

Highways and Infrastructure

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Main points

The Ministry of Highways is responsible for maintaining provincial highways including approximately 800 bridges. The Ministry conducts regular inspections to determine the condition of its bridges and to plan short-term bridge maintenance. It carries out bridge maintenance as planned.

At March 2010, the Ministry needed to make the following improvements to the processes it uses to keep bridges in good repair over the long term. It needs:

- ◆ To keep its bridge management system records up to date. This would assist management to have readily accessible and current information to make decisions about bridge planning and required maintenance.
- ◆ To document its key bridge maintenance planning processes and overall bridge maintenance plan. Improved documentation would reduce the risk that unplanned staff turnover may have on bridge maintenance plans.
- ◆ To establish and use long-term bridge service objectives to determine its annual and longer-term maintenance priorities. Service objectives would reflect the level to which the Ministry would maintain bridges to achieve the desired level of safety. Use of these objectives would also help the Ministry select the right maintenance activities at the right time (over the short, medium, and long term) to avoid unnecessary bridge maintenance costs and unintended differences in bridge conditions.
- ◆ To develop a report that senior management can use to monitor the results of bridge inspection and maintenance activities.

Doing the right maintenance at the right time reduces long-term costs and minimizes the risk of bridge failure.

Introduction—Keeping bridges in good repair

This chapter describes the results of our audit of processes at the Ministry of Highways and Infrastructure (Ministry) to keep bridges in good repair on provincial highways. A bridge is a structure that allows people or vehicles to cross an obstacle such as a railway, river, or another highway.

Background

The Highways and Transportation Act, 1997 sets out the Ministry's responsibility for all matters relating to bridges on the provincial highway system, including the maintenance of those bridges. The Ministry's mission is to optimize the role of transportation as it relates to the economic and social development of Saskatchewan.¹ A properly maintained transportation system enhances public safety and ensures that the transportation system supports a fully functioning economy.²

At March 31, 2010, the 800 bridges on the provincial highway system had a recorded cost of over \$161 million (2009 - \$153 million) and a net book value of about \$86 million (2009 - \$80 million). The average age of the bridges is about 37 years.³ In 2009-10, the Ministry spent about \$1.2 million maintaining bridges.

The Ministry classifies its bridges using two general categories: minor⁴ and major.⁵ It has about 630 minor bridges with an average age of the various minor bridge types ranging from 24 to 42 years⁶ and 170 major bridges with an average age of about 41 years.

The Ministry has divided the highway system, including bridges, into three regions and assigned staff to these regions. Also, the Ministry has two

¹ 10-11 Ministry Plan, *Ministry of Highways and Infrastructure*, p. 2.

² *Ibid.*, p. 9.

³ The Ministry of Highways and Infrastructure estimates the useful life to be 40 years for accounting purposes.

⁴ Minor bridges are on average smaller and consist of both timber & shorter-span concrete/steel bridge structures. Total deck surface area of minor bridges is 107 thousand square meters.

⁵ Major bridges are on average larger, and the majority of the bridge structure is made of concrete that is reinforced with steel. Total deck surface area of major bridges is 136 thousand square meters.

⁶ Per Ministry records: bridges made entirely of timber had an average age of 42 years, other shorter-span bridges with a timber substructure but non-timber deck had an average age of 28 years, and other minor bridges had an average age of 24 years.

teams that specialize in maintaining bridges: a preservation engineering team and a bridge preservation crew.

Exhibit 1 sets out the Ministry’s spending on bridge maintenance (preservation) and bridge construction (infrastructure capital) over the last five years. Also, the exhibit notes the results of the Ministry’s public performance measure related to bridge condition inspections.

Exhibit 1

	2009-10	2008-09	2007-08	2006-07	2005-06
Spending on: (in millions of \$)⁷					
Preservation	1.2	1.8	1.3	1.2	0.8
Infrastructure capital	12.5	15.7	8.9	8.5	n/a
Measurement results⁸					
Percentage of bridges inspected annually	41%	n/a	n/a	n/a	n/a

The Ministry identifies “preservation of the transportation system” as one of its key programs. Preventative maintenance focuses on activities to keep the bridge structures in good repair to maintain safety. Doing the right preventative maintenance at the right time maintains safety and reduces long-term costs of the bridges.

Audit objective, criteria, and conclusion

The objective of this audit was to assess the adequacy of the Ministry’s processes to keep bridges within the provincial highway⁹ system in good repair. We assessed the processes in place for the year ended March 31, 2010. The scope of the audit did not include the maintenance of the pavement surface (e.g., the asphalt) on the decks of bridges or maintenance of culverts.¹⁰

To conduct this audit, we followed the *Standards for Assurance Engagements* published 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 this chapter.

⁷ Obtained from Ministry of Highways and Infrastructure financial records.

⁸ 2009-10 Annual Report - Ministry of Highways and Infrastructure, p. 17.

⁹ Section 2(b) of *The Highways Act, 1997* defines provincial highways.

¹⁰ Culvert - a transverse and totally enclosed drain under a road or railway.

<http://wordnetweb.princeton.edu/perl/webwn> (April 11, 2011).

Exhibit 2 – Criteria

To have adequate processes to keep bridges within the provincial highway system in good repair, the Ministry should:

1. Obtain reliable information on bridges
2. Develop a maintenance plan
3. Carry out maintenance effectively
4. Monitor performance

We concluded that, for the year ended March 31, 2010, the Ministry of Highways and Infrastructure had adequate processes to keep bridges in good repair except for:

- ◆ **Maintaining up-to-date bridge management system records for use in making decisions about planned and required maintenance**
- ◆ **Documenting the key bridge maintenance planning processes and the overall bridge maintenance plan to facilitate the planning of bridge maintenance**
- ◆ **Setting and using long-term service objectives for bridges for prioritizing maintenance activities**
- ◆ **Providing a report that senior management can use for monitoring the results of bridge maintenance and inspection activities each year**

Key findings and recommendations

In the following sections, we set out key findings for each criterion (see Exhibit 2). Our detailed expectations for each criterion are set out in italics under each subheading.

Obtain reliable information on bridges

We expected that the Ministry's processes would include maintaining a complete list of bridges. The Ministry would:

- ◆ *Identify and keep a list of the key elements of those bridges*
- ◆ *Determine key information such as bridge condition and previous maintenance activities*
- ◆ *Have qualified personnel collect this information on a consistent and reliable basis*

- ◆ *Determine the risks of damage to bridge structures to the point bridges could no longer operate at intended service levels*

The Ministry uses a computer system (called the bridge management system (BMS)) to track all bridges (by distinct bridge number) and to accumulate key information about those bridges (e.g., location, structure type, date of last inspection and condition rating). The Ministry also keeps in separate manual files and in spreadsheets more detailed information for each bridge. This detailed information includes the nature of maintenance activities planned or undertaken on each bridge, the results of detailed inspection reports (bridge element condition), and design specifications.

The Ministry requires all bridge inspectors to have specified qualifications. Ministry staff, located throughout the province, collect most of the required information. Ministry staff inspect minor bridges and carries out specialized bridge inspections¹¹ of some major bridges. The Ministry hires private sector contractors to inspect major bridges. In 2009-10, these contractors did about 29% of all bridge inspections completed in the year.

The Ministry uses comprehensive, industry-accepted standards to complete bridge inspections.¹² These standards provide inspectors with details on bridge elements, potential defects, required inspection procedures, standardized condition ratings, measures for defects, the format for reports, and recommended actions for identified defects.

The Ministry keeps current manuals that set out expected bridge-data-collection activities. The manuals include clear definitions, naming conventions, and methods for collecting and reporting information. The manuals provide staff with criteria to collect, track, and record required information on a consistent and comparable basis.

Bridge inspections consist of detailed visual inspections, photographing bridge elements, measuring deficiencies (if any), and completing standard

¹¹ Specialized inspections generally include processes more precise than visual inspections. One example is called a half-cell test. This test uses a battery and measurement equipment to map electrical conductivity across the bridge deck. This “map” of conductivity helps to assess corrosion of the steel components inside the concrete structure.

¹² The Ministry has adopted the *Ontario Structure Inspection Manual (OSIM)* as the basis for its bridge inspection standards. The Ministry has adjusted these standards to make them more applicable to the risks and conditions bridges face in Saskatchewan.

inspection reports. The Ministry uses standard inspection reports so that consistent information is collected. This includes the condition of each bridge element, suggested maintenance work, and other inspection observations.

Ministry preservation engineers use the inspection reports to make decisions on the safety of the bridge, its weight capability, the risk of bridge failure, and maintenance work necessary. Inspectors inform preservation engineers of any potentially significant issues.

Ministry bridge inspectors are responsible for updating the BMS with the results of their inspections. Preservation engineers are responsible for updating the BMS for inspections done by private sector contractors. Preservation engineers do not update the BMS until they review the contractors' inspection reports.

During our audit, we found that preservation engineers were behind in their review of certain inspection reports (that is, those not flagged for significant issues). They were also behind in their entry of information into BMS. For over half of the files we examined, information from their latest cycle of inspections (i.e., either the 2008 or 2009 inspections) was missing in the BMS. Some information was also missing from inspections prior to the latest cycle (that is, results from the 2006 and 2007 inspections).

Delays in reviews of inspection reports means preservation engineers may not provide inspectors with timely feedback on the quality of their inspection reports. Also, because the BMS was not kept up to date, management did not have readily accessible and up-to-date information on bridge conditions to make informed decisions about planned and required maintenance.

- 1. We recommend that the Ministry of Highways and Infrastructure keep bridge management system records up to date.**

Develop a maintenance plan

We expected maintenance plans would reflect the expected level of service over the life of the bridge. A complete maintenance plan would

help the Ministry take targeted and timely action to select the right maintenance treatment at the right time. Targeted and timely actions keep bridges able to support the desired traffic weight and, in turn, help ensure the highway system is safe and provides the desired or acceptable level of service.

To develop a maintenance plan, we expected the Ministry to use well-established and documented processes. We expected these processes would include establishing specific maintenance objectives, strategies, and performance measures. We expected the Ministry would set service objectives for maintaining bridges to an acceptable condition over the long term;¹³ estimate the cost of strategies; set maintenance priorities; and rank priorities against available resources over the short, medium, and long term. We also expected its comprehensive maintenance plan would include its maintenance strategies, supporting project lists, and work plans.¹⁴

The Ministry does not have documented procedures for its bridge maintenance planning processes, nor a combined bridge maintenance plan. Rather, its plan is comprised of various documents (e.g., a list of approved and prioritized maintenance work, a list of new and major rehabilitation projects it plans to complete over the next five years, lists of bridge inspections, and information used to support its annual budget). We found that Ministry staff understood the current bridge-planning processes and practices.

Because of low turnover of staff involved in bridge maintenance, many of the Ministry's processes are only partially documented. Lack of documented detailed procedures could hamper the Ministry's ability to effectively plan and carry out bridge maintenance activities in the event of unplanned staff turnover.

In 2010-11, management started to document its bridge maintenance planning processes. It expects that this documentation, when complete, will assist Ministry staff in planning and scheduling bridge maintenance.

¹³ At March 2010, industry-accepted service objectives for bridges did not exist.

¹⁴ Work plans set out the types and cost of various maintenance activities to achieve the defined service objectives.

2. We recommend that the Ministry of Highways and Infrastructure document its key bridge maintenance planning processes and its bridge maintenance plan.

The Ministry, on a broad basis, uses its categories of highways to reflect the levels of service it expects bridges to provide over their service life.¹⁵ The Ministry recognizes that the maintenance of bridges must correspond to specific weight restrictions and traffic requirements as reflected in the related category.

The Ministry sets some performance measures related to its bridge maintenance activities. For example, as noted in its Annual Report, the Ministry plans to inspect 50% of its bridges each year. However, the Ministry has not formally determined what constitutes a safe bridge – that is, it has not formally decided how it will consistently measure bridge safety. Also, it has not formally set the level to which it will maintain bridges to achieve the desired level of safety (i.e., service objectives) over the life of the bridge. Rather, the Ministry prioritizes and approves short-term maintenance activities using information on bridge category, bridge condition, planned rehabilitation projects, and available annual budget. Also, its bridge planning sets out measureable amounts of deterioration that drive its annual repair work to ensure bridge safety.

Use of long-term service objectives will help the Ministry select the right maintenance activities at the right time over the life of the bridges. Also, their use will help the Ministry determine the maintenance resources necessary over the long term.

Not doing the right maintenance activity at the right time increases the risk that some bridges may be maintained at a higher level than necessary or become unsafe, and that costs of future repair may increase. Bridges not sufficiently maintained can adversely impact travel safety as well as the provincial economy through excessive weight restrictions on highways. Unsafe bridges can result in serious injury and loss of life. Use of service objectives will help ensure staff make decisions on maintenance activities consistent with the Ministry's priorities.

¹⁵ These categories reflect the bridge structure type, expected level of usage (e.g., traffic nature and volume), and priority (such as high-priority routes).

- 3. We recommend that the Ministry of Highways and Infrastructure set long-term service objectives for bridges and use them to determine its annual and longer-term maintenance priorities.**

Carry out maintenance effectively

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

The Ministry uses staff experience, research, and participation on national forums¹⁶ to develop and revise its maintenance standards and manuals. It maintains two manuals that provide staff with sufficient detailed guidance on carrying out various bridge maintenance activities. Senior staff formally review and approve changes to the Ministry's manuals.

The first manual sets out the maintenance standards, the type of work involved during each type of treatment, and the standard procedures. It also provides information on the potential impact of each type of treatment on the surrounding environment. Making information on potential environmental impacts readily available helps make the Ministry's requests for environmental approvals efficient.

A second manual sets out standard operating procedures for maintenance work. For each type of repair (such as replacing wood pilings), the manual outlines the safety precautions, the normal procedures used to make the repair, and the resources needed (equipment, labour, material). It also provides guidance on traffic management.

Preservation engineers are primarily responsible to monitor completion of work plans and project lists, and to prioritize maintenance activities. These engineers work with the bridge preservation crew to update the bridge-maintenance work plan and project lists on a quarterly basis.

¹⁶ Several of these national forums develop and review national standards. For example, staff participate on Transportation Association of Canada committees and projects. The Association is a forum for gathering or exchanging ideas, information, and knowledge on technical guidelines and best practices. <http://www.tac-atc.ca/english/about/index.cfm> (December 29, 2010).

Because the Ministry has not defined the bridge condition level to maintain over the medium and long term, staff do not have guidance or criteria to help them choose optimal maintenance activities to avoid unnecessary bridge maintenance costs and unintended differences in bridge conditions (see earlier recommendation about the use of service objectives in determining priorities).

The bridge preservation crew is primarily responsible for detailed scheduling of maintenance work and monitoring the availability of labour, equipment, and materials. When scheduling bridge maintenance, staff consider the planned location of the crew (based on scheduled construction or rehabilitation work) and the priority level of maintenance work as assessed by the preservation engineers. The Ministry schedules major rehabilitation and new construction work up to two years in advance because of the complexity of these projects (e.g., need to obtain environmental approvals or order specialized bridge components). The crew adjusts its plans when emergency or urgent maintenance work arises.

Monitor performance

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

The Ministry has adequate processes for monitoring financial performance. The Ministry does not have a documented policy or a process for reporting the results of its inspection activities and the impact of its maintenance activities to senior management.

For financial reporting, the Ministry uses well-defined processes to track and prepare reports on planned, actual, and forecasted costs. It actively manages whether maintenance activities are within the approved budget. The Ministry produces summarized financial reports at various times. For example, staff receive weekly detailed financial reports, middle management receives monthly financial reports, and senior management receives quarterly financial reports. Quarterly reports include significant

risks, use of labour, and the status of commitments set out in the Ministry's public performance plans.

Senior management does not receive reports about the progress of bridge inspection activity, changes in bridge condition over time, or the expected impact of deferred maintenance work on the condition of bridges. Senior management needs the results of maintenance and inspection activities to make informed long-term decisions about the bridges.

- 4. We recommend that senior management of the Ministry of Highways and Infrastructure receive and review reports on the results of bridge inspection and maintenance activities.**

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