

# Highways and Infrastructure

# 7

<b>Main points .....</b>	<b>82</b>
<b>Introduction .....</b>	<b>83</b>
Background .....	83
<b>Audit objective, criteria, and conclusion.....</b>	<b>85</b>
<b>Key findings and recommendations .....</b>	<b>85</b>
Obtain reliable information on the highways system .....	86
Develop a maintenance plan .....	87
Carry out maintenance effectively.....	91
Monitor performance.....	92
<b>Selected references .....</b>	<b>95</b>

## Main points

The Ministry of Highways and Infrastructure is responsible for maintaining the provincial highways. In 2008-09, the Ministry spent almost \$130 million on highway maintenance. Maintenance focuses on activities to keep the surface of the highways in good repair. Doing the right maintenance at the right time reduces long-term costs and minimizes the risk of pavement damage and failure of highways. Poor highway conditions can adversely affect our economy and safety of travel.

Saskatchewan has 26,000 kilometres (km) of provincial highways. Asphalt concrete and granular pavements, excluding pavements in the National Highways System, account for almost 12,000 km of the provincial highways. At March 31, 2009, the Ministry had adequate processes to maintain those highways except for the following matters.

The Ministry needs to set and use long-term service-level objectives. Use of those objectives would help the Ministry select the right maintenance activities at the right time. Because the Ministry has not set those objectives, it is unclear if the condition of highways is at the level the Ministry expects. The Ministry needs to use service-level objectives to guide the prioritization of its maintenance activities. Use of objectives would provide staff with a basis to make decisions on maintenance activities consistent with the Ministry's priorities. Improper priorities increase the risk that highways are not maintained as expected.

Although required, staff did not give senior management reports on the results of its maintenance activities (e.g., the surface condition of all highways compared to expected, impact of uncompleted work on the condition of the highways, status of planned work). Senior management need sufficient information to monitor the success of the Ministry's maintenance activities.

## Introduction

This chapter describes the results of our audit of the Ministry of Highways and Infrastructure's (Ministry's) processes to maintain provincial highways.

## Background

*The Highways and Transportation Act, 1997* gives the Ministry responsibility for all matters relating to highways including the maintenance of provincial highways. The Ministry's mission is to optimize the role of transportation as it relates to the economic and social development of the province of Saskatchewan.<sup>1</sup>

Saskatchewan's road network consists of 26,398 kilometres (km) of highways, including 9,644 km of asphalt concrete pavements, 4,888 km of granular pavements, 5,645 km of thin membrane surface highways, 5,941 km of gravel highways, and 280 km of ice roads.<sup>2</sup> For the year ending March 31, 2009, the provincial highway system had a recorded cost of over \$3 billion and net book value of about \$1.6 billion. On average, the system was about half way through its useful life of 40 years.

The Ministry's staff is located throughout the province. The Ministry has divided the highways system into three regions; each region is divided into areas; each area is further divided into sections. Staff within each level is assigned responsibility for the maintenance of a specific group of highway segments.<sup>3</sup>

Exhibit 1 sets out the Ministry's spending on preservation (maintenance) and infrastructure capital (road construction) over the last five years. Also, the exhibit sets out the results of Ministry's public performance measures related to preventative maintenance.

---

<sup>1</sup> *Ministry Highways and Infrastructure. Plan for 2009-10*, p.1.

<sup>2</sup> *08-09 Annual Report. Ministry of Highways and Infrastructure*, p.6.

<sup>3</sup> A highway segment is a homogenous piece of road with a defined start and end point.

**Exhibit 1**

	2008-09	2007-08	2006-07	2005-06	2004-05
<b>Spending on:<sup>4</sup> (in millions of \$)</b>					
Preservation <sup>5</sup>	129.9	128.1	110.3	73.3	71.4
Infrastructure Capital	215.0	170.0	134.0	124.8	120.5
<b>Measurement results<sup>6</sup></b>					
Per cent of National Highway System <sup>7</sup> in “good” condition	94%	94%	n/a	n/a	n/a
Per cent of kilometres resurfaced on National Highway System to meet the targeted life cycle	5.4%	4.5%	2.9%	n/a	n/a

**Key:** n/a – information not available

The Ministry identifies preservation of the transportation system as one of its key programs. Preventative maintenance focuses on activities to keep the surface of the highways in good repair to reduce the risk of damage to the underlying structure of the highways. Doing the right preventative maintenance at the right time reduces long-term costs and minimizes the risk of pavement damage and failure of highways.

The Ministry refers to its maintenance activities as treatments. It has organized these treatments into three main groups.

1. routine and light treatments (e.g., crack sealing & filling)
2. medium treatments (e.g., light seal & micro-resurfacing)
3. heavy treatments (e.g., overlay (resurfacing))

Ministry staff carry out routine and light treatments. The Ministry contracts private sector companies to carry out medium and heavy treatments.

Keeping Saskatchewan’s transportation system safe and in good repair is vital to our economy.

<sup>4</sup> (2005-2009). Public Accounts – Volume 2. Details of Revenue and Expenditure. Dollar amounts are not adjusted for inflation.

<sup>5</sup> The 2004-05 to 2006-07 amounts include the total spending on surface preservation and the Strategic Partnership Program – Road Management as reporting in Public Accounts – Volume 2 of the related year.

<sup>6</sup> *08-09 Annual Report. Ministry of Highways and Infrastructure*, p.15.

<sup>7</sup> The National Highways System is made up of about 2,700 km of roads that link Saskatchewan to regional, national, and international economies and markets. (*08-09 Annual Report. Ministry of Highways and Infrastructure*. p.15.)

## Audit objective, criteria, and conclusion

The objective of this audit was to assess the adequacy of the Ministry’s processes for the year ending March 31, 2009 to maintain provincial highways excluding thin membrane surface, gravel, ice roads, and highways that are part of the National Highway System. In this chapter, we refer to these provincial highways as highways.

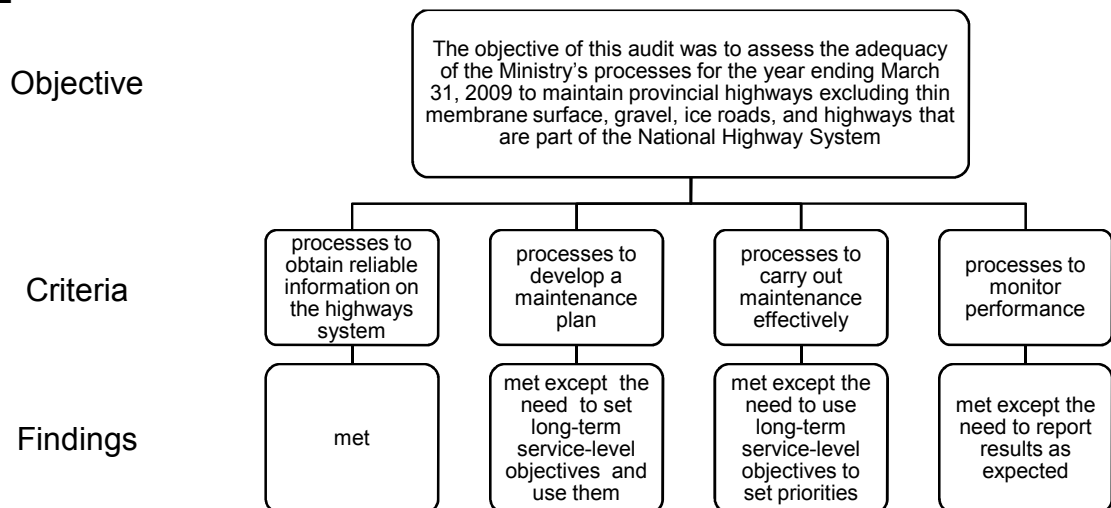
To conduct this audit, we followed the *Standards for Assurance Engagements* set out in the CICA Handbook - Assurance. To evaluate the Ministry’s processes, we used criteria based on related work, reviews of literature including reports of other auditors, and consultations with management. The Ministry agreed with the criteria set out in Exhibit 2 below.

**For the year ending March 31, 2009, the Ministry of Highways and Infrastructure had adequate processes to maintain highways except it needs to set long-term service-level objectives for highways, use these objectives to prioritize its maintenance activities, and provide senior management with a report on the results of maintenance activities each year.**

## Key findings and recommendations

Exhibit 2 provides a brief summary of key findings by criterion. Following the exhibit, we set out, in more detail, the criteria (expectations) in italics and key findings along with related recommendations, if any.

Exhibit 2



## Obtain reliable information on the highways system

*We expected that the Ministry's processes would include keeping a complete list of highways to maintain. It would determine key information it needs to manage maintenance such as highway condition and previous maintenance activities. It would collect this information on a consistent and reliable basis. It would determine the risks of damage to pavement to a point a highway can no longer operate at the intended service level (highway failure).*

To track highways for which it is responsible to maintain and the nature of those highways, the Ministry uses two computer systems. One system records all highways (by distinct highway segments) for which the Ministry has some responsibility.<sup>8</sup> The other system contains detailed data for each highway segment. Data includes past maintenance treatments, weight specifications, and highway surface-condition data. Through processes documented in manuals, the Ministry provides staff with clear direction on when and how to keep this information current and accurate.

The Ministry designs certain highways (like Highway Number 6 – Regina to Melfort) to handle more traffic and weight than others. Also, some highways are identified as more essential to our economy. The Ministry classifies or groups the highway segments into broad categories. These categories reflect the highways structure or pavement type, expected level of usage (e.g., traffic volume, nature of traffic), and priority (e.g., national gateway corridors). These categories reflect, on a broad basis, the potential level of service a highway segment can provide.

The Ministry uses data on surface condition as its primary basis for predicting highway condition and risk of damage to pavement and highway failure. At March 2009, the Ministry does not collect data on the current structural integrity of the highways (e.g., take core samples of the roadbed<sup>9</sup>). It monitors the industry to identify cost-effective methods to collect this data.

Consistent with national industry standards, the Ministry collects information on three surface-condition factors and has adopted a related

---

<sup>8</sup> In some cases, the Ministry has agreed to maintain highways it does not own (e.g., those within the provincial park system).

<sup>9</sup> Roadbed is the foundation of earth or rock supporting a road or highway.

methodology to predict the risk of damage to pavement and highway failure. It has documented these decisions in its practice and procedures manual. The three surface-condition factors are the extent of rutting in a highway, roughness of ride (IRI), and extent of cracking in a highway's surface. An industry-accepted computer program incorporates the related methodology. In this chapter, we refer to this program as the computer modelling system.

The Ministry has well-defined and documented processes that set out information needed to develop its maintenance plan, decide which maintenance activities to undertake, and track the completion of these activities. Its processes set out what information it needs to collect, who is to collect this information, and when. Senior management formally review and approve key changes to processes before they are put into effect.

Area and regional staff, located throughout the province, are assigned responsibility to collect most of the required information. The Ministry keeps current manuals that set out its data collection activities including clear definitions, naming conventions, and methods for collecting and reporting information it requires. Guidance in manuals provide staff with formalized criteria so that they collect, track, and record required information on a consistent and comparable basis. Required information includes data on surface condition, construction history, and nature and cost of maintenance activities planned or undertaken on each highway segment.

To collect the required data on the surface condition of highways, the Ministry uses a data collection vehicle (DCV) which is equipped with computer software, cameras, and sensors. The DCV collects data on rutting, IRI, and cracking every fall as part of its annual asset management program. Each year, the Ministry verifies that data is collected consistently and accurately. It keeps at least five years of this data.

## **Develop a maintenance plan**

*Highways are built to last a long time. A properly maintained highway system enhances public safety and ensures that the transportation*

*system fully supports a fully functioning economy.<sup>10</sup> Rigorous maintenance plans would reflect expected level of service over the life of the highway. A maintenance plan would help the Ministry take targeted and timely action to select the right preservation treatment at the right time. Targeted and timely actions minimize the risk of pavement surface breaks and premature highways failures and, in turn, help ensure the highway provides the desired or acceptable level of service.*

*To develop a maintenance plan, we expected the Ministry's processes would include establishing specific maintenance objectives, strategies, and performance measures. The Ministry would set service-level objectives that would maintain highways to a level acceptable over the long term. The Ministry would estimate cost of strategies, set maintenance priorities, and rank priorities against available resources over the short, medium, and long term.*

The Ministry has well-established and documented processes to develop its maintenance strategies and supporting project lists and work plans.<sup>11</sup> Its processes are flexible, enabling planning in various ways. It can determine the funding and resources necessary to maintain highways at defined surface-condition factors on an overall basis or by highway segment or type. Conversely, it can determine the optimal maintenance strategies to maintain highways at defined surface-condition factors within a defined budget. It can develop annual or multi-year maintenance strategies.

However, the Ministry has not formally set out the level of service from the highway system that is acceptable over the medium and long term (we call these service-level objectives). So that the Ministry selects the right maintenance activities at the right time, it needs to set long-term service-level objectives at levels (e.g., by highway category). These levels would need to reflect how it manages the highway system. Also, service-level objectives would help the Ministry determine maintenance resources necessary so that the transportation system supports our economy appropriately.

---

<sup>10</sup> *Ministry of Highways and Infrastructure. Plan for 2009-10, p.7.*

<sup>11</sup> Work plans set out, by each portion of highway, the types and cost of various maintenance activities (preventative treatments) to achieve the defined surface-condition. Staff are to do these activities in the next maintenance season. The maintenance season typically runs from spring to fall.



If the Ministry does not do the right maintenance activity at the right time, highways may become too damaged increasing the future costs of repair. Damaged highways can adversely impact the provincial economy and travel safety. Furthermore, because the Ministry has not set long-term service-level objectives, it is unclear if the Ministry maintains the entire highway system to an acceptable level. It may inadvertently maintain some portions of the highway system at a higher level than necessary and not sufficiently maintain other portions.

**1. We recommend that the Ministry of Highways and Infrastructure set long-term service-level objectives (such as long-term surface-condition factors).**

In its “Plan for 2009-10,” the Ministry notes, as a key action, the need to define service objectives for highways.<sup>12</sup>

Starting in 2008-09, the Ministry develops three-year plans for its heavy treatment activities. As previously noted, it hires private sector contractors to do this work. As heavy treatment activities require time to meet environmental requirements and cost more than medium or light treatment activities, a longer planning horizon facilitates efficiencies.

However, the Ministry plans its routine, light, and medium maintenance activities only for the upcoming year. Each year, the Ministry develops strategic scenarios by assigning varied combinations of surface-condition factors (rut, IRI, and cracking) to different categories of highways. To develop the provincial surface preservation program, its computer modelling system uses actual surface-condition data and estimated maintenance costs by treatment category. The Ministry then identifies highways on which to complete maintenance and the types and cost of various maintenance activities (preventative treatments) to achieve the defined surface-condition factors.

Each year, the Ministry develops scenarios based on various anticipated annual funding levels. In all cases, the scenarios fully allocate the anticipated budget. When its budget is finalized and approved, the Ministry enters the approved budget and selects a scenario. The selected scenario sets out maintenance activities that it will then carry out within

---

<sup>12</sup> *Ministry of Highways and Infrastructure. Plan for 2009-10, p.4.*

the approved annual budget (annual work plan, project list). Management confirms that the annual work plan and project lists are reasonable.

The combination of surface-condition factors included in the selected scenario become the Ministry's annual service-level objectives for the related category of highways. Although senior management approves the annual maintenance budget, it does not formally review and approve the surface-condition factors in the selected scenario.

The surface-condition factors are important. They are used to allocate the Ministry's annual maintenance budget and to select maintenance activities for the upcoming year. Because of this, senior management needs to ensure these factors result in maintaining highways to a level acceptable over the long term (long-term service level objectives) on a cost-effective basis.

Managing without long-term service-level objectives to guide the prioritization of maintenance activities increases the risk that the Ministry may not select the right preservation treatment at the right time. Improper priorities may cause the cost of maintaining the highway system to be higher over the life of the highways. Improper priorities also increase the risk that highways are not maintained to an acceptable level. Poor highways conditions can adversely affect our economy and safety of travel. Furthermore, long-term service-level objectives would provide staff with a basis to make decisions on maintenance activities consistent with the Ministry's priorities.

**2. We recommend that the Ministry of Highways and Infrastructure use service-level objectives to determine its annual and longer-term maintenance priorities.**

Estimated maintenance costs by treatment category are a key input into the computer system the Ministry's uses to develop its preservation program (annual work plans). Using past costs, the Ministry estimates its maintenance costs for the short term and adjusts them for its estimate of inflation. While it has sound processes to assess the reasonableness of its estimate for inflation, it does not have similar processes to assess the reasonableness of the methodology used to estimate maintenance costs. At March 2009, senior management did not review the reasonableness of those estimated maintenance costs or processes used to estimate these

costs. Unreasonable or inaccurate estimated maintenance costs may cause it to select the wrong preservation treatment for a particular highway segment.

- 3. We recommend that senior management of the Ministry of Highways and Infrastructure assess the reasonableness of maintenance costs used to develop its maintenance plan.**

## **Carry out maintenance effectively**

*To carry out maintenance effectively, we expected the Ministry would use recognized standards for its various maintenance activities. The Ministry would establish maintenance procedures consistent with those standards. It would track completion of maintenance activities and changes to its planned activities.*

The Ministry maintains two manuals that provide staff with detailed guidance on carrying out various maintenance activities. For example, for each type of highway failure, its Maintenance Practice and Procedures Manual defines the failure, its cause, and recommended repair. For each type of repair (such as deep patching), its sets out its purpose, normal practice used to make the repair, resources (equipment, labour, material), output measures (e.g., tonnes of asphalt), and where to find guidance to accommodate traffic when making the repairs.

The Ministry uses its staff's experience and research along with staff participation on national forums to develop and revise its maintenance standards. Several of these national forums develop and review national standards. The Ministry incorporates its standards into its manuals. Senior staff formally review and approve changes to manuals.

Managers located within the Ministry's three regions are primarily responsible to monitor completion of work plans and project lists. These managers (i.e., preservation engineers) finalize the work plan or project lists before the maintenance season and allocate projects within their region. A regional preservation engineer typically manages 30–50 projects. A project manager typically manages two to three projects. Staff typically have sufficient time to supervise and monitor the completion of a project. The practices used to monitor and report the completion of work plans/project lists differ in each region.

Staff located within areas monitor completion of work plans at a detailed level. Area staff carry out day-to-day supervision to assess status of projects and compliance with acceptable maintenance practices. They meet, often weekly, to assess progress, and identify and resolve issues. Regional preservation engineers monitor the completion of work plans and project lists on an overall basis. They meet with area project managers, about monthly, to discuss actual costs compared to budget and outstanding work, and adjust work plans / project lists to operate within budget.

Using the approved annual maintenance plan and their experience, the project managers and maintenance crew leaders prioritize and schedule treatments by category of highways (e.g., based weight capability, volume of traffic, strategic factors linked to Province's economy) and by type of treatment (e.g., deep patching or crack filling). The project managers and crews then carry out planned maintenance projects based on these priorities.

At times (e.g., due to bad weather or insufficient resources), staff need to change which maintenance treatments to do and when. Because the Ministry has not defined the level to maintain the highways' surface condition over the medium and long term, staff does not have guidance or criteria to help them decide. Without criteria, staff, across the three regions, may reach inconsistent decisions. Inconsistent decisions may result in unnecessary and unintended differences in maintenance costs and in highways conditions (See earlier recommendation about use of service-level objectives in determining priorities).

### **Monitor performance**

*To monitor performance, we expected the Ministry would regularly review and report on its progress in carrying out its maintenance plan and the impact of its maintenance activities. Reports would provide senior management with sufficient information on the results of its maintenance activities compared to plan. Senior management would use analysis to adjust its plans.*

The Ministry's manuals set out what information is to be reported to whom and when. In addition, they set out who is responsible for the preparation

of these reports and key analyses. This guidance helps staff located throughout the province to report on a consistent and regular basis.

The Ministry expects staff to:

- ◆ deliver their approved work plan or finalized project list within budget
- ◆ meet the commitments (such as the completion of certain projects) set out in public documents<sup>13</sup>
- ◆ provide senior management with a summarized report on the results of maintenance activities at the end of the maintenance season

As previously noted, the Ministry uses well-defined processes to track and prepare reports of costs (planned, actual, and forecasted), status of projects, and highway surface condition. The Ministry actively manages its maintenance activities to keep them within its approved budget. It summarizes financial information at various levels and produces reports at various times to coincide with the staff's responsibility. For example, area staff receive weekly detailed financial reports, middle management receive monthly financial reports, and senior management receive quarterly financial reports.

To review the status of work plans and projects, management review information captured within the related computer systems. They also meet monthly to discuss the status of maintenance work and adjust plans as needed.

Each quarter, senior management reviews reports on significant risks, use of labour, and the status of significant planned actions (as set out in its performance plan and commitments made in other public documents).

As previously noted, the Ministry assesses the surface condition of the highways each fall. This assessment reflects the impact of the Ministry's maintenance activities on all highways. Middle management receives reports on surface condition. In late spring when drafting its public annual report, senior management receives performance information about the condition of the National Highways System; it accounts for about 10% of

---

<sup>13</sup> Typically, most commitments in public documents are construction projects. Maintenance-related projects (if any) are incorporated into annual work plans or project lists.

the kilometres of its highway system.<sup>14</sup> However, senior management does not receive similar performance information on the remaining highway system.

Guidance in the Ministry's manuals recognizes that managers need information on the results of maintenance activities to make informed decisions about the long-term health of the highways system. This guidance requires staff to give senior management summarized reports on the results of maintenance activities (e.g., status of planned work, impact of uncompleted work on the condition of highways, comparison of actual surface condition to expected) each year. Although required, staff do not give management such reports.

- 4. We recommend senior management of the Ministry of Highways and Infrastructure receive a report on the results of the maintenance activities at the end of the maintenance season, as required.**

---

<sup>14</sup> Senior management receives information on the performance measures related to the National Highways System (i.e., percent of the National Highway System in good condition, percent of kilometres resurfaced on the National Highways System to meet the targeted life cycle cost).

## **Selected references**

- Government of Saskatchewan. (2008). *08-09 Annual Report. Ministry of Highways and Infrastructure*.  
<http://www.highways.gov.sk.ca/2008-09annualreport/> Regina: Author. <http://www.highways.gov.sk.ca/2008-09annualreport/> (09 Apr 2010).
- Government of Saskatchewan. (2009). *09-10 Plan for 2009-10: Ministry of Highways and Infrastructure*. Regina: Author.  
<http://www.highways.gov.sk.ca/reports>. (09 Apr 2010).
- Government of Saskatchewan. (2005-2009). *Public Accounts – Volume 2: Details of Revenue and Expenditure*. Regina: Author.
- National Guide to Sustainable Municipal Infrastructure. (November 2003), *Municipal Infrastructure Asset Management: A best practice*. Ottawa: Federation of Canadian Municipalities, Government of Canada, and the National Research Council.
- New South Wales Treasury. (June 2006). *Total Asset Management Guide: Asset Maintenance Strategic Planning*. Wales: Author.
- Norfolk County Council. (May 2004). *Delivering Best Value in Highway Maintenance, Code of Practice for Maintenance Management*. Norfolk County, England: Author.  
<http://www.committees.norfolk.gov.uk/papers/cabinet/plantran270504/plantran270504item11pdf.pdf>. (09 Apr 2010).
- Office of the Provincial Auditor. (May 2006). *2006 Report – Volume 1, Chapter 12 – Saskatchewan Water Corporation*. Regina: Author.
- Transportation Association of Canada. (October 2008). *Best Practices for the Technical Delivery of Long-Term Planning Studies in Canada-Final Report*. Ottawa: Author. <http://www.tac-atc.ca/english/resourcecentre/reports.cfm>. (09 Apr 2010).

This page left blank intentionally.