MUNICIPAL INFRASTRUCTURE
ASSET MANAGEMENT

A BEST PRACTICE BY THE NATIONAL GUIDE
TO SUSTAINABLE MUNICIPAL INFRASTRUCTURE
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INTRODUCTION
INFRAGUIDE – INNOVATIONS AND BEST PRACTICES

Why Canada Needs InfraGuide

Canadian municipalities spend $12 to $15 billion annually on infrastructure but it never seems to be enough. Existing infrastructure is aging while demand grows for more and better roads, and improved water and sewer systems responding both to higher standards of safety, health and environmental protection as well as population growth. The solution is to change the way we plan, design and manage infrastructure. Only by doing so can municipalities meet new demands within a fiscally responsible and environmentally sustainable framework, while preserving our quality of life.

This is what the National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices (InfraGuide) seeks to accomplish.

In 2001, the federal government, through its Infrastructure Canada Program (IC) and the National Research Council (NRC), joined forces with the Federation of Canadian Municipalities (FCM) to create the National Guide to Sustainable Municipal Infrastructure (InfraGuide). InfraGuide is both a new, national network of people and a growing collection of published best practice documents for use by decision makers and technical personnel in the public and private sectors. Based on Canadian experience and research, the reports set out the best practices to support sustainable municipal infrastructure decisions and actions in six key areas: 1) municipal roads and sidewalks 2) potable water 3) storm and wastewater 4) decision making and investment planning 5) environmental protocols and 6) transit. The best practices are available on-line and in hard copy.

A Knowledge Network of Excellence

InfraGuide’s creation is made possible through $12.5 million from Infrastructure Canada, in-kind contributions from various facets of the industry, technical resources, and the collaborative effort of municipal practitioners, researchers and other experts, and a host of volunteers throughout the country. By gathering and synthesizing the best Canadian experience and knowledge, InfraGuide helps municipalities get the maximum return on every dollar they spend on infrastructure – while being mindful of the social and environmental implications of their decisions.

Volunteer technical committees and working groups – with the assistance of consultants and other stakeholders – are responsible for the research and publication of the best practices. This is a system of shared knowledge, shared responsibility and shared benefits. We urge you to become a part of the
InfraGuide Network of Excellence. Whether you are a municipal plant operator, a planner or a municipal councillor, your input is critical to the quality of our work.

Please join us.

Contact InfraGuide toll-free at 1-866-330-3350 or visit our Web site at www.infraguide.ca for more information. We look forward to working with you.
ACKNOWLEDGEMENTS

The dedication of individuals who volunteered their time and expertise in the interest of the National Guide to Sustainable Municipal Infrastructure is acknowledged and very much appreciated.

This best practice was developed by stakeholders from Canadian municipalities and specialists from across Canada, based on a working paper prepared by five consulting firms (R.V. Anderson Associates Limited, CH2M HILL Canada, Dillon Consulting, Earth Tech, and Stantec Consulting). The following members of the National Guide’s Decision-Making and Investment Planning Technical Committee provided guidance and direction in the development of this best practice. They were assisted by the Guide Directorate staff and by R.V. Anderson Associates Limited.

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Acknowledgements

This and other best practices could not have been developed without the leadership and guidance of the Project Steering Committee and the Technical Steering Committee of the National Guide to Sustainable Municipal Infrastructure, whose memberships are as follows:

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EXECUTIVE SUMMARY

This document describes the fundamental concepts, components and considerations inherent in the establishment of an asset management plan as a municipal best practice. It is towards such establishment that this document is intended to inspire elected officials and senior appointed officials and administrators. Accordingly, the rationale for establishing asset management as a fundamental municipal business process may become endemic to municipal infrastructure management. Asset management has been described as “a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus asset management provides a framework for handling both short- and long-range planning” (US, DOT, 1999).

Canadian municipalities are beginning to realize that an asset management plan will be required to address the rising costs for, and competing priorities associated with, infrastructure renewal programs. An asset management plan is also required to address public demands for a higher level of service, more stringent regulations, population changes, limited financial resources, competition, and technology. Some benefits and risks of implementing an asset management program are described in Section 2.

KEY PRINCIPLES

Asset management is characterized by several key principles, including asset value, life cycle management, long-term affordability, risk management and assessment, performance measurement, and integration of technical and financial plans.

Two complementary approaches are used to develop an asset management plan, namely, a senior-directed approach and an operational approach. The senior-directed approach is used for strategic long-term planning of policies and programs. The operational approach is used for short-term capital planning of projects. The operational approach requires a more detailed inventory and condition data than the senior-directed approach.

ESSENTIAL ELEMENTS

The framework for an asset management plan can be described in terms of seven questions.

1. What do you have and where is it?

2. What is it worth?

3. What is its condition and expected remaining service life?
4. What needs to be done?

5. When do you need to do it?

6. How much will it cost?

7. How do you ensure long-term affordability?

This framework is applicable to both the senior-directed and operational approaches.

**IMPLEMENTATION NEEDS**

Implementation of an asset management plan requires people, information, and technology. A business plan should be prepared prior to the implementation of an asset management plan to clearly outline the expected costs directly related to preparing and implementing the plan, and benefits expected to be realized from implementation.

An implementation plan should identify the short- and long-term objectives of asset management, a work plan, roles and responsibilities, schedule and budget for various milestones, and the deliverables. This best practice identifies several challenges that municipalities must overcome to implement an asset management plan successfully, including institutional, technical, and funding challenges. Several key initiatives and emerging trends in asset management are described: the Civil Infrastructure Systems Technology Road Map, the Municipal Infrastructure Investment Planning project, benchmarking, technology tools, regulations, public–private partnerships, and continuous improvement.

**SUCCESSFUL IMPLEMENTATIONS**

This report summarizes several successful implementations of asset management in Canadian municipalities. The application of asset management in small and remote municipalities is discussed in Section 4. As well, several methods are identified to evaluate the effectiveness of asset management in Section 5.
1. GENERAL

1.1 INTRODUCTION
In the past, most Canadian municipalities focused on expansion of their infrastructure (e.g., roads, bridges, sewers, water mains, and buildings) to support population growth. However, many municipalities are now beginning to realize that the cost for renewal of their ageing infrastructure is increasing. As a result, municipalities should recognize the need to manage their infrastructure as “assets” so they can maintain an adequate level of service at the lowest possible cost.

Asset management is not a new concept. It has been widely used for many years in real estate, property management, finance, manufacturing, information technology, and other areas of private industry. However, in these cases, the assets are usually more easily converted into money and have a shorter life expectancy than is the case with municipal infrastructure. At the same time, abandoning or eliminating the asset at the end of its life is not an option for municipal infrastructure. Furthermore, private companies are typically motivated by profit whereas basic civil infrastructure to the public has been a key responsibility of municipalities. Nevertheless, the fundamental asset management concepts are still applicable to municipal infrastructure.

Municipal infrastructure requires ongoing investment to sustain it. In other words, it should be recognized that municipal infrastructure has monetary value and its components will not last forever.

The Federal Highway Administration (US, DOT, 1999) describes asset management as “a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus asset management provides a framework for handling both short- and long-range planning.”

In other words, asset management should help municipalities identify the right amount of money to be spent on the right things, at the right time. Asset management should be viewed as a “way of doing business” and not simply as another program requiring another new bureaucracy.

1.2 PURPOSE AND SCOPE
1.2.1 PURPOSE
This report is intended to provide infrastructure managers, elected officials, and technical staff in municipalities with sufficient information so they can recognize the need to develop an asset management plan. The rationale for establishing asset management as an intrinsic aspect of the municipal strategic and business process will become apparent. A related objective is the development of an
appreciation among elected officials of their role as stewards of infrastructure assets and their related service for both current voters as well as the future. It is not intended to be a guide for the development of an asset management plan or for the implementation of an asset management system. References are provided throughout this report where additional information can be obtained.

1.2.2 SCOPE

The report provides an overview of the components of a municipal infrastructure asset management plan, in order to inspire elected officials and senior appointed officials and administrators to formulate and implement a plan customized for their own municipalities. Components of a municipal infrastructure asset management plan include the following issues:

- Key principles;
- Essential elements;
- Data collection;
- Implementation needs;
- Successful implementations;
- Emerging trends; and
- Application in small and/or remote municipalities.

1.3 HOW TO USE THIS DOCUMENT

Section 2 presents some background on asset management plans as well as the potential benefits and risks associated with their implementation.

Section 3 presents a framework for an asset management plan.

Section 4 presents some considerations for implementation of an asset management plan.

Section 5 describes several measures that can be used to evaluate the effectiveness of asset management. References are provided throughout this document for additional information on specific issues.

Readers should be aware that before release of this document, InfraGuide has already published several other best practice reports that are relevant to municipal infrastructure asset management, a sampling includes:
Developing a Water Distribution System Renewal Plan – This document outlines two complementary approaches for the development of a water distribution system renewal plan. The senior-directed approach is used for strategic planning of policies and programs whereas the operational approach is used for short-term capital planning of projects. Both approaches use a common framework although they differ in terms of the level of detail. Examples are provided to illustrate the application of both approaches. A renewal plan is a key component of an asset management plan.

Municipal Infrastructure Reinvestment Parameters and Their Applications – This document describes four practices that can be used to achieve adequate levels of investment in municipal infrastructure. These methods include an infrastructure asset report model, high-level parameters, detailed level parameters, and improved communication.

Planning and Defining Municipal Infrastructure Needs – This document presents five practices to assist with planning and defining municipal infrastructure needs, namely, strategic planning, information management, building public support and acceptance, exploring new and innovative methods for continuous improvement, and prioritization models.

An Integrated Approach to Assessment and Evaluation of Municipal Road, Sewer, and Water Networks – This document outlines the need for integrated renewal planning of municipal road, sewer, and water systems at a network level. This report describes a five-step procedure for assessment and evaluation of municipal infrastructure, including inventory, investigation, condition assessment, performance evaluation, and renewal planning.

Additional best practice reports and other documents related to this subject are available from the InfraGuide’s Web site <www.infraguide.gc.ca>.
1.4 GLOSSARY

Pursuant to the InfraGuide Glossary:

**Asset** — A physical component of a facility, which has value, enables services to be provided and has an economic life of greater than 12 months. Dynamic assets have some moving parts, while passive assets have none.

**Asset management** — The combination of management, financial, economic, engineering, and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner.

**Asset management plan** — A plan developed for the management of one or more infrastructure assets that combines multidisciplinary management techniques (including technical and financial) over the life cycle of the asset in the most cost effective manner to provide a specified level of service. A significant component of the plan is a long-term cash flow projection for the activities.

**Asset management strategy** — A strategy for asset management covering the development and implementation of plans and programs for asset creation, operation, maintenance, rehabilitation/replacement, disposal and performance monitoring to ensure that the desired levels of service and other operational objectives are achieved at optimum cost.

**Infrastructure** — The term as used in InfraGuide refers to roads and sidewalks, potable water, wastewater, stormwater, and transit.

**Level of service** — The defined service quality for a particular activity or service area against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability, and cost.

**Life-cycle costing** — A method of expressing cost, in which both capital costs and operations and maintenance costs are considered, in comparing different alternatives. “Present worth” is one way to express life cycle costs. The present worth represents the current investment that would have to be made at a specific discount (or interest) rate to pay for the initial and future cost of the works.

**Rehabilitation** — Works to rebuild or replace parts or components of an asset, to restore it to a required functional condition and extend its life, which may incorporate some modification. Generally involves repairing the asset to deliver its original level of service without resorting to significant upgrading or renewal, using available techniques and standards.
**Replacement** — The complete replacement of an asset that has reached the end of its service life, to provide an alternative that satisfies a targeted level of service.

**Reinvestment** — Funds allocated to capital projects that are rebuilding the existing municipal infrastructure asset base. Investment for operation and maintenance and new infrastructure are excluded from the infrastructure reinvestment decision.

**Service life** — The period of time that an asset provides an acceptable level of service. The economic service life is defined as the period when the present worth of the future maintenance costs are equal to the present worth of its replacement.

## RATIONALE

### 2.1 BACKGROUND

Historically, many Canadian municipalities have used a reactive approach to manage their municipal infrastructure. Although many municipalities have implemented pavement management systems, most municipalities do not have asset management plans for their water and sewer systems. Typically, these systems have a longer service life than roads, and their condition is not as apparent as roads — water and sewer systems are “out-of-sight and therefore out-of-mind.” Furthermore, only a few municipalities have an integrated asset management plan for their road, sewer, and water systems.

The following paragraphs describe some of the factors that are prompting municipalities to manage infrastructure proactively.

### 2.1.1 AGEING INFRASTRUCTURE

In Canada, some municipal infrastructure is over 100 years old and has reached the end of its service life. In addition, most Canadian municipalities experienced significant population growth in the two decades following World War II (i.e., baby boomers) and the proportional increase in municipal infrastructure. As this infrastructure reaches the end of its service life, the reinvestment in infrastructure renewal will have to increase accordingly to address the echo from the investment in infrastructure in the two decades following World War II.

### 2.1.2 PUBLIC DEMANDS FOR HIGH LEVELS OF SERVICE

The Canadian public demands higher levels of service from their municipalities. The public is also becoming less tolerant of such things as water supply interruptions, potholes in roads, and sewer backups. Consequently, municipalities will need to quantify the impacts on the costs of providing a high level of service.
2.1.3 More Stringent Regulations
All levels of government are increasingly implementing more stringent regulations related to public health and safety, the environment, and financial issues. For example, new regulations to define more stringent water quality criteria for drinking water as well as wastewater and stormwater discharges will require additional investment in municipal infrastructure.

2.1.4 Population Growth/Decline
Municipalities need to balance their investment in terms of population growth or decline. Many municipalities rely on the additional revenue generated from population growth to cover some of the costs for renewal of older infrastructure. However, this approach is not sustainable. In those cases where a municipality is experiencing a decline in its population and revenue base, efforts must be made to maintain only those essential services and to decommission those no longer needed to provide a given level of service to the community.

2.1.5 Liability/Risk Management
Municipalities are self-insured and need to exercise and demonstrate an acceptable degree of due diligence in their infrastructure stewardship role. In some cases, “minimum” service standards are being set by provincial governments which can be used as a test of due diligence in cases of litigation.

2.1.6 Limited Financial Resources
Demands for public money (i.e., taxes and utility fees) are increasing as the cost for social programs and hard services increases across Canada. In some cases, taxes and user rates have not increased sufficiently to compensate for inflation, increased maintenance responsibilities, or new facilities. Furthermore, some municipalities have borrowed money to cover the capital cost for municipal infrastructure, and the high cost for debt repayment has limited their ability to undertake other major renewal programs. Grants from senior levels of government have dwindled in recent years for infrastructure programs as the competition for funding has grown.

2.1.7 Increased Accountability
The Canadian public is becoming more demanding of governments in terms of accountability and transparent decision-making. Governments should have a long-term plan for their infrastructure that quantifies the relationship between the level of service and the cost of the service. Mandatory benchmarking helps municipalities determine efficiency and effectiveness.

2.1.8 Competition
As the global economy continues to evolve, there will be an increasing number of private companies who can provide a myriad of services that have traditionally been provided by municipalities.
2.1.9 TECHNOLOGY

Significant advances in technology improve the ability of municipalities to compile detailed inventories of their infrastructure, analyze the asset condition, evaluate renewal alternatives, and project the renewal needs.

2.1.10 CANADIAN INITIATIVES

To date, there have been few, if any, Canadian standards or guidelines for municipal infrastructure asset management. In 2002, the Canadian Institute of Chartered Accountants (CICA) conducted a study to explore the alternatives for accounting and financial reporting of infrastructure as assets and determine other asset information that could be provided by governments (CICA, 2002). Further to this, the Public Sector Accounting Board of CICA recommends that senior levels of government adopt accrual-based private sector accounting practices for financial reporting purposes. This involves the capitalization and depreciation of tangible capital assets rather than the practice of expensing items.

In 2002, the Ontario government passed Bill 175 (Sustainable Water and Sewage Systems Act). This Act makes it mandatory for Ontario municipalities to assess and report on the full costs of providing water and sewage services, and then to prepare and implement plans for recovering these costs. Similar legislation may be enacted in other parts of Canada over time. At the time of publishing this report, the Ontario government had not released the regulations that will define the reporting requirements for the Sustainable Water and Sewage Systems Act.

2.1.11 INTERNATIONAL INITIATIVES

The Governmental Accounting Standards Board (US, GASB, 1999) in the United States introduced a requirement (known as GASB Statement 34) for state and local governments to account for their capital infrastructure assets and submit an annual report.

New Zealand and Australia have developed asset management guidelines in response to national legislation in both countries requiring government agencies to use asset management systems (Australian Accounting Standard 27 (AAS 27) Financial Reporting by Local Government).

Starting in the 1980s, Great Britain undertook a nationwide privatization of its water industry. To justify pricing, United Kingdom water utilities had to develop detailed asset management plans.

Several associations have published manuals and guides dealing with municipal infrastructure asset management. A listing of these references is provided at the end of this report.
2.2 Benefits

The benefits of an asset management are many. These benefits are viewed best in a context that appreciates the complementary nature of asset management plans and strategic and corporate business processes. This is best achieved when policy objectives for what is expected from investment in assets is expressed in measurable terms in order that the performance of the assets and hence the municipal administration who manage the asset can be assessed both in the fullness of time and municipal objectives. Without strategic policy objectives, meaningful standards and targets for performance the full benefits of an asset management plan will not accrue to the municipality (Figure 2-1). Instead the asset management plan will reside in irrelevance and obscurity, never fulfilling its promise to optimize infrastructure management.

Figure 2-1 Corporate Strategic Framework for Asset Management
Specific benefits include:

- facilitating the establishment and subsequent implementation of policy objectives and the related measurement of performance;
- helping to avoid problems and potential crises;
- provision of better and consistent levels of service to the public, at less cost;
- improved and more effective communication with the public;
- improved evaluation of return on investment;
- reduced life cycle costs;
- improved service and performance;
- better decisions regarding resource allocation;
- reduced risk to the municipality;
- more effective communication with rate payers, elected officials, financial rating organizations, and regulatory agencies;
- more accurate financial planning;
- more efficient data management; and
- positive institutional change.

2.3 CHALLENGES

There are some potential challenges in implementing an asset management plan.

- One of the greatest challenges in formulating and implementing an asset management plan lies in securing consistent and unmitigated advocacy from senior levels of the municipality. A senior-level driven approach will go a significant way to securing the promise engendered in an asset management plan, on condition that it is situated securely within the municipality’s strategic and corporate business plan.

- There also rests a challenge in propagating meaningful and comprehensive communication among relevant municipal staff, elected officials and of course the public.

- Asset management could be viewed as a program that a municipality cannot afford and requiring additional resources (i.e., staff and equipment) without
significant short-term benefits. There could be a lack of support for an asset management plan from some stakeholders (e.g., operators, politicians, and the public) for those municipalities that have not yet experienced significant problems or if long-term benefits are not clearly identified.

- Implementation of an asset management plan could be challenging if it is not well defined and endorsed by all stakeholders. Members of the asset management team must have a clear mandate and not be expected to take on a new responsibility without downloading other responsibilities.

- The lack of a corporate sponsor for asset management means no overall corporate strategy or support to implement a plan.

- Some municipal employees may resist the asset management plan if they perceive that it will involve changes and threaten their job security.

- The asset management plan cannot be sustained if it is not sufficiently flexible to accommodate new information or needs.

- An asset management plan could result in the identification of significant increases in the revenues needed to support infrastructure forces.
3. METHODOLOGY

3.1 KEY PRINCIPLES
Asset management is characterized by the following key principles.

- A strategic and proactive approach that places a premium on sound data and information, inter-departmental collaboration and an inter-disciplinary management approach.
- A comprehensive, takes a long term view of infrastructure performance and cost, and emphasizes sustainability objectives.
- Is explicit, visible and transparent and requires effective communication among all its stakeholders.
- Viewed as a way of doing business and is driven by policy goals and objectives based on performance.
- Encompasses business processes involving investment choices that are policy and performance driven and that involve explicit trade-offs among competing priorities.

3.2 ASSET MANAGEMENT REQUIREMENTS
Asset management is premised on the following component requirements.

3.2.1 ASSET VALUE
It must be recognized that municipal infrastructure assets have monetary value.

3.2.2 LIFE CYCLE MANAGEMENT
Assets have a limited life expectancy, and their rate of deterioration can be estimated. The life cycle of an asset includes planning, design, construction, operation, maintenance, rehabilitation, and replacement (Figure 1). Municipalities should recognize that decisions made at any point in the life cycle of an asset could impact the remaining life.
3.2.3 SUSTAINABILITY

Sustainable development has been defined as “meeting the needs of the present generation without compromising the ability of future generations to meet their own needs” (InfraGuide, 2003b). An asset management plan should identify a financial plan to sustain the assets. The financial plan should ensure that resources are available to rehabilitate and ultimately replace the assets at the optimum time to achieve the lowest life cycle cost. This requires that the potential for unintended costs be consistently monitored. The plan must also ensure that current users pay a fair share for the service so future users do not have to pay a higher cost for the same level of service.

3.2.4 INTEGRATION OF TECHNICAL AND FINANCIAL PLANS

A municipality should develop an asset management plan that minimizes life cycle costs for infrastructure assets while maintaining an adequate level of service and an acceptable level of risk. An asset management plan should also include a financial plan that identifies the financial impacts on the public. Ideally, the asset management plan and financial plan should be integrated so the relationship between the level of service and the cost can be quantified. All of which must be done in the context of social and environmental impacts.

3.2.5 RISK ASSESSMENT

Risk should be managed in any decision-making process. The owner of the assets should analyze and document its acceptable risk tolerance. Risk can be quantified by multiplying the probability of failure by the consequences of failure. Traditionally, decision making has focused on cost–benefit analyses. Risk
management can be used to quantify both the cost of risk reduction and the benefits arising as a result and can be included as a component in the overall cost–benefit analysis. Risk factors in the analysis include parameters, such as financial, environmental, health, and safety factors. Negative externalities such as the cost of disruption and delay and social and environmental degradation also warrant consideration.

3.2.6 PERFORMANCE MEASUREMENT
To optimize an asset management plan, the performance of the assets must be monitored regularly and adjustments made at the appropriate stage in an asset life cycle to achieve an acceptable balance between cost, level of service (i.e., performance) and risk.

3.2.7 HIGH LEVEL AND DETAILED PLANS
Asset management plans should be developed for both strategic and operational planning purposes. Strategic planning of policies and programs requires a high level assessment of the assets (i.e., “30,000 foot view”). A high level assessment can be completed using a senior-directed approach in which the projected renewal costs for a group of assets can be estimated using replacement cost and life expectancy. The senior-directed approach is consistent with the accrual accounting method (common in the business world and regulated utilities) in which capital cost expenses include depreciating the value of an asset over its expected service life.

On the other hand, operational planning (e.g., capital planning of projects) requires more detailed information on the condition and deterioration rate of the asset. A detailed plan can be completed by applying a operational approach using a detailed inventory of the assets including the current condition and deterioration rate. The operational approach lends itself to the cash accounting method, which predominates in Canadian municipalities. With the cash accounting method, net capital outlays are expensed on an annual basis. To confirm that the investment in renewal is sufficient to sustain the infrastructure systems over the long term, a replicable condition assessment (with a measurement scale) is required on a regular basis.

The magnitude of projected costs to sustain municipal infrastructure over the long term can be quickly determined using the senior-directed approach. On the other hand, it may take several years to develop a comprehensive renewal plan for large municipalities using the operational approach. These two approaches are not conflicting, but complementary to each other. Over time, the results of the operational approach can be used to refine the senior-directed approach.
3.3 **ESSENTIAL ELEMENTS**

The framework for an asset management plan can be described in terms of seven questions, that should be answered in sequence.

1. What are the policy objectives (typically expressed in terms of service levels) and how is the achievement of these assessed?

2. How are priorities established among competing needs, particularly in the context of limited funding?

3. What do you have and where is it?

4. What is it worth?

5. What is its condition and expected remaining service life?

6. What needs to be done?

7. When do you need to do it?

8. How much will it cost?

9. How do you ensure long-term affordability?

The following paragraphs address each of these questions in terms of the senior-directed approach and the operational approach. This planning framework is illustrated in Figure 2.
Figure 3–2: Asset Management Planning Framework

1. Policy Objectives
   How is achievement assessed?

2. Establishing Priorities
   How is limited funding dealt with?

3. Asset Inventory
   What do you have & where is it?

4. Asset Valuation
   What is it worth?

5. Asset Condition
   What is its condition & expected remaining service life?

6. Evaluation of Renewal Alternatives
   What needs to be done?

7. Renewal — Priorities
   When do you need to do it?

8. Renewal Plan
   How much will it cost?

9. Financial Plan
   How do you ensure affordability?

Update Asset Inventory
3.3.1 What are the policy objectives — How is achievement assessed?

Policy objectives are typically expressed in terms of service levels. Businesses and residents expect certain levels of service from infrastructure providers and a comprehensive understanding of what is expected aids in effectively planning for infrastructure maintenance, repair and investment. Corporate or community goals, as reflected in the direction provided by elected officials and municipal administration, generally set the tone for the levels of service the community wants and is willing or able to support financially. These goals should reflect the values of the community.

Service levels represent service-cost trade-offs, established in a flexible, rational, and transparent manner. As such the assist and support decision making and investment planning related to the planning, development, operation, maintenance, rehabilitation, and replacement of municipal infrastructure. The obvious benefits in achieving and maintaining levels of service include health and safety, physical/natural development, economic/social development, quality of life/living standards and reducing life cycle cost.

3.3.2 How are priorities established — in context of limited funding?

Declining revenues and a growing demand for maintaining and expanding the quality of municipal infrastructure have placed enormous strain on municipalities to develop methods for prioritizing infrastructure asset investment alternatives. In the context of limited funding it is crucial that priorities are established both objectively and relative to municipal and corporate policy objectives.

Decision-makers at the municipal level are constantly engaged in comparing alternative courses of action. The ultimate objective of these activities is to sort out the desirable from the undesirable. To do this, it is often advocated that the decision-making process employed should be rational. Models are often put in place to assure that the decision-making process is rational and objective. An infrastructure asset management plan is an excellent method by which the prioritization of asset management alternatives are likely to be objective assessed while being correlated with strategic policy objectives.

3.3.3 Asset inventory — What do you have and where is it located?

The senior-directed approach requires an estimate of the quantity of the asset group (e.g., total length of water main). If the quantity of the asset group is not readily available, it may be estimated by pro-rating quantities for other municipalities based on population.

For the operational approach, a detailed inventory is required for each component (e.g., pipe length, diameter, material, year of installation). InfraGuide has
published a document entitled *Best Practices for Utility-Based Data* that presents a foundation and guide for identifying, storing, and managing sewer and water system data. This best practice can be adapted for roads and other utilities.

The level of detail in either approach will depend on the availability and requirement of data.

### 3.3.4 Asset Valuation – What Is It Worth?
Several techniques have been used to establish the value of municipal infrastructure assets, including original book value, appreciated book value, and replacement value.

For the purposes of renewal planning, replacement cost is generally the preferred method for quantifying the value of an asset. For the senior-directed approach, an average unit replacement cost can be used for a group of assets. On the other hand, a more detailed cost estimate is usually warranted when using the operational approach. For example, unit costs can be estimated for each pipe size when estimating the value of water distribution and wastewater collection systems.

### 3.3.5 Asset Condition – What Is Its Condition and Expected Remaining Service Life?
For the senior-directed approach, the average age of the asset group can be used as an indicator of its condition.

For the operational approach, data should be compiled on the condition and performance of each component. A replicable condition assessment protocol should be adopted (with a measurement scale) to provide a consistent basis for monitoring the condition of each component. The value of an asset can be used to determine an appropriate level of effort for its condition assessment (i.e., inspect the expensive assets as they are more expensive to replace).

### 3.3.6 Evaluation of Renewal Alternatives – What Needs to Be Done?
Typically, there are several alternatives for renewal of municipal road, sewer, and water systems, and each alternative could produce a different service life and a different capital cost. The life cycle costs (including current renewal cost, future maintenance costs, and future renewal costs) as well as social costs for each alternative should be estimated in order to identify the preferred alternative. Furthermore, the renewal plans for these systems should be integrated with each other to minimize overall costs and disruption.
3.3.7 **RENEWAL PRIORITIES – WHEN DO YOU NEED TO DO IT?**

For the senior-directed approach, the remaining service life of an asset group can be estimated by subtracting the average age of the asset group from the typical service life estimates for that asset group.

For the operational approach, the remaining service life of a component can be estimated if its age, current condition, and deterioration rate are known. The deterioration rate of any asset can be estimated by comparing the current condition and that from previous inspections with the age and condition of a selection of similar assets. It is also possible to consider potential economic growth and the related increase in the tax base, as well as integrated “corridor rehabilitation.” In this case, a multi-attribute decision-support system can be used.

3.3.8 **RENEWAL PLAN – HOW MUCH WILL IT COST?**

Based on the renewal priorities and asset valuation determined in the previous steps, it is possible to project the costs for infrastructure renewal. As noted previously, the senior-directed approach should be used for strategic planning whereas the operational approach should be used for operational planning. The renewal costs from both the operational approach and the senior-directed approach should be compared to ensure that the short-term plan is consistent with the long-term plan.

3.3.9 **FINANCIAL PLAN – HOW DO YOU ENSURE LONG TERM AFFORDABILITY?**

It is important to develop a financial plan that demonstrates how revenues will cover the projected costs for infrastructure management, including renewal. Municipal council should endorse the financial plan so a direct linkage can be made between renewal costs and the level of service.

It is important to project renewal costs over at least one life cycle for each component so a financial plan can be developed that anticipates any projected increases in cost. The overall plan should therefore encompass one life cycle of the longest-lived component of the system.

Two examples are provided in the best practice entitled *Developing a Water Distribution System Renewal Plan* to illustrate the application of the senior-directed and operational approaches to renewal planning for water distribution systems. These approaches can be adapted to project the renewal costs for municipal road and sewer systems.

3.4 **DATA COLLECTION**

Effective asset management begins with reliable, useful, and consistent data. The asset management plan should address data needs and data quality as well as data integration, accessibility, and maintenance.
3.4.1 Best Practice for Utility-Based Data

InfraGuide has published a document entitled *Best Practices for Utility-Based Data* that presents a foundation and guide for identifying, storing, and managing sewer and water system data. It can be adapted for roads and other utilities and recommends the use of a documented data model/structure, data collection standards, standard data units, and standard location referencing. It also makes suggestions for collecting, maintaining, properly storing, and effectively managing data.

All affected departments within a municipality should participate in the preparation of an asset management plan to standardize data collection and promote data sharing. The asset management plan should be updated periodically to reflect changing needs, new technologies, and new opportunities. In some cases, pilot tests should be initiated to confirm the feasibility and costs of some data collection and management technologies.

In light of the significant amount of data required to complete an integrated asset management plan for municipal infrastructure using the operational approach, municipalities should compile the inventories in relational databases. Ideally, the databases should be linked to geographic information systems (GIS) to facilitate spatial analysis and utilization of the data.

It is highly recommended that municipalities compile an inventory of their current enterprise databases and their other data sources (GIS, spreadsheets, word processing files, manual records, etc.) along with a description of the data they contain. Linkages between complementary data should be identified.

The format and content of the databases will vary among municipalities depending on the size of the municipality, available funding, the severity of the problems or apparent inefficiencies, and the capabilities of the municipal staff. In some cases, it may take several years for a municipality to compile a comprehensive inventory of its infrastructure. However, each municipality should adopt an appropriate plan for data collection and management that will eventually allow the municipality to manage its systems proactively in a cost-effective manner. At the outset, the key question is: “What information do I need to collect and at what level of detail, to answer specific management questions?” Typically these questions have at their core, ‘how do we identify and prioritize over the coming years capital expenditure needs to maintain, repair and replace the infrastructure asset base, while meeting assigned levels of performance and service’. Finally, how data collection will be prioritized must also be answered.

3.4.2 Maintenance of Data

Municipalities should not underestimate the effort required to maintain infrastructure data and keep it up-to-date. Formal quality control processes should be in place to ensure that the quality of the data is improved over time.
Some municipalities mandate that developers submit infrastructure data in an approved format for new subdivisions.
4. IMPLEMENTATION

4.1 IMPLEMENTATION NEEDS

“Asset management is a comprehensive business strategy employing people, information, and technology to effectively and efficiently allocate available funds amongst valid and competing asset needs” (TAC, 1999).

4.1.1 PEOPLE

As always, people are the most valuable resource for any endeavour. A successful implementation of asset management will require commitment from all levels within the municipality. A “champion” should be appointed to lead the asset management team and report to senior management at the municipality.

The asset management team, reporting to the champion, should include representatives from the various departments within the municipality (e.g., planning, design and construction, operations and maintenance, customer service, finance, information technology). In some cases, representatives from external agencies (e.g., utility companies), elected officials and the public should also be included. This participation may take the form of asset management teams or alternatively, public advisory and/or utility advisory committees. External advisors may be enlisted to assist with the development and implementation of the asset management plan.

In some municipalities, the implementation of comprehensive asset management may require organizational changes. In these cases, business process redesign and a change management strategy may be required to make the transition as smooth as possible.

4.1.2 INFORMATION

Effective information management is critical to the success of asset management. The ability to provide feedback throughout the life cycle of an asset is essential to manage it effectively. Feedback will, over time, allow the municipality to optimize the management of its assets in terms of life cycle costs, level of service and risk. Ideally, information should be shared among the various departments within a municipality.

4.1.3 INFORMATION TECHNOLOGY

Information technology (IT) continues to evolve rapidly. It is now possible to gather, store, analyze, retrieve, and communicate enormous quantities of data. Ideally, information technology should integrate the following systems within a municipality:

- maintenance management system;
- customer information system;
• purchasing;
• finance and human resources;
• mapping and asset inventory management system;
• capital asset plans;
• operations (e.g., water meter reading, SCADA, LIMS); and
• other applications (e.g., hydraulic models, traffic models).

Since the development of a detailed asset management plan requires extensive data, with condition rating systems and deterioration models as well as decision-support systems, numerous software tools have been developed. Some well-developed pavement management systems provide most of the functionality required by an asset management system for roads. However, maintenance management systems for water and wastewater systems focus on the maintenance of these systems and do not adequately address their renewal requirements and financial plan.

4.1.4 IMPLEMENTATION OF COMPUTERIZED ASSET MANAGEMENT SYSTEMS

Several references describe the process for implementing a computerized asset management system (e.g., NZ National Asset Management Steering Group, 2000; TransEducation Program, 2000). One reference (Lemer, 2002) lists the names of several companies that have developed commercially available software for infrastructure asset management. However, this reference states: “None of the packages available in early 2002 provide a comprehensive solution for infrastructure asset management.” It is important to realize that software is only a tool and the data are more valuable than the software.

4.1.5 BUSINESS PLAN

A business plan should be developed for implementing asset management. The business plan should clearly outline the expected costs and benefits of the implementation. Senior management at the municipality should endorse the business plan.

4.1.6 IMPLEMENTATION PLAN

An implementation plan should identify the short- and long-term objectives of the asset management plan, a work plan, roles and responsibilities, schedule and budget for various milestones, as well as deliverables. The implementation plan should be updated periodically to reflect current information and priorities.
To facilitate buy-in from stakeholders, the implementation plan should address a few problems that can be easily resolved (i.e., “quick wins”). Municipalities should also recognize that they do not have to compile a detailed inventory of their entire infrastructure before they can start applying asset management. With proper planning, municipalities can compile an inventory and conduct a condition assessment of their systems over a period of years.

Several references describe the process for implementing asset management systems (e.g., TAC, 1999; Lemer, 2002; NZ National Asset Management Steering Group, 2000; TransEducation Program, 2000). The Transportation Asset Management Guide (NCHRP, 2002) includes a self-assessment exercise to characterize a municipality’s current asset management practices and identify specific opportunities for improvement.

4.1.7 CHALLENGES

Municipalities must overcome institutional, technical and funding challenges before they can successfully implement asset management.

Institutional challenges:

- need for leadership and unmitigated advocacy (resolute senior commitment)
- organizational issues (conflicting priorities, lack of resources, poor communication between departments, silos of knowledge and responsibilities, lack of training, reliance on other agencies).

Technical challenges:

- limitations of asset management systems;
- no data standards, performance measures, and maintenance standards;
- lack of automated and cost-effective non-invasive and non-destructive inspection and condition assessment tools; and
- no domain-specific decision-support systems to assist in establishing the priorities among competing renewal projects.
- Lack of life cycle performance information
- Lack of information to quantify social and environmental costs

Funding challenges:

- inadequate funding; and
• lack of ongoing funding support.

Several measures can be used to address these challenges: improving communication, education, training, and advance planning.

4.2 SUCCESSFUL IMPLEMENTATIONS
Appendix A describes the implementation of asset management systems in several Canadian municipalities.

4.3 EMERGING TRENDS
There are several emerging trends in asset management. This trend is illustrated by numerous studies and initiatives intended to generally improve our understanding and appreciation of municipal infrastructure. Among these are included the following:

4.3.1 MUNICIPAL INFRASTRUCTURE INVESTMENT PLANNING
The Institute for Research in Construction (IRC) is conducting a three-year project to evaluate and develop support tools for municipal infrastructure investment planning (MIIP). The NRC, Department of National Defence and several municipalities fund the MIIP project. The objectives are to evaluate tools and techniques to assist municipal infrastructure investment planning and to develop prototype tools and techniques for asset managers to better manage their municipal infrastructure. Additional information on this project is available from <www.irc.nrc-cnrc.gc.ca/uir/miip/>.

4.3.2 NATIONAL ROUND TABLE ON THE ENVIRONMENT AND THE ECONOMY
The National Round Table on the Environment and the Economy is intended to play the role of catalyst in identifying, explaining and promoting, in all sectors of Canadian society and in all regions of Canada, principles and practices of sustainable development. Specifically, the agency identifies issues that have both environmental and economic implications, and attempts to identify actions that will balance economic prosperity with environmental preservation. The management of municipal infrastructure assets is clearly an issue that falls within this mandate.

4.3.3 TECHNOLOGY ROAD MAP
Four national organizations (Canadian Society for Civil Engineering, Canadian Council of Professional Engineers, Canadian Public Works Association, and the National Research Council) have recently published the Technology Road Map (TRM) for Canada’s civil infrastructure systems over the next decade (a copy of the TRM can be downloaded from <www.csces.ca>). The TRM represents a national consensus on the current state of civil infrastructure systems (CIS), a vision for the industry and a strategy for meeting the long-term needs of Canada’s CIS through technology innovation.
4.3.4 BENCHMARKING

Benchmarking is defined as “a systematic process of searching for best practices, innovative ideas, and highly effective operating procedures that lead to superior performance – and then adapting those practices, ideas, and procedures to improve the performance of one’s own organization” (AWWA, 1996).

There are two types of benchmarking (AwwaRF, 1996).

“Metric benchmarking is the quantitative measurement of performance in terms of inputs, outputs, outcomes and the relationships between them.

Process benchmarking is the mapping of one’s own process and subsequent comparison of your process with those of other companies with exemplary performance in a similar process.”

Several metric benchmarking studies have recently been completed (or are being conducted) in Canada to compare the performance of municipalities in terms of various technical and financial indicators. These include:

- the Ontario Municipal Chief Administrative Officers Benchmarking Initiative (OMBI) <www.caobenchmarking.ca>;
- the Ontario Municipal Performance Measurement Program (MPMP) <www.nationmun.ca/MPMP2001.htm>; and
- the Canadian National Water and Wastewater Benchmarking Partnership.

Caution must be used when using metric benchmarking since performance measures do not necessarily account for the unique circumstances within each municipality (e.g., demographics, climate). Furthermore, financial performance measures do not provide a true indication of the efficiency of a municipality. Nevertheless, an analysis of trends in performance indicators over several years will allow a municipality to determine whether its performance is improving.

4.3.5 TECHNOLOGY TOOLS

Rapid advances continue in the development of technology tools, such as asset management software, GIS, data collection tools (e.g., GPS), inspection and operation technologies, and rehabilitation technologies. In addition, some municipalities have started to use the Internet for customer service, information sharing, event management, and e-commerce.

4.3.6 REGULATIONS

In 2002, the Ontario government passed Bill 175 (The Sustainable Water and Sewage System Act). This Act makes it mandatory for Ontario municipalities to assess and report on the full costs of providing water and sewage services, and
then to prepare and implement a plan for recovering those costs. Similar legislation may be enacted in other parts of Canada over time.

**4.3.7 Public–Private Partnerships**

Opportunities for private companies to participate in the delivery, ownership, operation, and financing of municipal infrastructure are expected to increase over time. Comprehensive asset management will improve the opportunities for competitive service delivery through an improved ability to articulate needs and evaluate alternative project delivery methods. This improved selection methodology will minimize life cycle costs and support needed renewal programs.

**4.3.8 Continuous Improvement**

Some municipalities have implemented continuous improvement programs through AWWA’s QualServe program, ISO 9000, and ISO 14000; others have developed an environmental management system. A new ISO standard (ISO/TC 224) is being developed to address service activities related to drinking water and sewerage.
4.4 APPLICATION IN SMALL OR REMOTE MUNICIPALITIES

Asset management is applicable to all municipalities regardless of size and location. Municipalities should develop an implementation plan that maximizes the use of their existing data and tools. The plan must be tailored for each municipality to account for its size, organizational structure, available data and tools, condition of its systems, funding, and targeted levels of service. The implementation plan should strive for continuous improvement.

Strategic planning can be carried out with the senior-directed approach using an electronic spreadsheet to quantify the value of the infrastructure and the long-term investment needed to sustain it.

Operational planning, on the other hand, can be carried out using an operational approach. This requires municipalities to compile an inventory of their municipal infrastructure. As a minimum, scaled maps should be prepared for the sewer and water networks to indicate the pipe size, material and year of installation. A similar map should be prepared to indicate the width of roads, road standard (e.g., rural, urban), and surface treatment. Identification numbers should be assigned to each component in a system to allow all condition and performance data to be referenced to its component.

4.4.1 SMALL MUNICIPALITIES

For small municipalities, the next step in the implementation of asset management should include the implementation of a maintenance management system and the preparation of a renewal plan. Small municipalities will not likely have all the in-house expertise required to implement asset management. Furthermore, it may not be cost effective for small municipalities to use some asset management technologies.

4.4.2 ALBERTA MUNICIPAL INFRASTRUCTURE MANAGEMENT SYSTEM

The Province of Alberta and several municipal associations have sponsored an initiative called the Alberta Municipal Infrastructure Management System (MIMS). MIMS is an affordable, easy to use set of tools that will assist municipalities in managing and ultimately sustaining their infrastructure through solid decision-making. MIMS allows users to track municipal infrastructure assets for roads, water, storm, and sanitary sewer networks. Users will know what they own and its current state. The information can be used for capital planning tasks, such as forecasting, budgeting, and funding allocations.

MIMS includes a data registry as well as GIS capabilities. MIMS also includes a self-assessment tool to assist municipalities in identifying the gap between current infrastructure data and the appropriate data that should be collected. Additional information on MIMS can be obtained from <www.albertamims.org>.
4.4.3 REMOTE MUNICIPALITIES
Remote municipalities may not have access to some technologies for data collection, inspection, and renewal of municipal infrastructure. Even though municipal staff generally have local knowledge and expertise in managing municipal infrastructure, this knowledge can be lost with the person (corporate memory loss) and therefore asset management should still be implemented to ensure continuity of knowledge.
5. Evaluation

The following points describe several measures that can be used to evaluate the effectiveness of asset management.

- Monitor the condition of the infrastructure to ensure that an adequate level of service is maintained over the long term. A replicable condition rating system (with a measurement scale) should be used. For example, many Canadian municipalities have adopted the sewer rating system developed by the Water Research Centre in the United Kingdom (WRc, 1986). Similarly, many Canadian municipalities use the Pavement Quality Index (TAC, 1997) to quantify the condition of roads.

- Monitor the performance of the infrastructure to ensure that an adequate level of service is maintained over the long term and to assess the efficiency and effectiveness of the municipality. Technical performance measures (e.g., number of water main breaks, number of complaints, number of sewer blockages) can be used to track the performance of the infrastructure. Financial performance measures (e.g., cost to treat 1 ml of water, total operating cost per km of sewer) can be used to assess the efficiency of the service.

- Track unplanned spending on an annual basis to confirm that the asset management plan is effective. Implementation of an asset management plan should reduce the unplanned spending over a period of several years.

- Track total spending, on an annual basis, for each program as well as condition and performance data to optimize spending. Activity-based costing (ABC) and activity-based management (ABM) will assist in optimizing funding and budgets.

- Conduct a value engineering review of the asset management plan.

- Conduct a risk assessment study to confirm that risks are effectively quantified and mitigated.

Monitor program delivery measures to confirm that the asset management plan is on schedule and budget.

- Conduct metric benchmarking to compare the performance of the municipality with others. This may identify areas for improvement.
APPENDIX A – SUCCESSFUL IMPLEMENTATIONS

CITY OF SURREY, BRITISH COLUMBIA

A citywide asset management program for the City of Surrey has been underway since 1996. Before this date, each department operated autonomously, with separate asset management systems and approaches. The City saw the potential to eliminate systems and process redundancy, to combine and leverage staff and inventory, and to achieve greater efficiency by capitalizing on possible synergies.

OBJECTIVES

The objective of the citywide asset management program was to:

- Find a common communication platform;
- Plan and measure those processes and programs which would lead to lower cost of ownership and better performance;
- Introduce measurement control points and collection of performance measurement metrics;
- Increase the use of preventive maintenance, condition monitoring, failure code analysis, and reports;
- Support business process (re) engineering for increased workflow efficiency and effectiveness;
- Encourage continuous improvement of total costs, performance, and user satisfaction;
- Infuse the use of best practices into the process; and
- Measure actual results to verify improvement plans.

APPROACH

Surrey began its asset management program by first defining its goals “to improve customer service by ensuring all City assets are properly maintained through cost effective and process efficient means.” The City’s asset base is very diverse, with pumps and controls, water, sewer, roads, drainage, traffic, park and trees, and corporate facilities. Assets can range from brand new to almost 100 years old, and are in various life cycle stages and conditions.

Implementation was initiated through a team approach with representatives from each department including Engineering, Corporate Facilities, Parks, Finance and Information Technology. Ongoing implementation and maintenance of the system was transferred after Phase I of the project to the individual departments.
Asset management requires a strong and stable technological base, with the flexibility to be used by each department with its unique business requirements, and is a strategic lever for an asset management program. Like other organizations in an asset-intensive industry, the design group faced some basic philosophical issues. Should they go with a production-centric or a financial-centric approach to technology? The result: a production-centric philosophy and a customizable, best-of-breed solution to assist in the overall asset management solution, to help track the total cost of ownership (TCO) of assets, and to ensure the City’s stewardship role was addressed. Asset information, which had been captured in legacy systems was transferred into the new system, and previously unrecorded asset data were manually entered into the system. Immediate cost savings resulted through the reduction in the number of legacy systems and in the duplication of data entry.

Through the city-wide approach, which was undertaken by a steering committee, a design team and focus groups, the City looked at the costs of not providing asset management, assessed the business requirements, and associated gaps, provided cost benefit analysis and defined the project implementation and ongoing management.

Strategies applied in the City of Surrey were revised a number of times as the asset management team acquired more knowledge and expertise with asset management. Business processes are constantly refined to obtain efficiencies, or to attain goals set through performance metric evaluations. Capital budgeting is beginning to be driven by asset failures predicted through the asset management program, instead of emergency and short-term plans.

**Benefits**

The asset management program has been the catalyst for significant changes in business processes along with a raised awareness of regulatory requirements, budgeting limitations, and the need for long-term planning.

Other non-quantifiable gains made through the process have been the establishment of defined and documented business processes for many functions throughout the departments. This has included improved reporting capabilities; improved process efficiencies in purchasing, contracts, invoicing and cataloguing; full integration with the city’s financial system; the ability to retrieve the history of materials and purchasing transactions; improved business processes and work flow in many functional areas; clearer delineation of individual responsibilities within the processes and functional areas; and improved computer literacy of staff.

These are fundamental building blocks in the establishment of an asset management program. From these processes, and through the capture of asset data, key performance indicators are being established and monitored, which will
provide unique insight into how the City should structure its continued improvement initiative.

Further benefits to a fully implemented asset management program have included enhanced risk management, establishment of performance metrics, efficiency gains, reduction of corporate memory loss, and a central repository for asset and costing data.

**PAYBACK PERIOD**

The payback period for the investment was identified as seven years after full implementation. Full implementation included completion of detailed asset information and associated preventive maintenance and job plans as well as integration to other operational systems. The City considers itself to be two years away from citywide full implementation, but the benefits gained through the asset management program are considerable. What is exciting are the significant opportunities to realize future efficiencies in labour productivity and increased reliability of the assets in use.

**FUTURE PROJECTS**

Future projects include integration with GIS, a pavement management system, customization of a processing and tracking system (AMANDA), a parks irrigation system and a process control system (SCADA). A Web-based platform is being evaluated for the next upgrade. Hand-held technology has been implemented in a pilot program. Based on the success of the project, the integration possibilities will be extended for use to the project team as a whole.

Asset management is accomplished through the concerted efforts of technicians, clerical, trades, and management staff, and through a supportive business culture for asset management.

**CITY OF HAMILTON, ONTARIO**

The Asset Management Section at the City of Hamilton was formed in 2001 during restructuring initiatives related to the amalgamation of the Region of Hamilton-Wentworth and six former area municipalities. The Asset Management Section is organizationally structured within the Public Works Department.

The strategies applied in the City of Hamilton include:

- adoption of an organizational structure that reflects the various infrastructure systems being managed;
- full integration of all individual asset information data sets and programming initiatives; and
• development of capital works programs that address all the needs of a given section of municipal right-of-way.

Asset management continually reviews, develops, and implements trenchless technology for the rehabilitation of the subsurface infrastructure. Existing sewer/water maintenance management systems are being linked through the application of advanced GIS techniques to facilitate a completely integrated asset management approach.

Strategies are being implemented in conjunction with the development and implementation of bridge and pavement management systems. These systems have the technical capability to move the statistical analysis into the GIS format required for trend analysis. This work includes the development of land use data applications to address the socio-economic factors related to infrastructure programming initiatives.

Asset management is responsible for all capital budgeting related to the City of Hamilton. This team compiles all required capital project and account data into a budget for presentation to City Council. The approved budget is monitored and regular budget variance reports are generated for senior management teams.

The Asset Management Section is actively pursuing other initiatives, such as project management of a data collection and asset creation exercise for right-of-way infrastructure assets: sidewalks, catch basins, signs, and trees.

CITY OF QUÉBEC, QUEBEC

The Development and Planning Section at the City of Québec was formed in 2001 during restructuring initiatives related to the amalgamation of the City of Quebec and 12 former area municipalities. The Development and Planning Section is organizationally structured into the Engineering Service. The infrastructure assessment/project coordination role is accomplished by technical specialists working in the individual infrastructure asset areas. The specific areas include surface infrastructure, subsurface infrastructure, and infrastructure management systems.

The strategies applied in the City of Québec include the following items:

• adoption of an organizational structure that reflects the various infrastructure systems being managed;

• full integration of all individual asset information data sets and programming initiatives; and

• development of capital works programs that address all the needs of a given section of municipal right-of-way.
The subsurface infrastructure team has developed and implemented an integrated asset management approach. Enhanced capability is being developed within the existing sewer and water maintenance management system to enable condition analysis of the sewer system from the network level. This team is responsible for the administration of the City’s CCTV, Zoom Camera and remote field eddy current contracts.

These strategies are being implemented in conjunction with the development and implementation of pavement management systems. The Surface Infrastructure Team has implemented a Pavement Management System and is working on refinements to the decision model within that system. The entire pavement will be inspected and the data implemented into a road management system, which is capable of life cycle analysis and budget forecasting.

The infrastructure management systems team has been instrumental in the development of the integrated data sets and the automation of the various data set implementation exercises. This team provides the technical capability to move the statistical analysis into the GIS format required for trend analysis at the system level. Their works have included the development of land use data applications to address the socio-economic factors related to infrastructure programming initiatives.

**CITY OF EDMONTON, ALBERTA**

To ensure that the City would be in satisfactory financial condition and could effectively finance services on a continuing basis, Edmonton’s civic administration developed the 10-Year Long-Range Financial Plan in the mid-1990s. Results from preliminary research undertaken in 1998 confirmed a sizeable and growing discrepancy between infrastructure requirements and the funds available to finance those requirements, otherwise known as the infrastructure gap. It was clear that a comprehensive strategy was required, as the City could not afford to invest and re-invest in the rehabilitation and development of its physical assets. A direct reaction to those research findings was the development of the 1998 Infrastructure Strategy.

The Infrastructure Strategy is a strategic initiative to address the funding challenges associated with ageing infrastructure and a booming economy. The overall goal is to ensure that the City’s infrastructure is in a good state of repair, that expansion and restoration programs are sufficiently funded, and that these programs are as efficient and effective as possible. The Office of Infrastructure was created in 2000 to develop and implement strategies, tools, and processes that support the City’s plans and priorities for the sustainable renewal, upgrading, and expansion of infrastructure. Another essential component for the successful implementation of the strategy is a communications plan to raise awareness of infrastructure issues and solicit support from key stakeholders and citizens-at-large.
Senior management supports the Infrastructure Strategy initiative and provides the basis for coordination and cooperation between internal departments. To fulfill the need for input by external stakeholders, the Infrastructure Technical Advisory Committee (ITAC) was also established. It consists of technical stakeholders with expertise in design, development, and management, and provides an external perspective and guidance to the City. Representing a broad cross-section of professional organizations, business associations, community groups, academia, and provincial departments, ITAC’s input assists the City as it continues to refine and validate strategies, processes, and planning tools.

The physical assets, developed and used by the City of Edmonton to support the community’s social and economic activities, are organized into 12 key infrastructure areas and include such diverse assets as drainage and sewers, roads, parks, buildings, recreation facilities, fleet vehicles, transit, traffic control, waste management, computer networks, affordable housing, and library resources. Since 2000, the City has collected data on infrastructure inventory, replacement value, average age, and expected asset life, as well as financial investment needs and funding information for these assets. This, in addition to a standardized rating system developed in 2001, provides the foundation for effective asset management and decision-making.

A five-point standardized rating system was developed to evaluate the state and condition of the City’s infrastructure assets. Three key criteria — physical condition, demand/capacity, and functionality — are used to apply a consistent method of comparison between dissimilar infrastructure elements. By identifying which assets are most in need of repair, the rating system provides a high-level corporate perspective, which contributes to improved decision making in the capital priorities planning process. The rating system validates investment requirements by capturing the City’s infrastructure asset inventory and highlighting infrastructure elements with the greatest need for funding. Additional innovative tools, such as a risk assessment methodology, in combination with confirmed asset management techniques, such as life cycle costing, are being developed and evaluated.

The risk assessment methodology will apply deterioration functions to quantify the probability and impact of infrastructure failure in relation to funding deficiencies. This will enable the prediction of the future state and condition of infrastructure assets in relation to current investment scenarios. By determining the severity of the risks associated with current infrastructure investment, the civic administration will be able to compare disparate infrastructure elements on a corporate level and determine which critical areas require the most urgent action.

Life cycle costing, on the other hand, enables the assessment of future investment requirements by considering the total cost of an asset over its life expectancy rather than limiting decisions to initial construction costs. The Mobile Equipment
Services Branch, having successfully implemented life cycle costing management, reports that the practice has proven to be cost effective. The use of life cycle costing is being promoted on a corporate-wide basis.

Successful implementation of the Infrastructure Strategy also requires the integration of the strategy with the City’s major corporate initiatives. It is essential that the asset inventory, state and condition asset ratings, and critical need areas all be taken into consideration as Edmonton develops its annual Corporate Business Plan, Capital Priorities Plan and 10-Year Long-Range Financial Plan. Internally, the City has initiated preliminary talks in an effort to better standardize, simplify, and integrate IT systems, which will enhance asset management practices in the process. It is expected that, according to the Enterprise Resource Planning initiative, the City’s Spatial Land Inventory Management database, Computerized Maintenance Management system, Planning One Stop Service (POSSE) and Systems, Applications and Products (SAP) in Data Processing will be integrated to facilitate ease of use and information sharing.

Despite the development and use of those previously mentioned innovative tools and processes, adequate financial resources are still greatly needed. The City of Edmonton is exploring alternative funding strategies to help reduce the growing infrastructure gap. In 2003, City Council approved land drainage as a utility, resulting in self-sustained fee-for-service delivery and the consequent removal of drainage services from the City’s tax-supported capital budget projections. The Sanitary Servicing Strategy Fund is a partnership between the City and developers and builders to finance jointly the construction of major sanitary sewers to support development. This initiative has reduced the civic fiscal burden and enabled development to proceed that might otherwise have been delayed. The City has also introduced another cost-sharing partnership to ensure that developers pay their share of new infrastructure; the Arterial Roadway Assessment partners with developers in the construction of arterial roadways to service newly developed areas. For the first time since 1983, the City of Edmonton revised its debt management fiscal policy to allow the municipality the option of assuming tax-supported debt to pay for critical infrastructure projects that would otherwise be unfunded. City Council has given approval to borrowing $50 million in 2003 and will consider borrowing the same amount for another four years to support capital infrastructure projects.

Edmonton will continue to implement the Infrastructure Strategy as it develops corporate and departmental business plans and other key initiatives. This includes the development and deployment of effective and efficient infrastructure management tools, processes, and strategies to assign priorities for the sustainable renewal, upgrading, and expansion of infrastructure. The City will also continue to explore new funding approaches and management strategies to address the infrastructure gap.
CITY OF KITCHENER, ONTARIO

The City of Kitchener is designated as a lower tier municipality within the province of Ontario with a population of approximately 197,000. Although within a regional municipality, the City is responsible for the delivery and maintenance of a significant portion of “hard” municipal services and associated infrastructure. This includes full responsibility for all sidewalks, sanitary sewers, natural gas lines, and most roads, storm sewers, and water mains.

The goal of the City’s Integrated Asset Management System is to gather, systematically inventory, centrally store, and ultimately analyze all available data regarding the state of municipal infrastructure. From this, City staff are developing a complete understanding of the extent, condition, and operating performance of the networks. This will lead to better understanding and development of efficient proactive strategies concerning maintenance, rehabilitation, and reconstruction of the City’s infrastructure and ultimately improved cost effectiveness of the divisional work processes.

In 1995, the City of Kitchener’s Engineering Division embarked on the development and implementation of a GIS-based integrated infrastructure management system (IIMS). Since that time, considerable effort has been expended in the systematic collection of data and the development of analysis tools and criteria. Through systematic collection of sanitary sewer data, water main data and road inventories, the City has developed a prioritized plan for upgrades to infrastructure to maintain a sustainable level of funding.

Recent work by the Engineering Division includes the interconnection of work management applications to infrastructure management tools, and enhancements to the collection and dissemination of data. The City has recently developed a low-cost method of collecting inventory and defect data for sidewalks incorporating GIS technology and is developing a similar process for the collection of road defect inventories.
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