CANADIAN INFRASTRUCTURE REPORT CARD

Volume 1: 2012
Municipal Roads and
Water Systems

FCM

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THE CANADIAN INFRASTRUCTURE REPORT CARD

WELCOME

As the sponsoring organizations for Canada's first national report card on the state of its municipal infrastructure, we are pleased to present this benchmark study.

Following two decades of declining public investment in infrastructure, public and government interest rekindled in the 1990s, as the visible decline of infrastructure underscored the need for new approaches to its funding and management.

In the decade that followed, the state of public infrastructure—and what to do about it—became the subject of much discussion and debate. A great deal of that discussion and debate centred around the condition of infrastructure, with the need to develop objective assessment tools becoming increasingly apparent.

Despite the continuing, and still lively, debate on how to pay for municipal infrastructure, there is little disagreement now about its importance to our society and economy. During the recent financial crisis, governments in Canada began pooling resources and cooperating to an unprecedented degree, channelling stimulus funds into local infrastructure to create jobs and renew these valuable assets.

With this context in mind, our organizations—and others that supported this project—believe that creating reliable tools to objectively assess the condition of public infrastructure is necessary if we are to develop a comprehensive long-term national plan to fix and maintain that infrastructure.

This is not a prescriptive document. It does not provide recommendations for action, nor forecast future capital requirements resulting from municipal growth. It will be up to governments and organizations involved in the delivery of infrastructure services to assess needs and develop action plans. Our hope is that the data provided here will support those efforts.

As it is the first of its kind in Canada, there are lessons to be learned from this project that will undoubtedly inform future efforts. We regard these lessons, too, as an accomplishment. This report card breaks new ground where such an effort has long been needed. We congratulate the team that produced the report card, thank all municipalities that contributed data, and look forward to even broader participation and continued discussion in the future.

Canadian Construction Association • Canadian Public Works Association • Canadian Society for Civil Engineering • Federation of Canadian Municipalities

REPORT CARD
ADVISORY BOARD

The Report Card Advisory Board (RCAB) played a key role in providing guidance and direction to the project. The RCAB is made up of the following organizations.

- Association of Consulting Engineering Companies (ACEC) – John Gamble
- Canadian Association of Municipal Administrators (CAMA) – Jacques Des Ormeaux, Jennifer Goodine
- Canadian Automobile Association (CAA) – Ian Jack
- Canadian Construction Association (CCA)* – Chris McNally, Bill Ferreira
- Canadian Council of Public-Private Partnerships (CCPPP) – Cynthia Robertson
- Canadian Institute of Planners (CIP) – John Wall
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EXECUTIVE SUMMARY

Canada's first report card on municipal infrastructure offers an objective assessment of the state of infrastructure, and the state of infrastructure management, in 123 municipalities. This report card consolidates data obtained through a voluntary survey of Canadian municipalities, which was designed to assess the condition of municipal infrastructure in 2009–2010.

This document provides an assessment of the condition of four primary asset categories of municipal infrastructure: drinking-water systems, wastewater and stormwater networks, and municipal roads. This is the first assessment of its kind in Canada, and features the most comprehensive analysis and reporting to date on Canada's municipal infrastructure.

This report is also well timed. Following two decades of declining public investment in infrastructure, all governments have begun to reverse this trend by significantly increasing investment in the transportation, water and wastewater systems upon which Canadians rely each day.

The importance of investing in modern infrastructure has become synonymous with Canada's economic competitiveness and quality of life. During the recent financial crisis, all governments pooled resources and cooperated to an unprecedented degree, channeling stimulus funds into local infrastructure to create jobs, while also renewing the physical foundations of this country.

The Building Canada Plan will soon expire, casting a shadow over recent progress made in addressing Canada's municipal infrastructure needs. This report highlights how critical it is to continue building and renewing the infrastructure that is key to our continued economic vitality as a country.

As one would hope to find, the municipalities surveyed generally reported having basic water and wastewater infrastructure in good enough physical condition to meet current public needs and minimum performance standards. The single category in which municipalities reported having infrastructure in the best overall physical condition – stormwater management – was also the smallest category studied.

Despite some reassuring findings, however, the Report Card's results are no reason for complacency. In fact, a close examination of the data supplied by the participating 123 municipal governments reveals troubling trends in the condition and management of Canada's most essential public assets.

Infrastructure Rated Fair or Poor

Firstly, based on survey responses, overall report-card ratings for the four asset categories show that a significant amount of municipal infrastructure rank between "fair" and "very poor"—on average about 30%. The replacement cost of these assets alone totals $171.8 billion, nationally.

The report indicates that municipal roads require urgent attention. An overall grade of "Fair" means that the infrastructure "shows general signs of deterioration and requires attention, with some elements exhibiting significant deficiencies." More than half the roads surveyed fall below a rating of "good": 32% are in "fair" condition, and 20.6% are in "poor" to "very poor" condition, for a total of 52.6%. In addition, the report finds that one in four Canadian roads is operating above capacity, highlighting a real challenge to moving goods and people within our communities in the short and medium term. The estimated replacement cost of the roads in fair to very poor condition is $91.1 billion, nationally. For the average Canadian household, this amounts to a cost of $7,325.

A mixed picture emerges for wastewater infrastructure, with 40.3% of wastewater plants, pumping stations and storage tanks in "fair" to "very poor" condition, and 30.1% of pipes in "fair" to "very poor" condition. The replacement cost for the wastewater infrastructure in "fair" to "very poor" condition is $39 billion, or $3,136 per Canadian household. With wastewater infrastructure now subject to new and more stringent federal regulations, even good or very good wastewater infrastructure may require upgrading or replacement.

Despite its overall "good" rating, drinking-water infrastructure also presents some cause for concern: 15.4% of the systems were ranked "fair" to "very poor" for the condition of their pipes. The figures were not much better for plants, reservoirs and pumping stations, where 14.4% ranked "fair" to "very poor". Only 12.6% of plants, reservoirs and pumping stations ranked "very good", as did just 4.2% of the pipes. Considering the potential impact of drinking-water systems on human health, these deficiencies have significant importance. The replacement cost for the drinking-water infrastructure in "fair" to "very poor" condition is $25.9 billion, or $2,082 per Canadian household.

Canada's stormwater management systems are the best of the infrastructure classes covered in the report card. These were generally rated "very good". Even here, however, 12.5% of stormwater installations surveyed fall below "good" condition, with that figure rising to 23.4% for stormwater pipes. The replacement cost for the stormwater infrastructure in "fair" to "very poor" condition is $15.8 billion, or $1,270 per Canadian household.

A Penny Now, or a Dollar Later

Secondly, the report card points to the cost of delaying infrastructure repairs, rehabilitation, or renewal. It found that, under current practices (investment, operations, maintenance), most infrastructure, even if in good-to-very-good condition now, will require ever-increasing investment as it ages.

The report card emphasizes the importance of having an asset-management system in place, in order to establish practices that will increase the longevity of the assets and optimize investments in maintenance and rehabilitation.

Needs Improvement: The State of Asset Management in Canada

Thirdly, when assessing the state of municipal infrastructure management, the report card finds that many municipalities lack the internal capacity to assess the state of their infrastructure accurately on their own. This is not to say that the municipal sector lacks the wherewithal to undertake rigorous internal reviews of their assets; rather, that finite financial resources, staff and time preclude a much more thorough, real-time evaluation of the state and performance of their physical infrastructure.

For example, an average 30% of respondents had limited data on their water-treatment plants, reservoirs or pumping stations. A large percentage of municipalities reported having no data on the condition of their buried infrastructure: 41.3% for distribution pipes and 48.2% for transmission pipes. While it is clear that municipalities monitor the quality of their drinking water through rigorous testing and monitoring, evaluating the physical condition of their treatment plants and buried distribution networks remains a significant, on-the-ground challenge for many municipalities to undertake on their own.

With respect to roads, many respondents do not have regular condition-assessment programs: 41.2% reported that they do not have an inspection program for their highways, while the percentage dropped to between 20–25% for arterial, collector and local roads. Capacity data for roads was provided by 94 municipalities out of the 139 that responded to the roads questionnaire. Only 60% of these municipalities have a capacity/demand assessment process. The need to support additional capacity at the municipal level is a crucial finding of this report, for all four asset categories.

Objectives and Methodology

The primary objective of this report-card project was to develop a rigorous, repeatable process for assessing the condition of Canada's infrastructure. This would in turn serve to inform the public, decision-makers and other stakeholders regarding infrastructure issues and trends. This study provides useful qualitative information on municipal infrastructure and its management, which municipal governments can use to develop their asset-management capacity. The forecasting of trends or future conditions was not part of this study.

A total of 346 municipalities registered for the survey. The final analysis was based on responses by 123 municipalities distributed across all provinces. These municipalities represent from 40.7–59.1% of the Canadian population, depending on the infrastructure assets considered. This proportional representation made it possible to extrapolate the sample to provide a national estimate.

For a first report card, representation (on a population, demographics and geographical basis) exceeded the expectations of the Project Steering Committee. As this report card is repeated over several editions, a higher percentage of municipalities may participate, and the results will be more representative at the national level. Other types of infrastructure assets, such as bridges, buildings, facilities, public transit—and possibly privately owned public infrastructure, such as ports and airports—may be added in future editions.

I. INTRODUCTION

Building Infrastructure, Building Canada

Development of Canada's public infrastructure[1] has closely tracked that of the country,[2] beginning in the early 1800s with the first roads, canals and railways.

Development of Canada's public infrastructure has closely tracked that of the country, beginning in the early 1800s with the first roads, canals and railways.

The Lachine Canal was completed in 1825 to bypass rapids on the St. Lawrence River. The first Welland Canal (there have been four) opened in 1829. The Rideau Canal, originally built for its strategic importance, opened in 1832. Commitments to support railway construction were written into the British North America Act, and a transcontinental railway was one of British Columbia's conditions for joining Confederation in 1871.

By the time Saskatchewan and Alberta joined Confederation in 1905, Canadian public works reflected the new industrial reality. Electrification, safe drinking water, waste management, and public transit supported growing cities. Investment in transportation supported manufacturing and industrial growth.

The mid-century infrastructure boom—often referred to as the Golden Age of Infrastructure—began after the Second World War, and continued through the 1950s and 1960s, with transportation, health, and environmental infrastructure supporting urban and rural development.

In 1949, the federal government passed the Trans-Canada Highway Act, which set the stage for joint federal-provincial funding of what would become the world's longest national highway. Construction of the 306-kilometre section of the St. Lawrence Seaway from Montreal to Lake Ontario, which opened in 1959, was one of the great public works projects of its day.

Throughout Canada's first century, infrastructure largely meant public infrastructure, supported by the three orders of government. In the 1970s and 1980s, however, government spending on public infrastructure declined in the face of competing priorities and the end of the post-war economic boom.

[1] Engineers Canada's Public Infrastructure Engineering Vulnerability Committee defines public infrastructure as "those facilities, networks and assets operated for the collective public benefit, including the health, safety, cultural or economic well-being of Canadians, whether operated by government and/or non-government agencies. In general, public infrastructure consists of both physical (tangible) and non-physical (intangible) assets intended to provide services to the public and to the institutions that support the health, safety, security, mobility, well-being and prosperity of Canadians.

[2] "*Building for Prosperity: Public Infrastructure in Canada*," Infrastructure Canada, 2011

Roots of the Municipal Infrastructure Deficit

In 2006, FCM published a report that looked at a range of growing national challenges surfacing in cities and communities across the country, in areas such as infrastructure, transportation, housing, and policing and public safety. Its title was *Building Prosperity from the Ground Up: Restoring Municipal Fiscal Balance*.

This report traced the roots of these growing problems to a tax system that took too much out of communities and put too little back in. The result was a structural imbalance between the growing responsibilities of local governments, and their inadequate financial resources.

With revenue limited to the regressive and slow-growing municipal property tax, municipalities were collecting just eight cents of every tax dollar paid in Canada, while building and maintaining more than half of the country's core infrastructure, in addition to their many other responsibilities.

At the same time, federal and provincial governments were consuming more than 90% of the taxes paid by Canadians, and, through their sales, income, and corporate taxes, virtually all revenues generated by new economic growth. What they reinvested in municipal infrastructure was typically delivered through short-term, ad hoc programs that made it difficult for municipalities to plan effectively.

The result was a chronic municipal funding crunch. Local governments, prohibited by law from running budget deficits, were forced to raise property taxes, cut core services, and, most often, put off building and repairing core infrastructure such as roads and bridges, public transit, and drinking-water systems. This produced a $123-billion municipal infrastructure deficit, crowded transportation systems, and growing traffic gridlock—along with cities and communities lacking the resources to achieve their full potential as partners in building Canada.

For Canada's municipalities, this led to the deferral of needed investment in infrastructure, leading in turn to a physical decline that damaged the quality of life of their communities, and harmed their capacity to contribute to Canada's prosperity.

The need for renewed investment in public infrastructure became increasingly apparent and pressing in the 1990s. During the past decade, the three orders of government have begun working together to fund a range of infrastructure projects, from municipal infrastructure to major projects of regional importance.

Taking Stock of Canada's Public Infrastructure

During the past few years, federal, provincial and territorial governments have worked more closely with municipalities to begin repairing the country's rapidly aging infrastructure. To protect and build upon recent gains, the federal government committed itself in Budget 2011 to the development of a new long-term infrastructure plan, which would replace the Building Canada Plan when it expires in 2014. Without a new plan in place by 2014, much of the recent progress made by all governments to invest in municipal infrastructure will be lost.

> ## Federal Contributions to Municipal Infrastructure, 2007–2012
>
> Over the past five years, the federal government has invested billions of dollars in local infrastructure, including roads, water and wastewater systems, and public transit. As important as these investments have been, the new longer-term funding model, as demonstrated by the Building Canada Plan (BCP) and the permanent Gas Tax Fund (GTF), has been significant in moving Canada away from the short-term, ad hoc infrastructure funding of the past.
>
> Recent federal investments include:
>
> *Core Federal Investments:*
>
> - $1.25 billion/yr through the Building Canada Fund (expiring in 2014)
> - $2 billion/yr through the Gas Tax Fund (now permanent)
> - $800 million/yr through the municipal GST rebate
> - $400 million in dedicated transit funding (expired in 2010)
>
> *Economic Action Plan (Stimulus Investments):*
>
> - $2.4 billion through the Infrastructure Stimulus Fund
> - $500 million through the Recreation Infrastructure Canada (RInC) program

While governments struggle to catch up to infrastructure needs, those needs continue to grow, as older infrastructure exceeds its service life and a growing population requires new infrastructure. In addition, other pressures, such as climate change and the need to protect the environment, will require the replacement or upgrading of older systems.

Aging infrastructure is a concern for all developed countries. The Association of Consulting Engineers of Canada estimated in 2004 that 50% of public infrastructure will have reached the end of its service life by 2027.[3] Governments in Canada and elsewhere are now weighing how to invest in infrastructure to maintain competitiveness and standards of living.

The primary objective of the report-card project is to develop a rigorous, repeatable process for assessing the condition of Canada's infrastructure. This will in turn serve to inform the public, decision-makers and other stakeholders about infrastructure issues and trends.

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[3] "Brief to the Standing Committee on Finance Regarding the Federal Government's Pre-Budget Consultation Process," Association of Consulting Engineers of Canada, 2004

Measuring the adequacy and performance of public infrastructure is an enormous challenge. Owners and operators of infrastructure are diverse, and may not have uniform practices for data collection and analysis. Underground networks, spanning thousands of kilometres in some cities, are not readily accessible, and some infrastructure assets are expected to last a century or more.

Review of Infrastructure Reporting

Canada and other countries have made efforts to consolidate infrastructure information at the local, regional and national levels, and to present periodic updates on the condition of their public infrastructure. This information is commonly presented in a report-card format. A brief summary of some of these initiatives follows. A more complete review may be found in Guy Félio's 2007 report to Infrastructure Canada.[4]

Municipal: The cities of Edmonton[5] and Hamilton[6] took an early lead in producing "state-of-the-infrastructure" reports. These cities are the recognized Canadian leaders in the development and implementation of asset-management and investment-planning systems and strategies.

Provincial/Territorial: All of these jurisdictions have, at one time or another, produced either state-of-the-infrastructure reports or needs studies. Methodologies and scopes have varied, however, and it is not within the mandate of this report to analyze these.

National: The Council of Ministers Responsible for Transportation and Highway Safety publishes a report on the condition of Canada's National Highway System.[7] The latest assessment was published in September 2010, and reports on the condition of the system were published in 2009.

Organizations: Other studies assess the condition of infrastructure, and have focused on present or future needs. The Canadian Urban Transit Association (CUTA), the Canadian Water and Wastewater Association (CWWA), and the Federation of Canadian Municipalities (FCM) have all produced needs reports.

International: Two types of international studies are relevant to this project:

- State-of-the-infrastructure reports using report-card formats are published by Australia,[8] South Africa,[9] the United Kingdom,[10] and the United States.[11]
- Audits of infrastructure: The "stocktake" conducted in New Zealand.[12]
- "Infrastructure to 2030," published by the International Futures Programme of the Organisation for Economic Co-operation and Development (OECD), targets high-level, policy-oriented audiences. It has produced several reports, mostly comparing countries to one another.[13]

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4   Guy Félio, "Literature Review of Methodology to Evaluate the State of Infrastructure," Infrastructure Canada, 2007
5   Building the Capital City from the Infrastructure Up," City of Edmonton, 2006
6   "State of the Infrastructure, Report on Public Works Assets," R.V. Anderson Associates Ltd., report to the City of Hamilton, 2009
7   "Canada's National Highway System Annual Report 2009," Council of Ministers Responsible for Transportation and Highway Safety, September 2010.
8   "Australian Infrastructure Report Card 2010," Engineers Australia, 2010
9   "SAICE Infrastructure Report Card for South Africa 2011," South African Institution of Civil Engineers, 2011
10 "The State of the Nation: Infrastructure 2010," Institution of Civil Engineers, June 2010
11 "Report Card for America's Infrastructure," American Society of Civil Engineers, 2009
12 "New Zealand Infrastructure Stocktake," Ministry of Economic Development, 2004
13 "Infrastructure to 2030," Organisation for Economic Cooperation and Development

Our review of key international and national initiatives[14] showed that no single approach (needs vs. condition studies) is perfect, and led to the following conclusions:

- Most state-of-the-infrastructure reports are aimed at awareness; the target audience may vary, but generally includes elected decision-makers and the public. The second common objective of these studies is to influence senior government decisions.
- Most studies were performed within a 12-month timeframe, bearing in mind that the production of a first report always takes longer.
- Basic infrastructure systems lie at the core of most studies. These include transportation, water resources and energy.
- All of the international initiatives are one-dimensional in terms of stakeholder involvement. Most are produced by the engineering community, except New Zealand's report. When a report is released, organizations that did not participate in the study may become a major obstacle.
- The main barriers to the production of these reports are data availability and, for needs studies, defining the levels of service associated with investment needs.

The following lessons from these national and international initiatives helped to set the stage for the first Canadian infrastructure report card:

- Rigorous evaluation criteria are needed from the beginning.
- Multidimensional stakeholder involvement—from regions, sectors and professions— is essential.
- Complete accuracy is not possible.

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[14] Guy Félio, "Literature Review of Methodology to Evaluate the State of Infrastructure," Infrastructure Canada, 2007
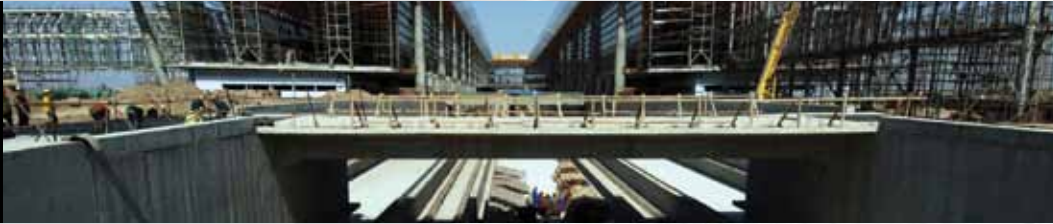
II. THE BENEFITS OF SOUND ASSET MANAGEMENT

Public infrastructure systems are complex. Many are underground and difficult to access and inspect. It is standard practice to differentiate between linear assets (pipes, roads, cables) and non-linear or discrete assets (pumps, plants, bridges, culverts), since each category presents different management challenges.

However, providing services to the public requires that all components within a system perform as expected, since robustness, and therefore the safety and quality of the service, depends on the strength of the weakest link.

Infrastructure assets also have long service lives. Water or sewer pipes, for example, are commonly in use for 80 to 100 or more years. It is therefore critical that these assets be properly planned and managed. The table on the next page illustrates some of the service lives of different infrastructure components.

Figure 1 – Typical service lives of infrastructure components[15]

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TYPE OF INFRASTRUCTURE	TYPICAL USEFUL LIFE (YEARS)
Roads	
Expressway	15 – 18 years
Urban arterial: major	15 – 18 years
Urban arterial: minor	25 – 40 years
Urban local	30 – 35 years
Rural local	40 – 50 years
Curbs and sidewalks	40 – 50 years
Drinking water	
Mains to plant	75 – 120 years
Mains (cast iron)	75 – 100 years
Hydrants	75 – 100 years
Meters (residential)	15 – 25 years
Pumping stations: long-life	50 – 100 years
Pumping stations: short-life	10 – 35 years
Wastewater	
Interceptor and trunk sewers	120 – 150 years
Local sewers (< 450 mm)	100 – 120 years
Combined sewers (< 450 mm)	100 – 120 years
Manholes	75 – 100 years
Pumping stations: short-life	15 – 30 years
Pumping stations: long-life	50 – 75 years
Stormwater management	
Sewers	80 – 100 years
Catch basins and leads	60 – 100 years
Culverts	25 – 30 years
Treatment ponds	30 – 50 years

Components of municipal infrastructure are constructed at different times. They have varying service lives and deteriorate at different rates depending on design, construction or maintenance practices.

Figure 2, on the next page, illustrates the typical service life for roads,[16] where PCI is the pavement condition index, a measure of road performance. The deterioration curve clearly shows that the road maintains a high level of service for the first three-quarters of its life, but deteriorates rapidly after this.

[15] Adapted from City of Hamilton SOTI report, 2005
[16] Larry Galehouse, James S. Moulthrop, and R. Gary Hicks, "Pavement Preservation Compendium II: Principles of Pavement Preservation—Definitions, Benefits, Issues, and Barriers," TR News, September-October 2003, pp. 4-15, Transportation Research Board (TRB), National Research Council, Washington, D.C.

Preventing the pavement from reaching this state through preventive maintenance and regular repair will prolong the service life of the road, thus avoiding premature and costly reconstruction.

Figure 2 – Typical service life for roads
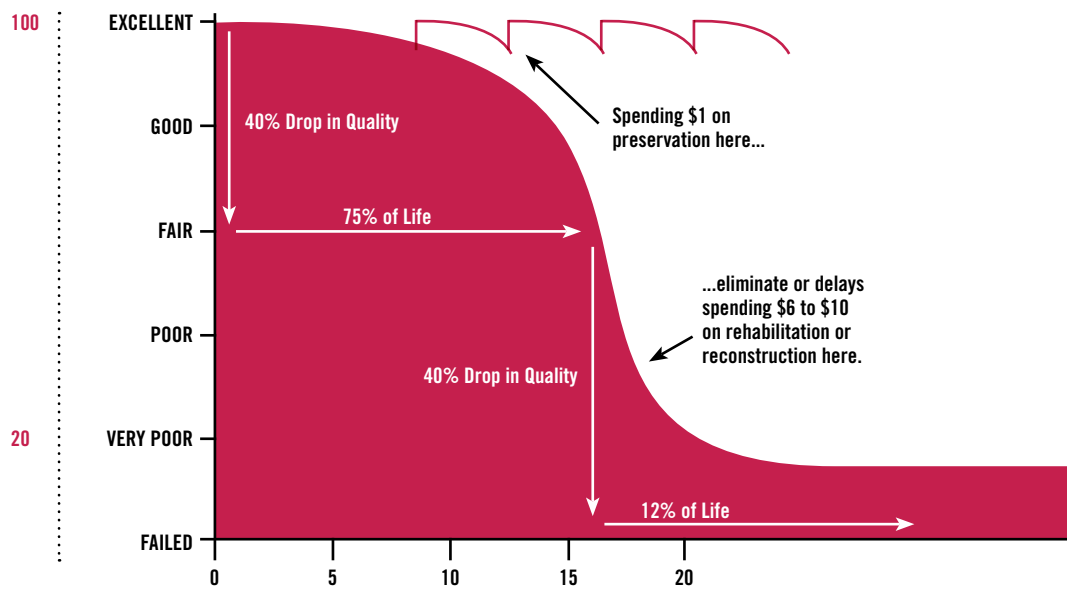
The benefits of sound asset management are widely accepted, and the principles of how to manage infrastructure are not new. The literature abounds with reports, studies or articles on the subject. The *InfraGuide Best Practice on Municipal Infrastructure Asset Management*[17] is recognized as an industry standard.

In recent years, regional and national groups have formed to promote the use of asset-management practices in municipalities. Groups such as Asset Management B.C. and Saskatchewan Municipal Asset Management gather multi-discipline (engineers, planners, accountants, finance officers) and multi-sector (public, private, water resources, transportation) experts to share expertise and experiences, offer training, and develop asset-management tools.

Nationally, the Canadian Network of Asset Managers was established in 2009 as a professional association to advance the state of practice and the state of the art of asset management.

Asset management is also necessary to avoiding future failures and unaffordable reconstruction costs. Figure 3, next page, presents the hypothetical condition distribution of components within an infrastructure system or network. The condition of the infrastructure is rated from very poor to very good. It is assumed the service life of the infrastructure is approximately 80 years.

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[17] *InfraGuide Best Practice on Municipal Infrastructure Asset Management,* InfraGuide, 2004

Figure 3 – Illustration of infrastructure system/network degradation over its service life

	TODAY	IN 20 YRS	IN 40 YRS	IN 60 YRS
VERY GOOD	15%	5%	10%	30%
GOOD	40%	15%	5%	10%
FAIR	30%	40%	15%	5%
POOR	10%	30%	40%	15%
VERY POOR	5%	10%	30%	40%
	TODAY	IN 20 YRS	IN 40 YRS	IN 60 YRS
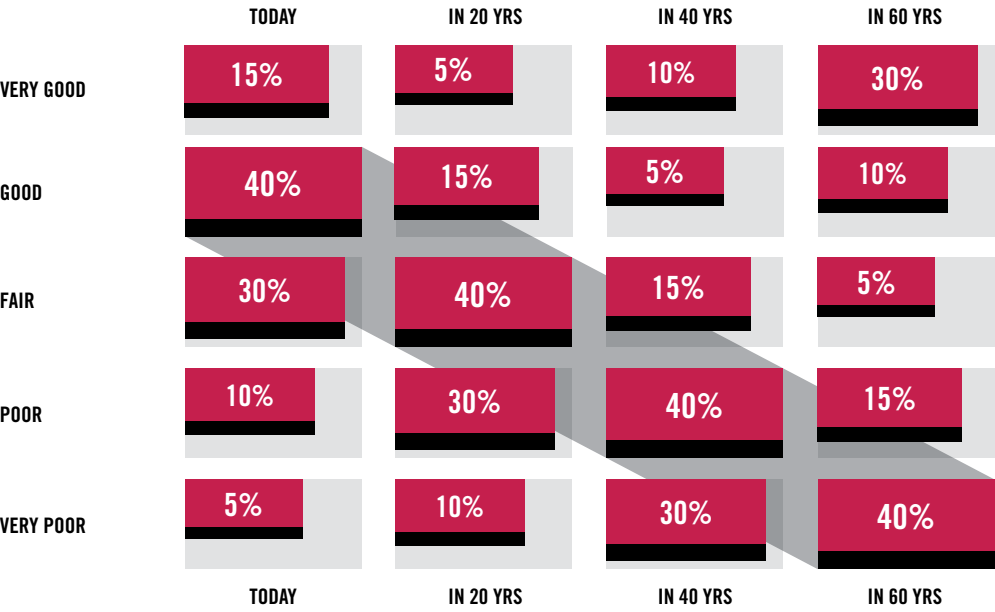
Investment needed to reconstruct infrastructure in "very poor" condition

Figure 3 illustrates infrastructure system/network degradation over its service life, assuming current practices are maintained and that every component in the "very poor" condition category is reconstructed.

As the figure shows, under current practices (investment, operations, maintenance), the majority of the infrastructure, even if in good to very good condition today, will require increasingly larger investments as it ages[18].

Asset management makes it possible to make these types of predictions for the system or component network in order to establish practices that will increase the longevity of the assets and optimize investments in maintenance and rehabilitation.

Finally, the importance of asset management has been recognized in Canada and abroad by local, provincial and federal funding programs, as well as by numerous professional associations, including those in engineering, planning and accounting.

More recently, the first recommendation relating to infrastructure, real estate and electricity of the Commission on the Reform of Ontario Public Services[19] dealt with asset management:

Recommendation 12-1: Place more emphasis on achieving greater value from existing assets in asset management plan reporting requirements than is currently proposed in the Long-Term Infrastructure Plan for certain organizations (e.g., universities, municipalities, etc.).

[18] In his report for the Federation of Canadian Municipalities, "Closing the Municipal Infrastructure Gap in Canada," Richard Zuker looked at a range of scenarios for dealing with the municipal infrastructure deficit. These scenarios demonstrated that the total cost (in 2004 dollars) required to eliminate the deficit decreases the earlier it is achieved.

[19] "Public Services for Ontarians: A Path to Sustainability and Excellence," Commission on the Reform of Ontario's Public Services, 2012
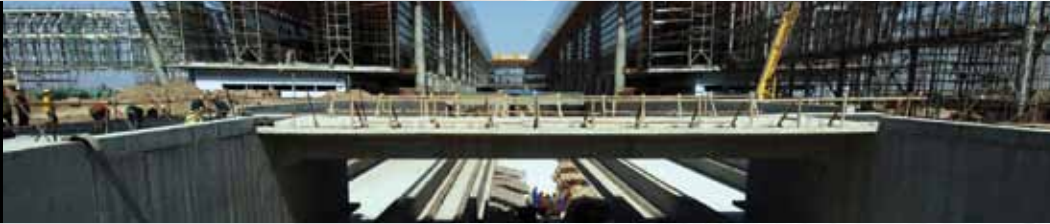
III. OBJECTIVES AND PRINCIPLES OF THE REPORT CARD

The primary objective of the report card is to develop a rigorous, repeatable process to assess the condition of Canada's infrastructure that will serve to inform the public, decision-makers and other stakeholders about infrastructure issues and trends.

The report card will:

- Present the overall state of the infrastructure using a five-level rating system: very good or excellent, good, fair, poor and very poor.
- Consider municipal infrastructure assets in the following asset groups: drinking-water systems; stormwater and wastewater collection and treatment; roads. Other infrastructure asset groups may be added in future.
- Use data collected from municipalities for the analysis to produce a factual account of the state of practice and state of the infrastructure.
- Establish a robust and repeatable methodology that can be used to identify trends if repeated regularly.
- Use an inclusive process that draws on multi-discipline and multi-sector experts to validate and confirm ratings.
- Focus on the physical condition of the assets, recognizing that assessing infrastructure performance involves other factors, including capacity, functionality, standards and regulations.

The report card consolidates data from a survey of 123 municipalities (see Methodology) to capture the state of practice and the state of the infrastructure in 2009–2010. This report card is the first attempt in Canada to measure the condition of municipal infrastructure, and the first in any country to base its results on a survey of owners and operators.

The data collected and aggregated at the national level will likely differ from the experience of individual municipalities due to differences in location, demographics, and local and regional practices and policies.

What the report card is not

The report card does not provide recommendations for action. It is the responsibility of the organizations involved in the delivery of infrastructure services to develop their own action plans based on the data provided.

It is not a "needs" study, nor does it forecast future capital needs due to growth. It does not attempt to determine the cost of bringing infrastructure to an acceptable level. Canada has no national guidelines on what is an "acceptable level" of service, which depends to some extent on the requirements of a given community.

The Methodology section below provides details on the process. In terms of project management, the following structure was established for this and future report cards[20].

A. PROJECT MANAGEMENT

Figure 4 – Project management structure

———— Action or Input relationship
······· Information sharing
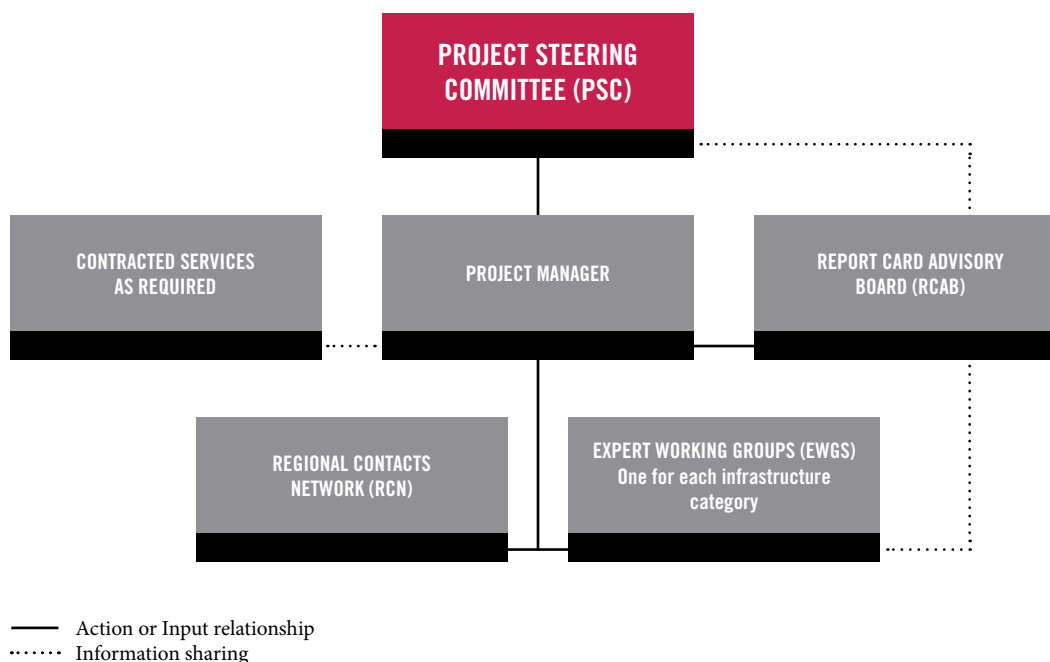
The Project Steering Committee (PSC) dealt with project administration issues. For this first report card, the PSC comprised the four funding organizations:

- The Canadian Construction Association (CCA)
- The Canadian Public Works Association (CPWA)
- The Canadian Society for Civil Engineering (CSCE)
- The Federation of Canadian Municipalities (FCM)

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20 Not all the elements of the project structure were in place for this first report card. For example, neither the Regional Contacts Network nor the Expert Working Groups were formally established.

The Report Card Advisory Board (RCAB) includes the following national infrastructure stakeholder associations:

- Association of Consulting Engineering Companies (ACEC)
- Canadian Association of Municipal Administrators (CAMA)
- Canadian Automobile Association (CAA)
- Canadian Construction Association (CCA)
- Canadian Council of Public-Private Partnerships (CCPPP)
- Canadian Institute of Planners (CIP)
- Canadian Network of Asset Managers (CNAM)
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- Canadian Urban Transit Association (CUTA)
- Canadian Water and Wastewater Association (CWWA)
- Engineers Canada
- Federation of Canadian Municipalities (FCM)
- Transportation Association of Canada (TAC)

The individuals representing these organizations on the RCAB were responsible for linkages between the report card project and their respective associations. They provided feedback on the process, the analysis, and the results.

Their respective networks allowed them to access the wide spectrum of expertise needed in the study.

RCAB members participated in the development of overall assessment statements for the report card and recommended approval of the report to the Project Steering Committee.

IV. RESULTS

Participation

A total of 346 municipalities registered for the survey. However, only 123 municipalities (listed in the Appendix) provided data usable in the analysis for the asset classes under consideration. Some municipalities may not own or operate a particular asset type. Some may have provided data that was incomplete or could not be verified. The detailed results for each of the asset types provide the number of municipalities included in analysis.

Figure 5 – Total number of municipalities included in the analysis

Region	Municipalities
TERRITORIES	0
PRINCE EDWARD ISLAND	3
ALBERTA	22
MANITOBA	9
NEWFOUNDLAND AND LABRADOR	14
BRITISH COLUMBIA	26
QUÉBEC	12
SASKATCHEWAN	12
NOVA SCOTIA	2
ONTARIO	30
NEW BRUNSWICK	2

All provinces are represented in the report-card database. The percentage of their population represented in the survey depends on the number of participating municipalities in the province. The demographic distribution of municipalities varies depending on the asset category under study: roads, drinking water, wastewater or stormwater management. The bar graph below presents the distribution of municipalities that provided data included in the analysis.

Figure 6 – Distribution of municipalities that provided data used in the analysis

	POPULATION > 250,000	POPULATION 100,000 – 250,000	POPULATION 50,000 – 100,000	POPULATION 10,000 – 50,000	POPULATION 5,000 – 10,000	POPULATION < 5,000
Storm water	19.1	11.8	19.1	22.1	5.9	22.1
Wastewater	16.7	11.9	17.9	21.4	6.0	26.2
Water	16.3	9.3	17.4	18.6	10.5	27.9
Roads	15.3	12.7	16.1	19.5	5.9	30.5
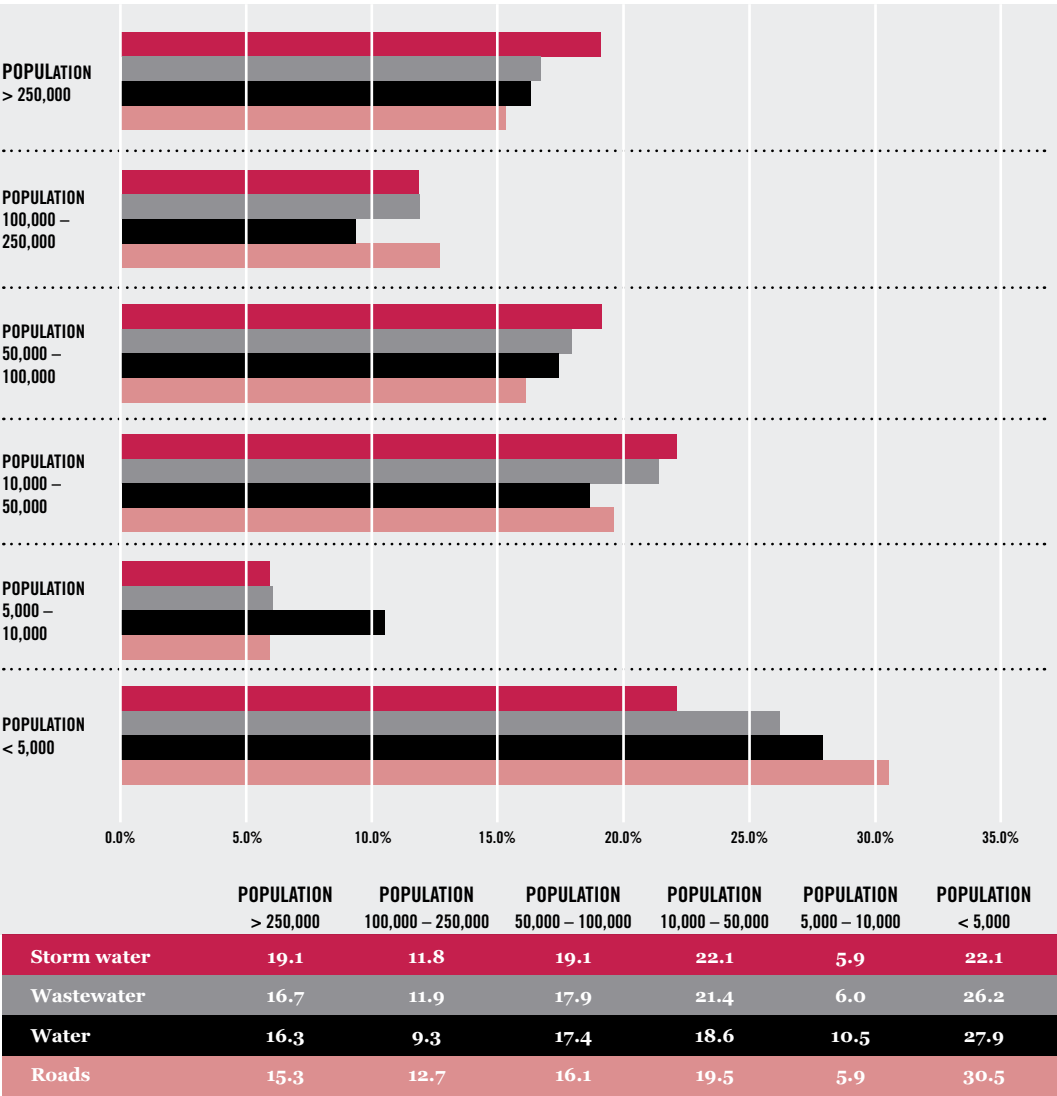
The report card results therefore adequately cover the spectrum of Canadian municipalities, from small and lower tier municipalities of fewer than 5,000 people to large urban centres of more than 250,000 people.

The current analysis does not break down results by region or population size. The data may allow a separate analysis by regions (individual or groups of provinces/territories) or by population. Data confidentiality, a commitment made to the respondents, will affect whether and how this breakdown can be done. This was not part of the current project.

The results presented below provide the national perspective of the infrastructure systems or networks owned or managed by the respondents. It is expected that within a given municipality or region, the results will be different due to local or regional practices and regulations.

Summary of results: state of the practice

This section presents an overview of the responses related to the management, inspection and condition assessment of the infrastructure, elements that provide an indication of the state of the practice. The responses to several questions in the survey establish how the infrastructure is managed, the general type and frequency of inspections, and the knowledge respondents have about the systems they manage.

Use of asset-management tools

The majority of municipalities reported using some type of asset-management system, computerized, paper-based or both. For each infrastructure category, the percentage of municipalities that use an asset-management system is listed below.

Drinking water	90% of respondents
Wastewater systems	68.8% of respondents
Stormwater management	50.5% of respondents
Roads	85.6% of respondents

Assessing the condition of the infrastructure

The survey requested physical and capacity data for the infrastructure considered. It also required respondents to identify the source of information: detailed inspection of the assets, opinions of qualified individuals, or other sources.

The results show variations between the sources of data depending on the type of infrastructure considered. Details are presented in each infrastructure category's chapter.

In general, more respondents use inspection data for the physical condition of the assets, while only a small percentage had data for the capacity of their networks or systems.

For example, an average of 30% of the respondents did not have data on treatment plants, reservoirs and pumping stations in their drinking-water systems. The percentage rose to 41% for water distribution pipes and 48% for transmission pipes. The assessment of the physical condition of drinking-water infrastructure was based on inspection data for between 14 and 30% of respondents, depending on the components within the system (plants, reservoirs, pipes, etc.).

Summary of results: state of the infrastructure

On the next page is a summary of the results that are presented later in this report in more detail for each of the infrastructure categories in the study. The table presents the replacement costs extrapolated to the entire country, using a 2009–2010 population of 33.7 million[21]. The data provided by the respondents for each of the infrastructure classes may be found in the individual infrastructure chapters.

[21] *Population Projections for Canada, Provinces and Territories 2009 to 2036*, Statistics Canada, Demography Division, June 2010, Report 91-520-X

Figure 7 – Summary of the physical condition assessment of the infrastructure studied, extrapolated to the entire country

Infrastructure	Replacement value of all assets (2009-10) (Note 1)	Rating (Note 2)	Assets in very poor and poor physical condition (Note 3)		Assets in fair physical condition (Note 3)	
			%	Replacement value	%	Replacement value
Municipal roads	$173.1 billion	Fair: requires attention	20.6%	$ 35.7 billion	32.0%	$ 55.4 billion
Drinking water	$171.2 billion	Good: adequate for now	2%	$ 3.4 billion	13.1%	$ 22.5 billon
Wastewater	$121.7 billion	Good: adequate for now	6.3%	$ 7.7 billion	25.7%	$ 31.3 billion
Storm water	$69.1 billion	Very good: fit for the future	5.7%	$ 3.9 billion	17.2%	$ 11.9 billion
Total	$538.1 billion			$50.7 billion		$121.1 billion

Notes:
1. The national level asset-replacement values were extrapolated using the asset-replacement values and the population served reported by all respondents, based on 33.7 million as the population of Canada for 2009-2010.
2. The ratings represent a distribution of the physical condition of the infrastructure (system or network), which comprises assets with long service lives. A well-managed system contains assets at various stages of deterioration that require different types of interventions (maintenance, repairs, rehabilitation or reconstruction) to provide the required level of service at the optimal cost. The ratings do not consider the capacity of the infrastructure to meet demand, since the data collected in this category was insufficient.
3. Not all respondents use inspection data to evaluate the condition of their infrastructure. When no inspection data was available, respondents in most instances used the opinions of qualified individuals to assess the condition of their infrastructure. This is generally the case for underground infrastructure, particularly stormwater and wastewater systems.

As indicated earlier, the individual rating represents a distribution of physical conditions across a system that contains thousands of components, which in turn have their own condition ratings and service lives. This distribution makes it possible to identify the percentage of assets in critical condition, where failure may be imminent; infrastructure that will deteriorate further if left unattended; and those assets in very good condition, where preservation measures will maintain high levels of service.

The two bar graphs below present the physical condition distributions for the asset classes considered in this report card.

Figure 8 – Physical condition: distribution for stormwater management and roads

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Roads	3.7%	16.9%	32.0%	25.7%	21.8%
Storm water: management facilities	0.6%	5.0%	6.9%	30.7%	56.8%
Storm water: pipes	0.8%	4.9%	17.7%	36.2%	40.5%
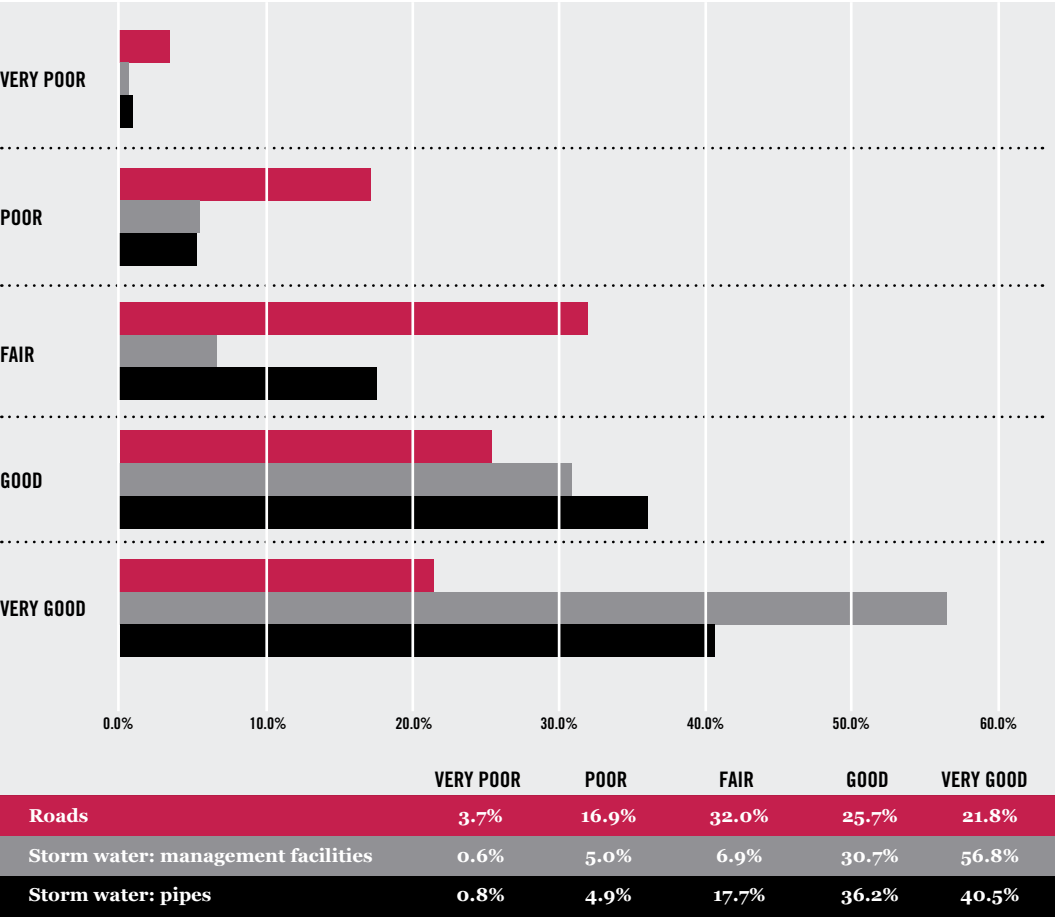
Figure 9 - Physical condition: distribution for drinking water and wastewater systems

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Drinking water: plants, reservoirs	0.3%	4.3%	9.8%	73.1%	12.6%
Drinking water: pipes	0.7%	0.3%	14.4%	80.5%	4.2%
Wastewater: plants, storage, pumping stations	0.1%	5.7%	34.5%	43.7%	16.0%
Wastewater: pipes	1.2%	6.5%	22.4%	36.1%	33.7%
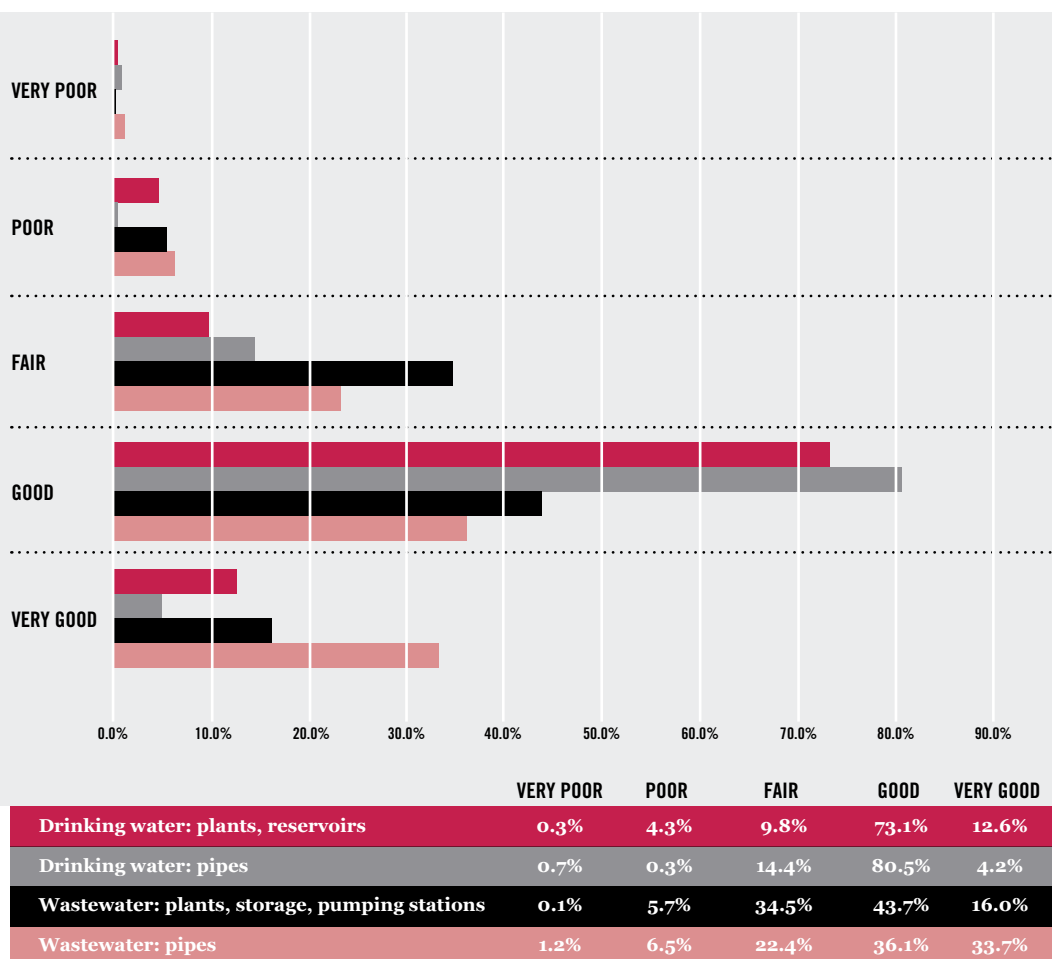
Although capacity data was not used in calculating ratings, the report-card data does indicate the capacity of the infrastructure systems to meet demand. In general, municipalities indicated the majority of their infrastructure networks and systems have "good" to "very good" capacity, except for road networks. The capacity data below shows the percentages in each asset category reported to have "good" and "very good" capacity:

• Drinking water: > 85%
• Wastewater systems: > 79%
• Stormwater management: > 84% (except for pumping stations, 63%)
• Roads: > 43%

A system's capacity to meet demand is highly dependent on individual components. For example, the pipe infrastructure in a stormwater management system may have the capacity to evacuate water from a given rainstorm event, but if one or more pumping stations have limited capacity, the entire system is limited.

Details about the breakdown of this data for individual asset categories and their related components are presented in each infrastructure chapter.

V. RATED INFRASTRUCTURE

A. DRINKING-WATER SYSTEMS

Potable water production, storage and distribution

Good: Adequate for now
The infrastructure in the system or network is in good condition; some elements show general signs of deterioration that require attention. A few elements exhibit significant deficiencies.

Figure 10 - Drinking water, physical condition: plants, reservoirs and pumping stations

GOOD 73.1%

FAIR 9.8%   POOR 4.3%   VERY POOR 0.3%   VERY GOOD 12.6%
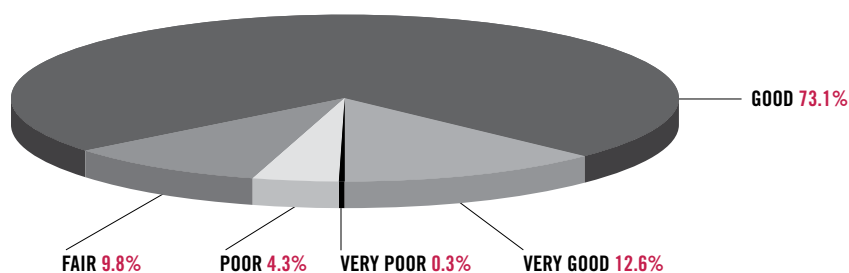
Figure 11 - Drinking water, physical condition: transmission and distribution pipes

GOOD 80.5%

FAIR 14.4%   POOR 0.3%   VERY POOR 0.7%   VERY GOOD 4.2%
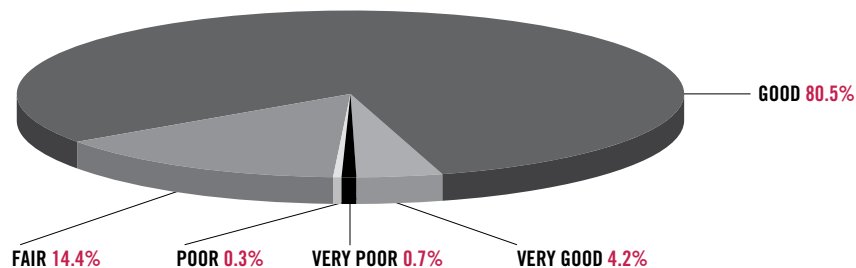
The infrastructure assets considered in this section relate to the linear portion of drinking-water systems (pipes: transmission, > 350 mm diameter, and distribution ≤ 350 mm), as well as water-treatment plants, pumping stations and reservoirs.

Network summary
The 86 municipalities that provided responses to the drinking-water questionnaire serve 13.5 million Canadians (three million households and 229,500 businesses). They reported a total of 719,630 km of pipes, composed primarily of distribution pipes (649,212 km or 90%). The remaining 70,418 km (10%) are transmission pipes.

Asset management and sources of data
The majority of the municipalities that own and/or operate drinking-water systems reported using asset-management systems, whether computer-based (43%) or paper-based (38%). Only 10% of these municipalities did not have an asset-management system.

An average of 30% of the respondents did not have data on their treatment plants, reservoirs or pumping stations, while an equal percentage reported they assess the condition of these assets at least every five years.

A large percentage of municipalities reported having no data on the condition of their water pipes: 41.3% for distribution pipes and 48.2% for transmission pipes. Approximately 36% of the respondents reported they assess the condition of their water pipes at least every 10 years. Between four and five% of the pipe networks were assessed in 2009.

The majority of respondents cited qualified individuals as the source of their information/data, as shown in the bar graph on the next page.

Figure 12 - Source of physical condition information

	PLANTS	PUMPING STATIONS	RESERVOIRS	LOCAL LINEAR	TRANSMISSION LINEAR
Other source	13.2%	14.7%	11.7%	17.2%	24.7%
Opinion of qualified individuals	57.4%	70.6%	64.9%	65.5%	61.6%
Reliable and complete data	29.4%	19.1%	23.4%	17.2%	13.7%
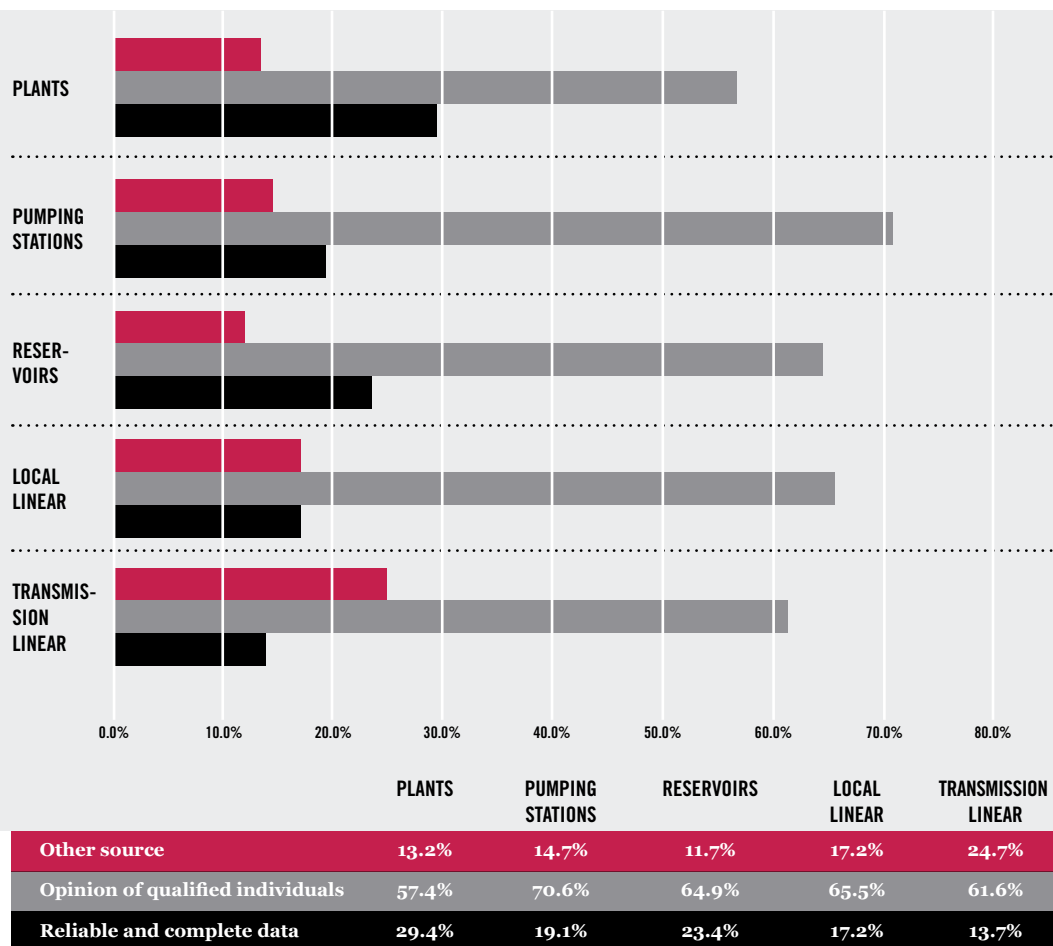
Physical condition of assets in drinking-water systems

The respondents were asked to rank their assets (plants, reservoirs, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1), using generally accepted industry condition definitions, as shown in the example below for distribution pipes. Similar rating systems were provided to respondents for other assets and for the demand/capacity rating.

Figure 13 – Physical Condition Ratings, Drinking-water Distribution System

PHYSICAL CONDITION	DISTRIBUTION SYSTEM
5 – Very good No structural defects	Little or no water loss through leakage
4 – Good Minor cracking, spalling or signs of wear	Deterioration causing minimal influences on levels of service and less than one break per km per year Equivalent to OFWAT condition grade 2
3 – Fair Medium cracking, spalling or signs of wear	Deterioration beginning to be reflected in deteriorating levels of service and/or increased operating costs Less than three breaks per km per year Equivalent to OFWAT condition grade 3
2 – Poor Fracture with deformation up to 10%	Nearing the end of useful life, further deterioration likely, affecting levels of service Greater than or equal to three to five breaks per km per year Equivalent to OFWAT condition grade 4
1 – Very poor Collapsed or collapse is imminent	No residual life expectancy, requires urgent replacement Equivalent to OFWAT condition grade 5

The responses for linear assets (pipes) provided the percentages in each condition classification that could be normalized with respect to pipe length for the calculation of the overall average rating. For non-linear (discrete) assets, such as plants, pumping stations and reservoirs, the normalization was done by using asset-replacement value.

Figure 14 - Physical condition, rating of non-linear assets

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Reservoir	0.0%	3.8%	32.0%	42.7%	33.4%
Pumping stations	0.8%	5.8%	17.3%	55.3%	20.8%
Plants	0.3%	4.1%	7.0%	80.6%	8.1%
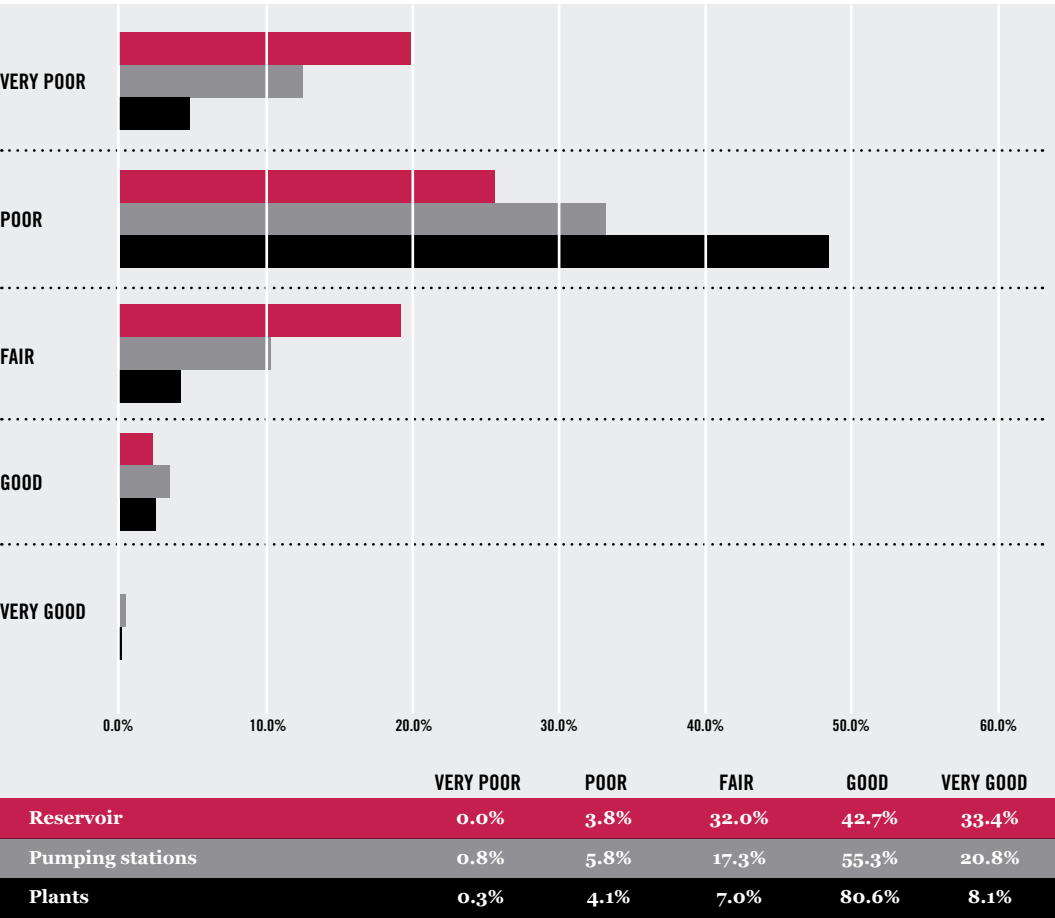
Figure 15 - Physical condition, rating of linear assets
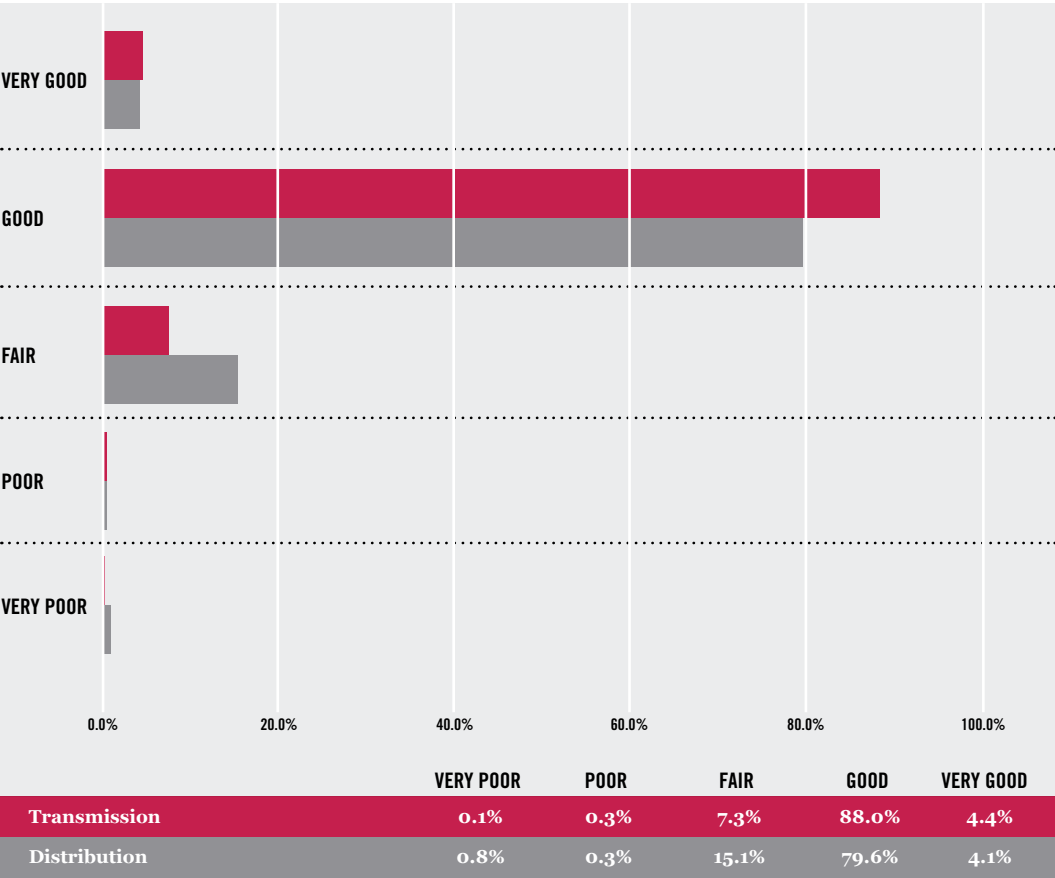
	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Transmission	0.1%	0.3%	7.3%	88.0%	4.4%
Distribution	0.8%	0.3%	15.1%	79.6%	4.1%

Capacity of water systems to meet demand

The respondents were asked to rank the capacity of their assets (plants, reservoirs, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1) using generally accepted industry condition definitions, as shown in the example below for pumping stations. Similar rating systems were provided to respondents for other assets.

Figure 16 – Demand/Capacity Condition Ratings, Drinking-water Distribution, Pumping Stations

DEMAND/CAPACITY CONDITION	WATER DISTRIBUTION PUMPING STATIONS
5 – Very good	Demand corresponds well to the design capacity; no operational problems experienced
4 – Good	Demand is within design capacity; occasional operational problems experienced
3 – Fair	Demand is approaching design capacity; significant operational problems occur frequently
2 – Poor	Demand exceeds design capacity; significant operational problems are evident
1 – Very poor	Demand exceeds design capacity; operational problems are serious and ongoing

Figure 17 - Capacity assessment of all drinking water assets
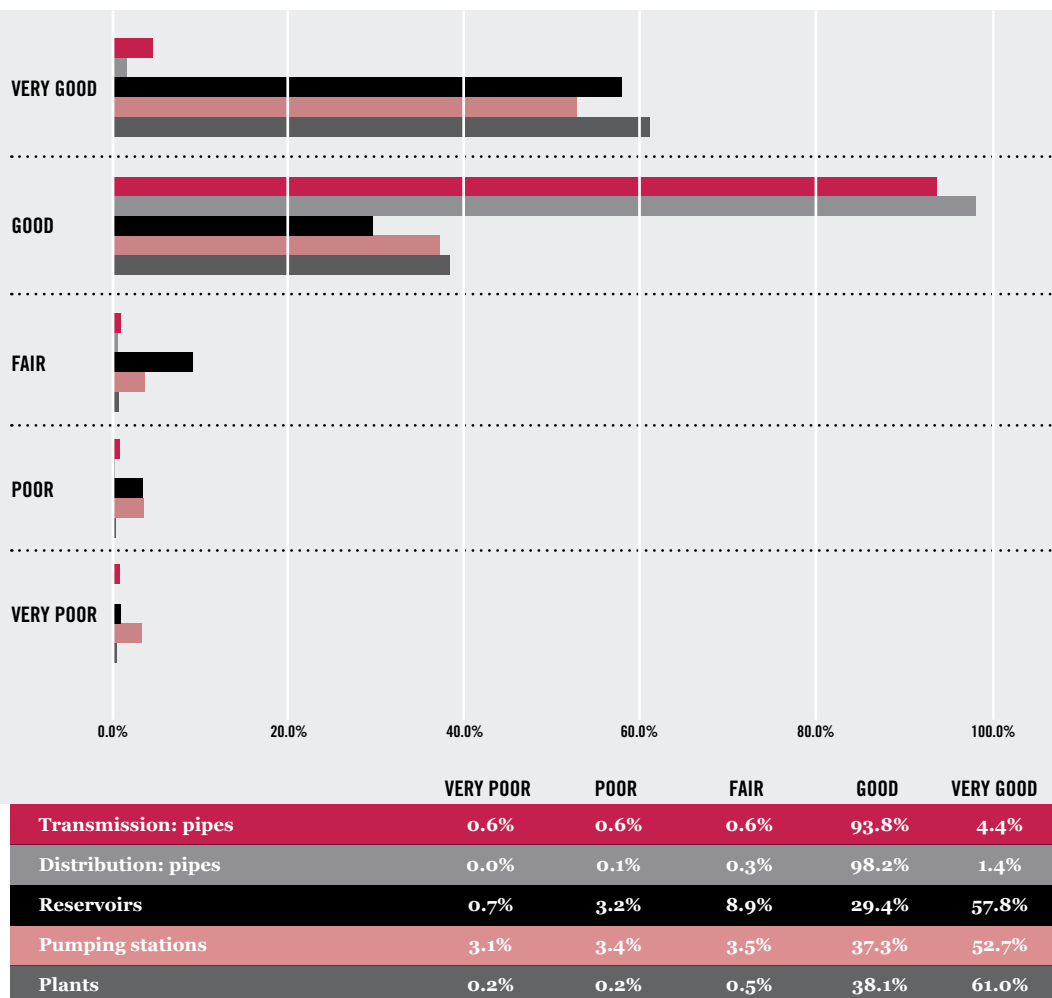
	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Transmission: pipes	0.6%	0.6%	0.6%	93.8%	4.4%
Distribution: pipes	0.0%	0.1%	0.3%	98.2%	1.4%
Reservoirs	0.7%	3.2%	8.9%	29.4%	57.8%
Pumping stations	3.1%	3.4%	3.5%	37.3%	52.7%
Plants	0.2%	0.2%	0.5%	38.1%	61.0%

Respondents that conducted a capacity/demand assessment reported that the demand on their system is well within the system's design capacity, with occasional operational problems, as shown in the bar graph.

Replacement value of the drinking-water systems

The total 2009–2010 replacement value of the assets reported by the 109 municipalities that provided data in this asset category was $68.6 billion; this corresponds to $5,000 per person served by the system.

Close to 73% of the total replacement value of water assets was for pipes (transmission and distribution). The breakdown of asset-replacement values for the various components is shown in the following tables.

Replacement value: linear assets (pipes)

Local	$37,748,856,532
Transmission	$12,165,631,491
Total	**$49,914,488,023**

Replacement value: non-linear (discrete) assets

Plants	$14,199,688,757
Pumping stations	$2,293,994,013
Reservoirs	$2,159,600,862
Total	**$18,653,283,631**

B. WASTEWATER SYSTEMS

New wastewater regulations change the equation for municipal governments

As important as wastewater regulations are to protect our lakes, rivers and oceans, Canada's wastewater treatment problems require more than regulations; they require investment. These problems include lack of sewage collection and/or treatment systems; inefficiently operated systems; treatment plants unable to cope with new pollutants; obsolete and costly infrastructure; and outdated monitoring, reporting and evaluation tools.

The new regulations will provide a workable set of rules for the municipal operators of the country's more than 3,500 wastewater-treatment systems, but only if they can afford to meet them. Over the next three decades, these regulations will require rebuilding or replacing more than one in four wastewater-treatment systems. When viewed in isolation, the costs of meeting these new requirements may appear substantial but manageable. However, the projected costs must be viewed in the context of Canada's municipal infrastructure deficit.

In 2007, an FCM-McGill survey estimated Canada's municipal infrastructure deficit at $123 billion. It set the deficit related to water supply, wastewater and stormwater systems at approximately $31 billion. For the most part, this deficit can be attributed to aging underground infrastructure and the accelerated deterioration of assets as they approach the end of their service life. The study identified the cost of bringing existing infrastructure up to then-current standards. It did not estimate the cost of new infrastructure or upgrades to meet new wastewater regulations, such as those announced in July 2012.

Many municipalities, particularly smaller ones, will require federal assistance to meet these federally mandated regulations. Upgrading wastewater treatment plants is expected to cost at least $20 billion, which does not include system-wide upgrades required to meet the regulations. The Federation of Canadian Municipalities says funding for the new regulations must be part of the federal governments new Long-Term Infrastructure Plan (LTIP) to help municipalities pay for this once-in-a generation infrastructure investment.

Wastewater collection, treatment and discharge

> **Good: Adequate for now**
> The infrastructure in the system or network is in good condition; some elements show general signs of deterioration that require attention. A few elements exhibit significant deficiencies.

Figure 18 – Wastewater, physical condition: plants, pumping stations and storage tanks

GOOD 43.7%

FAIR 34.5%   POOR 5.7%   VERY POOR 0.1%   VERY GOOD 16.0%
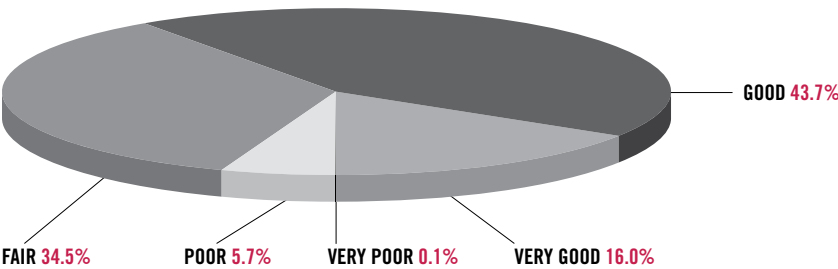
Figure 19 – Wastewater, physical condition: collection system (pipes)

GOOD 36.1%

VERY GOOD 33.7%   FAIR 22.4%   POOR 6.5%   VERY POOR 1.2%
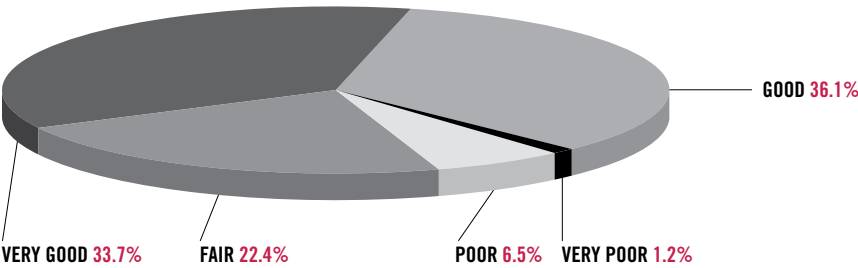
The infrastructure assets considered in this section relate to the linear portion of wastewater systems (pipes: local, collectors and trunks), as well as the following discrete assets: wastewater-treatment plants, pumping stations, storage structures.

Network summary

The 84 municipalities (total population of 19 million in 2009)[22] that provided responses to the wastewater questionnaire reported a total of 50,025 km of pipes. The network reported is composed primarily (78%) of small, local collection pipes (< 450 mm in diameter).

The pipes in the system are mostly plastic (41.8%) and concrete (31.6%), with the remaining pipes of metal, vitrified clay or other materials. Plastic is predominantly used in local wastewater systems (< 450 mm diameter), while concrete is equally used in all pipe sizes.

The responding municipalities jointly owned or operated 80 wastewater storage structures (tanks, pipe storage, ponds or lagoons) with a capacity of 6,870 megalitres[23].

[22] The data collected cannot be used to establish the population served by these wastewater systems.
[23] 10^6 L

Figure 20 – Average inspection cycle: wastewater linear assets
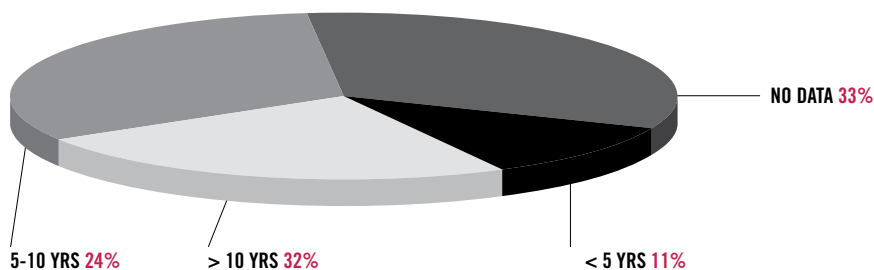
NO DATA 33%

5-10 YRS 24%   > 10 YRS 32%   < 5 YRS 11%

Asset-management and sources of data

The majority of the municipalities that own and/or operate wastewater collection and treatment systems reported using asset-management systems, either computer-based (34.8%) or paper-based (34%). The remaining 31.2% of the municipalities did not have an asset-management system.

An average of 35.1% of the respondents did not have data on their treatment plants, storage structures or pumping stations. Half of the respondents had no data on their storage facilities. On average, 47.8% of the municipalities perform inspections of their non-linear wastewater assets at least every 10 years.

The chart below illustrates the assessment cycle for the wastewater linear assets (pipes) reported.

The majority of respondents cited "qualified individuals" as the source of the information, as shown in the bar graph below.

Figure 21 – Source of physical condition information

	NON-LINEAR ASSETS	SMALL LOCAL SEWERS	LARGE LOCAL SEWERS	TRUNK SEWERS
Other source	15.7%	13.2%	16.4%	21.0%
Opinion of qualified individuals	62.7%	56.0%	52.1%	51.6%
Reliable and complete assessment data	21.7%	30.8%	31.5%	27.4%
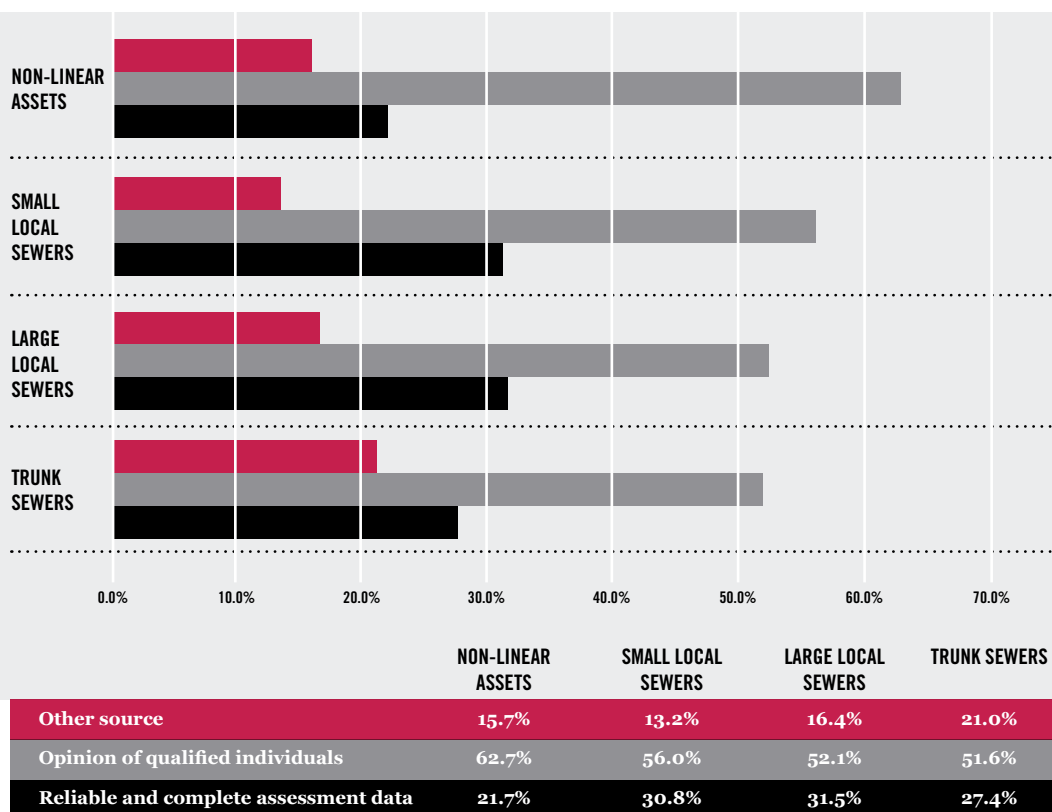
Physical Condition of Assets in Wastewater Systems

The respondents were asked to rank their assets (treatment plants, storage facilities, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1) using generally accepted industry condition definitions, as shown in the example below for wastewater collection pipes. Similar rating systems were provided to respondents for other assets and for the demand/capacity rating.

Figure 22 – Physical condition ratings, wastewater collection system

PHYSICAL CONDITION	WASTEWATER COLLECTION SYSTEM
5 – Very good No structural defects	Equivalent to CERIU, NASSCO PACP and WRc condition grade 1
4 – Good Minor cracking, spalling or signs of wear	Equivalent to CERIU, NASSCO PACP and WRc condition grade 2
3 – Fair Medium cracking, spalling or signs of wear Fracture with deformation > 5%	Equivalent to CERIU, NASSCO PACP and WRc condition grade 3
2 – Poor Fracture with deformation up to 10%	Equivalent to CERIU, NASSCO PACP and WRc condition grade 4
1 – Very poor Collapsed or collapse is imminent	Equivalent to CERIU, NASSCO PACP and WRc condition grade 5

The responses for linear assets (pipes) provided the percentages in each condition classification that could be normalized with respect to pipe length for the calculation of the overall average rating. For non-linear (discrete) assets, such as plants, pumping stations and reservoirs, the normalization was done by using asset-replacement value.

Figure 23 - Physical condition rating of non-linear wastewater assets

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Storage facilities	0.0%	0.0%	0.0%	90.7%	9.3%
Pumping stations	0.0%	7.2%	23.8%	58.1%	10.9%
Treatment plants	0.1%	5.7%	36.8%	40.6%	16.9%
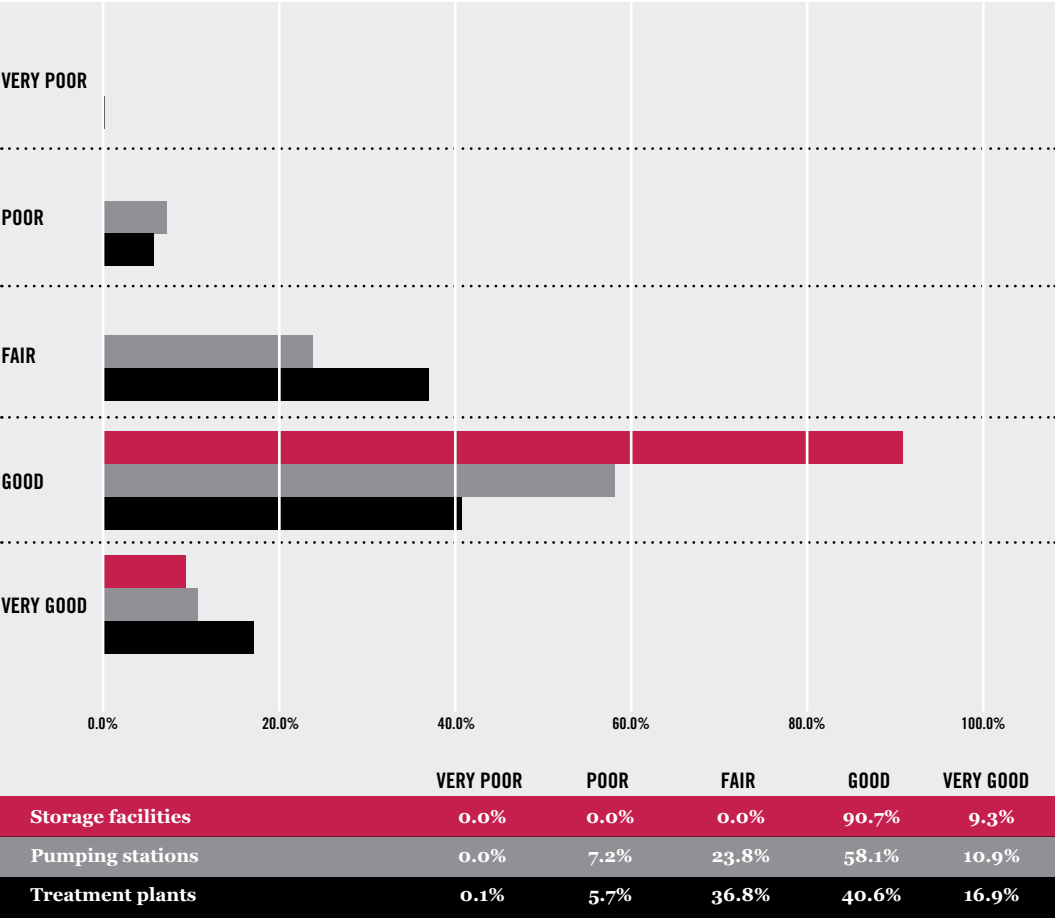
Figure 24 - Physical condition rating of linear (pipes) wastewater assets
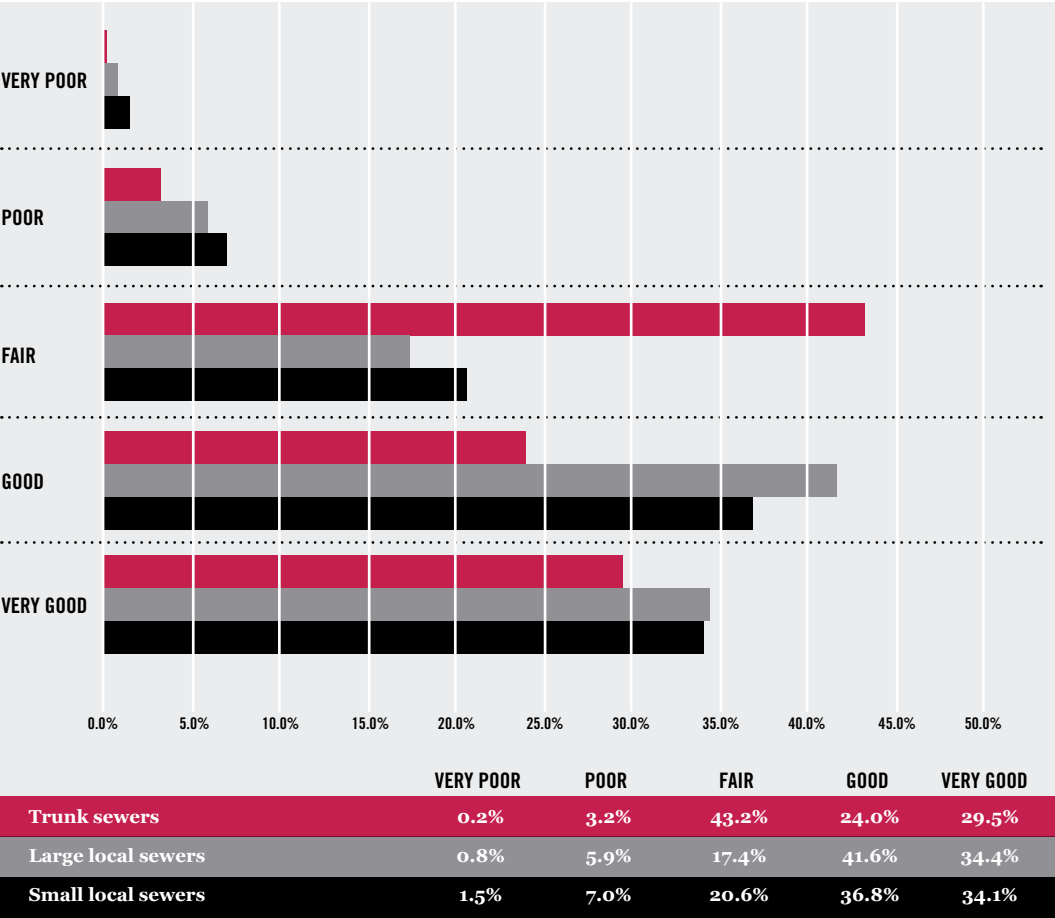
	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Trunk sewers	0.2%	3.2%	43.2%	24.0%	29.5%
Large local sewers	0.8%	5.9%	17.4%	41.6%	34.4%
Small local sewers	1.5%	7.0%	20.6%	36.8%	34.1%

Capacity of water systems to meet demand

The respondents were asked to rank the capacity of their assets (plants, reservoirs, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1), using generally accepted industry condition definitions, as shown in the example below for wastewater storage tanks. Similar rating systems were provided to respondents for other assets.

Figure 25 – Demand/Capacity Condition Ratings, Wastewater
Storage Tanks

DEMAND/CAPACITY CONDITION	WASTEWATER STORAGE TANKS
5 – Very good	Demand corresponds well to the design capacity; no operational problems experienced
4 – Good	Demand is within design capacity; occasional operational problems experienced
3 – Fair	Demand is approaching design capacity; significant operational problems occur frequently
2 – Poor	Demand exceeds design capacity; significant operational problems evident
1 – Very poor	Demand exceeds design capacity; operational problems are serious and ongoing

Respondents that conducted a capacity/demand assessment reported that the demand on their system was well within the system's design capacity, with occasional operational problems, as shown in the bar graph. On average, for all the wastewater assets considered, 65% of the respondents rely on qualified individuals for the capacity-assessment reported, while 21% based their responses on complete and reliable assessment data.

Figure 26 - Capacity assessment of all wastewater assets

	TREATMENT PLANTS	PUMPING STATIONS	STORAGE FACILITIES	SMALL LOCAL SEWERS	LARGE LOCAL SEWERS	TRUNK SEWERS
Excellent	18.5%	20.8%	23.9%	24.6%	26.6%	49.4%
Good	60.5%	60.2%	76.1%	57.2%	63.3%	48.6%
Fair	20.9%	15.3%	0.0%	15.6%	5.0%	1.8%
Poor	0.1%	2.7%	0.0%	1.6%	2.6%	0.2%
Very poor	0.0%	1.0%	0.0%	1.0%	2.5%	0.0%
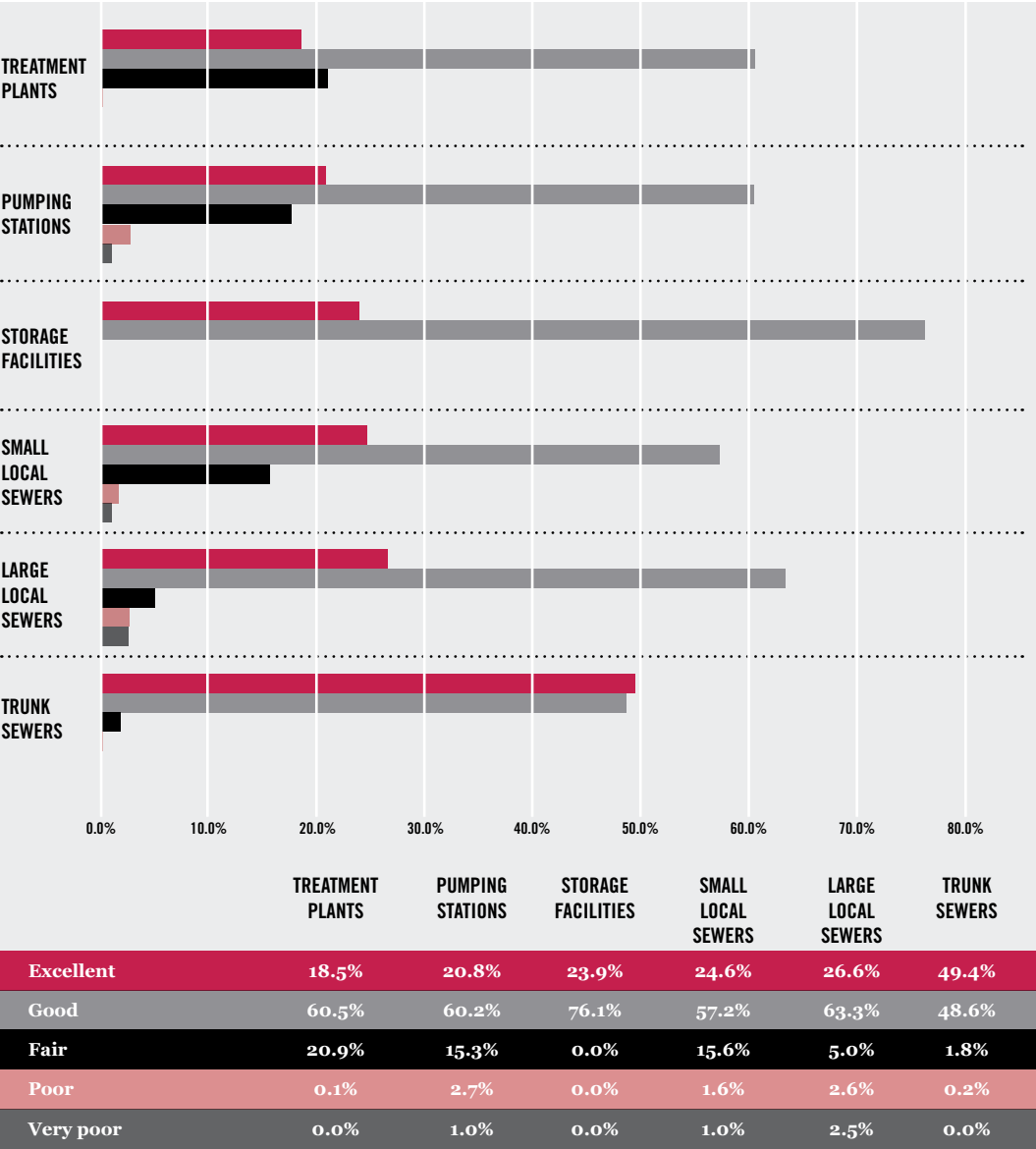
Replacement value of wastewater collection and treatment systems

The total 2009–2010 replacement value of the assets reported by the 106 municipalities that provided data in this asset class was close to $70 billion[24]. More than 79% of the total replacement value of wastewater assets was for the pipes (local and trunk sewers). The break-down of asset-replacement values for the various systems' components is shown in the tables on the next page.

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[24] A per capita value for the population served by these wastewater systems cannot be calculated based on the data collected.

Replacement value: linear assets (pipes)

Small Local Sewers	$39,976,283,477
Large Local Sewers	$9,823,709,769
Trunk Sewers	$5,678,053,860
Total	**$55,478,047,107**

Replacement value: non-linear (discrete) assets

Plants	$12,610,005,910
Pumping stations	$1,685,933,044
Reservoirs	$315,159,971
Total	**$14,611,098,926**

C. STORMWATER SYSTEMS

Collection, stormwater management facilities

> **Very good: Fit for the future**
> The infrastructure in the system or network is generally in very good condition, typically new or recently rehabilitated. A few elements show general signs of deterioration that require attention.

Figure 27 – Stormwater, physical condition: pumping stations and stormwater management facilities

VERY GOOD 56.8%
GOOD 30.7% FAIR 6.9% POOR 5.0% VERY POOR 0.6%
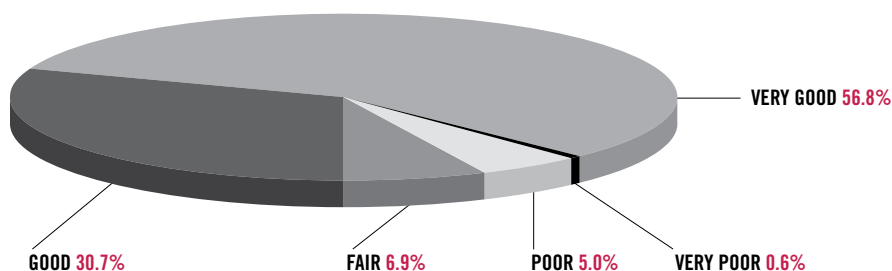
Figure 28 – Stormwater, physical condition: collection systems (pipes)

VERY GOOD 40.5%
GOOD 36.2% FAIR 17.7% POOR 4.9% VERY POOR 0.8%
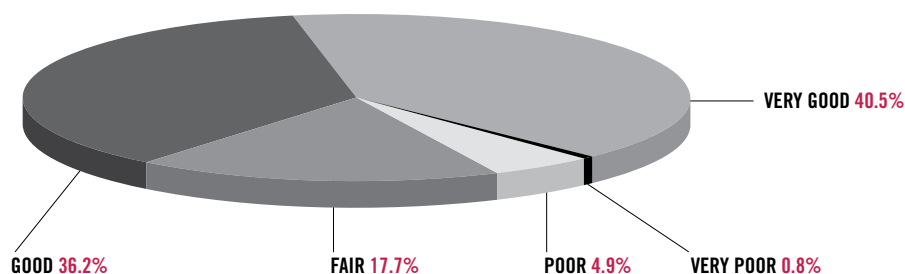
The infrastructure assets considered in this section relate to the linear portion of stormwater systems (pipes: local, collectors and trunks) and the following discrete assets: pumping stations and stormwater management (SWM) facilities.

Network summary
The 68 municipalities (total population of 19.9 million in 2009) that provided responses to the stormwater questionnaire reported a total of 34,212 km of pipes. The network reported is composed primarily (51%) of small, local collection pipes (< 450 mm in diameter). The pipes in the system are mostly concrete (65.2%) followed by plastic (18.3%) with the remaining pipes of metal, vitrified clay or other materials. The responding municipalities jointly owned and/or operated 671 stormwater management (SWM) facilities and 184 stormwater pumping stations.

Asset management and sources of data
A slim majority of the municipalities that own and/or operate stormwater systems reported using asset-management systems, whether computer-based (26.4%) and/or paper-based (24.1%).

The remaining 49.5% of the municipalities did not have an asset-management system.

An average of 55% of the respondents did not have data on their SWM facilities or pumping stations. On average, 18.4% of the municipalities inspect their non-linear stormwater assets at least every 10 years, while 53.6% did not have data on their non-linear networks.

The chart below illustrates the assessment cycle for the stormwater linear assets (pipes) reported.

Figure 29 - Average inspection cycle for stormwater linear assets

NO DATA 52.8%

> 10 YRS 27.7%   5-10 YRS 13.9%   < 5 YRS 5.7%

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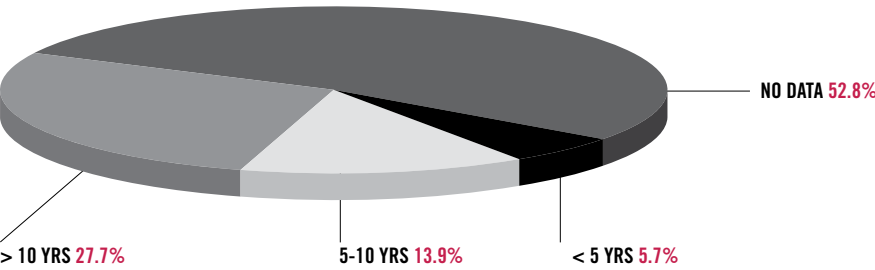
25 The data collected does not allow us to establish the population served by these stormwater systems.

The majority of respondents indicated their information/data came from qualified individuals, as shown in the bar graph below.

Figure 30 - Source of physical condition information

	NON-LINEAR	SMALL LOCAL	LARGE LOCAL	TRUNK
Complete and reliable data	30.6%	30.7%	32.4%	37.5%
Opinion of qualified individuals	48.2%	50.7%	52.1%	46.4%
Other source	21.2%	18.7%	15.5%	16.1%
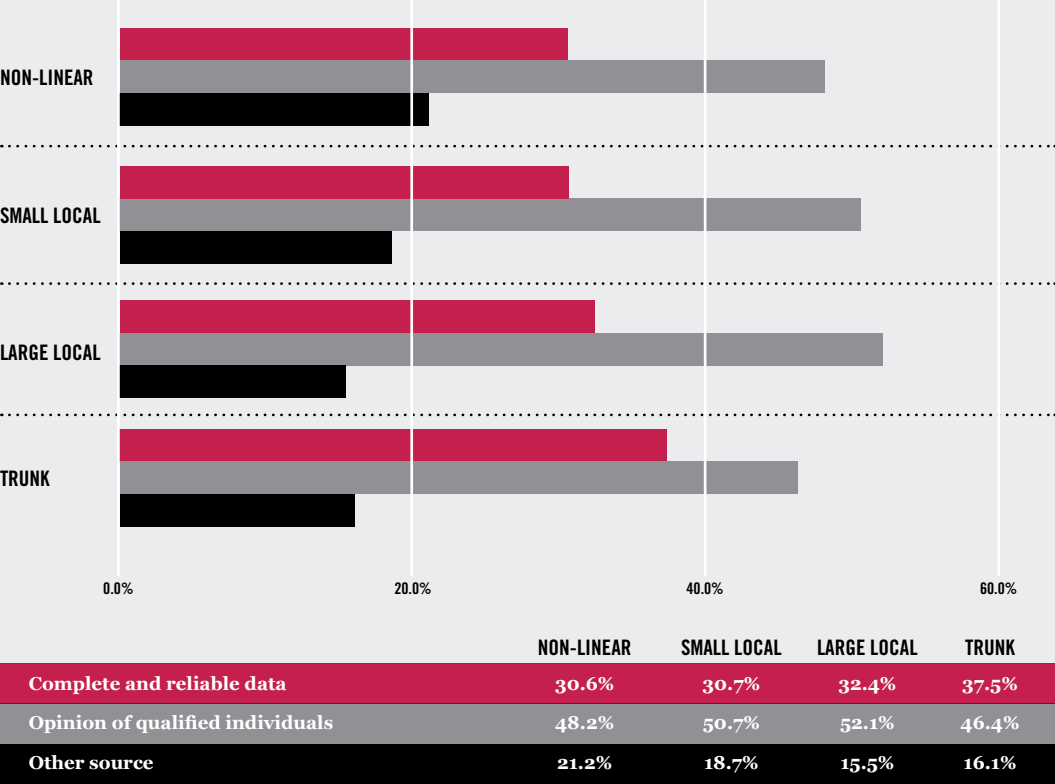
Physical condition of the assets in the stormwater management systems

The respondents were asked to rank their assets (stormwater management facilities/ponds, storage facilities, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1) using generally accepted industry condition definitions, as shown in the example below for stormwater collection pipes. Similar rating systems were provided to respondents for other assets and for the demand/capacity rating.

Figure 31: Physical condition ratings, stormwater drainage system

PHYSICAL CONDITION	STORMWATER DRAINAGE SYSTEM
5 – Very good	No structural defects
	Equivalent to CERIU, NASSCO PACP and WRc condition grade 1
4 – Good	Minor cracking, spalling or signs of wear
	Equivalent to CERIU, NASSCO PACP and WRc condition grade 2
3 – Fair	Medium cracking, spalling or signs of wear
	Fracture with deformation < 5%
	Equivalent to CERIU, NASSCO PACP and WRc condition grade 3
2 – Poor	Fracture with deformation up to 10%
	Equivalent to CERIU, NASSCO PACP and WRc condition grade 4
1 – Very poor	Collapsed or collapse is imminent
	Equivalent to CERIU, NASSCO PACP and WRc condition grade 5

The responses for linear assets (pipes) provided the percentages in each condition classification that could be normalized with respect to pipe length for the calculation of the overall average rating. For non-linear (discrete) assets, such as SWM facilities, ponds, pumping stations and reservoirs, the normalization was done by using asset-replacement value.

Figure 32 - Physical condition rating of non-linear stormwater assets

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
SWM facilities	0.7%	6.1%	4.1%	30.5%	58.6%
Pumping stations	0.0%	0.3%	18.6%	31.7%	49.4%
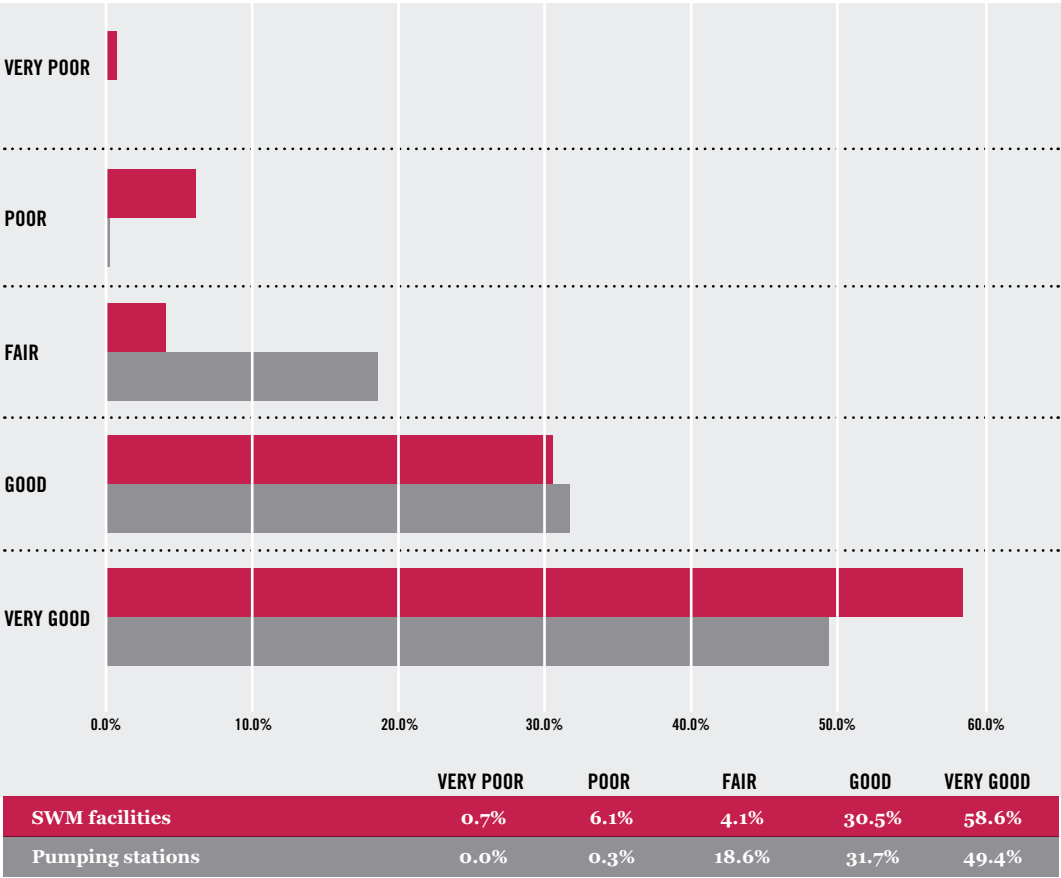
Figure 33 - Physical condition rating of linear (pipes) stormwater assets

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Trunk pipes	0.8%	4.9%	17.7%	36.2%	40.5%
Large local pipes (> 4500 mm to < 1500 mm)	0.8%	5.4%	18.9%	36.0%	38.9%
Small local pipes (< 450 mm)	0.8%	4.7%	17.6%	33.6%	43.4%
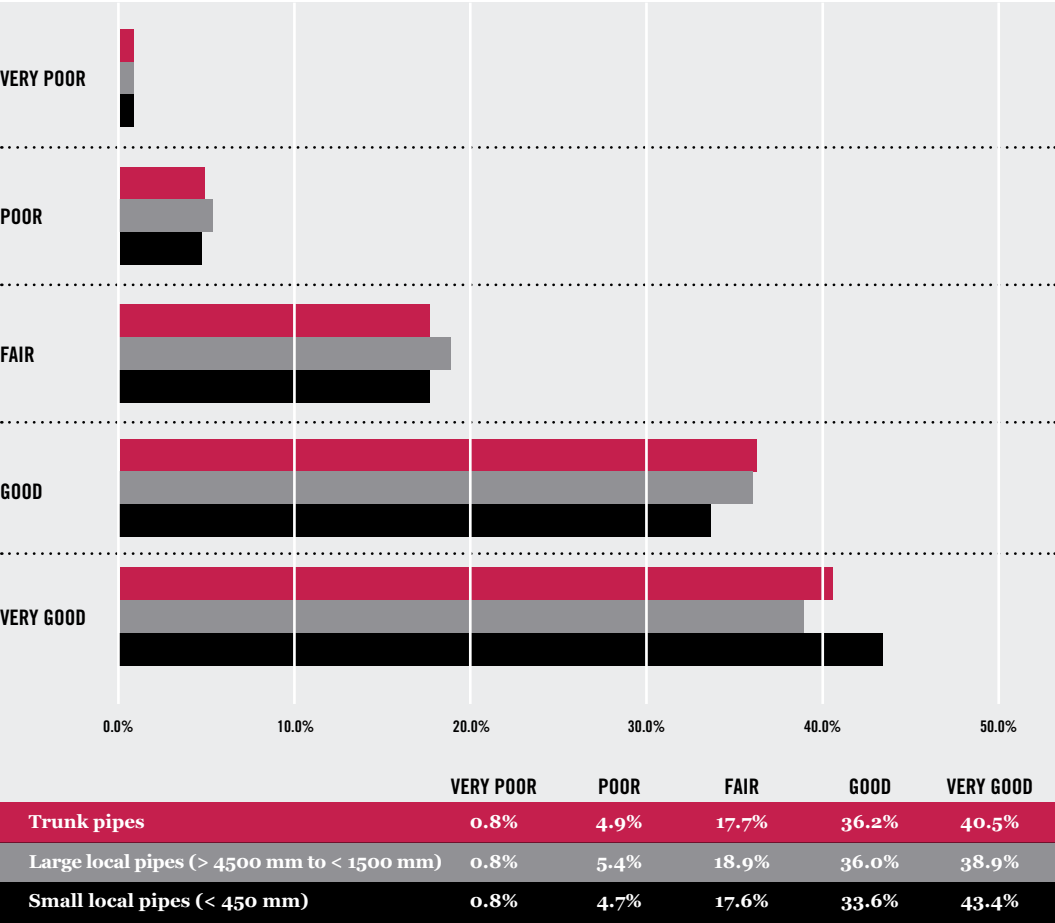
Capacity of the stormwater management systems to meet demand

The respondents were asked to rank the capacity of their assets (SWM facilities, pumping stations and pipes) from "very good condition" (5) to "very poor condition" (1) using generally accepted industry condition definitions as shown in the example below for stormwater pumping stations. Similar rating systems were provided to respondents for other assets.

Figure 34 – Demand/Capacity Condition Ratings, Stormwater Drainage System, Pump Stations

DEMAND/CAPACITY CONDITION	STORMWATER DRAINAGE SYSTEM PUMP STATIONS (LIFT STATIONS)
5 – Very good	Demand corresponds well to the design capacity; operational problems experienced
4 – Good	Demand is within design capacity; occasional operational problems experienced
3 – Fair	Demand is approaching design capacity; significant operational problems occur frequently
2 – Poor	Demand exceeds design capacity; significant operational problems are evident
1 – Very poor	Demand exceeds design capacity; operational problems are serious and ongoing

Respondents that conducted a capacity/demand assessment reported that the demand on their system is well within the system's design capacity while experiencing occasional operational problems as shown in the bar graph. On average, for all the stormwater assets considered, 53.5% of respondents rely on qualified individuals for the capacity-assessment reported, while 14.5% based their responses on complete and reliable assessment data.

Figure 35 - Capacity assessment of all stormwater system assets

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Collection system (pipes)	0.4%	2.4%	12.7%	56.8%	27.6%
SWM facilities	0.5%	2.3%	4.7%	15.5%	77.0%
Pumping stations	5.9%	11.0%	20.0%	26.1%	36.9%
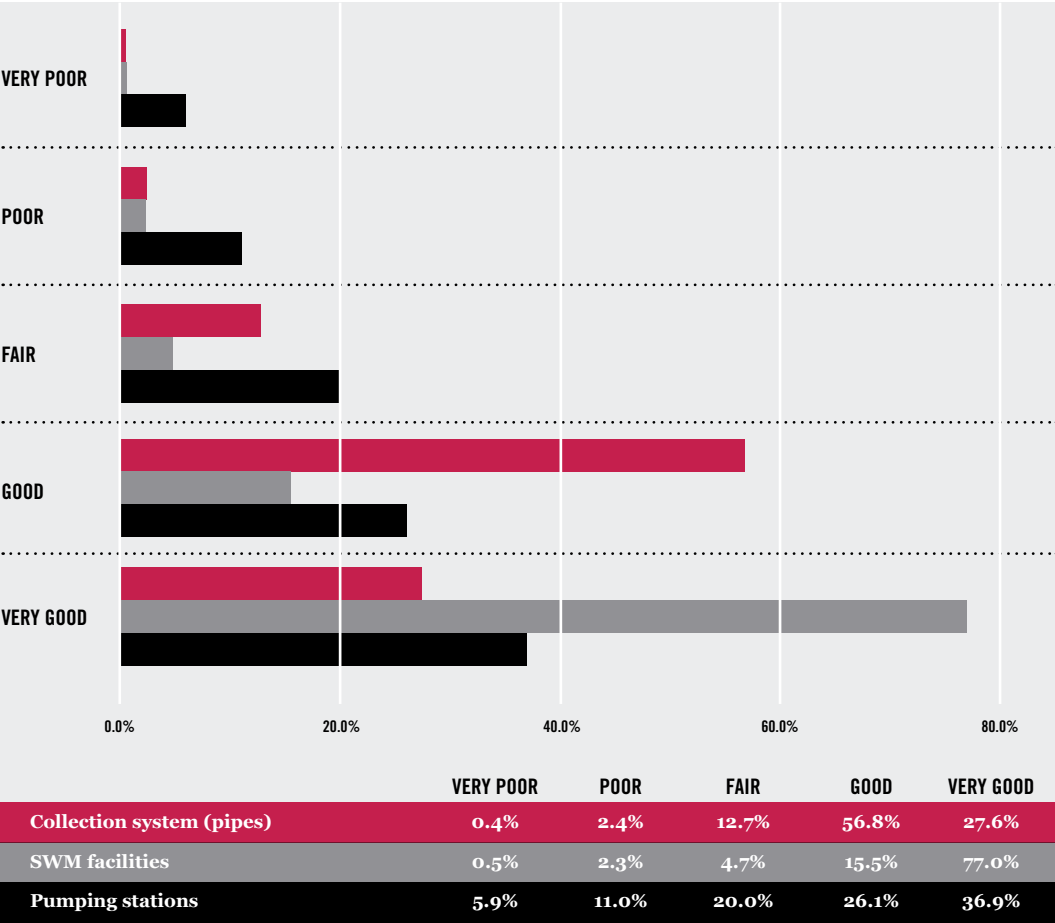
Replacement value of stormwater collection and management systems

The total 2009–2010 replacement value of the assets reported by the 112 municipalities that provided data was $40.8 billion[26]. More than 95% of the total replacement value of the stormwater system was for pipes (local and trunk sewers). The breakdown of asset-replacement values for the various systems' components is shown in the tables below.

Replacement value of stormwater linear assets

Small local	$15,185,615,574
Large local	$21,050,574,326
Trunk	$2,777,041,441
Total	**$39,013,231,340**

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[26] A per capita value for the population served by these stormwater systems cannot be calculated based on the data collected.

Replacement value of stormwater non-linear assets

Pumping stations	$353,814,275
SWM facilities	$1,455,380,958
Total	**$1,809,195,233**

D. MUNICIPAL ROADS

Keep Canada moving with new transit infrastructure

The Long-Term Infrastructure Plan is critical to repairing our aging infrastructure, and it must include transit investment and solutions to fight gridlock, cut commute times, and connect cities to growing markets and new opportunities.

Traffic gridlock in our cities and communities costs the average Canadian 32 working days of lost productivity, costing the national economy over $5 billion each year in congestion and adding to Canada's greenhouse gas emissions. Canadian cities don't have the tools to build and repair modern transit systems on their own, while also building roads and bridges and carrying out new responsibilities, many offloaded by other governments.

The federal government does help to support municipal investment in public transit through the Gas Tax Fund, but the high cost of building modern urban transit systems requires dedicated funding. The Public Transit Capital Trust, Canada's only national source of dedicated transit funding, expired in 2010. A 2012 national survey by the Canadian Urban Transit Association (CUTA) sets the total value of transit infrastructure plans for 2012-2016 at $53.5 billion. Strong commitments by all orders of government mean $40 billion can be drawn from existing funding streams, leaving $13.5 billion to come from new or additional sources.

While the federal government has given high priority to improving transit infrastructure and services over the last decade, more investment is needed to preserve and maintain today's infrastructure and serve a growing number of passengers. Past investments are paying off: public transit ridership rose nearly five% in the first half of 2011. Now Canada needs a national strategy to cut commute times, improve public transit, and bridge gaps in the national transportation system. The federal government must commit to setting concrete targets to cap rising commute times; reinvesting more of our communities' tax dollars in new buses, subways, and commuter rail; and working with municipalities, provinces and territories to fill critical gaps in transportation networks.

Highways, arterials, collectors, local roads and alleys

Fair: Requires attention
The infrastructure in the system or network is in fair condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies.

The infrastructure assets considered in this section relate to the driving surface (with curb and gutter) only and do not include other structures (e.g., bridges, culverts or overpasses) or equipment (e.g., lighting, signage or sidewalks).

Figure 36 – Road network, physical condition

FAIR 32.0%

VERY GOOD 21.8%

GOOD 25.7%   POOR 16.9%   VERY POOR 3.7%
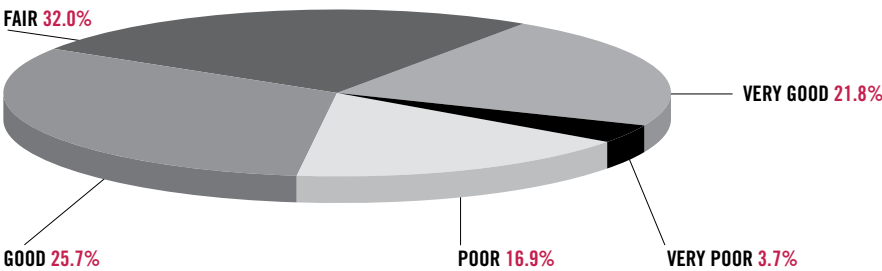
Network summary
The 118 municipalities that provided responses to the roads questionnaire reported a total of 124,383 km (two-lane equivalents) of roads for 2009–2010, serving a population of 16.1 million people. The network is composed of 29% rural and 71% urban roads, broken down as follows:

	Rural (2-lane km)	Urban 2-lane km)
Highways/Expressways	677.1	2,193.0
Arterial	11,644.8	19,019.7
Collector	7,651.7	14,879.2
Local	16,564.6	44,299.1
Alleys		7,453.5
	36,538.1	**87,844.5**

Roads management
Almost half of the respondents indicated using computer-based tools, paper records, or a combination of the two to manage their road networks. Twenty municipalities did not have an asset-management system, while 19 municipalities used other asset-management methods.

As of 2009, these municipalities had assessed the condition of approximately 33% of the roads in their networks. Many of the respondents do not have regular condition-assessment programs: 41.2% reported they do not have an inspection program for their highways, while the percentage dropped to between 20 and 25% for arterials, collectors and local roads.

Figure 37 – Assessment cycle for the road categories reported

	LESS THAN 2 YRS	2 – 4 YRS	GREATER THAN 4 YEARS	NO DATA
Alleys	11.5%	11.5%	35.4%	41.7%
Local	15.6%	26.2%	33.6%	24.6%
Collector	15.5%	36.1%	27.8%	20.6%
Arterial	18.1%	40.4%	21.3%	20.2%
Highways	9.8%	33.3%	15.7%	41.2%
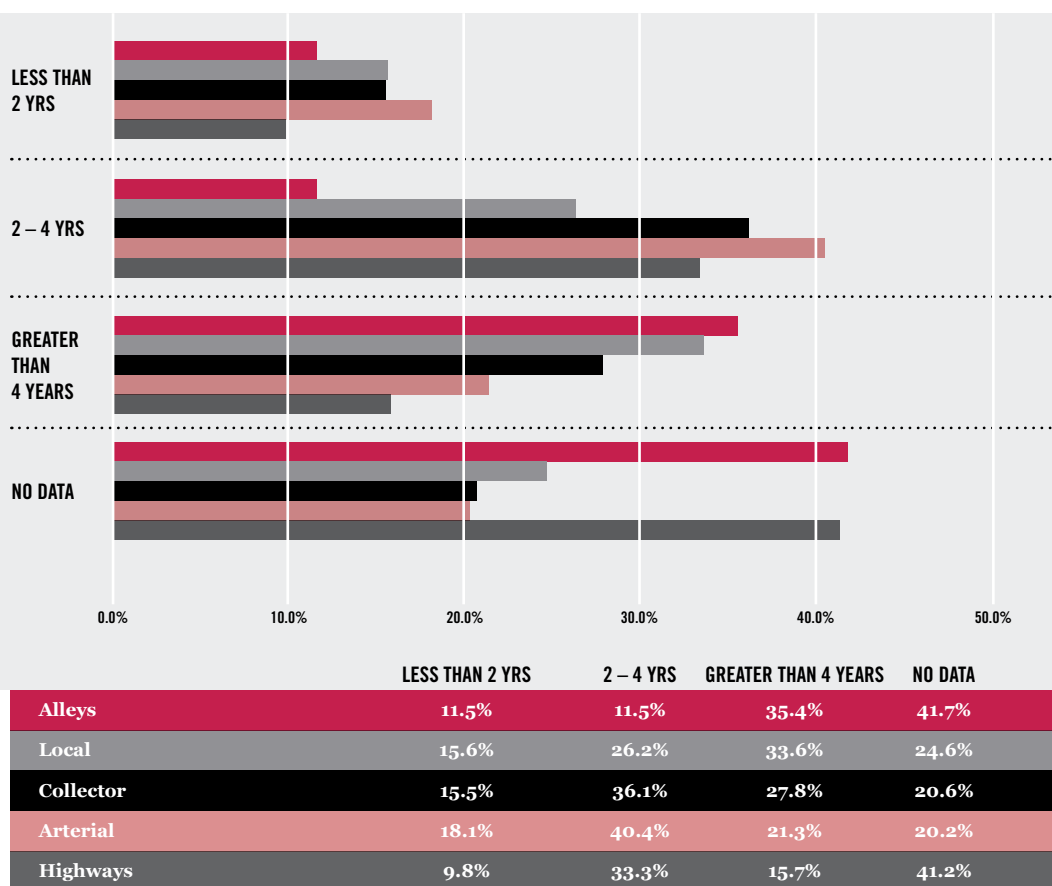
The majority of municipalities with condition-assessment programs use a two-to-four-year inspection cycle on their major roads (highways, arterials and collectors). Local roads and alleys are inspected less often.

Physical condition of the roads

The respondents were asked to rank their road networks from "very good condition" (5) to "very poor condition" (1) using generally accepted industry condition definitions as follows:

Figure 38 – Physical Condition Ratings, Municipal Roads

PHYSICAL CONDITION/STATE	ROADS
5 – Very good	Sound modern structure, operable and well maintained; includes new or like-new assets
4 – Good	Sound modern structure, operable and well-maintained, with minor signs of deterioration; routine refurbishment and maintenance required
3 – Fair	Functionally sound; appearance significantly affected by deterioration
2 – Poor	Deterioration has significant effect on performance of assets; requires significant maintenance to remain operational
1 – Very poor	Serious problems having a detrimental effect on asset performance; will require major overhaul/replacement in the short term.

Overall, the road-network data for the 139 municipalities reporting indicate 52.6% is in fair to very poor condition, while 47.5% is in good to very good condition.

Figure 39 – Percentage of reported road network in each condition category

Percentage of reported road network in each confdition category

VERY GOOD	22%
GOOD	26%
FAIR	32%
POOR	17%
VERY POOR	4%

Typical road degradation curve
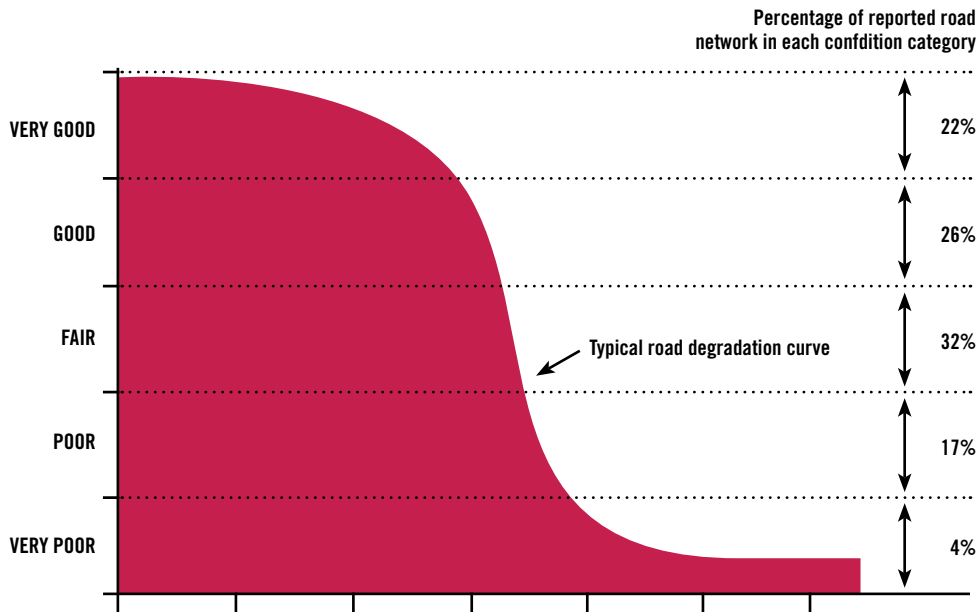
The breakdown by road types is shown in the chart below.

Figure 40 - Physical condition of the road networks reported

	VERY POOR	POOR	FAIR	GOOD	VERY GOOD
Alley	4.8%	17.4%	33.7%	25.3%	18.8%
Local	4.7%	15.4%	33.4%	23.3%	23.3%
Collector	2.7%	18.9%	31.5%	27.5%	19.4%
Arterial	2.3%	17.5%	29.3%	29.1%	21.8%
Municipal highway	2.9%	26.4%	27.2%	27.3%	16.3%
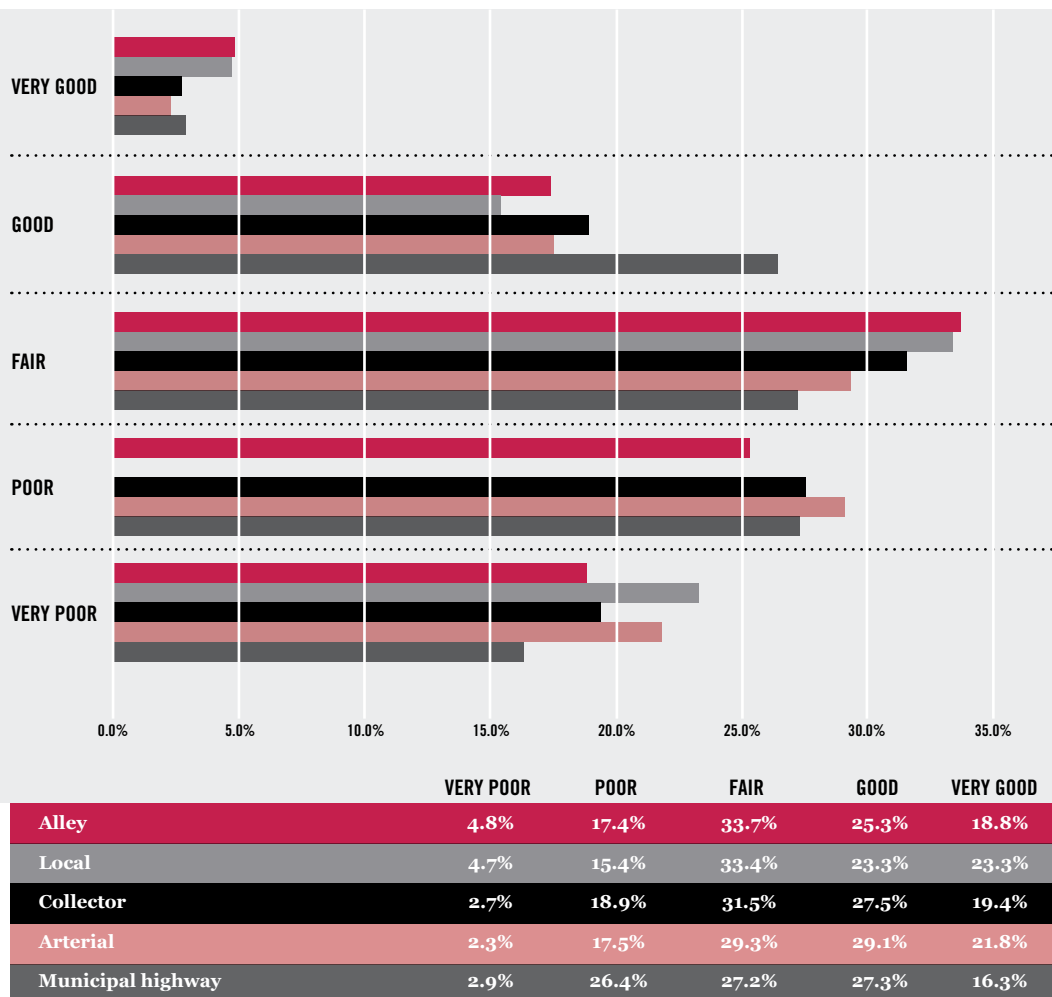
The source of the condition data varies greatly between types of roads assessed and reported. Approximately 35% of the respondents reported using inspection data to assess the condition of their arterials, collectors and local roads, while 13% used inspections to assess the condition of highways.

Municipal staff and others with expertise play an important role in assessing the physical condition of the road networks. Most municipalities use a combination of field inspections (visual or mechanical), operations and maintenance activities, and work by external consultants to assess their road networks.

Capacity of municipal roads to meet demand

Data about road capacity was provided by 94 municipalities out of the 139 that responded to the roads questionnaire. This represents 41,669 km (33.5%) of the total network reported. Only 60% of the municipalities that responded have a process in place to assess capacity/demand.

The respondents used the following rating:

Figure 41 – Demand/Capacity Condition Ratings, Municipal Roads

DEMAND/CAPACITY CONDITION	ROADS
5 – Very good	Demand corresponds well to design capacity; no operational problems experienced
4 – Good	Demand is within design capacity; occasional operational problems experienced
3 – Fair	Demand is approaching design capacity; significant operational problems occur frequently
2 – Poor	Demand exceeds design capacity; significant operational problems are evident
1 – Very poor	Demand exceeds design capacity; operational problems are serious and on-going

In general, respondents that conducted a capacity/demand assessments indicated that 74% of their road networks have good to very good capacity, while 10% have poor to very poor capacity.

The reported capacity of the municipal road networks to meet current demand is adequate. However, a large number of municipalities do not have capacity/demand assessment procedures to evaluate current conditions and predict future conditions.

Figure 42 - Capacity assessment all roads

VERY GOOD 43.0%

GOOD 31.0% FAIR 16.0% POOR 8.0% VERY POOR 2.0%
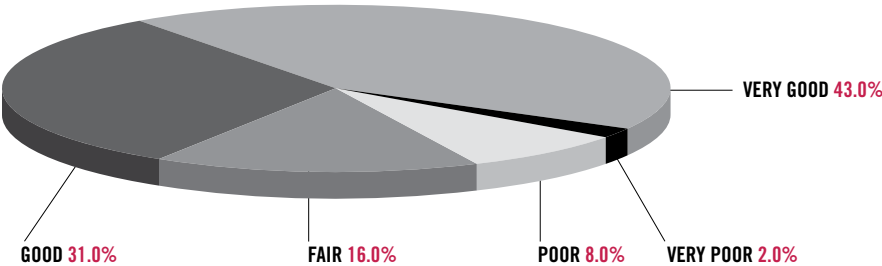
Replacement value of the municipal road networks

The total replacement value of existing roads reported by 86 municipalities, representing a 79,306 km network of (two-lane equivalent) roads, was $82.7 billion in 2010 or $6,300 per capita. Local roads account for almost 40% of this value, while arterials and collectors make up another 38%.

The replacement values of different types of roads (for two-lane equivalents) are shown below (rounded to the nearest $1,000):

	Average (2-lane km)	Median (2-lane km)
Highway	$1, 854,000	$2,063,000
Arterial	$1,095,000	$1,007,000
Collector	$1,002,000	$842,000
Local	$689,000	$583,000
Alley	$436,000	$258,000

VI. METHODOLOGY

A. DATA SOURCES AND COLLECTION

A review of published reports on the state and condition of infrastructure at the local, regional and national levels showed the literature did not contain the type of data and the level of detail needed to produce the intended report card.

The state-of-the-infrastructure reports available from cities; publically available PS 3150 reports; and provincial reports on roads, water or wastewater infrastructure would have limited the geographic and demographic representation of municipalities in the study. The project therefore used a direct survey of municipalities to collect data on the infrastructure assets to be studied.

The survey questionnaire was adapted from the work of the Core Public Infrastructure (CPI) Advisory Committee created by Infrastructure Canada and active from 2008 to 2010. In collaboration with Statistics Canada, this CPI Advisory Committee created a suite of questionnaires on municipal infrastructure.

For the report-card survey, the CPI questionnaires were reviewed and simplified, since this survey was intended to solicit broad input from all Canadian municipalities and not from a sample. The questionnaire was piloted with a limited number of municipalities in 2010 and underwent further modifications before its final release.

The survey was divided into five questionnaires (available for reference at www.CanadaInfrastructure.ca) requesting the following information:

- Financial data from PS 3150 reports
- Roads (excluding bridges)
- Drinking water purification and distribution
- Wastewater collection and treatment
- Stormwater management

Municipalities were asked to provide information for each of the four asset categories related to:

- Management of the assets, including asset-management systems, inspection and condition-assessment practices, and replacement value of the infrastructure
- Current physical condition of the infrastructure
- Capacity of the infrastructure to meet current demand

The figure below provides a sample question for roads.

The figure below provides a sample question for roads.

The figure below provides a sample question for roads.

Figure 43 - Sample question for roads

Using a 1 to 5 rating system, please indicate the percentage of the road network owned by your organization that was in each of the following <u>physical conditions</u> in 2009.

Note that the arterial road category does not include highways/expressways.
Detailed definitions about the 1 to 5 condition rating system can be found in the glossary.

ASSET TYPE	PHYSICAL CONDITION RATING (FOR EACH ASSET TYPE, PERCENTAGES SHOULD TOTAL 100%)						
	1 Very poor (%)	2 Poor (%)	3 Fair (%)	4 Good (%)	5 Very good (%)	Percentage for which assesment not presently possible (%)	Not Applicable (this organization does not own this asset type)
Highways/ expressways							
Arterial							
Collector							
Local							
Lanes and alleys							
Total all roads							

Each questionnaire contained a glossary of key definitions, since consistency in the responses is key to aggregating the individual responses. The terminology followed Canadian or North American industry standards. Where several existed, all were included in the glossary. When no common terminology existed, the report card used generally accepted definitions.

The online survey was the primary tool for municipalities to respond and provide their data; some preferred to complete the questionnaires offline and sent the information to the project team.

The initial call for participation in the survey was issued in December 2010 through the mayors and heads of councils of FCM member municipalities. This was followed in January 2011 by a reminder sent to municipal chief administrators. Parallel to this broad invitation, the other associations of the Project Steering Committee promoted participation in the survey. Efforts were also made to include public utilities that provide municipal services, such as water or wastewater services, for example EPCOR in Alberta.

The initial intent was to close data-collection by March 2011. However, a large number of respondents indicated time constraints and the high level of effort to report their data in the format required. The deadline for responding to the survey was extended to August 2011, with a few late responses arriving in September 2011.

B. ANALYSIS

The data analysis first involved ensuring the database contained consistent information and no obvious data errors. Following are some of the steps taken to clean-up the database before the computations.

- Data gaps: the first step in the analysis was to evaluate the data gaps in the responses and to follow-up with municipalities for additional information or explanations. In some cases, several respondents from the same organization provided information; those individuals were contacted to ensure the proper responses were included in the database.
- Population: the questionnaire requested information on the population served by each of the asset classes. Where there are upper and lower tier municipalities, the upper-tier municipality is used as the population served.
- Population data: Not all municipalities provided population data, so 2006 census data, adjusted based on Canada's 2009 population, was used in the analysis.
- Cross-checking with the financial data: the financial (PS 3150) data was used to verify some of the reported replacement values of assets as well as asset ownership.
- Corrections to units: in a number of cases, municipalities reported some data in units different from those requested; these were converted to the correct units.

The next step consisted in consolidating the results to generate the national results. This step included normalizing the data, which was done differently for linear and non-linear assets:

- For linear assets (pipes, roads), respondents provided the number of kilometres of the asset and percentages of their networks in one of the condition categories (very poor, poor, fair, good, and very good). The contribution of each respondent to the national average is therefore proportional to the number of kilometres of assets owned with respect to the total (national) length.
- For non-linear assets (treatment plants, pumping stations, reservoirs, etc.), the replacement value of the assets was used as the normalization parameter in the analysis.

The calculation of the overall condition rating assigned to an asset category used weighted averages, following a system adapted from the City of Edmonton:

Condition rating	Weight assigned
Very poor	0.2
Poor	0.4
Fair	0.6
Good	0.8
Very good	1.0

The table below illustrates this weighting system applied to hypothetical results.

Figure 44 - Example of the application of weights to physical-condition data: roads

EXAMPLE OF THE APPLICATION OF WEIGHTS TO PHYSICAL CONDITION DATA – ROADS						
Total 2-lane kilometers of roads = 200 km						
	PHYSICAL CONDITION RATING					
	VERY POOR	POOR	FAIR	GOOD	VERY GOOD	PERCENTAGE NOT ASSESSED
Weight	0.2	0.4	0.6	0.8	1.0	
	(% of total km)	(% of total km)	(% of total km)	(% of total km)	(% of total km)	(% of total km)
All roads (unadjusted)	5.0%	15.0%	45.0%	20.0%	10.0%	5.0%
Adjusted percentage (accounting non-assessed roads)	5.3%	15.8%	45.0%	20.0%	10.0%	5.0%
Weighted Average	63.0% used to rate the road network in this example					

C. LIMITATIONS

As indicated earlier, it is unrealistic to expect the report card to provide a completely accurate assessment of the physical and capacity conditions of municipal infrastructure in Canada. Difficulties include the nature of the infrastructure assessed; the broad range of owners and operators; and their varying knowledge of their assets.

The following limitations should be considered when using the report-card results for infrastructure program or policy recommendations.

1. The results provide an assessment of the condition of the infrastructure systems evaluated in 2009–2010. Physical condition alone was used in rating the state of the infrastructure, while the remaining information collected was used to evaluate the state of the practice.
2. With the exception of some population data, only data provided by the owners and operators was used in the study. Some population data was extracted and extrapolated from the 2006 Census of Canada.
3. Depending on infrastructure type, reported condition data comes from physical inspection of the assets or from the knowledge and opinions of qualified individuals within the organization. These individuals are responsible for the delivery of services within their respective organizations.
4. The report card is not a "needs study," since it does not define or suggest acceptable levels of service. Each community has established, explicitly or implicitly, its own levels of service based on financial or social considerations, risk tolerance, and other standards. This study does not intend to establish such levels of service.
5. The report does not assess whether the ratings are adequate or inadequate. Organizations involved in delivering services to the public through these assets will need to assess their adequacy from a number of perspectives. These include short, medium and long-term consequences (economic, social and environmental) if current practices are maintained.
6. The study provides useful qualitative information on the infrastructure and its management. Forecasting trends or future conditions is not part of this study.
7. The only statements included in the report card regarding the condition and management of the infrastructure surveyed are those supported by data. Many comments were received from respondents about their infrastructure or management practices. These comments remain confidential, since the intent is to provide a national picture of Canadian municipal infrastructure and not focus on particular municipalities.
8. Finally, this report presents an analysis of the best information available at the time it was produced. Several valuable lessons were learned throughout the process and these are discussed in the Lessons Learned chapter.

D. DEFINING THE RATING SCALE

Consolidating the condition of a system or network of assets into one rating parameter involved the choice and definition of a rating scale.

The Report Card Advisory Board reflected on the choice and definition of the rating scale for the municipal assets under study. These assets are part of a system or network, and the rating is used to consolidate all data into a single parameter. Under good asset-management practices and best use of resources (financial, human and material), there should be a distribution of assets in the network that fall under the various condition categories. The statements below consider these distributions.

Figure 45 - Definition of the rating used in the report card
 (physical condition only)

WEIGHTED AVERAGE	DEFINITION OF THE RATING USED IN THE REPORT CARD (PHYSICAL CONDITION ONLY)
≥ 80%	*Very good: Fit for the future* The infrastructure in the system or network is generally in very good condition, typically new or recently rehabilitated. A few elements show general signs of deterioration that require attention.
70% to 80%	*Good: Adequate for now* The infrastructure in the system or network is in good condition; some elements show general signs of deterioration that require attention. A few elements exhibit significant deficiencies.
60% to 69%	*Fair: Requires attention* The infrastructure in the system or network is in fair condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies.
50% to 59%	*Poor: At risk* The infrastructure in the system or network is in poor condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration.
< 50%	*Very poor: Unfit for sustained service* The infrastructure in the system or network is in unacceptable condition with widespread signs of advanced deterioration. Many components in the system exhibit signs of imminent failure, which is affecting service.

The above ratings used only physical-condition data. Analysis of capacity/demand data showed most respondents did not have processes in place to measure this variable.

VII. LESSONS LEARNED

This is the first report card on the state of municipal infrastructure in Canada, and the first in any country based solely on a survey of owners and operators. As with any pioneering effort, the process produced a number of lessons, which are described below.

A. DATA REQUIREMENTS

Not all municipalities had the data requested or had it but not in the format required. Many municipalities do not aggregate information on infrastructure components to present a system and/or network view and did not contribute to the report card.

The glossaries in each section of the questionnaires were useful but need more detail. There is also a lack of uniformity in definitions across the country. National guidelines may exist for some infrastructure classes or components, but these are not used consistently.

The questions requiring data on capacity to meet demand need to be improved. Capacity is an important element of an infrastructure system's overall performance. However, the data collected was not useful for rating this performance measure. Future report cards should revise this section of the questionnaire.

Financial information from PS 3150 reports was used to cross-check information from other sections of the questionnaires. This data may have other uses.

B. DATA COLLECTION

The online survey was preferred by the majority of municipalities responding. Some provided data through paper copies, faxes or scanned questionnaires. The survey tool will need to be refined to improve ease of use, additional cross-checking capabilities, and narrower or more rigorous data fields.

The amount of time required to complete the survey and the time of year it is administered are important considerations. Although the survey questionnaires were refined based on comments from some municipalities before the broad call for participation, responding to such an extensive survey requires time and effort.

The call for participation was issued mainly through municipal Heads of Council and CAOs, with further invitations through professional associations. To increase participation in future report cards, this top-down approach should be supplemented by a bottom-up approach through public works, engineering and other operational departments.

For a first report card, the representation (on a population, demographic and geographical basis) is beyond the expectations of the Project Steering Committee. However, this could be improved by targeted solicitation to key municipalities to ensure better representation.

C. ANALYSIS

With improved questionnaires, data-analysis automation should also be developed through "for example" templates and other database tools. Consideration should be given to the use of commercially available asset-management software that could be adapted to the analysis required to produce the report card.

The analysis was done at the national level. The potential for regional report cards, whether based on the current data or for future projects, should be explored.

In future and as additional types of infrastructure are added, the planned organizational structure will be required. For this report card, the regional networks and expert working groups were not formally defined, and only ad-hoc discussions were held with some of the participants. Future projects will need to establish an organizational structure and engage in official discussions with regional networks and expert working groups.

The role of the Report Card Advisory Board (RCAB) was crucial, providing guidance throughout the project. Although many key stakeholder organizations participated in the RCAB, other organizations may need to be identified and invited to participate, particularly if the scope of the report card is expanded to include other infrastructure types.

Considering the challenges of this first report card, the process and the results provide a strong foundation for future efforts. Refinements to the existing questionnaires for drinking water, wastewater systems, stormwater management, and roads will generate a more accurate representation of these assets in the next round of reporting. Other types of infrastructure assets, such as bridges, buildings, facilities, public transit and possibly privately owned public infrastructure, such as ports and airports, could be added to future editions.

D. ADDITIONAL CONSIDERATIONS

The data and information used to estimate the state of municipal infrastructure in Canada, while being the first of its type available, must be qualified in light of the primary purpose of this first survey: the national response rate and the survey methodology.

1. The survey was voluntary and did not target a particular sample of municipalities in soliciting responses. However, throughout the process, the study team tracked the representation of municipalities from various regions and of different demographics. Municipalities in groups with low representation were encouraged to participate. The final analysis relied on responses by 123 municipalities distributed across all provinces. These municipalities represented from 40.7% to 59.1% of the Canadian population, depending on the infrastructure assets considered. This representation supported extrapolating the sample to provide a national estimate.
2. The advisory board recognized a risk of bias inherent in the survey methodology. The survey was voluntary and did not target a particular sample of municipalities. It is possible that those municipalities that responded to the survey and provided the data used to estimate the national infrastructure condition have more mature infrastructure-management systems and may be more proactive in managing and maintaining their infrastructure. If this were true, extrapolating the survey results to the national level could overstate the condition of municipal infrastructure across the country.
3. The national survey methodology recognized that many communities are at different levels of maturity and sophistication in assessing the condition of their infrastructure. The survey addressed this issue by allowing respondents to qualify the source of their condition information to reflect different levels of rigour.

The long-term goal of a mature infrastructure asset-management system is to provide repeatable and auditable evaluation of infrastructure condition and investment needs. We encourage infrastructure owners to establish asset-management plans based on infrastructure life-cycle assessments that consider rates of deterioration and community service levels. We expect that, as this report card is repeated, a higher percentage of municipalities will participate and the results will be more representative.

VIII. CONCLUSIONS

Canada's first report card on municipal infrastructure provides an objective assessment of the state of infrastructure and the state of infrastructure management in 123 municipalities. The report offers an assessment of the state of performance for four primary municipal-infrastructure asset categories: drinking-water systems, wastewater and stormwater networks, and municipal roads. This report card is the first of its kind in Canada, and represents the most comprehensive work to date to analyze and report on Canada's municipal infrastructure.

The report is also well timed. Following two decades of declining public investment in infrastructure, all governments have begun to reverse this trend by significantly increasing investments into the roads and water systems upon which Canadians rely.

The importance of investing in modern infrastructure has become synonymous with our country's economic competitiveness and quality of life. The recent financial crisis saw all orders of government pooling resources and cooperating to an unprecedented level— channeling stimulus funds into local infrastructure to create jobs, while also renewing the country's physical foundations.

The Building Canada Plan will soon expire, casting a shadow over recent progress made in addressing Canada's municipal infrastructure needs. This report highlights how critical it is to continue building and renewing the infrastructure that is key to our continued economic vitality as a country.

The Results
As one would hope to find, the municipalities surveyed generally reported having basic water and wastewater infrastructure in good enough physical condition to meet current public needs and minimum performance standards. The single category in which municipalities reported having infrastructure in the best overall physical condition – stormwater management – was also the smallest category studied.

Despite some reassuring findings, however, the Report Card's results are no reason for complacency. In fact, a close examination of the data supplied by the participating 123 municipal governments reveals troubling trends in the condition and management of Canada's most essential public assets.

Fair to Poor Infrastructure

Firstly, based on the survey responses, the overall report card ratings for the four asset categories show a significant amount of municipal infrastructure falling between "fair" and "very poor": on average about 30%. The replacement cost of these assets alone totals $171.8 billion nationally.

The report indicates that municipal roads urgently require attention. An overall grade of "Fair" means that the infrastructure "shows general signs of deterioration and requires attention, with some elements exhibiting significant deficiencies." More than half the roads surveyed fall below "good" condition: 32% are in "fair" condition and 20.6% are in "poor" to "very poor" condition, for a total of 52.6%. In addition, the report finds that one in four roads in Canada is operating above capacity, highlighting a real challenge to moving goods and people within our communities in the short and medium term. The replacement cost of the roads in fair to very poor condition is $91.1 billion. For the average Canadian household, this amounts to a cost of $7,325.

A mixed picture emerges for wastewater infrastructure, with 40.3% of wastewater plants, pumping stations and storage tanks in "fair" to "very poor" condition, and 30.1% of pipes in "fair" to "very poor" condition. The replacement cost for the wastewater infrastructure in "fair" to "very poor" condition is $39 billion, or $3,136 per Canadian household. With wastewater infrastructure now subject to new and more stringent federal regulations, even robust wastewater infrastructure may require upgrading or replacement.

Despite its overall "good" rating, drinking-water infrastructure also presents some cause for concern: 15.4% of the systems were ranked "fair" to "very poor" in the condition of their pipes. The figures were not much better for plants, reservoirs and pumping stations, where 14.4% were ranked "fair" to "very poor". Only 12.6% of plants, reservoirs and pumping stations were ranked "very good", as were just 4.2% of the pipes. Considering the potential impact of drinking-water systems on human health, these deficiencies take on significant importance. The replacement cost for the drinking-water infrastructure in "fair" to "very poor" condition is $25.9 billion, or $2,082 per Canadian household.

Canada's stormwater management systems are in the best shape of the infrastructure classes covered in the report card. These were rated "very good". Even here, however, 12.5% of surveyed stormwater installations fall below "good" condition, with that figure rising to 23.4% for storm-water pipes. The replacement cost for the stormwater infrastructure in "fair" to "very poor" condition is $15.8 billion, or $1,270 per Canadian household.

A Penny Now, or a Dollar Later

The report card points to the cost of delaying infrastructure repairs, rehabilitation or renewal. It suggests that, under current practices (investment, operations, maintenance), most infrastructure, even if in good-to-very-good condition now, will require ever-increasing investment as it ages.

The report card emphasizes the importance of having an asset-management system in place, in order to establish practices that will increase the longevity of the assets and optimize investments in maintenance and rehabilitation.

Needs Improvement: The State of Asset Management in Canada

Thirdly, when assessing the state of municipal-infrastructure management, the report card suggests that many municipalities lack the internal capacity to assess the state of their infrastructure accurately on their own. This is not to say that the municipal sector lacks the wherewithal to undertake rigorous internal reviews of their assets; rather, that finite financial resources, staff and time preclude a much more thorough, real-time evaluation of the state and performance of their physical infrastructure.

For example, an average 30% of respondents had limited data on their water treatment plants, reservoirs or pumping stations. A large percentage of municipalities reported having no data on the condition of their buried infrastructure: 41.3% for distribution pipes, and 48.2% for transmission pipes. While it is clear that municipalities monitor the quality of their drinking water through rigorous testing and monitoring, evaluating the physical condition of their treatment plants and buried distribution networks remains a significant, on-the-ground challenge for many municipalities to undertake on their own.

For roads, many respondents do not have regular condition-assessment programs: 41.2% reported that they do not have an inspection program for their highways, while the percentage dropped to between 20–25% for arterial, collector and local roads. Capacity data for roads was provided by 94 municipalities out of the 139 that responded to the roads questionnaire. Only 60% of these municipalities have a capacity/demand assessment process. The need for supporting additional capacity at the municipal level is a crucial finding of this report in all four asset categories covered herein.

The report card emphasizes the importance of having an asset-management system in place, in order to establish practices that will increase the longevity of the assets and optimize investments in maintenance and rehabilitation.

The long-term goal of a mature infrastructure asset-management system is to provide repeatable and auditable evaluation of infrastructure condition and investment needs. Infrastructure owners are encouraged to establish asset-management plans, based on infrastructure life-cycle assessments that consider rates of deterioration and community-service levels.

First Steps

This first report card on Canada's municipal infrastructure reveals the challenges inherent in arriving at an accurate picture of the state of our infrastructure and assessing its condition—both of which are essential to the sound management of infrastructure assets.

This document also demonstrates the need for national efforts to assess the condition of all infrastructure; determine investment needs based on that assessment and accepted standards; and make infrastructure investments in the most efficient and cost-effective way possible.

Infrastructure is the foundation of our society and our economy. The hidden costs of deteriorating, outdated and under-performing infrastructure—to human welfare, property, and economic activity—are too great to be ignored. Whether acknowledged or not, these costs will continue to grow as infrastructure ages and deteriorates. This report card is a first step towards acquiring the data needed to manage infrastructure as the vitally important asset it is.

APPENDIX

The following municipalities and administrative jurisdictions provided the data used
in this report card:

British Columbia
- Capital Regional District
- City of Abbotsford
- City of Burnaby
- City of Chilliwack
- City of Coquitlam
- City of Dawson Creek
- City of Fort St. John
- City of Kamloops
- City of Langley
- City of Nelson
- City of New Westminster
- City of North Vancouver
- City of Prince George
- City of Surrey
- City of Vancouver
- Comox Valley Regional District
- District of Lake Country
- District of North Vancouver
- District of Saanich
- District of Sicamous
- Peace River Regional District
- Regional District of East Kootenay
- Township of Langley
- Village of Cache Creek
- Village of Salmo
- Village of Telkwa

Alberta
- City of Calgary
- City of Camrose
- City of Edmonton
- City of Lethbridge
- City of Medicine Hat
- City of Red Deer
- City of Spruce Grove
- City of St Albert
- City of Wetaskiwin
- County of Grande Prairie
- Cypress County
- Kneehill County
- Municipal District Foothills N°.31
- Regional Municipality of Wood Buffalo
- Town of Blackfalds
- Town of Canmore
- Town of Chestermere
- Town of Cochrane
- Town of Didsbury
- Town of High Level
- Town of Okotoks
- Village of Hines Creek

Saskatchewan
- City of Prince Albert
- City of Regina
- City of Saskatoon
- Rural Municipality of Grandview Nᵒ. 349
- Rural Municipality of Laurier Nᵒ. 38
- Rural Municipality of Moose Range Nᵒ. 486
- Town of Grenfell
- Town of Kindersley
- Town of Lumsden
- Town of Wynyard
- Village of Frontier
- Village of St. Louis

Manitoba
- City of Selkirk
- City of Winnipeg
- Rural Municipality of Alexander
- Rural Municipality of Dufferin
- Rural Municipality of Grandview
- Rural Municipality of Miniota
- Town of Stonewall
- Town of Winnipeg Beach
- Village of McCreary

Ontario
- City of Burlington
- City of Greater Sudbury
- City of Guelph
- City of Hamilton
- City of Kawartha Lakes
- City of Kitchener
- City of London
- City of Mississauga
- City of Oshawa
- City of Ottawa
- City of Toronto
- City of Waterloo
- City of Welland
- City of Windsor
- County of Elgin
- Lanark County
- Municipality of Chatham-Kent
- Municipality of Red Lake
- Northumberland County
- Regional Municipality of Halton
- Regional Municipality of Peel
- Regional Municipality of York
- Town of Bradford West Gwillimbury
- Town of Halton Hills
- Town of Markham
- Town of Oakville
- Township of Champlain
- Township of Montague
- Township of Woolwich
- United Counties of Leeds & Grenville

Quebec
- Municipalité de Sainte-Agathe de Lotbinière
- Municipalité de Sainte-Justine de Newton
- Municipalité de Sainte-Sabine
- Municipalité Saint-Pierre de Véronne à Pike River
- Municipalité Sainte-Hélène de Mancebourg
- Village de Pointe-Fortune
- Ville de Laval
- Ville de Lévis
- Ville de Montréal
- Ville de Saguenay
- Ville de Sainte-Anne de Bellevue
- Ville de Sherbrooke

New Brunswick
- City of Bathurst
- City of Moncton

Nova Scotia
- Municipality of Colchester
- Municipality of East Hants
- Town of Kentville
- Town of Mulgrave
- Town of Shelburne

Prince Edward Island
- City of Charlottetown
- City of Summerside
- Town of Montague

Newfoundland and Labrador
- Town of Conception Bay South
- Town of Gander