cycles had also undergone Net Present Value analysis (Edmonton, 2018a).

Capital prioritisation processes appear to be more flexible at The City of Calgary, without an apparent strict distinction between processes for Growth and Maintenance/Renewal investments. No capital prioritisation criteria similar to those used in Edmonton were publicly released for Calgary's 2019-2022 budget cycle. Rather, participants described the City of Calgary's overall approach to capital prioritisation as one characterised by ongoing 'dialogue' or 'conversation' within administration, and then with council. An administrator (INT-05) described this process as "an iterative back and forth internally within departments and between departments to manage" capital prioritisation, with needs identified according to "asset conditions and growth and service level needs". One exception relates to long-term infrastructure projects identified within the RouteAhead strategic plan for public transit, which are scored and ranked using weighted criteria. RouteAhead projects, in addition to the Green Line LRT project, also undergo Net Present Value analysis (Calgary, 2020b).

However, building on a similar document adopted for the 2015-2018 budget cycle, an updated list of six high-level capital investment principles were adopted by Calgary's Council in

2018. These included: “Support the delivery of City of Calgary services, at approved service levels”, “Promote the well-being of communities, environment, and economy”, and “Integrate, coordinate and optimise The City’s investment” (Calgary, 2018d, pp. 1–2).

Many participants noted the role played by Infrastructure Calgary in prioritising capital projects. Established in 2015, the Infrastructure Calgary team “provides a corporate approach to capital investment to support… a cultural shift to integrated service delivery and intentional management of The City’s capital portfolio.” (Calgary, 2022b). Prior to the establishment of this group, each department were said by one Councillor to separately prepare “a series of ranked lists… called the IIPs lists – Infrastructure Investment Plans” for each major category of assets (INT-10).

The same councillor (INT-10) described Infrastructure Calgary as the “place… where those IIPs lists come and live together and are weighted and worked on together” to better align with “council’s strategic goals” and to identify “synergies” between projects. Another councillor (INT-07) described Infrastructure Calgary’s prioritisation process as “data-driven”, where “what projects are important” are identified through “cost benefit analysis”. These remarks seem to imply the existence of some sort of criteria, though again, no documentation of this was made publicly available during recent budget cycles.

Within this context certain administrators stated that, per their understanding, allocating limited capital funding at The City of Calgary tends to focus on “first and foremost… managing risk[s]” (INT-01), and more specifically “mitigating risks to service provision” (INT-02). Some participants emphasised that, in their view, external funding sources impact capital

priorities. One councillor (INT-06), for example, stated that certain projects “can jump to the top of the queue because there might be a partner” willing to provide funding.

5.3.4 Earmarked and special-purpose funding

Research participants in both Calgary and Edmonton identified earmarking property taxes or establishing other forms of dedicated revenue sources for certain infrastructure categories as either actions taken to manage infrastructure gaps, or as factors that enhance municipal capacity to build needed infrastructure. Participants in Edmonton frequently emphasised the Neighbourhood Renewal Program; some also discussed the introduction of off-site levies for certain asset classes and strategic use of debt. Participants in Calgary discussed the importance of the 2016 Off-Site Levy Bylaw.

Edmonton’s Neighbourhood Renewal Program (NRP), with its dedicated funding and service level targets, was described by both councillors and administrators as introducing “proper lifecycle maintenance for our communities” (INT-11) so that “we don’t have to negotiate… neighbourhood-by-neighbourhood, which ones get to have their streets re-done.” (INT-14).

The NRP was “initiated in 2009 with a goal of having all Edmonton neighbourhoods’ [infrastructure] in acceptable condition by the end of 2038” (OCA, Edmonton, 2016, p. i). Neighbourhood streets and sidewalks were the program’s initial focus, with Council expanding the program to include alleys in 2016 (Edmonton, 2017c). The program uses the following indicators to measure ‘acceptable condition’, among others: proportion of “collector and local

sidewalks, and residential and industrial local roads" and "collector roads" in Poor and Very poor condition (Edmonton, 2020e, p. 2). Per the Council-approved Neighbourhood Renewal Policy, the target proportion of relevant assets in Poor and Very Poor is 0% by 2038.

The NRP is funded by earmarked, annual tax increases ranging from 1% to 2% that occurred beginning in 2009, originally planned to end in 2018 (OCA, Edmonton, 2016). Municipal Sustainability Initiative (provincial grant) allocations were used to supplement the program's resources while tax funds were accumulating (ibid). Following its 2016 audit of the NRP, Edmonton's City Auditor found that funding for the program was "sufficient at [that] time" (OCA, Edmonton, 2016, p. 11). The City's 2019-2022 budget allocated $635 million to the NRP, an amount "fully-funded through [the program's] dedicated tax levy" (Edmonton, 2018a, p. 4). Of note, between 2016 and 2020, the percentage of local and collector roads in Poor and Very Poor physical condition declined from 28% and 13%, and to 13% and 5% respectively (Edmonton, 2016a, 2020a). This seems to suggest that the NRP is moving the relevant assets towards their Council-approved service level goals.

The general approach represented by the NRP, with its associated tax levy and service level targets, seems to contrast with The City of Calgary's approach to setting aside property tax revenues as either PAYG funds or capital reserves. Though not specifically discussed by research participants, budget documents suggest that The City of Calgary utilises a more flexible approach where, for most purposes, tax-supported asset classes share common reserve and PAYG funding streams. Annually, 2.6% of property tax revenues (amount other funding sources) are allocated to the Lifecycle Maintenance and Upgrade Reserve (LMUR). Between 2008 and

2013, five-year PAYG funding was increased to $400 million with periodic adjustments accounting for population growth and inflation (Calgary, 2018c).

The City's LMUR tax allocation and PAYG amounts do not appear to have been set with the intention of achieving any particular service level(s) or asset condition(s). The annual property tax LMUR allocation was increased to 2.6% in 2008, however this increase was described at the time as "inadequate to fully address lifecycle maintenance needs" (Calgary, 2008, p. 5). It was acknowledged in spite of this, however, that accounting for "lifecycle costs in the property tax is a long-term strategy for both maintaining the infrastructure and conveying the full cost of building and operating the infrastructure". Similarly, Calgary's five-year PAYG allocation seems to have been established merely "to return the effectiveness of PAYG funding to a level comparable with 1996" (Calgary, 2008, p. 7), as five-year PAYG amounts had been fixed at $276 million between 1996 and 2008 without adjustments for inflation or population growth.

Research participants in both cities suggested that greater use of off-site levies is a key strategy for managing their infrastructure shortfalls. As suggested previously, Calgary and Edmonton have in general taken decidedly different paths with regards to developer-paid Off-Site Levies. The ways in which the two cities have increased their usage of these funding tools further illustrates this pattern.

In 2018, the provincial government amended Calgary and Edmonton's City Charters to allow the cities to define the types of infrastructure eligible for funding through off-site levies. Previously, Alberta municipalities (including Calgary and Edmonton) were only technically able to charge levies for water, sanitary sewer, and storm sewer infrastructure. Following this,

Edmonton administrator (INT-09) stated that The City has had "difficult conversations" with developers regarding "whether or not they should be paying for more" towards off-site infrastructure. Accordingly, in 2021 Edmonton's City Council approved a new off-site levy bylaw requiring that developers, for the first time, begin contributing funds to fire stations and related capital assets.

Calgary, meanwhile, has a long history of charging these levies for infrastructure beyond roads and water utilities. An Edmonton councillor (INT-11) stated they were "not sure how they [Calgary] were ever allowed to" charge these levies. Foran (2009) notes the existence of recreation levies for example (previously known in Calgary as 'acreage assessments') as far back as the 1970's, despite lacking formal legislative authority to do so until 2018. As early as 2016 The City of Calgary acknowledged that in the absence of legislative authority, 'levies' for fire stations, police stations, libraries, and transit buses were essentially "voluntary in nature" and that "developers [may] choose not to pay" (Calgary, 2016, p. 16). It is unclear if this risk ever materialised, however, as also in 2016 it was reported that the development "industry [was] continuing to support" these 'levies' as they "contribute to the funding of infrastructure necessary for the construction of complete communities" (Calgary, 2016, pp. 14, 2).

One councillor (INT-08) felt that Calgary's 2016 Off-site Levy Bylaw was an "game-changer", allowing The City to "absolutely… do growth properly" in that it established greenfield levies at rates intended to capture "100% of the proportionate share of the costs attributable to new growth" (Calgary, 2016, p. 1). This change is especially noteworthy for water and wastewater (sanitary) levies, as between 2011 and 2016 these rates were approved to recover only half of identified growth-related infrastructure costs with the remainder being

funded through utility rates (Calgary, 2016, p. 1). As discussed above, the total absence of water and wastewater levies between 2001 and 2011 resulted in The City accruing substantial amounts of self-supported debt.

5.3.5 Intergovernmental advocacy

Participants in both cities (primarily councillors) discussed intergovernmental advocacy for increased capital grants as a strategy used to address their infrastructure gaps. Certain participants stated that, in their opinion, both municipalities had been "very active in… lobbying other levels of government for support" (INT-09), and "trying to partner with other orders of government" (INT-06). One Calgary councillor (INT-10) felt that their city had been "unbelievably successful in receiving funding from other orders of government", pointing to the Green Line LRT project as an "unprecedented investment".

Participants also discussed the creation of specific grant programs, as examples of success in this regard. An Edmonton councillor (INT-18) pointed to the provincial Municipal Sustainability Initiatives, a granting program that in 2007 "kicked in to help with infrastructure issues". Similarly, one Calgary councillor (INT-07) viewed that advocacy by both former Calgary Mayor Dave Bronconnier in concert with the Federation of Canadian Municipalities resulted in "Gas Tax dollars… flow[ing] directly to municipalities… to help us pay for many of our local projects".

The pattern of intergovernmental grants received by both cities over the last two decades seems to support the above comments. Grant revenues have grown in both absolute

(adjusted for inflation) and relative (as a proportion of capital spending) terms since the early 2000's.

5.4 Summary

The Cities of Calgary and Edmonton have, for almost two decades, consistently reported multi-billion dollar 10-year infrastructure funding gaps (albeit at varying degrees of detail). Respectively, each municipality began reporting these figures as part of a long-term financial planning exercise, and as part of early asset management efforts. These figures are high-level estimates and appear to be largely based on extrapolations of existing trends in revenues and expenditures. Also reported, as part of their budget cycles, have been 3-to-4-year figures listing the value of unfunded capital projects.

In terms of asset classes, in the case of both cities, infrastructure gaps have only been reported for assets related to tax-supported services (that is, roads, recreation facilities, parks, and the like). Since the early 2000's, it does not appear that infrastructure gaps have been reported for water utilities or waste and recycling services in either city, which in both cases are funded through dedicated user fees.

Collectively, research participants in both Calgary and Edmonton exhibited ambivalence towards the infrastructure gap as a concept. Though many participants in both cities tacitly accepted the existence of an overall infrastructure gap in their municipality, others were more sceptical. Certain Councillors in both cities suggested that the infrastructure gap may merely represent a need for decisionmakers to better align citizens 'expectations' with their

'willingness to pay', in order for the municipality to 'live within its means'; one even called Calgary's infrastructure gap "imaginary". Concern was also expressed over how adherence to municipal policies may 'inflate' infrastructure gap estimates. Finally, it was acknowledged by administrators in both cities that these figures are, at least in part, utilised as 'advocacy tools' to leverage increased intergovernmental grant funding.

Participants in both cities perceived four broad categories of issues as contributing to their infrastructure gaps: growth and urban form, asset management challenges, political factors, and inadequate funding. The mitigation strategies pursued by each municipality were also broadly similar and, perhaps unsurprisingly, generally aligned to perceived contributing issues. Table 7 summarises these findings from participants.

Table 7: Infrastructure Gap: Contributing Factors and Mitigation Strategies

Contributing Factors	**Mitigation Strategies**
Growth and urban form	• MDP policies • Cost-of-growth modelling • Intensification targets
Asset management	• Adoption of governance policies • Improved inventory/data collection practices • Service level metrics
Political factors (regarding priorities)	• Capital budget prioritisation criteria and systems
Inadequate funding	• Earmarked resources (Off-Site Levies, property tax funds) • Advocacy for increased intergovernmental capital grants

Participants described growth and urban form considerations such as the location, nature, and density of new (especially peripheral) development as impacting their municipalities' infrastructure gaps. The operating and lifecycle cost implications of capital built and transferred by developers (as part of new development), per municipal specifications, to each city was raised as a concern, as well as challenges with each city's systems of managing off-site infrastructure.

In response to these issues, both municipalities had adopted Municipal Development Plan policies encouraging more efficient use of existing infrastructure through intensification of existing built-up areas. Although both Calgary and Edmonton had commissioned studies highlighting the potential for significant, long-term savings in connection to higher levels of redevelopment, both cities seem to be falling short of their associated targets. This seems to be, at least in part, due to difficulties in facilitating infrastructure expansion to enable desired levels of redevelopment. As well, neither city appears to be publicly reporting on savings realised to date as a result of these efforts. Both Calgary and Edmonton, through their respective Integrated Infrastructure Management Planning (IIMP) and Growth Management Overlay (GMO) Removal exercises, are working to better understand the costs of new suburban development to better support municipal growth decisions.

Several participants (councillors and administrators) in Edmonton highlighted asset management challenges as a contributor to that city's infrastructure gap, while only one participant in Calgary (a developer) suggested the same. Nevertheless, deferred maintenance, a related issue, was highlighted as a significant component of the former municipality's infrastructure gap.

Both Calgary and Edmonton have, since the early 2000's, exerted substantial effort to improve their understanding of their respective asset portfolios. This includes ongoing efforts to improve data collection and condition assessment practices, as well as the adoption of service level metrics and the creation of policies governing asset management practices. In general, it is challenging to either compare the two cities' asset management practices, or to assess whether their related capabilities are improving, due to differences in organisational procedures and the lack of external standards. It seems that Calgary has, over the last two decades, moved more quickly than Edmonton in adopting service level metrics across a greater number of asset classes, as well as overarching asset management governance policies.

Many participants in both cities discussed how various 'political' factors, such as public perception, challenges a strictly evidence-based process of allocating limited capital funds. Resoundingly, participants described investments in capital maintenance and renewal as "not sexy" politically, and that less relevant considerations may intrude on capital funding decisions.

As part of their budgeting processes, both municipalities have systems in place to evaluate proposed capital investments in relation to one another so as to inform ultimate funding decisions. Edmonton reports a relatively formalised approach, with its RIMS model recommending renewal funding levels according to assets' age, condition, risk posed by assets' failure, and other inputs; a publicly available weighted scoring procedure is used to prioritise Growth recommendations. Calgary seems to broadly consider the same factors in prioritising capital investments, while adopting a seemingly more flexible 'dialogue'-based approach without an apparent strict separation between prioritisation processes for growth versus renewal/maintenance projects. Ultimately, it was challenging to assess Calgary's capital

prioritisation approach due to lack of publicly available information from the current and prior budget cycles.

Finally, participants in both cities discussed how inadequate funding contributed to their infrastructure gaps. Specifically highlighted was the inability of the property tax to fund necessary capital costs, particularly large projects. The unreliable and conditional nature of intergovernmental grants was also discussed consistently by participants in both cities, as well as the broader issue of misalignment between municipalities' expenditure responsibilities versus their revenue-raising capacity.

Over the last two decades, the Cities of Calgary and Edmonton have pursued generally similar strategies in the context of their funding constraints, specifically cultivating earmarked funding sources within their control (dedicated property tax increases, and off-site levies), and engaging in intergovernmental advocacy for increased capital grants. The nature of earmarked property tax increases differs between the two cities, with Edmonton establishing a dedicated tax in 2009 to levy to fund its Neighbourhood Renewal Program, while at about the same time Calgary increased the amount of property tax funds dedicated to general Pay-As-You-Go funds and its Lifecycle Maintenance and Upgrade Reserve to align with inflation and population growth. In 2016, Calgary fully reinstated certain water utility off-site levies, whose absence (fully or partially) since 2000 had contributed to large self-supported debt increases; Calgary has a long history of collecting off-site levies and similar developer contributions for a wider (than previously permitted by legislation) range of infrastructure, including recreation centres and fire stations. Edmonton, meanwhile, by setting up inter-developer cost sharing mechanisms, has effectively removed itself from the actual construction of a substantial

amount of off-site storm and sanitary, as well as roadway, infrastructure related to new suburban growth. In contrast to Calgary, Edmonton has only recently begun collecting off-site levies for fire stations following legislative changes.

Next, in Chapter 5, findings will be discussed in relation to the literature and overall conclusions will be presented. Recommendations for municipalities, other orders of government, and related to planning education are then outlined, followed by a summary of this thesis' limitations and suggested areas for future research.

Chapter 6: Conclusions and Recommendations

This thesis set out to better understand Canada's municipal infrastructure 'gap' through comparative case studies of two cities, Calgary and Edmonton. The crux of this issue is, in essence, that Canadian municipalities' face an ongoing, systemic shortfall between available capital funds versus necessary capital expenditures. The relevant literature largely turns on the question of whether or not increased municipal revenues are needed, either through intergovernmental grants or additional taxation powers. In general, the literature acknowledges that local capital spending has likely been suboptimal in recent decades, however there is some disagreement as to whether municipalities possess adequate revenue tools to construct needed infrastructure. There are few in-depth case studies of one or more municipalities' experience managing their infrastructure gap(s) (the most commonly reported-on figure by individual municipalities, as opposed to infrastructure 'deficits' or 'debts').

Given the above, the following questions were posed: how do municipal stakeholders and decisionmakers understand their infrastructure gaps? what do municipalities perceive to be the larger cause(s) of their infrastructure debt, deficits, and gaps? And, how are municipalities addressing their infrastructure debt, deficits, and gaps?

To explore the above questions, a qualitative case study-based research approach was selected, comparing the City of Calgary and the City of Edmonton. These two cities were selected for a number of factors, including: convenience and familiarity to the author; their status as the largest pair of similarly sized urban municipalities located within the same Canadian province; as well as the two cities' consistent documentation of their infrastructure gaps over the past two decades.

The nature of each city's infrastructure gap was explored through key informant interviews, document analysis, and descriptive statistics. Research participants were identified via purposive and 'snowball' sampling and included municipal councillors; city administrators such as planners and engineers; community representatives; and real estate development industry representatives. Document analysis focused on municipal capital budgets, and those municipal strategies, plans, reports, policies, and other documents referenced either within budget documents or by research participants in interviews. Descriptive statistics, such as municipal debt figures, were used to contextualise and triangulate findings from document analysis and interviews, and to identify broader trends.

Findings for both Calgary and Edmonton were broadly similar in terms of the perceived causes of their infrastructure gaps. Research participants in both cities identified growth and urban form, historically poor asset management and deferred maintenance, political factors, and inadequate revenues as the primary drivers of their infrastructure gaps. Corresponding to these issues, the two cities have pursued similar strategies including: understanding and better managing the costs of growth, improved asset management processes, development of capital prioritisation processes, cultivation of earmarked funding streams, and advocacy for increased intergovernmental transfers. The major differences between the two cities seem to lie in how they have implemented these strategies.

The remainder of this chapter discusses major research findings in relation to the literature, and then concludes with final observations and recommendations, an overview of this thesis' limitations, as well as directions for future research.

6.1 Understanding municipal infrastructure gaps

Municipal infrastructure gaps are long-term projections based on municipalities' current understandings of future trends. Thus, several assumptions are inherent in these figures (such as future property tax rates, level of grant funding, population growth, etc.) which will almost always differ from actual events. This reality is inherent to all forecasting exercises and is not unique to municipalities or their infrastructure gap estimates.

With this caveat in mind, it is nevertheless interesting that over the last two decades neither Calgary or Edmonton seems to have reported 10-year infrastructure gaps or 4-year unfunded capital projects for their user fee-funded services, namely waste and recycling and water utilities (potable water, stormwater management, wastewater management). Rather, funding gaps have been consistently reported for tax-funded services and infrastructure, for example roads, recreation facilities, and parks.

Research participants expressed a range of views regarding their city's infrastructure gap as a concept. Though most administrators and councillors in Calgary and Edmonton seemed to implicitly accept the infrastructure gap as a valid concept, some did not, or expressed more nuanced points of view. One councillor in Calgary called that city's infrastructure gap 'imaginary', while another suggested it was 'inflated' in part by municipal policies and standards; an Edmonton councillor suggested the gap may reflect a 'lack of discipline' in spending and prioritisation decisions. Certain administrators in both cities spoke to the infrastructure gap's use as an 'advocacy tool' to pursue increased intergovernmental grants. These more critical perspectives broadly align with related concerns present in the literature

(Boadway & Kitchen, 2018; Hilton, 2007; see for example Kitchen, 2003; Slack & Tassonyi, 2017).

The above findings suggest that the literature's concerns with the infrastructure gap as a concept have merit. Namely, that the absence of pricing mechanisms seems to correlate with the presence of an infrastructure gap for a particular asset class, and that these figures have been produced in large part to support intergovernmental advocacy.

6.2 Contributors to municipal infrastructure gaps

One of the most frequently cited contributing factors to municipal infrastructure gaps in Calgary and Edmonton was growth and urban form, in particular the nature, location, and timing of new development. These included comments on the density and layout of existing built-up areas, as well as that of developing peripheral neighbourhoods. These findings broadly align with the literature, which recognizes how urban growth and form impact municipal capital expenditures (see for example Slack, 2002; Tassonyi, 2002; Blais, 2011).

Participants linked asset management and related issues to both cities' infrastructure gaps, albeit in slightly different ways. Edmonton participants noted the legacy of historically poor asset management practices, for example asset inventory data collection, while Calgary participants discussed the issue of deferred maintenance investments. The literature recognizes both issues' connection to municipal infrastructure gaps (see for example Kitchen, 2003; Mirza & Ali, 2017; Kitchen, McMillan, et al., 2019b).

Various 'political' factors were said to contribute to Calgary and Edmonton's infrastructure gaps. These comments focused on councillors and administrators' views of what types of capital investments were attractive to the public; investments in maintaining and renewing assets were almost universally described as "not sexy", politically speaking. Presumably, this influences both capital allocation recommendations from administrators, as well as elected officials' direct participation in the capital budgeting process. Though the literature acknowledges the political nature of municipal capital budgeting and allocation processes (see for example Forrester, 1993; Sancton, 2015), there seems to be a dearth of in-depth empirical explorations of how exactly such influence may be exerted, and which types of investments are likely to be privileged (for an exception see Flyvbjerg, 1998).

Participants frequently noted municipalities' limited revenue-raising capabilities as a contributing factor to both case study cities' infrastructure gaps. In keeping with themes found within the literature, property taxation was consistently criticized as both inadequate to finance major infrastructure projects and regressive. The former concern is disputed within the literature (for contrasting viewpoints, see Kitchen & Slack, 2016; Dahlby & McMillan, 2019b), while the latter seems to be consistently dismissed as irrelevant (see Kitchen, McMillan, et al., 2019b; McMillan & Dahlby, 2014). Intergovernmental grants were criticized as often unreliable and for distorting municipal decision-making, assertions broadly supported by many authors (R. Bird, 2001; Kitchen, 2006; Schaeffer, 2000; Slack & Tassonyi, 2017). Finally, many participants suggested that structural misalignment between municipalities' expenditure responsibilities and revenue tools contributed substantially to both cities' infrastructure gaps, a view supported by some authors (see Slack, 2006; C. Vander Ploeg, 2004).

The above findings confirm the primary drivers of municipal capital expenditures identified within the literature, namely: population/economic growth, and the condition of existing infrastructure (and thus capacity to support particular service levels). In terms of revenues, the other component of the infrastructure gap, these findings support predominant views on grants and, perhaps unsurprisingly, aligns with those in support of increased own-source revenues for municipalities. Views on the property tax represents a crucial nuance: municipal councillors and administrators present far more critical views of this revenue tool than authors in the literature. Municipal stakeholders seem to support additional own-source revenues due to property taxes' perceived shortcomings, however those in the literature supporting the same appear to do so on the grounds that "the property tax is a good tax, but cities would benefit from a mix of taxes" (Kitchen & Slack, 2016, p. 1) in response to growing expenditure pressures. Again, perhaps unsurprisingly, pricing issues (a key concern within the literature) were not raised as a contributor to either case study city's infrastructure gap.

6.3 Addressing municipal infrastructure gaps

The primary strategies pursued by both municipalities to address their infrastructure gaps align clearly with their perceived causes or contributing factors.

In part to address the impacts of growth and urban form on capital and other costs, both Calgary and Edmonton adopted Municipal Development Plan and other policies explicitly promoting better use or 'optimization' of existing infrastructure through redevelopment of existing built-up areas. As well, both cities have relatively recently begun conducting exercises

aimed at estimating the infrastructure costs associated with continued outward expansion of new neighbourhoods. The Canadian literature on municipal infrastructure gaps does not appear to comment on these strategies.

Over the last two decades both Calgary and Edmonton have made substantial efforts to improve their asset management capabilities. This includes adopting related governance policies, improving their asset inventory data collection capacity, and adopting service level metrics. To date, Calgary seems to have adopted service level metrics for a broader range of assets than Edmonton has. The literature recognizes the importance of these and other asset management efforts (Kitchen, McMillan, et al., 2019b; Schaeffer, 2000).

Participants in both cities discussed prioritisation of capital projects as an important means of managing their municipal infrastructure gaps. Edmonton seems to have adopted a more formalised prioritisation approach, with its RIMS system for Renewal projects and a separate list of weighted criteria for Growth capital projects. Calgary has developed a prioritisation approach that, in comparison, seems more flexible and dependent on internal 'dialogue'. Calgary's list of weighted criteria, assuming one exists, is not publicly available. As well, both cities seem to have occasionally used Net Present Value to analyse capital projects in recent budget cycles. Using weighted multiple criteria systems of some kind to rank potential capital projects is widely recommended within the literature (Chan, 2004; Marcelo et al., 2016; Srithongrung et al., 2019).

Both Calgary and Edmonton have cultivated 'earmarked' or dedicated revenue streams in support of specific infrastructure types. In recent years both cities have increased their use of Off-Site Levies to fund certain growth-related infrastructure. Edmonton introduced its

Neighbourhood Renewal Program (NRP) property tax levy in the late 2000's to fund local and collector roadway lifecycle costs. At about the same time, Calgary increased the amount of property tax funds allocated towards Pay-As-You-Go funding and its Lifecycle Maintenance and Upgrade Reserve, without earmarking these amounts to any particular asset class. Both cities' use of Off-site Levies (though this is legislatively required) and Edmonton's NRP tax levy seem to fulfil the condition present within the literature that earmarked revenues have a close 'benefit' link to the expenditures being funded (see R. Bird, 2001; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017). However, Calgary's Off-Site Levies tend to utilise an average cost approach, in contrast to Edmonton, a strategy that is not recommended within the literature (Blais, 2011; Slack & Bird, 2019a; see Tomalty & Skaburskis, 2003). Finally, participants from both cities stated that their municipalities had engaged in substantial (and successful) intergovernmental advocacy in support of increased capital transfers.

The above suggests that Calgary and Edmonton have taken steps to address both the expenditure- and revenue-related components of their infrastructure gaps, in line with prevailing perceptions of its contributing factors. Crucially, both cities have demonstrated their willingness to increase property taxes and other existing own-source revenues, at least somewhat, to address their infrastructure funding challenges.

6.4 Final observations and recommendations

This thesis' findings broadly confirm, and fits neatly within, previous research on municipal infrastructure gaps in Canada. The essential drivers of municipal capital expenditures

in Calgary and Edmonton align with those previously identified, as well as the importance of managing both urban growth and existing assets. The importance of asset inventories and service level metrics, key concepts within the literature, was also confirmed. This thesis' findings support lack of pricing/dedicated funding streams, asset management challenges, and vertical fiscal gaps as likely causes of municipal infrastructure gaps. Urban growth also appears to contribute directly to infrastructure gaps, a finding that appears to have received very little in-depth attention within the literature. As suggested by prior research, municipalities criticize the property tax as an inadequate and regressive revenue tool and seek additional revenue-raising powers while eschewing improved pricing of capital-intensive services.

Overall, this thesis finds that the conversation surrounding municipal infrastructure gaps in Canada has remained largely unchanged since the early 2000's. Criticisms of these figures summarised by Kitchen (2003) have been repeated consistently for the last twenty years (Bazel & Mintz, 2014; Dachis, 2018; Kitchen, McMillan, et al., 2019b; Mintz, 2006; Slack & Tassonyi, 2017), however, municipalities (in addition to other orders of government) seem to have mostly ignored them. During this time municipalities have, with apparent success, mobilised the infrastructure gap concept to help establish intergovernmental capital transfers as "a permanent feature of Canadian fiscal federalism" (B. Dahlby & Jackson, 2015, p. 1). This situation is not without challenges because grants are often unreliable and are made with conditions that may not reflect local priorities. Municipal officials and many academics share these concerns and seem to generally agree (for differing reasons) that instead, Canada's large urban municipalities require greater own-source revenues to meet their present and future infrastructure challenges.

How then, to convince sceptical provincial governments to extend additional revenue tools to their (large, urban) municipalities? It seems unlikely that current understandings of the infrastructure gap, with its many criticisms, will be sufficient to support this advocacy goal. Slack (2006) observes that, given their balanced budget requirements, misalignment between municipalities' expenditure responsibilities and their revenue-raising capacity will show through the condition of their asset portfolios and their overall service levels. More than fifteen years on, the continued absence of national standards for monitoring municipal service levels or asset conditions makes it challenging to fully assess the extent or impact of local governments' fiscal imbalances.

Since the early 2000's, substantial investments have been made (particularly by the federal government) to improve municipal asset management capacity across the country. This includes developing reference materials (see for example InfraGuide, 2005), including municipal asset management requirements within 2014-2024 provincial gas tax fund agreements (Government of Canada, 2020), establishing the Municipal Asset Management Program in collaboration with the Federation of Canadian Municipalities, and initiating the Core Public Infrastructure Survey. Provincial governments have also supported these efforts. Ontario, for example, adopted regulations in 2017 requiring consistent municipal service level and asset condition reporting by 2022-2024. Voluntary initiatives, such as the Municipal Benchmarking Network of Canada have also been established.

In light of the above, the following recommendations are made. These recommendations are provided tentatively, however, given that findings associated with the

two case study cities, Calgary and Edmonton, may not necessarily be relevant to all (large, urban) municipalities in Canada.

6.4.1 Recommendations

National Framework of Indicators

Building on the above efforts, a national framework of indicators for municipal services levels and asset conditions should be developed in order to better appreciate the misalignments between local governments' expenditure responsibilities and their fiscal capacities. To avoid the same 'conflict of interest' concerns raised over current infrastructure gap concerns, this framework should be stewarded by an independent intergovernmental commission. Provincial governments should require their municipalities to align their reporting with these indicators. This framework, through its development and implementation, would spark needed conversations about what minimum municipal service levels all Canadians should expect, regardless of their place of residence, as well as what resources are required.

Enhance understanding of costs

While national indicators are being developed, individual municipalities should continue or begin, as their capacity allows and situation requires, to improve their understanding of their infrastructure costs resulting from growth and from maintenance requirements, as well as in response to pressures such as climate change and demographic shifts. This includes improvements in cost forecasting, asset inventory and data collection practices, and the adoption/refinement of locally determined service level metrics. Municipalities should also

review the lifecycle costs associated with the specifications that they require developers to construct 'contributed' assets to (e.g., roadways in new subdivisions).

Improve budgetary and management decision-making transparency

In addition, municipalities should strive to improve the transparency of their capital budgeting and management processes. This includes clearly describing the linkages between capital projects and desired service levels; ensuring budgeted and actual spending figures can be easily compared; ensuring budgets can be easily compared between cycles; establishing open data platforms; and publicly reporting on capital projects' performance relative to approved budgets, scope, and schedules.

The issue of pricing likewise illustrates the impasse in the national conversation surrounding Canada's municipal infrastructure gap. No research participant in either Calgary or Edmonton mentioned lack of pricing mechanisms as contributing to the municipal infrastructure gaps of either city. This is not surprising given the widely noted unpopularity of user fees with municipal politicians (Bazel & Mintz, 2014; Slack & Tassonyi, 2017). Nevertheless, this omission is interesting in light of the fact that neither city seems to have reported funding gaps for user-fee funded services and associated infrastructure in the last two decades. This appears to support the assertion that (in)adequate pricing mechanisms exert great influence in determining the presence or absence of infrastructure gaps (Bazel & Mintz, 2014; Dachis, 2018; Kitchen, McMillan, et al., 2019b; Slack & Tassonyi, 2017; Tassonyi & Conger, 2015). However, the same can be said for infrastructure with earmarked resources writ large, whether user fees or taxes. For example, as of 2018 Edmonton, with its Neighbourhood

Renewal Program (NRP) and dedicated property tax levy, reports no funding gap for infrastructure within that program's scope. The NRP may then illustrate the potential for earmarked property taxes to act as 'surrogate pricing' (Bird, 2001), suggesting that user fees are not the only way of improving the linkages between capital expenditures and their funding sources.

Property taxes and infrastructure lifecycle costs

In the absence of additional revenue tools, (large urban) municipalities should work towards fully funding lifecycle costs of relevant, priority asset classes through property taxes. This may be local and collector roads, as in the case of Edmonton's NRP, or it could be recreation facilities, parks, fire stations, or other infrastructure.

Assess feasibility of pricing

In addition, municipalities should assess the feasibility of introducing pricing for roads and other, traditionally tax-supported, asset classes. Such exercises would contribute greatly towards advancing the conversation surrounding pricing and municipal infrastructure, specifically with identifying what logistical or other reasons exist for not pursuing these options (other than sheer unpopularity).

Education and training

Finally, planning education should place greater emphasis on real-world municipal decision making, especially as it relates to major resource allocation matters that shape built

and natural landscapes. As spatial plan implementation, development regulation, and many other matters hinge on resource allocation decisions, planners must be able to understand and navigate through these complex processes in order to successfully achieve the outcomes they are responsible for. This greater focus on municipal decision making could be achieved by integrating more real-world case studies into course material. This could entail students tracing a key capital project from concept through various stages of planning, to funding allocation, and then on to construction. Such an approach would give future planners an appreciation of how, for example, infrastructure projects are initiated, how limited resources are allocated, the role of internal and external stakeholders, and how local elected officials interface with their administrations.

Table 8: Summary of Recommendations

Category	Items
Municipal capital expenditures and budgeting	Municipalities should: 1. Continue to adopt or (refine, as the case may be) Levels of Services metrics and publicly report on performance in relation to these measures. 2. Continue to improve understanding of capital and other costs associated with urban growth. 3. Continue to improve asset management capabilities as well as understandings of asset maintenance and renewal costs. 4. Review lifecycle costs associated with developer-contributed assets required to be built to municipal specifications. 5. Improve consistency and transparency in capital budget formation and prioritisation methods.
Municipal revenues	Municipalities should: 6. Work towards fully funding the lifecycle costs of applicable, priority asset classes, per approved Levels of Service, through property taxes. 7. Assess the feasibility of pricing for certain tax-supported assets (e.g., road tolling).
Municipal reporting requirements	All orders of government should collaborate to: 8. Create a national framework to allow monitoring of municipal Levels of Service and asset conditions, and to facilitate comparison of municipalities within and between provinces.
Municipal revenues	Provincial governments should: 9. Grant their large urban municipalities with additional revenue raising tools to support needed capital expenditures.
Other	Post-secondary planning programs should: 10. Place greater emphasis on real-world municipal decision making, especially as it relates to capital and other resource allocation matters. One way to achieve this is through increased use of case studies as an educational tool.

6.4.2 Reflections on comparative case studies

Comparative case studies form a major component of this thesis' research design. As such, brief comments on the use and value of this approach are warranted. The case study cities were chosen given their record of publishing infrastructure gap estimates, their status as the two largest similarly sized pair of Canadian municipalities within a single province, and also due in part to their prior familiarity to the researcher.

A comparative case study approach allowed this thesis to better understand the phenomenon of municipal infrastructure gaps/debts/deficits than if a single case study had been selected, or if a provincial or national scale of inquiry had been adopted. First, comparing and contrasting the experience of two similar cities within the same province provided an additional way of validating findings. Second, this thesis' comparative case study approach provided opportunities to explore the research topic in greater depth by identifying both variations and similarities in how local infrastructure gaps are understood across more than one locale, while controlling for legislative and other differences in provincial context.

Though this thesis found broadly similar understandings of infrastructure gap estimates between the two cities, as well as similar views on their causes and what strategies have been implemented to address the same, some important differences were apparent. These differences arise primarily from how said strategies are implemented, which in turn must be understood in the context of each city's particular history and evolving institutional arrangements.

For example, differences in Calgary and Edmonton's approaches to both capital prioritization and property tax increases (earmarked to infrastructure maintenance) appear rooted in these cities' historical expenditure patterns. Edmonton experienced a period of reduced capital expenditures stretching from the 1990's to mid-2000's, correlating with rising proportions of assets in poor condition. This situation seems to have ultimately spurred the creation of Edmonton's RIMS system for estimating

required capital maintenance and renewal spending, as well as initiatives like the Neighbourhood Renewal Program with its dedicated tax levy. Calgary meanwhile underwent a shorter period of reduced capital spending, ending in the late 1990's (at least partly due to a return to oil-fueled economic growth), and appeared to enter the twenty-first century with fewer infrastructure renewal concerns than its northern neighbour. Thus, Calgary appears to have lacked any impetus to prioritize capital renewal and maintenance spending, let alone develop a cohesive system for capital prioritization (until well into the 2010's), or to earmark property tax increases intended to fund capital maintenance to any particular asset class to any particular service level.

Data limitations, this thesis' qualitative research design, and other factors create difficulties in arriving at conclusive explanations for municipal infrastructure challenges in the case study cities, let alone elsewhere in Canada. However, this thesis' comparative case study approach succeeds identifying plausible explanations which may be tested through further research and thus possibly generalized to other cases.

6.5 Limitations

This thesis' findings must be read in light of its limitations. First, its qualitative case study-based approach, combined with the structure of research questions, means that associated findings are not necessarily generalizable or exhaustive. The findings and recommendations may or may not be applicable to other large urban municipalities in Canada, particularly those outside of Alberta.

Second, certain methodological issues further circumscribe this thesis' findings. No administrators from the finance departments of either case city were interviewed. In addition,

certain documents (particularly asset management and capital budgets figures) produced by the two case cities were often not presented in comparable terms, requiring disaggregation and then reaggregation for consistent presentation where possible. Differences in budgetary definitions, exact asset management procedures and reporting categories, as well as differing organisation of water utility services between the two case cities further confound attempts at easy comparison. Finally, publicly available documentation provides a necessarily incomplete picture of the case study municipalities' capital budgeting, asset management, and other activities.

6.6 Directions for future research

This thesis highlights the need for more research into municipal capital budgeting, asset management, and related topics in Canada.

First and foremost, more research is required to fully understand the reasons why municipalities do not appear to report infrastructure gaps for user-fee funded infrastructure (e.g., waste and recycling services in Calgary and Edmonton), as opposed to tax-funded infrastructure (e.g., roads in Calgary and Edmonton). This could be achieved through detailed comparison of municipal capital budgeting practices for infrastructure with differing funding arrangements.

More research is also needed to understand how municipalities may best manage costs associated with urban growth while optimising existing infrastructure and realising savings associated with intensification. Research is needed on growth-related cost modelling and

forecasting, as well as how this information impacts decision making. Additional research is also needed to develop methodologies for municipalities to track ongoing capital savings realised through efforts to shift urban growth towards more compact patterns.

As well, more research is needed to fully understand the extent to which municipalities may actually be able to raise additional revenues through property taxes, without undue negative consequences. Negative consequences may include reduced built-form density (and thus potentially higher infrastructure costs), as well as reduced overall revenues from tax competition.

How climate change and increasingly frequent extreme weather events are impacting municipal capital expenditures, as well as local governments' ability to finance them, should also be further explored.

Finally, it is crucial to better understand the conditions under which local elected officials may choose to pursue long-term 'policy investments' (Jacobs, 2008) related to municipal infrastructure, for example the City of Edmonton's Neighbourhood Renewal property tax levy. Research into these types of programs is needed to better understand the necessary preconditions for long-term policymaking.

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Appendices

Appendix A: List of research participants

Number	Research Participant Description
INT-01	City of Calgary administrator
INT-02	City of Calgary administrator
INT-03	Calgary community representative
INT-04	Calgary development association representative
INT-05	City of Calgary administrator
INT-06	City of Calgary councillor
INT-07	City of Calgary councillor
INT-08	City of Calgary councillor
INT-09	City of Edmonton administrator
INT-10	City of Calgary councillor
INT-11	City of Edmonton councillor
INT-12	Edmonton community representative
INT-13	City of Calgary administrator
INT-14	City of Edmonton administrator
INT-15	Alberta municipal association employee
INT-16	City of Edmonton councillor
INT-17	City of Edmonton councillor
INT-18	City of Edmonton councillor
INT-19	Former City of Edmonton administrator
INT-20	City of Edmonton administrator

Appendix B: Interview guides

Municipal Councillors	**Municipal Administrators**
1. [Calgary or Edmonton] reported an infrastructure deficit of $x billion dollars in 20xx. How was this figure calculated? What kinds of information was considered? 1. What factors have contributed to [CITY]'s infrastructure deficit? 1. What strategies has [CITY] utilized to address its infrastructure deficit? 1. How does [CITY] determine the need for new infrastructure projects? 1. What factors impede [CITY]'s capacity to build infrastructure projects? 2. What factors enhance [CITY]'s capacity to build infrastructure projects? 1. Is there anyone else I should contact to discuss these questions with?	1. [Calgary or Edmonton] reported an infrastructure deficit of $x billion dollars in 20xx. How was this figure calculated? What kinds of information was considered? 1. What factors have contributed to this accumulated infrastructure deficit? 1. What strategies has [CITY] utilized to address its infrastructure deficit? 2. How does [CITY] determine the need for new infrastructure projects? 1. What factors impede [CITY]'s capacity to build infrastructure projects? 1. What factors enhance [CITY]'s capacity to build infrastructure projects? 1. Is there anyone else I should contact to discuss these questions with?
Researchers	**Developer Association/Community Representatives**
1. What factors have contributed to the large infrastructure deficits that Canada's large urban municipalities have accumulated? 1. What factors impede a city's capacity to build infrastructure projects? 1. What factors enhance a city's capacity to build infrastructure projects? 1. What can large urban municipalities do to address their infrastructure deficits? 1. Is there anyone else I should contact to discuss these questions with?	1. What factors have contributed to [CITY]'s infrastructure deficit? 1. What can [CITY] do to address its infrastructure deficit? 2. How does [CITY] determine the need for new infrastructure projects? 1. What factors impede [CITY]'s capacity to build infrastructure projects? 1. What factors enhance [CITY]'s capacity to build infrastructure projects? 2. Is there anyone else I should contact to discuss these questions with?

Appendix C: List of documents reviewed

The City of Calgary	The City of Edmonton
• Municipal Development Plan (2020, 2009) • One Calgary 2019-2023 Service Plans and Budget (2018) • Infrastructure Status Report (2020) • Off-site Levy Bylaw (2015, including Background Report) • Calgary's Asset Management Strategy (2004) • Debt Policy (2020)	• Municipal Development Plan (2020, 2009) • Capital Investment Outlook (2018) • Infrastructure State & Condition Report (2020) • Integrated Infrastructure Management Plan (2016) • Infrastructure Strategy (2018) • Debt Management Fiscal Policy (2008)