



DANGER AHEAD:
THE COMING COLLAPSE
OF CANADA'S MUNICIPAL
INFRASTRUCTURE

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SECTION 1: EXECUTIVE SUMMARY

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“CANADA’S QUALITY OF LIFE AND ECONOMIC COMPETITIVENESS DEPEND IN PART ON HAVING RELIABLE, EFFICIENT INFRASTRUCTURE THAT IS PROVIDED IN LARGE PART BY THE MUNICIPAL, PROVINCIAL, TERRITORIAL AND FEDERAL GOVERNMENTS.”

Restoring Fiscal Balance in Canada—Focusing on Priorities, Federal Budget 2006

Canadian municipalities build, own and maintain most of the infrastructure that supports our economy and quality of life. Yet for the past 20 years, municipalities have been caught in a fiscal squeeze caused by growing responsibilities and reduced revenues. As a result, they were forced to defer needed investment, and municipal infrastructure continued to deteriorate, with the cost of fixing it climbing five-fold from an estimated \$12 billion in 1985 to \$60 billion in 2003. This cost is the municipal infrastructure deficit, and today it has reached \$123 billion.

The upward trend of the municipal infrastructure deficit over the past two decades points to a looming crisis for our cities and communities and ultimately for the country as a whole. The deficit continues to grow and compound as maintenance is delayed, assets reach the end of their service life, and repair and replacement costs skyrocket. When compared with earlier estimates, the \$123-billion figure clearly shows the municipal infrastructure deficit is growing faster than previously thought.

Across Canada, municipal infrastructure has reached the breaking point. Most was built between the 1950s and 1970s, and much of it is due for replacement. We can see the consequences in every community: potholes and crumbling bridges, water-treatment and transit systems that cannot keep up with demand, traffic gridlock, poor air quality and a lack of affordable housing. The infrastructure deficit affects all communities, from major cities to rural, remote and northern communities, where municipal governments lack essential infrastructure and do not have the tax base to develop it.

Action is needed to eliminate this deficit and prepare for effective infrastructure management in the future. Since the first step in any project is to determine the scope of the problem, FCM commissioned Dr. Saeed Mirza of McGill University to survey municipal governments to determine their infrastructure needs as a first step toward determining the size, scope and growth rate of the municipal infrastructure deficit.

The \$123-billion estimate includes “sub-deficits” for key categories of municipal infrastructure: water and waste water systems (\$31 billion), transportation (\$21.7 billion), transit (\$22.8 billion), waste management (\$7.7 billion) and community, recreational, cultural and social infrastructure (\$40.2 billion). There is also an estimate of new infrastructure needs, defined as projects that increase infrastructure capacity through expansion and/or new construction. Similar to earlier studies, this report provides a “snapshot” of what municipal governments identify as their infrastructure funding needs. It does not provide an exhaustive or complete account of the physical condition of municipal infrastructure.



If Canada is to prosper, municipal infrastructure investments must support the economic potential of our cities and communities. For this to happen, financing must reflect the long-term nature of infrastructure investments, which will require a long-term investment plan with agreed-upon priorities. This plan must bring long-term certainty to infrastructure funding, which will promote new efficiencies, technologies and best practices in infrastructure delivery.

Any serious plan to address the municipal infrastructure deficit must begin with an acknowledgement of the scope of the problem and the urgency to address it. This study represents the first step towards a real plan.

SECTION 2: INTRODUCTION

Over the past two decades, Canada’s municipal infrastructure has continued to deteriorate. In 1985, it was estimated that \$12 billion would be needed to fix our deteriorating municipal infrastructure¹. By 1992 the figure had climbed to \$20 billion,² and four years later it had more than doubled to \$44 billion³. Since 2003, the municipal infrastructure deficit has been widely estimated to be \$60 billion and growing by about \$2 billion a year.⁴

In June 2007, FCM commissioned Dr. Saeed Mirza of McGill University to update the estimated deficit. A review of recent research suggested that the current estimate of \$60 billion is out of date and that a combination of aging infrastructure and continuing deterioration is accelerating the deficit’s growth. To test these findings, the project team conducted a survey of municipal infrastructure needs between October 6, 2007, and November 6, 2007.

This report provides an analysis of the survey results and a revised estimate of the municipal infrastructure deficit. As defined here and in previous studies, the “municipal infrastructure deficit” reflects the cost of maintaining and upgrading existing, municipally owned assets. The municipal infrastructure deficit does not include infrastructure owned by other orders of government (e.g. hospitals, schools, military bases, highways) or the cost of building new or expanded facilities to meet new needs or provide additional infrastructure capacity. This report also provides an estimate of new infrastructure needs, defined as projects that increase infrastructure capacity through expansion and/or new construction.

The goal of this report is to provide a more informed public discussion of how to deal with our municipal infrastructure funding challenges. Similar to studies conducted in 1985 and 1996, this report provides a “snapshot” of what municipal governments identify as their infrastructure funding needs. It does not provide an exhaustive or complete account of the physical condition of municipal infrastructure.

The report concludes with its single recommendation: that we establish a national plan to eliminate the municipal infrastructure deficit and prepare the groundwork for effective management of our infrastructure in the future. The first step in building that plan must be a comprehensive, national study—involving all three orders of government—to determine the size, scope and geographic characteristics of the municipal infrastructure deficit.

¹ FCM, *Municipal Infrastructure in Canada: Physical Condition and Funding Adequacy*, 1985.

² FCM, “*Green Card*” report, Ottawa, 1992.

³ FCM and McGill University, *Report on the State of Municipal Infrastructure in Canada*, 1996.

⁴ TD Bank Financial Group, *A Choice Between Investing in Canada’s Cities and Disinvesting in Canada’s Future*, p. 12, 2002.



SECTION 3: ABOUT THE MUNICIPAL INFRASTRUCTURE DEFICIT

I. What is the Municipal Infrastructure Deficit?

Municipalities build, own and maintain the majority of this country's infrastructure—infrastructure that supports our economy and quality of life.

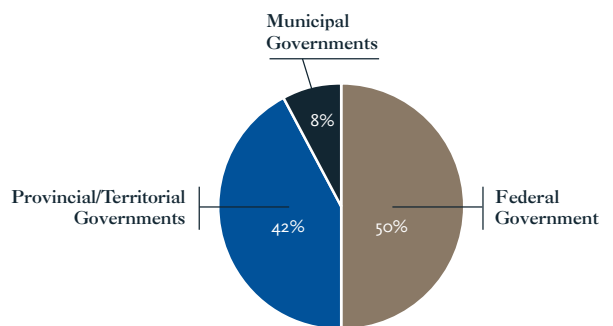
During the past 20 years, Canadian municipalities have been squeezed by increasing responsibilities and reduced transfer payments from other orders of government. This has had direct and negative consequences for Canada's infrastructure. Unlike other orders of government, municipalities are not allowed to run deficits on their operating budgets. This, in turn, has put tremendous downward pressure on municipal capital budgets, which do not face the same immediate pressures as operating expenditures, making capital investments easier to delay. This has fuelled the growth of a substantial national municipal infrastructure deficit.

This infrastructure deficit affects our communities in a number of ways. Municipal governments are finding it extremely difficult to manage current infrastructure demands, let alone deal with the accumulated backlog of infrastructure maintenance and rehabilitation. This is compounded by population growth, which further strains existing infrastructure resources while creating additional demand for more infrastructure.

We can see the consequences in every community: potholes and crumbling bridges, water-treatment and transit systems that cannot keep up with demand, traffic gridlock, poor air quality and a lack of affordable housing. The infrastructure deficit affects all communities, from major cities to rural, remote and northern communities, where municipal governments lack essential infrastructure and do not have the tax base to develop it.

Across Canada, municipal infrastructure has reached the breaking point. Most was built between the 1950s and 1970s, and much of it is due for replacement. Given municipalities' already strained fiscal situation, we are rapidly approaching a tipping point on the infrastructure deficit, one that will seriously harm both our quality of life and our competitiveness and productivity.

Figure 1
Municipal Government Share of All Tax Revenues



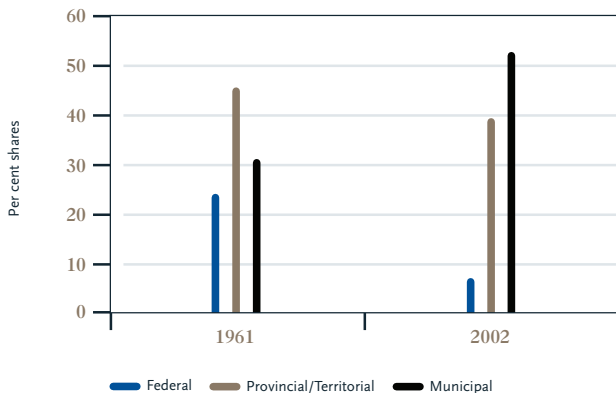
Municipal governments receive less than 10 per cent of existing revenues.

Source: FCM, 2006

THE MUNICIPAL INFRASTRUCTURE DEFICIT: ROOT CAUSES

In 1961, during the initial phase of heavy investment in Canada's infrastructure, federal, provincial/territorial and municipal governments each controlled 23.9, 45.3 and 30.9 per cent of the national capital stock, respectively. By 2002, the federal government's share had dropped from 23.9 per cent to 6.8 per cent, and the municipal share had grown from 30.9 to 52.4 per cent of all infrastructure, an increase of nearly 70 per cent.

Figure 2
Public Capital Stock in Canada



DECLINING INVESTMENT

Between 1955 and 1977, new investment in infrastructure grew by 4.8 per cent annually. This was a period of intense capital investment that closely matched Canada's population growth and rate of urbanization. This period stands in stark contrast to the 1978 to 2000 period, when new investment grew on average by just 0.1 per cent per year. Although the rate of population growth also declined, this does not account for the radical reduction in capital investment during this period. Clearly, all orders of government were under-investing.

More recently, capital spending by local governments has increased. Real investment spending posted an average annual increase of 7.5 per cent between 2001 and 2003. New investment—the portion of investment that actually adds to the overall capital stock—has been particularly strong, expanding at a rate of more than 11 per cent per year over the same period.

However, this recent growth in infrastructure spending should not be considered a solution to the infrastructure deficit. Much of this recent increase in investment can be traced to increased urbanization during the past 10 years, and it is not clear that the increase in capital stock is sufficient to meet population growth. Moreover, this increase in investment has not met the annual rehabilitation needs of existing capital stock, or alleviated the backlog of maintenance and rehabilitation that accumulated over the decade.

AGING INFRASTRUCTURE

This situation is reflected in our aging municipal infrastructure. The average age of local governments' capital stock has increased since the end of the 1970s, because investment has been insufficient to replace deteriorating stock.

INFRASTRUCTURE DEFICIT

This analysis points to a tremendous fiscal challenge for municipalities. Over the past 40 years, municipalities have assumed a growing—and now the largest—portion of Canada's capital stock. This had to be financed mainly through the property tax, a form of taxation that is less responsive to economic growth than income and sales taxes. Since the late 1970s, as the responsibility for infrastructure investment shifted to municipalities and the municipal property tax, there was a precipitous decline in capital stock. As a result, the average age of municipal infrastructure increased significantly over this period. In short, a vicious cycle was created that led to a critical backlog of investments in municipal infrastructure, now known as the municipal infrastructure deficit.

Source: FCM, *Building Prosperity from the Ground Up: Restoring Municipal Fiscal Balance*, 2006, p.37.
(Taken from a chapter authored by Roger Gibbins, Canada West Foundation, and Mario Lefebvre, Conference Board of Canada)

II. What Does the Municipal Infrastructure Deficit Include?

In formal terms, the municipal infrastructure deficit refers to the following:

- the unfunded investments required to maintain and upgrade existing, municipally owned infrastructure assets; and
- the funding needed over and above current and projected levels to bring existing facilities to a minimum acceptable level for operation over their service life, through maintenance, rehabilitation, repairs and replacement.

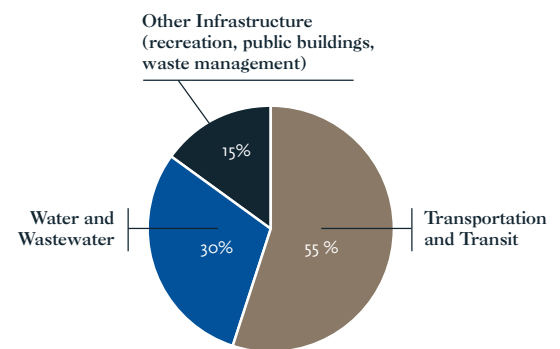
More simply, the municipal infrastructure deficit is an estimate of the total additional investment needed to repair and prevent deterioration in existing, municipally owned infrastructure assets.

This report focuses on the same broad infrastructure categories that have typically been included in the municipal infrastructure deficit. These assets fall into five categories :

1. Transportation (roads, bridges, curbs, sidewalks);
2. Water infrastructure (distribution, supply and treatment);
3. Wastewater systems (sanitary and storm sewers and related treatment facilities);
4. Transit systems (facilities, equipment and rolling stock); and
5. Other public infrastructure (including cultural, social, community and recreational facilities; and waste-management facilities).

These five categories—water, wastewater, transit, transportation and other public infrastructure—include most municipal capital assets. As of 2000, municipal transportation and transit infrastructure comprised 55 per cent of total municipal infrastructure, while water and sewer infrastructure comprised another 30 per cent, and recreational facilities, waste management, public buildings and others comprised the remaining 15 per cent.⁵

Figure 3
Canada's Municipal Infrastructure Stock (2000)



III. Does the Infrastructure Deficit Matter?

In commenting on the current state of infrastructure in Quebec, the commission investigating the collapse of a portion of the de la Concorde overpass.

+ “THE COMMISSION’S MANDATE REVEALED THE NEED TO MODERNIZE OUR INFRASTRUCTURE, BUILT LARGELY IN THE 30 YEARS FOLLOWING WORLD WAR II. QUÉBEC IS NOT ALONE; THE SITUATION IS SIMILAR ACROSS ALL OF NORTH AMERICA. AT ISSUE IS NOT ONLY PUBLIC SAFETY BUT THE ABILITY TO MAINTAIN FIRST-RATE INFRASTRUCTURE, WHICH PLAYS A ROLE IN THE QUALITY OF LIFE OF QUÉBEC’S RESIDENTS AND ITS ECONOMIC DEVELOPMENT.”⁶

In addition, the Federal Budget 2006, *Restoring Fiscal Balance in Canada—Focusing on Priorities*, noted:

+ “CANADA’S QUALITY OF LIFE AND ECONOMIC COMPETITIVENESS DEPEND IN PART ON HAVING RELIABLE, EFFICIENT INFRASTRUCTURE THAT IS PROVIDED IN LARGE PART BY THE MUNICIPAL, PROVINCIAL, TERRITORIAL AND FEDERAL GOVERNMENTS.”

⁵ M. Saeed Mirza, *Toward a Revised Estimate of the Municipal Infrastructure Deficit*, 2007, p.7.

⁶ Report of the Commission of inquiry into the collapse of a portion of the de la Concorde overpass, 2007, p. 198.

The health of Canada's economy is closely linked to the scope and quality of municipal infrastructure investment. Our quality of life and our productivity and competitiveness depend on infrastructure investment. Statistics Canada estimates that a one-dollar net increase in public capital stock generates approximately 17 cents on average in private-sector cost savings.⁷ For the transportation sector, each dollar invested in transportation infrastructure is projected to generate a saving of more than 40 cents.⁸

The cost of not investing in infrastructure is equally high. In 2004, the TD Bank Financial Group estimated that the loss from congestion and shipment delays in the Greater Toronto Area totals \$2 billion annually.⁹ Federal Finance Minister James Flaherty echoed this concern in a 2006 speech to the Whitby Chamber of Commerce, stating, "Infrastructure challenges are more than a daily inconvenience; they pose real risks to the future prosperity of our communities, and to the entire country."

In addition to its role in economic competitiveness, sufficient and well-maintained infrastructure is a basic requirement for safe communities. The collapse of an overpass in Laval, Que., and an interstate highway bridge in Minneapolis are tragic examples of infrastructure failures that led to loss of life and significant economic disruption.

Infrastructure investments are important for many other social, environmental and health reasons as well. For example:

- Investments in public transit help reduce greenhouse emissions and air pollution.
- Modern water treatment systems are required to provide safe, reliable drinking water and reduce the incidence of boil-water advisories across the country.
- New and expanded sports and recreation facilities are needed to increase physical activity and reduce growing rates of childhood obesity.
- Rural, northern and remote communities need a full range of public infrastructure, from roads and water supply to libraries and community centres, to protect quality of life and foster new economic development.

IV. Why a New Study?

There are several reasons why it is important to have an accurate, up-to-date estimate of the municipal infrastructure deficit:

- The municipal infrastructure deficit compromises our safety, economy and quality of life. The first step in finding a solution is to develop an accurate idea of the size and nature of the challenge before us.
- Eliminating the municipal infrastructure deficit will require significant, long-term investments. To account for those investments, and measure our progress toward eliminating the deficit, we need to know clearly where the deficit stands today and how it is growing.
- To make the most effective and efficient use of public dollars, we need to understand how much money needs to be spent and where investments are needed most. What should be the balance between investments in existing infrastructure on one hand, and new construction on the other? What is driving growth in the deficit, and what can we do to manage those factors in the future?

A comprehensive, national inventory of infrastructure assets is required to properly determine the size, scale and geographic character of the municipal infrastructure deficit. However, until such a project is undertaken, there remains a pressing need to track the deficit as accurately as possible using available methods. This is especially important given a growing body of evidence that the municipal infrastructure deficit is reaching crisis proportions. If this is the case, and we do not act prudently, the economic, social, and environmental costs of the deficit will grow at a rapidly increasing rate.

⁷ In *Mind the Gap* (pp. 5–6), the TD Bank argues that if the infrastructure gap had not been allowed to open in the first place, an additional \$100 billion or more in spending would have been required, implying a reduction of nearly \$17 billion in private-sector costs. However, had the money for this spending been borrowed at a rate of 6 per cent, a full \$6–\$9 billion in higher annual debt service payments would have been the result. This is still well below the \$17 billion in private-sector savings.

⁸ Tarek M. Harchaoui, Faouzi Tarkhani and Paul Warren, *Public Infrastructure in Canada: Where Do We Stand?* (Ottawa: Statistics Canada, 2003).

⁹ *Mind the Gap, Finding the Money to Upgrade Canada's Aging Public Infrastructure*, (TD Bank Financial Group, 2004), p.5.



SECTION 4: THE CURRENT PROJECT

The current project consisted of three main phases:

1. A literature review of research related to Canada's municipal infrastructure needs;
2. A survey of sample municipalities to provide a snapshot of current municipal infrastructure needs from the ground up; and
3. An analysis of survey results and conclusions.

I. Literature Review

Over the past decade, a number of studies have examined Canada's infrastructure needs.

- In 2003, the Canada West Foundation estimated the total deficit for all public infrastructure in Canada was as much as \$125 billion;¹⁰
- In a 2003 study, Mirza and Haider found that the infrastructure deficit for all public assets in Canada stood at \$125 billion and could reach \$400 billion by 2020.¹¹

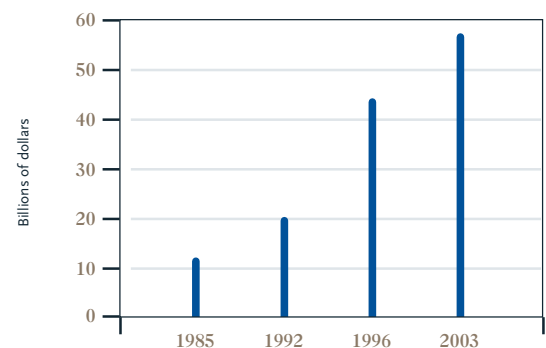
The most widely cited estimates of the municipal infrastructure deficit have been based on previous municipal surveys:

- Surveys undertaken by FCM and McGill University show a municipal infrastructure deficit that grew from \$12 billion in 1985 to \$44 billion in 1996 (see Figure 4).
- An update of previous survey results by the Technology Road Map, and the Canadian Society of Civil Engineering (CSCE), Canadian Council of

Professional Engineers (CCPE), Canadian Public Works Association (CPWA) and the National Research Council of Canada (NRC), placed the municipal infrastructure deficit at \$57 billion in 2003.¹²

- In 2002, TD Economics estimated that the municipal infrastructure deficit was growing by \$2 billion a year;

Figure 4
Municipal Infrastructure Deficit Estimates



These studies all point to a massive and growing backlog of municipal infrastructure requirements. Since 2003, the most widely cited estimate has been about \$60 billion. The infrastructure deficit is commonly believed to increase by \$2 billion a year,¹³ as calculated by TD Economics in 2002, which represents a modest degree of deterioration over a short period (such as five years).

¹⁰ *Mind the Gap, Finding the Money to Upgrade Canada's Aging Public Infrastructure*, (TD Bank Financial Group, 2004), p.5.

¹¹ M. Saeed Mirza, and M. Murtaza Haider, *The State of Infrastructure Policy in Canada*, 2003.

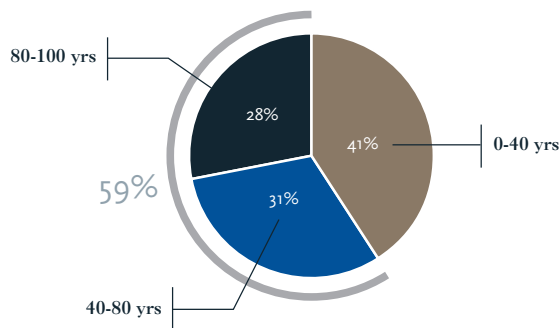
¹² CSCE, CCPE, CPWA and National Research Council Canada, *Technology Roadmap: 2003-2013*, 2003.

¹³ The 2007 FCM-McGill survey has shown that this estimate was too conservative.

THE LIMITATIONS OF EXISTING ESTIMATES

There are reasons to believe that current estimates are due for a significant revision. The most obvious shortcoming is their failure to account for the effects of rapid aging and escalating deterioration on certain categories of infrastructure. Age significantly affects future needs and the resulting infrastructure deficit. According to the Technology Road Map (TRM)¹⁴, only about 41 per cent of Canadian infrastructure is 40 years old or less. The age of 31 per cent of the assets is between 40 and 80 years, while the remaining 28 per cent is more than 80 years old. TRM found that Canada has used up about 79 per cent of the total service life of its public infrastructure. Moreover, it should be noted that infrastructure deterioration accelerates with age.

Figure 5
Age of Canada's Infrastructure (Years)



Under such conditions, the costs of upgrading a more severely deteriorated infrastructure asset to an acceptable level would multiply many times the funding required to upgrade the asset before it deteriorated. In some cases, it may not be possible to rehabilitate the asset. This would require the asset to be decommissioned, its debris removed, and a replacement built at a much higher cost.

Many other factors affecting infrastructure needs, and the infrastructure deficit, are not effectively captured in existing estimates. Some of these are the following:

- **Demographics:** Often smaller communities require larger per capita expenditures on infrastructure. However, larger urban centres have extensive transportation and transit systems and rapidly deteriorating water supply and wastewater disposal systems that require significant investments.
- **Geography:** A community's location significantly affects its infrastructure needs, especially if those communities are northern, rural or coastal.
- **Local needs:** Changing socio-economic and environmental conditions partly determine the infrastructure investments needed in a community.
- **Climate change:** Extreme weather is putting new strains on infrastructure, accelerating aging and deterioration and increasing the risk of failure.
- **Economics:** In deciding on needed investments, inflation, currency fluctuations and the cost of construction materials and labour must be considered.

Studies by the Canadian Water Network (CWN),¹⁵ the Canadian Water and Wastewater Association (CWWA),¹⁶ and the Canadian Urban Transit Association (CUTA)¹⁷ point to larger-than-ever deficits in water and wastewater facilities and transit systems. Taken together, these and other findings suggest the municipal infrastructure deficit has far surpassed previous estimates.

II. A Snapshot of Municipal Infrastructure Needs – Survey 2007

While a review of the literature supports a major revision in the estimate of the municipal infrastructure deficit, we must test these findings with on-the-ground data collected from municipal governments.

In June 2007, FCM engaged Dr. Saeed Mirza to design and oversee a new, targeted survey of municipal infrastructure needs and report on the results. The purpose of this project was to take a statistically significant “snapshot” of infrastructure needs in participating cities and communities, not to exhaustively enumerate infrastructure needs in every municipality.

¹⁴ CSCE, CCPE, CPWA and National Research Council Canada, *Technology Roadmap: 2003-2013*, 2003.

¹⁵ Canadian Water Network (CWN), *2004-2005 Annual Report, Bringing Water Research to Life*, 2005.

¹⁶ Canadian Water and Wastewater Association (CWWA), *Municipal Water and Wastewater Infrastructure: Estimated Investment Needs 1997-2012*, 1997.

¹⁷ Deloitte, 2007, <http://www.deloitte.com/dtt/article/0,1002,cidpercent253D53476,00.html>, accessed on April 28, 2007.

METHODOLOGY

In July 2007, our project team began preparing the 2007 FCM-McGill municipal infrastructure survey. The survey questionnaire was developed following a review of past municipal infrastructure surveys undertaken internationally and in Canada. A draft survey questionnaire was developed and circulated for review by a group of municipal finance, engineering, and infrastructure planning professionals across Canada. English and French versions of the final survey were then developed.

A list of target municipalities was identified to provide a regionally balanced set of potential respondents, ranging in size from smaller communities (less than 10,000) to the country's largest urban centres (more than one million). The survey was also made available to other interested municipalities upon request. In total, 166 surveys were distributed, beginning on October 6, 2007.

Participating municipalities were asked to answer six broad questions by November 6, 2007. These questions dealt primarily with current budgeting practices, existing and projected upgrading and new infrastructure (capital) needs, and factors compounding local infrastructure deficits.

The survey was developed in two basic formats: (1) an online format that enabled municipalities to submit information directly into a central database for collection and analysis by the project team; and (2) a version of the survey in Microsoft Word format that enabled municipalities to submit their responses by fax or e-mail to the project team, who subsequently entered the results in the central database on behalf of municipalities.

Where required, questions included an accuracy scale, where respondents could indicate the relative accuracy of their responses. The survey also included detailed instructions and a glossary of key terms. Throughout the response period, the project team was available to respond to participants' inquiries by telephone and e-mail.

SURVEY RESPONSES

Eight-five local governments provided full or partial responses to the FCM-McGill municipal infrastructure survey. This represents a relatively high response rate of 51 per cent (85/166). Together, these local governments represent 46 per cent of the national population. Respondents included local governments in every province and territory.

Responses were received from local governments with populations ranging from less than 10,000 to one million and above for the largest communities.

SECTION 5: THE FINDINGS

I. Water and Wastewater Systems

Assets in this category include the following:

- Water treatment, supply and distribution systems (water mains, distribution pipes, pressure reducing stations, water meters, treatment plants, storage capacity and pumping stations); and
- Sanitary and storm sewers and related treatment facilities (sewage pipes and interceptors, storm water pipes and interceptors, combined sewage pipes and interceptors, manholes, treatment plants and associated facilities and equipment, retention basins, septic tanks and lift stations).

As of 2000, water and wastewater systems made up approximately 30 per cent of Canada's municipal infrastructure stock.¹⁸

As Statistics Canada reported recently, "environmental management and the management of water systems mainly takes place at the local government level. Municipalities account for more than 80 per cent of capital spending in these areas."¹⁹

The Canadian Water and Wastewater Association (CWWA) estimated that Canada would need \$88.5 billion to upgrade existing infrastructure and build new water and sewer systems between 1997 and 2012. And, according to Statistics Canada, investments in water systems "barely compensated for the aging of existing equipment from 1993 to 2002."²⁰

The Canadian Water Network (2003) has noted a water infrastructure deficit of up to \$39 billion to maintain existing water and sewage systems. However, over a 10-year period, up to \$90 billion may be needed to replace and upgrade this infrastructure across the country.²¹ This estimate is quite consistent with the findings of the 2007 FCM-McGill survey, which shows that the current deficit related to the water supply, wastewater and stormwater systems stands at \$31 billion for the existing capital stock, while new needs are estimated at \$56.6 billion.

The deficit for existing infrastructure in this area has increased considerably from \$21 billion in the 1996 FCM-McGill survey to \$31 billion today. This steep increase over the last 11 years can be attributed mostly to the aging of underground infrastructure and accelerated deterioration toward the end of an asset's service life. These factors are further aggravated by deferred maintenance.

There is a major need to rehabilitate water and sewage infrastructure, especially in larger, older cities, such as Montreal, where 33 per cent of water-distribution pipes and about three per cent of the sewage pipes reached the end of their service lives in 2002.²²

Another 34 per cent of the water-pipe stock will reach the same state by 2020, partly explaining the need for new infrastructure in larger cities, where a more feasible option for rehabilitation of an old, deteriorated system could be reconstruction of the facility, with enhanced service life and increased capacity. The new needs are also inherent in smaller municipalities with populations

¹⁸ Tarek M. Harchaoui, Faouzi Tarkhani and Paul Warren, *Public Infrastructure in Canada: Where Do We Stand?* (Ottawa: Statistics Canada, 2003).

¹⁹ Statistics Canada - Canadian Economic Observer, *From Roads to Rinks: Government Spending on Infrastructure in Canada, 1961-2005, 2007*, p. 3.8.

²⁰ Statistics Canada - Canadian Economic Observer, *From Roads to Rinks: Government Spending on Infrastructure in Canada, 1961-2005, 2007*, p. 3.10.

²¹ *Bringing Water Research to Life, 2004-05 Annual Report* (Canadian Water Network, 2005).

²² SNC-Lavalin/ Dessau-Soprin, *Etude comportant la collecte d'informations et la portrait technique des infrastructures de la gestion publique de l'eau- Rapport final*, Montréal, 2002.

smaller than 10,000, where water-supply systems may not exist and large investments will be needed to build the system from scratch.

II. Transportation

Assets in this category include the following:

- Paved Roads
- Unpaved Roads
- Sidewalks
- Curbs
- Bicycle Paths
- Bridges
- Overpasses
- Road cleaning and snow-removal equipment and facilities

As of 2000, transportation and public transit infrastructure made up approximately 55 per cent of Canada's municipal infrastructure stock.

Much of the existing transportation systems in Canada, particularly the roads and highways built in the 1950s and 1960s, have reached the end of their service life and need to be replaced. Much of the newer transportation infrastructure also needs immediate attention due to a backlog of deferred maintenance over the years. According to Statistics Canada, "Governments have boosted the flow of investment in roads from \$4.3 billion in 1998 to \$7.3 billion in 2005, but this has barely offset the erosion of the road system."²³

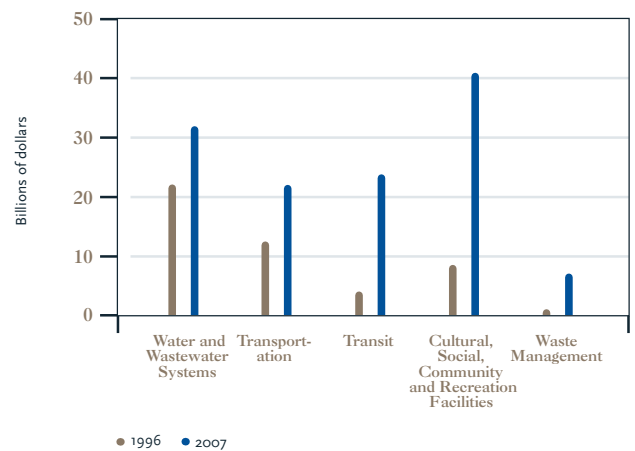
The 2007 FCM-McGill survey indicates that municipalities need an additional \$21.7 billion to maintain and upgrade existing transportation infrastructure assets.

The 1996 FCM-McGill survey considered roads, sidewalks, bridges and curbs as part of the transportation infrastructure category. The average cost to replace these was reported as \$384 per capita for all population groups considered. Based on the new \$21.7 billion figure for the infrastructure deficit in this category, this number has almost doubled rising to \$686 per capita. As expected,

the larger municipalities (with populations greater than one million) account for 65 per cent of this need.

There is also a significant need for investment in new transportation infrastructure of \$28.5 billion. In this case, smaller municipalities accounted for approximately 38 per cent of this need, confirming the need for more transportation networks and associated facilities in rural and northern communities, among other smaller municipalities.

Figure 6
Municipal Infrastructure Deficit: Growth by Category



III. Transit

Assets in this category include the following:

- Rapid transit systems, light rail transit systems and subways, including track, rolling stock, stations, service facilities and parking facilities;
- Buses – including dedicated lanes, rolling stock, stations, service facilities and park-and-ride facilities; and
- Trams – including tracks, rolling stock, stations, service facilities and park-and-ride facilities.

²³ Statistics Canada - Canadian Economic Observer, *From Roads to Rinks: Government Spending on Infrastructure in Canada, 1961-2005, 2007*, p. 3.6.

The 1996 FCM-McGill survey included an average cost needed to upgrade transit infrastructure facilities of \$103 per capita or a deficit of \$3.05 billion. The 2007 results show that \$22.8 billion are needed for existing infrastructure and \$7.7 billion are needed for new transit infrastructure.

IV. Other Public Infrastructure Assets

This infrastructure category includes the following:

- Cultural, social, community and recreational facilities (government buildings, public housing, public buildings, multi-purpose complexes, indoor and outdoor recreation facilities, and parks and playgrounds); and
- Waste management (landfills, municipal recycling facilities, and hazardous waste disposal/storage/recycling facilities).

The infrastructure stock included in the “cultural, social, community and recreational” category is relatively broad and heterogeneous in the types of facilities it includes. These facilities are generally operated by local governments and need immediate attention, as many facilities are in poor condition and have inadequate capacity. Aging and accumulated deterioration have also strained these facilities considerably. According to the Canadian Parks and Recreation Association (2007), the current deficit for sports and recreational facilities alone is \$15 billion.²⁴ This estimate covers only the repair, rehabilitation or replacement of the existing facilities, and does not account for new infrastructure needed to address deficient capacity or new needs in a community.

In the 1996 FCM-McGill survey, which included parks and recreational facilities, public buildings and community and social services in this category, the deficit for this category was estimated at \$255 per capita, for a total of \$7.55 billion.

The current deficit in this area is great and is estimated to be \$40.2 billion. Some municipalities have already planned considerable expenditures in this area to deal with the present crisis. In terms of new needs, about \$18.1 billion will be required in the near future to address this infrastructure category. This need is prevalent in larger cities and is associated with rapid urban growth. At the same time, many communities with populations of less than 100,000 may need to build new facilities in the near future.

Finally, waste management occupies a smaller share of the total deficit. The deficit for existing infrastructure is estimated at \$7.7 billion, with an additional \$4.3 billion required to meet new needs.

²⁴ Canadian Parks and Recreation Association, *Letter to Infrastructure Canada*, 2007.



SECTION 6: DISCUSSION OF FINDINGS

Municipal infrastructure deficit now \$123 billion

As shown in the previous section, the municipal infrastructure deficit is now estimated at \$123 billion. This is composed of the following:

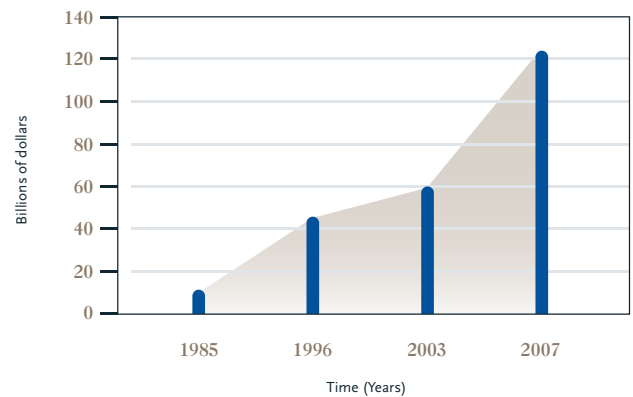
- \$31.0 billion – water and wastewater
- \$21.7 billion – transportation
- \$22.8 billion – transit
- \$40.2 billion – cultural, social, community and recreational infrastructure
- \$ 7.7 billion – waste management

A review of the 2007 data shows it is consistent with recent research findings indicating that the municipal infrastructure deficit should be revised upward from its current estimate of \$60 billion. Consistent with the findings of groups including the CWA, the CWWA and CUTA, the 2007 snapshot of municipal needs suggests a national, municipal infrastructure deficit in the range of \$123 billion for existing infrastructure and about \$115 billion required for new infrastructure needs.

The \$123-billion estimate is comparable with the following deficit estimates:

- A 2003 Canada West Foundation estimate of up to \$125 billion to upgrade Canada's infrastructure;
- A 2003 estimate by Mirza and Haider placing the national infrastructure deficit at \$125 billion with the potential to grow to \$400 billion by 2020; and

Figure 7
Municipal Infrastructure Deficit: Total Growth



- A preliminary revised estimate by Mirza of \$99.8 billion for water and wastewater infrastructure (water distribution, supply and treatment, sanitary and storm sewers and treatment facilities), transportation (roads, sidewalks, curbs, bridges), transit (facilities, equipment and rolling stock) and others (community and social services, public buildings, recreational facilities, solid and hazardous waste), based on the projection of \$88.5 billion for water and wastewater infrastructure by the Canadian Water and Wastewater Association (CWWA) and another \$14 billion for transit systems by the Canadian Urban Transit Association (CUTA).²⁵

It should be noted that the 2005 biennial survey of all U.S. infrastructure gave it a failing grade and estimated \$1.65 trillion was needed to upgrade the infrastructure to an

²⁵ M. Saeed Mirza, *Toward a Revised Estimate of the Municipal Infrastructure Deficit*, 2007.

acceptable level. Based on the populations of the United States and Canada, a rough rule of thumb places Canadian numbers for most expenditures at about one-tenth of the corresponding U.S. expenditure. This would place the estimate of upgrading all of Canada's infrastructure at about \$165 billion.²⁶ Given that governments in the United States recognized and reacted to the looming infrastructure crisis much earlier than their Canadian counterparts, the \$123-billion deficit in Canada's municipal infrastructure deficit is well within this projection.

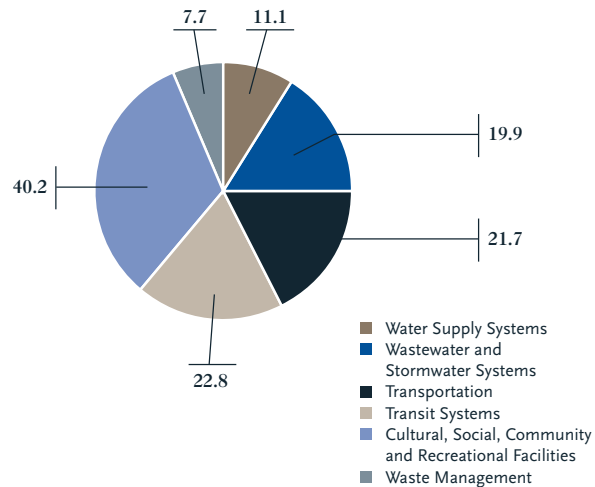
Discussion

Among the key findings of the 2007 survey are the following:

- Cultural, social, community and recreational facilities are aging and have deteriorated considerably. Lack of capacity is also a pressing issue. Some municipalities have dealt with the crisis by investing considerable funds in dealing with the problem. However, many others have directed capital dollars toward other pressing infrastructure needs (water, wastewater, transportation) and must now make overdue investments in these areas. The deficit in existing infrastructure for this category is now estimated to be \$40.2 billion, compared with the 1996 deficit of \$7.55 billion.
- Water supply, wastewater and stormwater systems are approaching the end of their service life, especially in older communities. The municipal infrastructure deficit for these categories stands at \$31 billion, a 47 per cent increase since 1996, when the deficit was estimated at \$21 billion.
- Significant funding is needed to address deteriorating transportation assets. The funding gap for existing infrastructure has grown from \$10.75 billion in 1996 to the present \$21.7 billion.
- Canada's urban transit systems were built mainly in the 1960s. Deterioration has been considerable, and many facilities need to be repaired or rehabilitated. Transit fleets need considerable investment. The municipal infrastructure deficit for this category was estimated at \$3.05 billion in 1996. Based on the 2007 survey, the deficit in this category has increased dramatically to \$22.8 billion.

- The waste-management deficit has also increased significantly, from about \$1 billion in 1996 to \$7.7 billion today.

Figure 8
Municipal Deficit for Existing Infrastructure by Category
(Billions of Dollars)



- The growth trend of the municipal infrastructure deficit in the last two decades has reached crisis proportions. In 1985, the estimated deficit was \$12 billion, which may have been conservative due to the overall lack of information about existing infrastructure. Canada's infrastructure deficit reached \$44 billion 10 years later, according to the 1996 FCM-McGill survey.
- When set beside earlier estimates, the \$123-billion figure clearly shows the municipal infrastructure deficit is growing faster than previously thought.
- In 2003, the Technology Road Map estimated that the municipal infrastructure deficit stood at \$57 billion. However, unlike studies in 1985, 1996 and 2007, the 2003 estimate was not based on new survey data.
- The new survey reveals a considerable increase in unmet needs for existing infrastructure, which stand at about \$123 billion. The survey included a more comprehensive list of assets in each category. However, the infrastructure covered by the survey questionnaire was consistent with the previous FCM-McGill 1996 survey for comparison purposes.

²⁶ American Society of Civil Engineering, ASCE Report Card on U.S. Infrastructure, 2005.

- The three different survey estimates clearly illustrate the deficit's tendency to compound. This can be attributed to the accelerated aging of some infrastructure assets and considerably increased deterioration due to deferred maintenance, lack of quality control in construction and fabrication of materials, and, in several cases, harsh climate and aggressive environments for which the infrastructure was not properly designed, operated and maintained.

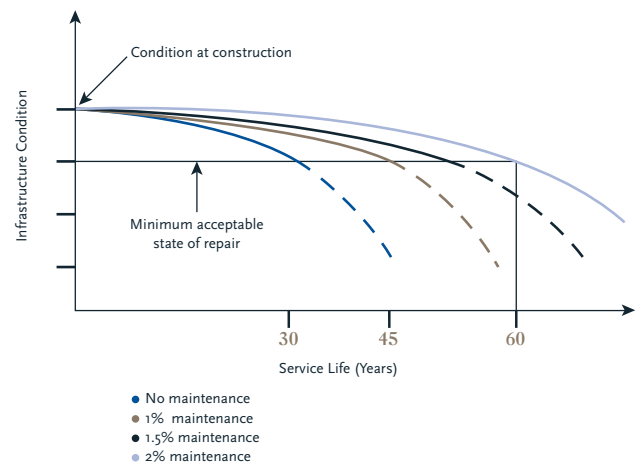
From Deferral to Disaster: Compounding Capital Needs

By definition, infrastructure spending relates mainly to long-lived capital assets. Capital investments have inherent long-term characteristics: investment in new infrastructure must include plans to repair and eventually replace the asset.

As infrastructure investments declined in the late 1970s and 1980s, maintenance, repair and rehabilitation activities were often deferred, even at the risk of jeopardizing assets and reducing their service life. Reversing this neglect is much more expensive than regular maintenance, so much so that it may not be possible to rehabilitate an asset, which instead must be decommissioned, demolished and constructed anew at an exorbitant cost to the taxpayer.

One of the principal causes of the extensive deterioration of Canada's infrastructure is deferred maintenance during fiscally difficult times. It is instructive to examine the influence of maintenance on the quality of performance and service life of a typical infrastructure asset. The qualitative influence of four different levels of annual maintenance rates—ranging from “no maintenance” (which would be the case with deferred maintenance) to two per cent of the asset's construction cost, which would normally keep the asset in an acceptable operating condition with on-going low-cost regular maintenance—is shown in Figure 9.

Figure 9
Infrastructure Condition as Determined by Maintenance

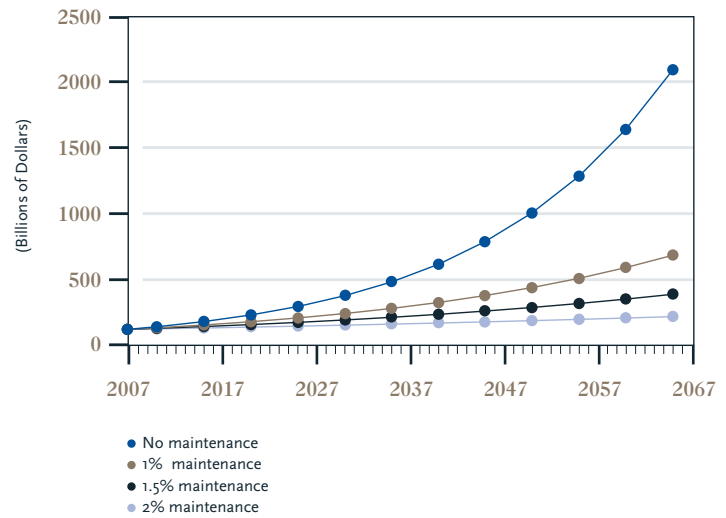


Note that with no maintenance or sporadic deferred maintenance, the infrastructure facility deteriorates very rapidly and with a considerable reduction in its service life. However, if about two per cent of the facility cost is invested in its maintenance, the deterioration rate is much slower, and a considerably longer service life is achieved. This clearly highlights the importance of both maintaining the infrastructure facility adequately and not deferring maintenance under any circumstances.

The influence of the four levels of maintenance on the escalation of the municipal infrastructure deficit over the next 50 years is demonstrated in Figure 10. Note that without maintenance or with deferred maintenance, the municipal infrastructure deficit could be close to \$2 trillion by 2065. However, with regular maintenance and good scientific management, the escalating infrastructure deterioration and the resulting infrastructure deficit can be controlled within manageable levels. In other words, our infrastructure will grow old (that is, attain its service life and beyond) gracefully (in a reasonable condition requiring inexpensive routine maintenance). Alternatively, the cost of the actions needed for renewal of our municipal and other infrastructure would be so high that governments would not be able to cope with them.

More research is required to establish the current rate of investment in infrastructure maintenance, repairs and rehabilitation. However, all available evidence suggests it is below the level required to keep municipal assets in good repair.

Figure 10
Municipal Infrastructure Deficit: Projected Growth



SECTION 7: NEW INFRASTRUCTURE NEEDS

The category of new infrastructure includes all infrastructure that needs to be expanded or built to meet the changing needs of a community for demographic, socio-economic, environmental and other related reasons. Capital investments required to provide an enhanced level of service or meet new regulations would also be included. The needs for new infrastructure are distinct from the needs for upgrading existing deteriorated infrastructure. However, works undertaken to replace existing assets, or restore/repair existing infrastructure capacity, would not be considered “new”.

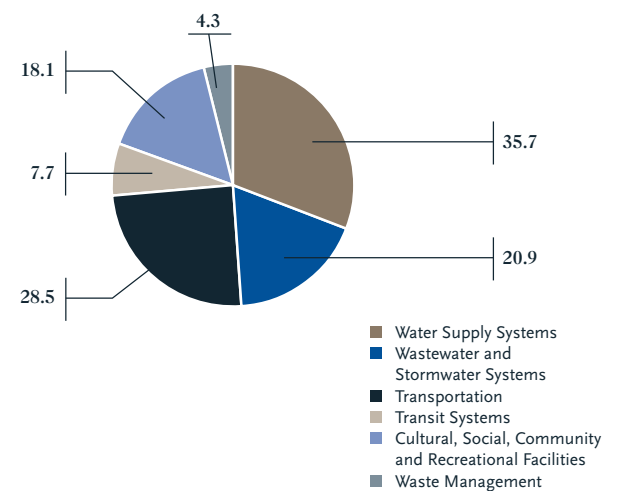
In general, previous infrastructure surveys, both in Canada and the United States, have not generated specific estimates for new infrastructure needs—the 2007 FCM-McGill survey is one of the first to do so. As a consequence, there is relatively little previous data to use as a basis for comparison.

The 2007 FCM-McGill survey requested information from all participating municipalities about their new infrastructure needs. Based on the responses received, the projected need for new infrastructure is \$115 billion.

Unlike the \$123-billion municipal infrastructure deficit, the estimate of new infrastructure needs does not necessarily represent a funding shortfall. It is simply a projection of overall investments required to meet growing or changing needs in our communities.

However, there are inherent links between investments required for new and existing infrastructure. First, because new infrastructure projects inevitably compete with existing assets for funding and put added pressure on municipal capital budgets. Second, because, by definition, investments in new infrastructure expand a municipality’s overall capital stock, and therefore create additional funding requirements for maintenance and repair in the future. Given this, it is important that new assets be designed for optimal life-cycle performance. It is worthwhile to consider a few options initially and adopt the option offering the lowest life-cycle cost. A similar philosophy should also be extended to rehabilitation projects involving existing deteriorated infrastructure. In short, we must not allow our infrastructure—old or new—to deteriorate.

Figure 11
New Municipal Infrastructure Needs
(Billions of Dollars)



Discussion

- Water-supply infrastructure will need a major investment in the future, representing the largest share of new capital needs. Capacity may be an issue in growing communities. Constructing new water-supply networks may be more feasible than rehabilitating existing ones that have deteriorated. These needs will be greater in larger municipalities, which have older underground infrastructure. Stormwater systems are not widely used in Canada, and generally stormwater and wastewater share the same piping system, placing a large burden on treatment plants. In view of new, more stringent environmental regulations, some municipalities may consider it to be more feasible to expand their stormwater system or separate it completely from the wastewater system. Considerable funds will be required in this area. In addition, wastewater and combined sewers are approaching the end of their service life. Much of this infrastructure was built during the Canadian industrial boom of the 1960s. Smaller communities also have considerable needs for new water and wastewater system projects.
- Transportation infrastructure is deteriorating in a highly accelerated manner, and several failures have been recorded before facilities reached the end of their service life. Although significant funding gaps exist for repair and rehabilitation of current assets, there is a pressing need to build new infrastructure for increased capacity, loading and safety. The needs are estimated at \$28.5 billion.
- Transit is the best solution to traffic congestion in larger urban areas. Moreover, the suburbs of large urban areas will also need effective transit systems. This orientation is also driven by the public awareness and preoccupation with climate change. The needs in this area are \$7.7 billion.
- Cultural, social and recreational facilities are facing a large funding gap. However, some municipalities have already allocated funds for expansion or construction of major facilities. This investment need will be reduced once all needed facilities have been constructed. Future needs in this category are \$18 billion.

- New waste-management needs are estimated at \$4.3 billion. Some facilities dealing with waste management have been designed using sustainability-based criteria, and this trend may continue in the future. However, the new needs in this area could increase considerably, due in part to stricter future environmental regulations.

Notes for Future Research

The results of this project are based on a survey of 85 municipalities, ranging in size from less than 10,000 to more than one million, representing 46 per cent of Canada's population.

The infrastructure expenditure records maintained by municipalities across Canada vary considerably, which created some difficulties in developing their responses to this survey. In future it would be useful to modify the survey categories to be consistent with the record format used by most municipalities.

The 1996 FCM-McGill survey showed that many Canadian municipalities did not have an inventory of the assets within their jurisdiction, but this situation has improved considerably over the past decade. It would be useful to develop a computerized GIS-based inventory of the assets in each municipality, along with a historical record of construction (materials and construction techniques used), maintenance and any rehabilitation and replacement. This would be consistent with the recommendations of the Technology Road Map.²⁷ An estimate of the need to upgrade existing infrastructure and acquire or build new infrastructure would be more scientific and accurate than any of the surveys undertaken previously. Based on such a record, each municipality can update these estimates on a regular basis with much greater ease.

²⁷ CSCE, CCPE, CPWA and National Research Council Canada, *Technology Roadmap: 2003-2013*, 2003.



SECTION 8: CONCLUSIONS

“...FEDERAL INVESTMENTS IN INFRASTRUCTURE ARE SIGNIFICANT, BUT THIS FUNDING NEEDS TO BE PUT ON A LONG-TERM TRACK TO ALLOW FOR LONG-TERM PLANNING, ESPECIALLY GIVEN THE TIME SPANS INVOLVED IN PLANNING AND BUILDING MAJOR INFRASTRUCTURE PROJECTS.”

Federal Budget 2006, Restoring Fiscal Balance in Canada – Focusing on Priorities.

The results of the 2007 FCM-McGill survey point to a single, inescapable conclusion: that much of our municipal infrastructure is past its service life and near collapse.

More specifically, the survey results indicate the following:

- The municipal infrastructure deficit is approximately \$123 billion and growing.
- The revised deficit includes sub-deficits for water and wastewater (\$31 billion), transportation (\$21.7 billion), transit (\$22.8 billion), waste management (\$7.7 billion), and cultural, social, community and recreation infrastructure (\$40.2 billion).
- a comparison of municipal surveys done in 1985, 1996 and 2007 clearly shows the tendency of the deficit to compound. Previous estimates of the deficit’s growth (e.g., \$2 billion per year) have been too conservative.
- Municipalities require an estimated \$115 billion in new infrastructure investments, which will compete with existing assets for investment and place pressure on municipal capital budgets.

These findings, combined with the evidence of deterioration Canadians see in their own communities, suggest that much of our aging municipal infrastructure is on the brink of failure.

The size of the infrastructure deficit has focused government and public attention on the need for action to find solutions. However, the lack of a clear understanding of its scope, or even agreement on a definition of infrastructure, makes finding solutions difficult.

Identifying and describing the problem to be solved—defining the size, scope and geographic and jurisdictional characteristics of the infrastructure deficit—should be the first step in developing a long-term policy framework for investments in municipal infrastructure. Understanding the problem and its scope in each region will help to identify investment priorities more accurately. This will provide the basis for a more rational intergovernmental strategy for infrastructure investment. It will also lay the foundation for a robust accountability framework.

EXISTING INFRASTRUCTURE INVENTORIES

Measuring the size, scope and nature of the state of public infrastructure will not be a new or unique endeavour. There are existing examples of comprehensive infrastructure asset inventories, which could be used as a model for a full inventory of key municipal infrastructure.

UNITED STATES NATIONAL BRIDGE INVENTORY

The National Bridge Inventory (NBI) was established in 1994 as a database, compiled by the Federal Highway Administration, with information on all bridges and tunnels in the United States. The data can be used to analyze bridges and judge their condition. It provides a searchable and easily updatable database of bridge identification information, bridge types and specifications, operational conditions, bridge data including geometric data and functional description, inspection data, etc.

PROVINCIAL BRIDGE MONITORING ACTIVITIES

As the Commission of inquiry into the collapse of a portion of the de la Concorde overpass (the “Johnson Commission”) found, although the province of Quebec, like most provinces, maintains one or more databases of bridges and overpasses in its jurisdiction, the data maintained were not sufficient. The Commission recommended that the Quebec transport department, as well as larger municipalities, implement an accelerated, comprehensive and easily accessible on-line system, containing all records and data relevant to bridge and overpass structures in the province, including reports on inspections and repair activities.

This information will allow all three orders of government to develop key elements of a national plan, such as:

- planning for the total investment required and its timing, which is key for federal, provincial/territorial and municipal budgeting;
- tailoring the plan and priorities to fit unique regional, demographic or geographic needs, rather than relying on national, one-size-fits-all approaches; and
- setting accountability measures, such as interim progress milestones, and the objectives of the plan (the elimination of the municipal infrastructure deficit).

Equally challenging are constantly changing, *ad hoc* definitions of what constitutes infrastructure in successive federal programs, definitions that fail to account for the full range of municipal infrastructure. Municipalities are responsible for a broad range of infrastructure beyond water, sewers, roads and bridges.²⁸ An agreed-upon definition of infrastructure must be developed that recognizes all municipal infrastructure and the importance to communities of having the full range of this infrastructure.

Other factors that must be considered include the impact of new environmental regulations, which can dramatically increase need and, by extension, limit municipal capacity to deal with the infrastructure deficit,²⁹ and extreme weather due to climate change, which is putting new strains on infrastructure, accelerating aging and deterioration and increasing the risk of failure.

If Canada is to prosper, municipal infrastructure investments must support the economic potential of our cities and communities. For this to happen, financing must reflect the long-term nature of infrastructure investments, which will require a long-term investment plan with agreed-upon priorities. This plan must bring long-term certainty to infrastructure funding, which will promote new efficiencies, technologies and best practices in infrastructure delivery.

Any serious plan to address the municipal infrastructure deficit must begin with an acknowledgement of the scope of the problem and the urgent need to address it. This study represents the first step toward a real plan.

²⁸ These include community centres, libraries, recreational facilities, assisted housing, parks and, in some cases, childcare facilities. Infrastructure investments aimed only at more traditional projects, such as roads or water systems, have often had the perverse effect of penalizing municipalities that have properly planned, financed and managed this category of infrastructure.

²⁹ For example, the costs for municipalities to comply with new wastewater standards proposed by the Canadian Council of Ministers of the Environment and Environment Canada have been estimated at \$8 billion to \$12 billion, which could increase by as much as 10 per cent the need for new infrastructure.

SECTION 9: ABOUT THE RESEARCH TEAM

Winner of several awards for outstanding teaching, research and international professional contributions, Dr. Saeed Mirza is one of Canada's leading experts on the state of our public assets and a frequent media commentator on infrastructure issues. He has authored numerous articles and studies on Canada's infrastructure needs, including the study that established the widely accepted \$60-billion estimate of the municipal infrastructure deficit.

Dr. Mirza is a Fellow of the Canadian Society for Civil Engineering, the Engineering Institute of Canada, the Canadian Academy of Engineering, the American Concrete Institute, and the Institute of Engineers Pakistan. He served as President of the Canadian Society for Civil Engineering (CSCE) in 1985–86 and has been chair or co-chair of several committees of that organization. He was Founding Chair of the CSCE's Technical Committee on Rehabilitation of Infrastructure.

Dr. Mirza has been a member of McGill University's Department of Civil Engineering and Applied Mechanics since 1966, where his specialty is structural engineering and rehabilitation of infrastructure.

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