

Bridge Inspection and Maintenance

Follow-up on VFM Section 3.02, 2009 Annual Report

Background

Ontario has about 14,800 bridges. Approximately 2,800 of these are located within the provincial highway system and are the responsibility of the Ministry of Transportation (Ministry). The remaining 12,000 are located in municipalities and are their responsibility.

Responsibility for the safety and maintenance of provincial bridges is set out in the *Public Transportation and Highway Improvement Act* (Act). The Act requires that all provincial and municipal bridges be inspected every two years under the direction of a professional engineer using the Ministry's Ontario Structure Inspection Manual (Inspection Manual). The Inspection Manual requires these biennial inspections to be a "close-up" visual assessment of each element of a bridge to identify any material defects, performance deficiencies, or maintenance and rehabilitation needs.

PROVINCIAL BRIDGES

In our 2009 Annual Report we noted that the Ministry had established comprehensive standards for bridge inspection in the Inspection Manual, and if the standards are followed, the required inspection procedures effectively enable structural deficiencies

to be identified. The Ministry was also conducting bridge inspections on a biennial basis as required.

However, we noted a number of areas where improvements to the Ministry's inspection and maintenance processes would help minimize potential safety risks—such as those caused by falling concrete or by parts of a bridge structure failing to perform their intended function of providing adequate protection to the vehicles travelling on or underneath the structure—and would ensure that bridges for which the province is responsible remain safe. Our observations were as follows:

- According to the Ministry's assessment, more than 180 or 7% of provincial bridges were in poor condition, defined as requiring repair or rehabilitation work within one year of the bridge inspection. We found that, despite their being in most need of repair or rehabilitation, over one-third of these bridges were not included in the Ministry's capital work plan for the upcoming year.
- The Ministry had not ensured that information on critical elements within each bridge was accurate and that all elements were accounted for. The state of these elements is the key to determining a bridge's overall condition and estimating any needed rehabilitation costs. In addition, the Ministry's database of bridge inventory—the Bridge Management

System (BMS)—did not have information on the rehabilitation history for almost one-third of the bridges that were 40 years or older.

- The Inspection Manual requires a detailed visual “close-up” inspection of each bridge element. Normally, this requires the closure of lanes and road shoulders to traffic. For example, without closing a lane, close-up inspection of the critical elements of certain bridges on Highway 401 in the Greater Toronto Area would not be possible, yet there had been no such lane closures for the previous three years at the time of our 2009 audit.
- We found several weaknesses regarding the process for ongoing oversight of inspections. For example:
 - The Inspection Manual stipulates that an inspector needs to spend at least two to three hours at a typical bridge site. However, inspectors were often conducting five or more inspections a day. For example, in the rounds of inspections between 2006 and 2008, we noted that 10 or more bridges were inspected by a single inspector in one day on 36 separate occasions.
 - A significant change in the rating of a bridge’s condition between inspections requires explanation and, potentially, a re-inspection. We noted that the latest inspection results at the time of our 2009 audit showed an improvement in the overall condition rating of over 300 bridges, even though little or no rehabilitation work had been done on these bridges since the previous inspection. In other instances, the overall rating did not change at all between inspections, and reports from the previous inspections were carried forward without any changes. Although in many cases there were photographs on file to indicate that an inspection had been done, when no changes whatsoever in the condition of the bridge had been noted since the last inspection, the adequacy of at least some of these

inspections should have been followed up on, especially on older bridges, because a bridge’s elements typically deteriorate over time.

- We noted that regions tended not to complete many of the maintenance recommendations resulting from biennial bridge inspections. In two of the three regions that we visited, only about one-third of the recommended maintenance work was actually completed, and the third region did not track this work at all.

With respect to the procurement of major projects for bridge design and construction, we noted that the Ministry generally followed a competitive selection process. However, in many of the contracts for design services and construction oversight consulting that we examined, there were changes to the scope of work that resulted in a final price of at least 50% more than the original contract price.

MUNICIPAL BRIDGES

To ensure the safety of municipal bridges, municipalities are also required to perform biennial inspections in accordance with the Inspection Manual. At the time of our audit, we noted that there was no legislation that requires or even enables the Ministry of Transportation or any other provincial ministry to oversee municipalities’ compliance with this requirement. There was also no central database on the number of municipal bridges and their overall condition.

Our survey of municipalities indicated that the average age of municipal bridges was generally higher than that of provincial bridges. However, it was not possible to get an accurate picture of the overall condition of municipal bridges or to make accurate comparisons between municipal and provincial bridges, because municipalities use many different systems to classify and determine the condition of their bridges. Nevertheless, the majority of municipalities (85%) that responded to our survey indicated that they had a backlog of rehabilitation work. Large and growing communities generally

did not have significant backlogs because their infrastructure was newer, in contrast to municipalities with a large number of bridges relative to their population and revenue base, which had more difficulty funding bridge rehabilitation.

The province had provided municipalities with one-time funding for municipal capital projects. However, funding decisions were often made on the basis of population and the network of roads rather than specific needs relating to bridges. As well, the funds were paid close to the end of the province's fiscal year, and many municipalities were not able to properly plan and spend the money. For instance, a significant portion of the funds provided in 2008 remained unspent one year later. Municipalities told us that better asset-management practices supported by more sustainable provincial funding were needed to ensure safety and maximize the lifespan of their bridges. At the time of our audit, a provincial–municipal working group was examining these issues.

STANDING COMMITTEE ON PUBLIC ACCOUNTS

The Standing Committee on Public Accounts held a hearing on this audit in March 2010. In November 2010, the committee tabled a report in the Legislature resulting from this hearing. The report contained nine recommendations and requested the Ministry to report back to the Committee with respect to the following:

- changes being made to ministry policies and practices to identify and differentiate between bridge deficiencies that pose a safety risk and those that indicate a loss in economic value, and whether all provincial bridges rated fair to poor had now been included in the Ministry's five-year capital plans;
- how the Ministry would provide more guidance on the practice of lane and shoulder closures in its Inspection Manual to allow both its staff and contract inspectors to perform consistent and effective bridge inspections;

- whether the Ministry had monitored the effectiveness of its enhanced oversight initiatives and inspection training for its staff and external engineering consultants, and the results of its monitoring, including whether significant increases or decreases in a structure's Bridge Condition Index from one inspection to the next were being followed up on;
- steps the Ministry had taken to better track and explain any incomplete work relative to scheduled maintenance for the year;
- steps the Ministry had taken to integrate missing information and to correct inaccuracies and discrepancies in its inventory of provincial bridges and their elements;
- the Ministry's conclusions stemming from its interim evaluation of its project to track and monitor the variance between estimated and actual design costs, and the results to date of its "smart sourcing" initiative;
- the status of the Roads and Bridges Review Study being conducted jointly by provincial and municipal representatives (the Committee also requested the Ministry to direct the review process to include possible options for the creation of a central oversight body to monitor biennial bridge inspection and maintenance activity at the municipal level);
- the Ministry's views on the merits of having a uniform bridge information and management system among municipalities, along with a report on the feasibility of making the Ministry's BMS available to municipalities for the purpose of providing better information on bridge inspection and maintenance processes at the local level; and
- a proposal that could enable the allocation of infrastructure funds from the province to priority municipal bridge improvement or repair projects where safety is the key criterion.

The Ministry formally responded to the Committee in February 2011. A number of the issues raised by the Committee were similar to our observations. Where the Committee's recommendations are

similar to ours, this follow-up includes the recent actions reported by the Ministry to address the concerns raised by both the Committee and our 2009 audit.

Status of Actions Taken on Recommendations

The Ministry provided us with information in spring 2011 on the current status of the actions taken on our recommendations. According to this information, significant progress has been made in addressing many of the recommendations we made in our *2009 Annual Report* with regard to provincial bridges, although some will require more time to address fully. Our concerns with regard to municipal bridges have been only partially addressed, since data collection and a provincial–municipal review were still under way at the time of this follow-up. The status of action taken on each of our recommendations at the time of our follow-up was as follows.

SAFETY OF PROVINCIAL BRIDGES

Recommendation 1

To ensure that appropriate and timely action is taken on bridges requiring repair and rehabilitation work, the Ministry of Transportation should:

- *strengthen its risk-assessment and priority-setting process, with particular consideration given to bridges identified as being in poor condition, so that any urgently required work is given first priority; and*
- *ensure that government decision-makers receive the information they require to adequately assess both safety and economic risks in order to prioritize the capital needs of Ontario's aging provincial bridges.*

Status

At the time of our follow-up, the Ministry indicated that it had strengthened its policies and procedures to identify and record safety-related defects by requiring that:

- bridge inspectors identify all urgent items in the comments section of the bridge inspection form and notify the appropriate ministry representative; and
- the nature of the work completed or other action performed is also recorded in the comments section of the bridge inspection form to provide a permanent record of the work done.

In addition, mandatory bridge inspection workshops held subsequent to our audit emphasized the process for identifying safety-related deficiencies.

The Ministry also indicated that it now requires the completion of a justification form that explains why any bridge with a Bridge Condition Index (BCI) of less than 60 is not on the five-year capital construction program and what measures are being taken to ensure the safety of the bridge.

The Ministry indicated that, to ensure that government decision-makers receive the information they need to prioritize the capital needs of Ontario's aging provincial bridges, it completed in September 2011 multi-year regional investment plans that list the needs and corresponding investments required for bridges and pavements over a 25-year period. The plans include information on bridge structure needs, construction costs, the recommended year for the improvements, as well as the projected outcome of the investments.

BRIDGE INVENTORY

Recommendation 2

To better ensure that the results of bridge inspections are accurately recorded and to better prioritize and estimate the cost of bridge repair and rehabilitation, the Ministry of Transportation should:

- *more closely monitor inspectors' compliance with the Bridge Inspection Manual so that*

critical bridge information is accurately updated; and

- *act on findings from its quality-assurance review and ensure the completeness and accuracy of information kept in the Ontario Bridge Management System.*

Status

In fall 2009, the Ministry issued a policy memo that requires inspectors to review the accuracy of the information on bridge inventory and the individual elements contained in each bridge as part of the inspection. Ministry engineers are required to conduct spot checks to ensure compliance with this requirement.

The Ministry also initiated a multi-phased project to ensure the accuracy of bridge information in the BMS. The project includes:

- identifying large differences between a bridge's deck area as recorded in its design drawings and its BMS data;
- ensuring that the BMS contains sufficiently detailed information for all bridges (the BMS "key aspects field");
- ensuring that the last rehabilitation date has been entered in the system, where applicable;
- reviewing bridge drawings to ensure that the inventory data in the BMS are accurate for those bridge elements that have the largest impact on the BCI; and
- confirming during field inspections the information on the elements of each bridge contained in its design drawings.

The Ministry indicated that its Bridge Office will review the inventory of all bridges and the data on the elements contained in each, after this information has been corrected at the regional level. This work is scheduled to be completed by December 2012. The Bridge Office's field audits, which involve re-inspections of 50 bridges annually, will now include a review of inventory and bridge element data.

Starting in 2011, the Ministry also increased the frequency of its quality assurance inspections from

a biennial to an annual basis. The inspections now include a review of recommendations from previous quality assurance inspections and a report on the status of those recommendations.

GAINING ACCESS TO BRIDGES FOR INSPECTION

Recommendation 3

To ensure that inspections are carried out in accordance with legislation, the Ministry of Transportation should:

- *arrange for the closure of lanes and shoulders whenever these are required to ensure that an adequate bridge inspection can be carried out;*
- *if closure of lanes and shoulders is not always possible for every bridge inspection, consider a risk-based approach that takes into consideration factors such as the age of the bridge and the feasibility of rotating inspections. Off-peak closures such as at night or on weekends also warrant more consideration to facilitate bridge inspection; and*
- *consider specifying lane and shoulder closures when tenders are issued for inspections to be done by external consultants.*

Status

At the time of our follow-up, the Ministry informed us that the policy memo issued in 2009 makes it mandatory for bridges requiring lane and shoulder closures to be identified and specified in bridge inspection assignments carried out by consultants. The Ministry's regional structural engineers are now required to make an accessibility assessment for each bridge before advertising the assignment. The required number of lane and shoulder closures is communicated to the consultants on the basis of these assessments.

In March 2010, the Ministry developed its "Bridge Inspection Accessibility Guidelines" to be used by regional structural engineers to develop accessibility plans for their bridges. The plans include information on access requirements, such

as lane and shoulder closures; special access equipment required, such as bucket trucks and boats; suspect areas that require an enhanced inspection; and the frequency of the enhanced inspections. The Ministry indicated that in April and June 2010 it delivered workshops to all ministry inspectors on completing the accessibility plans.

At the time of our follow-up, the Ministry informed us that the 2009 inspection cycle had required 50 lane and shoulder closures, and the 2010 inspection cycle had required 100.

INSPECTION OVERSIGHT

Recommendation 4

To ensure that inspections are conducted in accordance with legislation, the Ministry of Transportation should establish a risk-based approach for the ongoing monitoring of inspections. This approach should include:

- *assessing the reasonableness of the number of bridges that external contractors and ministry staff report as having been inspected in any one day to ensure that thorough inspections are being done;*
- *following up on any unusual changes in a bridge's condition since the previous inspection; and*
- *identifying high-risk bridges that should be subject to more in-depth condition surveys.*

The Ministry of Transportation should also consider standardizing its agreements with engineering firms. At a minimum, these agreements should contain provisions regarding the experience and qualifications of staff assigned by the firm to conduct the inspections.

Status

At the time of our follow-up, the Ministry indicated that the September 2009 policy memo requires that regional structural engineers and project managers record an estimate of the minimum inspection time for each bridge, and that estimate is then compared to the actual time taken to inspect the bridge. This

is intended to ensure that the inspector has taken the appropriate amount of time to complete the inspection. The 2010 bridge inspection workshops conducted by the Ministry also addressed consistency in time spent on the inspection process. The Ministry also noted that the BMS has added new data fields that record the time required for inspections and the start- and end-dates of the inspections.

Ministry policies and procedures now require that the regional structural engineer must review any bridges with significant changes in condition (either an increase of more than three points or a decrease of more than five points in BCI values) and that any such change be justified and rationalized by the bridge inspector. The Ministry also indicated that a new data field has been added to the BMS requiring an explanation for unexpected changes in the BCI between inspections.

The Ministry has also developed a standard Request for Proposal (RFP) document for inspections that are outsourced to engineering firms. The RFP now requires all lead inspectors to have a minimum of five years' inspection experience and to have completed the Ministry's bridge inspection course.

BRIDGE MAINTENANCE

Recommendation 5

The Ministry of Transportation should:

- *develop a formal asset-management plan as a basis on which to prioritize the preventative maintenance of bridges; and*
- *promptly carry out preventative maintenance, including the maintenance recommended in bridge inspections.*

Status

At the time of our follow-up, the Ministry indicated that it had instituted an interim process for tracking maintenance work. This process:

- defines the urgent maintenance needs that may affect safety;

- requires that items with the highest priority be completed first and prioritizes the remainder; and
- includes an annual chart to list non-urgent maintenance items for all bridges and record all maintenance work completed, with the information to be returned to the sections responsible for structures within each region.

The Ministry also informed us that its multi-year regional investment plans (discussed previously) include information on optimal preventative maintenance work required and the impact this work has on extending the life of structures. Planned improvements to the BMS will allow the Ministry to create reports on required maintenance work that can be distributed to regional offices.

ONTARIO BRIDGE MANAGEMENT SYSTEM

Recommendation 6

To make the Ontario Bridge Management System more useful, the Ministry of Transportation should:

- ensure that the information on bridge rehabilitation contained in the System is up to date; and
- assess whether the System meets users' needs and whether there are cost-effective ways of improving its performance and capabilities, especially with respect to reporting information needed for rehabilitation and inspection purposes.

Status

At the time of our follow-up, the Ministry indicated that it had updated the rehabilitation history for all bridges and transferred the data to the "Work History" section of the BMS.

The Ministry also informed us that it has made a number of improvements to its BMS, focusing on improving overall system performance as well as data access and reporting capabilities. Ministry documentation indicated that the overall speed of operation of the BMS over the Ministry-wide network has improved. The BMS now allows easier

management of bridge-related documents, such as engineering drawings and inspection photographs and reports. Engineering drawings that were previously contained in a separate document management system have been loaded into the BMS database.

The Ministry indicated that it has started the development of a plan to replace the current BMS.

PROCUREMENT AND CONTRACT MANAGEMENT

Recommendation 7

To ensure value for money on major capital projects and fairness in its procurement process, the Ministry of Transportation should:

- review the application of its two different sets of evaluation criteria for requests for proposals to ensure that they are consistently applied across the regions;
- reassess the evaluation criteria in which the bid price is a relatively minor factor in selecting the winning bidder; and
- given the frequent significant variances between the Ministry's estimated cost of a project and the bidder's cost, examine its internal estimation process as well as the possible impact of the increased trend of relatively few bidders.

Status

At the time of our follow-up, the Ministry informed us that it plans to explore an approach where simple and straightforward engineering assignments may be awarded solely on price, while for larger and more complex projects it would also consider factors such as the consulting engineering firm's past performance and proposed approach to the work.

The Ministry also indicated that it has been monitoring the variance between the estimated and the bidder's cost of design projects and has seen some improvement in this regard. The Ministry informed us that it will continue to monitor the estimated and actual costs of design projects, and if the

average actual costs exceed the estimated costs by 5%, it will analyze the reasons for the variance and implement measures in 2012 to further improve its cost estimates. These measures would include using the detailed breakdown of the bids of past design projects to estimate future design project costs.

To address the increased trend of relatively few bidders, the Ministry indicated that it continues to meet with senior members of the consulting industry to identify opportunities to increase interest in its engineering assignments.

MUNICIPAL BRIDGES

Recommendation 8

To help ensure the safety and proper upkeep of municipal bridges, and as part of its current provincial–municipal review, the Ministry of Transportation should work with municipalities and other stakeholders to:

- *review practices in other large provinces and U.S. states with respect to oversight of municipal responsibilities for bridge maintenance, with the aim of determining whether changes to the current accountability relationship are required;*
- *ensure that the condition of municipal bridges is consistently assessed, updated every two years as required, and publicly reported;*
- *review the Ministry's funding arrangement with municipalities to ensure that the funds provided are effective in sustaining the proper maintenance and rehabilitation of bridges; and*
- *promote good asset-management practices.*

Status

In fall 2009, the Ministry, in conjunction with the Association of Municipalities of Ontario and the City of Toronto, launched a joint provincial–municipal review to develop options for responsibilities and funding arrangements for municipal roads and bridges. A steering committee and three working groups have been established to:

- promote the development of asset management plans for municipal roads and bridges;
- develop objective criteria and a methodology for evaluating the municipal road network and determining which municipal roads are of provincial, municipal, or joint provincial–municipal interest across Ontario; and
- develop a funding framework for municipal roads and bridges that considers municipalities' investment needs and their ability to fund the required infrastructure.

The Ministry indicated that the final recommendations from the working groups were anticipated in fall 2011.

At the time of our follow-up, the Ministry also indicated that a review of municipal bridge oversight practices in most Canadian provinces and some U.S. states was under way, and the information gathered would be considered in assessing options for municipal bridge oversight in Ontario. Final recommendations from this jurisdictional review were also anticipated in fall 2011.

At the time of our follow-up, the Ministry indicated that it continues to provide funding to assist smaller municipalities to collect data on the condition of bridges and input the data in Municipal Data Works (MDW), a web-based system designed to manage municipal tangible capital assets. MDW was developed using the Ontario Structure Inspection Manual's method of conducting bridge inspections. This involves dividing the bridge into 20 to 30 elements and determining the quantity of defects in each element measured by four condition states. Using the inspection results, MDW can also determine the BCI for individual bridges. The system can also store information on the maintenance and rehabilitation needs of individual bridges.

According to the Ministry, as of June 2011, approximately 70% of municipalities either had loaded or were in the process of loading their bridge data into MDW.