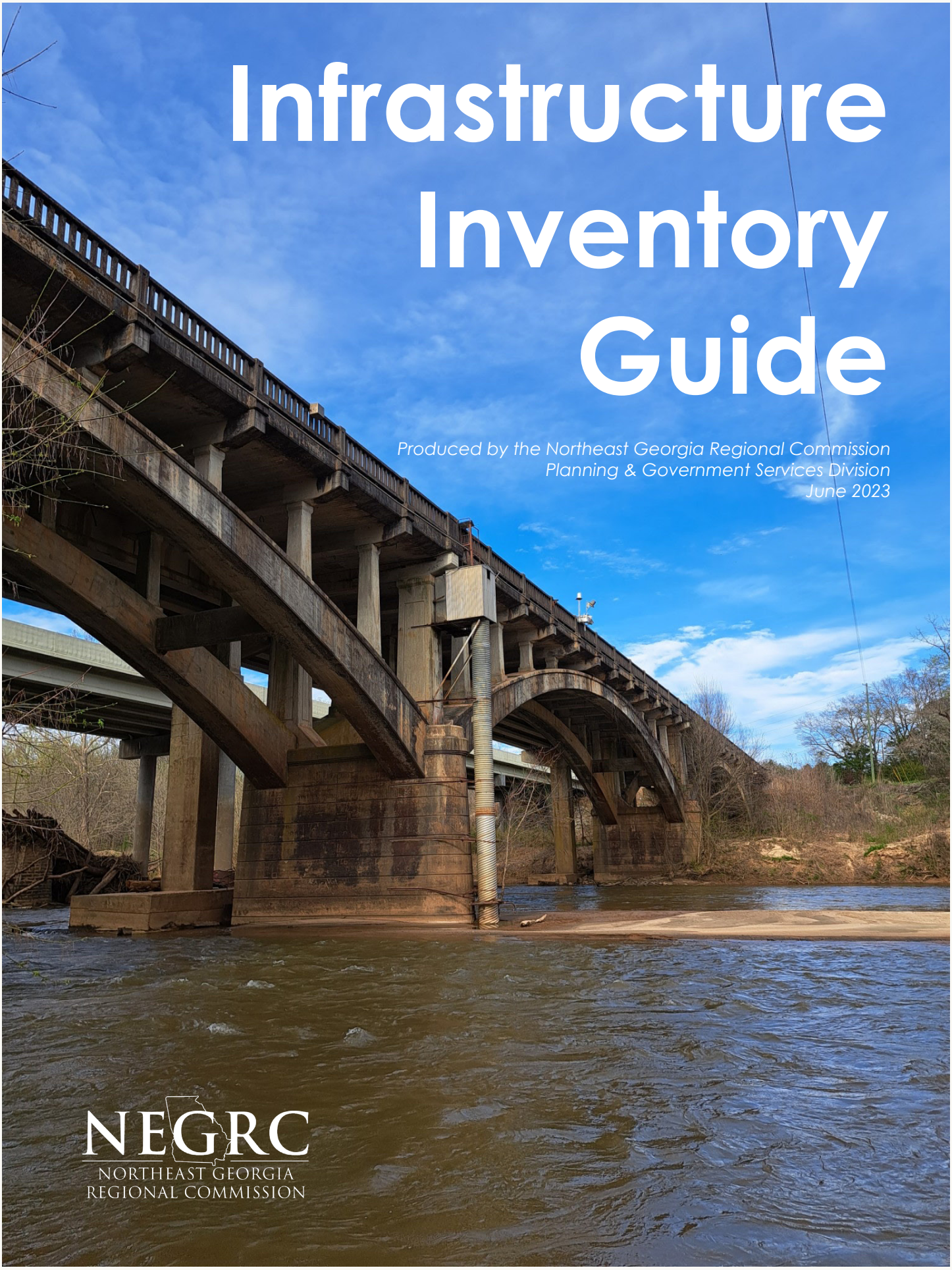
Infrastructure Inventory Guide



Produced by the Northeast Georgia Regional Commission
Planning & Government Services Division
June 2023

NEGRC
NORTHEAST GEORGIA
REGIONAL COMMISSION

Table of Contents

Introduction

Governments are responsible for operating and maintaining our public infrastructure. The term infrastructure refers to the pipes, roads, bridges, and other utilities that make up our built environment. that are traditionally understood as pieces of infrastructure. The financial obligation of updating public infrastructure depends on a variety of factors, including jurisdiction, ownership, service delivery strategies (SDS), state and federal guidelines, and availability of funding. The American Society for Civil Engineers estimates, in their 2021 Report Card for America's Infrastructure, that the United States, over the next ten years, is facing a $2.59 trillion infrastructure maintenance funding shortfall (p. 6). Government bodies at the federal, state, and local level all face deficiencies in infrastructure funding.

Infrastructure is an accrued liability and the tax base served by this infrastructure is the wealth-generating asset (Marohn, Is a street an assest?, 2014). Infrastructure should be accompanied with sufficient tax revenue and fees for service to maintain an adequate level of service. The decision-making processes of local governments should include a consideration of the size of their service areas per service linked with their future development map, especially for urban services such as water and sewer. This effort seeks to maximize the efficiency of services and local revenue in future decades. Conducting an inventory is the place to start when assessing the fiscal sustainability of infrastructure. Some local governments have found that regularly inventorying infrastructure extent and condition helps improve resource management, planning, and capital funding priorities. This guide intends to help local governments understand and develop an infrastructure inventory process that suits their needs and creates a more efficient workflow.

Conducting an Inventory

The Process:

This case outlines the steps of an infrastructure inventory as follows:

Phase I: Asset Inventory

The purpose of this phase is to answer the following questions:
What is owned and where is it located?
What is its current condition?
What is its value?
What is its recommended service life?
What are its maintenance requirements?
When are upgrades/maintenance projects required?

Phase II: Condition Assessment

Assign a condition rating scale to help predict when the asset will need rehabilitation or replacement.

Phase III: Performance Evaluation

All infrastructure is providing a service to the community and each community must decide the level of service with which they are comfortable providing. They need to ask questions like, "How rough will we let our roads get?," "How many water line breaks per mile of pipe are acceptable before we need to replace the entire line?," and "How many parts per million of contaminants are acceptable in our drinking water?"

Some of these standards may already be set by outside entities (e.g., the EPA), but the community should have a well-defined set of standards in place to judge their performance. The inventory should also prioritize based on risk and the severity of failure. For example, a dam or levee may not incur much annual maintenance, but it should receive a high maintenance priority because the consequences of failure would be severe.

Phase IV: Cost Analysis

Identify all costs associated with each asset such as construction capital costs, operations and maintenance costs, replacement costs, and decommissioning costs.

Focus on anticipating all costs for operating and maintaining infrastructure while properly allocating investments where they are required the most. In this phase, local governments will be encouraged to seek and consider alternative maintenance options, and to explore the advantages of planned preventative maintenance. Injecting appropriately timed investments into infrastructure can not only slow the deterioration process but can also extend the overall service life, ultimately saving the municipality money.

This inventory is not meant to be a one-time occurrence. The needs and expectations of a municipality, along with its' infrastructure are constantly changing. To account for this, infrastructure must be continuously re-evaluated and asset inventories must be kept up to date to ensure that decisions are based on the most current information. Implementing an asset management system can be a significant undertaking, but once the initial inventory is complete, subsequent inventories become much easier (Prince Edward Island Transportation and Infrastructure Department, 2015).

Calculating the Life Cycle Costs of Infrastructure

A lifecycle cost analysis identifies every dollar that will be spent on a piece of infrastructure (or buildings and equipment) over its life span and will be the focus of later phases in the infrastructure management plan. Lifecycle costs consist of capital (cost of construction or purchase), operating, maintenance, and decommissioning (demolition, removal) costs. For certain projects, the focus is often on capital costs, while some operating and maintenance costs are minimized. The chart below illustrates how to document annual costs (operation and maintenance), general costs, and revenues to create a foundation of lifecycle cost analysis that local governments can utilize as a starting template.

In the example table below, certain fields ask for annual costs or revenues. As these values often differ from year to year, an average for the previous five years is used as a mean. If information from the last five years is not available, proceed with the best available information. These figures can be estimates instead of exact figures, if necessary. The section is mainly intended to give local governments a snapshot of the financial state of their infrastructure assets on an annual basis (Prince Edward Island Infrastructure Secretariat, 2014).

Financial Information		
Annual cost		
1	**Annual Amortization Cost** *Indicate yearly cost associated with initial construction or recent additions or updates*	
2	**Average Annual Operating Costs** *Indicate costs associated with heat, electricity, insurance, cleaning internet , cable , utili*	
3	**Average Annual Maintenance Costs** *Indicate costs associated with yearly upkeep of building - re-painting, shingle replaceme*	
4	**Other Misc. Annual Costs** *Indicate any other annual costs that don't fit under the categories listed above*	
5	**Total Annual Expenses (1+2+3+4)**	
6	**Average Annual Income** *If applicable, estimate the revenue generated each year through rental fees, fundraisers,*	
7	**Average Annual Net Income (6-5)**	
General Cost		
8	**Insured Value** *Indicate the replacement value, as estimated by your insurance provider*	
9	**Annual Budgeted Amount For Emergency Repair** *If applicable, indicate what is budgeted for emergency repairs on an annual basis*	

Table 1: Life Cycle Costs ***(Prince Edward Island Infrastructure Secretariat, 2014, p. 14)***

Defining the Table

Annual Costs

1. *Annual Amortization Costs* are costs associated with the purchase or construction of an asset. They are to include any recurring payments being made to a financial institution or lending agency.

2. *Average Annual Operating Costs* are fixed costs that are usually invoiced on a monthly or yearly basis. Examples include utility, electricity, heat, insurance, cable, internet, janitorial services, etc. These are anticipated costs that are necessary for the overall operation of the asset.

3. *Average Annual Maintenance Costs* are incurred on a less routine basis and are the result of the asset's age and usage. Examples include roof repair, window replacement, furnace

and burner service, and asphalt patching in a parking lot. There is often confusion surrounding the difference between operating and maintenance costs. The following example outlines operating and maintenance costs for a car: Operating costs include registration, inspection and insurance fees as well as day-to-day necessities such as gas, windshield washer fluid, etc. Maintenance costs are incurred through oil changes, scheduled check-ups, tire rotations and repairs from collisions.

4. *Other Misc. Annual Costs* include any other costs associated with the assets on a yearly basis, aside from operation and maintenance. If one is unsure whether a cost should be documented under operation or maintenance, then include it on this row.

5. *Total Annual Expenses (1 + 2 + 3 + 4)* are the sum of each of the previous 4 rows (amortization, operation, maintenance and miscellaneous) and provides a yearly expense total.

6. *Average Annual Income* includes any income that the asset generates and if applicable, should include all revenue received from rental fees, funding, donations, fundraisers, taxes, etc. Similar to annual expenses, an average should be taken over the previous 5 years.

7. *Annual Net Income* is found by subtracting line 5 (Total Annual Expenses) from line 6 (Average Annual Income).

General Costs

8. *Insured Value/Replacement Cost* is used to determine the amount of capital that should be set aside for future replacement. Replacement Value can be determined in several ways:
-Inflated Capital Cost: If the information is available, use the original cost of construction or acquisition and inflate the price to the current year.
-Appraisal Cost: Consult a licensed land and property appraiser to determine the current value.
-Reproduction Cost: Consult a contractor or engineer to determine what the cost would be to completely reconstruct the asset or purchase a new version. If the infrastructure is insured, consult the insurance provider to see what the anticipated cost for replacement is.

9. *Annual Budgeted Amount for Emergency Repairs*. This will not apply to every asset as it is not always necessary, but if there is an amount of money that is continuously set aside for emergency maintenance and repairs then enter it in this field. Although there is no section for decommissioning costs, municipal administrations are encouraged to start thinking about them as their assets age and deteriorate. These costs are often overlooked and underestimated.

Measuring the Infrastructure Network

The inventory process is intended to be an ongoing endeavor that provides everyone with clarity over the infrastructure maintenance costs, conditions, and size that the local government manages. It is the foundation of the infrastructure management plan.

When measuring the size of the infrastructure network, this example recommends identifying segments with an "Asset ID" based on:

A. Street address at start and end point.
B. The start and end point of network components such as the distance between valves, pumps, or utility access hole covers in a water system.
C. Coordinate systems such as those included in a Geographic Information System or a Global Positioning System.

The asset numbering system should be systematic and consistent, as shown in the illustrations below: Note: Certain assets may have a Related Asset ID; a valve would have its own Asset ID, but it could be part of a well that also has an overall Asset ID (Prince Edward Island Infrastructure Secretariat, 2015).

Form	Asset Type	Asset Class Number
Water		
B.1	Well Field	32
B.2	Well	33
B.3	Buildings	11 – Buildings: Water
B.4	Pumps	34
B.5	Water Storage Tank	36
B.6	Valves	37
B.7	Hydrants	35
B.8	Pumping/Booster Stations	38
B.9	Chambers	39
B.10	Water Meters	40
B.11	Supplementary/Miscellaneous	41
W, WW Pipes Spreadsheet	Pipes	31
Wastewater		
B.3	Buildings	13 – Buildings: Wastewater
B.12	Manholes	47
B.13	Wastewater Lagoons	43
B.14	Supplementary/Miscellaneous	46
W, WW Pipes Spreadsheet	Pipes	42

Table 2: List of Forms ***(Prince Edward Island Infrastructure Secretariat, 2015, p. 11)***

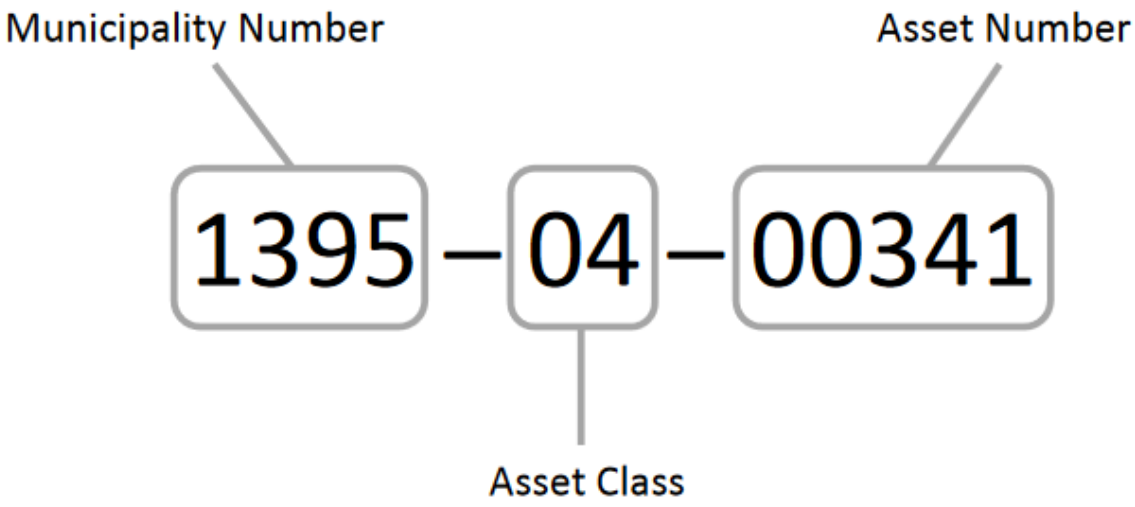


Figure 1: Asset ID Diagram (Prince Edward Island Infrastructure Secretariat, 2015, p. 12)

Calgary Infrastructure Status Report

Calgary's Infrastructure Status Report (ISR) provides a strong example of how local governments can manage their inventory. The ISR answers five questions:

What do we own? (Organize by business unit/system e.g., water, wastewater, roads)
What is its value?
What condition is it in?
What is its remaining service life? (Note: infrastructure can continue to provide useful service that is shorter or longer than the standard service life based on maintenance and use)
What is the infrastructure funding gap (if it exists)?

Condition Category	Description	Rating Scale
Physical	Physical deterioration of the asset.	**Very good** – Sound or "as new" condition
		Good – Acceptable physical condition. Asset shows only minor deterioration.
		Fair – Tolerable physical condition. Moderate deterioration evident.
		Poor – Major deterioration evident.
		Critical – Asset deteriorated to such an extent that it is generally inoperable or unsafe.

Table 3: Condition Assessment Rating Scale (2017, p. 16)

Asset Type	Quantity	Unit of Measure	Current Replacement Cost ($Millions)	Average Physical Condition
Boulevards	1,012.0	Hectares	$51.00	Fair
Bridges and Tunnels	363	Count	$1,514.40	Good
Curbs & Gutters	6,600.0	Linear kilometres	$2,514.10	Very Good
Facilities and Storage	n/a	Various	$46.60	Fair
Fences / Guardrails	317.6	Linear kilometres	$282.00	Fair
Guide Signs	276	Count	$34.50	Good
Lanes	3,067.1	Lane kilometres	$897.00	Fair
Machinery & Equipment	423.0	Count	$15.30	Fair
Engineered Walkways	96.4	Linear kilometres	$17.60	Fair
Pavement	16,254.6	Lane kilometres	$9,935.30	Good
Plants	2	Count	$22.30	Poor
Retaining Structures > 1 metre	35.8	Linear kilometres	$132.30	Good
Retaining Walls < = 1 metre	16.8	Linear kilometres	$16.50	Fair
Sidewalks	5,680.6	Linear kilometres	$2,627.70	Good
Signs	98,994	Sign posts	$48.00	Good
Street Furniture	1,799	Count	$3.20	Fair
Street Lights	83,792	Streetlight stands	$1,532.10	Fair
Timber Stairways	68	Count	$3.00	Fair
TMC	1	Count	$8.10	Fair
Traffic Barriers	112.1	Linear kilometres	$60.30	Fair
Traffic Signals	1,029	Signalized intersections	$208.30	Good
Pedestrian Passes (over 15)	90	Count	$515.00	Good
		Total:	**$20,484.60**	

Table 4: Road Asset Portfolio (2017, p. 59)

The tables below show the value of The City of Calgary's infrastructure assets, remaining life, infrastructure gap (forecast) as well as assets' physical condition over the five business cycles.

		2004	2007	2010	2013	2017
Value ($Billions)		**27**	**54**	**55.14**	**60.48**	**84.70**
Age (Years)	**Expected**	**68**	**65**	**67**	**59**	**68**
	Remaining	**31**	**31**	**43**	**32**	**29**
Gap ($Billions)	Operating	0.50	0.76	0.86	2.11	1.07
	Maintenance	2.30	2.67	3.23	1.70	1.41
	Growth	2.50	6.96	3.31	3.23	3.19
	Total Gap	**5.30**	**10.39**	**7.40**	**7.04**	**5.67**

	Physical Condition		
	Good* (combined with V. Good)	**Fair**	**Poor* (combined with Critical)**
2004	80%	14%	6%
2007	76%	17%	7%
2010	78%	16%	6%
2013	95%	3.50%	1.50%
2017	88%	9.70%	2.30%

Table 5: The value of the City of Calgary's infrastructure assets, remaining life, and infrastructure gap over 5 business cycles (2017, p. 20)

Calgary divides the infrastructure gap into the unfunded operating gap (required to bring existing infrastructure up to minimum viable standard), the unfunded maintenance gap (required to maintain/upgrade existing infrastructure), and the unfunded capital growth gap (required to support expansion of the city). Over time, these can be regular reports that allow comparison from year to year (2017 Infrastructure Status Report, 2017).

Application

Conducting an inventory is the first step to organizing and quantifying the responsibilities and needs that the local government is accountable for. For most communities, the reason there is a gap between resources and infrastructure needs is that the public commitment to new pieces of infrastructure has not generated enough tax revenue from adjacent land development to pay for the upkeep of that infrastructure over its lifespan.

Although not currently required by the Government Accounting Standards Board (GASB), full-accrual accounting is the best method to build-in the ongoing and future lifecycle infrastructure costs into the annual budget. Full-accrual accounting "recognizes the financial effect of events that impact an entity during the accounting period, regardless of whether cash was received or spent (Hegar, 2005)". Compared to cash basis accounting, which records revenue when payment or income has been received, full-accrual accounting provides a more accurate account of infrastructure costs.

A certain ratio of private investment to public investment is required to maintain infrastructure and services. One estimate places this ratio between 20:1 and 40:1 (or 2.5-5% of private investment value) (Marohn, The Desnity Question, 2015). According to that estimate, a fiscally sustainable community requires 20-40 dollars of private wealth to support each dollar of public expense. Once the infrastructure inventory has quantified the total operating and replacement costs for the network, the responsible local government or authority can determine the size of the network they can afford to maintain year over year. While infrastructure managers should do a more detailed analysis of exact costs and revenues, a basic estimate can be performed through the following process (Hawryluk, 2021):

1. Find your community's property assessment and infrastructure information.
    - Total value of tax base (start with property taxes) Note: sales tax is not included in the article
    - Total replacement value of infrastructure
2. Find private to public investment ratio: Private investment / public investment = ratio of private to public investment
3. How much tax revenue does the community need to collect each year? Infrastructure replacement value / remaining useful life of that infrastructure = how much must be annually allocated to pay for infrastructure
4. How much do people need to pay per year? Annual cost per $100,000 of private property = Total Annual Cost × ($100000 / Total Private Investment)

Note: This could be calculated per person, but a more accurate description is provided by using property values.

Conclusion

An inventory guide can organize and track the various attributes of a local community's public infrastructure, including current condition, value, and useful life. This information is critical in the prioritization of maintenance activities, upgrades, and the allocation of funds.

Communities with an infrastructure funding gap need to find ways to increase the ratio of private dollars invested in the community relative to the amount of public expenses necessary to fund infrastructure and services year after year. Based on the information from an inventory, a local communities' resources can be strategically invested into the community's infrastructure more efficiently. This investment will eventually lead to an increase in land value and, in turn, tax revenue, which will fund the continued maintenance and upgrade of the community's public infrastructure. An inventory of a local community's infrastructure is a critical tool in supporting, maintaining, and expanding a local community's public infrastructure.

References

American Society of Civil Engineers. (2021). *A Comprehensive Assessment of American's Infrastructure.* Reston: American Society of Civil Engineers. Retrieved from https://infrastructurereportcard.org/wp-content/uploads/2020/12/2021-IRC-Executive-Summary.pdf

Calgary. (2017). *2017 Infrastructure Status Report.* Calgary: City of Calgary. Retrieved from https://www.calgary.ca/cs/iis/asset-management-policies/Infrastructure-report.html?redirect=/isr

Hawryluk, N. (2021, February 22). How to #DoTheMath for Non-Math Majors. *Strong Towns*. Retrieved from https://www.strongtowns.org/journal/2021/2/20/how-to-dothemath-for-non-math-majors

Hegar, G. (2005, September 19). *Full Accrual Basis of Accounting*. Retrieved from Fiscal Management Division: https://fmx.cpa.texas.gov/fmx/pubs/afrrptreq/gen_acct/index.php?section=overview&page=full_accrual#:~:text=The%20full%20accrual%20basis%20of,cash%20was%20received%20or%20spent.

Liss, J. (2015, November 23). The Accounting Rules That Bankrupt Cities. *The Atlantic*. Retrieved from https://www.theatlantic.com/politics/archive/2015/11/accrual-accounting/417117/?google_editors_picks=true

Marohn, C. (2014, August 19). Is a street an assest? *Strong Towns*. Retrieved from https://www.strongtowns.org/journal/2014/8/19/is-a-street-an-asset.html

Marohn, C. (2015, March 30). The Desnity Question. *Strong Towns*. Retrieved from https://www.strongtowns.org/journal/2015/3/29/the-density-question

Prince Edward Island Infrastructure Secretariat. (2014). *Municipal Infrastructure Asset Inventories: A Guide for Municipalities.* Charlottetown: Prince Edward Island. Retrieved from http://www.gov.pe.ca/photos/original/tir_assetinvent.pdf

Prince Edward Island Infrastructure Secretariat. (2015). *Municipal Infrastructure Asset Inventories: A Guide for Municipalities Part II: Water and Wastewater Infrastructure.* Charlottetown: Prince Edward Island. Retrieved from http://www.gov.pe.ca/photos/original/tie_GFB.pdf

Prince Edward Island Transportation and Infrastructure Department. (2015, August 3). *Municipal Infrastructure Asset Management*. Retrieved May 2022, from https://www.princeedwardisland.ca/en/information/transportation-infrastructure-and-energy/municipal-infrastructure-asset-management

NORTHEAST GEORGIA
REGIONAL COMMISSION