Chapter 1
Section
1.08

Ministry of Transportation

Follow-Up on 2021 Value-for-Money Audit:

Inspection and Maintenance of the Province's Bridges and Culverts

RECOMMENDATION STATUS OVERVIEW

		Status of Actions Recommended				
	# of Actions Recommended	Fully Implemented	In the Process of Being Implemented	Little or No Progress	Will Not Be Implemented	No Longer Applicable
Recommendation 1	2		2			
Recommendation 2	2	2				
Recommendation 3	4	2	2			
Recommendation 4	2	2				
Recommendation 5	2	2				
Recommendation 6	3	2	1			
Recommendation 7	2	1			1	
Recommendation 8	1		1			
Recommendation 9	3		2			1
Recommendation 10	1		1			
Total	**22**	**11**	**9**	**0**	**1**	**1**
%	**100**	**50**	**41**	**0**	**4.5**	**4.5**

Overall Conclusion

The Ministry of Transportation (Ministry), as of November 17, 2023, has fully implemented 50% of actions we recommended in our *2021 Annual Report*. The Ministry has made progress in implementing an additional 41% of the recommended actions.

The Ministry has fully implemented recommended actions such as finalizing a Flood Response Guidelines for MTO Structures memo and issuing Guidelines for Emergency Inspection of Structures. The Ministry conducted its biennial webinar for internal staff, ,during which the Ministry's head office reminded its inspectors of the quality assurance requirements for consultant assignments, including the need to time-stamp photos. Also, the Ministry tested and deployed a tablet version of the Bridge Management System (BMS), which allows for the automatic upload of photos in the field. The Ministry explored the use of drones during inspections, conducted a pilot project and used drones on select bridge-inspection assignments. Based on these experiences, four of the five regions have purchased drones. In addition, to ensure

that safety and capital-planning decisions for the province's bridges are based on reliable and accurate inspection data, the Ministry has added a number of data-integrity checks to its BMS that would warn an inspector if the data appeared to be out of order before an inspection report was finalized. Finally, to improve the quality of its bridge inspections, the Ministry reinstated the practical field inspection component of the Ontario Structure Inspection Manual (OSIM) training.

The Ministry is in the process of implementing a new OSIM that will clarify and provide guidance for inspectors on how to quantify the degradation of a structure's material condition from "excellent" to "good" when they calculate the overall material condition of a bridge, and is incorporating tables into the OSIM that will allow inspectors to identify and summarize the elements that are critical to the structure's integrity. It is also developing an OSIM-training certification program that includes course and testing. In addition, the Ministry is updating its Structure Inspection Quality Assurance Requirements for Consultant Structure Inspections memo to ensure adequate oversight, receiving accurate inspection information, and enforcing its quality assurance processes for regional offices to verify that information is being observed and documented in the inspection files and is accurately recorded in the Ministry's systems. The Ministry is developing a new Structure Rehabilitation Manual (SRM), incorporating up-to-date construction methods used in bridge repair and rehabilitation so that construction methods are applied consistently across the province. It is also implementing a rating system for culverts (tunnels carrying a stream or open drain under a road) that includes key performance index (KPI) targets. The Ministry's Structures Office has begun reviewing regional maintenance work, auditing one of its five regions each year to determine whether the maintenance work is performed adequately.

However, the Ministry's Structures Office has told us that it will not be implementing one (4.5%) of our recommended actions. It will not audit a sample of contracts to ensure that the regions are performing quality assurance checks because the Structures Office continues to re-inspect a sample of bridges annually, and there are also year-end OSIM inspection-attestation memos confirming that engineers completed their oversight requirements for consultant assignments. The Office of the Auditor General of Ontario continues to support the implementation of this recommendation because it is necessary to review consultant work to ensure the quality of bridge inspections. Moreover, the Ministry had previously indicated, in response to our 2021 audit report, that the Structures Office would audit a sample of bridge inspections to validate that the quality of assurance checks had been undertaken. The Ministry anticipated that this work would begin within 12 months.

The status of actions taken on each of our recommendations is described in this report.

Background

As part of its mandate to deliver a safe highway network that promotes mobility for people and goods, the Ministry of Transportation (Ministry) is responsible for inspecting, maintaining and repairing approximately 3,000 bridges and 2,000 large culverts (tunnels carrying a stream or open drain under a road) located on provincial highways and in northern areas of the province. Under the *Public Transportation and Highway Improvement Act*, the province's bridges must be inspected every two calendar years by, or under the direction of, a professional engineer using the Ontario Structure Inspection Manual (OSIM). Regular visual inspections are conducted to ensure that bridges remain safe and in good repair, and to identify safety hazards and repair and maintenance needs. Enhanced and emergency inspections may be performed if serious deterioration or damage is suspected.

At the time of our audit, 89% of Ontario's bridges were in good condition, meeting the Province's goal of 85% of bridges being in good condition at all times. As

well, 10% of bridges were assessed to be in fair condition and 1% of bridges were assessed to be in poor condition. Poor condition was not an indication of any safety concern, but rather indicated that capital maintenance to rehabilitate the bridge was needed within a year.

The Ministry's Bridge Management System (BMS) supports the OSIM inspection and management process. Inspectors enter data into the BMS at the time of inspection, and the system calculates the Bridge Condition Index (BCI). The condition data and inventory information are uploaded into the Asset Management System, an analytical tool that generates individual bridge rehabilitation needs and expenditure requirements for capital planning. The expert engineer we contracted to assist us with our audit conducted an independent inspection of 15 bridges across the province and recorded virtually the same BCI results as Ministry inspectors, with minor variances.

Our audit found that, although the OSIM was widely used across Canada for bridge inspection, it did not provide a uniform inspection approach for all structures in Ontario, and it lacked a standard flood response protocol for structures affected by floods or at risk from flooding. Also, when guiding inspectors in how to record the material condition of a structure, the OSIM used less precise, qualitative descriptions rather than quantitative measurements of the degradation between "excellent" and "good."

In addition, the OSIM inspection tables used to assess the elements of a structure could not flag or describe those elements that were considered critical to a bridge's safety. Therefore, the deterioration or poor condition of a bridge element as assessed by the BCI may not predict the likelihood of failure of the bridge or even of the element itself. In addition, the BCI may not capture the actual repair and maintenance needs of these elements. As a result, Ministry staff calculated a modified BCI value for each bridge in order to assess its priority for repair.

Although the Ministry performed inspections on every bridge every two years, as required, we found there were issues with the quality of these inspections. Also, the Ministry performed audit inspections and provided recommendations to the regions to correct any errors, but did not follow up to ensure that its recommendations were being addressed.

Some of our significant findings were:

- Some inspectors were performing six or more inspections per day, contrary to the OSIM and Ministry guidance. The OSIM stipulated that all visual inspections should involve an element-by-element assessment of material defects and that an inspector should plan to spend approximately two to three hours on a typical bridge site in order to have enough time to adequately assess the condition of all elements. The Ministry did not assess the reasonableness of the number of inspections being completed in a day for either consultant inspectors or its own inspectors.
- The Ministry could not verify how much time was spent inspecting some bridges, since some inspection photos did not include the required time-stamps. Following our 2009 audit of Bridge Inspection and Maintenance, the Ministry's Bridge Office instructed Ministry engineers on how to assess consultants' work, including that they ensure inspection photographs have the date and time printed on them. When this practice was not enforced, the Ministry could not verify whether a consultant had spent enough time to conduct a thorough inspection of a bridge.
- Consultant inspection files were missing information or contained errors. We examined 173 inspection reports submitted by consultants and found errors and omissions that could have impacted the data the Ministry used to prioritize bridge maintenance and rehabilitation. Specifically, we found 10 instances where the condition of different portions of the bridge was incorrectly measured or recorded, and 31 inspections where a significant change in the bridge's calculated condition was not accompanied by an explanation.

- The Ministry's Structure Rehabilitation Manual (SRM) was outdated. This manual, used for planning rehabilitation work on bridges and culverts and their structural components, had last been updated in 2007. Since then, there were major changes in practice to all stages of rehabilitation work. The Ministry was issuing interim policy memos to provide updated guidance, but had not incorporated them into a revised manual to standardize guidance and simplify access to updates.
- The Ministry was unaware whether maintenance and repair work was conducted in a timely manner by the regions. The regions did not track as required the completion of maintenance work identified by inspectors and did not submit confirmation to the Ministry when work was completed. The Ministry's Head Office informed us that it did not follow up with the regions to confirm they were tracking and conducting maintenance work in a timely manner. It did not receive the regions' maintenance tracking spreadsheets or keep track of their completed work.

We made 10 recommendations, consisting of 22 action items, to address our audit findings. We received commitment from the Ministry that it would take action to address our recommendations.

Status of Actions Taken on Recommendations

We conducted assurance work between April 2023 and August 2023. We obtained written representation from the Ministry of Transportation that effective November 17, 2023, it has provided us with a complete update of the status of the recommendations we made in the original audit two years ago.

Quality of Inspection Manual and Standards

Recommendation 1

To improve the guidance given to bridge inspectors and provide a more uniform inspection approach across the province that yields a more accurate assessment of structures, we recommend that the Ministry of Transportation:

- *update the Ontario Structure Inspection Manual (OSIM) to provide clarity and guidance on how inspectors can quantify the degradation of a structure's material condition from excellent to good, for the calculation of the overall material condition of a bridge;*

  Status: In the process of being implemented by January 2024.

Details

In our 2021 audit, we found that the Ontario Structure Inspection Manual (OSIM) does not provide clear guidance on recording the transition of the condition of structures, which results in less precise quantitative assessments. The structural engineering expert we retained observed that when guiding inspectors in how to record the material condition of a structure, the OSIM does not adequately quantify the degradation of material condition from "excellent" to "good" over time. Instead, it describes the condition in qualitative terms. Our expert noted that the descriptors in the OSIM are "vague," leaving various inspectors and jurisdictions to interpret the OSIM requirement and to develop their own degradation curve in accordance with their interpretations. When it reported on its 2018 and 2019 audits of bridge inspections, the Ministry's Bridge Office noted a similar issue in its examination of factors that can skew inspection results.

In our follow-up, we found that the Ministry has established a working group tasked with reviewing and updating the OSIM to ensure it provides clear guidance on quantifying the degradation of a structure's material condition from "excellent" to "good." The working

group is made up of 10 structural engineers from all five ministry regions, as well as the head office (Structures Office, formerly the Bridge Office). In 2022, the Ministry's working group held discussions to create a draft version of the updated OSIM. The updated draft includes the reordering of the document so that it is more logical to a new inspector, guidance on how to downgrade an element from "excellent" to "good," and an updated Section 2.4 Material Condition States. In addition, the updated draft merged some condition state summary tables to avoid repetition and inconsistencies.

The Ministry's working group plans to create a final draft and present it to the Ministry's Bridge Committee for its required comments. The Bridge Committee is made up of the Heads of the Structural Section in each of the five regions, the Manager of the Structures Office, and the Head of Bridge Design and Bridge Management in the Structures Office. After obtaining the required comments and endorsement from the Bridge Committee, the updated OSIM will be posted for 21 business days on the Ministry's technical consultation portal to obtain comments on the proposed changes from Ministry consultants from the engineering community. At the time of our follow-up, the date for posting had not been finalized. The Ministry intends to publish the new OSIM by January 2024.

- *incorporate in the OSIM inspection tables that are used in assessing the elements of a structure the ability to identify and summarize the elements that are critical to the structure's integrity.*

  Status: In the process of being implemented by January 2024.

Details

In our 2021 audit, we found that the OSIM does not differentiate between elements based on how critical they are to the structure's integrity. The OSIM inspection tables used to assess the elements of a structure do not include any way to flag and detail those elements that are considered critical or potentially vulnerable. This is important because, while the OSIM is widely used across Canada for bridge inspection, it does not incorporate all the information that is relevant to the safety of a bridge in calculating the Bridge Condition Index (BCI).

In our follow-up, we found that the Ministry has been revising the reporting of critical elements to include some check boxes with each element for the inspector to "check" if they deem it to be a critical element. In addition, guidance is also being provided to define a list of specific elements. The Ministry stated that guidance will be provided to inspectors to identify these critical elements before going on inspections. As stated above, the Ministry established a working group that has been tasked with reviewing and updating the OSIM. The Ministry's working group plans to create a final draft and present it to the Ministry's Bridge Committee, as mentioned above, for its comments and endorsement. The working group has held discussions and is currently in the process of finalizing necessary changes to the OSIM to send to the Bridge Committee with the intent to incorporate its changes and finalize the document by January 2024.

Recommendation 2

To reduce the risk posed to the province's bridges, culverts and roadways by the potential for more frequent and intense floods and extreme weather events, we recommend that the Ministry of Transportation:

- *develop a standard flood response protocol for assessing, monitoring and inspecting provincial structures affected by floods, or at risk from flooding; and*

- *create a flood inspection manual for structures that are at risk from flooding, and review and update it periodically.*

  Status: Fully implemented.

Details

In our 2021 audit, we found that Ontario had not developed a standard flood response protocol for assessing, monitoring and inspecting provincial structures affected by floods or at risk from flooding. As a result, Ministry staff and contractors lack guidelines for performing these tasks uniformly across the province's five regions, meaning that safety standards may differ across the province. Also, not all regions have the experience of dealing with the threat of major flooding events.

In our follow-up, we found that in November 2022 the Ministry finalized a memo, Flood Response Guidelines for MTO Structures. The objective of the memo is to give guidance to structural engineers on what to look for when they are assessing structures in response to a flood and how to respond to a flood event. Whenever a Ministry's Structural Section Head is made aware of a flood event, the guidelines of this memo must be followed. The guidelines contain the specific procedures that the structural engineer needs to follow with respect to the initial assessment, site inspection, structure-closure criteria, monitoring of the structure and post-flood inspection.

In addition, we found that in March 2023, the Ministry's Structures Office issued Guidelines for Emergency Inspection of Structures. The purpose of these guidelines is to provide bridge-inspections guidance on the types of emergency inspections that may occur and to show some of the common defects that are encountered. Some of the scenarios addressed by the guidelines include emergency inspections of structures after floods, fires, earthquakes and vehicle collisions with the structure. The Flood Response Guidelines for MTO Structures memo serves as an appendix to this document. In the event of a flood, these two Ministry-created documents should be used in conjunction to address the risk posed to the province's bridges. The Ministry's practice is to update its manuals as required. This would occur if there is a change in a Code or Standard, when MTO internal reporting procedures change, or when additional information is obtained. Typically, this occurs on a five- to 10-year cycle, but varies greatly depending on comments received by users, or if new information becomes available.

Quality of Inspections

Recommendation 3

So that the bridge inspections are documented and are being performed in accordance with legislation, and so that accurate and thorough bridge inspection data is captured for decision-making, we recommend that the Ministry of Transportation:

- *implement practices that will enforce the guidance in the OSIM on the length of time an inspection should take, and regularly review the number of inspections completed per day by inspectors to assess their reasonableness and to take corrective action where it is necessary;*

  Status: In the process of being implemented by January 2024.

Details

In our 2021 audit, we reviewed a number of inspections conducted in 2018 and 2019 in Central, Northeastern and West regions and found that more than a dozen inspectors, both consultants and Ministry inspectors, had performed six or more inspections on the same day. Our review determined that inspectors, from three different engineering firms, had spent less than one hour inspecting each bridge. Moreover, we found instances where the time elapsed between the first and last photograph taken of the bridge was less than 20 minutes. We similarly highlighted this issue in our 2009 value-for-money audit of Bridge Inspection and Maintenance. There, we noted several instances where an inspector performed more than 10 inspections in a single day. We recommended that the Ministry take steps to confirm that thorough inspections are being conducted, including assessing the reasonableness of the number of inspections that are performed by an inspector in a single day. Yet, in spite of the OSIM protocol and our 2009 audit recommendation, the Ministry had not been assessing the quality of its inspections or considering how many inspections it is reasonable to complete in a day, for either its consultants or its own inspectors. We noted, however, that the Ministry had the information at hand to conduct such

an assessment, as much of the inspection data available to the Ministry gives a clear indication of the time spent on inspections.

In our follow-up, we found that the Ministry created a working group, as mentioned above, to review and update the Structure Inspection Quality Assurance Requirements for Consultant Structure Inspections memo. This memo provides requirements to Ministry engineers to ensure adequate oversight of inspections performed by consultant engineers. As part of this review, the working group will address the required time that should be spent on inspections and incorporate guidance into the newly updated OSIM. The quality assurance memo has been provided to the Bridge Committee, as mentioned above, for its review. The Ministry intends to publish the updated quality assurance memo by January 2024.

- *communicate to all bridge inspectors the requirement to date- and time-stamp all photographs taken during an inspection;*

  Status: Fully implemented.

Details

In our 2021 audit, we found that following our 2009 value-for-money audit of Bridge Inspection and Maintenance, the Ministry's Bridge Office provided instructions in September 2009 to Ministry engineers on how to assess consultants' work, including that they ensure that the photographs submitted with their inspections have both the date and the time printed on them. Nevertheless, our 2021 audit found that photos still did not always include the required time-stamps.

In our follow-up, we found that in April 2022, the Ministry conducted its biennial webinar for its internal staff during which the Ministry reminded its inspectors of the quality assurance requirements for consultant assignments, including the need to time-stamp photos. Attendance at the webinar was mandatory, and the Ministry recorded the webinar for those who could not make it. Since certificates were not issued for this webinar, attendance was not closely tracked. However, the Ministry told us that, based on the recording, there were 84 people (out of 100 invitees) in attendance. Consultants did not attend this webinar because regional offices conducted a consistency exercise with them (see **Recommendation 6**).

- *assess the feasibility of using current camera technology to assist in instantaneously uploading photos that are automatically date- and time-stamped;*

  Status: Fully implemented.

Details

In our 2021 audit, we found that seven of 28 consultant bridge inspectors hired by the Ministry in 2018 and 2019 submitted photographs that did not have time-stamps (hours and minutes), which prevented us and the Ministry from determining the amount of time consultants spent on the bridges they inspected. We also found that:

- photographs from two inspectors did not include the date, meaning that the Ministry would not be able to verify the duration of the inspection, the date of the inspection, and whether the inspection was conducted within the dates specified in the contract; and
- one inspector did not submit any photographs at all as part of his inspection report, making it impossible to determine whether the inspector actually visited the bridge site.

In our follow-up, we found that the Ministry has tested and deployed a tablet version of its Bridge Management System (a system that stores the inspection reports), which allows for automatic upload of photos in the field. Using the tablet technology, a bridge inspector is able to upload photos of bridges that are automatically date- and time-stamped by the camera technology.

- *enforce its quality assurance process for its regional offices to verify that the information that is being observed and documented in the inspection files is accurately recorded in the Ministry's systems.*

  Status: In the process of being implemented by January 2024.

Details

In our 2021 audit, we examined 173 electronic inspection reports from 2018 and 2019 submitted by consultants, and found errors and omissions that could impact the data the Ministry uses to prioritize bridge maintenance and rehabilitation. In our review we found:

- 10 inspection reports where the condition of different portions of the bridge was incorrectly measured and recorded. We reviewed the Bridge Management System in May 2020 and found that these errors had not been corrected.
- 11 inspections where the consultant did not provide enough photographic documentation to support the inspection results. Omitting photographs of the observed defects limits the Ministry's ability to review and confirm inspection results.
- 31 inspections where a substantive change in the bridge's calculated condition was not accompanied by a sufficiently detailed explanation for such a significant change.

In our follow-up, we found that the Ministry has started a process of updating its memo, Structure Inspection Quality Assurance Requirements for Consultant Structure Inspections. The Ministry already started discussing the quality assurance requirements with staff at the 2022 OSIM Inspection webinar, and further updates will be communicated through the Bridge Committee and at the 2024 OSIM Inspection webinar. According to the Ministry, the previous iteration of the Quality Assurance memo was completed in 2009 when the Ontario Structures Inspection Manual and Bridge Management System were introduced.

In 2022, the Structures Office started a process to review the requirements of the memo to better align with the current realities of the bridge-inspection process in Ontario, since the current BMS has data checks in place and its structural engineers have more expertise conducting bridge inspections. As a result, the high level of quality assurance provided by the 2009 memo is no longer required. The updated Quality Assurance memo has been provided to the Bridge Committee, as mentioned above, for its review. The Ministry intends to publish the updated Quality Assurance memo by January 2024.

Recommendation 4

In order to achieve cost-efficiencies and resolve accessibility issues in bridge inspections, we recommend that the Ministry of Transportation:

- *prepare a business case for incorporating new technology in the inspection process; and*
- *if possible, incorporate new technology such as drones to assist with the inspection process.*

Status: Fully implemented.

Details

In our 2021 audit, we noted that in our 2009 audit of the Bridge Inspection and Maintenance Program we found that having only limited access to bridges means that inspectors are forced to leave some elements uninspected, or to estimate their condition from a distance or without seeing them, which increases the risk of inaccurate assessments. When estimation is involved, different inspectors can arrive at different assessments of the same bridge components because of their own individual judgment. In our 2021 audit, we also noted that we found numerous studies, and confirmed with faculty at the University of Waterloo, that advancements made since our 2009 audit in drone, sensor and software technologies for performing inspections could help resolve accessibility issues and improve the accuracy and consistency of condition assessments by removing human judgment from the equation.

In our follow-up, we found that the Ministry used a Transportation Association Canada (TAC) presentation from October 2021 to examine how drones are used by various jurisdictions and consultants throughout Canada. Also, in September 2022, Ministry staff attended an Innovation Demonstration Event where attendees were provided with demonstrations of next-generation drone technologies. In February 2023, the Ministry's structural engineers prepared an information note seeking approval to purchase drones to assist with the inspection of structures. The Ministry has conducted a test flight to ensure applicability of using a drone for structure inspections, as well as required its consultants to use a drone for some of their bridge inspections to gain experience in viewing drone

inspections. During our follow-up, we found that four of the five Ministry regions have acquired and started using drones to assist during bridge inspections.

Compiling and Recording Inspection Data for the Capital Planning Process

Recommendation 5

So that the Ministry of Transportation (Ministry) bases its safety and capital planning decisions for the province's bridges on reliable and accurate inspection data, we recommend that the Ministry:

- *update inspection and data entry practices where they are seen to be outdated or open to error;*

  Status: Fully implemented.

Details

Our 2021 audit noted that, in all of the audit inspection reports we reviewed, the Ministry found deviations and consistently recommended almost word for word: "Regions should be reminded of the importance of correcting inventory, components and quantity information that affects accuracy of BCI values." When we asked the Ministry to explain why its Bridge Office needed to repeat this recommendation each year, it gave us the following explanations:

- Errors the Bridge Office audit inspection finds are not system errors, but human errors. Some are errors contained in inspection reports that were reviewed and considered complete by regional staff.
- Sometimes inaccurate dimensions were input in the Bridge Management System (BMS) for a bridge under audit, possibly because the bridge may have been altered in a rehabilitation, and the new dimensions were not yet entered into the system, causing differences between the BCI assessed by inspectors and the BCI assessed by Bridge Office auditors.
- The Bridge Office does not follow up on its recommendations to correct the bridge data, as the regions are custodians of the data and are responsible for making any required changes.

In our follow-up, we found that the Ministry has added a number of data-integrity checks to its BMS that would warn an inspector if the data appears to be out of order before the inspection report is finalized. Specifically, the BMS would give a warning if the surface area of a bridge element is entered incorrectly or if there is no explanation provided for a significant change in bridge condition. In addition, during its annual OSIM webinar, as mentioned above, the Ministry reiterated to its structural engineers the requirements related to reviewing inspection reports. In particular, the webinar emphasized that the structural engineers who review the inspection reports are responsible for ensuring that the information is documented and input accurately into the BMS.

- *have its Bridge Office inspection auditors follow up on their recommendations to the province's road network regions and ensure that errors its auditors have found in data that affects the accuracy of the Bridge Condition Index values are corrected, or that documentation exists demonstrating that no corrections are needed.*

  Status: Fully implemented.

Details

In our 2021 audit, we found that the Ministry performs audit inspections and provides recommendations to the regions without taking follow-up action to ensure that its recommendations are being followed. We selected a sample of inspections to verify whether the changes to the element quantities that were recommended in the 2017 and 2018 Bridge Office (Structures Office) audit inspection reports were actually made in the Bridge Management System (BMS) by the regional staff. We found that the noted incorrect quantities were not corrected in the BMS for any of the samples we reviewed.

In our follow-up, we found that in July 2021, the Structures Office issued a memo, Process for Completing Structures Office Bridge Audit Inspections, requiring regional Structural Sections to provide written responses by the end of September in response to the Structures Office Bridge Audit Inspections'

recommendations made by the end of May. The Ministry's Structure Inspection Structures Office completed a bridge audit in 2021 that looked at 12 structures located across three Ministry regions. The Structures Office did not find any issues with the bridge data, so no recommendations were issued. On completion of its bridge audit, the Structures Office issued a report stating that no deficiencies were found.

Training and Oversight of Inspectors

Recommendation 6

To improve quality of its bridge inspections, we recommend that the Ministry of Transportation (Ministry):

- *reinstate the practical field inspection component of the Ontario Structure Inspection Manual (OSIM) training;*

  Status: Fully implemented.

Details

In our 2021 audit, we reviewed the last five OSIM workshops/webinars held between 2012 and 2020 and found that the Ministry's program lacked rigour and testing to confirm that inspectors understand the OSIM and the inspection data they need to record. For example, we noted that until 2012, as part of its training program, the Ministry would take all in-house and consultant inspectors to bridges to conduct on-site inspections. This practical component was done to help inspectors with the consistency and accuracy of their inspections. The Ministry has not provided this practical component to its consultants since 2014, and it has not provided it to in-house inspectors since 2018. Our research of other jurisdictions in Canada found that, unlike Ontario, Quebec's transportation ministry requires its inspectors to take part in on-the-job field training. We noted in particular that, since 2018, rather than focusing on on-the-job training, the Ministry has been focused on instructing inspectors on data entry into the Bridge Management System in order to address data-accuracy issues.

In our follow-up, we found that in April 2022, the Ministry issued an MTO Bridge Inspection Consistency Exercise memo, reinstating the practical field inspection component. All regions were required to conduct a consistency exercise by summer 2022 to ensure that all staff and consultants conducting inspections had field inspection training. The intent was to evaluate whether each inspector has the necessary experience to inspect structures. The expectation was that each region inspect a structure that represents the complexity of an inspector's assignment. Inspectors were expected to provide any relevant information they would otherwise report on in an inspection, for example, pictures, maintenance needs, quantity review, comments, suspected performance deficiencies and overall structural safety. To test inspectors, regions could give the correct tombstone data or add some misinformation to see whether inspectors picked up on the mistakes. For the external consultant inspections, regions must review all of a consultant's reports with the consultant, out in the field or at a safe location, as soon as possible.

The Ministry plans to continue this consistency exercise to ensure all new inspectors take field training before inspecting structures. This is in addition to formal training, including testing inspectors as part of the Ministry's certification process, which the Ministry expects to develop by March 2024 (see the third action under **Recommendation 6**).

- *include quality assurance procedures for inspections as part of the future OSIM inspection training curriculum for Ministry staff;*

  Status: Fully implemented.

Details

In our 2021 audit, we reviewed the training material provided to inspectors from 2010 to 2021 and found no information about the quality assurance procedures for inspections that inspectors should know. In response to our 2009 audit, the Ministry developed the quality assurance procedures in 2009 to improve the quality of inspections; however, the Ministry confirmed that, more than 10 years after they were developed, the

quality assurance memo and procedures may not be known by all Ministry inspectors, including new staff.

In our follow-up, we found that the Ministry's Structures Office conducted its regular OSIM webinar in April 2022. During this information session, the Ministry presented excerpts from the Ministry's Structure Inspection Quality Assurance Requirements for Consultant Structure Inspections memo, stressing the importance of following all memo requirements to its regional structural engineers when overseeing consultant assignments, including how the Ministry verifies the quality of OSIM inspections for both in-house and consultant inspectors. In addition, the Quality Assurance memo was reshared with Ministry staff.

- *finalize the testing approach and test the inspectors as part of its certification process at the end of the OSIM training workshop.*

  Status: In the process of being implemented by March 2024.

Details

In our 2021 audit, we found that the Ministry does not test in-house and consultant attendees' knowledge of the training material at the completion of the training. Certificates of training completion are automatically issued. In comparison, the transportation ministry of Alberta tests its inspectors as part of the certification process. After we identified this lack of testing in 2020, the Ministry acted upon our finding and incorporated a quiz at the end of its OSIM inspection workshop in April 2021. However, this quiz has yet to be implemented as an ongoing instrument to test trainees at the completion of their training.

In our follow-up, we found that the Ministry has held discussions with the Ontario Good Roads Association (OGRA), an association dedicated to improving municipal roads and related infrastructure in Ontario by providing training, knowledge and advocacy to its member municipalities, along with several other training providers. OGRA's expertise was used to develop an outline for a Ministry-approved certification program for in-house and consultant inspectors. The certification program will include topics related to various bridge materials, as well as updates to the inspection manual and the in-house inspector's level of responsibility in regards to supervision of inspections. By March 2024, the Ministry plans to finalize an agreement with OGRA or another service provider to develop, with the Ministry's input, the bridge inspection courses that inspectors must complete to gain certification. Going forward, the Ministry plans to make it a requirement for its inspectors to take the courses to gain certification.

Recommendation 7

To ensure that its regional staff are aware of and follow its quality assurance requirements and other internal policies, the Ministry of Transportation (Ministry) should:

- *communicate the quality assurance requirements that are required to be performed by regions for consultant inspections through the biennial workshops held for Ministry staff;*

  Status: Fully implemented.

Details

In our 2021 audit, we found that regional structural engineers and project managers did not always oversee and conduct quality checks of inspectors' work to ensure that their inspections followed the OSIM standards and Ministry requirements. Without these quality assurance checks, the Ministry cannot verify the accuracy, completeness and consistency of the data produced during bridge inspections.

In our follow-up, we found that, during its biennial OSIM webinar conducted in April 2022, the Ministry presented our Office's findings on quality assurance requirements to its structural engineers who perform bridge inspections. The presentation reiterated the requirements of the Ministry's 2009 Structure Inspection Quality Assurance Requirements for Consultant Structure Inspections, such as conducting random spot checks when a consultant is on-site, reviewing a sample of consultant inspections before the assignment is

completed, and ensuring that supporting photographs are date- and time-stamped. In addition, the Structure Inspection Quality Assurance Memo for Consultant Structure Inspections was reshared with Ministry staff.

- *audit a sample of contracts to ensure that regions are performing the quality assurance checks.*

  Status: Will not be implemented.

  The Office of the Auditor General of Ontario continues to support the implementation of this recommendation.

Details

In our 2021 audit, we sampled four contracts that included hundreds of bridge inspection assignments that the Ministry awarded to consultant firms and checked whether quality assurance checks had been performed. We found that:

- In three of the four contracts, regions did not provide feedback to consultants on their performance, as required by the quality assurance policy.
- In three of the four contracts we sampled, regional staff did not visit 3% to 5% of bridge sites inspected by consultants, as its policy requires, to ensure that consultants were conducting inspections in the manner required by the quality assurance policy.
- In all four contracts we sampled, regional staff did not reinspect 3% to 5% of bridges in order to compare results to consultant inspections, as required by the quality assurance policy. Staff from one region informed us that they were not aware that they were supposed to complete these quality assurance tasks.

In our follow-up, we found that the Ministry's Head Office (Structures Office) will not audit a sample of contracts to ensure that regions are performing quality assurance checks as required by the 2009 Quality Assurance memo. Instead, the Structures Office continues to rely on the year-end OSIM inspection attestation memos signed off by the Ministry's engineers that they have completed their oversight requirements for consultant assignments.

The Ministry told us that it realized that the 2009 memo was written at a time when the inspection methods and the BMS were new, so higher quality assurance was required due to the uncertainty. Since that time, the quality assurance needs have not been as high. As a result, the Ministry is currently reviewing the 2009 Quality Assurance memo to determine the appropriate quality assurance procedures needed. For example, the Ministry has software that performs data checks, which addresses some of the quality assurance procedures. In addition, the Ministry started conducting a consistency exercise, as mentioned above, which ensures the competency of bridge inspectors and conveys the expectations for the way Ministry bridge inspections should be conducted.

Nevertheless, according to the Ministry, the quality assurance procedures continue to be performed at the regional level. However, limited supporting documentation of the quality assurance procedures being performed at the regional level was available at the time of our follow-up. Although the Structures Office will not be implementing this recommendation at this time, the regions will continue to perform the procedures as required by the Quality Assurance memo.

The Office of the Auditor General of Ontario continues to support the implementation of this recommendation because reviewing consultant work is necessary to ensure that a quality bridge inspection is obtained. As well, the Ministry had responded in our 2021 audit report that the Structures Office would audit a sample of bridge inspections to validate that the quality assurance checks had been undertaken. The Ministry had anticipated that this work would begin within 12 months.

Risk of Inconsistent Rehabilitation Practices Due to Ministry's Use of Outdated Structure Rehabilitation Manual

Recommendation 8

To ensure that construction methods used in the repair and rehabilitation of bridges are up to date and are applied consistently across the province, we recommend that the Ministry of Transportation update its Structure Rehabilitation Manual to incorporate all of the interim policy memos it has issued since its last update, and assess if any other relevant information should be included.

Status: In the process of being implemented by June 2024.

Details

In our 2021 audit, we found that the Structure Rehabilitation Manual was last updated in April 2007. Since then, there have been major changes in practice to all four stages (Condition Surveys, Rehabilitation Selection, Contract Preparation and Construction) of the rehabilitation work. For example:

- Part I–Section 1.3 of the manual describes the history of protective treatments for structures in Ontario. Historical context is important in understanding the performance and deterioration of structures over time, and potential impacts on repairs and rehabilitation treatments. The current version of the manual covers the protective treatments in use in Ontario from the 1950s to the early 2000s. The section does not capture treatment strategies that have emerged since the last publication and that now are part of the current standard.
- Some of the information in Part 4–Guidance to Designers, requires updates and supplements.

We noted in our audit that the Ministry was aware of the major changes in practice and had been issuing numerous interim policy memos to provide updated guidance to designers who rely on the Structure Rehabilitation Manual. However, a risk exists that designers will miss some of these policy memos or neglect to incorporate their guidance into their practice. As a result, the manual was not meeting its intended purpose, which is to facilitate consistent practice and quality control.

In our follow-up, we found that the Ministry formed a Structure Rehabilitation Manual (SRM) team that has been meeting regularly to develop a new and reformatted manual. The SRM team consists of a core team made up of structural engineers from the Ministry, and an extended team made up of regional structural engineers to brainstorm and provide overall thoughts and topics to improve or add to the new manual. In addition, these structural engineers from the Ministry's regional offices will be engaged to review sections of the manual and provide overall comments. The final draft of the SRM is scheduled to be completed by the end of 2023. Before publishing a new manual, the SRM team needs to present the updates to, and obtain comments from, the Ministry's Bridge Committee, and post the changes to the technical consultation portal to obtain input from the Ministry's consultants by early 2024. The Ministry intends to publish the new Structure Rehabilitation Manual by June 2024.

Inspection and Maintenance of Culverts

Recommendation 9

To improve the accuracy and usefulness of its data on the condition of large culverts, we recommend that the Ministry of Transportation:

- *review and update the existing rating system to better represent the actual condition of large culverts;*

  Status: In the process of being implemented by February 2024.

Details

In our 2021 audit, we found that Ministry staff noted that, while the Bridge Condition Index (BCI) is a good indicator of bridge deterioration, where visual inspection of the components can effectively forecast the rate of deterioration, BCI deterioration ratings are not representative of culvert conditions. A Ministry analysis found little

correlation between a culvert's age and its true condition; as well, a culvert may have a very poor appearance without needing work.

In our follow-up, we found that the Ministry has developed a rating system for its culverts and is in the process of calibrating it against the skilled assessment of the Ministry's structural engineers. The new rating system will act as a key performance indicator for culverts. The analysis to ensure accuracy of the new rating system is expected to be finalized in February 2024 through a policy memo.

- *review and update the deterioration model for large culverts used in the Asset Management System to predict future repair needs;*

  Status: No longer applicable.

Details

In our 2021 audit we noted, through our review of an internal memo sent to senior management in the Ministry, that Ministry staff who conducted culvert inspections from 2010 to 2015 have found that the Ministry's guidelines and schedules for maintenance and rehabilitation work may not be applicable to culverts:

- Culverts rated in poor condition (BCI <60) may not actually require rehabilitation or replacement within one year, as the guidelines stipulate.
- Culverts rated in fair condition (BCI 60–70) may not actually need rehabilitation or repair within five years, as stipulated by the guidelines.

This means that the deterioration models used by the Ministry and coded into the Asset Management System for planning capital work show more rapid deterioration than the actual deterioration observed by inspection staff. As a result, without accurate measures of its culverts' current condition or forecasting of their future condition, the Ministry cannot accurately plan and budget long-term capital work required for the culverts. In particular, there is a risk that the Ministry may order work on culverts prematurely when their actual condition does not require rehabilitation or replacement. To correct for the BCI ratings when applied to culverts, Ministry engineers apply judgment when needed to adjust the BCI. Ministry engineers informed us that they may ignore the data until these engineers point out that large culverts need work for other reasons, often when they become functionally deficient.

In our follow-up, we found that the Ministry is planning to transition away from the Asset Management System and will not be using its deterioration models. The Ministry has started a parallel project called Transportation Asset Management System (TAMS) in which it will seek vendors to propose a system that will determine asset deterioration and propose needs. The Structures Office will use TAMS to develop deterioration models to predict future repair needs for large culverts.

- *develop performance targets for large culverts, measure the culverts against the targets, and report on their condition publicly.*

  Status: In the process of being implemented by September 2024.

Details

In our 2021 audit, we noted that the Ministry does not have a performance target for large culverts, even though this asset is valued at $5 billion. As a result, there is no benchmark against which to compare the Ministry's performance in maintaining and repairing culverts. Many jurisdictions have such performance targets for culverts. For example, the Township of Enniskillen in Ontario sets a target of 100% for maintaining its large culverts in better than poor condition. The Ontario Township of Russell's target is to maintain the average condition of its culverts at fair or good. The US Federal Highway Administration sets 10% as the upper limit for all National Highway System bridges and culverts classified in poor condition. California's target for having its culverts in good or fair condition is 90%.

In our follow-up, we found that the Ministry developed a new key performance indicator for culverts, as part of its new Transportation Asset Management System (TAMS), as noted above. The Ministry is in the process of finalizing the new performance indicator and target for culverts with the aim of completing the process by February 2024 and measuring provincial culverts against this target in 2024. The Ministry stated

that the date for reporting publicly on performance targets for large culverts has not yet been confirmed but is expected to meet the September 2024 deadline.

Recommendation 10

To validate that regions are tracking the maintenance needs of the province's bridges and completing maintenance work in a timely manner going forward, the Ministry of Transportation Head Office should obtain the information from the regions or through the Bridge Management System and ensure that maintenance work is completed on a priority basis.

Status: In the process of being implemented by June 2027.

Details

In our 2021 audit, we noted that the regions were not required to submit confirmation to the Ministry that maintenance work had been completed. As a result, the Ministry's Head Office (Structures Office) was unaware whether maintenance work was completed in a timely manner. We obtained maintenance tracking spreadsheets from 2017 to 2020 from three of the five regions and found that these regions did not always record the procedures for acting on maintenance recommendations resulting from the biennial inspections.

- One region's spreadsheet with work dates completed from one bridge co-ordinator could not be located for one of the years.
- For two regions, we could not determine whether all recommended maintenance work, regardless of priority level, was actually performed because the completed work dates were not always recorded.
- For one region, none of the maintenance work on any spreadsheet was given priority levels, as required by the 2017 procedures document.
- For two regions that did track their completed work, we could not determine whether the work was completed in a timely manner because dates were not specified.

Since the regions do not track the completion of maintenance work as required, it cannot be confirmed that their maintenance work is being completed in a timely manner. We asked the Ministry's Head Office whether it followed up with the regions to confirm they are tracking and conducting maintenance work in a timely manner in accordance with the 2017 memo. The Head Office informed us that it does not receive the regions' maintenance tracking spreadsheets and does not monitor the completed work because the regions are responsible for tracking and managing their maintenance work.

In our follow-up, we found that the Ministry's Head Office (Structures Office) began reviewing regional maintenance work to determine whether the maintenance work is adequately performed. The Structures Office's approach is to audit one of its five regions each year. We found that, at the time of our follow-up, the Structures Office has audited one of its regions and concluded that maintenance work was being performed in a timely manner and no high-urgency maintenance needs from previous years were outstanding. Based on the Structures Office's schedule of reviewing one region each year, the Ministry intends to finish auditing all of its regions by June 2027.