

*Robert Prosser & Associates*

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## **CITY OF SASKATOON Paved Streets Management**

City Council approval of a comprehensive asset management plan for paved street infrastructure will validate the asset management system adopted by management and protect the City's \$670 million investment.

**August 2007**

# Report Highlights

## City of Saskatoon Paved Streets Management

### **Purpose of the Audit**

The objective of this audit was to determine whether:

- The Program has an effective asset management system in place,
- Adequate systems, practices and controls are in place to manage the major business risks faced by the Program, and
- The Program's activities are consistent with best practices and/or those advocated in the industry.

### **What Internal Audit Recommends**

- Preparation of a comprehensive paved streets asset management plan for City Council approval.
- Implementation of a risk-based unpaved utility cut inspection program.
- Acquisition of additional field data to ensure local roadway design assumptions are valid and appropriate.
- An evaluation of alternative contracting techniques for roadway capital projects.

### **What Internal Audit Found**

For several years, management has been implementing an asset management system for paved streets infrastructure based upon successful programs implemented by agencies in other jurisdictions. Management has made much progress in implementing a system to preserve the City's multi-million dollar investment in its roadway network and will continue to further the process by preparing a comprehensive asset management plan for City Council approval.

There are adequate systems, practices and controls in place to manage many of the significant business risks facing the Paved Streets program. Management has agreed to implement additional controls to further minimize the risks of injury to motorists and/or damage to their property and pre-mature deterioration of the paved street infrastructure.

For the most part, the Program's activities are consistent with best practices and/or those advocated in the industry. There may be opportunities to further advance the Program by monitoring the results of a Saskatchewan Highways and Transportation research project regarding rubberized asphalt and evaluating alternative contracting techniques for roadway capital projects.

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# Chapter 1 – Introduction and Background

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## **Introduction**

The corporate audit plan included provision to conduct an assurance audit of Paved Streets Management.

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## **Background**

The objective of the operational and capital programs associated with Paved Streets Management is to maintain all paved streets and lanes in a safe driving condition for vehicle and pedestrian traffic. In order to achieve this objective, the following activities are undertaken:

- Inspection of streets on a regular basis,
- Annual crack filling program,
- Pothole repairs on all paved streets or lanes,
- Repair of various paved street failures such as dips, frost boils, etc.,
- Milling of rutted sections identified through inspections,
- Providing temporary cold mix repairs to potholes and small excavations during the winter months,
- Applying treatments to pavements that are showing surface deterioration but are still structurally sound (e.g., blade level, micro-surfacing, overlays and resurfacing), and
- Reconstructing pavements upon structural failure.

Saskatoon's roadway network represents a multi-million dollar investment of tax dollars – in 2006, the replacement cost was estimated at \$670 million.

## *Introduction and Background, cont'd*

**Table 1: Operating and Capital Funding - 2003 - 2007**

<b>Operating Expenditures</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007 (budget)</b>
Staff Compensation	\$757,800	\$719,300	\$812,200	\$758,200	\$972,800
Operating Costs	760,900	815,600	750,900	735,800	927,000
Cost Recovery	(140,500)	(163,700)	(153,500)	(225,400)	(160,000)
	<b>\$1,378,200</b>	<b>\$1,371,200</b>	<b>\$1,409,600</b>	<b>\$1,268,600</b>	<b>\$1,739,800</b>
<b>Full Time Equivalent</b>	<b>16.03</b>	<b>16.78</b>	<b>17.08</b>	<b>17.34</b>	<b>17.57</b>
<b>Capital Expenditures</b>					
Local Road Preservation	\$1,300,000	\$1,100,000	\$975,000	\$1,000,000	\$1,000,000
Local Road Deferred Maintenance Backlog	700,000	1,155,000	1,000,000	1,250,000	1,200,000
Collector Road Preservation	900,000	1,000,000	1,000,000	600,000	600,000
Arterial Road Preservation	1,205,000	1,900,000	2,000,000	2,500,000	2,500,000
Expressway Preservation	1,285,000	210,000	600,000	600,000	600,000
	<b>\$5,390,000</b>	<b>\$5,365,000</b>	<b>\$5,575,000</b>	<b>\$5,950,000</b>	<b>\$5,900,000</b>

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### **Audit Objective & Scope**

The audit focused on the management systems, practices and controls within the Public Works Branch. Specific lines of enquiry included the following:

- Does the Program have an effective asset management system in place?
- Are adequate systems, practices and controls in place to manage the major business risks faced by the Program?
- Are the Program's activities consistent with best practices and/or those advocated in the industry?

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### **Acknowledgements**

Robert Prosser & Associates Inc. wishes to extend special thanks to the General Manager of Infrastructure Services, Strategic Services Branch Manager, Public Works Branch Manager, Roadways Section Manager and Asset Preservation Section staff for accommodating our requests for interviews, information and documents, and reviewing our audit findings.

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## Chapter 2 – Asset Management

One of the objectives of the audit was to determine whether the Program has an effective asset management system in place. For several years, management has been implementing an asset management system for paved streets infrastructure based upon successful programs implemented by agencies in other jurisdictions, namely the Roads and Traffic Authority of New South Wales (one of the first agencies to successfully implement an asset management program for transportation infrastructure). Since the success in New South Wales, several agencies have published manuals to assist others in implementing asset management programs, including the “International Infrastructure Management Manual” developed by the Association of Local Government Engineering New Zealand Inc. (INGENIUM) and the Institute of Public Works Engineering of Australia (IPWEA). The practices advocated in this manual were used as the basis against which to evaluate the Program’s practices (see Appendix A).

Of the fifty-four principles identified in the International Infrastructure Management Manual, the Program has fully or partially implemented twenty-nine. Management agrees with our recommendation to prepare a comprehensive asset management plan to address those principles that have not yet been implemented, and intends to have all principles fully in place within three years. Key components of this proposed asset management plan include:

- Evaluation of alternative levels of service and associated costs, as compared to current levels of service,
- Formalization of lifecycle management strategies,
- Enhancement and formalization of the decision-making framework,
- Adoption of a valuation model to demonstrate changes in service potential as a result of funding decisions,
- Adoption of a performance management system, including performance measures and short- and long-term targets, and
- Presentation of an updated financial forecast, with discussion of potential alternative funding sources.

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### **The overall direction for the Program’s asset management system should be formalized.**

Establishing and supporting the philosophy of asset management are two foundational components of an effective asset management system. In the absence of these components, the Program may lack direction, decisions may be made that are not cost-effective and corporate objectives may not be achieved.

Industry practice advocates aligning the Program’s asset management system with the organization’s corporate objectives, clearly defining responsibilities, documenting an asset management plan and ensuring corporate support for the program.

The City of Saskatoon's Corporate Strategic Plan and Corporate Business Plan both describe the City's commitment to asset management; approximately \$28 million has been invested in roadways preservation and maintenance in the last five years; and the Strategic Services Branch has recently been established with one of its responsibilities being to oversee the asset management systems for several infrastructure programs.

However, several documents that would serve to formalize the overall direction of the Program's asset management system have not yet been prepared, namely:

- A long-term strategy for Paved Streets service delivery,
- The mandate and responsibilities of the Strategic Services Branch, and updated job descriptions for recently transferred staff that reflect new duties and responsibilities, and
- An asset management plan that appropriately balances maintenance and capital needs (i.e., more maintenance now will result in lower capital requirements in the future).

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**Condition assessment and reporting processes could be improved; a performance management system and valuation model should be adopted.**

Complete and accurate information is necessary for informed decision making. Incomplete or inaccurate information can result in decisions that are not cost-effective or do not further achievement of Program objectives.

Industry practice advocates having reliable information regarding asset condition, performance and value in order to prioritize Program efforts and demonstrate progress and success.

Condition assessments are carried out on all paved streets in the city on a regular basis. Results can be displayed graphically (i.e., on a map) and are used to identify and prioritize segments for treatment. However:

- aggregate condition information is currently not available for reporting, although it has been reported to City Council in the past (e.g., the percentage of roadways that are in good, fair, poor condition),
- the data necessary for modelling is limited and can not be used to predict longer term needs at the present time, and
- user access controls have not been clearly defined (i.e., who can edit, delete or add data).

Management also expressed concern over the data collection procedures regarding a certain type of paved street deficiency – cracking – that, if left untreated, can result in premature failure of the paved surface. This type of deficiency does not affect the rideability of the paved surface and may be difficult to identify given the current condition rating process.

Performance measures for the paved street network and a valuation model have not been adopted, which precludes monitoring and reporting on whether Program efforts and activities are meeting user needs and have “made a difference.”

In cooperation with Saskatchewan Highways and Transportation, management is researching and analyzing valuation models currently in use throughout the industry. The selection of a model appropriate for the City of Saskatoon is expected to be complete by the end of 2007, with analysis completed and a report submitted to City Council within two to three years.

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**Levels of service should be approved by City Council.**

Levels of service are the key business driver of an asset management system. Levels of service can be considered the standard to which services are delivered; in the absence of such a standard, management can not know if they are meeting customer expectations and where adjustments are required.

Industry practice advocates having levels of service established and approved by the governing body (i.e. City Council); consulting customers regarding proposed levels of service and alternatives/associated costs; defining performance measures for each level of service; and specifying related short-term and long-term performance targets.

Levels of service, performance measures and performance targets have not been developed for the Paved Streets program. The most recent Civic Survey results indicate that a gap exists between how important citizens view paved street maintenance and how well the City is delivering the service.

Management intends to conduct a citizen tolerability study within the next eighteen months (i.e., identify the lowest level of service that would satisfy the expectations of the greatest number of citizens).

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**The Program’s lifecycle management strategy and decision-making framework should be formalized.**

Managing the lifecycle of an asset involves selecting the options and strategies that ensure reliable delivery of service in the most cost-effective manner over the entire life of an asset, from initial acquisition through to disposal. Failure to manage the lifecycle of paved street assets can lead to premature deterioration of the paved surface (e.g., inappropriate design, inadequate construction, poorly-timed maintenance treatments), resulting in the need for costly rehabilitation or reconstruction of the roadway.

Industry practice advocates that the lifecycle management strategy adopted for the Program be documented and consider costs, benefits and the time value of money; and that the decision-making process that supports the strategy be formalized with consideration given to risk (i.e., critical assets, critical failure mode), demand factors (e.g., traffic volumes, population growth, demographics, land use, etc.) and maintenance activities.

Management has adopted a lifecycle management strategy (see Chapter 4 for further discussion on lifecycle strategies) for the Program that considers costs and the time value of money. The strategy does not consider benefits (e.g., reduction in repair costs, improved service, reduced risk of litigation/property damage) and has not been formalized. The decision-making process used to support the strategy has not been documented and only considers risk and demand factors in a limited manner.

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**Current funding levels are not adequate to meet short- and long-term needs.**

Financial forecasts are one of the key outputs of an asset management system. Decision-makers need to know when funds will be needed for operations, maintenance and capital activities and how those activities will be funded. Failure to plan for and fund short- and long-term Program needs can result in a progressive deterioration in the condition of roadways and the need for more costly rehabilitation/reconstruction work.

Industry practice advocates preparation of a financial forecast that takes into account lifecycle management strategies, levels of service and growth; adoption of a valuation approach that can demonstrate the change in service potential (i.e. value of the asset) as a result of funding decisions; and funding levels that are sufficient to support the forecast.

A ten year financial forecast was prepared for City Council in February 2007. The forecast encompassed all unfunded civic capital requirements and disclosed an annual capital deficiency of over \$79.5 million. Of that total, the Paved Streets annual capital deficiency is estimated to be \$3.8 million. This estimate reflects the Program's lifecycle management strategies, current levels of service and growth/inflation of 10%. Since the preparation of this estimate, contract prices for roadway capital projects have increased 40% over 2006 prices, which will have a significant effect on this forecast and the resulting capital deficiency.

Management is participating in the Provincial Government's Municipal Asset Information System (MAIS) initiative. This initiative may help address capital deficiencies by providing the information necessary to support infrastructure funding requests to the Provincial and Federal Governments.

A valuation approach for paved street infrastructure has not been adopted. As mentioned above, management is working with Saskatchewan Highways and Transportation to select a valuation model appropriate for the City of Saskatoon.

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**Recommendations**

1. That a comprehensive asset management plan for the Paved Streets program be developed for City Council approval that:
  - Incorporates current practices,
  - Considers longer-term needs,
  - Provides an evaluation of, and management's recommendation regarding, alternative levels of service and associated costs, as compared to current state,
  - Formalizes lifecycle management strategies,
  - Formalizes an enhanced decision-making framework that takes into account benefits, risk and factors affecting current and future demand,
  - Proposes a valuation model that can demonstrate the change in service potential (i.e. asset value) as a result of funding decisions,
  - Proposes a performance management system, including performance measures and short- and long-term targets,
  - Includes an updated financial forecast, with discussion of potential alternative funding sources, and
  - Commits to status reporting (e.g., condition of network, capital deficiency, etc.) on a regular and periodic basis.
2. That the mandate and responsibilities of the Strategic Services Branch of the Infrastructure Services Department be documented.

## *Asset Management, cont'd*

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3. That job descriptions for staff of the Strategic Services Branch and Public Works Branch of the Infrastructure Services Department be updated to reflect new duties and responsibilities.
4. That access controls for the asset management information system be implemented.
5. That alternatives be evaluated to improve the identification and assessment of cracking deficiencies in paved streets.

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### **Management Response**

1. *Agree.*
2. *Agree.*
3. *Agree.*
4. *Agree.*
5. *Agree.*

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## Chapter 3 – Risk Management

The “International Infrastructure Management Manual” advocates the development of risk management standards and practices as components of an effective asset management system. The City Solicitor’s Office is currently completing an Enterprise Risk Management initiative at the corporate level. Risk assessments for the activities/programs of the Infrastructure Services Department have not yet been completed.

There are several significant business risks facing the Paved Streets program. There are adequate systems, practices and controls in place to manage many of these risks, and management is in the process of implementing several additional controls (see Appendix B). However, we believe additional steps should be taken to further address the following risks/constraints:

- Pre-mature deterioration of the paved streets due to inadequate financial resources to maintain/improve current condition of paved street infrastructure,
- Inability to extend the Program’s season,
- Pre-mature deterioration of the paved streets infrastructure due to poor quality maintenance attributable to staff non-compliance with quality standards,
- Injury to motorists and/or damage to their property, and
- Capital project design resulting in unanticipated premature infrastructure failure.

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### **Alternative funding sources may be required to maintain/improve the condition of paved street infrastructure.**

As discussed in chapter 2, the City of Saskatoon faces a significant capital funding challenge; it is uncertain whether citizens would be willing or able to bear mill rate increases to fund the shortfall. This situation is being faced by most municipalities across Canada.

Although management was unable to provide information regarding how condition has changed over time given actual funding levels, without adequate funding, capital work must be deferred and condition worsens, or less effective “stop gap” treatments substituted.

The Program’s comprehensive asset management plan (see chapter 2) should include an evaluation of alternative funding sources utilized by other municipalities. This analysis would enable Saskatoon to benefit from the experiences of others and identify viable funding alternatives.

**The Program's responsiveness would be improved if casual staff could be utilized.**

The duration of the Program's season is established long before the season begins, and the collective agreement includes a minimum six-week callback period. If the onset of inclement weather is delayed, it is currently not cost-effective to extend the Program's season and deficiencies remain untreated until the following season.

Management indicates that if the collective agreement were amended to allow for the use of seasonal staff on a casual basis, the Program could be more responsive to such opportunities.

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**Documented procedures would ensure maintenance activities are performed consistently and according to standards.**

Documented procedures communicate to staff how to achieve the level of quality expected for each maintenance activity and provide a standard against which actual performance can be evaluated. Poor quality maintenance can be a safety hazard for motorists and may be ineffective at preventing further deterioration of the paved surface.

Although Roadway Supervisors conduct inspections of the quality of maintenance work, Standard Operating Procedures have not been documented for all maintenance activities. Therefore, the quality standards against which some maintenance activities are evaluated may be inconsistent.

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**Unpaved utility cuts increase the risk of motorist injury or property damage.**

Section 306 of *The Cities Act* requires the City to keep its streets in "...a reasonable state of repair..." The City can be held liable for damage caused "...if the city knew or ought to have known of the state of repair." The City can minimize its liability by taking "...reasonable steps to prevent the disrepair from arising."

Management engages in several activities to minimize this risk, and recommendations have been made elsewhere in this report to further reduce this risk. However, Audit noted instances where unpaved utility cut excavations were open for traffic and could have resulted in injury or damage.

Management indicates the factors that are contributing to such situations include not being notified of the need for patching of utility cuts, traffic flows displacing the temporary gravel surface and unauthorized removal of traffic gates. Prompt notification of approved utility excavations would allow patching crews to be scheduled efficiently and in a timely manner, and a formal, documented inspection schedule that takes into account traffic flows and other risk factors would ensure temporary measures remain effective.

**Testing of site conditions would assist management in determining if local roadway specification assumptions are valid and appropriate.**

Detailed specifications that govern the construction of all new roadways in the city are published by the Municipal Engineering Branch and periodic inspections are conducted to ensure specifications are being adhered to. However, even if specifications are followed, if the original design does not take into account local environmental conditions, premature failure can occur.

Senior management indicates that site-specific environmental conditions are reflected in the specifications for collector, arterial and expressway roadways, but generalized assumptions are used when developing specifications for local roadways. Management agrees that additional testing of environmental conditions where local roadways will be constructed would help ensure the design assumptions being used are valid and appropriate, and reduce the risk of premature failure.

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**Recommendations**

6. That management pursue, in cooperation with the union, amendments to the collective agreement that would permit the use of seasonal staff on a casual basis.
7. That management document Standard Operating Procedures for all maintenance activities.
8. That management be notified of all planned utility cuts upon approval of the excavation.
9. That management implement a risk-based unpaved utility cut inspection program.
10. That, before local roadway construction specifications are finalized, management ensure sufficient field data has been acquired to validate design assumptions.

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**Management Response**

6. *Agree.*
7. *Agree.*
8. *Agree.*
9. *Agree.*
10. *Agree.*

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## Chapter 4 – Best Practices and Industry Standards

One of the objectives of the audit was to determine the extent to which the Program’s activities are consistent with best practices and/or those advocated in the industry. Management monitors industry developments through membership in industry organizations (e.g., Canadian Public Works Association, American Public Works Association, Transportation Association of Canada, InfraGuide, etc.), subscriptions to industry magazines, attendance at national and international conferences, relationship-building and information-sharing with other municipal roadway agencies/staff, and fact-finding missions to other municipalities.

For the most part, the Program’s activities are consistent with best practices and/or those advocated in the industry. We do note that there may be opportunities to further advance the Program in the following areas:

- Rubberized asphalt: a Saskatchewan Highways and Transportation research project is currently evaluating the suitability of rubberized asphalt for Saskatchewan roadways;
- Cost plus time bidding: this contracting technique awards roadway contracts based on consideration of the contract bid and the time needed to complete the project, thereby encouraging contractors to complete projects in a timely manner;
- Lane rentals: this contracting technique involves charging the contractor a fee for occupying driving lanes or shoulders during construction, thereby encouraging contractors to minimize traffic disruptions.
- Enhanced warranties: this contracting technique provides for longer-term warranty conditions that guarantee the quality of materials and workmanship, with three to five year terms being common.

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### **Management’s adoption of a pavement preservation strategy is consistent with industry best practices.**

According to The National Centre for Pavement Preservation, “[p]avement preservation is a cost-effective set of practices that extend pavement life and improve safety and motorist satisfaction while saving public tax dollars.” A pavement preservation strategy advocates focusing resources on preserving good roadways in good condition, over a “worst first” approach where resources are focused on those roadways that are in the worst condition. Although a “worst first” approach may make the most publicly visible improvements, it is also the most costly.

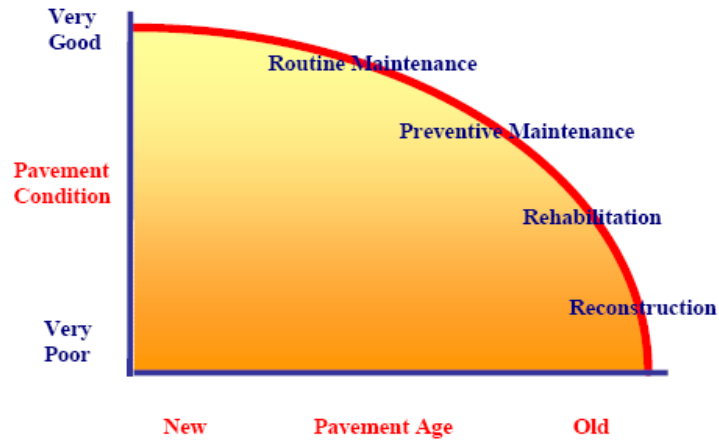
While it may be difficult to understand why a roadway that appears to be in good condition is being treated, when a short distance away there is a road that is falling apart, such an approach is much more cost-effective.

In order to understand why this is so, it is important to understand the deterioration curve of a typical roadway and the effect preventive maintenance has on that curve.

## Best Practices and Industry Standards, cont'd

Roadway condition typically declines slowly during the first few years of service, but as the roadway approaches the end of its service life, the rate of deterioration increases significantly. The most effective maintenance/repair strategy associated with each stage of deterioration also changes as condition worsens.

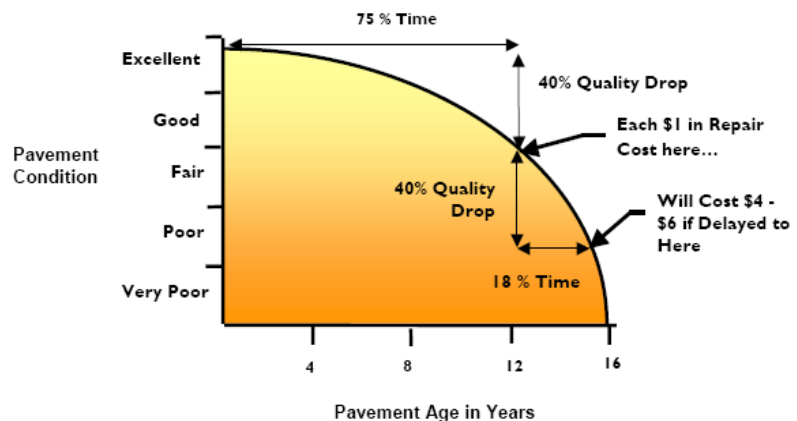
Figure 1: Maintenance/Repair Strategy vs. Pavement Condition



Source: "Pavement Management: A Guide for Local Officials (Delaware)" p. 1-5.

The longer a roadway is allowed to progress along the deterioration curve without maintenance/repair, the more costly it becomes to bring that roadway back up to an acceptable condition.

Figure 2: Pavement Condition vs. Maintenance/Repair Cost



Source: "Pavement Management: A Guide for Local Officials (Delaware)" p. 2-12.

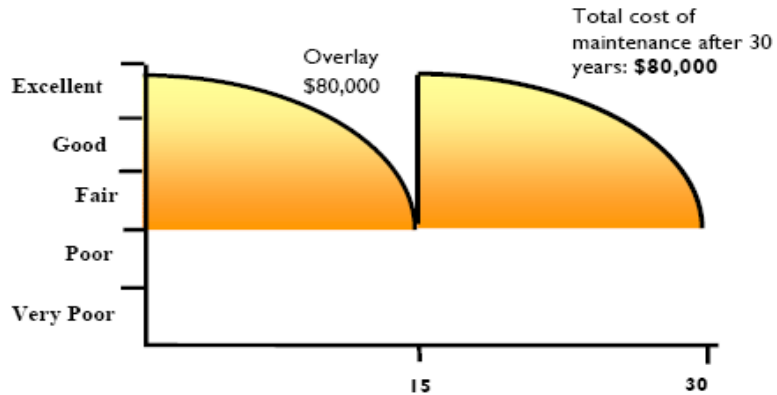
## Best Practices and Industry Standards, cont'd

When maintenance/repair activities are undertaken, the condition of the roadway is brought back up to good or excellent, thereby restarting the deterioration curve for that roadway. Over the long term, these preventive maintenance activities are more cost effective. "...[P]reventive maintenance, when applied at the appropriate time, is 3 to 6 times more cost-effective than rehabilitation techniques<sup>1</sup>."

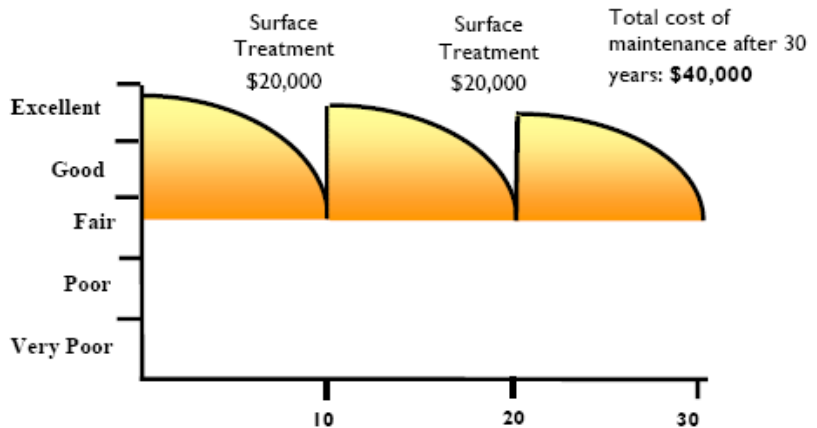
A hypothetical example that does not consider the time value of money illustrates this point.

**Figure 3: Total Maintenance/Repair Costs - Rehabilitation vs. Preventive Maintenance**

### Rehabilitation:



### Preventive Maintenance:

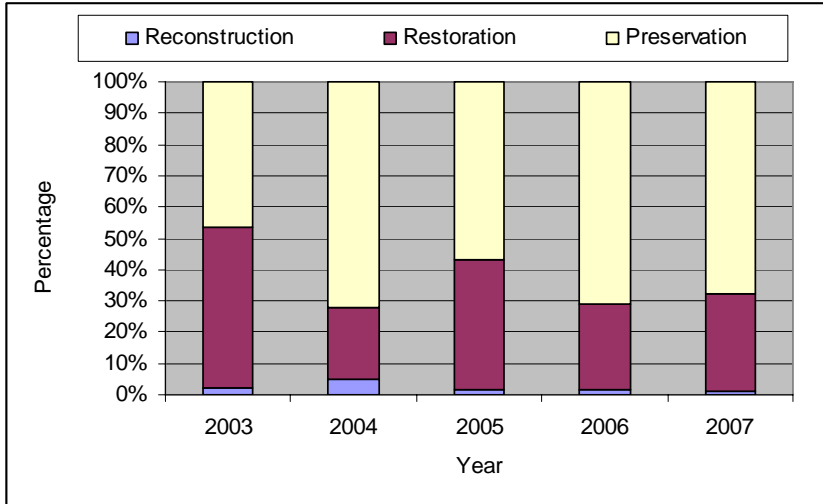


Source: Source: "Pavement Management: A Guide for Local Officials (Delaware)" p. 2-16.

<sup>1</sup> "Pavement Management: A Guide for Local Officials (Delaware)," Kercher Engineering, Inc., p. 2, [http://www.pavementpreservation.org/publications/pmg\\_page.php](http://www.pavementpreservation.org/publications/pmg_page.php)

Over the past several years, management has been following a pavement preservation strategy for paved streets in Saskatoon. This is evidenced in the following table that shows the trend in the proportion of total square meters receiving preventive maintenance, rehabilitation and reconstruction treatments over the past five years.

**Figure 4: Capital Program by Treatment Type - 2003 - 2007**



**Management's reuse/recycling of roadway construction and maintenance material is consistent with industry best practices.**

Reuse/recycling of roadway construction and maintenance material has become a standard asphalt technology in Canada and internationally as the cost of aggregate rises and environmental stewardship becomes an increasingly important social issue.

Asphalt pavement is 100% recyclable, thereby conserving natural resources (i.e., pits and quarries are non-renewable resources) and diverting material from landfills. According to a National Asphalt Pavement Association news release from April 2000, the most widely recycled product in terms of both percentage and tonnage was asphalt pavement (80%), greater than aluminum cans (60%), newsprint (56%), plastic soft drink bottles (37%), glass beverage bottles (31%) and magazines (23%).

Per management, all contracts for roadway capital work that involve the removal of asphalt (e.g., reconstruction) require that the asphalt be stockpiled on civic property (i.e., 8<sup>th</sup> Street or City Yards) or purchased by the contractor for reuse. The asphalt that is stockpiled on civic property is processed and used by civic staff in other maintenance activities (e.g., utility cuts).

## *Best Practices and Industry Standards, cont'd*

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Asphalt that is removed as a result of small-scale projects (e.g., utility cuts, water main breaks, etc.) is generally contaminated and disposed of in the landfill. However, management estimates that over 90% of asphalt is recycled and reused.

Another recycling initiative in the roadway industry is that of rubberized asphalt. Rubberized asphalt consists of regular asphalt mixed with “crumb rubber” – ground, used tires that would otherwise be discarded or take up space in landfills. Approximately 1,500 tires are used for every lane-mile of rubberized paving.

Rubberized asphalt has been used in milder climates in the United States since the mid 1960's with very good results. According to the Asphalt Institute's summer 2004 issue of *Asphalt Magazine* and California's Integrated Waste Management Board, the advantages to using this material for overlay treatments include:

- Certain defects (i.e., reflective cracking) may not “bleed” through from the existing pavement,
- Durability and skid-resistance are improved (e.g., in Phoenix, Arizona, a rubberized asphalt treatment that was intended to be a temporary measure to delay reconstruction actually lasted 20 years without reconstruction),
- Maintenance costs are lower (i.e., case studies in California have demonstrated up to a 50% longer lifespan than conventional methods; a case study in Arizona demonstrated that maintenance costs were 47% lower over 25 years), and
- Traffic noise is reduced which could lead to a reduction in the need for sound-attenuation walls (e.g., in Phoenix, Arizona, noise reductions of between 50%-90% were found).

There has been some research and limited application of this material in Canada (e.g., Ontario, Alberta and British Columbia). The primary concern preventing wide scale application appears to be severe winter conditions (e.g., temperatures, salt, snowplows, etc.).

In July 2005, a section of highway 11 near Findlater, Saskatchewan was overlaid with rubberized asphalt cement. Plans are to conduct research over a two year period to assess the treatment's performance. It is anticipated that this research will be completed in March 2008. Management should monitor the outcome of this research project to determine if rubberized asphalt is a viable treatment alternative for Saskatoon roadways.

**There may be opportunities to utilize innovative contracting techniques to reduce roadway project lapse time/inconvenience and improve quality.**

The City of Saskatoon awards tenders for roadway construction projects based primarily on cost (i.e., low bid). However, such awarding processes do not take into account other factors over and above financial cost (e.g., inconvenience to the public, traffic delays, risks to motorist and worker safety, public perception, etc.).

Since 1990, the U.S. Department of Transportation Federal Highway Administration (FHWA) has been working with state transportation agencies to evaluate non-traditional contracting techniques that would take these other factors into account when awarding roadway construction contracts (i.e., Special Experimental Projects No. 14, Innovative Contracting (SEP-14)).

In 1995, the FHWA declared the following three innovative contracting techniques to be operational (i.e., FHWA headquarters' concept approval is not necessary). Since that time, several states have adopted these practices.

#### Cost-Plus-Time Bidding

Often called "A+B Bidding," this contracting technique selects the low bidder based on consideration of the contract bid items and the time needed to complete the project. The intent of "A+B Bidding" is to encourage contractors to complete projects in a timely manner.

- The "A" component is the traditional bid for the contract items and is the dollar amount for all work to be performed under the contract.
- The "B" component is the total number of calendar days the bidder indicates will be required to complete the project.

The lowest bid is determined by adding the sum of the amount for the contract items to the cost associated with the time to complete the project.

The time cost is determined by multiplying the number of days by the "daily road user cost" as determined by the transportation agency. Daily road user cost can be specific for each project and consider such things as out of distance travel (i.e., the detour distance less the project roadway distance), traffic volumes, traffic characteristics (i.e., passenger vehicles, transport trucks, etc.), time delay costs, increased accident costs, detour maintenance costs, etc.

## *Best Practices and Industry Standards, cont'd*

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The total bid value used to evaluate the bids is calculated through the following formula:

$$A + (B \times \text{Daily Road User Cost}) = \text{Bid value}$$

For example, if the following three bids were received for a roadway construction project, traditional contract evaluation processes would result in the awarding of the contract to XYZ Company because the \$40,000 bid is the lowest. However, once time costs are considered, XYZ Company's bid is actually the most costly.

Of note, the bid value is only used to determine the successful bidder. Total payments are based on the "A" component of the bid only.

**Table 2: Cost-Plus-Time Bidding Example**

<b>Bidder</b>	<b>A Component</b>	<b>B Component</b>	<b>Daily Road User Cost</b>	<b>Bid Value</b>
ABC Company	\$50,000	7 days	\$5,000	\$85,000
123 Company	\$45,000	10 days	\$5,000	\$95,000
XYZ Company	\$40,000	14 days	\$5,000	\$110,000

### Lane Rental

This contracting technique charges the contractor a fee for occupying lanes or shoulders during construction. Charges can be hourly or daily and can vary with time of day (e.g., peak versus non-peak hours) and traffic volumes. The intent of lane rental is to encourage contractors to schedule their work to keep traffic restrictions to a minimum, in terms of both duration and number of lane closures.

Similar to "A+B Bidding," contractors are required to provide a traditional bid for the contract items and also specify the length and duration of all lane closures. The total bid value used to evaluate the bids is calculated through the following formula:

$$A + (B \times \text{Daily Lane Rental Cost}) = \text{Bid value}$$

## *Best Practices and Industry Standards, cont'd*

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Continuing with the example above, assume ABC Company planned on closing half of the project area at a time (i.e., completing one half and then moving on to the other half), 123 Company planned to close most of the project area at any given time, and XYZ Company planned on closing the entire roadway for the duration of the project. Traditional contract evaluation processes would again result in the awarding of the contract to XYZ Company. However, once lane closure costs are considered, XYZ Company's bid is again the most costly.

Of note, the bid value is only used to determine the successful bidder. Total payments are based on the traditional bid component only. In the event actual lane closures (length and duration) are in excess of those specified in the original bid, additional charges would be levied against the contractor and deducted from progress payments.

**Table 3: Lane Rental Bidding Example**

<b>Bidder</b>	<b>Traditional Bid</b>	<b>Lane Closures</b>	<b>Daily Lane Rental Cost</b>	<b>Bid Value</b>
ABC Company	\$50,000	0.5 km for 7 days	\$1,500	\$55,250
123 Company	\$45,000	.75 km for 10 days	\$1,500	\$56,250
XYZ Company	\$40,000	1 km for 14 days	\$1,500	\$61,000

### Warranties

This contracting technique imposes longer-term warranty conditions that guarantee the quality of materials and workmanship. Typically, the warranty term exceeds one year, with three to five years being common. The intent of these warranties is to encourage improved quality and contractor accountability.

Contractors are only required to warranty items over which they have control; they do not warranty the entire project. For example, for an overlay project, the contractor would be required to warranty the smoothness of the pavement and rutting, but would not be required to provide a warranty for cracking that "bleeds" through as a result of the condition of pre-existing pavement.

The City of Saskatoon currently has a two-year warranty period for capital work on paved streets.

**Management's treatment alternatives are consistent with industry practices.**

Further to the preventive maintenance strategy discussed above, the pavement management industry advocates preventive treatments that cost-effectively extend the life of roadway assets. All of the treatments most commonly used in the industry have been used, or are currently being used, by the City of Saskatoon.

Crack sealing

Sealing cracks in the roadway surface helps prevent premature failure of the pavement by preventing water from infiltrating into the road's sub-base. Water infiltration can reduce the supporting strength and integrity of the soil. A combination of civic staff and private contractors carry out the City's crack sealing program.

Thin hot mix asphalt overlay

Application of a thin (less than 40mm) level of asphalt over a structurally sound pavement can improve ride quality and extend the life of the roadway by 5-10 years. Overlay projects are contracted to the private sector.

Micro-surfacing

This treatment is generally used on high-speed roadways that show some surface distresses (e.g., cracking, raveling, rutting). Several courses (i.e., layers) of slurry-type material are applied to extend the effective life of the roadway by 4-6 years. Micro-surfacing projects are contracted to the private sector. The City's micro-surfacing program was temporarily suspended in 2006 due to cost, but will resume in 2007.

Slurry seals

Similar to micro-surfacing, slurry seals involve the application of several thin courses of slurry to structurally sound roadways that display surface distresses. The life of the roadway can be extended by 3-6 years. The City of Saskatoon contracted out this treatment strategy in the past but discontinued its use in 1997. Management found that, although the cost was similar to micro-surfacing, performance (in terms of extending the effective life of the roadway) was lower.

## *Best Practices and Industry Standards, cont'd*

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### Chip seals

This treatment involves the application of crushed stone over sprayed asphalt. The surface is compacted, allowed to cure, and excess stone is removed. This treatment is generally used on low-speed residential roadways that exhibit surface distresses (e.g., cracking, raveling). Although this treatment is one of the least expensive available, management found that the public was very dissatisfied – the environment is very dusty during the treatment, the final surface is not aesthetically pleasing (i.e., rough ride and resembles a medium-fine gravel road) and loose material can fly up and damage property.

### Ultra-thin whitetopping

Ultra-Thin Whitetopping involves the application of 50 to 100 mm of concrete that bonds to the underlying prepared asphalt surface. This treatment is especially effective for intersections that experience severe washboarding and rutting. This treatment has been used at certain problem intersections in the past (e.g., College Drive and Circle Drive). However, management has found that there have been quality control problems with this treatment and that by using better asphalt mixes at these locations, the rutting problem has been addressed and ultra-thin whitetopping is not cost effective.

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### **Recommendations**

11. That management monitor the outcome of the Saskatchewan Highways and Transportation rubberized asphalt research project in order to determine if it is a viable treatment alternative for Saskatoon roadways.
12. That management, in cooperation with the City Solicitor's Office and Purchasing Services, evaluate alternative contracting techniques for roadway capital projects.

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### **Management Response**

11. *Agree.*
12. *Agree.*

## Chapter 5 – Implementation Plan

	<b>Recommendations</b>	<b>Implementation Date</b>
1.	<p>That a comprehensive asset management plan for the Paved Streets program be developed for City Council approval that:</p> <ul style="list-style-type: none"> <li>• Incorporates current practices,</li> <li>• Considers longer-term needs,</li> <li>• Provides an evaluation of, and management’s recommendation regarding, alternative levels of service and associated costs, as compared to current state,</li> <li>• Formalizes lifecycle management strategies,</li> <li>• Formalizes an enhanced decision-making framework that takes into account benefits, risk and factors affecting current and future demand,</li> <li>• Proposes a valuation model that can demonstrate the change in service potential (i.e. asset value) as a result of funding decisions,</li> <li>• Proposes a performance management system, including performance measures and short- and long-term targets,</li> <li>• Includes an updated financial forecast, with discussion of potential alternative funding sources, and</li> <li>• Commits to status reporting (e.g., condition of network, capital deficiency, etc.) on a regular and periodic basis.</li> </ul>	January 1, 2008
2.	That the mandate and responsibilities of the Strategic Services Branch of the Infrastructure Services Department be documented.	November 15, 2007
3.	That job descriptions for staff of the Strategic Services Branch and Public Works Branch of the Infrastructure Services Department be updated to reflect new duties and responsibilities.	December 15, 2007
4.	That access controls for the asset management information system be implemented.	November 1, 2007
5.	That alternatives be evaluated to improve the identification and assessment of cracking deficiencies in paved streets.	Complete

## *Implementation Plan, cont'd*

	<b>Recommendations</b>	<b>Implementation Date</b>
6.	That management pursue, in cooperation with the union, amendments to the collective agreement that would permit the use of seasonal staff on a casual basis.	January 1, 2009
7.	That management document Standard Operating Procedures for all maintenance activities.	March 1, 2008
8.	That management be notified of all planned utility cuts upon approval of the excavation.	February 1, 2008
9.	That management implement a risk-based unpaved utility cut inspection program.	February 1, 2008
10.	That, before local roadway construction specifications are finalized, management ensure sufficient field data has been acquired to validate design assumptions.	Immediately.
11.	That management monitor the outcome of the Saskatchewan Highways and Transportation rubberized asphalt research project in order to determine if it is a viable treatment alternative for Saskatoon roadways.	November 1, 2008
12.	That management, in cooperation with the City Solicitor's Office and Purchasing Services, evaluate alternative contracting techniques for roadway capital projects.	January 1, 2009

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## **Appendix A – Asset Management System Principles**

ASSET MANAGEMENT PRINCIPLE	CURRENT STATE AND IMPLICATIONS
<b>CORPORATE PLANNING</b>	
<b>Confirm strategic objectives and establish asset management policies, strategies and goals.</b>	
1.	<p>Corporate objectives describe the organization’s commitment to the services provided and long-term strategies for infrastructure related service delivery.</p> <ul style="list-style-type: none"> <li>• The Corporate Strategic Plan (March 2004) explicitly states that one of the eleven core strategies of the City of Saskatoon is: <ul style="list-style-type: none"> <li>“Infrastructure Management – Build, maintain, and operate the City’s infrastructure in a manner that maximizes current infrastructure, fosters growth, and is fiscally sustainable.”</li> </ul> </li> <li>• The Corporate Business Plan (2006-2008) clarifies that one of the initiatives to achieve this strategy is: <ul style="list-style-type: none"> <li>“Maintain and preserve existing physical assets. <ul style="list-style-type: none"> <li>○ Monitor long-term funding requirements to address deterioration of existing assets.”</li> </ul> </li> </ul> </li> <li>• City Council has demonstrated its commitment to roadway infrastructure management through the establishment of the Infrastructure Replacement Reserve – Roadways and the ongoing funding of four capital projects – Collector Road Preservation (established in 1988), Local Roads Preservation (established in 1996), Expressway Road Preservation (established in 1999) and Local Roads Deferred Maintenance Backlog (established in 1998).</li> <li>• However, long term strategies regarding paved streets service delivery (i.e., level of service, lifecycle strategy, addressing the capital funding deficiency, etc.) have not been documented or formally adopted by City Council.</li> </ul>
2.	<p>An asset management framework of policies, strategies, objectives and performance measures has been developed which satisfies the broader corporate objectives.</p> <ul style="list-style-type: none"> <li>• An asset management framework for paved street infrastructure has not been developed.</li> <li>• In early 2007, the Strategic Services Branch of the Infrastructure Services Department was established. Although the mandate of the Branch has yet to be documented, management indicates that the Branch will be responsible for developing this framework.</li> </ul>
<b>Define responsibilities and ownership.</b>	
3.	<p>Top management has provided evidence of its commitment to the development, implementation and continuous improvement of asset management by appointing a member of top management with:</p> <ul style="list-style-type: none"> <li>• Responsibility for overall asset management activities within the organization, or</li> <li>• Responsibility for corporate sponsorship if asset management responsibilities are spread amongst more than one manager at the corporate management team level.</li> </ul> <ul style="list-style-type: none"> <li>• Although the mandate of the Strategic Services Branch of the Infrastructure Services Department has yet to be documented, management indicates that the Branch will be responsible for overseeing the development and implementation of an asset management program for several infrastructure programs – water distribution, waste water distribution, paved streets and sidewalks.</li> </ul>

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
4.	A management decision-making group or individual has been appointed to accept responsibility for the asset management program, resource requirements and effective implementation.	<ul style="list-style-type: none"> <li>Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department will be assigned these responsibilities.</li> </ul>
5.	Responsibilities for asset management are confirmed in job descriptions, with time and resources allocated to discharge those responsibilities.	<ul style="list-style-type: none"> <li>Job descriptions for those staff of the recently established Strategic Services Branch of the Infrastructure Services Department have not yet been updated to reflect new duties and responsibilities.</li> </ul>

**Decide core or advanced asset management plan.**

6.	An asset management plan has been documented, is based on corporate needs and takes into account costs/benefits; legislative requirements; size, condition and complexity of the assets; risk associated with failure; skills and resources available; and customer expectations.	<ul style="list-style-type: none"> <li>Although the mandate of the Strategic Services Branch of the Infrastructure Services Department has yet to be documented, management indicates that the Branch will be responsible for developing an asset management plan for each infrastructure program that takes into account the considerations listed.</li> </ul>
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**Gain organizational commitment.**

7.	There is strong corporate support for the asset management program.	<ul style="list-style-type: none"> <li>City Council has demonstrated its support for the paved street asset management program. Over the past five years, Council has approved over \$28 million for roadways preservation and maintenance projects.</li> </ul>
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**Capital Funding by Project (in thousands) – 2003 – 2007**

	2003	2004	2005	2006	2007	5-Year Total
<b>Local Road Preservation</b>	\$1,300	\$1,100	\$975	\$1,000	\$1,000	\$5,375
<b>Local Road Deferred Maintenance Backlog</b>	700	1,155	1,000	1,250	1,200	5,305
<b>Collector Road Preservation</b>	900	1,000	1,000	600	600	4,100
<b>Arterial Road Preservation</b>	1,205	1,900	2,000	2,500	2,500	10,105
<b>Expressway Preservation</b>	1,285	210	600	600	600	3,295
<b>Total</b>	\$5,390	\$5,365	\$5,575	\$5,950	\$5,900	\$28,180

<b>ASSET MANAGEMENT PRINCIPLE</b>		<b>CURRENT STATE AND IMPLICATIONS</b>
8.	There is commitment for the asset management program from the staff who are responsible for implementation.	<ul style="list-style-type: none"> <li>• Management indicates that those individuals who are being assigned to the recently established Strategic Services Branch of the Infrastructure Services Department are highly committed to the asset management program.</li> </ul>
<b>REVIEW/COLLATE ASSET INFORMATION</b>		
<b>Existing information sources.</b>		
9.	The asset management information system satisfies data requirements for core business functions.	<ul style="list-style-type: none"> <li>• The core business functions of the paved streets program are as follows:               <ul style="list-style-type: none"> <li>○ Preventive maintenance (i.e., treatments applied at the early stages of deterioration to extend the life of the roadway).</li> <li>○ Reactive maintenance (i.e., treatments applied in response to reported deficiencies (e.g., potholes, dips)).</li> <li>○ Rehabilitation (i.e., treatments applied at the latter stages of deterioration to return the roadway to an acceptable condition).</li> <li>○ Reconstruction (i.e., replacement of the roadway as a result of widespread failures).</li> </ul> </li> <li>• Management indicates that the information currently gathered adequately supports the core business functions of the paved streets program and includes:               <ul style="list-style-type: none"> <li>○ Asset inventory – a comprehensive spatial inventory (i.e., GIS, Map Guide) of all roadways for which the City is responsible.</li> <li>○ Asset attributes – historical roadway characteristics for each roadway segment (e.g., block, crescent) such as age, last treatment date, last treatment type, last condition rating date, etc.</li> <li>○ Asset deficiencies – location, type and severity of deficiencies that exist on the roadway segment as of the date of last inspection (e.g., cracking, dips, popouts, raveling, etc.).</li> <li>○ Activity tracking – workload and cost data (i.e., planned vs. accomplished workload, planned vs. actual unit cost, planned vs. actual expenditures).</li> </ul> </li> <li>• The information listed above is used to identify and prioritize roadway segments for preventive maintenance treatments, rehabilitation and reconstruction.</li> </ul>
10.	The asset management information system considers longer term needs.	<ul style="list-style-type: none"> <li>• The current asset management information system does not consider longer term needs due to limitations in the data necessary for modeling.</li> <li>• Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department will be responsible for implementing such a system.</li> </ul>

## Appendix A, cont'd

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
11.	The asset management information system interfaces with other business systems.	<ul style="list-style-type: none"> <li>• The asset management information system interfaces with property and land-based information, which allows for the mapping of the location and condition of all paved streets.</li> <li>• Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department will be responsible for evaluating the extent to which the system could/should be interfaced with other systems.</li> </ul>
12.	The asset management information system is supported by spatial data.	<ul style="list-style-type: none"> <li>• A comprehensive spatial inventory of all roadways for which the City is responsible has been created using GIS technology and can be displayed in an easy-to-understand format (i.e., Map Guide).</li> </ul>
13.	The asset management information system is adequately supported and protected.	<ul style="list-style-type: none"> <li>• There are quality control procedures in place to ensure information entered into the asset management information system is accurate.</li> <li>• The system is backed up by Corporate Information Services on a regular basis, thereby ensuring that if a system failure were to occur, the data would not be lost.</li> <li>• Several user groups have access to the system (e.g., Roadways, Water and Sewer, Saskatoon Light and Power) but access controls have not been clearly defined (e.g., who can edit, delete or add data; what data can be accessed by each user).</li> </ul>
<b>Data collection.</b>		
14.	The adopted data collection program is fully documented with standards and quality procedures to ensure the data collected is complete and accurate.	<ul style="list-style-type: none"> <li>• Data collection standards have been documented regarding condition ratings (i.e., the primary raw data source for the asset management information system). <ul style="list-style-type: none"> <li>○ The Road Surface Condition Rating Reference Manual outlines the procedures for conducting condition ratings.</li> <li>○ Road Raters enter all condition information on a handheld computer in the field and the Rating Supervisor reviews all data for completeness and accuracy.</li> </ul> </li> <li>• Despite these standards, management expressed some concern over the data collection procedures regarding a specific type of paved street deficiency – cracking. This type of deficiency does not affect the rideability of the paved street surface and may be difficult to identify given the current condition rating process.</li> </ul>
15.	Staff who are responsible for data collection are adequately trained and informed of the use of the information and required accuracy.	<ul style="list-style-type: none"> <li>• The training program for condition rating includes classroom and field training and in-process inspections (i.e., segments are rated by one team of Road Raters and then assigned to another team of Road Raters; the ratings of the two teams are compared to ensure they are consistent).</li> <li>• Management is also in the process of drafting Street Defect Inspection Standards. These standards will apply to complaints regarding potholes, cracking, dips and intersection rutting. Once finalized, a training program will be developed.</li> </ul>

*Appendix A, cont'd*

<b>ASSET MANAGEMENT PRINCIPLE</b>		<b>CURRENT STATE AND IMPLICATIONS</b>
16.	Asset data collection is prioritized and focuses on those assets that are reaching the end of their effective life (i.e., critical assets that are liable to cause the most concern and will require further attention in the near future).	<ul style="list-style-type: none"> <li>• The prioritization system for collecting condition information is currently based on roadway classification. The condition of expressways and arterial roadways is assessed on an annual basis; the condition of collector roadways and local streets is assessed every three years.</li> <li>• This inspection frequency is based on traffic volumes, weight and speed (i.e., expressways carry the most, heaviest (e.g., semi-tractor-trailer units) and fastest traffic in the city). These factors affect the rate of deterioration of the paved surface.</li> <li>• Management has utilized different condition rating frequencies in the past, but has found that the current frequency, which does not consider remaining effective life, is adequate.</li> </ul>
17.	Accountability for ongoing management and maintenance of data has been assigned.	<ul style="list-style-type: none"> <li>• Accountability for all condition information has been assigned to the Rating Supervisor of the Asset Preservation Section, Strategic Services Branch.</li> </ul>
18.	The same staff should be responsible for assessing condition of assets, determining remaining residual life and identifying rehabilitation or renewal work.	<ul style="list-style-type: none"> <li>• These responsibilities have been assigned to the staff of the Asset Preservation Section, Strategic Services Branch.</li> </ul>
<b>Condition assessments.</b>		
19.	The current condition of all assets is known.	<ul style="list-style-type: none"> <li>• Detailed information regarding the current condition of all paved streets in the city is known.</li> <li>• However, aggregated information at the network level is not available for reporting (e.g., percentage of roadways that are in good, fair, poor condition).</li> </ul>
20.	Asset condition is monitored on a regular and ongoing basis.	<ul style="list-style-type: none"> <li>• The condition of expressways and arterial roadways is assessed on an annual basis.</li> <li>• The condition of collector roadways and local streets is assessed every three years.</li> </ul>
21.	Formal condition assessment techniques have been developed to give repeatable and objective assessments.	<ul style="list-style-type: none"> <li>• Condition assessment techniques have been developed (see section 14).</li> <li>• However, as discussed above, management expressed some concern over the techniques regarding a specific type of paved street deficiency – cracking. This type of deficiency does not affect the rideability of the paved surface and may be difficult to identify given the current condition inspection process.</li> </ul>
<b>Performance monitoring.</b>		
22.	Performance measures, related to strategic objectives and levels of service, have been developed.	<ul style="list-style-type: none"> <li>• Performance measures have not yet been developed for the paved streets program.</li> <li>• Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department will be responsible for developing performance measures.</li> </ul>

## Appendix A, cont'd

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
23.	Actual performance is monitored and reported to management and customers in an appropriate form.	<ul style="list-style-type: none"> <li>Since performance measures have not yet been developed for the paved streets program, there has been no reporting to management, City Council and the public regarding actual performance of the paved street infrastructure.</li> </ul>
<b>Valuation data.</b>		
24.	The current value of all assets is known.	<ul style="list-style-type: none"> <li>A valuation model for paved street infrastructure has not yet been adopted and therefore the current value of the infrastructure is not known.</li> <li>In cooperation with Saskatchewan Highways and Transportation, management is researching and analyzing valuation models currently in use throughout the world. The selection of a model appropriate for the City of Saskatoon is expected to be complete by the end of 2007, with analysis completed and a report submitted to City Council within two to three years.</li> </ul>
25.	Value is monitored on a regular and ongoing basis.	<ul style="list-style-type: none"> <li>Since a valuation model for paved street infrastructure has not yet been adopted, a monitoring system has not been developed.</li> </ul>
26.	Formal valuation techniques have been developed to give repeatable and objective assessments.	<ul style="list-style-type: none"> <li>Since a valuation model for paved street infrastructure has not yet been adopted, formal valuation techniques have not been developed.</li> </ul>
<b>ESTABLISH LEVELS OF SERVICE</b>		
<b>Establish strategic linkages.</b>		
27.	For each relevant aspect of the corporate strategic plan, customer and technical levels of service have been developed.	<ul style="list-style-type: none"> <li>Expectations with regard to levels of service have not yet been defined for paved street infrastructure.</li> </ul>
<b>Define and adopt statements.</b>		
28.	Customer and technical levels of service have been approved by City Council.	<ul style="list-style-type: none"> <li>Since levels of service have not yet been developed for paved street infrastructure, levels of service have not been approved by City Council.</li> </ul>
<b>Establish measures and targets.</b>		
29.	For each customer and technical level of service, performance measures have been defined.	<ul style="list-style-type: none"> <li>Since levels of service have not yet been developed for paved street infrastructure, performance measures for each level of service have not been defined.</li> </ul>
30.	For each performance measure, short-term and long-term targets have been specified.	<ul style="list-style-type: none"> <li>Since levels of service and performance measures have not yet been developed for paved street infrastructure, short- and long-term targets have not been specified.</li> </ul>
<b>Consultation.</b>		
31.	Customer input is considered in the determination of level of service.	<ul style="list-style-type: none"> <li>Since levels of service have not yet been developed for paved street infrastructure, customer input has not been solicited and considered.</li> </ul>
32.	Customers are consulted regarding alternative levels of service and the associated costs of each option.	<ul style="list-style-type: none"> <li>Customers have not been consulted regarding alternative levels of service and the associated costs of each option.</li> </ul>

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
33.	Customer perceptions are regularly monitored to ensure the service is still being managed to deliver to customer expectations.	<ul style="list-style-type: none"> <li>• Although levels of service have not yet been developed for paved street infrastructure, customer perceptions are monitored through the City of Saskatoon Civic Survey.</li> <li>• The most recent survey results (October 2005) indicate that paved street maintenance is important to citizens. <ul style="list-style-type: none"> <li>○ On a scale of 1 to 10, with 1 being “not at all important” and 10 being “extremely important,” citizens rated maintenance of roadways and freeways at 8.33 and street maintenance at 8.05.</li> </ul> </li> <li>• The most recent survey results (October 2005) also indicate that citizens believe that the City is above average in terms of delivering these services. <ul style="list-style-type: none"> <li>○ On a scale of 1 to 10, with 1 being “very poor,” 10 being “excellent” and 5 being “average,” citizens rated maintenance of roadways and freeways at 6.52 and street maintenance at 6.27.</li> </ul> </li> <li>• These survey results indicate that a gap exists between how important citizens view paved street maintenance and how well the City is delivering the service.</li> </ul>
<b>LIFECYCLE MANAGEMENT STRATEGIES</b>		
<b>Develop lifecycle strategies.</b>		
34.	Asset lifecycle strategies have been developed and documented.	<ul style="list-style-type: none"> <li>• Although management has adopted a lifecycle strategy for paved street infrastructure (see chapter 4), this strategy has not been documented.</li> </ul>
<b>Describe service delivery strategy.</b>		
35.	Service delivery mechanisms for asset operations, maintenance, renewal and development have been selected which best meet organizational needs.	<ul style="list-style-type: none"> <li>• Management periodically compares in-house service delivery (i.e., staff costs, specialized equipment needs and expertise/skill sets) to the private sector in order to ensure the most timely and cost effective service delivery strategy is pursued.</li> <li>• Some services are delivered in partnership with the private sector (e.g., spring pothole program), some are delivered solely by the private sector (e.g., reconstruction and rehabilitation treatments) and some are delivered solely in-house (e.g., blade level treatments).</li> </ul>
<b>Risk management strategies.</b>		
36.	Risk management standards and practices have been developed.	<ul style="list-style-type: none"> <li>• Full implementation of a risk management framework is planned pending completion of the Enterprise Risk Management initiative of the City Solicitor’s Office.</li> </ul>
37.	All decisions about the rehabilitation, replacement or disposal of an asset, and the timing for such activities, are based on a sound determination of what the critical failure mode is (i.e., the critical failure modes are the ones which have the highest consequences).	<ul style="list-style-type: none"> <li>• The critical failure mode for paved street infrastructure (i.e., the “trigger point” at which rehabilitation or replacement is deemed necessary) has not been formalized.</li> <li>• Management intends to incorporate these “trigger points” into the determination of levels of service for City Council approval.</li> </ul>

## Appendix A, cont'd

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
38.	Critical assets as well as the critical failure modes have been identified.	<ul style="list-style-type: none"> <li>• The definition of critical assets is based upon roadway classification (i.e., expressway, arterial, collector and local roadway classes in decreasing order of criticality).</li> <li>• All paved streets in the city have been categorized into one of these classifications.</li> <li>• As discussed above, the critical failure mode for paved street infrastructure has not been formalized.</li> </ul>
<b>Demand forecasting and management.</b>		
39.	The key drivers of demand, and how they might affect future demand quantities, are understood.	<ul style="list-style-type: none"> <li>• Management considers traffic patterns and traffic volumes to be the key drivers of demand.</li> <li>• However, other factors such as trends in population growth, alternative modes of transportation, location of commercial areas, demographics, land use, density of development, and vehicles per household can also affect demand and should be considered.</li> </ul>
40.	A demand forecast model has been developed.	<ul style="list-style-type: none"> <li>• A demand forecast model for paved street infrastructure has not been developed.</li> </ul>
41.	A demand management strategy has been developed.	<ul style="list-style-type: none"> <li>• Since a demand forecast model has not yet been developed, a demand management strategy has not been developed.</li> </ul>
<b>Optimized decision making (renewals, new works, disposal).</b>		
42.	A decision making framework has been documented.	<ul style="list-style-type: none"> <li>• Management considers the following factors when making decisions regarding preventive maintenance treatments, rehabilitation and reconstruction: <ul style="list-style-type: none"> <li>○ Roadway classification (i.e., expressway, arterial, collector, local),</li> <li>○ Type of deficiency (e.g., cracking, raveling, rutting, popouts, etc.),</li> <li>○ Extent of deficiencies (i.e., localized, widespread),</li> <li>○ Severity of deficiencies (i.e., minor, moderate, significant),</li> <li>○ Treatment options, and</li> <li>○ Cost and funding levels.</li> </ul> </li> <li>• However, a formalized decision making framework that reflects these factors has not been documented (e.g., a decision tree, matrix, etc.).</li> </ul>
43.	The decision making framework considers all associated benefits and costs, and takes into account the time value of money.	<ul style="list-style-type: none"> <li>• The decision making process described above considers the capital cost at the time of treatment and the present value of future treatments that will be required to preserve the roadway (i.e., the time value of money is taken into account).</li> <li>• Benefits are not considered (e.g., reduction in repair costs, improved service, reduced risk of litigation/property damage).</li> </ul>

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
<b>Optimize maintenance strategies.</b>		
44.	A maintenance plan has been developed.	<ul style="list-style-type: none"> <li>• Each year, an annual work plan is developed that specifies the type and quantity of maintenance activities that will be carried out.</li> <li>• For the most part, maintenance activities are reactive in nature (i.e., in response to citizen complaints, inspection findings, utility cuts, etc.) and are performed by civic staff. Therefore, quantities are planned for, not necessarily locations.</li> <li>• In 2006 and 2007, the spring pothole program was delivered in partnership with the private sector.</li> </ul>
45.	Maintenance workload is optimized to the greatest extent possible.	<ul style="list-style-type: none"> <li>• Maintenance activities are generally prioritized by road classification (e.g., expressway, arterial, collector and local roadways in decreasing order of priority) and are assigned to staff based on activity (e.g., potholes, patching, crack sealing, etc.) and area of the city in order to minimize downtime.</li> <li>• On a monthly basis, management monitors workload and cost (i.e., planned vs. accomplished workload, planned vs. actual unit cost, planned vs. actual expenditures).</li> <li>• Overtime is planned during the spring pothole program. During the remainder of the season, overtime is minimal but does occur occasionally (e.g., work on higher volume roadways is planned for the weekends in order to decrease the inconvenience to motorists and reduce the safety risk for staff).</li> </ul>
<b>FINANCIAL FORECASTS</b>		
<b>Lifecycle analysis.</b>		
46.	A lifecycle costing approach, that takes into account all appropriate costs, has been adopted and is used in decision making.	<ul style="list-style-type: none"> <li>• A lifecycle costing approach for the evaluation of treatment alternatives has been developed and is used in decision making (see section 43). However, benefits (e.g., reduction in repair costs, improved service and reduced risk of litigation/property damage) are not considered and the overall approach has not been documented.</li> </ul>
<b>Financial forecast summary.</b>		
47.	A long term financial forecast has been prepared.	<ul style="list-style-type: none"> <li>• A ten year financial forecast was prepared in early 2007.</li> <li>• This forecast was based on historical paved street infrastructure treatment practices (e.g., treatments at certain stages of the street's life – at 5 years, 10 years, 25 years, etc.), expected useful life of paved street infrastructure, the average age of the current paved street infrastructure and growth/inflation of 10%.</li> </ul>
<b>Valuation/depreciation.</b>		
48.	A valuation approach has been adopted.	<ul style="list-style-type: none"> <li>• A valuation approach for paved street infrastructure has not yet been adopted.</li> <li>• In cooperation with Saskatchewan Highways and Transportation, management is researching and analyzing valuation models currently in use throughout the world. The selection of a model appropriate for the City of Saskatoon is</li> </ul>

ASSET MANAGEMENT PRINCIPLE		CURRENT STATE AND IMPLICATIONS
		expected to be complete by the end of 2007, with analysis completed and a report submitted to City Council within two to three years.
<b>Funding.</b>		
49.	Funding levels are sufficient to support the long term financial forecast.	<ul style="list-style-type: none"> <li>• Management indicates that existing funding levels are not sufficient to support the long term financial needs for paved street infrastructure.</li> <li>• According to the Corporate Services Department's February 2007 report "10-Year Capital Deficiency Discussion Paper – 2007 – 2016," there is an average annual capital deficiency of over \$10 million related to the City's infrastructure (i.e., sidewalks, roadways, bridges, grade separations, primary watermains, storm water and wastewater trunks, storm ponds and collection, wastewater collection and connections, gravel streets and lanes). <ul style="list-style-type: none"> <li>○ Paved street infrastructure represents \$3.8 million of this average annual capital deficiency.</li> </ul> </li> <li>• Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department is participating in the Provincial Government's Municipal Asset Information System (MAIS) initiative. <ul style="list-style-type: none"> <li>○ The goal of this initiative is to develop a system that will provide municipal asset inventory and condition information to the Provincial and Federal Governments to support future infrastructure funding requests.</li> </ul> </li> </ul>
<b>IMPROVEMENT PLAN</b>		
<b>Assess current/desired practices.</b>		
50.	Gaps between current practices and desired practices have been identified.	<ul style="list-style-type: none"> <li>• With the aid of this report, gaps between current practices and desired practices can be identified.</li> </ul>
51.	Consideration has been given to benchmarking with comparable organizations.	<ul style="list-style-type: none"> <li>• Management indicates that the recently established Strategic Services Branch of the Infrastructure Services Department is working with the City of Regina to develop an asset management program for several infrastructure programs – water distribution, waste water distribution, paved streets and sidewalks.</li> <li>• Benchmarking activities are planned for the future.</li> </ul>
<b>Develop improvement plan.</b>		
52.	Specific actions/projects/tasks to "close the gap" between current and desired practices have been identified and prioritized.	<ul style="list-style-type: none"> <li>• With the aid of this report, specific actions/projects/tasks can be identified and prioritized.</li> </ul>
<b>Implement improvement strategy.</b>		
53.	Responsibility and accountability for the asset management improvement program is clearly assigned.	<ul style="list-style-type: none"> <li>• With the aid of this report, responsibility and accountability for an improvement program can be assigned.</li> </ul>
<b>Asset management plan review and audit.</b>		
54.	A review/audit process is in place that fosters confidence in the asset management plan and promotes continuous improvement.	<ul style="list-style-type: none"> <li>• With the aid of this report, a review/audit process can be implemented.</li> </ul>

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## **Appendix B – Risk Matrix**

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<b>Financial</b>			
<p><b>Financial resources are inadequate to maintain/improve current condition of paved street infrastructure.</b></p>	<ul style="list-style-type: none"> <li>• The City of Saskatoon faces a significant capital funding challenge. The most recent report to City Council<sup>2</sup> regarding long-term infrastructure funding needs identified an average annual capital deficiency of over \$79 million.               <ul style="list-style-type: none"> <li>○ Paved street infrastructure funding needs represent \$3.8 million of that annual total.</li> </ul> </li> <li>• This situation is not unique to the City of Saskatoon.               <ul style="list-style-type: none"> <li>○ In September 2006, the Federation of Canadian Municipalities estimated that the Canadian municipal infrastructure deficit is \$60 billion and growing by \$2 billion a year.</li> <li>○ The Canada West Foundation estimated that the combined infrastructure deficit of the six big western Canadian cities (Vancouver, Edmonton, Calgary, Saskatoon, Regina and Winnipeg) totalled \$564 million in 2003<sup>3</sup>.</li> </ul> </li> <li>• The Federal and Provincial Governments have taken steps in recent years to assist municipalities in addressing this challenge (e.g., Canada Strategic Infrastructure Fund, Municipal Rural Infrastructure Fund, Canada-Saskatchewan Infrastructure Program, Saskatchewan Infrastructure Fund).</li> <li>• Management was unable to provide information regarding how condition has changed over time given actual funding levels, so we are unable to determine the affect the funding deficit has had on condition. However, without adequate funding, capital work must be deferred or less effective “stop gap” treatments substituted.</li> </ul>	<p><b>High.</b></p> <p>A significant capital funding deficit exists.</p>	<p><b>Moderate.</b></p> <p>Deferred capital work will result in the requirement for more costly treatments in the future.</p>

<sup>2</sup> “10-Year Capital Deficiency Discussion Paper 2007 to 2016,” Corporate Services Department, Finance Branch, February 2007.

<sup>3</sup> “A Capital Question – Infrastructure in Western Canada’s Big Six,” Canada West Foundation, Western Cities Project Report #27, October 2003.

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<p><b>Significant increases in capital costs.</b></p>	<ul style="list-style-type: none"> <li>• The private sector is contracted to perform most types of paved street capital work (i.e., resurfacing, reconstruction, micro-surfacing, rut fill).               <ul style="list-style-type: none"> <li>○ Civic staff perform maintenance activities (e.g., potholes, spray patching) and limited capital work (i.e., blade level treatments only).</li> </ul> </li> <li>• Management has found that the cost of capital work contracted to the private sector has increased significantly in recent years, with a 40% increase experienced in 2007 alone. Certain capital programs have been scaled back or temporarily cancelled as a result.</li> <li>• There are several factors that have led to these increases, including:               <ul style="list-style-type: none"> <li>○ Construction services in all industry sectors are in high demand.</li> <li>○ Saskatchewan is facing a skilled trades labor shortage.</li> <li>○ Raw material and transportation costs are increasing.</li> </ul> </li> <li>• Management is in the process of reevaluating the cost-benefit of contracting capital work to the private sector versus the potential for in-house service delivery. However, management is exercising caution given that the City would experience many of the same pressures that the private sector faces and would have to invest heavily in specialized equipment prior to pursuing any significant changes in service delivery strategy.</li> </ul>	<p><b>High.</b> Capital costs are expected to increase further in the future.</p>	<p><b>Moderate.</b> Deferred capital work will result in the requirement for more costly treatments in the future.</p>
<b>Human</b>			
<p><b>The ability to extend the Program's season is constrained by the collective agreement.</b></p>	<ul style="list-style-type: none"> <li>• Most Paved Streets program staff are full-time seasonal employees. The duration of the season is determined at the time job openings are posted.</li> <li>• A minimum callback period of six weeks is included in the collective agreement.</li> </ul>	<p><b>High.</b> The onset of inclement weather can vary significantly each year.</p>	<p><b>Moderate.</b> Untreated deficiencies can accelerate deterioration of the paved surface.</p>

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
	<ul style="list-style-type: none"> <li>• Management has found that even if the construction season could be extended due to mild weather conditions, it is not cost-effective to do so.               <ul style="list-style-type: none"> <li>○ For example, if seasonal staff are hired for the season of May 1 to September 30, extending the program by even one week requires hiring staff for at least six weeks (i.e., the minimum callback period).</li> </ul> </li> <li>• Management indicates that if the collective agreement could be amended, in cooperation with the union, to allow for the use of seasonal staff on a casual basis, the program could be more responsive to such opportunities.</li> </ul>		
<b>Loss of expertise/intellectual capital.</b>	<ul style="list-style-type: none"> <li>• The skilled trades labor shortage in Saskatchewan, and across Canada, has driven up wage rates in many sectors and made it harder to recruit new staff and retain experienced staff.</li> <li>• In addition, several Paved Streets staff members (permanent and seasonal) have been with the City for several years, have developed specialized skills and knowledge, and are nearing eligibility for planned or early retirement.</li> <li>• Turnover and succession planning are concerns throughout the organization and steps are being taken at the corporate level and at the program level to address this concern.               <ul style="list-style-type: none"> <li>○ The corporate “Management Development Program” provides civic staff with the opportunity to gain the skills necessary to become effective leaders.</li> <li>○ A training program has recently been implemented for the Public Works Branch. This program will involve identifying short- and long-term training needs, determining the best approach to fulfilling those needs (e.g., formal training, mentorship, skills-transfer, etc.) and establishing a training budget.</li> </ul> </li> </ul>	<p><b>Medium.</b></p> <p>Several staff members with specialized skills and/or knowledge are nearing retirement.</p>	<p><b>Moderate.</b></p> <p>Lack of qualified staff could place program delivery at risk.</p> <p>Implementation of a training program would reduce the impact of this risk to <b>low</b>.</p>

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<b>Infrastructure</b>			
<p><b>Outside agencies or civic departments negatively affect condition/lifecycle of paved street infrastructure.</b></p>	<ul style="list-style-type: none"> <li>• Many utility services are installed underground (e.g., water, sewer, power, natural gas, cable) and run beneath paved roadways. In order to access these utilities for maintenance, repairs and upgrades, the paved street must be cut.</li> <li>• Utility cuts in paved streets weaken the structural integrity of the roadway, both where the cut is made and in the area surrounding the cut, which reduces the expected useful life of the roadway.</li> <li>• Management has implemented several controls to help ensure the roadway is reinstated to original condition after utility cuts have been made:               <ul style="list-style-type: none"> <li>○ Utilities must apply for approval to excavate the right-of-way at least one day prior to commencing work (with the exception of emergency excavations such as water main breaks).</li> <li>○ Fees are charged to the utility based on the width of the excavation and the type of roadway excavated.</li> <li>○ Specifications have been developed for the restoration of the roadway.</li> <li>○ In some cases, test results regarding compaction of the backfill material must be provided.                   <ul style="list-style-type: none"> <li>▪ If test results are required but not provided, the fees charged are increased by 30%.</li> <li>▪ If test results are unsatisfactory, the contractor must excavate, re-compact and re-test the material and the fees charged are increased by 20%.</li> </ul> </li> <li>○ Upon completion of the work, but prior to leaving the work site, the utility must fax a restoration report to the City.</li> </ul> </li> </ul>	<p><b>Low.</b></p> <p>Controls appear to be adequate to reduce the likelihood of this risk to an acceptable level.</p>	<p><b>Significant.</b></p> <p>Poorly restored utility cuts can be a safety hazard for motorists and accelerate deterioration of the paved surface.</p>

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
	<ul style="list-style-type: none"> <li>▪ This allows for the notification to paving crews to place asphalt over the excavation.</li> <li>▪ However, management indicates the duration of traffic detours/restrictions could be shortened and paving crews scheduled more efficiently if they were notified of the utility cut location upon approval of the application (i.e., at least one day prior to the work) rather than when the work is complete.</li> </ul>		
<b>Administrative</b>			
<p><b>Inconsistent prioritization of maintenance requests and/or capital work.</b></p>	<ul style="list-style-type: none"> <li>• With a limited amount of funding in place each year for both maintenance and capital work, management must prioritize the projects that will be undertaken within each program.</li> <li>• Regarding maintenance work, a combination of planned and complaint-based activities are carried out.               <ul style="list-style-type: none"> <li>○ Planned maintenance work can include patching (e.g., as a result of a utility cut) and crack filling. Procedures are adequate to ensure consistent prioritization of these activities.                   <ul style="list-style-type: none"> <li>▪ Patching is performed in response to requests from outside agencies/civic departments and prioritized based on the roadway classification system that is used for all programs that affect the right-of-way.</li> <li>▪ Crack filling can be planned or reactive (see below). Planned crack filling is identified through periodic condition assessments and is prioritized based on the roadway classification system and severity (as measured by width, depth, length and placement – in the wheelpath or not).</li> </ul> </li> </ul> </li> </ul>	<p><b>Medium.</b></p> <p>Implementation of Street Defect Inspection Standards and critical failure modes would reduce the likelihood of this risk to <b>low</b>.</p>	<p><b>Moderate.</b></p> <p>The public's perception of the program could be negatively affected; roadways that are deferred could deteriorate further, requiring a more costly treatment in the future.</p>

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
	<ul style="list-style-type: none"> <li>○ Complaint-based work includes filling potholes and dips, and crack filling. All of these activities are performed upon notification from the public or civic staff and are prioritized based on the roadway classification system. Management is in the process of developing Street Defect Inspection Standards to ensure consistent prioritization of these activities.</li> <li>• All capital work is scheduled on a planned basis. Locations/ segments where capital work will be carried out are identified through periodic condition assessments.               <ul style="list-style-type: none"> <li>○ Three factors are used to prioritize capital work - rut (i.e., depressions in the wheelpath), ride (i.e., roughness when traveling) and ravel (i.e., separation of aggregate from the pavement surface).                   <ul style="list-style-type: none"> <li>▪ Locations/segments that display one of these deficiencies are of a lower priority for treatment than those that display two; those that display all three of these deficiencies are the highest priority.</li> </ul> </li> <li>○ Rutting is measured by the depth of the rut in millimeters, ride is measured by IRI (International Roughness Index) and raveling is measured by the number of ravels/cracks per square meter.                   <ul style="list-style-type: none"> <li>▪ Although the measurement system has been defined for each deficiency, the critical mode or “trigger point” that justifies treatment has not (e.g., ruts deeper than Xmm, IRI greater than Y, more than Z ravels/cracks per square meter).</li> </ul> </li> </ul> </li> </ul>		

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<b>Service Delivery</b>			
<b>Contractors do not comply with capital project specifications.</b>	<ul style="list-style-type: none"> <li>• The private sector is contracted to perform most types of paved street capital work (e.g., resurfacing, reconstruction, micro-surfacing, rut fill).</li> <li>• A comprehensive set of specifications has been established to ensure contractors use quality materials and work practices in these projects.</li> <li>• When submitting their bids, contractors are required to supply a bid bond of 10% (i.e., the contractor will honor its bid), a contract performance bond of 50% (i.e., the contractor will complete the project in accordance with the terms) and a labour and materials bond of 50% (i.e., the contractor will properly pay subcontractors and suppliers).</li> <li>• Throughout the course of the capital project, Municipal Engineering staff conduct inspections to ensure contract terms and specifications are being adhered to. For some materials and/or work practices tests are conducted, the results of which are provided to the City.</li> <li>• If specifications are not followed or test results are unsatisfactory, the contractor must remedy the situation at their own expense.</li> </ul>	<b>Low.</b> Controls appear to be adequate to reduce the likelihood of this risk to an acceptable level.	<b>Significant.</b> Substandard work can be a safety hazard for motorists and result in premature deterioration of the paved surface.
<b>Staff do not comply with quality standards.</b>	<ul style="list-style-type: none"> <li>• For capital work performed in-house (e.g., blade level treatments), specifications are the same as for contracted projects. Throughout the course of the capital project, Municipal Engineering staff conduct inspections to ensure specifications are being adhered to.</li> <li>• For maintenance work, Roadways Supervisors conduct inspections to ensure quality materials and work practices are being used. These inspections are documented.</li> <li>• However, management indicates that Standard Operating Procedures have not been documented for all maintenance activities. Therefore, the quality standards against which these activities are evaluated may be inconsistent.</li> </ul>	<b>Moderate.</b> Documentation of standardized work practices and a quality assurance program would reduce the likelihood of this risk to <b>low</b> .	<b>Significant.</b> Substandard work can be a safety hazard for motorists and result in premature deterioration of the paved surface.

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<b>Lack of coordination between civic departments/programs.</b>	<ul style="list-style-type: none"> <li>• Coordination of work that occurs on the city’s right-of-way minimizes the number and duration of traffic detours/restrictions and is a more cost-effective use of capital dollars.</li> <li>• The Paved Streets program works closely with the Water and Sewer program to try and coordinate roadway projects with water and sewer infrastructure projects.</li> <li>• In late winter, a construction schedule is prepared that takes into account the major construction projects anticipated by all civic departments/programs for the upcoming construction season. A group meeting is held with all involved parties and the Communications Branch to ensure projects are coordinated to the greatest extent possible.</li> </ul>	<p><b>Low.</b> Controls appear to be adequate to reduce the likelihood of this risk to an acceptable level.</p>	<p><b>Moderate.</b> The public’s perception of the City could be negatively affected; resources are wasted if work performed by one party is damaged by another.</p>
<b>Loss of productivity due to delays in getting equipment ready for the season and/or equipment breakdown.</b>	<ul style="list-style-type: none"> <li>• Various pieces of equipment are used by civic staff to perform paved street maintenance activities (e.g., large trucks, passenger trucks, oil distribution trucks, spray patchers, hotbox patchers, graders, compaction equipment, etc.). Equipment is to be repaired and readied for the upcoming season over the fall and winter.</li> <li>• When equipment is in good working condition, the program is able to start promptly in the spring and, on a daily basis, staff are able to proceed to their worksites immediately and perform their work in a productive manner.</li> <li>• However, if equipment is not ready for use in the spring or breaks down once the program has commenced, staff must be reassigned to other equipment and/or may lose time returning the equipment for repairs, waiting for replacement equipment or waiting for the repairs to be made. Some of the equipment is specialized and spares are not available.</li> <li>• Management has found this issue to be of growing concern for this and other seasonal programs over the past few years and, in cooperation with V&amp;E, will be evaluating options to ensure seasonal equipment is ready for use when required in the spring and remains in good working condition throughout the season.</li> </ul>	<p><b>Medium.</b> Resolution of challenges being faced by V&amp;E would reduce the likelihood of this risk to <b>low</b>.</p>	<p><b>Moderate.</b> Resources are wasted if staff are unproductive.</p>

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<b>Accidents and Incidents</b>			
<b>Staff are injured.</b>	<ul style="list-style-type: none"> <li>• Employees working on or adjacent to the roadway face unique safety risks – traffic volumes, traffic speed, driver inattention, driver frustration.</li> <li>• Management has implemented several controls to help ensure safe work zone practices:               <ul style="list-style-type: none"> <li>○ At the start of the season staff receive safety training, and the importance of safety is stressed at monthly “toolbox” meetings.</li> <li>○ Staff are instructed, verbally and in written procedures if prepared, to adhere to the City’s Traffic Control Manual and Occupational Health and Safety Regulations.</li> <li>○ Roadway Supervisor site inspections include an assessment of whether staff are using the required personal protective equipment, have established a safe work site and are performing their work safely.</li> <li>○ Many vehicles are equipped with arrow boards to notify motorists that there is an upcoming traffic restriction.</li> </ul> </li> <li>• Public Service Announcements notifying motorists about traffic detours/restrictions are released often in order to increase awareness.</li> <li>• Management has also utilized new equipment that contributes to staff safety (e.g., ROSCO spray-patching vehicle that is operated from within the cab, thereby allowing staff to stay in the vehicle and avoid exposing themselves to traffic flows).</li> <li>• Despite these controls, management continues to express concerns for staff safety. Management has noted that days and times that historically had lighter traffic flows and were safer for staff are becoming busier and therefore riskier. Management plans to evaluate alternatives to address this issue (e.g., days of work, hours of work, etc.).</li> </ul>	<p><b>Medium.</b></p> <p>Staff are exposed to traffic flows on a daily basis.</p>	<p><b>Significant.</b></p> <p>Serious injury, or death, could result.</p>

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
<p><b>Motorists are injured or their property is damaged.</b></p>	<ul style="list-style-type: none"> <li>• Section 306 of <i>The Cities Act</i> requires the City to keep its streets in "...a reasonable state of repair..." The City can be held liable for damage caused "...if the city knew or ought to have known of the state of repair." The City can minimize its liability by taking "...reasonable steps to prevent the disrepair from arising."</li> <li>• Management engages in several activities to minimize this risk:               <ul style="list-style-type: none"> <li>○ Periodic condition assessments allow for the monitoring of the state of repair over time.</li> <li>○ The preventive maintenance strategy adopted for the program keeps good roads in good condition and plans for the treatment of those roads that are in poor condition.</li> <li>○ Tracking of complaints (e.g., potholes, dips, etc.) ensures those hazards that the City is aware of are addressed.</li> <li>○ The roadway classification system utilized for prioritization of treatments and complaints ensures that those roadways that expose the greatest number of motorists to risk are addressed first.</li> </ul> </li> <li>• The establishment of levels of service (i.e., the definition of what is a "reasonable state of repair") and implementation of the Street Defect Inspection Standards (i.e., establishment of response times for complaints) would further reduce this risk.</li> <li>• Despite these controls, Audit noted instances where unpaved utility cut excavations were open for traffic and could have resulted in injury or damage (i.e., sudden braking due to ruts and depressions, veering into opposing traffic lanes to bypass the site).               <ul style="list-style-type: none"> <li>○ For various reasons, utility cut excavation sites may be opened to traffic before replacement asphalt can be applied (e.g., repair parts are unavailable, patching crews are unavailable or unaware of the need for patching).</li> <li>○ Management indicates that unpaved utility cut excavations are to be opened for traffic only after a temporary gravel surface is firmly in place and traffic gates are erected.</li> </ul> </li> </ul>	<p><b>Medium.</b></p> <p>Establishment of levels of service, adoption of Street Defect Inspection Standards and implementation of an inspection program for unpaved utility cuts would reduce the likelihood of this risk to <b>low</b>.</p>	<p><b>Moderate.</b></p> <p>Legal action could be brought against the City.</p>

*Appendix B, cont'd*

Risk Event	Analysis	Residual Risk	
		Likelihood	Impact
	<ul style="list-style-type: none"> <li>○ However, traffic flows can quickly displace the gravel and traffic gates can be removed.</li> <li>○ Periodic inspections of unpaved utility cut excavations are performed, but management believes that a formalized, documented inspection program would ensure consistency and further reduce this risk.</li> </ul>		
<b>Secondary Impacts</b>			
<p><b>Capital project design results in unanticipated premature infrastructure failure.</b></p>	<ul style="list-style-type: none"> <li>• Although the original construction of a roadway is funded through Prepaid Levies, ongoing maintenance and repair of the roadway is the responsibility of the Paved Streets program. Poorly designed roadways may perform satisfactorily in the short term, but can result in significant maintenance and capital costs in the long term.</li> <li>• Detailed roadway construction specifications are published by the Municipal Engineering Branch. Specifications are developed based on industry standards and are also balanced with other factors (e.g., reasonable expected useful life, cost). Specifications also can, and have been, tailored to local environmental conditions when required (e.g., high water table).</li> <li>• Senior management indicates that site-specific environmental conditions are reflected in the specifications for collector, arterial and expressway roadways, but generalized assumptions are used when developing specifications for local roadways.</li> <li>• Management agrees that additional site-specific testing of environmental conditions where local roadways will be constructed would help ensure the design assumptions being used are valid and appropriate, and reduce the risk of premature failure.</li> </ul>	<p><b>Medium.</b></p> <p>Site-specific field data would ensure design assumptions are valid and reduce the likelihood of this risk to <b>low</b>.</p>	<p><b>Significant.</b></p> <p>Correcting problems resulting from poor design can be extremely costly.</p>