A Guide
for
Road and Bridge Asset Management Plan Development

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Definitions

Amortization . . .	means the method by which the government consumes the tangible capital asset's economic benefits or service potential in the provision of services.
Asset . . .	means a physical component of a facility, which has value, enables services to be provided and has an economic life of greater than 12 months.
Asset Management . . .	means the combination of management, financial, economic, engineering, operational 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 Policy . . .	means council articulates its commitment to asset management and provides policy statements to guide staff in carrying out the organization's business strategies, plans and activities.
Asset Management Plan . . .	means 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.
Bridge . . .	means a structure which provides a roadway or walkway for the passage of vehicles, pedestrians or cyclists across an obstruction, gap or facility and is greater than or equal to 3 metres in span
Capitalization Threshold . . .	means the minimum dollar level a municipality will use to determine which expenditures will be capitalized as assets and amortized and which expenditures will be treated as current year expenses.
Culvert . . .	means a structure that forms an opening through soil for the passage of water, vehicles or pedestrians/ cyclists and has a span of 3 metres or more
Gross Book Value . . .	means all costs "directly attributable" to the acquisition, construction or development of a tangible capital asset. This includes installing the asset at the

	location and in the condition necessary for its intended use.
Level of Service . . .	means to the quality, quantity, functionality and reliability of a municipality's roads and bridges
Remaining Service Life . . .	means how much longer will an asset perform its function.
Road . . .	means the part of the highway that is improved, designed or ordinarily used for vehicular traffic, but does not include the shoulder, and, where a highway includes two or more separate roadways, the term "road" refers to any one road separately and not to all of the road collectively
Structure . . .	means a bridge or a culvert
Useful Life . . .	means the shortest of the asset's physical, technological, commercial and legal life.

Preamble

In order to make informed decisions about the allocation of resources, infrastructure asset managers, financial managers, politicians and ultimately the customer all need useful information. Asset management is a resource allocation tool that will provide the information municipalities will need to make decisions as to how they will build, operate, maintain, renew and replace an asset over the assets useful life. Asset management plans will identify the technical and financial needs of roads and bridges and provide information well in advance of a major asset renewal or replacement enabling a municipality to plan for these major projects should the timing of the needs coincide.

Asset management is not a new practice. Managers of infrastructure assets at all levels of government, school boards, universities, etc have managed a diversified set of built assets for many years. What is changing today is that many of the assets built in the 1950's, 60's and 70's are at or near the end of their useful life and many municipalities that experienced significant growth in the past realize that for these aging assets they must turn their attention away from building new assets and focus their efforts on renewal and replacement. On top of this, the public is demanding higher levels of service from their municipalities and is less tolerant of such things as water supply interruptions, potholes in roads and sewer backups. The public has an increased expectation that government will be more accountable and for municipalities to take a businesslike approach to managing their assets.

Asset management plans are not a one size fits all document. A municipality because of its size, composition of assets, degree of urbanization, current and projected asset condition and performance will need to customize an asset management plan to fit their specific needs. The municipality in preparing a plan will need to:

- Review current policy and if necessary make adjustments to policy;
- Consider customer expectations for the quality and quantity of services provided;
- Consider the construction and maintenance practices used by the municipality;
- Determine how asset management will fit within the current organizational structure; and
- Determine the revenue streams that will fund the operating, maintenance, renewal and replacement of assets.

Asset management plans can be prepared for all municipal assets. As this document discusses only road and bridges, the municipality will need to determine what road and bridge assets to include in the asset management plan. Will the plan include:

- All bridges and culverts, regardless of size and material;
- All roads: paved, unpaved and surface treated;
- All signs: regulatory, warning and information;
- All traffic signal systems;
- All guiderails and safety barriers;
- Storm water management systems which may include; storm sewers, maintenance holes, catchbasins, retention ponds, roadside ditches and outfalls;
- All maintenance equipment and fleet; and

- All maintenance yards, buildings and structures (i.e. salt dome) within those yards

Asset management plans are a summary document which can be developed and implemented by the municipality for all assets all at once. An alternative would be to develop the asset management program for a limited number of assets. In defining the scope of an asset management plan the municipality needs to determine:

- Which assets will be included in the asset management plan;
- Which services will be covered (operations, maintenance, capital);
- Which business processes will be included; and
- Which principles of asset management will our plan emphasized (performance measurement, monitoring and reporting, asset condition, etc)

This document was prepared by the Provincial/Municipal Roads and Bridges Working Group 1 as a framework and a step-by-step guide document to assist in the development of an asset management plan. The target audience for this document are municipalities <15,000 population. Reading through the next 40+ pages presents what may be to some a very overwhelming and onerous process. The good news is that municipalities may have many of the components of an asset management plan already in place. The work may simply involve, organizing the various independent documents into a comprehensive asset management plan (a template is provided in “A Framework for Road and Bridge Asset Management Plans” document for that purpose). Once the individual documents are consolidated, you will need to determine the gaps that exist between what you have today and where you want the plan to be when complete. The effort required by each municipality to prepare an asset management plan will vary.

A Framework for Asset Management

Asset management represents a way of doing business that makes decisions on infrastructure management based on quality data. The goal of an asset management program is to: build, maintain and operate infrastructure cost effectively; provide value to the customer for the services delivered and improve the credibility and accountability of the municipality. Asset management is a move away from current infrastructure management practices to managing a network of interrelated assets with interdependent programs and services that:

- Allocates scarce resources ($) amongst valid and competing asset needs;
- Considers the useful life of an asset plus the technical, financial and program spending needs to operate, maintain, renew and replace an asset over said useful life;
- Links user expectations for asset condition, performance and availability with system management and investment strategies; and
- Is increasingly being used to characterize a “business-like approach” to managing assets , which implies:
    - Looking at projects and programs as investments
    - Monitoring asset performance and value
    - Developing sound and competitive short and long term investment strategies

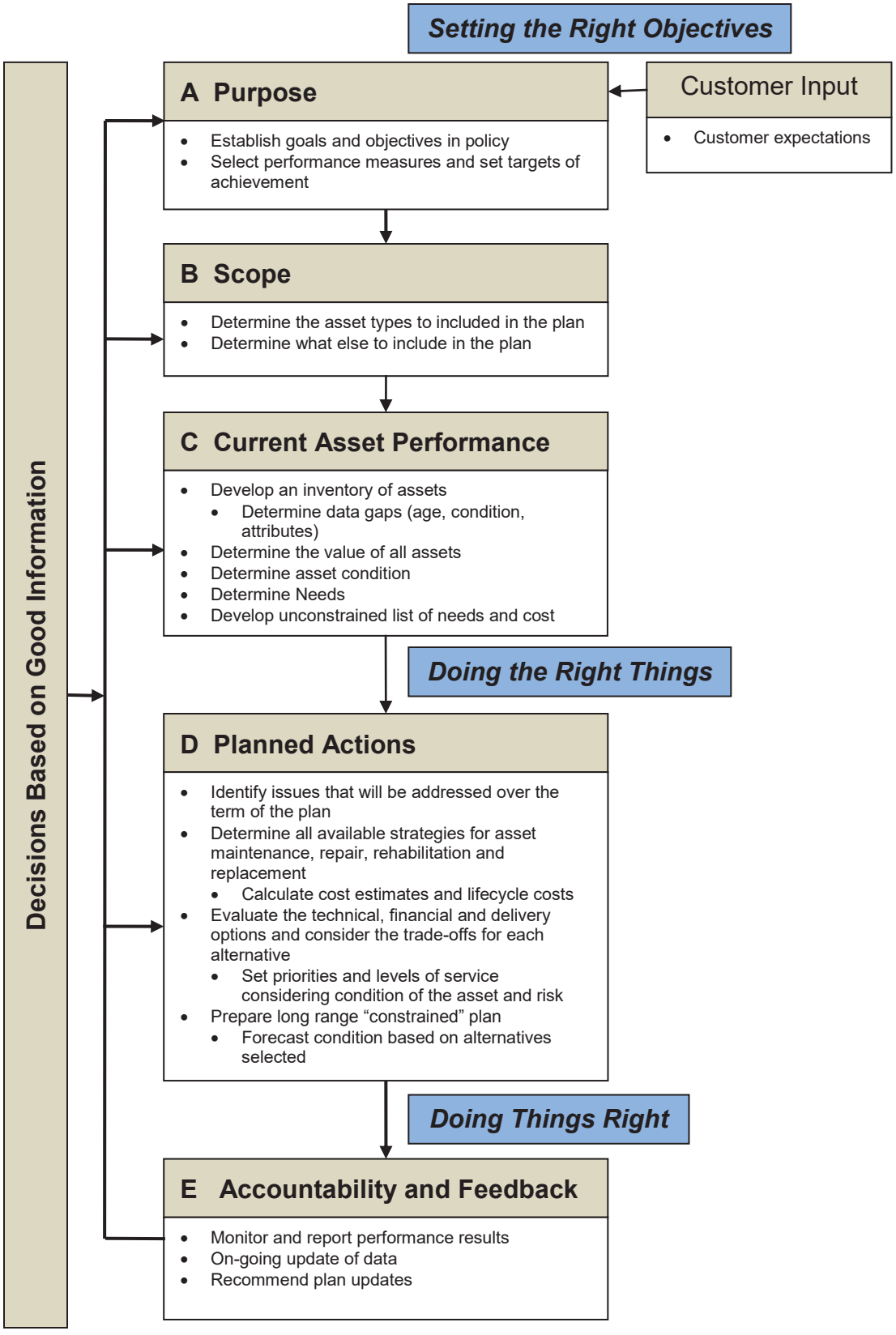
Your municipality’s processes and procedures are not changed by the implementation of asset management. Asset management improves the decision making process: by basing decisions on the plans goals and objectives; by using long range vision to guide the resource allocation decisions; by identifying and evaluating technical and financial alternatives and; by using performance based analysis to confirm achievement.

An asset management plan sets out a methodology for allocating resources based on the following key elements of asset management:

1. What do I have and where is it located?
2. What is it worth?
3. What is its condition and remaining services life?
4. What needs to be done?
5. When do I need to do it?
6. How much will it cost?
7. How do I ensure accountability?

Using these key elements the following framework (Figure 1) was built for road and bridge asset management plans.

Figure 1


Setting the Right Objectives
A Purpose
Establish goals and objectives in policy
Select performance measures and set targets of achievement
Customer Input
Customer expectations
B Scope
Determine the asset types to included in the plan
Determine what else to include in the plan
C Current Asset Performance
Develop an inventory of assets
Determine data gaps (age, condition, attributes)
Determine the value of all assets
Determine asset condition
Determine Needs
Develop unconstrained list of needs and cost
Doing the Right Things
D Planned Actions
Identify issues that will be addressed over the term of the plan
Determine all available strategies for asset maintenance, repair, rehabilitation and replacement
Calculate cost estimates and lifecycle costs
Evaluate the technical, financial and delivery options and consider the trade-offs for each alternative
Set priorities and levels of service considering condition of the asset and risk
Prepare long range "constrained" plan
Forecast condition based on alternatives selected
Doing Things Right
E Accountability and Feedback
Monitor and report performance results
On-going update of data
Recommend plan updates
Decisions Based on Good Information

Building an Asset Management Plan

Getting Started

There are a number of steps and a number of decisions that need to be made to develop a municipality's asset management plan. There are also decisions that will be required as to what is to be included in an asset management plan, what will be the focus of the plan, what programs, services, activities, processes or assets will be subject for review.

The first step in getting started is to assemble a team (Table 1) that will lead the project and build the asset management plan. The project should be lead by a champion. That person should be someone who can influence change within the organization. The team, once assembled, may require input from others as the project develops. Table 1 provides suggestions as to when input from others outside of the team should be acquired.

The first task of the team will be to pull together all current:

- Road and bridge data, including condition ratings and age;
- Policy including level of service;
- Legislative requirements;
- Renewal and replacement strategies for roads and bridges;
- Maintenance strategies for roads and bridges;
- Funding strategies for capital, operating and maintenance.

Table 1

	Elected Officials	Senior Mgmt	Customer/ stakeholder	Champion	Process Owner	Finance Staff	Team Members
Determine Scope	X	X	X	X	X		X
Policy Review	X	X		X	X		X
Program Review		X		X	X	X	X
Services Review				X	X	X	X
Determine goals and objectives	X	X	X	X	X		X
Determine programs and services		X		X	X		X
Capital and financial plan	X	X		X	X	X	X
Implement plan		X		X			X
Monitor plan	X	X		X			

Once the team knows where they are today, they will need to determine:

- The Purpose of the asset management plan:
  - Goals and objectives to be achieved;
  - Performance targets.
- The Scope of the asset management plan:
  - What assets to be included in their plan;
  - What Other considerations will be made.
- The Current Conditions:
  - What is the inventory of assets to be included;;
  - What is the value of the assets;
  - Asset condition and needs.
- The Planned Actions:
  - What issues may impact roads and bridges and how/when resolved;
  - What are the available strategies for asset maintenance, repair, rehabilitation, replacement and how much will it cost;
  - What are the preferred technical, financial and delivery options.
- How will we be accountable:
  - How will we monitor the plan and report results.

A Purpose

In the development of an asset management plan a number of business processes related to infrastructure management must be considered, including processes related to asset needs prioritization, engineering, financing and program delivery. What you are attempting to achieve via the asset management plan should be outlined early in the plan.

A1 Goals and Objectives

Resource allocation decisions are based on a well-defined set of policy goals and objectives that center on the question, “Why is the service provided and what do we expect from it” (Felio, Lounis 2009). Policy goals and objectives must be established that provide clear direction to decision makers and reflect desired system condition, level of service and/or safety provided to customers. Goals are statements that define the intent of the policy, examples include: preserve the existing road system; move goods and services efficiently and effectively; enable growth and economic development. Objectives are specific aspects of the goals to be attained (i.e. to improve ride comfort or reduce collisions).

Policy will link user expectations for asset condition (smooth roads), performance (no traffic delays) and availability (no load restricted bridges) with system management and investment strategies. Council can set user expectations without additional public input. However, in a growing municipality with a diverse population council may choose to acquire input from the public as to their expectations. Public input can be acquired via questionnaires (telephone, mailed, in person), public meetings, focus groups, etc. The results of the public input can be summarized similar to Table 2. From this simple table council and senior management can quickly gain insight into what the public deems as

important to them and what needs improvement. Additional questions may need to be asked to determine what they are not satisfied with (e.g. condition, width, capacity, parking, etc).

To confirm that the goals and objectives have been met performance targets of achievement must be established. Appendix B contains a list of key performance indicators that can be used to create a snapshot of municipal performance in a given year that will be used to develop trend lines for that municipality as time goes on. The list of key performance measures could have been much longer, but is limited to a few indicators every municipality should be able to calculate easily. Municipalities may wish to use only one or two of the key indicators or supplement the list with additional performance indicators that have local significance. The choice is yours to make.

Table 2 – Example Public Input

AVERAGE SURVEY RESULTS		IMPORTANCE		
		VERY >4	QUITE 3 - 4	NOT AS <3
SATIFACTION	VERY >4	▪ Garbage ▪ Fire		▪ Landfill hours
	SOME WHAT 3 – 4	▪ Winter Mtce ▪ Water ▪ Sewer	▪ Landfill ▪ Cemetery ▪ Library	▪ Arena ▪ Parks ▪ Museum
	NOT <3	▪ Paved Rds ▪ Sidewalks	▪ Gravel Rds ▪ Recycling	

B Scope

There is no single approach to improving how a municipality manages their assets. Where to focus your efforts in the development of an asset management plan, what to do and how to do it all depends on your municipalities priorities, needs and capabilities. How you answer a few questions may assist in determining the projects scope:

1. Does the municipality's current long range planning consider the useful life of an asset and the total lifecycle costs for an asset?
2. Does current long range planning take into account alternative strategies for asset maintenance, preservation, renewal and replacement?
3. Does your current management approach provide guidance for capital and financial planning?
4. Is the allocation of resources for the provision of programs and services consistent with policy goals and objectives?
5. Do you use performance measures to confirm achievement?

B1 Assets to Include

Asset management plans can be developed for all assets all at once. This can be a very onerous task for a small municipality and prevent the project from moving forward. A preferred approach would be undertaking a staged implementation where assets are added to the plan over time. Table 3 provides a list of road and bridge assets that may be included in an asset management plan. A municipality may choose to exclude some assets from the plan altogether and concentrate efforts on the primary (more expensive) road, bridge, sewer, water, sidewalk and building assets.

B2 Other Considerations

An asset management plan may include improvements and integration with a municipality's current capital and financial planning tools. The municipality may also want to use new technologies such as work management software and Global Information Systems to assist in the management of assets. The project scope can be determined once the answers to: what to include; when to include it and; what tools to use are known.

Table 3 – Example Asset Types to include in an Asset Management Plan

Asset Type	Asset	Included in Asset Management Plan		Does the asset have				Comments
		yes or no	When to include in plan	Condition ratings	age	Geometric values	Sufficient attribution	
Road Section	Unpaved road							
	Paved road							
	Surface treated road							
	Guiderail							
	Street lights							
	Sidewalk							
	Curb							
	Catchbasins							
	Catchbasin leads							
	Storm sewer							
Structures	Bridges >3m span							
	Culverts >3m span							
	Culverts <3m span							
	Noise walls							
	Retaining walls							
Signs	Regulatory signs							
	Warning signs							
	Information signs							

Asset Type	Asset	Included in Asset Management Plan		Does the asset have				Comments
		yes or no	When to include in plan	Condition ratings	age	Geometric values	Sufficient attribution	
Traffic Signal Systems	Signal head							
	Pole							
	Controller cabinet							
Fleet	Pickup							
	Combination tandem Plow truck							
	Sweeper							
	Backhoe/loader							
Equipment	Grader							
	Brine making							
Facility	Patrol yard							
	Salt storage							

C Current Asset Performance

C1 Asset Inventory

Asset management plans are built on quality, reliable data. The process to formulate an asset management plan does not begin until good data is available. Sufficient data on the attributes of a road and bridge, the geometrics, age and condition must be readily available and in a format that enables analysis of the technical, financial and service delivery alternatives. It is true that an asset management plan is not a one size fits all document. Asset management plans must be customized to meet the municipality's needs. However there must be some standardization. The public will always want to know how their city, town, village or township is doing as compared to others. Senior levels of government making tough funding allocation decisions require comparable information. This will necessitate standardization of the data collected and reported along with standard key performance indicators. Appendix B provides a list of standard data elements and key performance indicators that all municipalities should collect and keep up to date for the road and bridge assets included in their asset management plan.

A municipality may maintain a robust database for all asset types, but far too often databases are incomplete in that they have information for some but not all asset types or they are missing key data. If data does not exist for all roads or all bridges a plan must be put in place to fill the data gaps before moving forward with the asset management plans development. Before heading into the field to collect data municipalities must grapple with the question: How much data is too much? Every

municipality will need to assess the purpose and value of the information it needs based on the reasons for, and the costs of, collecting and maintaining it. Processes must be set in place for the gathering of the initial data and the ongoing maintenance of the data.

Staff must be aware of the data required for applications such as capital planning and work management and make plans for collecting that data. Once gathered, data for all asset types included in an asset management plan data should be stored in a database that can be shared with all departments corporation wide. This database must be capable of establishing the relationship between assets over, under and beside a road and bridge as well as determine how these different asset types interoperate.

Road assets will require segmentation into manageable sections to determine which road segments require only routine maintenance, which segments require preservation and which require replacement. There is no absolutely right or wrong answer as to how long may be too long for a road section. Some tips for segmenting roads assets are:

- If the surface type changes;
- If the geometry changes;
- If the roadside environment changes (urban to rural);
- If the classification changes (local residential to collector);
- If the traffic volume changes significantly (% trucks) and;
- If the condition of the road surface changes dramatically over an extended length (e.g. >150 meters)

C2 Asset Value

Knowing what an asset is worth is different than knowing the capital requirements. A municipality acquires or builds a tangible capital asset. Once the gross cost (gross book value) to acquire, construct or develop a tangible capital asset is known, that cost is amortized over the assets useful life.

As work is completed on a road or bridge that work will need to be capitalized and amortized if the value of the work completed exceeds the capitalization threshold set by the municipality in policy. Asset managers and treasurers will need to work together to ensure that all costs for asset betterments, replacement and write downs, if any, are captured and recorded against the asset. Meeting the Public Sector Accounting Board requirements may have an impact on how the municipality will segment linear assets, as partial asset replacement (replacing only 1 kilometre of a 2 kilometre long linear asset) may be additional criteria to add above.

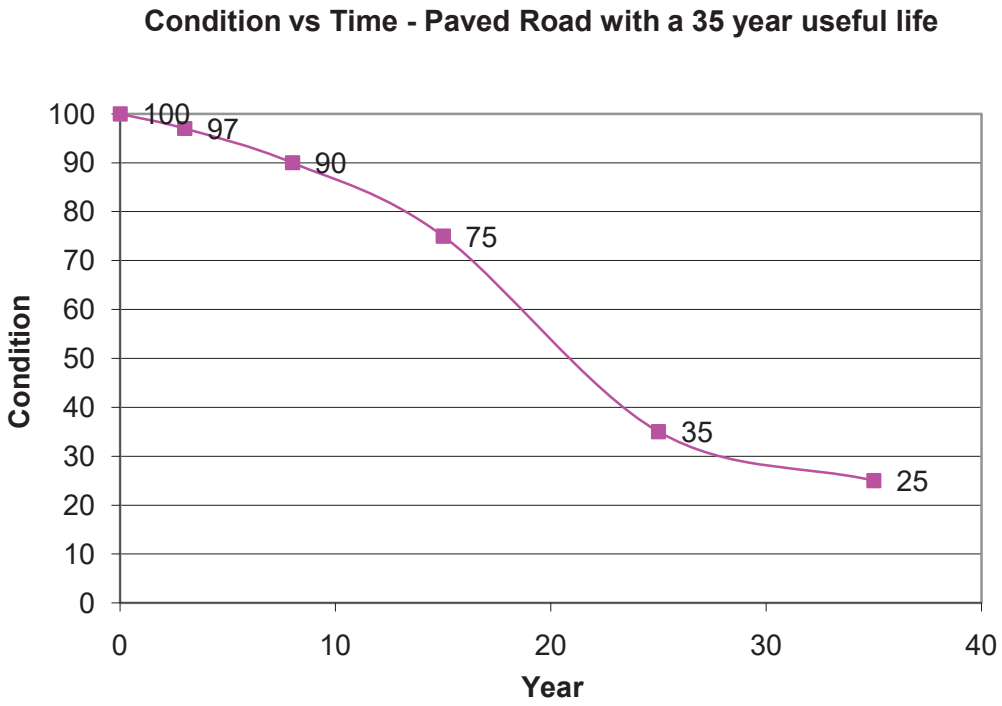
C3 Asset Condition

There are several rating methodologies for roads and bridges. The most commonly used methods are the Pavement Condition Index[1] (PCI) and the Bridge Condition

[1] Manual for Condition Rating of Flexible Pavements SP-024, Manual for Condition Rating of Surface Treated Pavements SP-021 and Manual for Condition Rating of Gravel Surfaced Roads SP-025 are included in the road inspection module of Municipal DataWorks.

Index[2] (BCI). PCI rates the severity and density of 15 specific distresses in pavement while a BCI value is calculated based on the condition of the elements of the bridge. Once the condition is known, the remaining service life of the asset (whether the asset is brand new or near the end of its useful life what you are managing is the remaining service life of the asset) can be determined using a chart similar to Figure 2. Using this chart; if a road section with a 35 year useful life has a current PCI condition rating of 80 the road section would be at an estimated age of 12 years. Within 3 years the road section should be at condition rating 75. At this condition rating a renewal strategy, as identified in the asset management plan, would be applied. Likewise at condition rating 35 in year 25 of the assets useful a second strategy would be applied and finally the asset replaced at year 35 or condition 25.

Figure 2



Condition based planning can also be applied to maintenance activities. The Ontario Good Roads Association has a condition based Maintenance Planning and Budgeting[3] document that includes a methodology for setting maintenance priorities.

C4 Asset Needs – Unconstrained

Municipalities are responsible for many different asset types. These different asset types all deteriorate at different rates and all have different priorities and timing for maintenance, renew and replacement. Difficulty has occurred when major renewal or

[2] Ontario Structure Inspection Manual requirements for the inspection of the elements of a bridge are included in the bridge inspection module of Municipal DataWorks
[3] Maintenance Planning and Budgeting – OGRA, October 2010

replacement of these various asset types coincides. Developing an unconstrained list of needs identifies the cost and timing of actual events for major renewal or replacement.

As the inspector determines the condition of roads and bridges, the NOW, 1 to 5 year and 6 to 10 years Needs should also be determined. Needs include all future work require to preserve, renew and/or replace a road or bridge. Once needs are known the NOW and 1-5 year work must be prioritize. You may choose to set priorities for the 6 to 10 year needs, but this may not be necessary. Priorities can be set at the PCI and BCI level, but this sets up a worst first program. There is nothing wrong with worst first if there were no other factors to consider. There are several methodologies that use various criteria to prioritize work. The former Road Inventory Management System (RIMS) used a calculation that included condition and traffic volume. The Road Sufficiency Index (RSI) calculates a value for each of 9 factors and subtracts the sum of those values from the PCI value. These factors look at issues such as substandard horizontal and vertical alignment, substandard stopping sight distances, collisions and other factors. RSI would require an engineer's input to determine the correct value for most of the factors. Pavement management software often has its own priority setting methodology and each methodology varies slightly depending on the vendor. A Pavement Priority Number methodology has been included in Appendix D for those wishing to use a simple manual method of priority setting. This methodology rates 4 readily available factors which are then subtracted from the PCI value.

For bridges, the Bridge Sufficiency Index subtracts the sum of 4 factors from the BCI value. As a bridge is a complicated component of the road system requiring an inspection by a professional engineer every second calendar year, the engineer should be instructed, as part of the work, to identify and prioritize the repair, renewal and replacement work for all bridge assets in the inventory.

D Planned Actions

D1 Safety, Capacity, Condition and Other Issues

An asset management plan includes a list of work that will be completed over the term of the plan. That work is often generated from a list of issues that impact roads and bridges. The issues can range from safety concerns, capacity, condition and any other relevant issue that may be a potential risk to the network. There may be temporary controls in place to deal with the issue, but the plan should identify how, when and the cost of addressing the identified issue.

D2 Available Strategies – maintenance, renewal, replacement

Developing an asset management plan means it's time to look at other ways of completing work or providing service. There are numerous pavement management strategies that can be applied to pavements that include:

- Asphalt rejuvenators
- Crack sealing
- Chip sealing

- Slurry sealing
- Micro surfacing
- Ultra thin overlays - ≤25mm
- Overlay - ≥50mm
- Grind and overlay
- Cold-in-place recycling
- Hot-in-place recycling
- Any other relevant strategy

The strategies used and the timing of the work will vary depending on the type of road (freeway versus residential) location of the road (urban versus rural) and availability of local contractors with expertise in undertaking the selected strategy. When to apply a strategy is dependent on the assets condition. Asset age can be used as an alternative method for program planning. However, asset age does not take into consideration that well maintained older assets may not require extensive rehabilitation, preventive maintenance, or anything more than regular routine maintenance. In order to properly determine which strategy to apply to an asset the condition of that asset must be known.

Completing work is also dependant on what type of a program the municipality wishes to use. If a pavement preservation program is put in place, municipalities will be maintaining and applying selected strategies to pavements even when there is nothing visibly wrong with the pavement. The benefits of applying a pavement preservation program include:

- Extend useful life of the pavement (i.e. delay rehabilitation/replacement)
- Lower overall costs
- Improved overall system condition
- Improved safety
- Fewer emissions – from vehicle using the road and by delaying major work/ replacement

For every strategy, including replacement, and for each asset type included in the asset management plan a cost will be calculated. Costs should be based on local experience in the completion of similar projects. Replacement cost should be calculated using a design criterion that would reflect the future traffic volumes or usage with appropriate depths of road base and sub base. The costs for the NOW and 1 to 5 year needs should be fairly accurate. Beyond that, estimates of costs enable planning for any large expenditure items expected in the 6 to 10 year timeframe and beyond. Where assumptions have been made, the basis for these assumptions should be provided. As costs are calculated, funding strategies also need to be identified. Funding for capital projects typically comes from local property tax, reserves, grants/subsidies, local improvements, development charges or long term debt. With each funding strategy the plan should identify the limitations and sustainability of that funding strategy.

Don’t forget about maintenance. A good maintenance program, keeps roads and bridges open to traffic or ensures that the useful life of the asset is optimized. Developing an asset management plan is the time to consider alternatives for service

delivery, improved program planning, improved quality of service, improved timeframes for delivering service, etc. An "improvement" may also include the potential to reduce the service, or dispose of an asset. In order to consider the alternatives, the quality of service provided and the timeframe within which to provide service must be established in policy (level of service). Knowing the level of service is important as it establishes the customer's expectation for service and provides a means to measure performance.

D3 Evaluate of Technical, Financial and Delivery Options

Proposed long term financial projections should be based on a minimum 20 year timeframe developed from:

- Levels of service and/or performance targets of achievement;
- An analysis of the likely growth in population and household distribution and the resulting future demand;
- An assessment of the risks (e.g. asset failure, natural hazards) that the assets are exposed to and the possible mitigation measures
- Recognition of lifecycle asset needs and costs;
- Review of historical cost trends.

In order to select the preferred strategy(s) and delivery options that results in the lowest total cost to a municipality over the useful life of the asset, the lifecycle cost must be calculated. Lifecycle costs are the sum of all recurring operating, maintenance and renewal costs plus any other one-time costs that may be incurred over the full useful of an asset. This includes purchase price, installation/construction cost, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life. Lifecycle costs are usually developed based on current year costs. These costs will need to be updated on an on-going basis. In recent years, many project specific grant programs have been available for infrastructure each with their own priorities and objectives. Taking advantage of these grants may require adjustments to the asset management plan and to the funding decisions made. Asset managers and finance departments will need to work together.

Once all the lifecycle costs for each strategy and delivery alternatives are known, trade-offs can be made. Trade-off analysis requires you to make a choice and when you make that choice you forfeit another choice, in other words you are trading off something for another. Trade-off analysis is a way to consider alternative resource allocations (Table 4). The analysis involves agreeing on the consequences of shifting funding from one program to another and making a judgment as to which technical option or resource allocation option is the most favourable. In trade-off analysis you must know what can be traded with what and what are the limits of acceptance.

Table 4 – Example Program & Service Alternatives

Program	Service	Objective	Performance Target	Alternatives		Trade-offs	
				Technical	Financial	Alternatives	Cost
Capital	Pavements	Reduce current congestion levels	Within (x) years reduce the current hours per day roads congested to (x)	• Do nothing • Provide alternate modes of transportation to relieve congestion • Add continuous left turn lanes • Intersection improvements	• Finance from current year budget • Finance from development charges • Incur long term debt		
Pavement Maintenance	Patching	Provide services that meet level of service targets	90% of patches intact one year later	• Do nothing • Use premium cold mix • Use hot mix asphalt, with service delivered by in-house staff • Use contracted services to complete operation	• Current year budget		

D4 Multi Year Plan – Constrained

Once all the alternatives have been examined, the preferred options selected and cost estimates calculated, a long range asset management plan can be assembled. The plan will include:

- The capital projects to be completed within the term of the plan and whuch are constrained by the financial limitations;
- Identify any other issues or process changes to be dealt with over the term of the plan, include the timing of implementation and cost;
- Identify funding shortfalls, if any;

- Identify backlog of Needs at the end of the term of the plan, if any.

E Accountability and Feedback

E1 Monitor the Plan

Monitoring the delivery of programs and services can:

- Provide feedback to senior staff, council and the public that identifies whether or not programs and services have been delivered on time, within budget or at a level which meets customer expectations
- Identify a problem that requires staff and council to remedy the problem by making adjustments to policy, program delivery or select alternate technical, financial or resource allocation options.

Accountability means doing what you said you would do. An annual report on the delivery of programs and services and progress made in achieving the plans targets should be written. This report will stimulate the feedback process and provide senior staff, council and the public with information as to whether or not programs and services have been delivered on time, within budget or at a level which meets customer expectations. In reporting results, ensure that the performance measures used in the report are the same measures as used in previous reports even if the measures show unfavourable results. Sometimes things just don't go according to plan. The public will not trust the results if there is an attempt made to hide poor performance by using different performances measures.

E2 Performance Measures

Information on system performance in terms proposed targets and values actually achieved in the field must be readily available. To optimize an asset management plan, performance of the assets should 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 risks. Policy objectives are translated into performance measures that are used for both day-to-day and strategic management.

Performance measurement is a process of assessing progress towards achieving predetermined goals/targets. The ultimate goal of a performance measurement program is to establish a series of measures that allows the municipality to determine desired results, find its strengths and weaknesses and consider alternative solutions to improve performance. It measures the efficiency in which resources are transformed into services, the quality of the services and the effectiveness of the program. Just like the asset management plan must be customized for your municipality, performance measurement is not a one size fits program either. Every municipality will require performance measures tailored to their local priorities, size, goals and objectives. A performance measurement program requires a balanced set of a few vital measures:

- To produce timely reports at a reasonable cost;
- To make available information that can be easily shared and is understood by most (if not all);

- To support the municipalities values and the relationship it has with all stakeholders.

Two key thoughts that can assist you in determining what is to be measured: it is important to measure what matters to your municipality; once you determine what matters, "what gets measured gets managed" (Osborne & Gaebler – Reinventing Government, 1992).

Every level within the organization should know what level of performance they are required to achieve. Measures should be established at: the strategic level reviewed by council and senior management; the program level a responsibility of program managers and; the service/activity level a responsibility of front line staff. Performance measurement should be used consistently for capital and financial planning, program evaluation, project evaluation, trade-off analysis, system monitoring, reporting and feedback. Appendix C provides an example of the goals, objectives and measures that could be used for a paved municipal road program.

A series of Key Performance Indicators have been provided in Appendix B as a starting point for selecting appropriate performance measures.

E3 Update Data

As assets are purchased, maintained, renewed or replaced the database used to inventory the assets will need to be kept up-to-date. Good decisions are based on good data; it is only through the updating of the database that an asset management plan remains valid.

E4 Update Plan

An asset management plan is a living document that will be updated from time to time as: costs change; as the municipality grows; as the demographics change; as strategic goals and objectives change. A suggested minimum would be after an election and before the incoming council has its first budget deliberations.

Decisions Based on Good Information

Asset management relies on good Information in the development of policy, the delivery of programs and services and the reporting of accomplishments. The top 10 characteristics of good data are:

1. Consistent – the attributes of an asset type must be consistently collected across all assets within that asset type. For example, if paved surface width is collected it should be collected for all road sections.
2. Reliable – As maintenance, rehabilitation and replacement occurs, data on the asset must be updated once the work is complete in order for the municipality to be able to rely on the data for decision making.
3. Accurate – recorded measurements must reflect actual condition. Every measurement does not require millimetre accuracy. But when you state that a sidewalk is 1.5 metres wide, it is indeed that measurement.
4. Validity – data should be recorded with the correct process including any rules or definitions applied.

5. Timeliness – data should be updated and available for its intended use within a reasonable timeframe after a lifecycle event.
6. Relevant – data should be relevant for the purposes it will be used.
7. Complete – the data must meet the information needs of the municipality and the requirements for data collection clearly specified by the municipality.
8. Accessible – information needs to be in formats that can be accessed by users when and how they need it. Data locked in expensive proprietary systems adds cost and slows down processes.
9. Integrated – data should be created and maintained so that it can be integrated with other data and process across the organization. Assets with "orphan" ID's cannot be cross-referenced to other datasets for analysis purposes.
10. Standard processes – processes for data creation, edits and backups need to be defined so that users know what and where the one and only current version of the data resides. Multiple versions of the same data can cause confusion, misuse and liability.

Benefits of good information are

1. Trust – the data can be trusted for use in decision making
2. Reduced liability – good data will reduce instances where the municipality is at risk of actions based on incorrect or incomplete data (e.g. digging in the wrong place).
3. Improved – budgeting by knowing the numbers are based on quality data
4. Improved – knowledge of your assets
5. Improved customer response – knowing the data is good and where to get it reduces time required to respond to queries

Benefits of Asset Management

1. Well defined policy goals will guide the decision making process for both staff and council and ensure investment priorities are achieved and that program delivery meets public expectations.
2. Asset management provides the ability to show how, when and why resources were committed. Knowing the total investment required to maintain infrastructure assets at acceptable levels of service supports sound decision-making.
3. Condition based planning will reduce the amount of unplanned or high priority maintenance activities that requires a response before the next budgeting cycle occurs. Decisions can be made between competing asset needs that ensure the priorities of each asset type are met.
4. Monitoring the performance of roads and bridges over the long term will ensure an adequate level of service is maintained and measure the progress made in achieving performance targets.
5. Life cycle costing provides knowledge as to the total cost of asset ownership. Lifecycle costing identifies the investment required to operate, maintain, renew and replace an asset. Determining how much it will cost enhances financial planning and helps decision-makers to select the most cost-effective options.

6. Funding decisions can then be made with a view to the total cost to be incurred over the useful life of an asset.
7. Customer Satisfaction!

Conclusion

"In managing existing infrastructure, a great outcome is attained when the desired level of service in terms of the level of safety, physical condition, and capacity are provided reliably at the minimum life cycle cost. Doing the right thing, at the right time, involves knowing and actually doing the most cost-effective maintenance, repair, rehabilitation or replacement activity at the right time throughout the entire life cycle of the asset" (Sparks 2007).

Asset management plans are built on a premise that better information will lead to better decisions and a better way of doing business. Asset management focuses on the benefits of investment, as well as its costs and takes a comprehensive view of all municipal resources. Asset management is an improved way of doing business that helps a municipality respond to increasing system demands, aging infrastructure and build, maintain, operate, renew and replace infrastructure cost effectively with limited resources.

Standardizing performance indicators and the development of an asset management plan is important for the eventual roll-up of information at regional, provincial/territorial or national levels. The availability of information at the provincial and federal level is important for their understanding of the total value of municipal infrastructure assets, the capital reinvestment being made today and how wide the infrastructure gap is today and if that gap will only get wider in the future. A standardized framework will avoid communities across Ontario (and possibly Canada) developing their own tools with little or no knowledge of what exists elsewhere, spending limited resources on development which may ultimately make the roll up of information nearly impossible.

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Appendix A - Case Studies
Hamilton

The City of Hamilton is a Great Lakes port city at the western end of Lake Ontario in the Canadian Province of Ontario. Hamilton has a population of over 500,000 and lies midway between Toronto, ON and Buffalo, NY. Its major physical features are Hamilton Harbour, marking the northern limit of the City, and the Niagara Escarpment running through the middle of the City across its entire breadth, bisecting the City into upper and lower parts. Hamilton is also significantly impacted by all of the major modes of transportation, namely, rail, air, water and road. Hamilton's population is expected to increase to almost 623,000 by 2031 at the current growth rate.

Executive Summary:

Since 2001, Hamilton has been applying Asset Management (AM) principles across our transportation, water and wastewater assets, and more recently since 2006, for our facility and park assets. Hamilton has a dedicated AM group of 22 staff that is responsible for buried infrastructure (water and wastewater distribution and collection) and aboveground assets (pavement, bridges, parks, corporate and community facilities). A manager and two senior project managers oversee the section. They are responsible for a diverse group of disciplines including surface assets, buried infrastructure, finance, and information technology. The AM group resides within the Environmental & Sustainable Infrastructure Division, within Public Works. The AM group sets and facilitates all AM policy and oversees and coordinates all infrastructure projects. The General Manager of Public Works ensures that the AM policy is carried out across other divisions and promotes the policies and practices across the corporation.

The AM group is responsible for the citywide condition assessment of surface and subsurface assets. The condition assessment is used to forecast and schedule appropriate rehabilitation and reconstruction activities to produce an annual capital budget program. The AM group monitors current levels of service, life cycle trends and deterioration models to plan and develop an integrated 3- to 5-year detailed budget, a 20-year long-range capital budget and a 100-year financial forecast to predict the City's infrastructure investments.

The City's vision for an AM program began in 1998 when senior managers were asking serious questions about asset sustainability and funding issues. They learned about the international model for managing assets (as characterized in the International Infrastructure Management Manual). The managers began to apply AM principles and developed a financial sustainability plan. In 2000 the Province of Ontario required the amalgamation of the Regional Municipality of Hamilton-Wentworth and six other municipalities into one city. The reorganization caused by the amalgamation gave managers the impetus for creating and funding an AM group.

Everyone involved recognized the need to move away from the "*silo mentality*" of keeping asset groups separate and promoted a more integrated approach to dealing

with the economic and geographic diversity of the seven municipalities conjoined during the amalgamation.

Hamilton's AM approach is an integrated, bottom-up approach that gained momentum after the amalgamation when top executive managers took advantage of the need to reorganize. Today, the city council highly values the City's AM approach. A council priority is to deliver quality services at the lowest possible tax structure. Information provided by the AM group helps council members address their constituents with respect to infrastructure projects and necessary funding, and it helps them make the business case for projects.

Constant communication and education of City Council members has been key to Hamilton's successful AM program. The communication and education strategies between AM staff and council members include: annual one-on-one meetings, council workshops, City tours and developing informational materials for specific issues. These approaches have built relationships and trust between City staff and City Council and have built credibility for the AM program.

Our City is ahead of most cities in North America in implementing generally recognized AM principles and practices and is working toward its goal of development of an Enterprise Asset Management Plan.

Our City has seen many benefits of applying the AM principles. Staff members feel that their program is validated and proven because of the many representatives from U.S. and Canadian cities that have sought Hamilton AM staff expertise and the many inquiries about our City's AM program. These discussions with other cities have provided significant value in developing Hamilton's and others' theories and approaches to AM. It was in light of these discussions that Hamilton initiated a national AM group known as CNAM (Canadian Network of Asset Managers) with it's first official workshop held in Hamilton in 2007. This group has grown rapidly and was registered as a not for profit association in 2009 with currently over 100 members across the country. The board of directors consists of 13 municipal representatives and 3 private business representatives voted on by the members. The 13 municipal board members are regional across the country and represent 10 cities. To date, the group has successfully run four (4) national working sessions drawing participation from more than 175 asset management professionals annually, who represent more than 40 municipalities and15 private sector organizations across the country and internationally.

Other benefits include the following:

- Via the AM program, staff can demonstrate to City management and the public that the City is using its resources cost-effectively.
- The AM process and information produced has sped up the capital budget development process.
- The process has taught all players to see the community as a whole and how the assets function together to deliver a higher quality of life.

The City has produced *State of the Infrastructure Reports on Public Works Assets* since 2005.

The reports have served to promote support for the AM program from staff, politicians and the public. The focus of the reports is to evaluate the current state of various public works assets within the City, to predict their status in 2020, identify major funding gaps and recommend policy development. The reports include asset operating costs and capital to project revenue requirements over the life cycle of the asset. The City also develops annual State of the Infrastructure Report Cards to provide an easy-to-understand reference that is updated regularly to track the City's path toward sustainability.

The City's Public Works Department developed a strategic plan in 2007 titled *Innovate Now! A Compass to Public Works to 2017*. The strategic plan defines the City's fundamental purpose, explains its vision for 2017, identifies top priorities critical for achieving the vision and plans for sustaining the momentum for implementing its strategies.

Asset Management has worked for the City of Hamilton and is now an integral element of our planning for infrastructure replacement or renewal. Everyone and I do mean everyone is on the same page and can readily advise the inquisitive public if and when their streets, sewers and/or waterpipes will receive a facelift. I encourage you to at least consider AM…it just might work for your community.

Lessons Learned:

The City has learned many lessons developing and implementing its AM program. The General Manager of Public Works recognizes that getting the process started can be vastly overwhelming and that it is difficult to even determine where to begin. His advice is to follow Hamilton's lead and "just jump in." He said that they "made of lot of mistakes and asked for forgiveness (instead of permission)." His bottom line advice is, "Do not be afraid to step forward—even if you fall on your face, you are still moving forward." Another lesson learned is that it is important to form a strong relationship with decision makers (i.e., city council) to build a successful and credible AM program. The State of the Infrastructure report has also been important in setting the program's framework and as a go-to-guide for staff and council.

Other insights offered by staff and managers to others initiating AM programs include the following:

- Do not reinvent the wheel. Build on what has been done by other communities. Follow the *International Infrastructure Management Manual*—it is cradle-to-grave in its approach.
- The City realized that *assets were becoming liabilities* and that coordinating and approving every capital project through the AM group was critical.
- The authority given to the AM group to control the budget is key to making the process work.

- Strive to achieve *quick wins* or early demonstrations of clear improvements in the AM process. Also show early that you have better information to improve decision making.
- It is important to educate the public and council on the value of the infrastructure. Clearly demonstrate the critical need to change the current practice. Hamilton did the latter by developing forecasts for the City's overall asset life through 2031.
- Use participatory strategies to involve users in changing the current practice, such as council tours and presentations to the public.
- The biggest challenge is on the people side—getting staff, politicians and public to buy in and participate in the process. A major challenge is to convince people to change their mindset; even getting them to listen can be a challenge.
- Upper management support is essential to the success of an AM program.
- People who are willing to play in an unrestrained format (i.e., they have open minds and an innovative spirit) are valuable to the process.
- Staff and managers must exercise patience with all parties involved.
- Staff had to break through the mindset that AM was not a data system and teach people that it goes beyond that—AM is a business model, a way of thinking and making investment decisions about physical assets.
- Departure of key people has a huge effect on the AM process, and lack of adequately trained staff can be a major challenge.
- Be tolerant of mistakes because it is the only way to move forward and improve.
- Be willing to share knowledge and experience with peers. Improvements can be made as an industry much quicker than as individual cities.

Benefits of AM:

A key benefit the City has realized from its AM program is the strong working relationship it has built between the AM group and city council. The council has fully accepted the AM principles and practices and recognizes that the AM program helps them do their job and that they are *doing the right thing* for their community. The council has confidence in the funding requests made by the AM group on behalf of the Public Works Department, and funding requests are more easily approved. The council has embraced the AM policies and can better relate return on investment data to funding decisions. The AM program has benefitted greatly from working to obtain buy-in from council members.

Constant communication and education of council members has been key to Hamilton's successful, sustainable AM program. Every year, the asset managers meet with every council member to review the latest 3-year capital plan. The managers spend a day with each council member and update them on the status of the AM program. Staff members refer to these meetings as Council Boot Camp. Also once a year, the AM group takes the mayor and council members on a bus tour to every ward. The City tours with council members are very well received and are considered a *reality check* for members to

present their specific issues and compare issues with other wards. This approach has helped the AM group reduce hesitation from council members to promote projects in other wards. The AM group also provides ward maps to each council member denoting current and future public works projects and meets with council members throughout the year about specific projects. The AM group also provides information to council members when they are responding to constituents about the status of specific projects.

Additional beneficial outcomes that City staff members have attributed to the AM program include the following:

- The process has taught all players to see the community as a whole and how the assets function together to deliver a better quality of life.
- Via the AM program, staff can demonstrate to city management and the public that the City is using its resources cost effectively.
- The AM process, and information produced, has sped up the capital budget development process.
- Now AM is an expectation, and the demands are greater for how and what to deliver.
- The AM process sets expectations and raises the understanding of community needs.
- The council asks more informed questions now and has asked that the AM program incorporate other areas, such as parks.
- The AM process enabled the City to provide a better and more efficient level of service—the AM group is a *one-stop shop*
- The City now is better able to quantify what assets it has and what they require to sustain performance.
- AM staff members are recognized by their peers as experts on the AM process and have been asked to speak at a number of conferences across North America. This reinforces that the City is doing the right thing.
- The finance department now reports on asset deficits and uses AM concepts in its budget projections.

What's Next?

After the initial impetus, Hamilton's approach to implementing AM practices has been largely *bottom-up*—that is, driven by concerted but rather separate efforts within each sector (Water and Transportation) loosely integrated by the co-managers. This strategy (as opposed to a *top-down* approach driven by a highly integrated roadmap) allowed the City to adopt best practices at the asset level faster. Hamilton will continue to work toward developing an Enterprise Asset Management Plan. Staff members say a challenge they have is that their strategies are not adequately documented because they simply have not had the time to devote to it. The next step, which is currently underway, will be to take the two frameworks that exist—one in water and wastewater, one in transportation—and pull out the commonalities to set a common AM framework.

The City has achieved sustainability with water and wastewater linear (pipe) assets at current levels of service in 2009—a remarkable goal for the AM program. Note: I have referenced only linear assets here as the plant program, and in particular the plant expansion, would effect the sustainable projection.

Another key next step for the asset management program is a public engagement process to involve Council, staff, citizen groups and the public at large. The ultimate goal of this process will be to establish infrastructure levels of service that the current and future community want and are prepared to pay for, in the most cost effective way. It will set new targets for sustainability across all asset categories which are balanced with community affordability.

Case Study – North Bay

Executive Summary

Most Canadian municipalities are struggling to maintain existing infrastructure under current tax and rate levels. They continue to deal with downloaded responsibilities and, at the same time, face growing needs to maintain and renew aged and decaying infrastructure.

The focus for asset managers has been impacted by the introduction of Bill 175, the Sustainable Water and Sewage Systems Act in 2002, and the upcoming implementation of "Full Cost Accounting" through PSAB, which is scheduled for introduction in 2009. The emphasis is now being placed on not only knowing the true cost of providing services to your customers today, but also understanding what will be required to maintain the services virtually in perpetuity (or as long as they are required), through the use of life-cycle costing. In other words, we are moving towards Sustainable Asset Management.

As part of Stantec's assignment to advise City staff on the implementation of asset management philosophies, within the City of North Bay, we have developed this State of the Infrastructure Report (State of the Infrastructure Report) using Life-cycle Analysis covering the City's water distribution system, sanitary sewer system, and road network. The approach utilized within this assignment is firmly grounded in the asset management principles encapsulated in the Federation of Canadian Municipalities InfraGuide, and has been successfully applied in other Cities, including the City of Hamilton, who was awarded the 2005 InfraGuide National Award for Excellence for their State of the Infrastructure Report.

Asset management is not just a set of procedures, it is, in fact, a philosophy and requires a significant change in organizational culture, as well as at the community and political levels. This change will not occur overnight; however, the State of the Infrastructure Report and associated Report Card will provide City staff with a series of important tools, which can be used to begin the education/communication process. For this to occur the State of the Infrastructure Report was written in plain language, with explanatory text; it is a communication document, which is based upon reasonable technical and financial assumptions.

This report is based on a high-level analysis of the replacement, rehabilitation, and maintenance needs of the City's Public Works Assets. This includes the preparation of a report on the current and assumed future state of these assets. In addition, a Report Card was produced that evaluates the current state of various Public Works assets within the City, and predicts their status in 2025, should the current management approach be maintained. The following assets were included in the study, with Water Pipes, Sanitary Pipes, and Road Sections being reviewed:

1. Water System: Pipes, Valves, Hydrants, Chambers, Industrial Meters, Service Connections, Storage Reservoirs, and Booster Stations.

2. Sanitary System: Gravity and Siphon Pipes, Forcemains, Manholes, Services, and Pumping Station Structures and Equipment.

3. Road Network: Road Centreline, Sidewalks, Curbs, Signs and Supports, Lighting, Walkways, Retaining Walls, Signals, Pavement Markings, Bridges (includes Culverts >1.5m), Level Railroad Crossings, Shoulders, Guard Rails, Ditches, and Driveway Culverts.

It must be noted that the analysis utilized for the State of the Infrastructure Report excluded rehabilitation for all assets with the exception of road sections.

The Report Card produced within the State of the Infrastructure Report has been developed to provide an easily understood reference that can be regularly updated to document investment gaps and progress the City is making towards sustainability. The State of the Infrastructure Report and associated analysis are

strategic documents that identify trends and highlight possible issues involved in delivering services and maintaining the assets for those services. Recommendations within the report have been provided to assist the City with the continued deployment of asset management practices. This “Top Down” analysis complements the existing “Bottom Up” Asset Management practices that have been initiated by the Department and will serve as a catalyst for communication amongst stakeholders. The State of the Infrastructure Report will also assist in the development of more detailed tactical and operational plans aimed at identifying expenditures needed to provide service in a cost-effective, sustainable manner

In November 2003, the National Guide for Sustainable Municipal Infrastructure published a Best Practice for Municipal Infrastructure Asset Management. This publication included a listing of seven questions which could be used as a framework for an asset management plan. The State of the Infrastructure Report employs this framework:

1. What do you have and where is it? (Inventory)
2. What is it worth? (Costs/replacement Rates)
3. What is its condition and expected remaining service life? (Condition and Capability Analysis)
4. What is the level of service expectation, and what needs to be done? (Capital and Operating Plans)
5. When do you need to do it? (Capital and Operating Plans)
6. How much will it cost and what is the acceptable level of risk(s)? (Short- and Long-term Financial Plan)
7. How do you ensure long-term affordability? (Short- and Long-term Financial Plan)

The City’s Public Works assets have a replacement value of over $1 billion. The breakdown of those replacement values per serviced property, based on approximately 25,600 serviced properties in the City, are shown in Figure E.1.

Based on the analysis results, the 2008 operating and capital revenues (as supplied by City Staff) fall short of the sustainable revenue requirements. Table E.1 illustrates the magnitude of this deficit and the percent impact, should rates or levies be increased to address this shortfall. The analysis projects the finance requirements of each program over a 100 year period, to include the full life-cycle of each asset type. It should be noted that the values presented for Water and Sanitary Sewers exclude the cost of purchasing water and wastewater treatment from the City. In addition, there is a grey line between certain O&M and Capital activities; the City may be completing activities, which have been identified as Capital within the analysis, using O&M budgets.

Figure E.1: Asset Replacement Value per Serviced Property

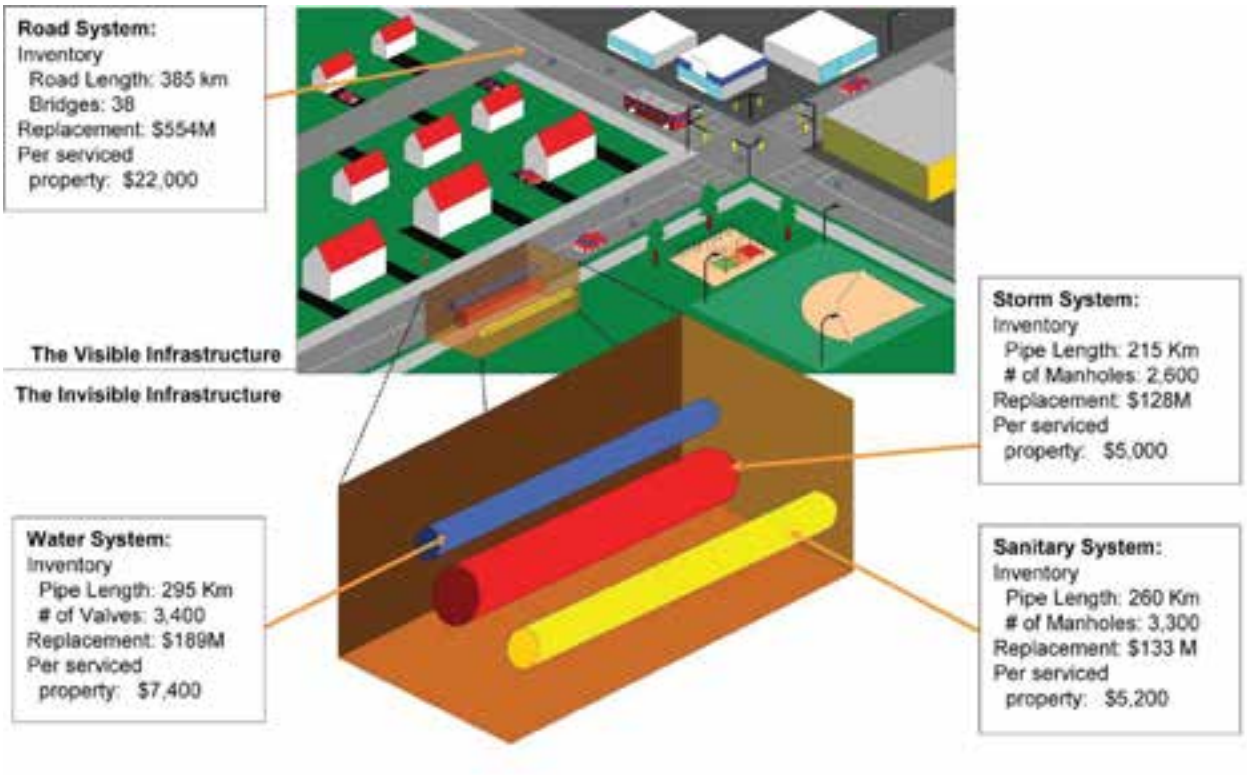


Table E.1: Sustainable Revenue Impact

Program		2008 Revenue ($M)		Sustainable Revenue ($M)		Overall Deficit ($M)
		O&M	Capital	O&M	Capital	
Rate	Water	$3.1	$1.3	$3.4	$4.2	$3.2
	Sanitary Sewer	$2.0	$1.1	$1.5	$4.0	$2.4
Levy	Roads	$12		$7.5	$20.0	$15.5

The City of North Bay's current Pay-as-You-Go (PAYG) policy, that is, not borrowing in order to finance Public Works Capital projects, is a wise one that positions the City very well for the future. This policy is actually a crucial one to maintain in the face of deteriorating infrastructure, because it delivers considerable savings to the taxpayers in the longer term. The more traditional approach to capital financing, as adopted by many municipalities, is to issue debentures that are usually repaid over a fifteen- to twenty-year period. This practice reduces the short-term impact of financing capital projects, since the full amount for the project does not have to be found or taxed for in the following year. In fact, only the cost of the annual payment needs to be added to the tax base in the first year. Although this method has perceived advantages in the short-term, this practice can add up to 30% to the cost of services in perpetuity; that is taxes would be 30% higher than they need to be to provide that service.

There are obviously cases where borrowing can be justified, but the City's PAYG policy, as a whole, is generally-speaking a sound one. It is strongly recommended that the City's Public Works and Finance Departments work together to identify how funding levels can be increased to the necessary level, while balancing the immediate needs of the community as a whole. As a related issue, the City may want to consult the community to determine what level of financial burden it is willing to accept versus the level of service that it demands.

This SotI Report and related Report Card, as well as the rating system that was used, were developed with input from staff in the Public Works Department. Their expert and knowledgeable comments, input, and concerns are reflected throughout these documents. Preparation of this high-level strategic report, limited to a few of the City's assets, could also be used for other City assets. Furthermore, this approach is the basis for development of a more detailed and tactical analysis in the future.

The SotI Report contains numerous asset-specific recommendations. However, there are ten recurring recommendations that should be addressed in future strategic asset management initiatives:

1. Develop, through more detailed analysis, a plan for allocating the additional funds to the operating and/or capital budgets, as required (including additional staff), in order to successfully develop, implement, and maintain the required asset management plans;

2. Develop a plan to close the gap between sustainable revenue and the current revenues applied to the assets identified in the State of the Infrastructure Report;

3. Develop a policy and implement a strategy to reach sustainable funding for each of the assets covered in this SotI Report;

4. Implement a comprehensive budget structure along service delivery lines, so that service managers can adequately know what the true total cost of their service is (including asset management, operations, capital, and borrowing costs) as well as measure their progress towards sustainable funding;

5. Develop a public communication program to engage the community in discussing the true cost of services and the assets required to provide those services. Develop and implement service levels (and by default the required assets) that are in line with public expectations and willingness/ability to pay;

6. Review the selection and use of rehabilitation technologies on a least life-cycle cost and return-on-investment (ROI) basis. This State of the Infrastructure Report Analysis was generally based only on replacement costs except for the road centreline sections. Within the road centreline section analysis, rehabilitation has been selected for all sections that have not past the point of rehabilitation;

7. Review operating and maintenance practices balancing least life-cycle cost against level of service and risk exposure, on a business-case basis using InfraGuide Best Practices and other industry sources;

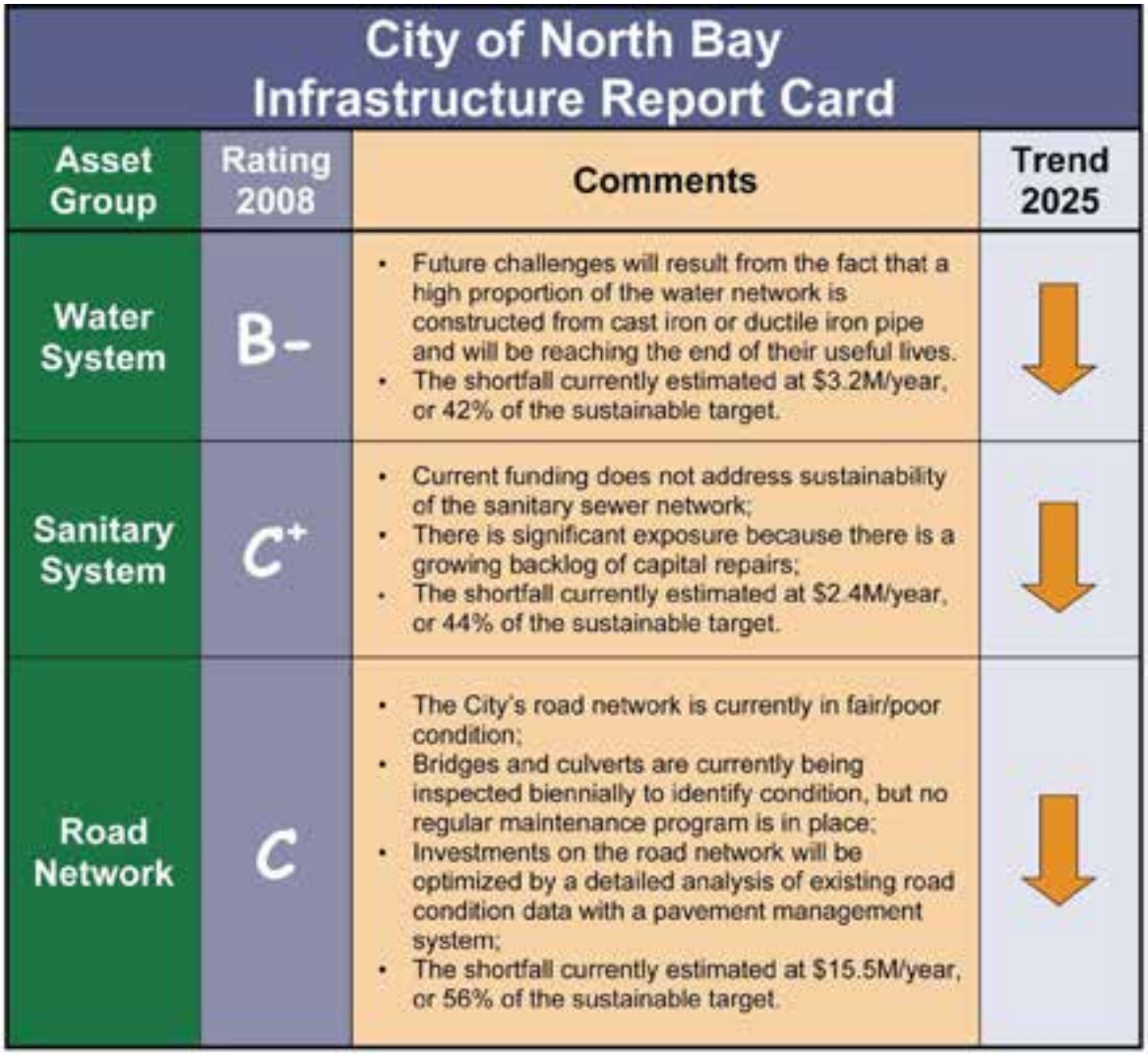
8. Develop the necessary operations, maintenance, inspection, and analytical programs as the City reduces its reliance on internal resources for execution of capital projects and increases its focus on life-cycle management of its assets;

9. Develop more robust figures for optimum funding of operations and maintenance activities, as a percent of replacement cost. This will assist in future SotI Reports;

10. Provide regular updates to the SotI Report Card and Analysis.

The following is the City of North Bay State of the Infrastructure Report Card:

Figure E.2 - Infrastructure Report Card



City of North Bay
Infrastructure Report Card

Asset Group	Rating 2008	Comments	Trend 2025
Water System	B-	• Future challenges will result from the fact that a high proportion of the water network is constructed from cast iron or ductile iron pipe and will be reaching the end of their useful lives. • The shortfall currently estimated at $3.2M/year, or 42% of the sustainable target.	↓
Sanitary System	C+	• Current funding does not address sustainability of the sanitary sewer network; • There is significant exposure because there is a growing backlog of capital repairs; • The shortfall currently estimated at $2.4M/year, or 44% of the sustainable target.	↓
Road Network	C	• The City's road network is currently in fair/poor condition; • Bridges and culverts are currently being inspected biennially to identify condition, but no regular maintenance program is in place; • Investments on the road network will be optimized by a detailed analysis of existing road condition data with a pavement management system; • The shortfall currently estimated at $15.5M/year, or 56% of the sustainable target.	↓

Appendix B – Standardized Data and Indicators

The attributes of an asset are those elements that describe the asset[4]. Tables are provided that indicate the minimum attributes that must be collected for comparison purposes. Municipalities can collect additional data to supplement the tables and develop a robust database of information. However, each municipality will need to assess the purpose and value of the information it needs based on the reasons for, and the costs of, collecting and maintaining data. Processes must be set in place for the gathering the initial data and maintaining data going forward.

Table – Minimum Asset Attribution

Roads	**Definition**
Functional Classification:	freeway, arterial, collector commercial/industrial, collector residential, local commercial industrial, local residential, laneway
Surface material type:	earth, grass, unpaved, low class bituminous, intermediate class bituminous, high class bituminous, portland cement concrete, asphalt over concrete
Roadside Environment:	Rural, Urban, Semi-Urban
Maintenance Class:	1,2,3,4,5,6
Location	For roads it would typically be from the centreline of intersection of street A to the centreline of intersection of street B. For cul-de-sacs it would a measurement from the centreline intersection of street A a distance of (x) metres to the end of pavement. GPS coordinates can be used to supplement the linear reference. Coordinates would be taken at the centerline of the cross streets.
Average Annual Daily Traffic	is the average annual daily traffic, which is a manual count of the traffic on a road section taken once per year in one of the months of May, June, October or November. Manuals and training on procedures for traffic counting should be acquired.
Number of lanes	on the road section
Speed limit	Posted speed limit for the road section
Length (lane km)	measured to the nearest one hundredth of a kilometre (9.99). Typically measured from centreline to centreline of intersecting roads or from centreline to end of pavement on dead end roads and cul-de-sacs
Surface width (m)	measured from edge of pavement to edge of pavement to the nearest tenth of a metre. In urban areas surface width to include bicycle lanes. In rural areas where paved shoulders exist ensure that surface width reflects the operational traffic lanes and that the additional pavement be shown as paved or partially paved shoulder, which may include a bicycle lane. For unpaved roads,

[4] A data dictionary for road attributes titled – Municipal DataWorks Inventory Manual, Transportation Network is available at http://www.municipaldataworks.ca/Support/tabid/58/Default.aspx

	the surface width is the platform width less 1 metre.
Shoulder Material	paved, partially paved, unpaved
Shoulder Width	measured to the nearest tenth of a metre is ½ the difference between the platform width less the surface width
Age	The year the road section was constructed or the year of the last major rehabilitation
Drainage	no ditch, open ditch, ditch and storm sewer, storm sewer
Terrain	non rocky flat, non rocky rolling, non rocky rugged, rocky flat, rocky rolling, rocky rugged
Right of Way Width	measured to the tenth of a metre from property line to property line
Bridges	
Structure Type	refers to the superstructure type i.e. rigid frame vertical legs, solid slab, half through beams or girders, etc
Material Type	Primary load carrying component: cast in place concrete, precast concrete, steel, weathering steel, cast iron, timber/wood, masonry
Deck Type	thick slab, concrete-cast in place, steel grid open, steel grid concrete filled, etc.
Roadside Environment:	Rural, Urban, Semi-Urban
Crossing Type:	over navigable waterway, over non-navigable waterway, over railway, under railway, over road, under road
Location	would be a linear reference measured from the centreline of intersection of the cross street to the center of the bridge. The linear reference could be supplemented with a GPS coordinate taken at the center of the bridge
Number of spans (ea)	where span is the horizontal distance between adjacent supports of the superstructure of a bridge, or the longest horizontal dimension of the cross-section of a culvert or tunnel taken perpendicular to the walls.
Deck length (m)	is measured to the nearest tenth of a metre and is the distance from outside to outside of the superstructure or face-to-face of ballast walls
Deck width (m)	is measured to the nearest tenth of a metre from outside to outside of the deck surface. Where a cantilevered section is an integral part of the structure include it in the deck width
Deck Area (m^2)	is the deck length times the deck width rounded to the nearest tenth of a m^2
AADT	on the road section over the bridge
Roadway width (m)	is the road surface width
Detour length around bridge (km)	is measured to the nearest tenth of a kilometre and is the distance a vehicle will travel on a appropriate route to access the next upstream or downstream crossing and return to the same road on the opposite side of the bridge.

Age	The year the bridge was constructed or the year of the last major rehabilitation
Classification	of the road section over the bridge

Performance Indicators

The following tables contain key performance indicators that can be used to create a snapshot of municipal performance in a given year and develop trend lines for that municipality as time goes on. The list of key performance measures could have been much longer, but is limited to a few indicators every municipality should be able to calculate easily. Municipalities may wish to supplement the list with additional performance indicators that have local significance or are set at the program or service delivery levels.

Table – Key Performance Indicators – Roads

Objective	**Performance Indicator**	**How measured**
Quality	Collision Rating*	Number of collisions per million vehicle kilometres
	Ride Comfort	A drive over a road section at posted speed. Measured on a scale of 1 to 10 where 10 is very good and 1 is very poor
	Condition	% of roads in good to very good condition (MPMP)
	Pavement Condition Index	Sum of the severity and density of surface distresses
Customer	System usage*	Measured as the number of annual vehicle kilometres per lane kilometre.
	Congestion Duration*	The duration of congestion is the length of time that the traffic flow is congested, often referred to as the "peak period" of traffic flow.
	Temporary Load Restrictions	Percent of total road system with a spring load restriction.
	Permanent Load Restrictions	Percent of total road system with a year round truck restriction
Management	Capital Reinvestment in Roads	Total annual capital expenditure for roads divided by the replacement cost expressed as a percent
Financial	Cost per person per day	Total daily cost for roads and bridge operating and capital divided by total population, which includes: unpaved maintenance costs, paved maintenance costs, bridge and culvert maintenance

Objective	Performance Indicator	How measured
		costs, traffic management costs, roadside maintenance costs, storm water management costs and winter maintenance costs.
	Paved Road Maintenance Cost	Paved maintenance includes frost heave/base/utility cut repair, cold mix patching, hot mix patching, shoulder maintenance, surface maintenance, surface sweeping, and surface flushing. Surface maintenance activities include crack sealing, spray patching, micro surfacing and slurry seal. Includes direct overhead (MPMP)
	Unpaved Road Maintenance Cost	Unpaved maintenance includes dust suppression, loose top grading, loose top gravelling, spot base repair and wash-out repair. Includes direct overhead (MPMP)
	Winter Road Maintenance Cost	The measure for winter control is based on the functional definition for winter control: continuous and spot snowplowing, ice control, combination plowing/salting/sanding, winging back snow. Ice blading, salting, sanding including spot sanding, snowfencing, snow removal, spring clean-up, winter drainage, winter patrol, winter standby, other. Include direct overhead (MPMP)

*measure applicable to larger urban, regional or county municipalities

Table – Additional Key Performance Indicators – Bridges

Objective	Performance Indicator	How measured
Quality	Condition	% of structures in good to very good condition (MPMP)
	Bridge Condition Index	The results of an Ontario Structure Inspection Manual compliant inspection of a bridge expressed as a percent of the current equivalent value divided by the total equivalent value
Customer	Restrictions	Number of structures with a

Objective	Performance Indicator	How measured
		posted load restriction
	Detour Length	Length in kilometres of detour required should the bridge be closed to traffic
Management	Capital Reinvestment in Structures	Total annual capital expenditure for bridges divided by replacement cost expressed as a percent
Financial	Structure Maintenance Cost	Total $ per m^2 for bridges and culverts ≥3m span (MPMP)

Appendix C – Example Goals and Objectives

Example goals, objectives and performance measures for the Pavement Program
Italics denotes measures that can be input to Key Performance Indicators

Goal	Provide quality, cost effective services for the municipality's road network			
Objective	1. Maintain all arterial roads in good to very good condition or a minimum pavement condition index of 80 2. Within 10 years, improve all high class bituminous pavement (paved) local residential streets to fair to good condition or a minimum pavement condition index of 65 3. Within 20 years, improve all bridges and culverts ≥3 metre span so that the primary components of the bridge or culvert is in good to very good condition or a minimum bridge condition index of 70.			
Measured by	**Financial**	**Customer**	**Quality**	**Management**
At the Strategic Level	***% annual (±) change in the cost per person per day*** ***% change (±) in net book value of road system***	***% annual (±) change in the hours per day that arterial roads are congested*** ***% annual (±) change in time delays due to congestion*** **# of days per year roads closed due to winter weather**	***% annual (±) change in ride comfort*** ***% change (±) in total vehicle emissions*** ***% annual (±) change in collision rating*** ***% change (±) in bridge and culvert condition***	**% of capital rehabilitation projects completed on time and within budget** ***% of capital projects that meet lifecycle targets***
At the Program Level	**Capital $/m^2 by rehabilitation type** ***Operating $ per lane km (paved, unpaved, winter)***	**% of complaints that did not receive a response within (x) working days**	***% of paved system with a PCI of (x) or greater*** **% of base repairs requiring additional work within 1 year**	**% change *(±)* in the number of kilometers of road requiring expansion to relieve congestion**
At the Service Level	**Manhours/tonne of cold mix patching**	**% of potholes cold mix patched prior to the target time to respond**	**% of pothole patches intact 1 year later**	**% of employee productivity improvement ideas implemented annually**

Appendix D – Pavement Priority Number

Pavement Condition Index (PCI) should be measured every 2 years

- Ride measured mechanically, International Roughness Index (IRI) or manually Ride Comfort Rating (RCR)
- Distresses assessed by staff (DMI)
- PCI is from 0-100 and is a function of IRI/RCR and DMI.

$PPN = PCI - I_t - I_e - I_w - I_p$

Where I_t = traffic factor

I_e = economic factor

I_w = width factor

I_p = profile factor

Values for I_t

5	Where four or more left turn related collisions occur per year or where six or more left turn collisions occur within a two year period
4	Deficient intersection stopping sight distance
3	Road section is congested for >1 hour a day every work day of the week
2	Road section is congested for <1 hour per day and/or <5 days a week
1	Average operating speed is less than minimum tolerable speed
0	Traffic moves freely

Values for I_e

Transportation of Goods and Services	Percent Trucks		
	>15%	5-15%	<5%
The road is used 7 days a week, 52 weeks of the year, for the transportation of goods and services	5	4	3
The road is used frequently for the transportation of goods and services (5 days a week or less and >6 months of the year)	4	3	2
The road is used infrequently for the transportation of goods and services (<5 days a week and <6 months of the year)	3	2	1

Values for I_w

5 – additional lanes required for current traffic volumes
4 – continuous left turn lane required
3 – narrow lanes
2 – narrow shoulder
1 – parking lane required

Values for I_p

5 – inadequate vertical or horizontal stopping sight distances
4 – inadequate vertical or horizontal alignment
3 – inadequate longitudinal grade (exceeds maximum %)
2 – inadequate clear zone
1 – inadequate ditching/sewers

Bridge Condition Index

Bridge Condition Index (BCI) is used as a key Performance Measure of the overall Bridge Condition

- BCI range is a number from 0 – 100
- BCI is a ratio of the bridge's current value to its replacement value (essentially, a weighted average of various bridge elements)
- As a bridge ages, the present value decreases relative to its replacement value; BCI decreases with time.
- Data collected every 2 years (bridge inspection cycle)

Example:

Element	Total Quantity	Unit Replacement Cost	Total Replacement Cost	Excellent	Good	Fair	Poor	Current Element Value
				(1.0)*	(0.75)	(0.4)	(0)	
	(m^2)	($/m^2$)	($)	(m^2)	(m^2)	(m^2)	(m^2)	($)
Deck	1000	250	250,000	500	100	200	200	163,750
Beams	600	400	240,000			300	300	48,000
Abutments	100	900	90,000		50	50		51,750
Piers	100	900	90,000		50	50		51,750
Barrier	200	200	40,000		120	80		24,400
		Total	710,000				Total	339,650

* Condition state weight factors (contribution to remaining value)

Sample Calculation for Deck:
Current Element Value = Quantity in condition state x weight factor x unit replacement cost

= (500*1.0*250+100*0.75*250+200*0.4*250+200*0.0*250)
= 163,750

Bridge Condition Index = Current Element Value/Total Replacement Cost
= (339,650/710,000)*100
= 48