Costs of Providing Infrastructure and Services to Different Residential Densities

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1 Executive Summary

This study documents the costs of providing infrastructure and services to different residential densities. It is an accessible, informational resource to inform municipal planning initiatives and regional growth policies pertaining to different densities and forms of residential development, such as 'infill' and 'greenfield'.

This study summarizes available references, case studies, best practices, and informational interviews, and is focused on findings and implications most relevant to the Metro Vancouver region. It is based on a literature review of available publications and informational interviews with leading practitioners and academics.

KEY CONSIDERATIONS

The following should be considered when making land use and urban form decisions, as well as those associated with public infrastructure investments to support desired forms of residential land uses and densities, and when reviewing property tax and utility fee policies:

- It is critical to permit and facilitate higher density and more cost-effective forms of development in urban / developed areas (i.e., infill, intensification, redevelopment), where public infrastructure investments can be best utilized. Where regulatory barriers exist to urban densification in such locations, consider a review of policies and regulations and discourage developments that are not compact form, mixed-use, and that cannot be cost-efficiently serviced.
- Achieving compact, complete communities does not necessarily require extremely high density development forms. Optimum densities are a factor of context, and are often a combination of densities and uses that result in more livable, sustainable, and balanced communities. For example, moving from low density to medium densities in urban centres and along transit corridors can provide significant improvements in infrastructure servicing cost outcomes.
- The costs of infrastructure and utility provision should be set to better reflect actual service costs and charge those who directly benefit:
    - The use of metering for utilities should be considered, where possible, such as for water and sewerage; with new and emerging technologies, such as improved metering, user fees can be more precise and effective, and managed electronically.
    - Utility fees should not be focused simply on raising revenues, but also on changing behaviours and outcomes. Fees and incentives can be set and adjusted to encourage desired actions and choices and meet community buildings objectives.
- Applying Development Cost Charges that vary by residential unit type / size / density as well as sub-area geography, better reflects the actual costs of servicing demand.
- Closely coordinating and integrating land use planning, engineered infrastructure, asset management, and municipal financial decision-making including full lifecycle costing, leads to improved land use and financial outcomes.

SUMMARY FINDINGS OF THE STUDY

Literature Review

- 'Urban sprawl' refers to dispersed, segregated (single-use), automobile-oriented, urban-fringe development, while 'Smart Growth' comprises more compact, mixed-use, multi-modal forms of development. Some, but not all, public services are sensitive to a city's development patterns and residential densities.
- More compact development forms tend to reduce infrastructure costs on a per capita basis, support more efficient use of resources, and encourage more sustainable forms of transportation. However, the relationships between residential densities and public costs are complex; actual costs depend on the specific services and conditions, and local context.
- Higher density development forms are associated with lower per capita municipal expenditures for streets and highways, sewer, water, and solid waste.
- While property taxes are for general municipal services and are calculated on assessed property values, a user fee, such as for utilities, is a charge for consuming a municipally provided good or service.
- User fees are a 'cost-recovery revenue tool' and must be set based on the costs of providing the good or service to the user.

Case Studies

- The case studies generally indicate that the infrastructure servicing costs per dwelling unit declines as residential densities increase.
- This is largely associated with reduced linear infrastructure (i.e., roads, water pipes, sewer lines) per capita for higher density, compact design and development forms, as compared to lower density forms.
- However, large urban infill projects still require significant infrastructure investments. Other costs, such as labour-intensive services (rather than capital-intensive infrastructure), are more directly related to population levels and incurred on a per capita basis.
- Thus, the relationship between residential density and municipal costs is nuanced, and also can be impacted by local matters, such as the condition (age, capacity) of infrastructure and other physical elements such as geography and topography.

Infrastructure Servicing Costs

- The costs for onsite infrastructure / servicing for house vs. apartment developments are approximately five to nine times more expensive on a per capita basis ($13,000 vs. $2,000) and on a per unit basis ($40,000 vs. $5,000), respectively.
- This illustrates the greater cost effectiveness of higher density and multi-unit residential development forms can be as compared to lower density, single-detached development, because the infrastructure costs can be apportioned to more units.
- As most of these infrastructure costs are initially borne by a developer and ultimately the resident, lower infrastructure costs can help contribute to lower housing costs.

- Furthermore, after construction and development, the cost of maintaining the infrastructure is typically the responsibility of the municipality and ultimately taxpayers, therefore more efficient infrastructure systems can reduce public operating costs and fees / taxes over the long term.

Development Cost Charges

- Development Cost Charges (DCCs) in British Columbia are enabled under provincial legislation to pay for new or expanded infrastructure (sewer, water, drainage, parks, and roads) necessary to adequately service the demands of new development.
- In Metro Vancouver, the municipal DCC rates per unit are almost always highest for single-detached houses (up to $40,000 to $60,000), lowest for apartment units (approximately $10,000), and in between for townhouses.
- However, when adjusted for the typical number of residents in a household, which varies by unit type, the range of per capita DCC rates vary only by a few thousand dollars, averaging: $9,000 per apartment resident, $10,000 per townhouse resident, and $11,000 per house resident.
- The DCC rates by unit type can vary considerably by municipality, yet within individual municipalities generally do not vary. While allowable under provincial legislation, most municipalities do not charge different DCC rates for different sub-areas or catchment areas.

Municipal Expenditures Analysis

- Based on a review of current municipal budgets in the region, approximately one-third of expenditures (i.e., both capital and operating costs) are related to utilities / engineering services that could be impacted to some degree by land uses, development forms, and densities, and associated infrastructure requirements with the balance (approximately two-thirds), being unrelated.
- The balance of municipal costs (operating and capital) are for various types of ‘soft’ services that are generally labour-intensive and more a function of population than density.
- While there are potential municipal cost savings associated with more compact forms of development, the scale of this possible amount should be considered within the overall municipal context.

Property Taxes and Utility Fees

- Property taxes are a function of the assessed value of a property, with municipal tax rates set by the host municipality. Nearly half of the property taxes collected go to other levels of government than the local municipality, such as to the provincial government and other agencies.
- Municipal utility fees for such services as water, sewage, and garbage, may also apply.
- On average in Metro Vancouver, detached houses pay $5,600 in property taxes; the amounts are lower for townhouses ($3,000) and apartments ($2,100).
- These amounts vary by municipality as the mill rates vary by jurisdiction, and also vary within municipalities depending on the assessed values of properties. Of the total taxes and fees paid by typical households, a quarter to a third of that amount goes to utility fees.

Methodological Complexities

- Defining, calculating, and attributing costs and revenues for different services by different asset classes or unit types can be a data and methodological challenge.
- Conceptually, there are four categories: infrastructure (capital) costs and revenues, and service (operating) costs and revenues.
- Some of these may be paid for by a developer as one-time charges during construction, be it through providing the infrastructure and / or paying DCCs, and some by residents in the form of ongoing property taxes and utility fees.
- Some practical challenges for such calculations are defining ‘urban’ or ‘suburban’ development forms / densities for data collection and reporting purposes, and potentially attributing some costs and revenues to other non-residential land uses (such as commercial and industrial).
- Many municipal services and associated costs are more a function of residential population level rather than housing density, and some services, such as capital-intensive infrastructure can benefit from economies of scale, while labour-intensive services do not.
- There are also significant local considerations and contextual issues. Some municipal costs may be higher on an absolute basis in a high-density, established urban location because of ‘urban harshness’ and increased complexities, but lower on a per unit or per capita basis because of the greater development densities.
- Given these complexities and limitations, the expectations about the resulting values should be understood as high-level or estimates.

2 Introduction and Context

The Metro Vancouver region is home to 2.8 million residents and 1.6 million jobs. With a limited land base and continued growth, development patterns and housing forms should be guided by cost-effectively using existing and new infrastructure investments and services. The region is also well-known as having high housing costs and strong demand for additional housing supply which can be addressed, in part, by reducing infrastructure costs through efficient land use and infrastructure planning.

Various research into this matter has already been completed in Canadian (mostly Ontario), American, and Australian geographies, but no similar study has been undertaken in the Metro Vancouver region to date. This study provides an analysis that goes beyond 'business as usual' planning and development to elevate the conversation, and address possible some prevailing misconceptions about municipal costs and revenues based on residential forms and densities in the Metro Vancouver region.

Documenting the costs of providing infrastructure and services to different residential densities, this study summarizes available references, case studies, best practices, and informational interviews with leading practitioners and academics, focusing on findings and implications most relevant to the region. It is based on a literature review of available publications and provides an accessible, current, central, informational resource to inform municipal planning initiatives and regional growth policies pertaining to different densities and forms of residential development, such as 'smart growth' (infill and intensification) and 'urban sprawl' (greenfield development). The results are summarized in the following sections, and supplemented with detailed data in appendices.

2.1 Study Objectives

Metro 2050, the Regional Growth Strategy, directs, supports, and encourages growth within the Urban Containment Boundary and specifically to the region's Urban Centres and Frequent Transit Development Areas. This overarching goal advances a number of objectives, including the efficient provision and use of infrastructure, increased transit ridership, building complete, mixed, and walkable communities, protecting environmental areas, and reduced driving, energy consumption, and GHG emissions. This principle has been a long-standing growth management objective for the region, and is still relevant as the population continues to grow.

To better understand the costs and revenues associated with different residential unit types in the region this study explores the municipal infrastructure / servicing capital and operating costs for different residential forms / densities of housing (e.g., typologies). This study helps inform the discussion about the possible financial benefits and drawbacks of housing development within existing urban / high density (infill) areas vs. expanding housing development to new suburban / low density (greenfield) areas.

This study defines six residential typologies, each with different attributes, including density and form, and estimates the associated infrastructure servicing costs, typical DCCs, and average property taxes and utility fees. Specifically, this study documents the municipal servicing costs and property taxes / utility fees for different forms / densities of residential housing, on a per unit and/or per capita basis. This illustrates the differences between them and outlines the considerations that can inform effective land use planning and infrastructure investments at the regional and local scales. A series of case studies were created representing the characteristics and densities of the various geographies and residential forms to further illustrate these costs.

While there are many environmental, economic, and social benefits of compact residential development forms (i.e., more efficient use of resources, protection of important lands, supporting walkable and transit-oriented communities, etc.), the focus of this study is on municipal financial considerations, specifically related to public infrastructure and services.

2.2 Scope of Work

The following is the study scope of work:

- Compile and complete research / literature review on the topic:
  - Review of the urban form and infrastructure cost analysis completed in other jurisdictions;
  - Review the latest research, focused on relevant sources and examples.
  - Complete informational interviews with key informants, such as academics and subject matter experts.
  - Analyze local government services provided in the Metro Vancouver region, and consider both capital costs and operating costs, and property taxes / utility fees.
  - Summarize existing publications and associated costing / financial estimates.
- Identify a series of case study locations using land uses / densities and residential form characteristics to determine costs per unit.
- Profile findings that are most relevant to the Metro Vancouver context.

The study did <u>not</u> intend to:

- Address non-residential forms of development, such as commercial or industrial land uses.
- Make recommendations about possible changes in levels of municipal services or amenities, property taxation, or Development Cost Charges / Community Amenity Contributions.
- Compare costs / revenues of services for housing by municipality within the region.
- Consider housing supply and demand implications or the recommendations of completed Housing Needs Reports.
- Address the impacts of land use regulations on housing costs, or the development approval / review process.
- Explore other indirect advantages or disadvantages of different housing forms / densities.

2.3 Development Forms

Compact development forms are often nearly synonymous with the term 'smart growth' or sustainable, complete communities, the key principles of which include:

- Efficient use of land and infrastructure.
- A greater mix of uses and housing choices.
- Complete neighbourhoods and communities focused around human-scale, walkable, mixed-use centres.
- A balanced, multi-modal transportation system providing increased transportation choice.
- Well-defined community edges, such as agricultural areas, natural corridors, or open spaces.

'Urban sprawl' is a term generally defined as homogenous low density residential development, typically in the form of single-detached housing, a separation of land uses, spread out development patterns, and auto-oriented transportation modes.

In terms of servicing costs for such different forms or densities of residential development:[1]

- The longer distance water and wastewater facilities are from the property they service, the costlier it is to serve, holding density constant.
- The farther away properties are from fire stations, the greater the risk of loss from fire and the higher the fire insurance costs.
- As the distance between origin and destination increases, the road costs per trip increases as do the road costs per vehicle kilometres travelled.
- For many facilities: as distance increases between the service and those who are served, the cost of service increases per person and the amount or quality of service decreases.
- More spread out and lower density development requires more infrastructure to support it.

2.4 Defining the Issue

Research shows that as residential density increases, municipal costs per residential unit decreases for roads and other transportation, linear infrastructure like water and sewage pipes, as well as some services. Density can be measured as units per hectare, and reflected in different building forms, be it large single-detached house lots, townhouse units, and high rise apartment buildings.

Costs associated with development and growth can be separated into two categories: infrastructure / capital costs, and service / operating costs. Over the lifecycle of the infrastructure, which can span 30-100 years, the operation, maintenance, and repair costs of public facilities is often comparable to their initial capital costs.

Typically, most of the infrastructure costs are initially paid for by the developer in the form of installing on-site engineering civil works and paying DCCs for off-site works as part of the initial development. The perpetual ongoing operating and maintenance costs are the responsibility of the municipality, funded by property taxes / utility fees. However, it is not always the case in that some 'local' services may be provided by other agencies, such as transit, hospitals, and schools, and some infrastructure costs may be funded by senior levels of government, such as capital grants for rapid transit lines and treatment plants. Furthermore, there is also necessary large scale regional infrastructure provided by Metro Vancouver to municipalities (e.g., treatment facilities, major trunk lines) which convey services via local infrastructure to properties within their geography.

2.5 Study Structure

This study explores the relevant costs and revenues of different housing forms and densities, extracting highlights from a review of available publications and studies completed in other jurisdictions, with some calculations provided as examples for typical typologies in the Metro Vancouver region.

Notably, there are considerable methodological and practical challenges to calculating and allocating costs and revenues. The results of this study are profiled and summarized in each of the sections, with additional materials included in the appendices. The final section identifies considerations for policy actions associated with the noted challenges and opportunities.

[1] Rationale for Smart Growth Fiscal Impact Analysis and Model, Smart Growth America, Arthur Nelson, 2022.

3 Literature Review

This section summarizes results from a review of available relevant literature (see Appendix A for greater detail).

3.1 Sprawl and Compact Development Forms

This section defines ‘urban sprawl’ or low-density development forms, and ‘smart growth’ or compact development forms, and explains the difference between them.

Urban Sprawl – Sprawl is defined as excessive or inefficient suburbanization[2]. Research suggests this excessive spatial growth is the result of market failures to consider: the social value of open space; the social costs of commuting patterns by individuals; and the public, social, economic, and environmental costs of development projects. This leads to excessive commuting, homogenous land uses, cities that are geographically too large, and artificially inexpensive developments on the urban fringe.

Urban sprawl refers to dispersed, segregated, single-use, automobile-oriented, urban-fringe forms of development. The alternative, often referred to as smart growth, involves more compact, mixed-use, multi-modal forms of development. Figure 3.1 compares these two development patterns[3].

Smart Growth – Compact, complete communities is a general set of planning principles that can be applied in many different ways. In rural areas, it creates compact, walkable villages with a mix of single- and multi-unit housing oriented around a commercial centre. In large cities, smart growth creates dense, mixed-use, walkable, and transit-oriented neighbourhoods. Between these is a wide range of neighbourhood types, a common theme of which is being compact and multi-modal. In mature cities, smart growth consists primarily of incremental infill and redevelopment in existing neighbourhoods, but in growing cities it often consists of outward urban expansion.[4] Smart growth does not necessarily require all residents to live in high-rise apartments and forego automobile travel, nor does it preclude outward expansion.

[2] The Fiscal Impacts of Urban Sprawl: Evidence from US County Areas, Christopher B. Goodman, 2019.
[3] Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.
[4] Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.

Figure 3.1: Urban Sprawl and Smart Growth Comparison

	Sprawl	Smart Growth
Density	Lower-density, dispersed activities.	Higher-density, clustered activities.
Land use mix	Single use, segregated.	Mixed.
Growth pattern	Urban periphery (greenfield) development.	Infill (brownfield) development.
Scale	Large scale. Larger blocks and wide roads. Less detail, since people experience the landscape at a distance, as motorists.	Human scale. Smaller blocks and roads. Attention to detail, since people experience the landscape up close.
Services (shops, schools, parks, etc.)	Regional, consolidated, larger. Requires automobile access.	Local, distributed, smaller. Accommodates walking access.
Transport	Automobile-oriented. Poorly suited for walking, cycling and transit.	Multi-modal. Supports walking, cycling and public transit.
Connectivity	Hierarchical road network with many unconnected roads and walkways.	Highly connected roads, sidewalks and paths, allowing direct travel.
Street design	Streets designed to maximize motor vehicle traffic volume and speed.	Reflects *complete streets* principles that accommodate diverse modes and activities.
Planning process	Unplanned, with little coordination between jurisdictions and stakeholders.	Planned and coordinated between jurisdictions and stakeholders.
Public space	Emphasis on private realms (yards, shopping malls, gated communities, private clubs).	Emphasis on public realms (shopping streets, parks, and other public facilities).

3.2 Municipal Infrastructure

The most common factors influencing infrastructure project costs and service delivery costs include[5]:

- Urban form: population size, density, lot size and shape, location of development, dispersion of development, housing typology, and street network pattern.
- Site conditions / topography: geographical location, space availability, transportation access, slope.
- Utility capacity utilization: catchment of existing infrastructure and the level of augmentation required is an important location specific factor affecting costs, especially in infill areas.
- Proximity to service areas: distance of the new development from existing utility plants and trunk infrastructure.

Many public services are sensitive to a community's pattern of development because the configuration of a community and the way the community is connected geographically can profoundly affect service delivery. A compact development pattern will, at the very least, save operating costs simply because service vehicles are required to drive fewer kilometres. In some cases, the actual number of vehicles and facilities can be decreased, along with the personnel required to provide those services.[6]

The relationship between density and public costs is complex. Actual costs depend on the specific services and conditions. There can be costs associated with development density including increased congestion and friction between activities, special costs for infill development, and higher design standards. One study concludes that costs are[7]:

- Lowest in rural areas where most households provide more of their own services.
- Increase in suburban areas where services are provided to dispersed development forms.
- Lowest for infill redevelopment in areas with adequate infrastructure capacity.
- Increase at very high densities due to congestion and high land and construction costs.

[5] Literature Review of the Costs of Infrastructure Provision for Different Development Forms, Shivani Ragha, and Dena Kasraian, Eric J. Millers, 2019.

[6] Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development, Smart Growth America, 2013.

[7] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.

3.3 Housing Density and Infrastructure Costs

Development density was found to be negatively associated with per capita municipal expenditures for the following cost categories:

- Operational costs for: fire protection, streets and highways, parks and recreation, sanitary sewer, solid waste management, and water servicing.
- Construction costs for: streets and highways, parks and recreation, sewer, and water.
- Facility costs for: police, sanitary sewer, and water servicing.

Results tend to be insignificant for other cost categories. In general, results support the conclusion that increased development density is associated with reduced per capita municipal spending for several cost categories.[8]

Lower density, auto-oriented developments tend to require more infrastructure per capita than do more compact developments. Sprawling cities tend to have a greater length of streets and water and sewer pipes per person to maintain, and services such as trash collection and fire and police protection have a larger area to service per resident. This can result in an increase in per capita infrastructure, maintenance, and service costs for cities. More compact developments can lead to cost savings through economies of scale and economies of geographic scope. Economies of scale are exhibited when the marginal cost of providing services per person decreases as more residents cluster within an area. Economies of geography are found when the marginal cost decreases as each person locates more closely to existing major public facilities.[9]

Dispersed development tends to increase the per capita length of roads and utility lines (e.g., water, sewage, power, etc.), and the travel distances needed to provide public services (e.g., garbage collection, policing, emergency response, etc.). While rural residents tend to accept lower service quality (unpaved roads, slower emergency response times, lack of water and sewer servicing, etc.) and provide many of their own services (well water, septic systems, garbage disposal, etc.), suburban developments tend to attract residents who often expect urban levels of services in dispersed, low density locations, which greatly increases public costs.[10]

3.4 Property Taxes

Property taxes are the largest source of revenue for local governments and fund local services. Their application can in some cases be considered unfair as they are unrelated to ability to pay or to the benefits received, unsuitable as they support services that are not related to the property, and inadequate as they do not provide sufficient public revenues to meet local expenditure needs.[11]

Benefits from services are more closely reflected in property values than in the size of the property. For example, properties close to transit or parks tend to see higher property values. Moreover, market value

[8] Relationships between Density and per Capita Municipal Spending in the United States, Upper Great Plains Transportation Institute, Jeremy Mattson, 2021.
[9] Relationships between Density and per Capita Municipal Spending in the United States, Upper Great Plains Transportation Institute, Jeremy Mattson, 2021.
[10] Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.
[11] How to Reform the Property Tax: Lessons from around the World, IMFG Papers on Municipal Finance and Governance, Enid Slack and Richard M. Bird, 2015.

also has the advantage of capturing the value added by neighbourhood amenities created by government expenditures and policies.[12]

There is less economic rationale for higher taxation of non-residential property. Differentially higher taxation can distort land use decisions and favour residential use over commercial and industrial uses.

3.5 User Fees

A user fee is a charge for a publicly provided good or service. The revenues from such a fee must be used solely to fund the provision of that good or service, and the amount of the fee is dictated by the cost of providing the good or service. Furthermore, payment of the fee is a necessary condition for consuming the good or service. User fees, therefore, are valuable tools when it comes to covering the operating costs of municipal services. There are many examples of user fees at the municipal level, such as: public transit fares, recreation fees, electric and natural gas provision, and utility and garbage collection payments.[13]

These features of user fees have several implications for their design, implementation, and use. First, user fees are a 'cost-recovery revenue tool' (i.e., the fees must be used to recoup the actual costs incurred). The revenues from the fees must be used solely to offset the costs of providing the good or service, and a link must exist between the activity being charged and the activity funded by the revenue from the user fee. That is to say, user fees involve a need to track: (1) the money collected and (2) how the money is spent.

Second, the user fee must be designed in such a way that it does not intentionally generate a surplus of public revenues. Ongoing surpluses are a clear indication that the fee charged exceeds the costs incurred and thus violates the cost-recovery nature of the revenue tool. At the same time, there is no requirement that the revenue from the user fee fully offset costs (although any shortfall must be made up from other revenues, typically property taxation).

Third, the fee charged to the user must be reasonably connected to the costs of providing the good or service to that user. If the costs of providing the service are fixed (i.e., if it costs the same amount to provide each unit, or if it costs the same amount to provide the service to every user) the fee charged cannot vary by unit or user.[14]

3.6 Setting User Fees[15]

User fees should be set and designed by considering the cost differentials attributed to economies of scale, capacity constraints, and differential demand in peak and non-peak periods, when second-best circumstances are prevalent and when externalities exist. Ultimately, the objective in setting fees should be the establishment of a clear link between services received and the charges for these services.

Current practice in setting user fees, however, is often to set fees to generate revenue rather than to allocate resources to their most efficient use. As an example, the tendency to charge a fixed price for water, regardless of the quantity consumed can be considered unfair, on the premise that lower income

[12] How to Reform the Property Tax: Lessons from around the World, IMFG Papers on Municipal Finance and Governance, Enid Slack and Richard M. Bird, 2015.
[13] Non-Tax Revenue for Funding Municipal Governments, Funding the Canadian City, Lindsay M. Tedds, 2019.
[14] Non-Tax Revenue for Funding Municipal Governments, Funding the Canadian City, Lindsay M. Tedds, 2019.
[15] Municipal Taxes and User Fees, Tax Policy in Canada, H.M. Kitchen and A. Tassonyi, 2012.

earners cannot afford to pay, provides an implicit subsidy for higher-income households with more bathroom fixtures, and larger lawns to water.

Failure to set prices efficiently can lead to a demand for more services and subsequently a demand for infrastructure that is not efficiently or optimally allocated. Inefficiently set user fees have led to overinvestment and larger facilities than would otherwise be justified if more efficient pricing practices were adopted.

3.7 Fees vs. Taxes

User fees are not only efficient but also can be more equitable than taxes, depending on how they are implemented. They satisfy the benefits-received principle of equity, which prescribes a clear link between the good, service, or right being provided and the benefit that the consumer receives.[16]

Opponents of user fees often discount them as a means for raising revenues on the basis that they are regressive -- that is to say, they take up more of the income of a lower-income household than of a higher-income one. This argument ignores the fact that the relative regressivity of a revenue tool depends not on the fee itself but on how it is designed and implemented. The potential regressivity of a user fee can often be offset by careful implementation, such as discounts, increased service provision, and cash transfers.[17]

3.8 Summary

'Urban Sprawl' refers to dispersed, segregated (single-use), automobile-oriented, urban-fringe development, while 'Smart Growth' comprises more compact, mixed-use, multi-modal forms of development. Some, but not all, public services are sensitive to a city's development patterns and residential densities. More compact development forms tend to reduce infrastructure costs on a per capita basis, support more efficient use of resources, and encourage more sustainable forms of transportation. However, the relationships between residential densities and public costs are complex; actual costs depend on the specific services and conditions, and local context. Higher density development forms are associated with lower per capita municipal expenditures for streets and highways, sewer, water, and solid waste. While property taxes are for general municipal services and calculated on assessed property values, a user fee, such as for utilities, is a charge for consuming a municipally-provided good or service. User fees are a 'cost-recovery revenue tool' and must be set based on the costs of providing the good or service to the user.

[16] Non-Tax Revenue for Funding Municipal Governments, Funding the Canadian City, Lindsay M. Tedds, 2019.
[17] Non-Tax Revenue for Funding Municipal Governments, Funding the Canadian City, Lindsay M. Tedds, 2019.

4 Case Studies

The literature review completed as part of this study included identifying and reviewing published studies from other jurisdictions relating to infrastructure servicing and municipal finance.

These studies are varied but generally address in whole or in part the infrastructure expenditures associated with different residential forms / densities, developer contributions towards infrastructure, operating costs of services, and / or property tax and utility fee revenues.

The summaries profile ten cities / regions as case studies, presenting key points in table format, for the following jurisdictions:

- Ottawa; Ottawa-Carleton; Kingston; Calgary; Edmonton; Halifax (Canada)
- Portland (USA)
- Perth, Adelaide (Australia)

Each profile contains a summary of the study purpose, geography covered, scenarios and typologies documented, results and key findings (see Appendix B for greater detail).

The purpose / objective of the profiled studies varied, as well as the methodology. In some cases, fiscal analysis was for existing developed areas, while in other cases evaluating multiple possible development scenarios for a large, new greenfield site (sometimes referred to as 'sprawl' or 'suburban development' vs. 'compact' or 'infill development'). In some cases, the costs were calculated on a per unit or per capita basis, and in other cases only totals were provided. Furthermore, some studies considered the entire lifecycle costs of infrastructure and services, and others only parts of it. The costs that were included in the analyses varied and are not consistent, thus direct comparison between results is not feasible. The site / area specific factors and geographies can greatly influence required infrastructure improvements and costs, and introducing mixed-use development forms with commercial components can also affect the attribution of costs.

Some of the case studies note other matters, such as development costs for developers which can be higher in an urban location due to additional complexities, and personal transportation costs which are not borne by the municipality, etc. Furthermore, the case studies note, but do not quantify, other considerations, such as land uses and environmental impacts.

4.1 Summary

The case studies generally indicate that the infrastructure servicing costs per dwelling unit declines as residential densities increase. This is largely associated with reduced linear infrastructure (i.e., roads, water pipes, sewer lines) per capita for higher density, compact design and development forms, as compared to lower density forms. However, large urban infill projects still require significant infrastructure investments. Other costs, such as labour-intensive services (rather than capital-intensive infrastructure), are more directly related to population levels and incurred on a per capita basis. Thus, the relationship between residential density and municipal costs is nuanced, and also can be impacted by local matters, such as the condition (age, capacity) of infrastructure and other physical elements such as geography and topography.

5 Infrastructure Servicing Cost Estimates by Residential Typology

5.1 Residential Housing Typologies Defined - Densities, Forms, Types

Residential housing ‘types’ or ‘typologies’ can be classified and organized in many ways, including along a spectrum or continuum. This definitional analysis can be based on tenure (from below market rental to luxury ownership), or density / form (from low rural density to high urban density) (see Appendix C for greater detail).

The measure of density changes (e.g., Floor Area Ratio (FAR) or Units per Hectare (UPH)), as other attributes are also affected by and part of the typology. This can include building size, height, and site coverage, etc. This influences the built form, be it ground oriented housing with yards or stairs and elevators for upper levels. For example, lower density forms can have surface level parking and be constructed out of wood frame, whereas higher densities are likely to have underground or structured parking facilities and concrete construction, which can vary widely in terms of construction costs.

The ratio of the neighbourhood lands devoted for roads and parks may also vary, as well as area amenities and transit service. This all contributes to the amount of population, required infrastructure, transportation patterns, commercial activities, etc., for the area. A community can include multiple typologies, and these land uses / densities can change over time and intensify to more urban forms through redevelopment.

5.2 Typologies for Study and Servicing Cost Estimates

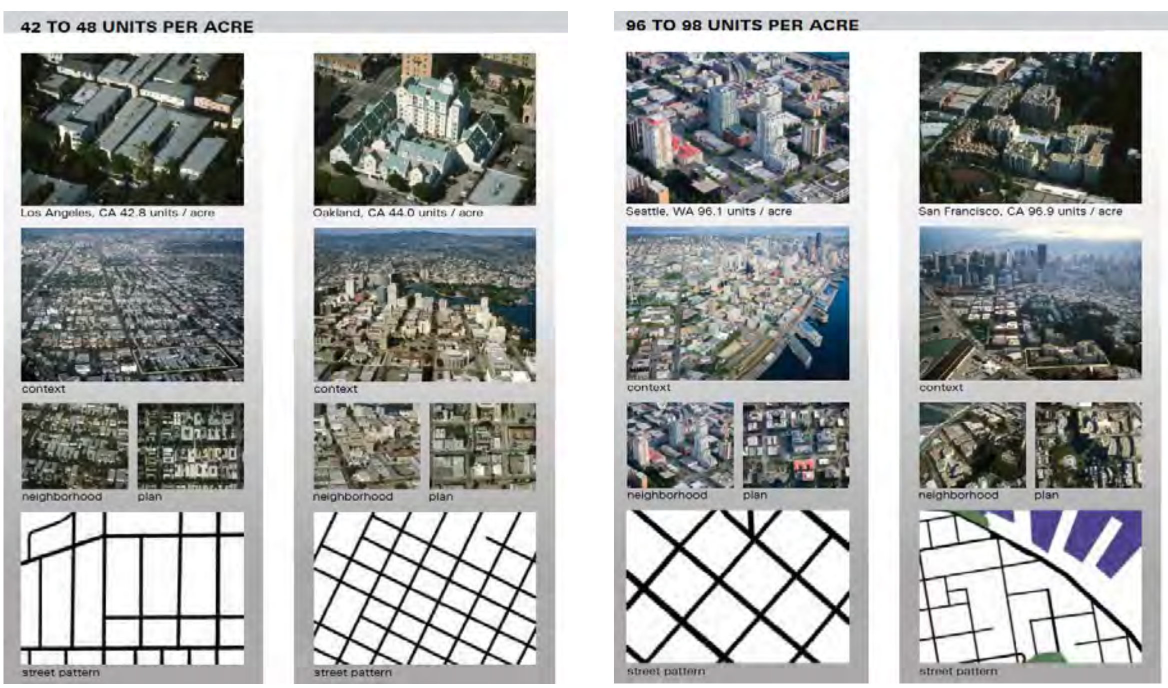
For this study, the following residential density typologies were used as the basis to prepare the simplified infrastructure / servicing cost estimates. Three residential types were established (i.e., houses, townhouses, apartments), each with a ‘low’ and ‘high’ density variant, creating a total of six typologies. See Figures 5.1, 5.2, and 5.3 for representative images for these typologies.[18]

Figure 5.1: House Typologies (Low and High)

[18] Visualizing Density, Lincoln Institute of Land Policy, Julie Campoli and Alex S. MacLean, 2007.

Figure 5.2: Townhouse Typologies (Low and High)

Figure 5.3: Apartment Typologies (Low and High)



While these typologies are simplistic and with limitations, for consistency and comparability the development scenarios and costing estimates prepared for the six scenarios all use the same amount of land and road areas, i.e.,:

- Road: 100 metres length, 18 metres wide, though the centre of the site (with developable land on both sides).
- Land: 100 metres strip of land on both sides of the road, 40 metres deep.
- Site: 8,000 m^2 (0.8 hectare / approx. 2 acres) of net developable land (plus the road in-between).

With this assumed constant amount of land and road, the development scenarios by residential form and density are as follows:

1. HOUSE (Low) – 100 metre road length, with 8 lots / houses on each site (Lots: 12.5 m wide x 40 m deep; 500 m^2 lot size) = 16 lot utility connections (16 houses), plus the road with services.
2. HOUSE (High) – 100 metre road length, with 12 lots / houses on each site (Lots: 8.33 m wide x 40 m deep; 333 m^2 lot size) = 24 lot utility connections (24 houses), plus the road with services.

3. TOWNHOUSE (Low) – 100 metre road length, with 2 townhouse strata lots on each side (each 50 m wide x 40 m deep; 200 m^2 lot size) = 4 lot utility connections (40 townhouse units total), plus the road with services.
4. TOWNHOUSE (High) – 100 metre road length, with 2 townhouse strata lots on each side (each 50 m wide x 40 m deep; 200 m^2 lot size) = 4 lot utility connections (60 townhouse units total), plus the road with services.

5. APARTMENT (Low) – 100 metre road length, with 2 apartment strata lots on each side (each 50 m wide x 40 m deep; 200 m^2 lot size) = 4 lot utility connections (100 apartment units total), plus the road with services.
6. APARTMENT (High) – 100 metre road length, with 2 apartment strata lots on each side (each 50 m wide x 40 m deep; 200 m^2 lot size) = 4 lot utility connections (200 apartment units total), plus the road with services.

For each of the six scenarios, the servicing costs to construct the public road with infrastructure and lot utility connections were estimated using the same amount of land and road areas for each. The road and servicing requirements vary slightly depending on the development scenario, such as assuming that for single-detached (house) lots a local road standard would be adequate, and for multiple units (townhouses and apartments) the road standard would be higher at three lanes instead of two, and larger pipes sizes. Furthermore, the size and number of utility connections for each scenario may differ as well. Table 5.1 shows the resulting unit yields and densities.

Table 5.1: Residential Typologies and Densities

	NET LAND AREA (excluding public road)					
	Scenario	**Unit Yield**	**Land Area Ha**	**Land Area Ac**	**Net UPH**	**Net UPA**
1	House (Low)	16	0.80	1.98	20.0	8.1
2	House (High)	24	0.80	1.98	30.0	12.1
3	Townhouse (Low)	40	0.80	1.98	50.0	20.2
4	Townhouse (High)	60	0.80	1.98	75.0	30.4
5	Apartment (Low)	100	0.80	1.98	125.0	50.6
6	Apartment (High)	200	0.80	1.98	250.0	101.2
	GROSS LAND AREA (including public road)					
	Scenario	**Unit Yield**	**Land Area Ha**	**Land Area Ac**	**Gross UPH**	**Gross UPA**
1	House (Low)	16	0.98	2.42	16.3	6.6
2	House (High)	24	0.98	2.42	24.5	9.9
3	Townhouse (Low)	40	0.98	2.42	40.8	16.5
4	Townhouse (High)	60	0.98	2.42	61.2	24.8
5	Apartment (Low)	100	0.98	2.42	102.0	41.3
6	Apartment (High)	200	0.98	2.42	204.1	82.6

The total infrastructure costs, irrespective of if installed or funded by a developer or a municipality, were estimated, and divided by unit yield to calculate cost per residential unit. It is again noted that this is an estimate, using simple industry averages for construction, and does not take into account any local considerations, off-site infrastructure, etc.

The resulting cost estimates are shown below in Table 5.2. The cost of constructing the road to a higher standard for multiple units is slightly higher than for single-detached use. With single-detached developments, each lot has a utility connection to the public system, whereas for multiple-unit developments, each complex has a connection.

As the densities / yields are much higher for the apartment scenarios, dividing the total servicing costs by the number of residential units provides for significantly lower infrastructure costs per unit. When adjusted for the number of persons per household which varies by unit type (1.85 per apartment, 2.75 per townhouse, and 3.10 per house based on 2021 Census data), the cost per capita is also seen to be lower as densities increase, but not to the same degree.

Table 5.2: Residential Typologies - Servicing Costs

	Scenario	**Unit Yield**	**Servicing Costs**	**Cost Per Unit**	***Persons per Household***	**Cost Per Capita**
1	House (Low)	16	$ 640,000	**$ 40,000**	*3.10*	**$ 12,903**
2	House (High)	24	$ 880,000	**$ 36,667**	*3.10*	**$ 11,828**
3	Townhouse (Low)	40	$ 680,000	**$ 17,000**	*2.75*	**$ 6,182**
4	Townhouse (High)	60	$ 700,000	**$ 11,667**	*2.75*	**$ 4,242**
5	Apartment (Low)	100	$ 800,000	**$ 8,000**	*1.85*	**$ 4,324**
6	Apartment (High)	200	$ 900,000	**$ 4,500**	*1.85*	**$ 2,432**

5.3 Summary

The costs for onsite infrastructure / servicing for house vs. apartment developments are approximately five to nine times more expensive 1) on a per capita basis ($13,000 vs. $2,000) and 2) on a per unit basis ($40,000 vs $5,000), respectively. This illustrates the greater cost effectiveness of higher density and multi-unit residential development forms can be as compared to lower density, single-detached development, because the infrastructure costs can be apportioned to more units. As most of these infrastructure costs are initially borne by a developer and ultimately the resident, lower infrastructure costs can help contribute to lower housing costs. Furthermore, after construction and development, the cost of maintaining the infrastructure is typically the responsibility of the municipality and ultimately taxpayers, therefore more efficient infrastructure systems can reduce public operating costs and fees / taxes over the long term.

6 Calculating Typical Development Cost Charges in the Region

6.1 Development Cost Charges[19]

Local governments in British Columbia can levy development cost charges (DCCs) on new development to pay for new or expanded infrastructure such as sewer, water, drainage, parks, and roads necessary to adequately service the demands of that development.

DCCs are established by bylaw with the approval of the provincial Inspector of Municipalities. A DCC bylaw may establish charges over the entire local government or just a portion of it.

DCCs are calculated separately for each category of infrastructure: water, sewer, drainage, parks, and roads. The amount of a DCC for each infrastructure category is determined by dividing the expected infrastructure costs (required to service new development over the DCC timeframe) by the number of new development units that will be served.

Separate DCCs may be established for different classes of development, for example, residential, commercial, industrial, and institutional. Charges may then be collected from developers either at the time of subdivision approval (for single-detached lots) or at the issuance of a building permit (for multi-unit residential and commercial buildings). Area specific charges can also be imposed to defined benefiting areas.

6.2 Community Amenity Contributions[20]

Beyond DCCs, municipalities may charge Community Amenity Contributions (CACs) or density bonusing fees. As defined by the Province:

> *Community amenity contributions are negotiated amenity contributions agreed to by the developer and local government as part of a rezoning process initiated by the developer. Community amenity contributions typically include the provision of amenities, affordable housing and/or financial contributions towards amenities. The agreed-to contribution is obtained by the local government, if the local government decides to adopt the rezoning bylaw.*
>
> *As an additional approach, local governments sometimes negotiate CACs from those seeking a change in zoning. A change in use or an increase in density generally boosts the value of land, and provides the possibility of a financial benefit to the land owner, developer or local government. Increasingly, local governments and residents see this as a reasonable opportunity to help fund community amenities.*

[19] Province of British Columbia, Development Cost Charges, Website: www2.gov.bc.ca/gov/content/governments/local-governments/finance/local-government-development-financing/development-cost-charges

[20] Province of British Columbia, Density Bonusing and Amenities, Website: www2.gov.bc.ca/gov/content/governments/local-governments/planning-land-use/land-use-regulation/zoning-bylaws/density-bonusing-amenities

6.3 Regional Development Cost Charges

In this region, Metro Vancouver and TransLink also charge DCCs, noted as follows in Tables 6.1, 6.2 and 6.3:

Table 6.1: Metro Vancouver Water DCC Rates

Residential	Townhouse	Apartment	Non-Residential
$6,692 / unit	$5,696 / unit	$4,261 / unit	$3.39 / ft^2 of floor area

Table 6.2: Metro Vancouver Liquid Waste DCC Rates

Sewerage Area	Residential	Townhouse	Apartment	Non-Residential
Fraser	$6,254 / unit	$5,390 / unit	$4,269 / unit	$3.30 / ft^2 of floor area
Lulu Island West	$3,313 / unit	$2,756 / unit	$2,042 / unit	$1.54 / ft^2 of floor area
North Shore	$3,300 / unit	$2,786 / unit	$2,030 / unit	$1.67 / ft^2 of floor area
Vancouver	$3,335 / unit	$2,983 / unit	$1,988 / unit	$1.63 / ft^2 of floor area

Table 6.3: TransLink Transportation DCC Rates

Type of Development	Rates effective January 1, 2022
Single Family Dwelling	$2,993 per Dwelling Unit
Duplex	$2,485 per Dwelling Unit
Townhouse Dwelling Unit	$2,485 per Dwelling Unit
Apartment Dwelling Unit	$1,554 per Dwelling Unit
Retail/Service	$1.26 per sq. ft. of Floor Area*
Office	$1.01 per sq. ft. of Floor Area*
Institutional	$0.50 per sq. ft. of Floor Area*
Industrial	$0.30 per sq. ft. of Floor Area*

Depending on the unit type and location, these regional DCCs can total approximately $8,000 to $16,000 per housing unit.

6.4 Municipal Development Cost Charges in Metro Vancouver

Using eight representative municipalities in the Metro Vancouver region, the applicable municipal DCCs were calculated for each of the six residential typologies studied. This reporting excludes other DCCs, such as those levied by Metro Vancouver and TransLink, as well as other possible municipal fees or charges such as Community Amenity Contributions or special area charges. Furthermore, developers may be expected to pay for infrastructure servicing costs for both on-site and off-site works associated with development, depending on a site's location or context.

The results are show in Table 6.4. DCC rates by unit type can vary considerably by municipality within the region, yet within individual municipalities generally do not vary. Municipal DCCs range up to $40,000 to $60,000 for a single-detached house, to as low as approximately $10,000 for an apartment.

Table 6.4: Representative Municipal Development Cost Charges by Unit Type

Residential Typology	Langley Twp	Langley City	Pitt Meadows	Coquitlam	Port Moody	Surrey	Richmond	DNV	AVERAGE	AVG HHS	AVG per Capita
House (Low)	$40,104	$18,409	$13,493	$60,422	$33,453	$48,595	$41,533	$33,269	$ 36,160	3.10	$ 11,664
House (High)	$40,104	$18,409	$13,493	$60,422	$33,453	$43,050	$41,533	$33,269	$ 35,467	3.10	$ 11,441
Townhouse (Low)	$32,704	$14,503	$10,686	$35,807	$20,045	$38,790	$33,885	$23,808	$ 26,278	2.75	$ 9,556
Townhouse (High)	$32,704	$14,503	$10,686	$35,807	$20,045	$38,790	$33,885	$23,808	$ 26,278	2.75	$ 9,556
Apartment (Low)	$26,647	$ 9,549	$ 9,250	$22,694	$ 9,844	$23,488	$19,024	$13,653	$ 16,769	1.85	$ 9,064
Apartment (High)	$26,647	$ 9,549	$ 9,250	$22,694	$ 9,844	$23,200	$19,024	$13,653	$ 16,733	1.85	$ 9,045
Municipal DCCs only - excludes: School Site Acquisition Charge, Metro Vancouver Utilities Charge, TransLink Transportation Charge.											
Excludes Community Amenity Contributions or Bonus Density Charges, etc											
Includes Parkland Acquisition fee where included in municipality DCC bylaw.											

The number of persons per household also varies by unit type, which is different by municipality. Based on the 2021 Census, the number of residents per unit was determined (1.85 per apartment, 2.75 per townhouse, and 3.10 per house). When calculating the municipal DCCs by the number of household residents (rather than per unit), the results indicate a very close relationship between DCC rates and residents, averaging approximately $10,000 per person, as shown in Table 6.5. This suggests that DCCs rates are largely set based on population or per capita, rather than building form.

Table 6.5: Representative Municipal Development Cost Charges per Capita

Municipal Development Cost Charges by Unit Type and per Capita

Residential Typology	Langley Twp	AVG HHS	DCC per Capita	Langley City	AVG HHS	AVG per Capita	Pitt Meadows	AVG HHS	AVG per Capita	Coquitlam	AVG HHS	AVG per Capita
House (Low)	$40,104	3.20	$12,533	$18,409	3.00	$ 6,136	$13,493	3.00	$ 4,498	$60,422	3.20	$18,882
House (High)	$40,104	3.20	$12,533	$18,409	3.00	$ 6,136	$13,493	3.00	$ 4,498	$60,422	3.20	$18,882
Townhouse (Low)	$32,704	2.35	$13,917	$14,503	2.40	$ 6,043	$10,686	2.70	$ 3,958	$35,807	2.95	$12,138
Townhouse (High)	$32,704	2.35	$13,917	$14,503	2.40	$ 6,043	$10,686	2.70	$ 3,958	$35,807	2.95	$12,138
Apartment (Low)	$26,647	1.80	$14,804	$ 9,549	2.05	$ 4,658	$ 9,250	1.85	$ 5,000	$22,694	1.95	$11,638
Apartment (High)	$26,647	1.80	$14,804	$ 9,549	2.05	$ 4,658	$ 9,250	1.85	$ 5,000	$22,694	1.95	$11,638

Port Moody	AVG HHS	AVG per Capita	Surrey	AVG HHS	AVG per Capita	Richmond	AVG HHS	AVG per Capita	DNV	AVG HHS	AVG per Capita	AVG	AVG HHS	AVG per Capita
$33,453	3.10	$10,791	$48,595	3.40	$14,293	$41,533	3.20	$12,979	$33,269	3.00	$11,090	$36,160	3.14	$11,400
$33,453	3.10	$10,791	$43,050	3.40	$12,662	$41,533	3.20	$12,979	$33,269	3.00	$11,090	$35,467	3.14	$11,196
$20,045	2.80	$ 7,159	$38,790	2.75	$14,105	$33,885	2.90	$11,684	$23,808	2.65	$ 8,984	$26,278	2.69	$ 9,749
$20,045	2.80	$ 7,159	$38,790	2.75	$14,105	$33,885	2.90	$11,684	$23,808	2.65	$ 8,984	$26,278	2.69	$ 9,749
$ 9,844	1.90	$ 5,181	$23,488	2.10	$11,185	$19,024	1.95	$ 9,756	$13,653	1.85	$ 7,380	$16,769	1.93	$ 8,700
$ 9,844	1.90	$ 5,181	$23,200	2.10	$11,048	$19,024	1.95	$ 9,756	$13,653	1.85	$ 7,380	$16,733	1.93	$ 8,683

Although some infrastructure use may have a close relationship to the number of residents regardless of unit type (e.g., sewers), other services like water consumption can be heavily influenced by built form (e.g., single-detached residents tend to use more water for lawn watering and have a higher number of bathroom fixtures). Other services can have somewhat mixed relationships to densities / forms, for example lower density neighbourhoods tend to be more auto-oriented and thus use more roads, while residents of houses with yards may use less park space. Stormwater / drainage is largely a function of site coverage / impervious areas, rather than development density per se.

6.5 Summary

The municipal Development Cost Charges (DCCs) in British Columbia are enabled under provincial legislation to pay for new or expanded infrastructure (sewer, water, drainage, parks, and roads) necessary to adequately service the demands of new development. In the Metro Vancouver region, the municipal DCC rates per unit are almost always highest for single-detached houses (up to $40,000 to $60,000), lowest for apartment units (approximately $10,000), and in between for townhouses. However, when adjusted for the typical number of residents in a household, which varies by unit type, the range of per capita DCC rates vary only by a few thousand dollars, averaging: $9,000 per apartment resident, $10,000 per townhouse resident, and $11,000 per house resident. That noted, the DCC rates by unit type can vary considerably by municipality within the region, yet within individual municipalities generally do not vary. While allowable under provincial legislation, most municipalities do not charge different DCC rates for different sub-areas or catchment areas.

7 Municipal Budgets Expenditures Analysis

Municipal budgets typically comprise revenue from various sources (e.g., property taxes, user fees, and grants) and expenditures of various types for operating or capital matters. Some municipal functions tend to be very capital intensive like infrastructure, whereas others are very labour-intensive like services or amenities. Thus, possible efficiencies of scale and efficiencies of geography will vary by the function (see Appendix D for greater detail).

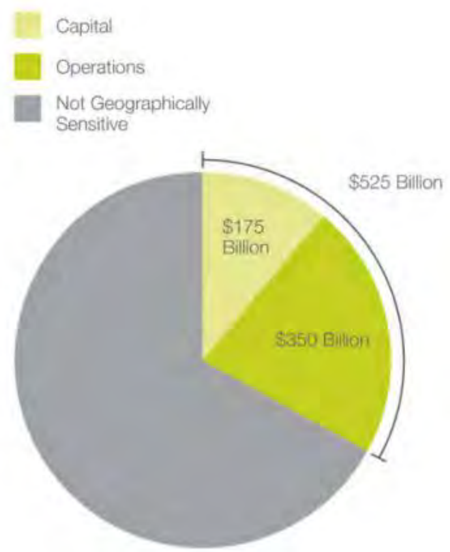
In British Columbia, municipalities are not generally responsible for services and associated costs for transit, school, and social or health provision, unlike in some other jurisdictions in Canada and the United States.

7.1 Budgets of American Cities

According to one American study completed in 2010, and as illustrated in Figure 7.1[21]:

- The cost of infrastructure like roads and sewers, as well as services like fire departments, ambulances and police are major budget items for any municipality, and decisions about development patterns can raise or lower the cost of these services.
- Local governments in the United States raised and spent $1.6 trillion USD, representing more than 10% of the U.S. Gross Domestic Product. Of that, approximately one-third ($525 billion) was expended on projects and activities that are heavily affected by local development patterns. That means future decisions about where to build will have implications for one-third of a typical municipality's budget.
- Of the $525 billion, $175 billion was spent on capital projects such as school buildings, roads and highways, water and sewer facilities, libraries and utilities. The remainder (about $350 billion) was spent on operations for the provision of public services such as police and fire service, utility service, highways and water and sewer service.

Figure 7.1: Part of Local Budgets Influced by Land Use Choices



7.2 Metro Vancouver Municipal Budgets

From a high level review of the larger municipalities in the Metro Vancouver region (i.e., Vancouver, Surrey, Burnaby, Richmond), of their total budget expenditures, the majority of costs are associated with providing services of various types that do not generally have a direct relationship with development densities or forms. For example, costs like community parks, recreational facility, library, licencing / permitting, police, fire, general government / administration, are largely services required for the population, thus a function of the number of residents or per capita, rather than density of development.

[21] Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development, Smart Growth America, 2013.

Municipal services that have a more direct relationship to land use patterns and densities are utilities / engineering relating to roads, water, sanitary, and garbage services.

For the cities in the Metro Vancouver region that were analyzed, it appears that in the range of 27-37% of municipal expenditures are associated with these types of utilities / engineering services (i.e., both capital and operating costs).

This suggests that approximately one-third of municipal budgets could be impacted to some degree by land uses, densities, development patterns, and associated services required. Furthermore, some of these utilities / engineering services may not have a direct relationship between costs and development densities. For example, the costs of a water or sewage treatment plant may be fixed and largely a function of number of residents in the catchment area, while the pipes to connect the plant to the service area are a function of the development pattern / density.

Thus, while there are potential municipal cost savings associated with more compact forms of development, the scale of it should be considered within an overall municipal context. It is important to note that some of these costs are related to commercial and industrial land uses, which are not the focus of this study.

Separate from this analysis are other 'local' services such as transit, hospitals, and schools, which are the responsibility of different levels of government in British Columbia.

7.3 Summary

Based on a review of current municipal budgets in the region, approximately one-third of expenditures (i.e., both capital and operating costs) are related to utilities / engineering services that could be impacted to some degree by land uses, development forms, and densities, and associated infrastructure requirements. The balance of municipal costs (operating and capital) are for various types of 'soft' services that are generally labour-intensive and more a function of population than density. Thus, while there are potential municipal cost savings associated with more compact forms of development, the scale of this possible amount should be considered within the overall municipal context.

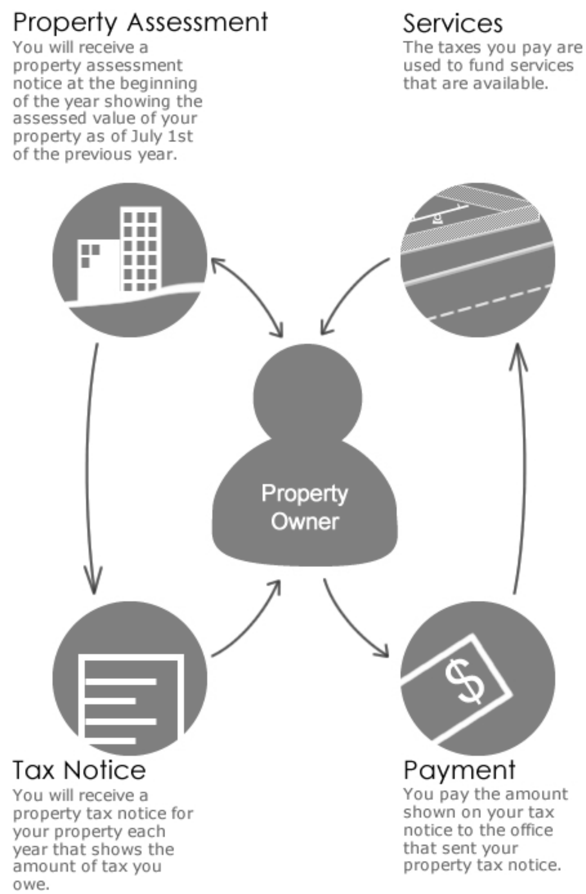
8 Calculating Typical Property Taxes and Utility Fees in the Region

8.1 Property Taxes in British Columbia Explained[22]

Municipal property taxes must be paid annually for each property (Figure 8.1). The money collected from property taxes funds local programs and services, such as:

- Police and fire protection
- Emergency rescue services
- Road construction and maintenance
- Garbage collection services
- Recreation and community centres
- Parks
- Libraries
- Local government administration
- Schools
- Hospitals

Figure 8.1: BC Property Tax System



In addition to annual property taxes there may be a separate bill for utilities or services in the area. This may be an additional bill from an improvement district, municipality or private company for services, such as:

- Water
- Fire protection
- Street lighting
- Sewage
- Parks

8.2 Property Classes and Exemptions[23]

In BC, there are nine classes for property taxation purposes. These classes are listed below, with the definition for Class 1 Residential. The property tax rate varies by class; notably for most municipalities the tax rate is much higher for utilities, industry, and businesses than it is for residential uses.

BC Assessment completes an annual value assessment of every property and categorizes them in one or more of the nine classes, typically based on a property's type or use. Municipal zoning does not determine the property class, though it may be a factor in some cases.

[22] Province of British Columbia, Annual Property Tax, Website: www2.gov.bc.ca/gov/content/taxes/property-taxes/annual-property-tax

[23] BC Assessment Authority, Understanding property classes and exemptions, Website: https://info.bcassessment.ca/Services-products/property-classes-and-exemptions/understanding-property-classes-and-exemptions

BC Assessment Property Classes:

- **Class 1, Residential –** single-family residences, multi-family residences, duplexes, apartments, condominiums, nursing homes, seasonal dwellings, manufactured homes, some vacant land, farm buildings and daycare facilities.
- **Class 2, Utilities**
- **Class 3, Supportive Housing**
- **Class 4, Major Industry**
- **Class 5, Light Industry**
- **Class 6, Business and Other**
- **Class 7, Managed Forest Land**
- **Class 8, Recreational Property, Non-profit Organization**
- **Class 9, Farm**

- **Split Classification –** Properties with several distinct uses can fall into more than one class. For example, commercial and residential space might be combined in one building, or a property combines residential, farm and forest land. In these cases, BC Assessment determines the share of the value of the property attributable to each class.

8.3 Calculations for Typical Housing Units in the Region

Using a sample of seven representative municipalities in the Metro Vancouver region (i.e., Vancouver, Burnaby, Richmond, Surrey, Langley Township, Coquitlam, North Vancouver District), the average or typical property taxes and utility fees were calculated based on available information for the three different unit typologies used in this study (i.e., house, townhouse, apartment). This was based on the benchmark or index market price from local real estate board publications (April 2023 values), the 2022 property tax mill rates, and the utility charges for different services, such as for water, sewage, and garbage by municipality.

The results in Table 8.1 show that, on average, in the Metro Vancouver region houses pay $5,600 in property taxes and $1,700 in utility fees, totalling approximately $7,400 per year. The amounts are lower for townhouses and apartments. These amounts vary by municipality as the mill rates vary by jurisdiction, and furthermore would also vary within individual municipalities depending on assessed value of the representative properties. For multi-unit complexes (i.e., townhouses and apartments) there may be a strata organization responsible for some private on-site utilities and services, which would be charged to the owner as a strata amenity fee rather than a municipal fee or property tax.

Table 8.1: Average Property Taxes and Utility Fees by Unit Type

House	Unit Value	General Municipal	School	Regional District	Hospital	BCA, MFA and Other	Total Taxes	Total Charges	Total Taxes and Charges	*Taxes as % of Total Tax & Charge*	*% of Total Taxes to City*
Average	*$1,953,852*	*$3,192*	*$1,860*	*$100*	*$0*	*$510*	*$5,663*	*$1,718*	*$7,381*	*77%*	*56%*
Townhouse	**Unit Value**	**General Municipal**	**School**	**Regional District**	**Hospital**	**BCA, MFA and Other**	**Total Taxes**	**Total Charges**	**Total Taxes and Charges**	***Taxes as % of Total Tax & Charge***	***% of Total Taxes to City***
Average	*$1,050,133*	*$1,721*	*$999*	*$54*	*$0*	*$274*	*$3,048*	*$1,285*	*$4,333*	*71%*	*56%*
Apartment	**Unit Value**	**General Municipal**	**School**	**Regional District**	**Hospital**	**BCA, MFA and Other**	**Total Taxes**	**Total Charges**	**Total Taxes and Charges**	***Taxes as % of Total Tax & Charge***	***% of Total Taxes to City***
Average	*$737,119*	*$1,204*	*$700*	*$38*	*$0*	*$192*	*$2,135*	*$1,201*	*$3,336*	*64%*	*56%*

Of the property taxes only, slightly over half (56%) of the amount is for the local / host municipality, and the rest to other authorities such as Metro Vancouver, TransLink, and the Province (via school taxes). Furthermore, of the total taxes and fees paid by typical households, a quarter to a third of that amount goes towards utility fees. Table 8.2 shows these results for the sample municipalities in the Metro Vancouver region.

Table 8.2: Average Property Taxes and Utility Fees by Unit Type for Select Municipalities

City / House	Unit Value	General Municipal	School	Regional District	Hospital	BCA, MFA and Other	Total Taxes	Res Parcel Taxes	Res User Fees	Total Charges	Total Taxes and Charges	*Taxes as % of Total Tax & Charge*	*% of Total Taxes to City*
Vancouver	*Mill Rate*	*1.53131*	*0.84770*	*0.05042*	*0.00000*	*0.26100*	***2.69043***						
	$2,535,200	$3,882	$2,149	$128	$0	$662	$6,821		$2,264	**$2,264**	$9,085	*75%*	*57%*
Burnaby	*Mill Rate*	*1.54710*	*0.98440*	*0.05030*	*0.00000*	*0.26100*	***2.84280***						
	$1,943,067	$3,006	$1,913	$98	$0	$507	$5,524		$782	**$782**	$6,306	*88%*	*54%*
Richmond	*Mill Rate*	*1.65745*	*0.99580*	*0.05127*	*0.00000*	*0.26100*	***2.96552***						
	$2,137,600	$3,543	$2,129	$110	$0	$558	$6,339		$2,011	**$2,011**	$8,350	*76%*	*56%*
Surrey	*Mill Rate*	*1.50005*	*0.99140*	*0.05079*	*0.00000*	*0.26100*	***2.80324***						
	$1,579,100	$2,369	$1,566	$80	$0	$412	$4,427		$2,088	**$2,088**	$6,515	*68%*	*54%*
Langley Twp	*Mill Rate*	*1.75720*	*1.02420*	*0.05158*	*0.00000*	*0.26100*	***3.09398***						
	$1,541,200	$2,708	$1,578	$79	$0	$402	$4,768		$1,434	**$1,434**	$6,202	*77%*	*57%*
Coquitlam	*Mill Rate*	*1.94270*	*1.00730*	*0.05270*	*0.00000*	*0.26100*	***3.26370***						
	$1,747,900	$3,396	$1,761	$92	$0	$456	$5,705		$1,526	**$1,526**	$7,231	*79%*	*60%*
DNV	*Mill Rate*	*1.57023*	*0.87870*	*0.05225*	*0.00000*	*0.26100*	***2.76218***						
	$2,192,900	$3,443	$1,927	$115	$0	$572	$6,057		$1,919	**$1,919**	$7,976	*76%*	*57%*
Average	***$1,953,852***	***$3,192***	***$1,860***	***$100***	***$0***	***$510***	***$5,663***		***$1,718***	***$1,718***	***$7,381***	***77%***	***56%***

City / Townhouse	Unit Value	General Municipal	School	Regional District	Hospital	BCA, MFA and Other	Total Taxes	Res Parcel Taxes	Res User Fees	Total Charges	Total Taxes and Charges	*Taxes as % of Total Tax & Charge*	*% of Total Taxes to City*
Vancouver	*Mill Rate*	*1.53131*	*0.84770*	*0.05042*	*0.00000*	*0.26100*	***2.69043***						
	$1,296,300	$1,985	$1,099	$65	$0	$338	$3,488		$1,777	**$1,777**	$5,265	*66%*	*57%*
Burnaby	*Mill Rate*	*1.54710*	*0.98440*	*0.05030*	*0.00000*	*0.26100*	***2.84280***						
	$925,833	$1,432	$911	$47	$0	$242	$2,632		$708	**$708**	$3,340	*79%*	*54%*
Richmond	*Mill Rate*	*1.65745*	*0.99580*	*0.05127*	*0.00000*	*0.26100*	***2.96552***						
	$1,116,400	$1,850	$1,112	$57	$0	$291	$3,311		$1,590	**$1,590**	$4,901	*68%*	*56%*
Surrey	*Mill Rate*	*1.50005*	*0.99140*	*0.05079*	*0.00000*	*0.26100*	***2.80324***						
	$849,200	$1,274	$842	$43	$0	$222	$2,381		$762	**$762**	$3,143	*76%*	*54%*
Langley Twp	*Mill Rate*	*1.75720*	*1.02420*	*0.05158*	*0.00000*	*0.26100*	***3.09398***						
	$811,200	$1,425	$831	$42	$0	$212	$2,510		$1,354	**$1,354**	$3,864	*65%*	*57%*
Coquitlam	*Mill Rate*	*1.94270*	*1.00730*	*0.05270*	*0.00000*	*0.26100*	***3.26370***						
	$1,037,600	$2,016	$1,045	$55	$0	$271	$3,386		$1,181	**$1,181**	$4,567	*74%*	*60%*
DNV	*Mill Rate*	*1.57023*	*0.87870*	*0.05225*	*0.00000*	*0.26100*	***2.76218***						
	$1,314,400	$2,064	$1,155	$69	$0	$343	$3,631		$1,624	**$1,624**	$5,255	*69%*	*57%*
Average	***$1,050,133***	***$1,721***	***$999***	***$54***	***$0***	***$274***	***$3,048***		***$1,285***	***$1,285***	***$4,333***	***71%***	***56%***

City / Apartment	Unit Value	General Municipal	School	Regional District	Hospital	BCA, MFA and Other	Total Taxes	Res Parcel Taxes	Res User Fees	Total Charges	Total Taxes and Charges	*Taxes as % of Total Tax & Charge*	*% of Total Taxes to City*
Vancouver	*Mill Rate*	*1.53131*	*0.84770*	*0.05042*	*0.00000*	*0.26100*	***2.69043***						
	$1,043,900	$1,599	$885	$53	$0	$272	$2,809		$1,777	**$1,777**	$4,586	*61%*	*57%*
Burnaby	*Mill Rate*	*1.54710*	*0.98440*	*0.05030*	*0.00000*	*0.26100*	***2.84280***						
	$774,333	$1,198	$762	$39	$0	$202	$2,201		$708	**$708**	$2,909	*76%*	*54%*
Richmond	*Mill Rate*	*1.65745*	*0.99580*	*0.05127*	*0.00000*	*0.26100*	***2.96552***						
	$751,200	$1,245	$748	$39	$0	$196	$2,228		$1,271	**$1,271**	$3,499	*64%*	*56%*
Surrey	*Mill Rate*	*1.50005*	*0.99140*	*0.05079*	*0.00000*	*0.26100*	***2.80324***						
	$537,000	$806	$532	$27	$0	$140	$1,505		$762	**$762**	$2,267	*66%*	*54%*
Langley Twp	*Mill Rate*	*1.75720*	*1.02420*	*0.05158*	*0.00000*	*0.26100*	***3.09398***						
	$575,500	$1,011	$589	$30	$0	$150	$1,781		$1,354	**$1,354**	$3,135	*57%*	*57%*
Coquitlam	*Mill Rate*	*1.94270*	*1.00730*	*0.05270*	*0.00000*	*0.26100*	***3.26370***						
	$675,300	$1,312	$680	$36	$0	$176	$2,204		$1,181	**$1,181**	$3,385	*65%*	*60%*
DNV	*Mill Rate*	*1.57023*	*0.87870*	*0.05225*	*0.00000*	*0.26100*	***2.76218***						
	$802,600	$1,260	$705	$42	$0	$209	$2,217		$1,354	**$1,354**	$3,571	*62%*	*57%*
Average	***$737,119***	***$1,204***	***$700***	***$38***	***$0***	***$192***	***$2,135***		***$1,201***	***$1,201***	***$3,336***	***64%***	***56%***

8.4 Summary

Property taxes are a function of the assessed value of a property, with municipal tax rates set by the host municipality. Nearly half of the property taxes collected go to other levels of government than the local municipality, such as to the provincial government and other agencies. Municipal utility fees for such services as water, sewage, and garbage, may also apply. On average in the Metro Vancouver region, detached houses pay $5,600 in property taxes and $1,700 in utility fees, totalling approximately $7,400 per year; the amounts are lower for townhouses and apartments. These amounts vary by municipality as the mill rates vary by jurisdiction, and furthermore also vary within individual municipalities depending on the assessed values of properties. Of the total taxes and fees paid by typical households, a quarter to a third of that amount goes to utility fees.

9 Methodological Complexities

Based on the literature review and informational interviews undertaken, the following is a summary of methodological considerations and complexities with the calculation and attribution of municipal costs and revenues and related matters (see Appendix E for greater detail).

9.1 Overview of Considerations

It is difficult to compare findings between locations and jurisdictions, such as different provinces, as there are many different variables, in terms of services, costs, revenues, allocation, governance, etc. For example, BC and Alberta municipalities tend to spend less on social services compared to Ontario; transit service is the responsibility of the Province in BC but of the municipalities in Alberta and regions in Ontario. Ambulance services are provided by regions in Ontario, but are the responsibility of the province in BC.

A range of uses and facilities are required for a community, and must be provided, regardless of cost and revenue distributions, even if not all are revenue neutral from a municipal finance perspective. In a metropolitan context like in the Metro Vancouver region, people and economic activities tend to move around during the day from home (residential) to work (industrial), and to shops (commercial) and services (institutional), each with their own attributes, contributing to and impacting the municipal and regional economies and services.

The definitions used for low and high development densities and areas can vary widely and thus associated boundaries and measures may not be consistent, resulting in different calculations and values.

Separating and allocating costs is not simple or consistent. There are theoretical and ideal policies on one hand, and on the other hand what typically occurs in practice. The difference (and similarities) between a tax and a fee, noting some items may not be properly classified, can confuse the matter.

9.2 Allocating Costs

Total costs by service are generally tracked and reported by municipalities for their entire jurisdiction, but it is difficult to disaggregate and allocate by sub-area and by unit types and forms of development. There are different catchment areas for different service types and different cost profiles. The results can be heavily influenced by the assumed attribution of costs to non-residential uses and taxpayers, such as commercial and industrial uses.

There are challenges with apportioning costs, be it by land use type, housing unit type, location / geography, components of services, and infrastructure amortization periods. For example, crime may occur in one area by a resident or victim from another area, and traffic flows between and through communities.

How municipal governments decide to value an asset and the associated amortization / depreciation schedule affects assigned costs per year. Some infrastructure may last longer or shorter than initially estimated. Reserve allowances for replacement costs can vary, and may be fully funded, or not, in municipal budgets.

In some cases, a service can have both a fixed and variable aspect, each with different cost profiles. The cost of producing and delivering a service can be very different, with only the delivery varying by its location within a municipality (e.g., a water treatment plant for the city, with service mains to local properties). Regional infrastructure facilities may be less impacted by development density than municipal / local service infrastructure connections. Therefore, the cost implications of different densities may vary by function and authority.

Some services and infrastructure with economies of scale can best be provided regionally, whereas others can be done more effectively and efficiently at the local level.

9.3 Municipal Revenues

Municipal services in Canada are largely funded by property taxes generally based on a system of the assessed value of property, rather than on a 'services consumed' basis. More expensive properties generally pay more towards city services.

User fees are applied only for some services. Some utilities / services are metered (such as water, or garbage) vs. others are not (and funded via general taxation). User fees are charged for products / services consumed that can be readily allocated to the user / benefiter, and the other municipal services are funded through general property taxation.

Some major infrastructure may be funded through grants by senior levels of government rather than local government. Maintenance of this infrastructure may later become a long-term operating cost for the municipality.

Municipal DCCs are typically applied at a municipal-wide rate as it is administratively simpler and provides more flexibility, rather than having to limit infrastructure expenditures to within the individual revenue generating geographies. Note this is a one-time charge for construction only and does not fund operation, maintenance, or replacement costs.

Municipal capital infrastructure costs are one-time costs and, unlike variable user fees, do not influence consumption / usage decisions in the same way as metered charges for water, electricity, natural gas, etc.

9.4 Local Considerations / Contexts

Some municipal and related services and costs are a function of per capita demand, and others a function of geography or development density. There is an overlap between economies of scale and efficiencies of geography. Higher population municipalities, not necessarily high development densities, tend to achieve economies of scale to a certain point before becoming less efficient thereafter.

Servicing costs in many cases are generally heavily impacted by local context-specific matters, such as the condition of existing infrastructure (i.e., capacity, age), geography, topography, etc. Infrastructure capacity available vs. incremental threshold reached can result in very different costs to provide additional services for new development.

Beyond residential densities and types, level of service decisions, as well as the delivery costs, may vary by location and circumstances due to such thing as topography, geography, street pattern, condition, and the capacity of existing infrastructure, sharing with non-residential uses, etc. Residential densities and neighbourhood ages are also factors that may impact servicing and infrastructure costs in other ways.

Historic downtown cores tend to have older infrastructure, and thus more expensive to maintain, whereas the suburban fringe areas that were developed more recently have newer infrastructure that does not require as much short-term maintenance.

Major infrastructure facilities that are large and expensive are generally constructed and financed all at once (referred to as 'lumpy' investments). Given the indivisible nature of major infrastructure capital assets / projects, municipal service capacity cannot easily be expanded incrementally to match the gradual increase in demand that comes from new development. In some cases, creating excess capacity may have been done intentionally for future planned development that has not yet occurred. Initial overbuild typically needs to be publicly funded upfront for future users / benefiters.

The redevelopment of areas that were not planned for higher densities, such as identified urban infill / intensification areas, can be a challenge and more expensive to service if the needed infrastructure capacity is not present. This may necessitate extensively replacing and expanding existing infrastructure before it would otherwise need to be replaced due to age.

9.5 Relationship Between Costs and Development Densities

Some costs are more or less sensitive to development density and form than others. The relationship between residential density and infrastructure demand is intuitive for some items, e.g., larger house lots require more linear distance of pipes and pavement per household resulting in higher costs. Yet parks and recreation costs are generally based on the demand associated with population. Stormwater management costs are most directly relevant to building site coverage / impervious surface, than development density or population.

Most of the municipal operating budgets are for labour costs and therefore do not vary much due to geography or development densities / forms as compared to other costs such as linear infrastructure. Often there are economies of scale associated with capital intensive infrastructure (e.g., water and sewage treatment plants) that can vary by type of infrastructure, but not for labour-intensive services. There are natural economies of scale for some types of infrastructure, which work at different levels and vary by type of infrastructure / service. Thus there is no single optimum level for all combined municipal services.

Some costs increase with higher densities in established urban areas associated with 'urban harshness', such as higher land costs and more complex and time consuming construction works. While absolute project costs may be higher in urban areas, it tends to support more intense development accommodating a greater population, thus resulting in lower per unit and per capita costs.

Although charges / fees may vary by residential unit types, often that variance is mostly due to the differences in the number of occupants in each unit, not significantly by other attributes; thus per capita rates are similar when adjusted for the number of persons per household.

Even though the per capita infrastructure costs in dense urban sites may be lower, the land development and construction costs tend to be higher. This can result in higher housing costs in city centres, pushing some residents to seek out lower density suburban locations in search of lower housing costs. The Housing and Transportation Cost Burden Study [24]has shown that in those cases, often the associated household increases in transportation costs offset much of the perceived savings.

While infill and intensification development may have lower infrastructure costs, they generally do not have lower municipal DCCs. This may indicate that DCCs may not be set correctly if they are the same for the entire municipality despite variances in infrastructure costs, and as a result may unintentionally incent lower density urban fringe developments which are most costly to service.

9.6 Community Preferences

Public residential preferences are a major determinate of urban form, and housing choices are important. Different communities have different population profiles and resident behaviours that can be influenced by where they currently live and their associated environment or other self-selecting location decisions and preferences. Different demographics desire or consume different amounts and types of services, which is often impacted by income levels and ability to pay for certain services, demographics, and household composition.

Different municipalities may choose to provide different levels of services in terms of quantity or quality, which are difficult to consider and estimate in any financial analysis. The presence of a large industrial or commercial property tax base in a municipality compared to its residential areas will result in a different distribution of municipal costs and revenues as well as the services demanded and provided.

9.7 Other Considerations

Based on the literature review, below are some of the common findings and suggestions when considering costs and revenues related to residential development:

- Wherever reasonably possible, utility fees could be considered rather than property taxes as a cost recovery tool, as they are more reflective of the actual cost of service delivery. This would move closer to linking revenues and expenditures to the party benefiting and paying, via transparent user fees that are based on the actual consumption of services.
- Transparently illustrate and explain infrastructure / servicing costs and trade-offs when multiple scenarios are being considered for a proposed development or redevelopment, such as when preparing a master plan for greenfield lands (e.g., using different development and density options with resulting cost per unit and per capita calculations to reflect the trade-offs being considered).
- Direct efforts towards items that matter the most with the greatest opportunity for improvement. The capital and operating costs that are most impacted by spatial and development density factors should be the principal focus rather than the population-based costs apportioned on a per capita basis.
- Given the many possible methodological complexities and challenges, expectations about precision should be adjusted when completing any cost / revenue analysis. Noting the degree to which any such analysis can be influenced by context, modelling assumptions and data, the results should be treated more as indicators or estimates for consideration as a means to better understand the trade-offs of service levels and short- and long-term implications.

[24] Housing and Transportation Cost Burden Study, Metro Vancouver, 2015.

9.8 Summary

Defining, calculating, and attributing costs and revenues for different services by different asset classes or unit types can be a data and methodological challenge. Conceptually, there are four categories: infrastructure (capital) costs and revenues, and service (operating) costs and revenues. Some of these may be paid for by a developer as one-time charges during construction, be it through providing the infrastructure and / or paying DCCs, and some by residents in the form of ongoing property taxes and utility fees. Some practical challenges for such calculations are defining 'urban' or 'suburban' development forms / densities for data collection and reporting purposes, and potentially attributing some costs and revenues to other non-residential land uses (such as commercial and industrial). Furthermore, many municipal services and associated costs are more a function of residential population level rather than housing density, and some services, such as capital intensive infrastructure, can benefit from economies of scale, while labour-intensive services do not. There are also significant local considerations and contextual issues. Some municipal costs may be higher on an absolute basis in a high-density, established urban location because of 'urban harshness' and increased complexities, but lower on a per unit or per capita basis because of the greater development densities. Given these complexities and limitations, the expectations about the resulting values should be understood as high-level or estimates.

10 Summary of Findings and Considerations

The study's findings and considerations are not meant to be definitive, and should be further explored and discussed with stakeholders and decision-makers to better understand the trade-offs inherent in all land use plans and development approvals, and to support more financially-sustainable and cost-effective forms of residential development.

10.1 Key Considerations

The following should be considered when making land use and urban form decisions, as well as those associated with public infrastructure investments to support desired forms of residential land uses and densities, and when reviewing property tax and utility fee policies:

- It is critical to permit and facilitate higher density and more cost-effective forms of development in urban / developed areas (i.e., infill, intensification, redevelopment), where public infrastructure investments can be best utilized. Where regulatory barriers exist to urban densification in such locations, consider a review of policies and regulations and discourage developments that are not compact form, mixed-use, and that cannot be cost-efficiently serviced.
- Achieving compact, complete communities does not necessarily require extremely high density development forms. Optimum densities are a factor of context, and are often a combination of densities and uses that result in more livable, sustainable, and balanced communities. For example, moving from low density to medium densities in urban centres and along transit corridors can provide significant improvements in infrastructure servicing cost outcomes.
- The costs of infrastructure and utility provision should be set to better reflect actual service costs and charge those who directly benefit:
  - The use of metering for utilities should be considered, where possible, such as for water and sewerage; with new and emerging technologies, such as improved metering, user fees can be more precise and effective, and managed electronically.
  - Utility fees should not be focused simply on raising revenues, but also on changing behaviours and outcomes. Fees and incentives can be set and adjusted to encourage desired actions and choices and meet community buildings objectives.
- Applying Development Cost Charges that vary by residential unit type / size / density as well as sub-area geography, better reflects the actual costs of servicing demand.
- Closely coordinating and integrating land use planning, engineered infrastructure, asset management, and municipal financial decision-making including full lifecycle costing, leads to improved land use and financial outcomes.

10.2 Summary

The result of such shortcomings is that municipalities may be inadvertently encouraging inefficient growth patterns. These patterns are costly not only from an environmental and social point of view, but also from a municipal finance perspective. The symptoms include mounting infrastructure deficits, reduced service levels, growing threats to quality of life, and a loss of economic competitiveness.

There are many opportunities through planning and taxation / fee setting policy adjustments to better advance municipal and community interests relative to land use patterns and housing forms. This can include: better aligning the parties who receive services with those who pay for them via enhanced utility user fees, where appropriate; fully understanding the short and long-term costs and revenues associated with different land use types and development densities; applying Development Cost Charges based on smaller geographies to more accurately reflect the different local marginal servicing costs; and encouraging, including through reducing barriers and costs, and though public education programs, higher density and mixed-use development in urban locations already served by infrastructure, where possible. Utility user fees and charges can be an incentive to achieve the desired development forms and encourage more compact and cost-effective forms of growth.

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Appendix A: Literature Review – Concept and Theory

The following is text extracted from the referenced publications, providing key points from the literature review. These publications and research were used to inform the study.

Urban Sprawl: Do its Financial and Economic Benefits Outweigh its Costs for Local Governments?[25]

In general, the growth of urban sprawl has a significant effect on local costs. The nature of "sprawl communities" creates a greater demand for costly new investments (roads, sewage systems, as well as, for example, kindergartens). In addition, local authorities in suburban municipalities are under pressure from "new residents" (who previously lived in central cities and were accustomed to higher levels of municipal services) due to the need for new investments. Urban sprawl is associated with large infrastructure investments such as roads for new residents on the outskirts of the city.

Many of the adjustments for urban sprawl are tolerated by the upper levels of the government through the financing of grants (mainly capital transfers) along with its role related to the property cycle (taxes and fees on land use improvement, building permits, construction tax, public land sales, etc.). However, municipalities' reliance on grants and fees to adjust their budgets highlights a potential problem. The additional infrastructure needs associated with large-scale spatial growth are met mainly by the upper levels of government and can encourage municipalities to expedite urban expansion without considering the full financial implications of such policies.

On the other hand, urban sprawl has immediate consequences for political institutions because construction, land development, fees, and sale of building materials and structures, once completed, mean taxes and revenue for municipal and other governments. Local government incentives to slow down or change the direction of urban sprawl are limited. Initially, it is a significant source of employment, contract opportunities, and tax revenue for your constituency. This new model of urban development is also a potential source of revenue for municipalities. Land development has not only served as a passive result of urbanization but has also been actively pursued by local governments as a means of generating revenue to finance local economic growth. Due to the budget constraints of municipalities, revenues from urban sprawl quickly become local government expenditures.

Municipal Finances and Growth Planning in the Greater Golden Horseshoe: Opportunities for Better Integration to Support Smart Growth[26]

These are complex matters and some of the connections between growth patterns and fiscal costs are still being debated in the academic literature, but the general picture that has emerged is clear: low-density, auto-dependent growth requires more infrastructure that is more expensive to operate and maintain over its life-cycle. Despite this finding, municipalities in Canada have an uneven record when it comes to integrating the management of growth and financial decisions. There are three key weaknesses:

- Municipalities tend to perform well when it comes to assessing the immediate costs of planned growth, but not so well when it comes to assessing long-term financial sustainability of that growth. In other words, municipalities are geared towards the immediate problem of financing anticipated

[25] Urban Sprawl: Do its Financial and Economic Benefits Outweigh its Costs for Local Governments?, GeoJournal, Mehran Hajilou, Abolfazl Meshkini, Mohammad Mirehei, Safar Ghaedrahmati, 2022.
[26] Municipal Finances and Growth Planning in the Greater Golden Horseshoe: Opportunities for Better Integration to Support Smart Growth, Greenbelt Foundation, Ray Tomalty, 2022.

growth in terms of the up-front capital costs. They tend to pay less attention to assessing the long-term costs of growth in terms of operating, maintaining, refurbishing, and ultimately replacing the infrastructure that growth entails. This is a serious issue because much of the infrastructure needed to support growth have long lifetimes and therefore imply long-term (typically permanent) commitments in both operating and capital dimensions. These so-called life-cycle costs often exceed the original cost of installing the infrastructure, sometimes by several fold. Some municipalities seem to believe that property taxes and user fees arising from growth will cover these long-term costs, but this often turns out not to be the case. A failure to adequately foresee and budget for long-term commitments could distort decision-making concerning the amount and pattern of growth that is desirable in a community.

- Municipalities routinely shape growth to help achieve political, economic, social, and environmental goals, but they pay far less attention to the potential for shaping growth to achieve financial objectives. Municipalities seldom look at growth parameters such as greenfield density, concentration around transit, and intensification as tools for reducing the long-term financial costs associated with growth. They may also be driven by the desire to attract investment that will create new jobs and attract new residents, provide housing to a growing population, or expand the assessment base. In some cases, growth is managed to preserve agricultural lands and natural heritage features. However, it's less common for municipalities to consider shaping growth as a way of ensuring the optimum use of infrastructure dollars and reducing long-term costs to the municipality. As a result, accommodating population and employment growth may be unnecessarily expensive in the short- and long-term.
- Municipalities are very good at shaping their revenue tools to ensure they generate the needed funds to cover upcoming capital and operating costs (minus debt and grants from other governments) but not as good at thinking through how those design choices might impact growth patterns. The rules that govern the way taxes and user fees are collected from residents and businesses and the way development cost charges are exacted from developers have the potential to generate a system of subsidies from some property types or locations to others, generating impacts on decisions that affect the shape of growth. For example, property taxes that charge more to the owners of high-density residential buildings than those of low-density buildings are effectively subsidizing low-density housing (unless it can be shown that such housing is cheaper to service than high-density buildings, which it is generally agreed it is not). There are many such subsidies that are operating in communities. While the impacts of each subsidy may be small, on a cumulative basis, they may be contributing to inefficient growth patterns and higher financial costs for everyone.

The result of such shortcomings is that municipalities may be inadvertently encouraging inefficient growth patterns. These patterns are costly not only from an environmental and social point of view, but also from a municipal finance perspective. The symptoms include mounting infrastructure deficits, reduced service levels, growing threats to quality of life, and a loss of economic competitiveness.

This state of affairs can be partly attributed to the oft-noted silos through which municipal governments organize their work. Typically, the task of managing growth falls to professional planners in the planning department, while infrastructure decisions are made by engineers in the transportation and public works departments, and financial decisions are taken by officials trained in public finance, economics and accounting in the finance department. Bringing together these diverse professionals into a system of integrated decision-making can be a challenge. Another reason is the inertia that is built into growth planning and financial management systems.

Based on best practices an ideal "Integrated Growth Planning Program" would look like:

- Growth scenario assessment: In the context of an official plan review, the municipality develops a growth management strategy that describes the anticipated location, structure, density, and housing mix of development needed to accommodate the forecasted growth. The strategy includes an assessment of several possible growth scenarios based on a range of parameters that reflect public priorities, including fiscal long-term sustainability. In two-tiered regions (with a regional [upper-tier] and municipal [lower-tier] governments), the process is led by staff from the upper-tier, but local municipalities are fully involved throughout the process. The growth management strategy includes a phasing plan that concentrates growth in a limited number of areas at any one time and coordinates major infrastructure projects to take advantage of potential economies.
- Master plans: The growth management strategy is carried out concurrently and iteratively with master plans for the key infrastructure classes, including water, wastewater, stormwater, roads, and transit. Staff responsible for preparing the master plans feed high-level ("order of magnitude") cost, revenue, and fiscal impact data related to the infrastructure needed to support the different scenarios into the scenario assessment process. Master plans identify spare capacity in the system and ensure it is filled before taking on new liabilities. Once the preferred growth scenario is selected, the master planning process moves on to detailed costing and revenue projections for the preferred scenario.
- Development cost charges background study: A development cost charges background study is prepared concurrently with the above processes, itemizing the prioritized capital projects and showing how the up-front costs of the infrastructure projects proposed in the various master plans will be funded (primarily through development cost charges). The study analyzes the associated long-term, life-cycle costs and revenues associated with the contemplated projects, identifying potential shortfalls and other financial risks. The results of the analysis are fed back into the growth management process to help mitigate any identified financial risks.
- Asset management plans and long-term financial planning: The results of the development cost charge background studies are also fed forward into Asset Management Plans and Long-Term Financial Plans, which are designed to flag any serious financial risk to the municipality. Risks that can be mitigated through better growth planning are taken into account in the next growth planning cycle.

Occasionally, municipalities review individual revenue tools to assess whether they are achieving the goals that are set for them or if they are having negative effects on some public priority issue. For example, a higher property tax rate on commercial or industrial buildings compared to residential buildings may be reviewed to see if it is inadvertently chasing away new business investment. A fiscal alignment audit does that for all the fiscal instruments that the municipality uses but takes a growth management lens instead of an economic development one.

Following is a list of items that could be considered for inclusion in an audit, phrased as measures that could improve alignment with Smart Growth objectives:

Development cost charges:

- differentiate charges by area instead of using municipality-wide charges,
- differentiate charges applied to larger vs. smaller dwelling units (e.g., by floor area or number of bedrooms) within the various dwelling-type categories,
- differentiate residential charges applied to larger vs. smaller lots,
- differentiate among non-residential uses to avoid favouring uses that generate more vehicular traffic,

- discount/exempt development above a target density in targeted locations,
- discount/exempt intensification or redevelopment to a higher density of a residential or non-residential parcel in targeted locations,
- discount/exempt charges on agricultural land,
- discount/exempt charges on higher-density affordable housing,
- use accurate assumptions (e.g., for population, housing mix, intensification rates, greenfield densities) as inputs into development cost charge background studies.

Property taxes:

- avoid applying a higher tax rate on multi-residential properties than on other residential properties,
- avoid taxing parking lots and commercial properties that generate car traffic, such as shopping centres, at a lower rate than other properties in that class,
- avoid taxing vacant non-residential (commercial and industrial) properties at a lower rate than other properties in that class,
- discount/rebate property taxes in specific areas (e.g., along frequent bus routes) or on specific types of sites (e.g., brownfields) to encourage development that is consistent with Smart Growth principles.

User fees:

- charge for parking on residential streets, in municipal parking lots, in commercial areas (e.g., metres), and at municipal facilities,
- incorporate lot size and/or location into the calculation of water and sanitary sewer charges,
- charge a stormwater user fee based on lot (or non-pervious surface) size and/or location,
- discount planning fees for development that supports Smart Growth objectives in targeted locations,
- set transit fares at a level low enough to achieve the modal share targets in the municipality's official plan or transportation master plan.

Development Charges and City Planning Objectives[27]

Hardly anywhere is there an attempt to structure development cost charges so as to achieve planning goals. There has been a gradual shift in municipal infrastructure financing practices from a marginal cost or "site-specific" approach, favoured by developers, to an average cost or "municipal-wide" approach, favoured by municipalities.

In designing a local development cost charge regime, municipalities must choose between an average cost and a marginal cost approach. An average cost approach would see the charges assigned on a municipal-wide basis according to specific criteria, such as number and type of dwelling units, so that all projects meeting the criteria pay the same charge, regardless of the actual costs they create. In contrast, a marginal cost approach tries to estimate the actual costs created by specific projects. A site-specific regime estimates the impact that the development is likely to have on the need for public infrastructure provision. In this approach, sites that are more expensive to service because of their topography, their distance relative to existing infrastructure, or their location outside areas targeted for intensification would pay higher fees. Sites that are within the existing urban envelope or within designated sub-

[27] Development Charges and City Planning Objectives: The Ontario Disconnect, Canadian Journal of Urban Research, Ray Tomalty, Andrejs Skaburskis, 2003.

centres, where infrastructure could be more efficiently provided, would have lower development cost charges.

Moreover, the argument that infill development using existing capacity should pay charges seems to contradict the notion that development cost charges are meant to pay for development that increases the need for services. This suggests that the equity principles used to justify the municipal-wide approach - that growth must pay for itself and users should pay for benefits received - may be contradictory.

Because the area-specific approach levies different amounts on different areas of the municipality depending on the cost of servicing that area, it can approximate a marginal cost approach. For instance, an area-specific development cost charge may reflect cost differences attributable to the distance of the development area from major facilities.

The area-specific approach is described by advocates of the municipal-wide system as administratively cumbersome because it requires more elaborate studies to forecast population growth and capital needs for a variety of smaller areas. It also requires a more complicated accounting system to separate the reserve funds for the various development cost charge areas. The area-specific approach is also frowned upon by advocates of the municipal-wide approach for equity reasons: i.e., it unfairly burdens the population in some areas of the municipality that happen to have high growth-related costs.

This reflects the widespread belief that development cost charges are meant to raise funds for growth-related infrastructure, not to influence development patterns or the production of different housing types. The overall conclusion is that development cost charges are geared almost exclusively to their revenue-raising role and are disconnected from planning goals. This emphasis on the revenue raising aspect of development cost charges reflects an underlying political reality: the municipal decision-makers who preside over the design of development cost charges tend to be more concerned with reducing the impacts of growth on existing tax payers (voters) and not so much motivated by a desire to achieve other social objectives.

Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development[28]

Smart Growth is a general term for policies that result in more compact, accessible, multimodal development, in contrast to *urban sprawl*, which refers to dispersed, urban fringe, automobile-dependent development. Comprehensive Smart Growth policies create transit-oriented communities, neighbourhoods where high quality walking, cycling, public transit and carsharing services allow households to minimize their vehicle ownership and use. The following table compares the attributes of Smart Growth and urban sprawl, and the figure map illustrates these different land use patterns.

[28] Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development, Victoria Transport Policy Institute, Todd Litman, 2023.

Table 1 **Comparing Smart Growth and Sprawl** ("Smart Growth," VTPI 2006)

	Smart Growth	Sprawl
Growth pattern	Mostly infill (brownfield) development.	Mostly urban fringe (greenfield) development.
Density	Higher-density, clustered activities.	Lower-density, dispersed activities.
Land use mix	Mixed land use.	Homogeneous (single-use, segregated) land uses.
Scale	Human scale. Smaller blocks and roads, more local services, for pedestrian access	Large scale. Larger blocks, wider roads, more regional services, assuming automobile access.
Services (shops, schools, parks)	Local, distributed, smaller. Accommodates walking access.	Regional, consolidated, larger. Requires automobile access.
Housing types	Diverse, including compact housing types such as townhouses an d apartments.	Primarily single-family housing.
Transport	Multi-modal. Supports walking, cycling and public transit.	Automobile-oriented. Poorly suited for walking, cycling and transit.
Transport connectivity	Highly connected roads, sidewalks and paths, and good connections between modes.	Poorly connected networks with numerous dead-end streets, few paths, and inadequate intermodal connections.
Parking supply	Lower parking supply, higher parking prices	Parking facilities are abundant and usually unpriced
Street design	*Complete streets* that accommodate diverse modes and activities.	Streets designed to maximize motor vehicle traffic volume and speed.
Planning process	Planned and coordinated between jurisdictions and stakeholders.	Poorly planned, with little coordination between jurisdictions and stakeholders.
Public space	Emphasis on the public realm (streets, sidewalks and public parks).	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs).

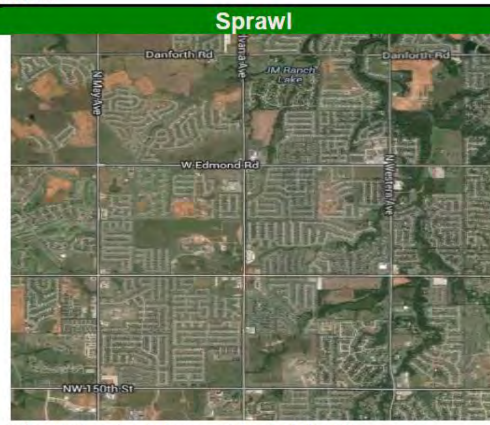
Smart Growth is a set of general principles that can be applied in many ways. In rural areas, it creates compact, walkable villages with a mix of single- and multi-family housing organized around a commercial centre. In large cities, Smart Growth may create dense, urban neighbourhoods with high-rise buildings organized around transit stations. Between these is a wide range of neighbourhood types, their common theme is compact and multi-modal development. In mature cities, Smart Growth consists primarily of incremental infill in existing neighbourhoods, but in growing cities it can consist of urban expansion. Smart Growth does not require that all residents live in high-rise apartments and forego automobile travel; excepting cities with severe geographic constraints, the approach focuses more on providing a variety of ground-oriented and other housing forms, with an overall higher density. See examples in the following figure.

Figure 3 **Sprawl and Smart Growth Illustrated**

Smart Growth

This German town has concentrated and mixed development, with houses close to services and well-defined boundaries. A major portion of travel is by walking, cycling and public transit.

Sprawl



This U.S. suburb has residential development scattered among farms. Many streets lack sidewalks and there is virtually no transit service. This results in high rates of automobile travel.

Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl[29]

Although urban sprawl and Smart Growth differ in many ways, they are often measured based only on density (residents or employees per acre or hectare) or its inverse land consumption (e.g., square feet or metres per resident or employee). Density is a useful indicator because it is widely available and easy to understand, and because it tends to be positively correlated with other Smart Growth factors including development mix (the proximity of residential, commercial and institutional buildings), transport network connectivity (density of sidewalks, paths and roads), centricity (the degree that employment is concentrated into commercial centres), and transport diversity (quality of walking, cycling and public transport).

However, by itself, density is an imperfect indicator since it is possible to have dense sprawl (high-rise buildings in isolated, automobile-dependent areas), and rural Smart Growth (such as compact, walkable villages linked by high quality public transit). If possible, Smart Growth should be analyzed using an index which reflects various land use factors including density, mix, and connectivity.

Density analysis can be confusing because it is measured in many different ways:

- What is measured: residents, residents plus employees, dwelling units (du) and motor vehicles.
- Land area units: acre, hectare, square mile / kilometre.
- Geographic scale: parcel (just the land that is developed), neighbourhood (including local streets, schools, parks, etc.), or region (including industrial areas and regional open space).
- Weighting: Population-weighted density, which measures the density that residents actually experience, is a better indicator than simple average densities for evaluating land use economic and livability impacts, but is more difficult to compute.

A common justification for urban sprawl is that it increases residents' access to "nature" (open space). Sprawl advocates sometimes argue that urban living results in "nature deficit disorder." However, Smart Growth does include open space, including public parks, street trees, and preserved farmlands. Although sprawl residents may have more private open space, they displace more total open space per capita, so sprawl residents can be considered to consume nature while Smart Growth residents preserve nature, resulting in more open space overall.

Open space external benefits are well recognized, including agricultural productivity, wildlife habitat, stormwater percolation, and support for tourism. The loss of these benefits can sometimes be quantified and monetized based on direct economic costs, such as reduced agricultural production or tourism activity, or increased stormwater management costs, or based on the value that nearby residents place on greenspace.

Fiscal Impact Analysis: Methodologies for Planners[30]

There are two basic approaches to fiscal evaluations: using average costs and using marginal costs. Average-cost approaches are simpler and more popular; costs and revenues are calculated based on the average cost per unit of service multiplied by the demand for that unit. Average-cost approaches assume a linear relationship and do not consider excess or deficient capacity of facilities or services.

[29] Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.
[30] Fiscal Impact Analysis: Methodologies for Planners, American Planning Association, L. Carson Bise II, 2010.

DEFINING FISCAL IMPACT ANALYSIS

A Financial Impact Analysis (FIA) projects the net cash flow to the public sector (the local government and, in many cases, the school district) resulting from new development, whether residential, commercial, industrial, or other. An FIA is similar to the cash-flow analysis a developer conducts in order to project costs and revenues likely to result from a proposed development over multiple years. Just as a household benefits by forecasting its long-term cash-flow needs (e.g., incorporating anticipated expenses for higher education and other expensive items) and setting money aside to pay for future outlays, local governments are better prepared to manage community needs during changing financial circumstances if they anticipate and plan for future costs and revenues.

Fiscal analysis enables local governments to estimate the difference between the costs of providing services for new development and the taxes, user fees, and other revenues that will be collected as a result of new development. FIA can be used to evaluate the fiscal effect of an individual development project (e.g., a request for rezoning), a change in land use policy (e.g., increasing allowable densities for development), or a proposed annexation.

It is important to keep in mind that the fiscal impact of development policies, programs, and activities is only one of the issues that local government officials should consider when evaluating policy or program changes related to land use and development. Land uses that are a financial drain or are less beneficial financially than other alternatives should not necessarily be excluded, since they may be necessary to the community's goals related to affordable housing, economic diversity, quality of life, and so on. Moreover, localities have a responsibility to consider other impacts, too, such as the need to evaluate environmental impacts, needs for housing and employment, and other concerns. Nevertheless, fiscal impact data can be used as part of a larger cost-benefit analysis to craft a land use plan that incorporates the appropriate mix of land uses necessary to achieve fiscal sustainability or, at a minimum, fiscal neutrality.

Marginal-cost approaches describe the unique characteristics of a jurisdiction's capital facilities. Although over the long term, average- and marginal-cost techniques will produce similar results, the real value of fiscal analysis is in the longer term period, when a community can incur costs. Marginal-cost analysis is most useful in this time frame. However, average-cost techniques are generally simpler to use, so for relatively small development projects with modest impacts or impacts that are realized over a long time frame, they may be preferred. Some local governments may find it worthwhile to use more than one analysis approach and compare the assumptions and results as part of the decision-making process.

In communities where facilities in geographic sub-areas already are insufficient, the average-cost approach will underestimate costs, whereas the marginal-cost approach will more accurately project the short- to mid-term costs of infrastructure required to accommodate new development. For instance, if an analysis examined school services costs, the average-cost approach would divide the expenditure for school services by the number of students to arrive at a figure per student. This analysis would not consider any spatial distribution of new homes and the resulting schoolchildren. The marginal-cost approach would consider both current school enrollment as well as capacity in each school. If new residential growth were to occur in areas where schools have excess capacity, the only real cost increase will be for operating expenses, whereas if new residential development was to locate in an area with no school capacity, costs would be incurred for additional school capacity (i.e., capital costs) as well as the associated operating expenses.

AVERAGE-COST TECHNIQUES

Per Capita Multiplier

The most popular average-cost technique is the per capita multiplier. This is obtained by dividing the budget for a particular service, such as parks, by the current population, yielding an estimated service cost per person. Under the per capita approach, it is assumed that each service level will be maintained into the future and that each additional resident will generate the same level of costs to the jurisdiction as each existing resident currently generates. This figure is then used to estimate additional costs resulting from new development.

The per capita approach is easy to use but has the disadvantage of being less accurate than other approaches if local officials want to look beyond broad levels of overall costs and expenditures.

Service Standard

A second average-cost approach is the service-standard method. This approach estimates the future costs of development based on average staffing and capital facility service levels for municipalities of similar size and geographic location. This methodology assumes that service levels for both personnel and capital facilities are, to a large extent, a function of a jurisdiction’s total population, and that communities of a similar size will therefore have similar service levels, especially within a geographic region.

Since a fundamental assumption is that personnel growth within one community is equivalent to average personnel growth in the region, to the extent that a community is dissimilar to the “average” in terms of services, costs, or demographics, the figures will be in error.

Proportional Valuation

The third average-cost approach is the proportional valuation method; it is typically used for evaluating the fiscal impacts of non-residential growth. This methodology assumes that assessed property values are directly related to public services costs.

Also included as part of the analysis are refinement coefficients, which are intended to prevent significant differences in the value of residential and non-residential property from skewing cost relationships. The total number of non-residential land parcels is divided by the total number of land parcels, and this figure is used to select the area of a refinement coefficient curve.

The proportional-valuation approach is used infrequently because most analyses include a residential component and because selecting a refinement coefficient for each public service is a fairly subjective process. Additionally, this method assumes that costs increase with land use intensity. This may or may not be the case.

MARGINAL-COST TECHNIQUES

Local Case Study

The most thorough of the FIA approaches uses locally based case information. This case-study approach assumes that every community is unique and that the assumptions regarding levels of service and cost and revenue factors should reflect what is occurring in that community. Department representatives are interviewed about existing public facilities and service capacities. Local information on excess park capacity, for example, makes it possible to predict when new facilities, programs, or personnel may be needed.

In cases where it is difficult to obtain marginal-cost information, communities might use average-cost data in place of local data. For example, estimating the increase over time in general government operating expenses may be done most efficiently using the per capita average-cost approach. On the other hand, local interviews could indicate that the cost for a particular local government service is fixed (i.e., not affected by growth) or semi-variable by population (i.e., affected by growth but not fully variable on a per capita basis).

The primary drawbacks of the case-study approach are that it can require a significant amount of time and that the accuracy of the data depends on the accuracy of each department's estimates. It is not uncommon for departments to estimate that the marginal impacts from new development will require more resources than are currently provided, resulting in new development being charged for a higher level of service than is currently provided.

Comparable City

The second marginal-cost approach looks at costs in comparable jurisdictions. The data are organized by population and by growth rate. This approach assumes that growth will affect expenditure patterns and includes that effect in projecting future costs. Without the rate of population increase or decrease reflected in the tables, this methodology would be very similar to the service-standard approach. This methodology is used infrequently.

BENEFITS OF FISCAL IMPACT ANALYSIS

Encourages Anticipation of Change

One of the major benefits of FIA is that it describes what is likely to happen due to change within a jurisdiction. A fiscal analysis measures the impact of growth or decline on a local government's services, including capital facilities, and the resulting costs and revenues. This is different from the preparation of the next year's budget. In most cases, a fiscal analysis does not replicate the budget; it projects marginal changes in the budget given possible land use, demographic, and employment changes. Fiscal analysis enables local officials to ask "what if" something happens and to consider the effects beyond the next fiscal year. While the resulting data are not necessarily completely accurate, they do provide a clear sense of the likely effects of various policies, which can be crucial to local officials making policy decisions.

Helps Define Achievable Levels of Service

The level of service the local government will provide is an important factor in calculating impact fees and other user fees. To quantify levels of service, department managers must choose an indicator as a basis: the number of residents or jobs in the community, the number of average daily trips on local roads, or some other appropriate denominator. Defining the level of service promotes discussion about the adequacy of services and enables the local government to determine through fiscal analysis whether the community can afford various levels of service, both in terms of the costs of new or expanded capital facilities and annual operating costs.

Projects Capital Facility Needs

A fiscal impact analysis can incorporate information on the available capacity of current capital facilities and project when additions or new facilities will be needed for each development alternative being evaluated. Fiscal analysis also can be used to help allocate new capital facilities to geographic subareas of the community.

The evaluation of capital facilities needs can be helpful in developing or revising the local government's capital improvement program (CIP). The costs and staging of facilities included in the CIP are often based on the independent best estimates of the departments that have activities or programs affected by the proposed capital improvements. Fiscal analysis can add an additional perspective.

Fiscal analysis can help the local government forecast capital-facilities needs over a longer period of time and in a more thorough fashion, giving decision makers more information to make better investment decisions.

Clarifies Development Policy Impacts

In most cases, fiscal impact analysis focuses on the effects of growth or development, usually defined in a development scenario. Development scenarios must be defined for each year of the forecast period in terms of population, employment, housing by type, and non-residential square footage.

Defining development scenarios can be useful. The process of describing in narrative form how and why the numbers were developed is a very important aspect of a fiscal impact analysis, which provides local officials with information to evaluate the logic of the assumptions underlying policies or proposals.

The development scenario and fiscal impact analysis can be used to project how providing the various types of housing that could accommodate this growth (e.g., garden apartments, townhouses, single-detached homes, and condominiums) would affect the need for services over time. Since this scenario projects job growth as well, the fiscal analysis could also assess the fiscal impact of alternative job-growth pictures (e.g., mostly offices with some retail versus industrial growth with some office and retail). Using this process, local officials can review existing and proposed policies from a more informed perspective. Fiscal impact analysis can help not only local officials but also developers take realistic looks at the viability of proposed development.

Calculates Capital Costs and Operating Expenses

The calculation of capital costs and operating expenses is an obvious benefit of a fiscal impact analysis. If the FIA focuses on the marginal costs associated with growth, rather than using an average-cost approach, the results are more likely to accurately reflect annual needs and therefore will be more useful. The calculation of capital costs and operating expenses associated with service changes clearly shows decision makers how the local government's budget will be affected by growth or redevelopment.

Calculates Revenues; Helps in the Development of Revenue Strategies

A fiscal analysis calculates the additional local government revenues resulting from new development, assuming existing rates and fee structures. A fiscal analysis can show the magnitude of the revenues that would be collected under different development scenarios and can show whether there would be a surplus or deficit of revenues over expenditures on an annual as well as a cumulative basis for each alternative considered. This enables local officials to consider alternative sources of revenues.

The first area to evaluate is the structure of rates for various revenue sources. Revenue formulas used to set user fees, utility rates, and property taxes should be reviewed as part of developing a revenue strategy. Possible new revenue sources can also be evaluated.

Even if the fiscal analysis projects a surplus of revenues over expenditures as a result of new development, rate structures for revenues such as user fees should be evaluated regularly so that appropriate fees can be applied to new growth.

Encourages "What If" Questions

A good fiscal impact analysis with a narrative explaining all assumptions and inputs encourages managers to ask a number of "what if" questions. Alternative scenarios can be described for service levels, for the cost and revenue factors, for growth itself, or for almost any other aspect of the analysis. Decision-makers find that some of the major benefits of fiscal analysis are the explicit defining of all the different service level and cost and revenue factors, as well as the ability to change assumptions and quickly see the impact of the changes. This makes fiscal analysis a very effective policy tool.

Appendix B: Case Study Profiles

<table>
<tr><td>Name / Area</td><td>City of Ottawa, Ontario</td></tr>
<tr><td>Study Purpose</td><td>The Update to Comparative Municipal Financial Analysis examines the comparative operating and capital costs and revenues attributable to four categories of development in the City of Ottawa: higher-density urban; lower-density urban greenfield; low-density villages; scattered estate and low-density rural.

The analysis of local services and development charges employs a marginal cost approach derived from 13 representative developments. The capital analysis considers one-time and long-term replacement costs of growth-related capital.</td></tr>
<tr><td>Scope / Year</td><td>City-wide analysis. Operating and capital costs and revenues.
Four different residential categories.
Study completed in 2013.</td></tr>
<tr><td>Scenarios / Typologies</td><td>To account for differences at a more detailed level, a marginal cost approach was employed in regard to growth-related capital. The marginal approach was also used to estimate the revenue (one-time and ongoing taxation and utility rates) that could be anticipated from new development.

The marginal cost and revenue estimates developed were based on a sample of recently built developments. The unit composition for the four scenarios is shown in the following table, ranging from exclusively single-detached housing form in the two rural scenarios, to 41% townhouses in the lower density greenfield scenario, and 30% townhouses and 46% apartments in the higher density urban scenarios.

<table>
<tr><th colspan="6">Urban</th><th colspan="6">Rural</th></tr>
<tr><th colspan="3">Higher-Density</th><th colspan="3">Lower-Density Greenfield</th><th colspan="3">Low-Density Village</th><th colspan="3">Scattered Estate and Low-Density</th></tr>
<tr><th colspan="3">Unit Composition</th><th colspan="3">Unit Composition</th><th colspan="3">Unit Composition</th><th colspan="3">Unit Composition</th></tr>
<tr><td>Singles</td><td>125</td><td>20%</td><td>Singles</td><td>1,251</td><td>57%</td><td>Singles</td><td>545</td><td>100%</td><td>Singles</td><td>558</td><td>100%</td></tr>
<tr><td>Semis</td><td>28</td><td>4%</td><td>Semis</td><td>46</td><td>2%</td><td>Semis</td><td>0</td><td>0%</td><td>Semis</td><td>0</td><td>0%</td></tr>
<tr><td>Towns</td><td>189</td><td>30%</td><td>Towns</td><td>894</td><td>41%</td><td>Towns</td><td>0</td><td>0%</td><td>Towns</td><td>0</td><td>0%</td></tr>
<tr><td>Apts.</td><td>290</td><td>46%</td><td>Apts.</td><td>0</td><td>0%</td><td>Apts.</td><td>0</td><td>0%</td><td>Apts.</td><td>0</td><td>0%</td></tr>
<tr><td>Total</td><td>632</td><td></td><td>Total</td><td>2,191</td><td></td><td>Total</td><td>545</td><td></td><td>Total</td><td>558</td><td></td></tr>
</table>
</td></tr>
<tr><td>Annual Tax Levy and Rate Supported Services (per capita)</td><td>Costs:
• Higher Density Urban - $1,220
• Lower Density Urban Greenfield - $1,627
• Low Density Rural Village - $1,823
• Scattered Estate and Low Density Rural - $1,734
Revenues:
• Higher Density Urban - $1,811
• Lower Density Urban Greenfield - $1,358
• Low Density Rural Village - $1,757
• Scattered Estate and Low Density Rural - $1,490</td></tr>
<tr><td>Net Annual Variance</td><td>• Development in the higher density urban category produces a surplus of $590/capita ($1,124 per household) when levy and rate services are combined.</td></tr>
</table>

(per capita / household)	• Lower-density urban greenfield category has a negative variance of $269/capita ($770 per household). • Low-density rural categories have a negative variance of $66/capita ($188 per household). • Scattered estate have a negative variance of $244/capita ($623 per household).
Key Findings	A significant infrastructure funding gap can be observed when comparing the City's current capital spending to that required, according to ideal asset replacement schedules. As growth occurs the gap will continue to grow. The City should encourage development in higher-density urban areas as it is generally the most cost-efficient. Practically, however, not all future growth can be accommodated by this form of development. One of the primary reasons why the higher-density urban category is preferable in the analysis is due to the higher proportion of apartments and other multiple dwellings in the representative developments. The City should encourage the development of these units throughout the City which would reduce cost disparities. Although the initial capital costs of local services infrastructure are borne by the developer, the long-term replacement of the assets is an important consideration in the analysis. The lower the amount of local infrastructure required by new development, the lower the annual replacement provisions. This is a major reason why apartment developments are preferable from a fiscal standpoint. The City should encourage the development of larger apartment units suitable for families as the municipal cost and revenue per capita values are favourable. However, from a homebuyer's standpoint, the cost per floor area of these units is often higher than of comparatively sized ground-oriented units. When feasible, the City should make use of existing facilities to accommodate growth while looking for opportunities to combine facilities across departments to reduce future upfront capital costs and replacement provision.
Source	'Update to Comparative Municipal Financial Analysis', City of Ottawa. Completed by HEMSON Consulting Ltd. Revised August 2013.

<table>
<tr><td>Name / Area</td><td>Regional Municipality of Ottawa-Carleton, Ontario</td></tr>
<tr><td>Study Purpose</td><td>The Infrastructure Costs Associated with Conventional and Alternative Development Patterns study compares the cost effectiveness of two patterns of development: a conventional suburban development and a mixed-use compact development pattern. The analysis considers the long-term life-cycle costs of various linear infrastructure and community services, and differentiates between public and private costs.</td></tr>
<tr><td>Scope / Year</td><td>An existing development site (338 ha gross) within the Ottawa-Carleton region.
Operating and capital costs and revenues.
Two different development scenarios.
Study completed in 1995.</td></tr>
<tr><td>Scenarios / Typologies</td><td>The studied conventional site exhibits all of the characteristics of a conventional post-war suburban development pattern, including a curvilinear street pattern, relatively low residential densities, homogeneity and separation of land uses, and an emphasis on the private automobile over other modes of travel. An alternative development, planned according to the principles of New Urbanism (with a finer mix of land uses, higher residential densities, narrower rights-of-way and pavement widths, a modified grid system of streets, transit supportive design), was overlaid onto the existing site, and the life-cycle infrastructure costs of the two plans, including emplacement, replacement, and operating and maintenance costs, were calculated and compared.

The conventional plan includes 184 ha of residential land, which yields 4,005 dwellings and a population of 13,045. By comparison, the alternative plan includes 158 ha of residential land, yielding 6,857 dwellings and a population of 20,949. The net residential density of the conventional plan was 21.7 units per hectare, with a gross density of 12.2 uph, while the corresponding residential densities for the alternative plan was a net 43.3 uph and gross 20.9 uph.

There are some significant differences between the two plans:
• The alternative plan has more than twice as much land devoted to commercial uses, and 20% more recreation and open space lands.
• The alternative plan contains 71% more dwelling units than the conventional plan, due, in part, to smaller lot sizes.
• There are over 500 more apartments in the alternative plan, mixed in with commercial, retail and office uses along the main street.
• The alternative plan has a 16% greater length of roads, and almost 15% more asphalt road surface area, not including the rear lanes.</td></tr>
<tr><td>Capital Costs (per unit)</td><td>The initial capital cost of emplacing the infrastructure is approximately $5,300 per unit less in the alternative plan (i.e., 16% cheaper) than in the conventional plan. Savings for road construction are a result of: (1) the increase in residential density spreading the cost of roads over more dwelling units; and (2) the higher proportion of non-residential land uses (7.5% more) lowering the percentage of total road costs apportioned to the residential sector.

Significant cost savings in the areas of storm and sanitary sewers, water distribution, and other services which parallel the road network arise for the same reasons.</td></tr>
</table>

Comparison of Per Unit Emplacement Costs ($)

	Service Component	Conventional Site	Alternative Plan	Difference	%
1.	Roads (inc. utilities & service connections)	5,272	3,311	-1,961	-37
2.	Sidewalks & Streetlighting	498	636	+138	+28
3.	Sanitary Sewer	1,885	1,191	-694	-37
4.	Stormwater Management	3,491	2,210	-1,281	-37
5.	Water Distribution	1,758	1,258	-500	-28
6.	Transit	1,059	881	-178	-17
7.	Fire Protection	348	301	-47	-14
8.	Police Protection	362	313	-49	-14
9.	Parkland	3,591	3,368	-223	-6.2
10.	Recreational Facilities	3,335	3,183	-152	-4.6
11.	Libraries	522	489	-33	-6.3
12.	Works & Parks Department	417	358	-59	-14
13.	Garbage Collection	0	0	0	0
14.	Hydro-Electric Services	1,992	1,731	-261	-13
15.	School Facilities/Transportation	10,034	10,033	-1	0
	Total	**$34,564**	**$29,263**	**$-5,301**	**-16**

Lifecycle Costs (per unit)

Infrastructure costs were more economical in the alternative plan; life-cycle savings of approximately $11,000 per unit over a 75-year period. Expressed as a percentage, the linear infrastructure, including roads, utilities, sewer, water, and stormwater management, represents the greatest per unit cost savings.

A reduction in infrastructure emplacement (i.e., roads, street lights, piped services, parks) costs of approximately $5,300 per unit represents the largest life-cycle cost savings. Operating and maintenance costs are $3,700 less per unit in the alternative plan, and infrastructure replacement is $2,000 less per unit. Construction, replacement, operating, and maintenance costs, as a proportion of total lifecycle costs, remain relatively constant in both plans, at approximately 26%, 7%, and 65-68%, respectively.

Comparison of Per Unit Total Life-Cycle Costs ($)

	Service Component	Conventional Site	Alternative Plan	Difference	%
1.	Roads (inc. utilities & service connections)	10,446	7,392	-3,054	-29
2.	Sidewalks & Streetlighting	936	1,225	+289	+31
3.	Sanitary Sewer	2,652	1,677	-975	-37
4.	Stormwater Management	4,105	2,606	-1,499	-37
5.	Water Distribution	3,534	2,446	-1,088	-31
6.	Transit	9,104	7,774	-1,330	-15
7.	Fire Protection	5,204	4,496	-708	-14
8.	Police Protection	7,466	6,450	-1,016	-14
9.	Parkland	4,735	4,325	-410	-8.7
10.	Recreational Facilities	7,794	7,434	-360	-4.6
11.	Libraries	2,934	2,752	-182	-6.2
12.	Works & Parks Department	772	663	-109	-14
13.	Garbage Collection	2,453	2,301	-152	-6.2
14.	Hydro-Electric Services	6,270	5,893	-377	-6.0
15.	School Facilities/Transportation	56,804	56,799	-5	0
	Total	**$125,209**	**$114,233**	**$-10,977**	**-8.8**

Key Findings

In addition to providing significant public and private cost savings, the alternative development plan accommodates many more units, thereby reducing pressures to find and develop new residential land. The increased density supports mixed-use development, stimulates the provision of a range of housing and transportation options, and a variety of employment, commercial, and community activities.

Source

'Infrastructure Costs Associated with Conventional and Alternative Development Patterns: Final Report and Summary Report', for CMHC, Regional Municipality of Ottawa-Carleton, prepared by: Essiambre Phillips Desjardins Associates Ltd., in association with J.L. Richards & Associates Limited, C.N. Watson Associates Ltd., A Nelessen Associates Inc., 1995.
'Infrastructure Costs Associated with Conventional and Alternative Development Patterns', CMHC Research Highlights, Socio-Economic Series, Issue 26, 1996.

Name / Area	**City of Kingston, Ontario**
Study Purpose	The intent of the Lifecycle Fiscal Impacts of Development study was to draw observations from the analysis that can be used to inform strategic growth management decisions. The study measures the fiscal impacts of growth as anticipated within the City’s Population, Housing and Employment Growth Forecast, 2016 to 2046.
Scope / Year	City of Kingston, 2021
Scenarios / Typologies	The study considered the full cost accounting obligations of new development, including operating and lifecycle capital costs of service on an annualized basis at full development. Residential Development Types: • Low Density: Single/Semi-Detached; With Second Residential Units • Medium Density: Townhouse; Row; Duplex, Triplex, Quad, Sixplex • High Density: Condominium; Apartment; Retirement Home
Fiscal Impacts by Geographic Area	The table below summarizes the fiscal impacts for residential development by geographic area. The first part of the table provides the full cost lifecycle accounting fiscal impacts by dwelling unit type for each of the surveyed developments, and by land area (net hectare) based on the underlying development type and density assumptions of the City’s Growth Forecast. The second half of the table aggregates these observations by geographic area, comprising the averages of each surveyed development in the respective geographic area.

Residential Fiscal Impacts by Geographic Area (2020 dollars per hectare)

Area	2020 Surplus/(Deficit) per Dwelling Unit					2020 Total Surplus/(Deficit) per Hectare					
	Low	Low (w/ 2nd Unit)	Medium	Apartment	Condo	Low	Low (w/ 2nd Unit)	Medium	Apartment	Condo	Total
Cataraqui North	(1,130)	(2,915)	(313)	(224)	1,061	(13,301)		(1,157)	(2,003)	1,675	(14,785)
Williamsville Main Street	(764)	(2,584)	(964)	(220)	1,458	(324)	(13,247)	(4,491)	(9,227)	10,804	(16,485)
Greenwood Park	(1,668)	(3,776)	(732)	(80)	2,619	(21,754)		(2,482)	(195)	1,127	(23,304)
Westbrook	(1,040)	(3,358)	(711)	(299)	2,730	(12,243)		(2,631)	(2,674)	4,308	(13,240)
Near Queen's Campus	2,738	(289)	(367)	(515)	7,981	1,160	(1,480)	(1,712)	(21,616)	59,163	35,516
North King's Town	(1,232)	(2,584)	(1,640)	(457)	1,503	(522)	(13,247)	(7,644)	(19,176)	11,139	(29,450)
Bayridge	(908)	(2,584)	(788)	(299)	2,730	(10,684)		(2,916)	(2,674)	4,308	(11,966)

Area	2020 Surplus/(Deficit) per Dwelling Unit					2020 Total Surplus/(Deficit) per Hectare					
	Low	Low (w/ 2nd Unit)	Medium	Apartment	Condo	Low	Low (w/ 2nd Unit)	Medium	Apartment	Condo	Total
Kingston West	(1,026)	(2,952)	(604)	(274)	2,174	(12,076)		(2,235)	(2,450)	3,430	(13,330)
Kingston Central	247	(1,819)	(990)	(397)	3,647	105	(9,324)	(4,615)	(16,673)	27,035	(3,473)
Kingston East	(1,668)	(3,776)	(732)	(80)	2,619	(21,754)		(2,482)	(195)	1,127	(23,304)
Total Kingston	(572)	(2,584)	(788)	(299)	2,869	(5,231)	(3,212)	(3,075)	(4,879)	8,262	(8,135)

Fiscal Impacts by Development Type	The table below summarizes the net levy fiscal impacts on a per dwelling unit basis for different types of residential uses, and on a per 1,000 square feet of gross floor area basis for various non-residential development, in 2020 dollars.

Fiscal Impact Summary for Residential and Non-Residential Developments ($2020)

Type	Average assessed value	2020 Property tax revenue	2020 Net operating expenditure	Incremental facility/ equipment operating expenditures	2020 Operating surplus	Incremental life cycle capital expenditures	Incremental local service capital expenditures	2020 Surplus/ deficit
Single detached, semi-detached	408,099	4,614	2,023	347	2,244	1,685	1,131	-572
With second residential unit	363,376	4,067	2,754	473	841	2,294	1,131	-2,584
Rowhouse, townhouse	243,544	2,741	1,584	272	886	1,319	354	788
High rise condominium	472,790	5,273	1,151	198	3,924	959	96	2,869
High rise apartment	188,373	2,105	1,151	198	756	959	96	-299
Commercial retail	151,021	3,276	585	242	2,449	1,072	293	1,084
Commercial office	142,315	3,185	836	346	2,004	1,532	376	96
Industrial	68,913	1,954	641	265	1,047	1,176	567	-695

<table>
<tr><td>Fiscal Impacts by Land Area (Net Hectare)</td><td>
Based on this weighting of development:

Kingston West would produce an annual fiscal deficit per net hectare of $13,460 for full cost lifecycle accounting obligations. This would equate to an increase to 2020 tax rates of 15% to fully fund these obligations.
Kingston Central would produce an annual fiscal surplus of $2,309 per ha.
Kingston East forecast development would produce an annual fiscal deficit of $24,464 per ha. or requiring 2020 tax rate increases of 33% to achieve full cost accounting recovery. Incorporating the respective development across the three geographic areas would produce a weighted overall deficit of $7,701/ha.
To achieve full cost lifecycle accounting levels, the 2020 tax rate would be required to increase by 7%.

Overall Fiscal Impacts by Geographic Area (2020 dollars per hectare)
<table>
<tr><th rowspan="2">Area</th><th colspan="2">Residential</th><th colspan="2">Non Residential</th><th rowspan="2">Total 2020 Surplus/ (Deficit) per Ha</th><th rowspan="2">Total 2020 Tax Revenues per Ha</th><th rowspan="2">Full Lifecycle Cost Tax Impact</th></tr>
<tr><th>Net Developable Land (Ha)</th><th>2020 Surplus/ (Deficit) per Ha</th><th>Net Developable Land (Ha)</th><th>2020 Surplus/ (Deficit) per Ha</th></tr>
<tr><td>Kingston West</td><td>80%</td><td>(13,330)</td><td>20%</td><td>(13,970)</td><td>(13,460)</td><td>87,437</td><td>-15%</td></tr>
<tr><td>Kingston Central</td><td>69%</td><td>(3,473)</td><td>31%</td><td>15,335</td><td>2,309</td><td>155,001</td><td>1%</td></tr>
<tr><td>Kingston East</td><td>65%</td><td>(23,304)</td><td>35%</td><td>(26,590)</td><td>(24,464)</td><td>73,256</td><td>-33%</td></tr>
<tr><td>Total Kingston</td><td>75%</td><td>(8,135)</td><td>25%</td><td>(6,378)</td><td>(7,701)</td><td>105,817</td><td>-7%</td></tr>
</table>
</td></tr>
<tr><td>Key Findings</td><td>
Based on the current average assessed value per residential unit in the respective geographies, the study found the following:

Low density residential development (in the Near Queen’s Campus area) would fiscally perform better as compared to the other areas, generating surplus revenues of $2,738 per unit. Similar development in the Greenwood Park area would fiscally perform worse at an annual deficit of $1,668 per unit.
For second residential units (in the Near Queen’s Campus area) would fiscally perform better as it has a comparative advantage in assessed value to the other surveyed areas of the City.
Medium density residential development (in the Cataraqui North area) would fiscally perform better compared to the other areas, generating an annual deficit of $313 per unit. Similar developments in the North King’s Town area would fiscally perform worse at an annual deficit of $1,640 per unit.
High rise condominiums (in the Near Queen’s Campus area) would fiscally perform better which produces higher than average annual surplus revenues per unit. Comparatively, similar developments within the Cataraqui North area would produce the lowest per unit assessed values for the surveyed geographic areas.
High rise apartment residential (in the Greenwood Park area) would fiscally perform better and worse in the Near Queen’s Campus area given the property assessment values across the surveyed geographic areas of the City for these types of residential dwelling units is generally consistent.

</td></tr>
<tr><td>Source</td><td>‘Lifecycle Fiscal Impacts of Development’, City of Kingston.
Watson & Associates Economists Ltd. March 23, 2021.</td></tr>
</table>

<table>
<tr><td>Name / Area</td><td>Calgary, Alberta</td></tr>
<tr><td>Study Purpose</td><td>The City of Calgary commissioned to study to assist in development of an integrated plan for land use and transportation. Over the projected 60 years the population of Calgary is expected to grow from approximately 1 million to 2.3 million people, with another 0.5 million people in the surrounding region.

The types of infrastructure investigated in the report are transportation (i.e., roads and transit), water and sewage service, police, fire, parks, recreation centres in schools.</td></tr>
<tr><td>Scope / Year</td><td>City-wide analysis. Capital and operating costs totals (not per capita).
Two different growth / development scenarios.
Study completed in 2009.</td></tr>
<tr><td>Scenarios / Typologies</td><td>The study examines the infrastructure implications of two growth patterns: the dispersed scenario, reflecting current trends and the continuation of current city policy; while the recommended direction intensifies jobs and population in specific areas in the city and links them with high quality transit infrastructure.

Comparison of alternative development forms: conventional suburban development or Sprawl vs. traditional neighbourhood development or Smart Growth. The land required for the recommended direction / scenario is 25% smaller than the dispersed scenario.</td></tr>
<tr><td>Infrastructure Costs</td><td>As shown in the table below, the cost to build the recommended direction is 33% less expensive than the dispersed scenario.

Total Cost ($billion)
<table>
<tr><th></th><th>Dispersed Scenario</th><th>Recommended Direction</th><th>Difference</th><th>Percent Difference</th></tr>
<tr><td>Road Capital Cost</td><td>$17.6</td><td>$11.2</td><td>$6.4</td><td>-36%</td></tr>
<tr><td>Transit Capital</td><td>$6.8</td><td>$6.2</td><td>$0.6</td><td>-9%</td></tr>
<tr><td>Water and Wastewater</td><td>$5.5</td><td>$2.5</td><td>$3.0</td><td>-54%</td></tr>
<tr><td>Fire Stations</td><td>$0.5</td><td>$0.3</td><td>$0.2</td><td>-46%</td></tr>
<tr><td>Recreation Centres</td><td>$1.1</td><td>$0.9</td><td>$0.2</td><td>-19%</td></tr>
<tr><td>Schools</td><td>$3.0</td><td>$2.1</td><td>$1.0</td><td>-32%</td></tr>
<tr><td>Total</td><td>$34.5</td><td>$23.1</td><td>$11.4</td><td>-33%</td></tr>
</table></td></tr>
<tr><td>Operating Costs (total)</td><td>As shown in the table below, the recommended direction would be 14% less expensive to operate over the 60 years of the scenario.

"Horizon Year" Annual Operating Cost Comparison ($billion)

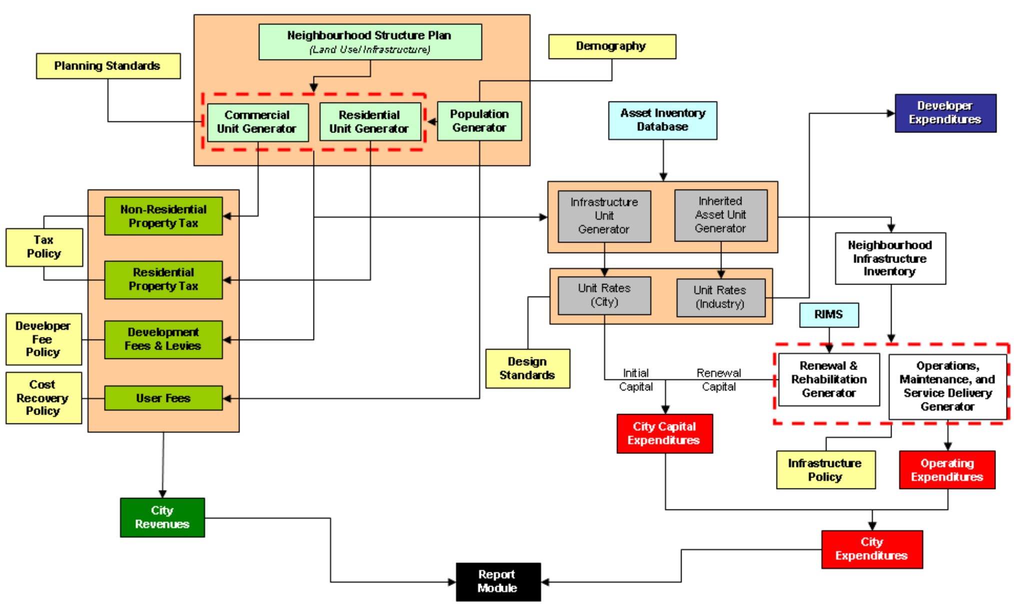
Total Cost ($billion)
<table>
<tr><th></th><th>Dispersed Scenario</th><th>Recommended Direction</th><th>Difference</th><th>Percent Difference</th></tr>
<tr><td>Road Operations</td><td>$0.23</td><td>$0.19</td><td>$0.04</td><td>-18%</td></tr>
<tr><td>Transit Net Operating</td><td>$0.30</td><td>$0.30</td><td>$0.00</td><td>0%</td></tr>
<tr><td>Water and Wastewater</td><td>$0.06</td><td>$0.03</td><td>$0.03</td><td>-55%</td></tr>
<tr><td>Fire Stations</td><td>$0.28</td><td>$0.23</td><td>$0.05</td><td>-18%</td></tr>
<tr><td>Parks</td><td>$0.13</td><td>$0.12</td><td>$0.01</td><td>-9%</td></tr>
<tr><td>Total</td><td>$0.99</td><td>$0.86</td><td>$0.13</td><td>-14%</td></tr>
</table></td></tr>
</table>

Net Variance	The fiscal estimates provide for a relative comparison of the two growth patterns. The compact growth 30-year scenarios (2010 to 2040) identified savings of 33% for the City of Calgary, for the capital cost of roads, transit, water, emergency response, schools and recreation services, and savings of 14% on operational costs.
Key Findings	The primary development settings for urban growth include high-density, clustered infill development (Smart Growth) within inner city areas and low-density, dispersed greenfield developments (Urban Sprawl) in fringe areas. Compact growth through infill instead of fringe development reduces per-capita land consumption and saves on costs of new land development, building new roads and extending underground linear utilities.
Source	'The implications of alternative growth patterns on infrastructure costs', City of Calgary, Report by IBI Group, 2009.

<table>
<tr><td>Name / Area</td><td>Edmonton, Alberta</td></tr>
<tr><td>Study Purpose</td><td>The City of Edmonton encounters infrastructure challenges owing to rapid growth, including issues of sustainability, land use planning, changing service levels, and municipal financing. New developments have a significant impact on the short and long term financial health of the City in terms of revenues and expenditures. To overcome these challenges, the City developed an analytical model to assess neighbourhood growth on a case-by-case basis. The Development Infrastructure Impact Model is a prototype model that was developed to understand the growth and development of new neighbourhoods in Edmonton.</td></tr>
<tr><td>Scope / Year</td><td>17 neighbourhoods in the city-region.
Study completed in 2012.</td></tr>
<tr><td>Scenarios / Typologies</td><td>The model was developed to understand the growth and development of new neighbourhoods in Edmonton. The model provides a high level quantitative analysis of infrastructure, in terms of physical quantities and financial investment in individual neighbourhoods, whose build-out is based on anticipated growth patterns.

The model uses neighbourhood-specific information provided by a developer, detailing expected population, land use areas, circulation areas and residential density breakdowns. This information is used by the model to create infrastructure requirements based on three related drivers:

Population based requirements and costs for service facilities such as libraries, police stations, fire halls and community recreation facilities.
Area based requirements and costs for infrastructure such as local, collector and arterial roads, storm and sanitary sewers, and parks.
Population and area based requirements such as transit service.


</td></tr>
<tr><td>Infrastructure Costs</td><td>17 neighbourhoods were selected for the analysis and were based on current development status, neighbourhood areas, population demographics, land use patterns (residential vs. commercial), and residential densities. The Neighbourhood Structure Plans that had been created by the development industry served as input for the analysis.</td></tr>
</table>

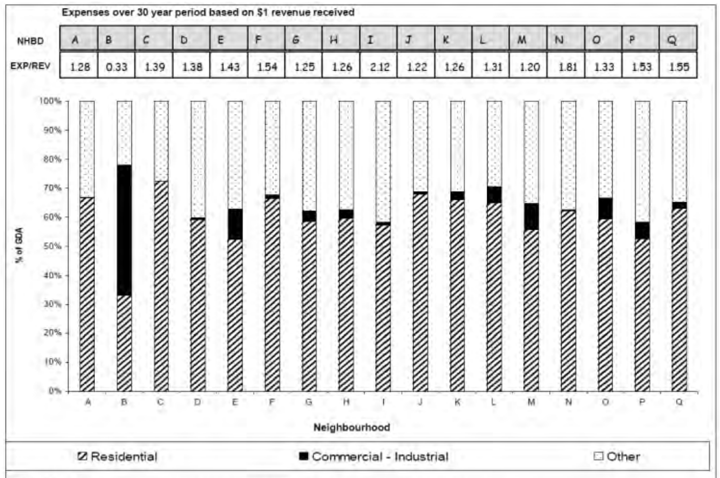
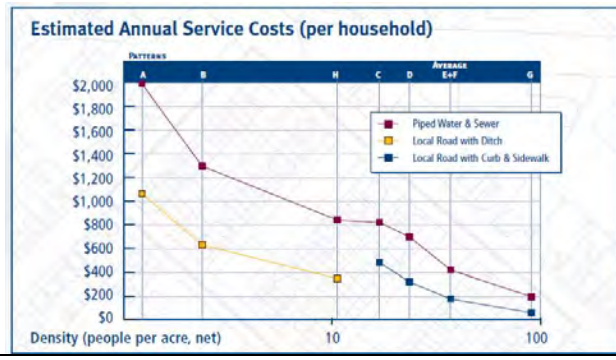
<table>
<tr><td>Operating Costs over 30 years (total)</td><td>The table below summarizes the revenue and expenditure ratio for each of the analyzed neighbourhoods against its ratio of residential, commercial and other land uses. The revenue and expenditure ratio depicts the amount of expenditure for each dollar of revenue received during the first 30 years (i.e., once the neighbourhood is fully developed). All have greater expenses than revenues, with one exception, i.e., the highest land use mix and residential densities.


Table 1 LAND USE BASED ON PERCENTAGE OF GROSS DEVELOPABLE AREA</td></tr>
<tr><td>Net Variance</td><td>It is worth noting that the renewal values presented within the first 30 years reflect an attempt to depict realistic expenditure. In other words, major renewal expenditures do not occur until later in the lifecycle of an asset, and in some assets little activity would typically occur in the first 30 years. The ongoing expenses and revenues beyond the 30-year period are represented on an annual basis, based on the trend analysis of each of the 17 neighbourhoods.</td></tr>
<tr><td>Key Findings</td><td>It is very clear that expenditures incurred far exceed the revenues generated from the neighbourhoods, in all but the one case.

Direct revenues (i.e., property taxes and user fees) resulting from residential development are not sufficient to pay for the initial capital, operation, maintenance, and life cycle renewal costs of services and infrastructure. However, these developments have a broader positive effect on the community and economy overall.

From the results of the case study, it is evident that neighbourhoods by themselves do not pay for themselves. Rather there are several contributing factors that need to come into play while determining a sustainable neighbourhood, including a dynamic mix of land use patterns, residential density mixes, and various tax patterns. Given the interconnectivity and proximity of neighbourhoods within their vicinity, there is a need to take a holistic approach when dealing with neighbourhood analysis.</td></tr>
<tr><td>Source</td><td>‘Quantifying Financial Impacts of New Suburban Development: A Case Study’, 1st International Specialty Conference on Sustaining Public Infrastructure, Edmonton, 2012.</td></tr>
</table>

Name / Area	**Halifax Regional Municipality, Nova Scotia**
Study Purpose	The 2005 study analyzes the impact of local densities on servicing costs. Samples of different residential patterns that may be seen in the Halifax Regional Municipality and estimates of service costs were used. The 2013 study assesses four regional growth scenarios for the Halifax region, to determine and compare public, private, and social costs and benefits anticipated from these scenarios over the period from 2011 to 2031.
Scope / Year	2005 study: eight case studies of densities. 2013 study: four growth scenarios.
Scenarios / Typologies	The first scenario was to reflect Regional Municipal Planning Strategy goals for growth in designated urban (Regional Centre), suburban, and rural portions of the region. The second scenario was to reflect the continuation of recent trends that have fallen short of the Strategy's goals. The third and fourth scenarios were to reflect stronger regional goals emphasizing greater concentration of growth in the core of the region.
Servicing Costs Per Household by Density	The following public services were considered: Roads, Transit, Water, Wastewater & Stormwater, Solid Waste, Parks & Recreation, Libraries, Police, Fire. The figure shows three services very closely linked to land use (i.e., roads, water and sewer) and illustrates the link between density and costs. 
Operating Costs by unit	The table below shows the costs across different density patterns for comparable levels of service. A summary of the costs for each of the eight sample patterns: from left to right, density increases from lower to higher, as costs decrease. In Pattern A, there are more than 122 metres (400 feet) of total road frontage for each household, while the frontage is less than 1.8 m (6 ft) per household in Pattern G, which includes apartments. Of the services that are commonly available, Pattern A is nearly three times as expensive as Pattern G. From the perspective of public services, the higher levels of service and cost available in more urbanized areas, such as sidewalks and central water and wastewater services, will offset some of this differential. However, this is only true to the extent that: 1) these services are never extended to the low density areas and, 2) the costs of private water and sewage treatment, as well as other private, social, and environmental costs, are excluded.

SUMMARY Estimated Annual Costs per Household (Listed according to density)

	Pattern A[1] Rural Commutershed	Pattern B[1] Rural Commutershed	Pattern H[1] Rural Commutershed	Pattern C[1] Suburban	Pattern D[1] Urban	Pattern E[2] Suburban	Pattern F[2] Urban	Pattern G[3] Urban
	Low Density 1.2 people/acre	Low Density 2.2 people/acre	Low Density 10.4 people/acre	Low Density 16 people/acre	Low Density 22 people/acre	Mid Density 36 people/acre	Mid Density 36 people/acre	High Density 92 people/acre
Common Services:								
Roads (no curbs)	$1,053	$621	$339	$280	$184	$76	$124	$26
Solid Waste	$200	$200	$200	$185	$185	$185	$185	$185
Libraries[4]	$72	$72	$72	$72	$72	$48	$48	$38
Parks/Recreation[4]	$129	$129	$129	$129	$129	$86	$86	$69
Police[4]	$360	$360	$360	$360	$360	$240	$240	$192
Fire[4]	$324	$324	$324	$406	$379	$231	$248	$177
School Bussing	$186	$186	$186	$87	$25	$58	$17	$13
Culture/Economy	$36	$36	$36	$36	$36	$24	$24	$19
Governance	$297	$297	$297	$297	$297	$198	$198	$158
HRM to Province	$435	$435	$435	$435	$435	$290	$290	$232
Subtotal	**$3,092**	**$2,660**	**$2,378**	**$2,287**	**$2,102**	**$1,436**	**$1,460**	**$1,109**
Other Services:								
Curbs&Sidewalks	$0	$0	$0	$194	$128	$52	$86	$27
Transit[1]	$171	$171	$171	$171	$171	$114	$114	$91
Water	$425	$425	$425	$197	$176	$77	$146	$42
Waste/Stormwater	$625	$625	$625	$613	$514	$235	$364	$147
Subtotal	**$1,221**	**$1,221**	**$1,221**	**$1,175**	**$989**	**$479**	**$710**	**$307**
extended[5] Water/Wastewater	$927	$234	-$219					
Total	**$5,240**	**$4,115**	**$3,380**	**$3,462**	**$3,091**	**$1,914**	**$2,170**	**$1,416**

1) Household size estimated at 3 people per household
2) Household size estimated at 2 people per household
3) Household size estimated at 1.6 people per household
4) Costs allocated simply on "per capita" basis
5) incremental on-going (annual) costs, only; does not include remediation/installation (capital) costs

<table>
<tr><td>Total Costs</td><td>The top three cost categories that drive the differences between scenarios are transportation (e.g., travel time, travel costs, road construction, and capital), water and wastewater capital and operation, and health and environment (e.g., GHG emissions, traffic accidents, and other transport-related environmental costs). For the municipality, the main cost drivers are: local / regional road capital, water / wastewater capital, and services for solid waste, police, and fire protection.

These differences to the year 2031 shared across the new dwelling units would represent an $8,845 cost savings ($385/year); a $22,841 savings ($993/year) for Scenario A; and a $31,645 savings ($1,376/year) for Scenario B (totals are shown in the table).

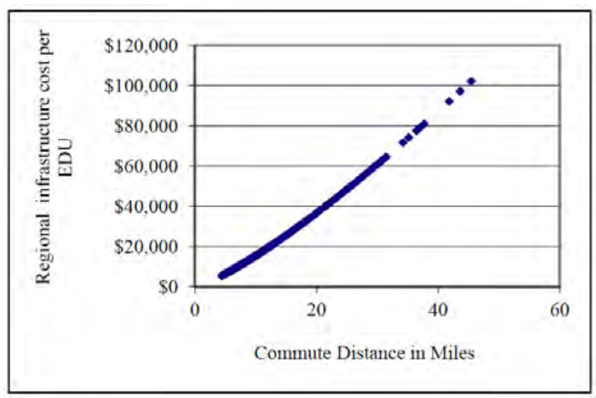
<table>
<tr><th colspan="5">Table 9.4 Summary of Municipal Revenues ($000s) by Scenario, HRM, 2009-2031</th></tr>
<tr><th>Dwelling Unit Type</th><th>RMPS Goals</th><th>Post RMPS Trend</th><th>Scenario A</th><th>Scenario B</th></tr>
<tr><td>Singles and Semis</td><td>$1,088,552</td><td>$1,079,812</td><td>$865,955</td><td>$714,617</td></tr>
<tr><td>Difference from trend</td><td>$8,741</td><td>$0</td><td>-$213,856</td><td>-$365,195</td></tr>
<tr><td>Apartments and Other</td><td>$292,795</td><td>$287,253</td><td>$388,015</td><td>$449,175</td></tr>
<tr><td>Difference from trend</td><td>$5,542</td><td>$0</td><td>$100,761</td><td>$161,922</td></tr>
<tr><td>TOTAL REVENUES</td><td>$1,381,347</td><td>$1,367,065</td><td>$1,253,970</td><td>$1,163,791</td></tr>
<tr><td>Difference from trend</td><td>$14,282</td><td>$0</td><td>-$113,095</td><td>-$203,274</td></tr>
</table>

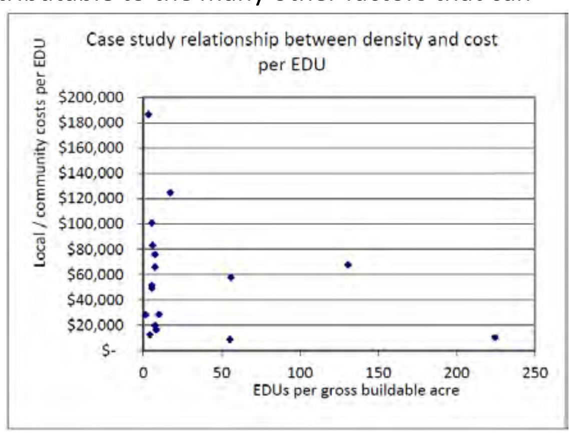
Relative to the trend since the adoption of the Strategy, adherence to its goals would yield $14 million more property tax revenue over the 2009 to 2031 period ($0.6 million/year); while Scenario A would produce $113 million less revenue (-$5 million/year), and Scenario B would yield $203 million less (-$9 million/year). The lower revenues found for Scenarios A and B are attributable to the greater number of apartment units.

Overall municipal costs estimated to deal with new development substantially exceeded expected revenues by a factor of at least two under all four scenarios. These costs produce net losses (municipal revenues minus costs), ranging from just over $1 billion for Scenario A to nearly $2 billion for the Trend Scenario. New residential developments, in other words, do not pay their way and are subsidized by the existing tax base and by new commercial development that they complement and support.

<table>
<tr><th colspan="5">Table 9.5 Summary of Net Municipal Impacts ($000s) by Scenario, HRM, 2009-2031</th></tr>
<tr><th>Category</th><th>RMPS Goals</th><th>Post RMPS Trend</th><th>Scenario A</th><th>Scenario B</th></tr>
<tr><td>Costs</td><td>$3,243,263</td><td>$3,294,595</td><td>$2,844,354</td><td>$2,375,832</td></tr>
<tr><td>Revenues</td><td>$1,381,347</td><td>$1,367,065</td><td>$1,253,970</td><td>$1,163,791</td></tr>
<tr><td>Revenues - Costs</td><td>-$1,861,916</td><td>-$1,927,530</td><td>-$1,590,384</td><td>-$1,212,041</td></tr>
<tr><td>Difference from trend</td><td>$65,614</td><td>$0</td><td>$337,146</td><td>$715,489</td></tr>
</table>

The net savings for each scenario relative to the trend over the period is $66 million for the strategy, $337 million for Scenario A, and $715 million for Scenario B.</td></tr>
<tr><td>Key Findings</td><td>Densities of residential areas and their distance to commercial areas and large public infrastructure (e.g., treatment plants) have a significant impact on the costs of ‘hard’ infrastructure-based services such as water, wastewater, and roadways. Some residential patterns may have life-cycle costs ten times that of other patterns. Often, the capital cost of a new road or facility is seen as the main financial barrier to service growth, however most of the service costs occur after it is built.</td></tr>
<tr><td>Source</td><td>‘Settlement Pattern and Form with Service Cost Analysis’, Halifax Regional Municipality, 2005.
‘Quantifying The Costs And Benefits Of Alternative Growth Scenarios’, Halifax Regional Municipality, Stantec, 2013.</td></tr>
</table>

Name / Area	**Portland Region, Oregon, USA**
Study Purpose	To assist in growth management decisions, the Comparative Infrastructure Costs: Local Case Studies analysis focuses on the infrastructure capital costs for new developments in both urban and newly urbanizing areas from throughout the Portland Region. These developments are each unique, having different benefits, proposed uses, levels of service, surrounding uses, and topography. Nevertheless, these case studies are a useful means of understanding what factors may influence infrastructure costs.
Scope / Year	17 different case studies in the region. Capital costs only. Study completed in 2008.
Scenarios / Typologies	The case studies have different sizes, proposed uses (e.g., residential or employment), access to existing facilities and amenities, locations, and topographies. The analysis does not control for all of these differences as these factors all influence infrastructure costs. In the case of land use, however, the analysis standardizes the case studies because employment and residential uses place different demands on infrastructure. Therefore the analysis uses a standardized measurement called an equivalent dwelling unit (EDU). The analysis divides infrastructure into two categories, depending on the infrastructure's user base: local / community and regional infrastructure, and only documents the public capital costs of providing new infrastructure. It does not include the cost of ongoing maintenance and operations of public facilities.
Infrastructure	The focus of this analysis is on the following categories of infrastructure: • Civic buildings, parking structures, public plazas • Regional facilities, such as marine and air ports • Parks, Schools • Sanitary Sewers, Stormwater, Water • Transportation (Roads, bridges, highways; Transit, bike, pedestrian)  Depending on the type of regional infrastructure, either flat or variable costs were applied for each anticipated household or job. Flat costs were applied for marine, air, and other non-transportation regional facilities. These costs are not for specific facilities but were instead intended to represent the typical regional infrastructure demands that new households and jobs create. To estimate the demand that different case study locations may place on regional transportation facilities (e.g., highways, transit and bridges), variable costs were calculated. As illustrated in the figure, an EDU that makes longer distance trips places greater demands on transportation facilities than an EDU that makes shorter distance trips. An EDU's demand for regional transportation facilities was assumed to vary according to forecasted commute distance.

Cost per Unit	This analysis is not a statistical analysis that can definitively determine the effects of any particular factor on infrastructure costs. However, some general lessons can be gleaned. The case studies indicate that some factors that can influence the costs of serving an EDU include: • Site topography; • Environmental features; • Land ownership patterns; • Distance from existing infrastructure; • Presence or absence of existing infrastructure capacity; • Development density; • Proposed use; • Level of service or quality of amenities; and • Travel behaviour (of residents or employees).
Key Findings	As illustrated in the figure, all other things being equal, higher density developments are less expensive to serve (on a per EDU basis) than lower density developments. The relationship between residential density and infrastructure demand is fairly intuitive, i.e., larger lots require more lineal feet of pipes and pavement per household. These increased lengths translate into higher costs. Despite this general rule, however, the lower density case study areas reveal a great deal of variation in the costs per EDU. This variation is attributable to the many other factors that can influence costs. These factors may include level of service or the provision of amenities such as parks and sidewalks and other facilities such as schools. Most of the higher density case studies (e.g., those with 50 or more EDUs per gross buildable acre) do, however, have relatively low local / community infrastructure costs per EDU. 
Source	‘Comparative Infrastructure Costs: Local Case Studies’, Discussion draft, Metro Portland, 2008.

<table>
<tr><td>Name / Area</td><td>Perth, Australia</td></tr>
<tr><td>Study Purpose</td><td>The Costs of Urban Sprawl – Infrastructure and Transportation, Environment Design Guide and Cost Comparison of Infrastructure on Greenfield and Infill Sites examined the implications of two alternative approaches to urban development: i.e., redevelopment in walkable transit-oriented developments, and fringe development in conventional low-density car dependent suburbs.</td></tr>
<tr><td>Scope / Year</td><td>Comparing two different theoretical development forms.
Papers completed in 2010 and 2017 respectively.</td></tr>
<tr><td>Scenarios / Typologies</td><td>As shown below, the research examined the economic costs associated with the two forms of development, first assessing the physical planning costs associated with the different transport and infrastructure requirements.
<table>
<tr><th></th><th>Urban Redevelopment</th><th>Fringe Development</th></tr>
<tr><td>Daily per capita Greenhouse Gas Emissions from transport (Measured in CO_2-e)</td><td>0 to 4 Kg</td><td>8 up to 10 Kg</td></tr>
<tr><td>Distance to CBD</td><td>less than10 km</td><td>more than 40 km</td></tr>
<tr><td>Activity Intensity (measured by population and jobs per hectare)[1]</td><td>> 35</td><td>< 20</td></tr>
<tr><td>Transit Accessibility[2]</td><td>more than 80% with >15min service</td><td>less than 15% with >15min service</td></tr>
</table>
The challenge in interpreting the assessments is that infrastructure costs are so heavily dependent on area-specific factors. For example: road costs among different prospective development areas may vary based on the necessity for major arterial roads; costs for sewerage and water infrastructure could vary immensely depending on terrain and soil conditions; and many other infrastructure components will differ depending on the level and degree of excess capacity. It is also difficult to determine who bears the costs of new infrastructure developments because of constantly changing government-induced fees, taxes, policies, and building standards.</td></tr>
<tr><td>Infrastructure Costs (total)</td><td>The table displays the economic breakdown of inner city and urban fringe initial capital costs, and represent the higher estimates reported by the studies surveyed by the City of Perth.

Despite the area-specific nature of calculating development costs, the evidence suggests that initial capital costs and operating costs of sprawling developments outweigh the costs associated with inner-city redevelopment.
<table>
<tr><th></th><th>Inner</th><th>Outer</th></tr>
<tr><td>Roads</td><td>$5,086,562</td><td>$30,378,881</td></tr>
<tr><td>Water and Sewerage</td><td>$14,747,616</td><td>$22,377,459</td></tr>
<tr><td>Telecommunications</td><td>$2,576,106</td><td>$3,711,851</td></tr>
<tr><td>Electricity</td><td>$4,082,117</td><td>$9,696,505</td></tr>
<tr><td>Gas</td><td>$0</td><td>$3,690,843</td></tr>
<tr><td>Fire and Ambulance</td><td>$0</td><td>$302,509</td></tr>
<tr><td>Police</td><td>$0</td><td>$388,416</td></tr>
<tr><td>Municipal Services</td><td>Not Reported</td><td>Not Reported</td></tr>
<tr><td>Education</td><td>$3,895,458</td><td>$33,147,274</td></tr>
<tr><td>Health</td><td>$20,114,867</td><td>$32,347,327</td></tr>
<tr><td>Total</td><td>$50,502,726</td><td>$136,041,065</td></tr>
</table>
Table 4: Initial capital costs for redevelopment versus fringe development infrastructure</td></tr>
<tr><td>Transportation Costs</td><td>The cost of infrastructure for fringe development was determined to be significantly higher (approximately $136,000 per dwelling) than that for inner suburban development ($50,500 per dwelling). Of note are the costs of infrastructure for education and roads which were determined to be ten times and six times higher for fringe developments respectively. The analysis assumed that no additional infrastructure for gas, emergency services or police was required in inner suburban locations.</td></tr>
</table>

The estimated transportation costs were calculated as functions of vehicle kilometres travelled and covered all of private, public, and external costs. The table displays a summary of the costs for transportation costs for residents / households, which constitute the recurring annual costs of a development of 1,000 dwellings. 'Outer' can be seen to be approximately twice as expensive as 'Inner'.

Data collected is not always directly comparable. Nevertheless, the studies suggest that the infrastructure cost of infill development appears to be significantly less costly for government than greenfield development on the urban fringe across Australian capital cities.

Cost For 1000 Dwellings	Inner	Outer
Capital cost of car ownership	$2,990,802	$8,628,654
Fuel costs	$1,203,925	$3,255,349
Other operating car costs	$1,476,392	$4,259,675
Time costs (total)*	$6,158,348	$8,210,448
Private transport	$3,116,810	$8,210,448
Public transport	$3,041,538	$0
Walking and cycling	$0	$0
Road costs	$1,216,597	$3,508,806
Parking costs	$2,184,489	$7,709,869
Externalities (total)	$243,731	$703,250
Fatalities	$73,368	$211,693
Injuries	$23,627	$68,172
Property damage	$38,549	$111,228
Air pollution	$90,777	$261,925
Noise pollution	$17,409	$50,232
Transit costs (capital, and operating)	$3,136,540	$470,481
Total	**$18,610,824**	**$36,746,532**

Table 5: Transportation costs for 1000 inner-city and fringe dwellings

The evidence of cost effectiveness for developers is less definitive since diverse factors such as development site size, open space contributions, and final market value complicate the analysis.

Net Variance

Once established, there are many ongoing operational costs of both urban typologies, but the most significant operational costs are associated with transportation. Private and public costs are incurred to ensure people travel more easily to and from these urban areas.

Key Findings

The cost of both private and public transport operations for greenfield development is around $18,000 per household per year more than that for urban redevelopment forms. Over a 50-year period this adds up to a difference of $251 million for 1,000 dwellings, or $251,000 per household.

The savings in transport and infrastructure for 1,000 dwellings are in the order of $86 million up-front for infrastructure and $250 million for annualized transportation costs over 50 years.

Source

'The Costs of Urban Sprawl – Infrastructure and Transportation, Environment Design Guide', Roman Trubka, Peter Newman, Darren Bilsborough, 2010.

Name / Area	**Adelaide, Australia**
Study Purpose	The Cost Comparison of Infrastructure on Greenfield and Infill Sites paper explores the range of infrastructure provision issues to identify the actual costs of provision in different locations. Three case studies in metropolitan Adelaide were used to explore the cost factors for developers and governments.
Scope / Year	Case studies. Completed in 2017.
Scenarios / Typologies	Three case studies in Australia were examined: 1) Playford greenfield; 2) Playford Alive (urban renewal); 3) Bowden Urban Village (infill TOD).
Infrastructure Costs (total)	Infill TOD developer costs per dwelling were determined to be significantly less than the infill development of urban renewal. The developer was charged less for open space contributions per dwelling in the infill TOD compared to the Urban Renewal project and expended less on roads. While there is a higher cost to the developer to provide energy infrastructure in the infill TOD site compared to the other sites, overall the developer expended less on infrastructure in the infill TOD site, which supports the view that infill development results in reduced need for infrastructure per dwelling. It should be noted that the costs to developers and to governments are different.

Table 6. Developer infrastructure costs per dwelling—3 cases.

Infrastructure category	Case 1: playford greenfield	Case 2: playford urban renewal	Case 3: Bowden infill TOD
Infrastructure design and approvals	$2580	$2775	$749
Roads	$45,500	$28,400	$10,433
Water and sewerage	$1650	$7750	$2887
Telecommunications	n.a.	n.a.	$105
Electricity	$3850	$4000	$8188
Gas	n.a.	$250	$963
Open space	(land)	$6488	$3330
Total per dwelling	$53,580	$49,663	$26,655

n.a. = not available.
Note: These are costs of provision of the listed infrastructure and do not include maintenance costs.

Table 7. Summary of government capital costs for infrastructure in the case study areas.

Infrastructure category	Case 1: playford greenfield	Case 2: playford urban renewal	Case 3: Bowden infill TOD
Roads	$4,975,000	$10,600,000	n.a.
Public transport system upgrade	$13,000,000		
Fire and ambulance	n.a.	n.a.	n.a.
Police		Police and community working together programme	
Open space	$5,000,000	$2,250,000	$4,900,000
Municipal services	$17,301,000	$8,170,000	$403,000
Education	$68,400,000 to $88,400,000	$44,800,000	$579,674
Health	$7,500,000	OPAL programme	
Total	$116,176,000 to $136,176,000	$65,820,000	$5,882,674
Cost per dwelling	$29,044 to $34,044 (4000 dwellings)	$36,566 (1800 dwellings)	$2451 (2400 dwellings)

(n.a. = not available).
Note: These are costs of provision of the listed infrastructure and do not include maintenance costs. Where these relate to items listed in Table 6 these costs are additional. The total development cost to government in each case may be higher than the infrastructure total as total development costs may include land purchase, remediation, marketing and other sundry expenditure.

Net Variance	The table shows that there is very little difference in total infrastructure costs for government and developer between the greenfield and renewal areas of Playford Alive, while the total cost of infrastructure for infill TOD at Bowden Urban Village is only one-third of that for the Playford project.

<table>
<tr><td></td><td>Table 8. Combined developer and government infrastructure costs per dwelling.
<table><tr><th>Infrastructure category</th><th>Case 1: playford greenfield</th><th>Case 2: playford urban renewal</th><th>Case 3: Bowden infill TOD</th></tr><tr><td>Developer</td><td>$53,580</td><td>$49,663</td><td>$26,655</td></tr><tr><td>Government</td><td>$29,044 to $34,044</td><td>$36,566</td><td>$2451</td></tr><tr><td>Total</td><td>$82,624 to $87,624</td><td>$86,229</td><td>$29,106</td></tr></table>
The estimated cost to the developer to provide infrastructure to the greenfield site ($53,580 per dwelling) is similar to the renewal area ($49,663 per dwelling), which is an interesting finding as the latter was previously serviced.</td></tr>
<tr><td>Key Findings</td><td>The infrastructure required in delivering new residential development is site-specific and is influenced by the type of housing being delivered. This in turn is driven by the market demographics of household type, age, income and employment. In established areas, the increased density of planned development implies the need for a review of the capacity of existing infrastructure.

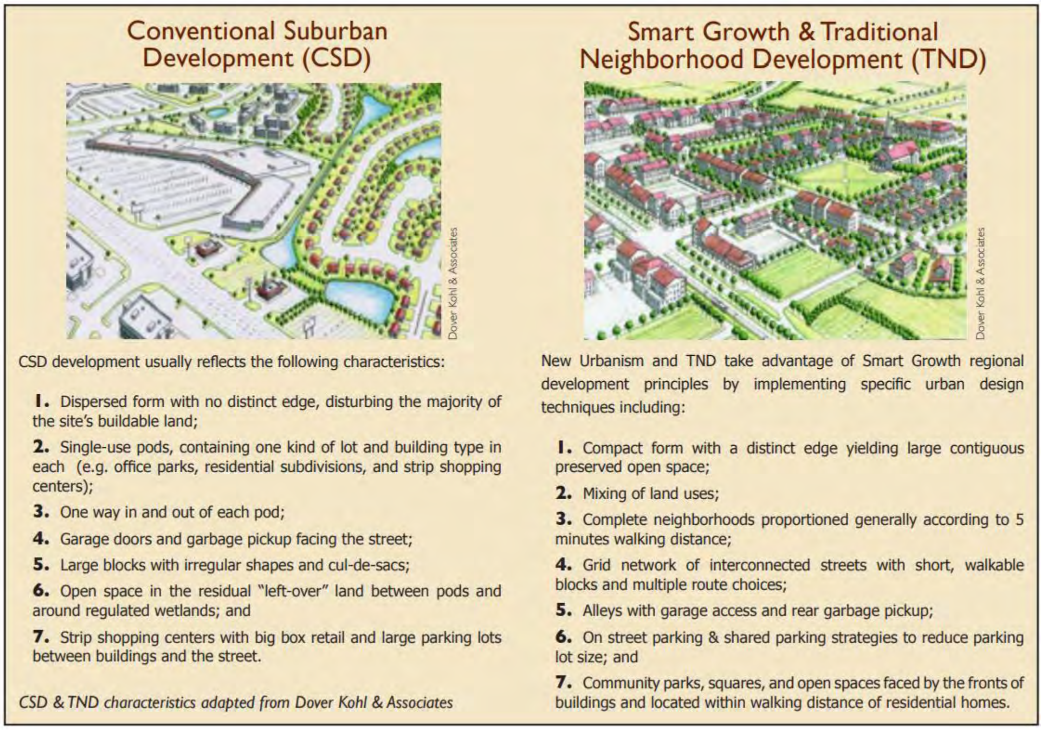
While some absolute costs were determined from the review of budget documents and annual reports of state and local government agencies, the analysis demonstrates the difficulty of obtaining detailed information about government infrastructure costs for specific projects. Some data could not be provided or apportioned to either local government or state government, so were aggregated and presented as government cost since details of cost-sharing for open space and street infrastructure upgrades were not available.

In general, the evidence suggests that it is less costly in infrastructure terms to develop on infill sites rather than greenfield sites. However, there is some evidence to suggest that developer’s construction costs can be higher in infill situations, which may go some way to explaining the resistance on the part of the development industry to current urban growth policy.

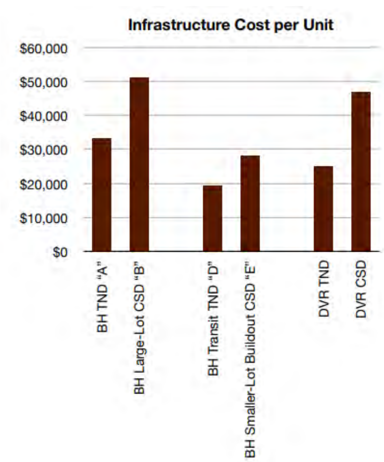
Planning policies need to recognize the variety ownership patterns that can have an impact on development costs for both government and the development industry. In addition, the analysis confirms the importance of understanding the capacity of the existing infrastructure to cope with growth and the extent to which infill development renews established areas. As governments plan for increased density in established areas, they should ensure they understand and direct development toward areas where there is spare existing infrastructure capacity. In addition, government should develop mechanisms to fund infrastructure shortfalls that may limit infill development. Where government proposes mechanisms to spread the cost burden of new infrastructure, the standards for such infrastructure should be agreed beforehand so developers may make informed decisions about where and what they build.</td></tr>
<tr><td>Source</td><td>‘Cost Comparison of Infrastructure on Greenfield and Infill Sites’, Cathryn Hamilton, Jon Kellett, 2017.</td></tr>
</table>

<table>
<tr><td>Name / Area</td><td>Smart Growth and Conventional Development, U.S.A.</td></tr>
<tr><td>Study Purpose</td><td>Several Conventional Suburban Development (CSD) and Traditional Neighbourhood Development (TND) alternatives were prepared for two case study sites, and then the total infrastructure costs were calculated. Variables that drive infrastructure cost including lot size, product type, residential density, thoroughfare cross section, and thoroughfare network pattern, which were studied to quantify and compare the impact on the total infrastructure cost.

The following figure illustrates the different density, form, and design attributes between conventional suburban development and Smart Growth development.


</td></tr>
<tr><td>Scope / Year</td><td>Two scenario case studies.
Completed in 2010.</td></tr>
<tr><td>Scenarios / Typologies</td><td>Each development scenario was engineered at a schematic level including thoroughfare typology analysis, streetscape design, parking analysis, and utility design. The engineering design ended at the building footprints; building foundations and cost of vertical construction were not part of the study. Once an estimate of infrastructure quantities was compiled for each development scenario, material quantities were multiplied by industry standard unit cost data and adjusted to account for regional cost variations.

TND scenarios designed according to Smart Growth and New Urbanist principles with smaller lot sizes, compact urban form, a variety of multi-unit housing types, and a mix of land uses results in infrastructure systems that serve more development in proportion to their cost to construct. In comparison, typical lower density Conventional Suburban Development (CSD) alternatives require far-reaching infrastructure systems to serve lower-density development, with higher costs to build. The case studies showed a clear reduction in infrastructure costs for scenarios with higher density.</td></tr>
</table>

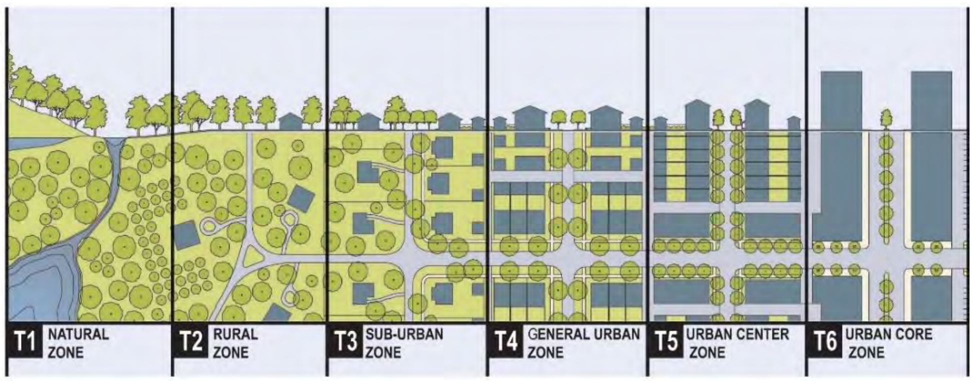
Servicing Programs	Although numerous TND (high density) and CSD (low density) case study examples were evaluated, the following three direct comparisons were selected for presentation in the report to isolate the effects of specific development variables: • Belle Hall TND A vs. Belle Hall Large-Lot CSD B Using the same development program, a comparison of TND vs. Large-Lot sprawl. • Belle Hall TND D vs. Belle Hall Smaller Lot Buildout CSD E Using the same development program, a comparison of transit supportive TND vs. CSD using smaller residential lot sizes comparable to that of TND. • Dove Valley Ranch TND vs. Dove Valley Ranch CSD A comparison of built CSD single-family residential with a hypothetical TND demonstrating the land's potential. To directly compare development scenarios with different development build-out, the results were divided by the scenario's number of residential units to provide per-unit metrics. Infrastructure serving mixed-use areas of the Belle Hall and Dove Valley Ranch TND scenarios was counted as residential infrastructure so as not to unfairly benefit TND scenarios in the comparisons. Therefore, commercial development above residential can be considered a TND 'bonus' where the same infrastructure serves multiple uses.
Costs per Unit	The bottom line results of the comparative infrastructure cost study are illustrated in the table. The variables discussed in the report including density, urban form, and impervious area led to a clear cost savings for TND infrastructure when compared with that of CSD. 
Key Findings	When comparing CSD (low density) scenarios to alternative TND (high density) designs, the study found that infrastructure costs for the TND scenarios were consistently less than CSD. Reductions in infrastructure costs due to TND development patterns ranged from 32% to 47%, with the extent of TND cost savings based principally on density.
Source	'Smart Growth & Conventional Suburban Development: An infrastructure case study', completed for the EPA, 2010.

Appendix C: Residential Typologies and Attributes

Rural to Urban Transect 'Zones'

The rural to urban 'transect' is a tool used to analyze and categorize community form and character. The transect is divided into six 'zones' based on intensity of the built environment and physical characteristics and other attributes. Certain forms and elements belong in certain environments. As transect zones become more urban, they also increase in complexity, density, and intensity.

This transect is illustrated in the below figure[31], from T2 Rural Zone (with very low density residential, in the form of single-detached houses on large estate lots), to T5 Urban Centre Zone (with multi-unit residential ranging from stacked townhouses to apartment towers). As depicted, the road network, amount of green space, and other infrastructure and amenity attributes also vary along this spectrum.



These six transects / zones are described in greater detail as follows[32]. For the purpose of this servicing cost study, the residential typologies used for analysis are in the T3 to T5 range[33].

- **T-1: The natural zone,** is an area with little or no human impact consisting of lands approximating or reverting to a wilderness condition. This includes lands unsuitable for development due to hydrology, topography, vegetation, or special and unique areas such as protected areas like a park, environmentally-sensitive areas, etc.
- **T-2: The rural zone,** comprises sparsely settled lands in a cultivated or open state. Often they are made up of woodlands, agricultural lands and grasslands. The typical building located in this zone would be farmhouses, agricultural buildings, large estate style homes, and cabins or other isolated housing types.
- **T-3: The sub-urban zone,** consists of low density residential areas. Setbacks are relatively wide and plantings are natural in character. There is some mixed uses but primarily in areas adjacent to higher transect zones. Blocks are large and roads can be irregular to accommodate the natural features.
- **T-4: The general urban zone,** consists of mixed uses but primarily residential urban fabric. A wide variety of attached and detached housing types are found in this zone. Setbacks and landscaping are variable. Streets with curbs and sidewalks define the small to medium sized blocks, and street connectivity is high with storm sewers and urban servicing such as water and sewer.
- **T-5: The urban centre zone,** comprises higher density mixed uses that provide for retail offices, and a range of housing types including rowhouses and apartments. Setbacks are minimal and buildings

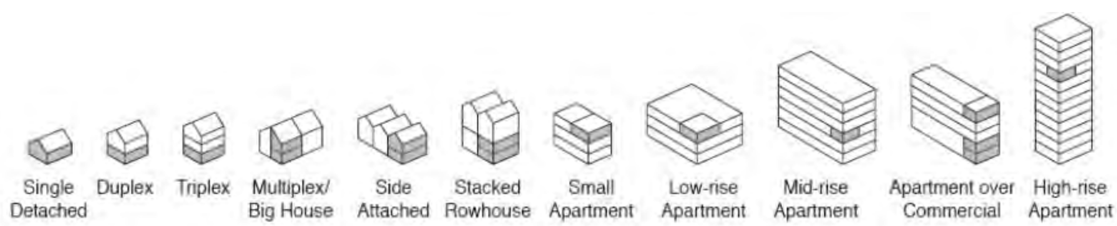
[31] https://transect.org/rural_img.html
[32] https://www.canr.msu.edu/news/where_are_you_located_on_the_transect
[33] https://www.canr.msu.edu/news/understanding_the_urban_transect

are close to the sidewalks, which are wide. There is a fine-grained street network forming small blocks and high connectivity and intersection density. The urban centre is often the location of traditional mixed-use downtowns in many North American cities.

- **T-6: The urban core zone,** consists of the highest density and building height with the highest intensity and diversity of land uses. Buildings are sited on the sidewalk, which are wide and there is good street connectivity. The largest cities tend to have such an urban core area(s).

Outside of urban core areas, ground-oriented housing forms can range from semi-detached or duplex houses, to multiplexes, to townhouses to low rise apartment buildings, often referred to as 'missing middle' housing.[34] Missing middle housing is a range of multi-unit or clustered housing types, compatible in scale with single-detached homes, that help meet the demand for walkable urban living, and meet the need for more housing choices at different price points.

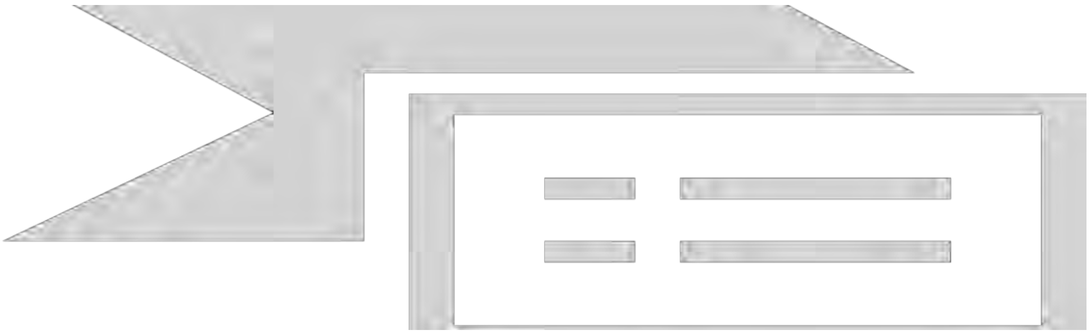
On the left-hand side of the figure below are single-detached homes.[35] The suburban growth in North American cities has primarily been dominated by these housing types since the 1940s. Towards the right-hand side of the figure is the other end of the form / density spectrum with large, five-to-seven-plus floor, multi-unit apartment, strata, or mixed-use buildings.



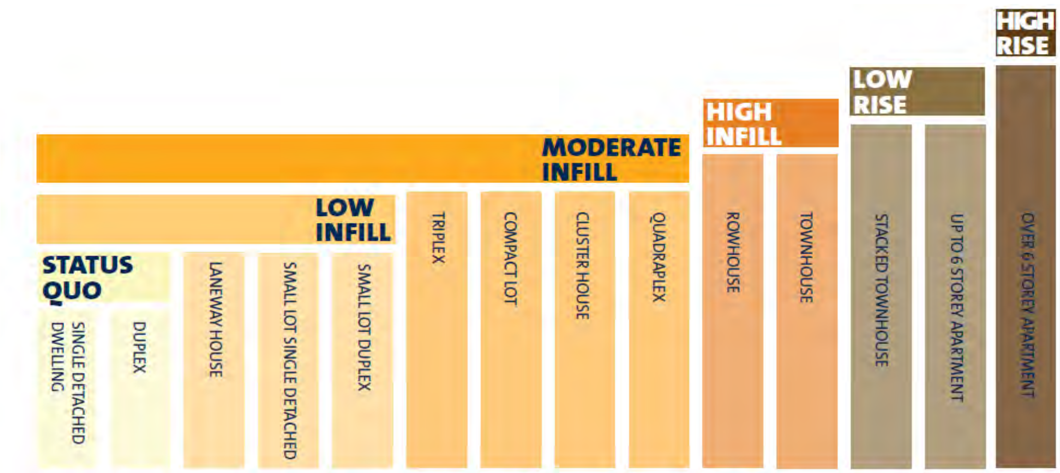
Residential Typology by Tenure[36]

In addition to building form, typology of units can also consider different tenures, including above and below market rental, fee simple (ownership), and other forms.

[34] Missing Middle Housing: Thinking Big and Building Small to Respond to Today's Housing Crisis, Daniel G. Parolek, 2020. https://missingmiddlehousing.com
[35] Missing Middle Housing: Thinking Big and Building Small to Respond to Today's Housing Crisis, Daniel G. Parolek, 2020. https://missingmiddlehousing.com
[36] City of New Westminster.



There can be a relationship between building form and housing tenure. Generally single-detached houses and townhouses are owner-occupied, while many apartments are either renter or strata owner occupied. This is conceptually shown in both the above and below figures. For the purposes of this servicing cost study, only built form, not tenure or affordability, is considered in the analysis.



Defining Typologies and Terms – Additional Considerations and Attributes

Land use patterns can generally be defined and evaluated based on the following attributes[37]:

- Density – the number of people, jobs, or housing units over an area.
- Clustering – whether related destinations are located close together (e.g., commercial centres, residential clusters, urban villages).
- Land Use Mix – whether different land use types (commercial, residential, etc.) are located together or in close proximity.
- Connectivity – the number of connections within the street and pedestrian / cycling networks, with a high intersection density.
- Impervious surface – land covered by buildings and pavement, also called the footprint, which creates rain runoff that must be managed.
- Greenspace – the portion of land used for lawns, gardens, parks, woodlands and other natural spaces.
- Accessibility – the ability to reach desired activities and destinations.
- Non-motorized accessibility – the quality and connectivity / completeness of walking, cycling, and rolling infrastructure.

[37] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.

Land use attributes can be evaluated at various scales[38]:

- Site – an individual parcel, building, facility or campus.
- Street – the buildings and facilities along a particular street or stretch of roadway.
- Neighbourhood or centre – a walkable area, that is typically defined by unique use or building forms, often with a commercial centre or node.
- Local community – a small geographic area, often consisting of several neighbourhoods that share a defining geographic, historical, or landform characteristic.
- Municipal – a town or city jurisdiction.
- Region – a geographic area where residents share services and employment options. A metropolitan area typically consists of one or more cities and various suburban areas, smaller commercial centres, and surrounding semi-rural areas that share large public, commercial, and industrial infrastructure.

Geographic areas can be categorized in the following ways[39]:

- Village – a small urban settlement (generally less than 10,000 residents).
- Town – a medium size urban settlement (generally less than 50,000 residents).
- City – a large settlement (generally more than 50,000 residents).
- Metropolitan region or metropolis – a large urban region (generally more than 500,000 residents) that usually consists of one or more large cities, and various smaller peripheral cities and towns, which development pattern is considered ‘polycentric’.
- Urban – relatively high densities (25+ residents and 15+ housing units per hectare), with: mixed-use development forms; employment / commerce and institutional / education centres; shared public infrastructure such as water, sewer, garbage collection; and a multi-modal transportation system.
- Suburban – medium densities (8-20 residents and 3-15 housing units per hectare), separated, homogenous land uses, and an automobile-oriented transportation system.
- Central business district – the main commercial centre in a town or city.
- Exurban – low densities (less than 6 residents or 2 housing units per hectare), primarily estate-style detached homes, rural landscapes and undeveloped lands, located peripheral and near enough to an urban area that exurban residents often commute, shop and use urban services there.
- Rural – very low densities (less than 6 residents or 2 housing unit per hectare), primarily farms and undeveloped lands.

There are often debates about the different development patterns and characteristics of ‘urban sprawl’ and ‘smart growth’ and how they should be measured. The following table compares different development patterns, generally termed urban sprawl and smart growth (or compact development)[40].

[38] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.
[39] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.
[40] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.

Attribute	Sprawl	Smart Growth
Density	Lower-density	Higher-density.
Growth pattern	Urban periphery (greenfield) development.	Infill (brownfield) development.
Activity Location	Commercial and institutional activities are dispersed.	Commercial and institutional activities are concentrated into centers and downtowns.
Land use mix	Homogeneous land uses.	Mixed land use.
Scale	Large scale. Larger buildings, blocks, wide roads. Less detail, since people experience the landscape at a distance, as motorists.	Human scale. Smaller buildings, blocks and roads, care to design details for pedestrians.
Transportation	Automobile-oriented transportation, poorly suited for walking, cycling and transit.	Multi-modal transportation that support walking, cycling and public transit use.
Street design	Streets designed to maximize motor vehicle traffic volume and speed.	Streets designed to accommodate a variety of activities. Traffic calming.
Planning process	Unplanned, with little coordination between jurisdictions and stakeholders.	Planned and coordinated between jurisdictions and stakeholders.
Public space	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs).	Emphasis on the public realm (streetscapes, sidewalks, public parks, public facilities).

Land Use Patterns

Additional considerations associated with varied development forms and densities also include the amount of land devoted to roads and housing in cities. The following figures illustrate some planning objectives and considerations when arranging land uses and patterns as part of a municipal or regional structure, and the relationships between different uses, and associated attributes, what can and cannot be measured. The figures also show typical amounts of land used for different functions in a city, as well as how both the amount of road area and the design of road network can vary. Notably, suburban areas may have proportionally less land devoted to roads, yet are still auto-centric. Furthermore, the amount of space devoted for commercial uses tends to be higher in urban centres, which also have mixed uses and higher densities for all land uses, which can better sustain public transit systems.

The following four figures show conceptual considerations when arranging land uses and city or region scale land use framework.

Land Use Patterns

- Land requirements for different purposes
- Hierarchy / structure / distribution of functions / uses at different scales, examples:
  - Live close to work
  - Amenities close to homes
  - Industry close to transportation
  - Stores close to customers

Evolution of uses / patterns over time

Relationships Between Land Uses

- Defining and Measuring Uses:
  - **Type** - what is it
  - **Amount** - how much
  - **Intensity / density** - measures
  - **Location / proximity** - access
- Interactions – adjacency / linkages / transport
- Impacts / implications – complement / conflict

Typical Municipal Forms

Urban Function (% land):

- Residential – 51%
- Commercial – 3%
- Industrial – 8%
- Institutional – 8%
- Transport./Utility – 5%
- Rec./Open Space – 5%
- Streets – 20%

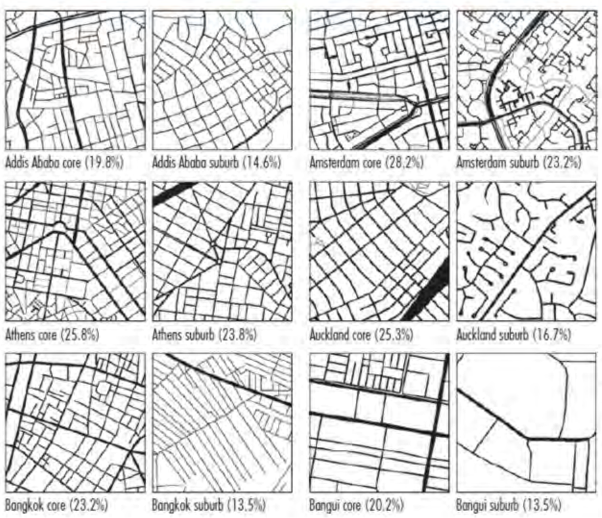
Travel Times:

- Work – 20-30 min.
- CBD – 30-45 min.
- Local shopping – 10 min.
- School – 5-10 min.
- Major parks – 30-45 min.

Note: Approximate / typical amounts

Road Networks and Land Use Patterns

Different Designs and Different Issues



% share of the land that is streets

Land and the City Lincoln Institute 2015: One-Square Kilometer Street Maps in the Core and Suburban Areas of Selected Cities

Calculating Residential Densities

For analysis purposes, residential density in the form of units per hectare is a key component of the density for the typologies used in this servicing cost study. The below figures show the difference between gross land areas and land net land areas, which must be considered when calculating and comparing development densities and urban form.

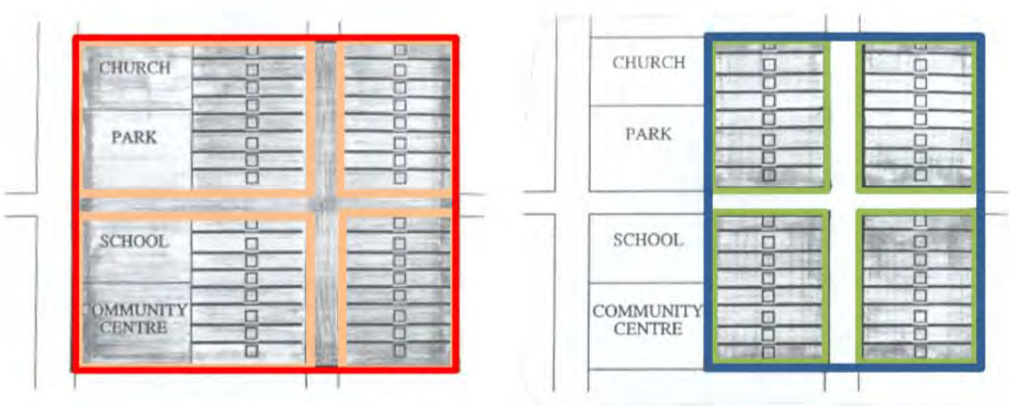
Calculating Density (Site Area)

- Gross Density / Net Density
- Site Area:
  - – Gross Area (total site)
  - – Net Developable Area (excl. non -develop. areas)
  - – Net Saleable Area (excl. also road dedications)
- Calculating Density: Units and Floor Area

Site Area: Gross / Net Land

Gross: includes all lands (roads, parks, enviro)

Net: remaining subdivided parcels of land (lots)



The figures below show how to calculate density (shown as units per acre in the figure), by dividing the number of units (which should be clearly defined; for example, consistently including or excluding secondary suites in houses) by the amount of land area, and associated built form.

Calculating Density (Units)

- Density ratio = amount of use (number of units) divided by amount of area (ac or ha of land)
- Different measures:
  - Number of 'Units' – housing, residents, jobs, etc
  - Units per Acre (upa) or Units per Hectare (uph)
  - Ex. Number of houses per acre of land

$$\text{UPA} = \frac{\text{Number of Units}}{\text{Land Area Acres}}$$

Housing Forms and Densities

…. 1 upa to 100 upa ….

Visualizing Density[41]

The Visualizing Density: The Density Catalog helps define both the physical qualities and numerical measures of development density and urban form. While density may vary or be the same, the design and desirability of neighbourhoods may vary. Notably, it is not development density that makes a neighbourhood appealing or unattractive, but rather the built and urban form, e.g., the street layout,

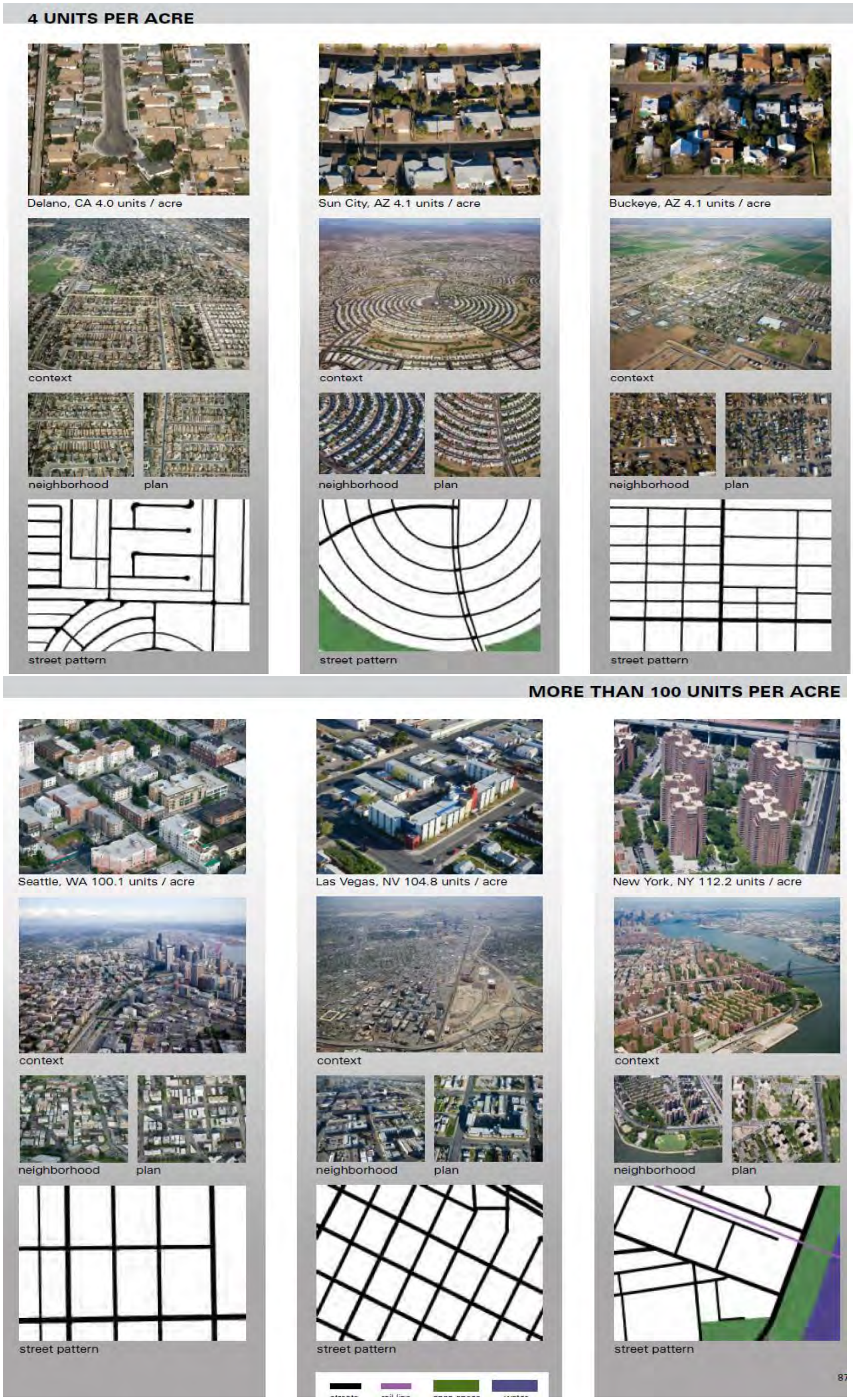
[41] Visualizing Density: The Density Catalog, Lincoln Institute of Land Policy, Julie Campoli, Alex S. MacLean, 2007.

the arrangement of buildings, the quality of architecture and building design, and use of landscaping and open space.

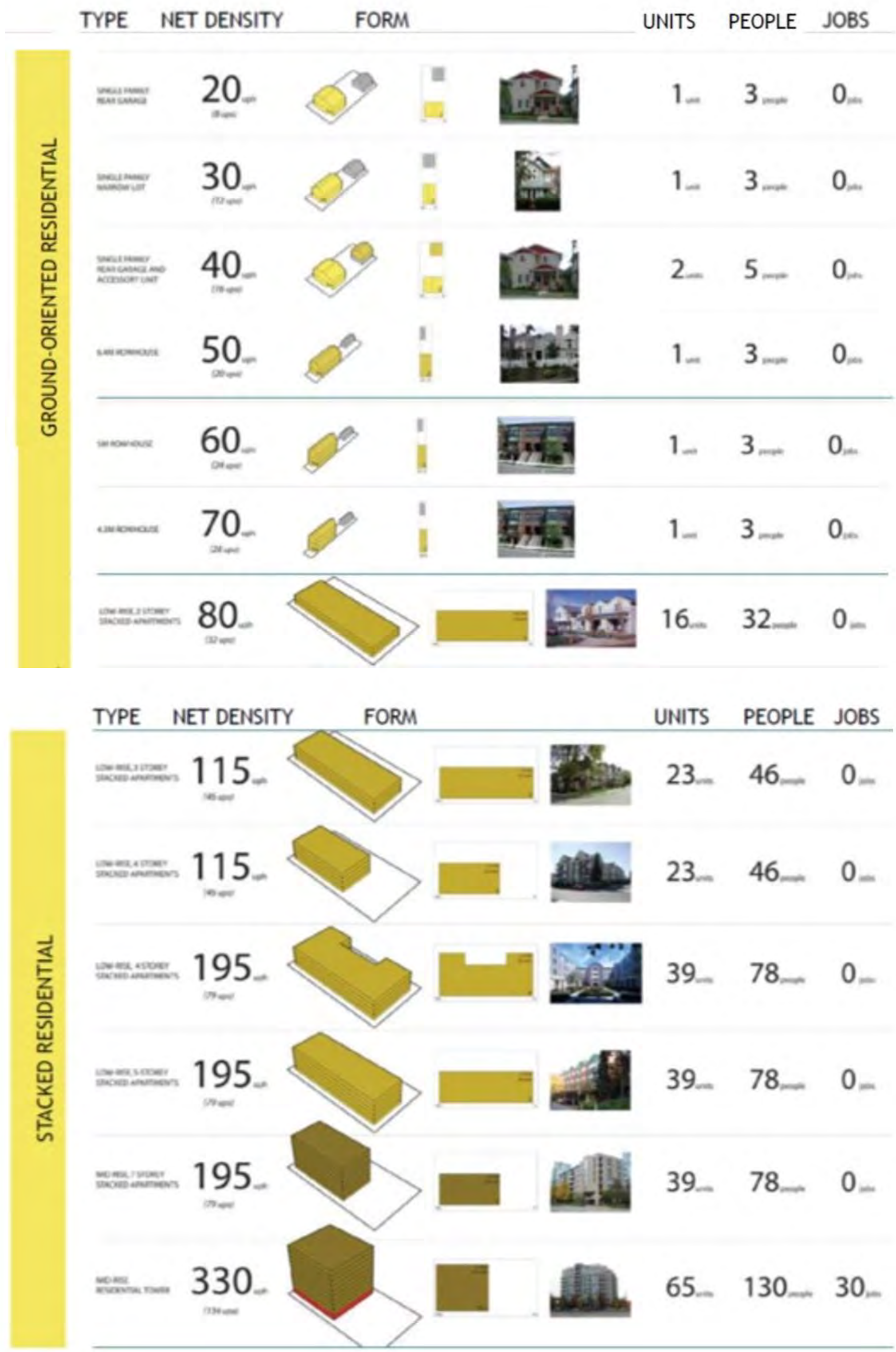
> *Density is easy to calculate. Divide the number of persons by the number of square* [kilometres], *or the number of housing units by the number of* [hectares], *and you will know the* [gross] *density of a given area.*
>
> *But, although measuring density is a rational process, our perception of density is neither rational nor quantifiable. What does a place look like? How does it feel to be there? These qualitative factors, not numbers, determine how we perceive density.*
>
> *We react to the physical environment, which can be shaped in countless ways. How we arrange the streets, buildings, and open spaces of cities and neighbourhoods affects the perception, or feeling, of density.*[42]

Below are some residential density / form examples from the Visualizing Density catalog, from very low to very high densities. These were used to create and inform the typologies for this study.

[42] Visualizing Density: The Density Catalog, Lincoln Institute of Land Policy, Julie Campoli, Alex S. MacLean, 2007.


4 UNITS PER ACRE
Delano, CA 4.0 units / acre
Sun City, AZ 4.1 units / acre
Buckeye, AZ 4.1 units / acre
context
context
context
neighborhood
plan
neighborhood
plan
neighborhood
plan
street pattern
street pattern
street pattern
MORE THAN 100 UNITS PER ACRE
Seattle, WA 100.1 units / acre
Las Vegas, NV 104.8 units / acre
New York, NY 112.2 units / acre
context
context
context
neighborhood
plan
neighborhood
plan
neighborhood
plan
street pattern
street pattern
street pattern
87

The following figures show the other quantifiable attributes associated with a range of residential densities and forms, noting the number of units and residents (and jobs, if applicable).[43]



[43] UBC Design Centre for Sustainability.

Appendix D: Cost Estimate Studies

Literature on sprawl is much related to capital and operating costs, both public and private. Public capital and operating costs usually refer to roads, water and sewer infrastructure, and public buildings, as well as annual expenditures to maintain them. Private capital and operating costs refer to the construction and occupancy costs of private housing and how metropolitan location and the density and form of development might cause them to vary. The following text is extracted from the referenced publications, providing key findings from the literature review.

Literature Review of the Costs of Infrastructure Provision for Different Development Forms[44]

All linear infrastructure like roads, transit, water and wastewater distribution and collection network and electricity distribution lines, needs to extend to service new areas as a city undergoes physical expansion. Most cities have response time goals for emergency services like ambulance or fire protection, which require additional medical centres / fire stations and vehicles to be located in new growth areas and ongoing improvements to infrastructure to be able to reach a target within the designated response time. The same is true for schools, which are planned based on maximum travel distances by walk and school bus for students to access the school safely, as well as a target teacher to student ratio. Police infrastructure is generally based on staffing ratio for police officers to residents as well as emergency response time goals, which relate the service planning to both population and city growth. Minimum population standards are set for providing parks and open spaces, which tend to be related to population growth and spatial distribution, but they impact urban form as more land is converted to urban uses.

The most dominating development forms for managing growth discussed in all studies are the high-density centralized or clustered development, and the low-density dispersed development. The former compact urban form is also referred to as 'Smart Growth' or 'Infill' development and the latter is referred to as 'Urban Sprawl' or 'Greenfield' development. This report discusses the impact of the individual features (like density and dispersion) of these two alternative development settings on infrastructure and development costs. The basic four dimensions of urban sprawl and their related urban characteristics have been defined in a seminal report. These urban form features are the most critical factors defining alternative development settings.

Table 1. Urban form factors of sprawl. Source: Ewing et al. (2002)

Sprawl dimension	Urban form factors
A population that is widely dispersed in low-density development	Residential density
Rigidly separated homes, shops, and workplaces	Neighborhood mix of homes, jobs, and services
A network of roads marked by huge blocks and poor access;	Accessibility of the street network
A lack of well-defined, thriving activity centers, such as downtowns and town centers	Strength of activity centers and downtowns

Development cost is a function of land costs, infrastructure costs and structure costs, which eventually influence the final cost of dwelling units. Out of these, infrastructure costs are typically of the highest concern to local governments and authorities. However, analyzing costs of infrastructure provision for

[44] Literature Review of the Costs of Infrastructure Provision for Different Development Forms, University of Toronto Transportation Research Institute, Shivani Ragha, Dena Kasraian, Eric J Millers, 2019.

different development settings is challenging due to variations in urban contexts of cities, socio-demographic differences as well as varying record keeping and accounting practices.

The common major factors influencing infrastructure asset project costs and service delivery costs are listed and described briefly below.

Cost factors affected by the development setting:

- Urban form: population size, density, lot size and shape, location of development, dispersion of development, housing typology, and street network pattern.
- Site conditions / topography: geographical location, space availability and transportation access, slopes.
- Utility capacity utilization: catchment of existing infrastructure and the level of augmentation required is an important location specific factor affecting costs, especially in infill areas.
- Proximity to service areas: distance of a new development from existing utility plants and trunk infrastructure.

Other cost factors:

- Technological change: Infrastructure materials, construction methods and service delivery technology have largely been the same for decades, but there have been design and efficiency improvements in capacity planning and equipment specifications. It is difficult to account for these differences when comparing cost estimates.
- Factor price measures: costs for design and engineering, technical specifications, vertical construction, equipment redundancy, price premiums, market demands, labour factors and many other local area market factors.
- Demographics: age distribution, household size, etc.
- Service delivery standards: per capita service level goal.

Serving large populations may offer a cost advantage from economies of scale, although empirical evidence is mixed about whether scale economies in infrastructure delivery exist, and suggests that it depends on the type of infrastructure service. Generally, services with large capital inputs capture economies of scale in production, like a treatment plant of a given capacity can treat additional water at low marginal costs, allowing for periodic increases in serviced population. However, low per unit costs of treatment may be offset by the higher per capita cost of water distribution, if the population is distributed over a large geographic area.

In terms of drinking water servicing, increasing distance from the source of raw water increases the cost of distribution (i.e., extensive pipeline network and numerous water storage towers) as well as the operational costs of pumping water through the system. Residential density and distance to treatment plants have a significant impact on the costs of 'hard' infrastructure-based services. Distribution infrastructure is much more compact and efficient for a dense development consisting of high-rise towers built in a small area, producing cost savings.

In other words, low density developments are spread over a large area, resulting in high capital costs for linear infrastructure for all capital-intensive hard infrastructure like water, sewerage and stormwater drainage as well as roads and rail-based transit systems. Similarly, each additional kilometre of road or pipeline results in additional maintenance costs over time.

However, costs for labour-intensive services like fire-fighting and education services (i.e., the number of schools / classrooms / teachers) tend to increase with population size and density, because these have a fixed ratio of personnel to serviced population.

While high density development can reduce the cost of producing services (on a per unit basis), it does tend to increase the overall cost due to increase in total demand for services. Thus, effects of density on costs of providing community services cannot be generalized as scale economies are complex and service-specific.

Researchers have suggested designing separate cost-minimizing service-specific districts for infrastructure elements such as water, sewerage, fire protection and schools, to capture scale and size economies for a given residential population and density. This strategy may not be a practical solution however due to differing size jurisdictions for the different services.

Another noteworthy finding is that the majority of cost savings associated with high-density compact developments are made in the user-pay component of infrastructure (i.e., service delivery charges). For example, existing rail-based transit station areas are excellent opportunities for infill transit-oriented developments (TOD) with shared public-private infrastructure costs. TODs create dense, walkable, mixed-use centres of activity and are an essential Smart Growth strategy.

The primary development settings for urban growth include high-density, mixed-use, clustered infill development (Smart Growth) within inner city areas and low-density, dispersed greenfield developments (Urban Sprawl) in fringe areas. These different development patterns are illustrated in the figure below. Compact growth through infill developments instead of fringe growth reduces per-capita land consumption and saves on costs of new land development, building new roads, and extending and maintaining underground linear utilities.

Fig. 3.a. Fig. 3.b.

Figure 3.a-b. Comparison of alternative development forms (Conventional suburban development or Sprawl vs. Traditional neighborhood development or Smart Growth). Source: Ford, 2009.

Infill and intensification of development is generally recognized as having lower infrastructure costs due to the opportunity for developers to utilize servicing capacity within existing infrastructure systems, provided that spare capacity exists. Several studies have established that municipal infrastructure and service delivery costs tend to decline with increased density achieved by infill developments relative to that of greenfield expansion.

If development cost charges are applied as location-specific and reflect the full costs and benefits of development, then developers and public sector decision makers will be incentivized to make more efficient location choices for new development.

Comparing infrastructure costs for different development settings and locations in a metropolitan region can be complex, due to the sharing of costs across municipal boundaries, a lack of long-term data availability, variable units of analysis, cost components, recording methods and their interpretations, and different local contexts. Despite these challenges, the common significant cost factors for infrastructure provision have been identified and some conclusions can be drawn about the effects of two principal alternative development forms on infrastructure costs: high-density infill redevelopment and low-density urban sprawl, greenfield development.

These findings indicate that density and location are the major determinants of infrastructure costs in a metropolitan region. Infrastructure costs are found to be inversely related to density. However, density-related savings from economies of scale are scale and service-specific, that is savings may be captured in production (e.g., a water or sewage treatment plant) but additional demand may or may not result in distribution savings as distribution infrastructure depends on the form and density of development (e.g., compact or dispersed).

Another important trend observed in infrastructure costs varying by urban density is that cost savings may be subject to diminishing returns and decline at very high densities in urban areas. This is in part due to the negative effects of overcrowding, and access constraints and saturation / over use of existing infrastructure capacity in the area. Density benefits need to be combined with spatial factors (i.e., distance from a city centre and from existing infrastructure) to capture cost savings in existing infrastructure. Scale and size economies can be exploited by creating separate cost-minimizing service districts for different infrastructure services. Cost analysis may be conducted for a single infrastructure service at a given time, as it is easier to determine appropriate input and output measures for designing optimum-sized service districts.

Similarly, neighbourhood design and street patterns can affect the costs of linear infrastructure. Mixed housing neighbourhoods based on a grid street pattern, as opposed to curvilinear or cul-de-sac based suburban streets, tend to be the most efficient and cost effective for infrastructure service delivery.

Policies supporting the redevelopment of land in urban areas in the form of infill redevelopments, are needed as providing and maintaining new infrastructure for greenfield developments is fiscally challenging for local governments, especially in the absence of the true pricing of infrastructure costs of development. Moreover, Smart Growth savings from compact, mixed-use and more accessible land use patterns extend beyond municipal government costs to savings for other stakeholders like private sector utilities, school districts, other levels of government, businesses and consumers.

Addressing the Fairness of Municipal User Fee Policy[45]

User fees fund some or all of the costs of a range of municipal services in Canada. These include water supply, sewers, solid waste collection and disposal, public recreation, public transit, and parking, as well as some social services. Fees can range from fixed charges that are unrelated to consumption levels, to charges that vary directly with quantity consumed, to a mix of fixed and variable charges, and may cover

[45] Addressing the Fairness of Municipal User Fee Policy, Institute on Municipal Finance and Governance, Almos Taassonyi, Harry Kitchen, 2021.

all or only a portion of production and delivery costs.

Decisions about pricing structures and the proportion of costs recovered from user fees depend on considerations such as the type of service, the preferences of residents, and the willingness of local officials to substitute fees for local taxes. Furthermore, in two-tier local governing structures, the importance of user fees in the overall revenue mix is determined by the distribution of functional jurisdiction.

The current design of fees is based largely on the principle of 'benefits-received' and addresses ways in which the fee policy could be modified to take the 'ability-to-pay' criterion of property tax and fee design into account. Put simply, the benefits-received principle is that "the costs of providing a good or service are borne as directly as possible by those benefiting from them". The ability-to-pay criterion suggests that those with higher incomes should bear a greater proportion of the cost of providing a good or service.

From an economist's perspective, user fees should be adopted whenever and wherever possible. They are ideal for funding services for which specific beneficiaries can be identified, non-users can be excluded, and the quantity of service consumed can be measured. These are services such as water, sewers, solid waste collection and disposal, and public transit.

User fees may be less appropriate in the funding of services with certain public good characteristics, i.e., services for which it is difficult or more costly to exclude individuals from using a service and there is a broader benefit to a community. Examples include local roads, and neighbourhood and community parks. Inefficiently set user fees can lead to overinvestment and larger facilities than would be justified if more efficient pricing practices were adopted.

Growing concerns over municipal fiscal sustainability and increasing pressure on the property tax base have highlighted the importance of examining where user fees might be used and how they should be structured to ensure that resources are not wasted or applied in an unfair and inequitable manner.

Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development[46]

The report surveys 17 studies that compare different development scenarios. The development scenarios are separated into two categories:

- 'Smart Growth development' is characterized by more efficient use of land; a mixture of homes, businesses and services located closer together, and better connections between streets and neighbourhoods; and
- "Conventional suburban development" is characterized by less efficient use of land with homes, schools and businesses separated and areas designed primarily for driving.

When compared to one another, findings indicate:

[46] Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development, Smart Growth America, 2013.

1. In General, Smart Growth Development Costs One-Third Less for Upfront Infrastructure.

Smart Growth development saves an average of 38% on upfront costs for new construction of roads, sewers, water lines and other infrastructure. Many studies have concluded that this number can be as high as 50%.

Smart Growth development patterns require less infrastructure, meaning upfront capital costs, long-term operations and maintenance costs, and, presumably, cost for eventual replacement are all lower. Smart Growth development also often uses existing infrastructure, lowering upfront capital costs even more.

All development requires infrastructure to support and supply it. The studies included in this report primarily refer to roads, water lines and sewer lines, which account for most of the infrastructure cost associated with new development. Smart Growth development patterns require less infrastructure, meaning upfront capital costs, operations, maintenance and, presumably, cost for eventual replacement are all lower. Smart Growth development also often reuses and increases the use of existing infrastructure, lowering the upfront capital costs even more.

The survey determined one-third savings in upfront infrastructure costs by compiling the estimated savings from case studies considering infrastructure costs. The case studies compared urban and suburban growth between a Smart Growth and a conventional suburban development; the fiscal impacts of rural development scenarios were excluded because their geographic differences produced significantly higher savings.

2. Smart Growth Development Saves an Average of 10% on Ongoing Delivery of Services.

Smart Growth development saves municipalities an average of 10% on police, ambulance and fire service costs.

The geographic configuration of a community and the way streets are connected significantly affect public service delivery. Smart Growth patterns can reduce costs simply by reducing the distances service vehicles must drive. In some cases, the actual number of vehicles and facilities can also be reduced along with the personnel required.

Many public services are sensitive to a community's pattern of development. The configuration of a community and the way it is connected geographically profoundly affects service delivery.

The survey determined an average of 10% savings in service delivery costs by compiling the estimated savings from case studies considering service costs. Services considered across studies were not consistent, and levels of service and economic conditions vary. However, all case studies consistently demonstrated a cost reduction in delivery of services examined when pursuing Smart Growth development. The overall savings figure is a conservative, rough average of savings reflective of available data.

3. Smart Growth Development Generates 10 Times More Tax Revenue per Acre than Conventional Suburban Development.

On an average per-acre basis, Smart Growth development produces 10 times more tax revenue than conventional suburban development.

Tax revenue, typically refers to property taxes and sales taxes, and in some instances licensing fees and other small sources of revenue. Property tax in particular is an extremely important source of revenue for most communities. In a 2010 U.S. Census survey of local government budgets nationwide, 48% of revenue from municipalities' own sources came from property taxes, and 10% came from sales taxes, though the relative importance of these taxes varies across the country.

Relationships Between Density and per Capita Municipal Spending in the United States[47]

The objective of this research was to determine the relationship between land use, particularly density, and per capita spending levels in cities across the United States for different spending categories. A model was developed using data for 2012–2016 from the U.S. Census Bureau's Annual Survey of State and Local Government Finances. This data source provides individual city spending levels for several different spending categories.

This study focused on municipal spending for eight categories that theoretically could be influenced by land use development: fire protection, streets and highways, libraries, parks and recreation, police, sewer, solid waste management, and water. Results from the model show how density and other independent variables are associated with per capita municipal expenditures.

Density was found to be negatively associated with per capita municipal expenditures for the following cost categories: operational costs for fire protection, streets and highways, parks and recreation, sewer, solid waste management, and water; construction costs for streets and highways, parks and recreation, sewer, and water; and land and existing facility costs for police, sewer, and water. Results were insignificant for other cost categories, and a positive relationship was found for police operations costs. In general, results support the conclusion that increased density is associated with reduced per capita municipal spending for several cost categories.

Lower density, auto-oriented developments require more infrastructure per capita than do more compact developments. Sprawling cities have more kilometres of streets and water and sewer pipes per person to maintain, and services such as trash collection and fire and police protection have a greater distance to cover per person. This can result in an increase in per capita infrastructure, maintenance, and service costs for cities. More compact developments can lead to cost savings through economies of scale and economies of geographic scope. Economies of scale are exhibited when the marginal cost of providing services to each additional person decreases as more residents cluster within a smaller geographic area. Economies of geographic scope are found when the marginal cost decreases as each person locates more closely to existing major public facilities.

Urban sprawl was defined as including non-contiguous development, larger lot sizes, and lower floor-to-area ratios for non-residential development. Smart Growth was described as more compact and concentrated around existing urban centres, limiting peripheral developments and reducing the need for new infrastructure. Results showed the substantial savings for water and sewer infrastructure, road infrastructure, and local public service costs that would result by pursuing Smart Growth development instead of conventional sprawl.

The following table illustrates the per capital municipal spending by budget line item.

[47] Relationships between Density and per Capita Municipal Spending in the United States, Upper Great Plains Transportation Institute, Jeremy Mattson, 2021.

Table 1. Per capita municipal spending data, cities with population greater than 25,000.

Spending Category	N	Mean	Median	Standard Deviation	Minimum	Maximum
				dollars per capita		
Operations						
Fire	942	164.55	157.13	76.51	1.99	567.97
Streets/highways	994	93.32	81.06	55.15	2.64	457.33
Libraries	535	37.01	30.52	28.17	0.09	206.58
Parks and recreation	954	88.92	74.11	78.19	0.60	1331.94
Police	998	253.06	232.74	108.28	2.13	1077.97
Sewer	902	111.19	98.22	72.36	0.64	619.49
Solid waste	814	69.70	61.74	48.39	0.07	594.77
Water	826	139.48	121.39	84.71	0.12	746.93
Construction						
Fire	114	7.68	5.36	7.35	0.04	38.92
Streets/highways	593	87.55	67.95	77.12	0.04	578.89
Libraries	58	9.34	3.61	14.09	0.13	81.43
Parks and recreation	382	33.02	18.05	79.70	0.15	1406.53
Police	120	13.29	6.66	18.85	0.01	111.86
Sewer	418	71.92	44.14	82.96	0.02	673.67
Solid waste	68	16.43	7.14	37.77	0.09	294.83
Water	416	79.66	52.34	112.26	0.51	1356.78
Land and Existing Facilities						
Fire	357	7.40	5.36	7.88	0.01	53.29
Streets/highways	362	14.58	7.03	24.83	0.01	219.23
Libraries	84	3.26	1.68	4.15	0.06	24.18
Parks and recreation	373	8.84	4.41	12.44	0.06	98.39
Police	471	7.72	5.96	6.90	0.04	53.14
Sewer	222	25.95	9.17	61.91	0.13	694.14
Solid waste	138	7.84	5.58	8.23	0.03	52.17
Water	218	19.68	9.77	28.72	0.11	217.38

Developments were classified as either Smart Growth or conventional suburban. They defined Smart Growth as being characterized by more efficient use of land, greater land use mix, and better connections between streets and neighbourhoods. Conventional suburban (urban sprawl) was then defined by less efficient use of land, separated land uses, and development designed primarily for driving. Their main findings were that Smart Growth development costs about one-third less for upfront infrastructure and saves an average of 10% on ongoing delivery of services, specifically for police, ambulance, and fire.

The research is mixed, but there is some evidence that increased density and Smart Growth development patterns reduce public service expenditures for local governments (on a per capita basis). A number of studies have shown a reduction in total costs. With regard to specific services, different studies provide different results. While it may be expected that many costs would decrease with density, most studies tend to show only some cost reductions to be significant or evident. Many studies find costs decrease with density for roadways, police, and fire protection, while others show similar results for parks and recreation, libraries, or education. Fewer studies have shown reductions in costs for water, sewer, or sold waste, though this may be expected. Some costs have also been shown to increase with density, such as housing and community development or police.

Besides density, previous research has examined several other factors that can influence per capita municipal expenditures. Many studies have examined the effect of population size and whether economies of scale exist. Some research shows that smaller municipalities exhibit higher per capita costs than larger municipalities.

In the construction costs models, density is negative and statistically significant for streets / highways, parks and recreation, sewer, and water, indicating that per capita construction costs are lower in these categories as densities increase, while the relationship is insignificant for the other cost categories. In the land and existing facilities costs models, density is negative and statistically significant for police, sewer, and water, indicating that per capita land and existing facility costs are lower in these categories as densities increase. For police costs, while the results show a positive correlation between density and operational costs, there was a negative relationship between density and land / existing facility costs.

Overall, the models clearly show a general negative relationship between density and per capita municipal expenditures for several cost categories. These results indicate that a 10% increase in density would reduce operational costs for fire protection by 1.3%, streets and highways by 2.7%, sewer by 3.1%, etc.

Median house age was positive and statistically significant in all operational cost models except for parks and recreation. This suggests older neighbourhoods require increased operational expenditures, except that parks and recreation expenditures were higher in cities with newer housing. Construction costs for streets / highways, sewer, and water were also higher in cities with older housing, everything else equal. There is some correlation between the age of a neighbourhood and density, as older neighbourhoods tend to be denser. The density contributes to lower costs, while the age of the buildings and infrastructure may contribute to higher costs.

The findings have important implications for the fiscal sustainability and resiliency of cities. By increasing population density, cities can use resources more efficiently and reduce the cost per person of constructing and maintaining infrastructure and providing services. Practices that cities can employ to achieve these outcomes include focusing on infill development, providing a diversity of housing types beyond single family homes, avoiding non-contiguous development, promoting more compact development with smaller lot sizes and multi-use buildings, and building cities at a human scale, where distances between buildings and activities are shorter. Many cities are pursuing these strategies to promote sustainability, reduce automobile use, and create more vibrant, livable communities. This research provides further evidence that these strategies also lessen the burden on taxpayers and reduce some types of municipal spending.

Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl[48]

These density and costing relationships are complex. Denser, infill development can increase some costs due to higher design standards and infrastructure development costs in dense areas, and sometimes brownfield remediation (cleaning up hazardous conditions such as polluted soils), but such costs are not significantly related to development density. A tall building has similar utility connection and brownfield remediation costs as a smaller building, so unit costs often decline with Smart Growth policies that allow higher densities.

Critics argue that sprawl infrastructure costs are exaggerated, citing studies which indicate that per capita government expenditures are often higher in higher-density counties, although such aggregate analyses do not account for important factors such as the tendency of rural residents to supply their own utilities and services (e.g., water, sewage and garbage collection), and incomes (which tend to be higher in larger cities), and the additional public service costs borne by urban areas which tend to contain a disproportionate share of businesses and lower income residents. In addition, such aggregate analysis, which only considers population density at a jurisdictional scale, does not accurately reflect Smart Growth policies which include other factors related to the location and type of development that occurs within a jurisdiction. Two different geographic areas can have the same overall density but differ significantly to the degree that they reflect Smart Growth principles. As a result, if evaluated at an aggregate scale, any Smart Growth public service cost savings would be negligible.

[48] Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.

This review indicates that numerous credible studies demonstrate that sprawl typically increases the costs of providing a given level of infrastructure and public services by 10-40%, and sometimes more. These studies reflect lower-bound impacts since most only consider a subset of total public service costs and relatively modest Smart Growth policies, such as more compact single-detached development, as opposed to substantial shifts from single-detached to multi-unit housing. Comprehensive Smart Growth policies that result in greater density increases can provide even larger savings and efficiency benefits.

Some of the largest impacts result from the way that sprawl increases per capita vehicle travel, which increases transport costs including road and parking facility costs, consumer expenditures, traffic accidents and pollution emissions.

Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development[49]

Ewing and Hamidi's 2014 report, *Measuring Sprawl*, calculated a compactness index score for 221 U.S. metropolitan areas and 994 counties reflecting four factors: *density* (people and jobs per square mile), *mix* (combination of homes, jobs and services), *roadway connectivity* (density of road network connections) and *centricity* (the portion of jobs in major centres). The table summarizes the key results.

Table 3 **Summary of Smart Growth Outcomes** (Ewing and Hamidi 2014)

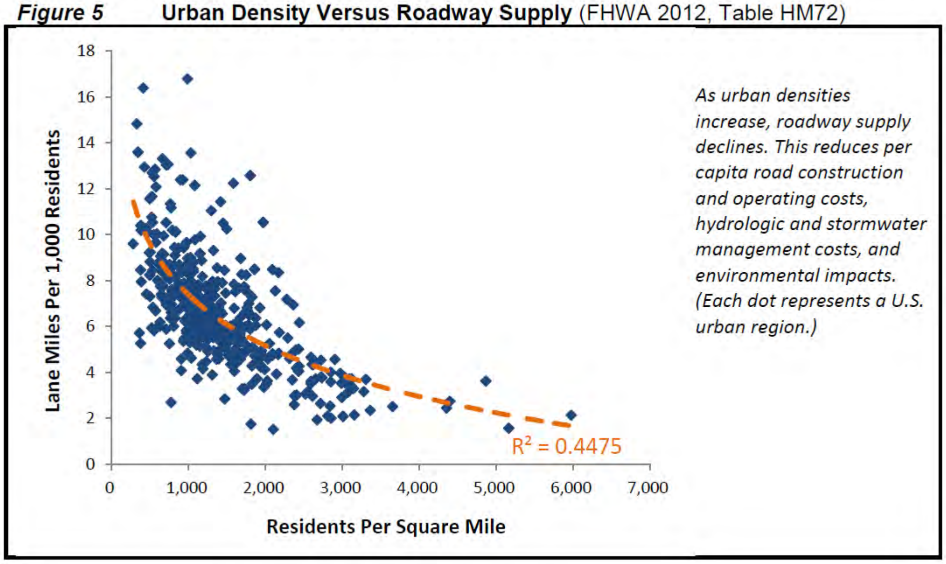
Outcome	Impact of 10% Compactness Score Increase
Average household vehicle ownership	0.6% decline
Vehicle miles traveled	7.8% to 9.5% decline
Walking commute mode share	3.9% increase
Public transit commute mode share	11.5% increase
Average journey-to-work drive time	0.5% decline
Traffic crashes and injuries per 100,000 population	0.4% to 0.6% increase
Fatal crash rate per 100,000 population	13.8% decline
Body mass index	0.4% decline
Obesity	3.6% decline
Any physical activity	0.2% increase
Diagnosed high blood pressure	1.7% decline
Diagnosed heart disease	3.2% decline
Diagnosed diabetes	1.7% decline
Average life expectancy	0.4% increase
Upward mobility (probability a child born in the lowest income quintile reaches the top quintile by age 30)	4.1% increase
Transportation affordability	3.5% decrease in transport costs relative to income
Housing affordability	1.1% increase in housing costs relative to income.

This table summarizes various economic, health and environmental impacts from more compact development.

The table above shows how per capita lane-miles decline with urban density. U.S. cities with less than 1,000 residents per square mile (approximately 1.6 residents per acre) have about 670 square feet of road space per capita, nearly three times as much as the 235 square feet in denser cities with more than 4,000 residents per square mile (approximately 6 residents per hectare). Similarly, central neighbourhoods require less road space per capita than at the urban fringe, as illustrated in the following figure.

[49] Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development, Victoria Transport Policy Institute, Todd Litman, 2023.

Figure 5 **Urban Density Versus Roadway Supply** (FHWA 2012, Table HM72)



Smart Growth reduces the costs of providing many types of public infrastructure and services. More compact development reduces the length of roads and utility lines, and travel distances needed to provide public services such as garbage collection, policing, emergency response, and school transport, and so reduces the per capita costs of providing these services. However, some of these impacts are complex and require detailed analysis.

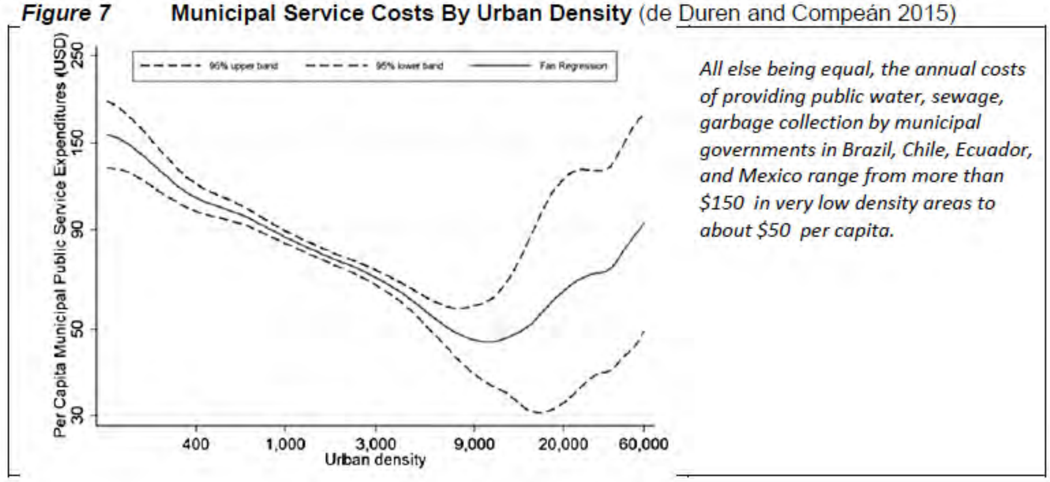
Rural residents traditionally accept lower public service quality, such as unpaved roads and volunteer fire departments, and provide many of their own utilities (e.g., well water, septic systems, garbage disposal), but urban sprawl tends to attract residents who demand urban level services in dispersed locations, despite the higher costs. Infill development can increase some infrastructure costs by increasing design standards, planning requirements and brownfield remediation, but such costs are not proportionate to density; taller buildings usually have similar development mitigation requirements and brownfield remediation costs as a smaller building, so unit costs tend to decline with density.

Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development[50]

- Burchell and Mukherji (2003) found that sprawl increases local road lane-miles 10%, annual public service costs about 10%, and housing development costs about 8%, increasing total costs an average of $13,000 per dwelling unit, or about $550 in annualized costs.
- A Charlotte, North Carolina study found that neighbourhoods with low densities and disconnected streets require four times the number of fire stations at four times the cost compared with more compact and connected neighbourhoods (CDOT 2012).
- Analyzing municipal budgets in 8,600 municipalities of Brazil, Chile, Ecuador and Mexico, de Duren and Compeán (2015) found that low-density development approximately triples per capita expenditures on public service, with the greatest efficiencies at approximately 90 residents per hectare (see figure below). This justifies policies that encourage densification, particularly in medium-sized cities.

[50] Understanding Smart Growth Savings: Evaluating Economic Savings and Benefits of Compact Development, Victoria Transport Policy Institute, Todd Litman, 2023.

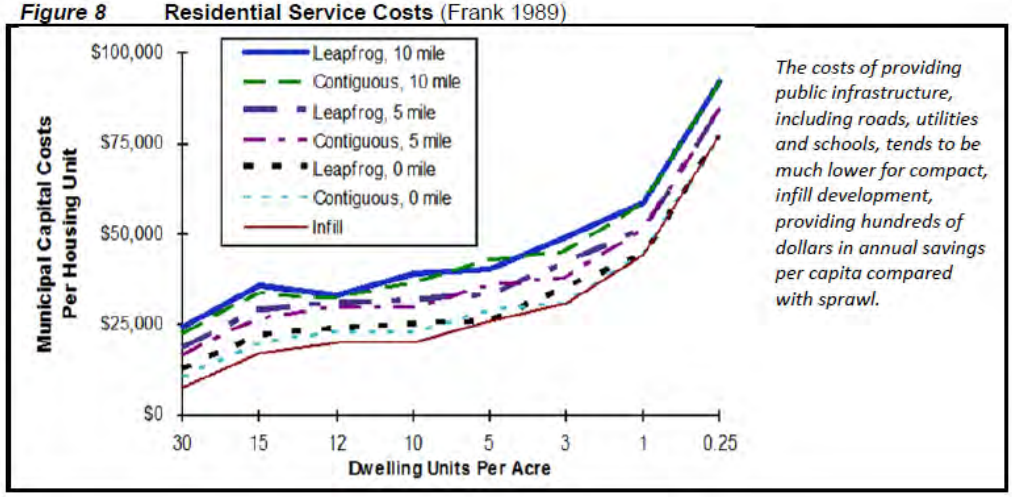
Figure 7 **Municipal Service Costs By Urban Density** (de Duren and Compeán 2015)



- A study by Mattson (2021) found that the construction and operating costs of municipal streets and highways, emergency services (expect police operations), parks and recreation, water, sewage and solid waste management tend to decline with density.
- Goodman (2019) analyzed separately the effects of development density and sprawl on the costs of providing public services. The study found that increased density slightly increases some public costs, but this effect is small compared with the costs of sprawl, which increases per capita costs for education, fire services, police protection, and sewerage. Increasing a city's density from the 25th to the 50th percentile ranking increases annual per capita expenditures by $5, but reducing its sprawl ranking from the 50th to the 25th percentile reduces per capita annual expenditures by $61.
- Detailed analysis of 2,500 Spanish municipal budgets found that lower-density development increases per capita costs of providing local services (Rico and Solé-Ollé 2013). The study found that in lower density urban areas with less than 25 residents per acre, each 1% increase in urban land area per capita increases municipal costs by 0.11%. Of this, 21% is due to increased basic infrastructure costs, 17% to increased culture and sports program costs, 13% to increased housing and community development costs, 12% to increased community facilities costs, 12% to increased general administration costs, and 6% due to increased local policing costs.
- Fernández-Aracil and Armando Ortuño-Padilla (2016) found that each 1% increase in compact population is associated with a 0.217% per capita decrease in public service costs in Spanish urban areas.
- Using data from three U.S. case studies, the study, *Smart Growth & Conventional Suburban Development: Which Costs More?* (Ford 2010) found that more compact residential development can reduce infrastructure costs by 30-50% compared with conventional suburban development.
- *Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development* (SGA 2013) found that Smart Growth development typically reduces public infrastructure construction costs by a third and ongoing public services costs by 10%.
- The City of Calgary (2016) developed cost-based development fees using detailed and transparent accounting of infrastructure costs, such as new water and sewage lines, roadway improvements and other public services. The resulting fees are significantly higher in sprawled locations to reflect the higher costs of providing public infrastructure and services there. Fees range from $2,593 per multi-unit unit, $6,267 for a single family home, and $422,073 to $464,777 per hectare in suburban areas.

The figure below illustrates the results of a study showing that municipal infrastructure costs tend to decline with density and are lowest for infill development.

Figure 8 **Residential Service Costs** (Frank 1989)



Evaluating Transportation Land Use Impacts[51]

- More compact development could save Calgary, Alberta about a third in capital costs and 14% in operating costs for roads, transit services, water and wastewater, emergency response, recreation services and schools (IBI 2008).
- A Charlotte, North Carolina, USA study found that lower density neighbourhoods with disconnected streets require four times the number of fire stations at four times the cost compared with more compact and connected neighbourhoods (CDOT 2012).
- A study for the City of Madison, Wisconsin, USA (SGA and RCLCO 2015a) found that annual net fiscal impacts (incremental tax revenues minus incremental local government and school district costs) are $6.8 million net revenue ($203 per capita and $4,534 per acre), compared with $4.4 million ($185 per capita and $1,286 per acre) for the low density scenario.
- A similar study for West Des Moines, Iowa, USA predicts that, to accommodate 9,275 new housing units, compact development designed to maximize neighbourhood walkability would generate a total annual net fiscal impact of $11.2 million ($417 per capita and $17,820 per acre), about 50% more than the $7.5 million ($243 per capita and $2,700 per acre) generated by the least dense scenario (SGA and RCLCO 2015b).
- Similarly, de Duren and Compeán (2015) found that in 8,600 municipalities of Brazil, Chile, Ecuador, and Mexico, municipal service efficiencies are optimized at about 90 residents per hectare, which justifies densification policies, particularly in medium-sized cities of developing countries.

Analysis of Public Policies that Unintentionally Encourage and Subsidize Urban Sprawl[52]

- Burchell and Mukherji (2003) found that sprawl increases local road lane-miles 10%, annual public service costs about 10%, and housing costs about 8%, increasing total costs an average of $13,000 per dwelling unit, or about $550 in annualized costs.
- A Charlotte, North Carolina, USA study found that a fire station in a low-density neighbourhood with disconnected streets serves one-quarter the number of households at four times the cost of an otherwise identical fire station in a more compact and connected neighbourhood (CDOT 2012).
- In a detailed analysis of 2,500 Spanish municipalities' expenditures, Rico and Solé-Ollé (2013) found that lower-density development patterns tend to increase per capita local public service costs.

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[51] Evaluating Transportation Land Use Impacts, Victoria Transport Policy Institute, Todd Litman, 2022.

[52] Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute, Todd Litman, 2015.

- The Delaware Valley Regional Planning Commission, USA (DVRPC 2003) estimated the infrastructure costs of five alternative development scenarios for the Philadelphia region. They found that roads, schools and utilities would cost $25,000 per household for the most compact scenario, 44% less than the $45,000 required by the most sprawled scenario. The compact option provides approximately $850 in annual savings per household.
- Analysis of options for accommodating 1.25 million additional residents and 800,000 additional jobs in Central Texas, USA found $3.2 billion ($2,560 per capita) lower infrastructure costs if development is concentrated in existing urban areas, 70% less than the $10.7 billion ($8,560 per capita) required if lower-density development trends continue (Envision Central Texas 2003).
- Using data from three U.S. case studies, the study, Smart Growth & Conventional Suburban Development: Which Costs More? (Ford 2010) found that more compact residential development can reduce infrastructure costs by 30-50% compared with conventional suburban development.
- More compact development could save Calgary, Alberta about a third in capital costs and 14% in operating costs for roads, transit services, water and wastewater, emergency response, recreation services and schools (IBI 2008).
- Building Better Budgets: A National Examination of the Fiscal Benefits of Smart Growth Development (SGA 2013) found that Smart Growth development costs one-third less for upfront infrastructure costs and saves an average of 10% on ongoing public services costs.
- The Utah Governor's Office, USA (2003) sponsored the Municipal Infrastructure Planning and Cost Model (MIPCOM), an easy-to-use spreadsheet model that estimates how factors such as development location and density affect various costs including regional (regional roads, transit and water supply facilities), subregional (water, sewage and stormwater networks, and minor arterials) and on-site infrastructure (local roads, water and sewer lines, stormwater systems, telephone, electricity, etc.).

Literature Review of the Costs of Infrastructure Provision for Different Development Forms

- For Los Cabos, Mexico, savings on capital costs were 38% and operational cost savings were 60% (Sustainable Cities International, 2012).[53]
- Growth simulations for the USA using mathematical impact models suggest that sprawl developments increase local road lane-miles by 10%, annual public service costs by 10%, and housing development costs by 8%, increasing total development costs by about $550 per dwelling unit per annum (Burchell & Mukherji, 2003).[54]
- The city of Halifax, Nova Scotia, studied how different settlement patterns affect the cost of services delivered by the city. They studied eight different types of development patterns, and similar to other research, they found that cost decreases with density for many services, especially for roads but also for libraries, parks and recreation, police, fire, water, transit, and sewer. Specifically for roads, they estimated that the cost per household is $1,053 for low-density rural development (2.5 acres per dwelling unit), $280 for low-density suburban (8,100 sq ft per dwelling unit), $124 for mid-density urban (2,400 sq ft per dwelling unit), and $26 for high-density urban (760 sq ft per dwelling unit). Total per household costs ranged from $5,240 for low-density rural to $1,416 for high-density urban. They also noted that operations and maintenance make up 60% to 90% of the overall service costs.[55]

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[53] Literature Review of the Costs of Infrastructure Provision for Different Development Forms, University of Toronto Transportation Research Institute, Shivani Ragha, Dena Kasraian, Eric J Millers, 2019.
[54] Literature Review of the Costs of Infrastructure Provision for Different Development Forms, University of Toronto Transportation Research Institute, Shivani Ragha, Dena Kasraian, Eric J Millers, 2019.
[55] Relationships Between Density and per Capita Municipal Spending in the United States, Upper Great Plains Transportation Institute, Jeremy Mattson, 2021.

Appendix E: Methodological Complexities of Costs and Revenues of Infrastructure by Residential Densities

The following is a summary of methodological considerations and complexities with the calculation and attribution of municipal costs and revenues related to infrastructure by residential densities. These findings were identified through the research associated with preparing the study, and particularly the literature reviews and informational interviews. These noted challenges and complexities do not preclude the need to complete financial analysis, however identify some of the limitations that participants should be aware of. For example, expectations about precision of numeric amounts should be understood as estimates rather than exact; coordination is required between different municipal departments and related functions; and there may be non-financial matters that should be considered as part of the land use planning and community building program.

Definitions, Concepts and Complexities of Calculating Costs and Revenues

- The definition of low / sprawl and high / urban densities and areas can vary, and thus associated boundaries and measures may not be consistent, resulting in different calculations and values.
- To define density consistently, data analysis can try to use a standardized proximity measure database (i.e., Walk Score, Statistics Canada).
- The link between costs and benefits (or payers / users), or lack thereof, is complex.
- What is the relevant scale, as arguably these different uses are all part of a city / region / community / society.
- Policy approaches (and associated studies) that seek to capture value associated with rezoning land are not the same thing as actual measures of infrastructure / service costs (i.e., development impacts and their costs).
- The differences (and similarities) between a tax and a user fee, noting some items may not be properly classified, is not easy to define.
- The definition and attributes of 'hard' infrastructure vs. 'soft' services vary.
- Fixed costs and past investments vs. variable costs, including baseline operating costs. In some cases, part of a service will have a 'fixed' aspect, and part a 'variable' aspect, each with different cost profiles.
- The difference between the costs of producing and delivering a service, where the cost of the latter may vary by location / geography (e.g., a treatment plant for the city, with service mains to the different areas). Thus, the cost implications of different densities may vary by function and authority; e.g., regional infrastructure treatment facilities may be less impacted by development density than municipal local service infrastructure connections.
- Average costs vs. marginal / incremental costs can differ. Marginal costs may be relevant at the development scale (or for the individual), but average costs are more relevant for the community (and society) longer term / larger scale. In practice, the costs are incurred when infrastructure upgrades are needed. The selected timeframe for amortization is a part of the answer to such cost allocation matters.
- Cumulative impact consideration; the argument that infrastructure costs should be borne by everyone in a community, not just new development / population growth.
- Some services / infrastructure with economies of scale should be provided regionally where possible, whereas others can be done more effectively and efficiently at the local level.

- There are natural economies of scale for some types of infrastructure. Economies of scale work at different levels and vary by type of infrastructure / service. And these economies usually come to an end after a certain size. Thus no single / simple optimum level for all combined services.
- Often an economy of scale is associated with capital-intensive infrastructure (such as water and sewerage treatment plants), but not for labour-intensive services (such as library services, administration).
- Local considerations / context are important. Infrastructure capacity available and incremental thresholds reflect existing local infrastructure and their respective costs.
- In some cases, creating excess capacity may have been done intentionally for future planned development that has not yet occurred (i.e., upsizing pipes for future capacity while replacing them is more cost effective than having to upsize later).
- Some local government and related services and costs are a function of per capita demand, and others based on geography / density, and some a bit of both.
- There are differences, similarities, and overlapping relationships between economies of scale and efficiencies of geography. Higher population cities, not necessarily higher density, can achieve economies of scale, while denser cities can also achieve economies of geography.
- Per unit calculations often fail to acknowledge that the housing unit types are different (i.e., a house and an apartment are both residential units, but not the same in terms of size, number of residents, and infrastructure / service demand).
- Different housing unit types/sizes or household sizes generate different per capita or costs by floor area, rather than just costs per 'housing unit'.
- Smaller housing units generally have lower assessed property values and generally pay less property taxes.

Allocating Costs

- Separating and allocating growth and non-growth related costs is complex.
- There are challenges with allocating / apportioning costs by land use, housing unit type, location / geography, components of services, and infrastructure amortization periods. Cities often do not track sub-area budgets or data.
- When comparing infrastructure costs between scenarios and allocating it to different types and numbers of residential units the results can be influenced by the assumed attribution of costs to non-residential land uses, such as commercial and industrial uses.
- Different development scenarios may not simply be defined as 'high' or 'low' residential densities, but have a mixture of different unit sizes, and different types non-residential uses which pay different tax rates. A higher density community is likely to have more housing units and households, thus more population / consumers that could support a greater amount of local population-based retail and other businesses.
- Any analysis of cost and revenue data for exclusively residential uses would need to separate out values associated with non-residential sectors.
- How best to allocate some infrastructure costs can be complex; e.g., roads could be budgeted by lane kilometre, by area, per year, yet roads are also used by people who do not live in an area or even the community.
- Notably there are some local-serving services such as public transit and schools that are not provided, maintained, or paid for by municipalities, but may be relevant considerations.

- Some other costs such as major infrastructure can be funded by one-time grants by senior levels of government rather than local ratepayers. Even if such capital projects are funded, they become a long-term operating cost liability for a municipality.
- Property taxes calculated based on the value of the property may not be ideal, as the amount of municipal services a household consumes is not directly related to property values.
- User fees could be charged for services consumed that can be readily allocated to a user, while other municipal services could be funded through general property taxation. In Canada taxation is set on assessed property value, but it could be differently allocated, such as based on lot size, lot frontage, building area, etc., as property value is not always an ideal measure of services needed or consumed.
- Based on research, larger cities tend to depend proportionally greater on user fees than smaller ones.
- The manner in which municipalities decide to value a capital asset and associated amortization / depreciation schedule effects assigned costs per year is complex. Some infrastructure may last longer or shorter than initially estimated.
- Reserve allowances for replacement costs may be funded or not, and show up differently in municipal budgets.
- There are different catchment areas for different service types, and thus costs.
- Data about revenues and expenses by item may not be readily available or assignable by sub-geography or unit type.
- Municipal DCCs are typically applied at a municipal-wide rate as it is administratively simpler and provides more flexibility, rather than having to limit infrastructure expenditures to within separate geographies.
- It can be simpler to use averages and equalize tax rates, but that can result in the most efficient areas subsidizing other areas.
- Some services and costs can be metered while others are not, and funded via general taxation.
- Some property taxes go to other levels of government rather than the local municipality.
- Private infrastructure is not typically included in municipal financial analysis. Some services are private responsibilities and do not show up as municipal cost; e.g., strata amenity fees for multi-unit housing which includes private utilities is a cost to those homeowners.
- Some items are not included in the financial analysis; e.g., in some rural communities service levels are low, and there is no reported financial cost as they are paid for privately (e.g., water, sewer) or provided via volunteers, such as firefighting.
- What level of government should provide societal responsibilities is a complex question; e.g., poverty, homelessness, affordable housing, etc. may be addressed via municipal efforts at local costs, but may be the responsibility of other levels of government.

Local Considerations / Contexts

- Servicing costs in many cases are impacted by local matters, such as the available capacity, age, and condition of existing infrastructure, which is often a context / area specific matter. Available infrastructure capacity provides for very different costs to service new development.
- Beyond residential density and type, level of, and costs to provide services may vary by location and circumstances, due to topography, geography, street pattern, condition and capacity of existing infrastructure, non-residential uses, etc.

- If neighbourhoods were developed at different times / places, they may be built to different standards, thus different infrastructure capital and maintenance costs.
- Residential densities and neighbourhood ages are associated with other attributes, which may impact servicing and infrastructure costs in other ways.
- The intensification of areas that were not initially planned for higher densities, such as urban infill areas, can be a challenge and more expensive if infrastructure capacity is not present. This may necessitate replacing existing infrastructure to increase capacity before it would otherwise need to be replaced due to age.
- Older cities have older infrastructure, which is more expensive to maintain, whereas outer suburban areas that may have been developed / built more recently will have newer infrastructure that may not require as much maintenance, and associated cost impacts.
- Complexities and costs of developing in urban areas are notable as 'urban harshness'. Although absolute project costs may be higher, it can be spread over a larger population, thus the per unit cost is lower.
- There are trade-offs between the densities and harshness of a place. Density and agglomeration, both localized and urbanized, may save costs, however some costs increase with higher densities, such as land costs, more complexities, construction works in urban environments. Municipal labour costs may also be higher in larger cities.

Relationship Between Costs and Densities

- Some costs are more or less sensitive to density than others. Some items / categories of costs and their attribution are clear while others may not be.
- Impacts of growth and development, irrespective of location or form / density, can be the same or can vary.
- There are different issues between high growth and no or low growth cities / regions.
- The relationship between residential density and infrastructure demand is fairly intuitive for some items; i.e., larger residential lots require more linear distance of pipes and pavement per household, thus higher costs, yet parks and recreation costs are based on population of a community, and stormwater drainage costs tend to be related to building site coverage rather than density per se.
- Most of the municipal operating budgets tend to be for labour costs. Some government services are very labour-intensive, thus the costs do not vary much due to geography / density, vs. other costs such as linear infrastructure.
- Urban development provides for lower infrastructure costs, but that's on a per unit basis, not on an absolute basis. Not all services are more efficient with higher densities, and some may have diseconomies of scale.
- Different municipalities may provide different levels of service, in terms of quantity or quality, with unique efficiencies or inefficiencies, which are difficult to address in any cost analysis.
- At some threshold levels, some types of services must move from one delivery program to another, with a significant change in cost structure. This is most often associated with population growth, not density per se; e.g., moving from a volunteer firefighting service to a professional paid one once a municipality reaches a certain size.

Policies / Regulations

- The notion that urban sprawl is caused by planning policies that distort market decisions, fails to acknowledge that other planning policies can cause their own sets of distortions.
- Allowing higher density development forms in urban areas can be a challenge in terms of local resident opposition, a complex and lengthy approvals process, and higher municipal fees, which all add costs over greenfield forms of development.
- While 'Smart Growth' and similar concepts support infill, intensification, and redevelopment, it does not prohibit single-detached housing forms. Many Smart Growth illustrations show the inclusion of small lot, ground-oriented houses as a means of encouraging a greater diversity of housing mix, not all high-density housing forms.
- While 'Smart Growth' is not synonymous with reducing the supply of land that can be developed, it generally discourages greenfield development and outward urban expansion. All else being equal, a reduced land supply in a market with strong demand for housing is likely to create upward pressures on housing price.
- Even though infrastructure costs (per capita) in dense infill sites may be lower, the land development and construction costs tend to be higher due to municipal policies or space / access constraints, which can result in higher housing costs in city centres. An unintended result is a push of some residents to lower-density suburban areas where housing costs are comparatively less, but household transportation costs are higher.
- While infill development may have lower municipal infrastructure costs, it generally does not see lower Development Cost Charges. This indicates that DCCs may not be set correctly if they are the same for an entire municipality, and in fact subsidize some forms of development. In fact, that approach encourages the development of lower density, suburban development where the DCC rates do not necessarily reflect actual infrastructure costs.
- While some charges / fees may vary by residential unit types, often that variance is mostly due to differences in the number of occupants per unit, not significantly by other inputs. Thus the per capita rates are similar when adjusted for the number of residents per household.

Community Populations / Preferences

- Residential market preferences are a major determinate of urban form, and housing choices are important.
- Differing demographics / populations require or consume different levels and types of services, with, as example, poverty, homelessness and crime and the associated costs tending to concentrate in the urban areas.
- Different areas / communities have different population profiles and behaviours as a result of where they live and the environment, or their decisions to live there.
- Different levels of municipal services can be demanded by different communities, often a result of income levels, demographics, cultural background, ability to pay, and household composition.
- Consumer expectations regarding level of service are increasing. In many suburban areas residents expect urban levels of services given the proximity to and familiarity with the services provided in urban communities.
- Communities that have a large industrial or commercial property tax base compared to residential, have the benefit of a different distribution of municipal costs and revenues for residents.
- Externalities and impacts may be within the municipality, or they may extend beyond the geographies / jurisdictions.

- Low growth jurisdictions may have very low DCCs or waive them to attract development activity, indicating that the community benefits from such development, investment, and growth. This results in an infrastructure shortfall that must be made up generally from taxation or other revenue sources.

Decision Making

- Costs and benefits are borne by different parties (i.e., individuals, businesses, society). Thus calculations can vary from the perspective of the consumer vs. municipality.
- There is an element of uncertainty about future costs vs benefits about decisions made now.
- Maintenance can be deferred for a time and not reflected in municipal budgets, although infrastructure deficits typically end up costing more to address the longer they accumulate. Similarly deferring maintenance of infrastructure and waiting for a failure to address also typically end up costing more.
- A range of uses and facilities are required for a community, and must be provided even if not all are high preforming from a municipal finance perspective. Infrastructure and service planning should consider the economic and functional needs of the entire city or region over the long term.
- Municipal services in Canada are largely funded by property taxes on an ad valorem system (value of property), rather than on a service consumed basis. Higher value properties pay more towards city services, while user fees are applied only for some services.
- Cities typically charge city-wide average DCCs instead of variable ones by sub-area. This approach is often seen as fairer, and setting different rates for different areas could result in pressures to alter city service provision and reduce city-wide cooperation.

Scale / Timeframe Allocation

- A geographic analysis of spatial activity may be unrealistic or calculated results may vary depending on the selected scales. The scale at which the analysis is undertaken of costs and revenues will impact the results.
- Total costs by service may be tracked and reported by municipalities for their entire jurisdiction, but it is much more difficult to disaggregate by sub-area and by unit type.
- Some major infrastructure that serves one municipality and regional services that support multiple municipalities like sewerage, water, dikes, etc., may be funded by senior levels of government, rather that local government and not reflected in municipal budgets.
- Paying for infrastructure by Development Cost Charges puts the cost on the respective developer and the new residents instead of the broader community through general municipal taxation, thereby transferring infrastructure costs to the private sector from the public sector.
- Some services also have different levels of consumption depending on the unit type, which is associated with development density, such as water, sewerage, and waste, which tend to be much higher in houses than apartments.
- The infrastructure in some municipalities have been over-planned for much larger populations than they currently have, thus affecting services and costs.
- Major infrastructure is large, expensive, and often has to be built all at once and cannot be spread out over time or expanded incrementally to match the gradual increase in demand as a community grows. In those cases, the overbuild needs to be funded upfront for future users / benefiters.

Other Considerations

- Costs to build infrastructure increase every year, primarily driven by labour costs. The construction sector, unlike other sectors such as manufacturing, has not become more efficient / productive over the past decades, through technological innovation.
- Municipal capital infrastructure costs are incurred at once, and unlike variable user fees, do not necessarily influence consumption / usage decisions, such as is the case with water meter charges, for example.
- It is difficult to compare findings between locations and jurisdictions as there can be many different variables in terms of services, costs, revenues, allocations, governance, etc. For example, Quebec's property tax system is more in line with a user-fee basis, with a direct link to services provided to property users, than is Ontario's. BC and Alberta municipalities spend relatively little on social services. Public transit service is the responsibility of the Province in BC and of the municipalities in Alberta, where is the responsibility of regions in Ontario.

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