NATIONAL BRIDGE INSPECTION PROGRAM: ASSESSMENT OF FHWA'S IMPLEMENTATION OF DATA-DRIVEN, RISK-BASED OVERSIGHT

Federal Highway Administration

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Memorandum

U.S. Department of Transportation
Office of the Secretary of Transportation
Office of Inspector General

Subject: ACTION: National Bridge Inspection Program: Assessment of FHWA's Implementation of Data-Driven, Risk-Based Oversight Federal Highway Administration Report Number MH-2009-013

Date: January 12, 2009

From: Joseph W. Comé
Assistant Inspector General for Highway and Transit Audits

Reply to Attn. of: JA-40

To: Federal Highway Administrator

This report provides the results of our audit of the Federal Highway Administration's (FHWA) actions to address recommendations made in our March 2006 report to improve its oversight of states' bridge inspections, load ratings, and maximum weight postings (postings).[1] We also reported that FHWA should encourage states to use more detailed data to manage their bridge programs.

The safety risks of the Nation's nearly 600,000 bridges were underscored when the Interstate 35W Bridge (I-35W) in Minneapolis, Minnesota, collapsed on August 1, 2007, killing 13 people. According to the American Association of State Highway and Transportation Officials (AASHTO), the average bridge in the United States is 43 years old and almost one in four bridges either has major deterioration, cracks, or other deficiencies in its structural components or is functionally obsolete. Further, despite a 16-percent increase in funding for the Federal Highway Bridge Program, from $4.3 billion in fiscal year 2001 to $5.0 billion in fiscal year 2007, FHWA recently estimated that $65 billion could be invested immediately to address current bridge deficiencies.

Shortly after the I-35W bridge collapse, the Secretary of Transportation asked us to determine whether FHWA's National Bridge Inspection Program delivered the

[1] OIG Report Number MH-2006-043, "Audit of Oversight of Load Ratings and Postings on Structurally Deficient Bridges on the National Highway System," March 21, 2006. OIG reports and testimonies are available on our website: www.oig.dot.gov.

highest level of bridge safety. Our objectives for this audit were to evaluate FHWA's (1) implementation of data-driven, risk-based oversight to target bridge safety risks most in need of attention, particularly those related to load ratings and postings and (2) promotion of state use of bridge management systems. To address these objectives, we conducted our audit at 10 FHWA Division Offices in 10 states and at FHWA Headquarters.[2] FHWA developed a range of actions in response to our March 2006 report. For this audit we focused our review on two of FHWA actions—the implementation of eight new bridge data reports and a risk assessment of states' load rating and posting practices. Additional information on our scope and methodology is in exhibit A.

We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards as prescribed by the Comptroller General of the United States, including limited testing of data in the National Bridge Inventory (NBI) to determine whether the data were sufficiently reliable for our purposes. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

RESULTS IN BRIEF

FHWA made limited progress implementing data-driven, risk-based bridge oversight. FHWA's progress was limited because differences in how bridge engineers at the 10 Division Offices we reviewed used the eight new data reports and conducted risk assessments limited their usefulness. By not using the data reports as FHWA recommended and using different methodologies in performing the risk assessments, bridge engineers missed opportunities to identify and remediate bridge safety risks in coordination with states. For example, of the nine bridge engineers who conducted risk assessments, only three performed risk assessments using the guidance and tools provided by FHWA. We attributed Division Offices' limited use of the NBI data reports and the inconsistent manner in which they performed the risk assessments to FHWA's lack of minimum requirements for bridge engineers performing data-driven, risk-based oversight.

Further, FHWA's annual review of state bridge inspection programs assured compliance with Federal standards, but FHWA Headquarters did not routinely incorporate systematic data-driven oversight to comprehensively address nationwide bridge safety risks. Until FHWA implements systematic data-driven

[2] Alabama, California, Iowa, Kansas, New York, Oregon, Pennsylvania, Texas, Washington, and West Virginia.

oversight, it has limited assurance that Federal oversight activities are addressing the Nation's most significant bridge safety risks.

We also found that FHWA could strengthen its role in expanding states' use of bridge management systems, which are computerized systems that prioritize replacement and repair projects and help ensure bridge safety. Although it lacks the statutory authority to require states to use bridge management systems, FHWA can do more to actively encourage their use by targeting those states most in need of help for technical assistance and training resources.

Given the potentially catastrophic safety consequences, the volume of needs of the Nation's nearly 600,000 bridges, and the limited funding available to repair and replace bridges, FHWA's oversight activities must incorporate targeting higher-priority bridge safety risks. Accordingly, it is critical that FHWA make further progress in implementing data-driven, risk-based bridge oversight to better identify risks most in need of timely and thorough evaluation and remediation. A complete list of our recommendations is on page 12.

We provided FHWA with our draft report on November 19, 2008. FHWA provided its formal comments on December 22, 2008. FHWA concurred with our recommendations and provided its planned actions and target completion dates. FHWA comments and our response are fully discussed beginning on page 12.

BACKGROUND

Standards for states' bridge safety inspections. Monitoring bridge safety has been a significant challenge for FHWA and the states for years. States are responsible for ensuring that bridges within their jurisdictions are safe and FHWA is responsible for overseeing states' efforts. As part of the National Bridge Inspection Program, FHWA sets the standards for proper safety inspections of public highway bridges through the National Bridge Inspection Standards (NBIS). The NBIS outlines requirements regarding the frequency with which states should conduct inspections, the qualifications of inspection personnel, and the data to be collected. FHWA conducts an annual review of state bridge inspection programs' compliance with the NBIS, which is FHWA's primary method of overseeing state bridge inspection programs. An annual review consists of a field review of bridges, interviews with state bridge staff, and a review of state bridge inspection data. FHWA's Division Office bridge engineers conduct the annual NBIS compliance reviews. Division Offices are located in each state, the District of Columbia, and Puerto Rico; and one bridge engineer is typically located in each Division Office.

FHWA maintains the NBI database, which includes records with information on the location, age, ownership, condition, and load rating and posting of nearly

600,000 public highway bridges nationwide. Each year, FHWA collects bridge inspection data from states to update the NBI.

OIG March 2006 report. In our March 2006 report, we recommended that FHWA incorporate a data-driven, risk-based approach to its NBIS compliance reviews to ensure that load ratings and postings are timely and accurate. Calculating load ratings and, if necessary, posting weight limit signs serves to prevent vehicles that are too heavy from traveling over bridges. In a worst case scenario, the lack of a correct load rating or posting could lead to a bridge crossing that causes severe structural damage or bridge collapse. We also recommended that FHWA improve the accuracy of NBI data and reduce load rating data discrepancies between state bridge databases and the NBI. Further, we recommended that FHWA evaluate states' use of bridge management systems, a tool to more effectively manage their bridge infrastructure.

FHWA concurred with our recommendations and in April 2006 convened a working group—comprised of representatives from the Office of Bridge Technology, Division Offices, and Resource Centers—to develop its planned actions in response to our recommendations. According to FHWA, its planned actions will be fully implemented by December 31, 2010.

FINDINGS

FHWA Has Made Limited Progress Implementing Data-Driven, Risk-Based Bridge Oversight

We found that FHWA made limited progress implementing data-driven, risk-based bridge oversight. Until FHWA implements systematic data-driven oversight, it has limited assurance that high priority nationwide bridge safety risks are targeted for timely remediation. We evaluated two of FHWA's actions in response to our March 2006 report on load ratings and postings—implementation of eight new NBI data reports (see exhibit B) and a risk assessment of load rating and posting practices. Based on our audit of 10 Division Offices, we found that differences in how bridge engineers used the NBI data reports and conducted the risk assessments limited their usefulness. Further, although FHWA's annual NBIS compliance review ensured compliance with Federal standards, it did not incorporate routinely a systematic data-driven approach to identifying, prioritizing, and remediating nationwide bridge safety risks in coordination with states, including those related to bridge load ratings and postings. Additionally, FHWA's progress in implementing data-driven, risk-based oversight was limited by data inaccuracies and bridge condition data that lacked detail and were vulnerable to subjective interpretation. FHWA did not require states to fix data errors by validating NBI data in a timely manner. FHWA also did not make use of the more

detailed bridge data collected by 45 states, the District of Columbia, and Puerto Rico.

Lack of Systematic Assessment of Bridge Safety Risks

FHWA bridge engineers made limited use of NBI data reports and were inconsistent in performing risk assessments nationwide. At the 10 Division Offices we reviewed, we found limited use of the new NBI data reports as part of the 2007 NBIS compliance review. FHWA developed the NBI data reports to help bridge engineers identify potential load rating and posting problems, such as identifying bridges that had not been posted with weight limit signs as required. FHWA recommended, but did not require, that bridge engineers use the data reports while conducting annual NBIS compliance reviews. At the time of our interviews with the 10 Division Office bridge engineers, only 3 used the data reports as part of their 2007 NBIS compliance reviews. FHWA's New York bridge engineer demonstrated how the data reports can enhance safety oversight. Using an NBI data report, the engineer identified safety risks associated with 300 bridges and ensured that New York mitigated the risks. Of the remaining seven engineers, six were familiar with the data reports, but did not use them during their compliance reviews, and one was not familiar with them. By not using the NBI data reports as FHWA recommended, bridge engineers missed opportunities to identify and remediate bridge safety risks in coordination with states.

FHWA also directed its Division Offices to conduct risk assessments of state load rating and posting practices. Of the nine bridge engineers who completed the risk assessment, three performed the risk assessment of load ratings and postings using the guidance and tools FHWA provided. Of the remaining six, five did not conduct an assessment specifically on load rating and posting practices and one performed the assessment before FHWA issued the guidance. As a result of bridge engineers using different methodologies to perform the risk assessments, FHWA can not assess the nationwide risks of load ratings and postings.

We attributed Division Offices' limited use of the NBI data reports and the inconsistent manner in which they performed the risk assessments to FHWA's lack of minimum requirements for bridge engineers performing data-driven, risk-based oversight. FHWA administers programs such as its NBIS compliance review through a decentralized structure and has delegated much of its decision making and program implementation to Division Offices. FHWA Headquarters Office of Bridge Technology oversees NBIS compliance reviews by providing policy direction and guidance, but has no direct authority over the bridge

engineers in the Division Offices who conduct the reviews.[3] For example, the Office of Bridge Technology's guidance to bridge engineers for conducting the NBIS compliance review in its *Bridge Program Manual* is limited to suggested activities and contains no requirements for implementing data-driven, risk-based oversight. Consequently, we are recommending that FHWA develop and implement minimum requirements for data-driven, risk-based oversight during bridge engineers' annual NBIS compliance reviews.

FHWA Headquarters did not routinely exercise systematic data-driven oversight to comprehensively address nationwide bridge safety risks, including those related to load ratings and postings. Unlike FHWA, other modes within the Department of Transportation—specifically, the Federal Railroad Administration's National Inspection Plan, the Federal Motor Carrier Safety Administration's Motor Carrier Safety Status Measurement System (SafeStat), and the Federal Aviation Administration's Air Transportation Oversight System (ATOS)—have adopted systematic approaches to identifying nationwide safety risks. Results of the annual NBIS compliance review provide FHWA with a readily available dataset to conduct this kind of analysis.[4]

According to FHWA officials, their main purpose in evaluating the results of the annual compliance review was to ensure states' compliance with the NBIS. For example, using the results of the 2006 NBIS compliance review, FHWA officials identified a state that had not shortened the duration of its inspections cycles for fracture critical bridges[5] to a 24-month interval, as required by a revision to the NBIS. In response to FHWA, the state completed its overdue fracture critical inspections and committed to complying with the requirement in the future.

To its credit, the Office of Bridge Technology identified a nationwide bridge safety risk using the results of an NBIS compliance review and took steps to remediate it. FHWA identified the need to improve the uniformity of states' quality control and quality assurance (QC/QA) of bridge inspection programs. In response, FHWA developed basic QC/QA guidance, posted it on the FHWA website in November 2005, and helped initiate a study to develop more robust guidelines.

However, FHWA did not routinely exercise systematic data-driven oversight to comprehensively identify nationwide bridge safety risks, prioritize them, and

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[3] Bridge engineers report to Division Office Administrators, who report to Directors of Field Services, who report to the Executive Director. Meanwhile, the Director of the Office of Bridge Technology reports to the Associate Administrator of the Office of Infrastructure and to the Executive Director.

[4] FHWA established its commitment to identifying and addressing risks across programs in its policy memorandum, "Policy on Stewardship and Oversight of the Federal Highway Programs," June 22, 2001.

[5] A fracture critical bridge is a bridge with members whose failure would be expected to result in collapse of the bridge.

target those higher priority risks for remediation in coordination with states. To perform comprehensive risk assessment, the Office of Bridge Technology needs to identify higher priority risks using methods that may include qualitative and quantitative ranking activities, forecasting and strategic planning, and findings from other assessments, such as FHWA's risk assessment of states' load ratings and postings practices. The specific risk analysis methodology used can vary because of differences in objectives and the difficulty in qualitatively and quantitatively assigning risk levels. Division Office bridge engineers should continue to identify state-level risks, but can also play a critical role in helping the Office of Bridge Technology identify nationwide risks. Once these risks have been identified, they should be analyzed for their possible effect. Risk analysis generally includes estimating the risk's significance, assessing the likelihood of its occurrence, and deciding how to manage the risk and what actions should be taken to address it. FHWA's efforts in coordination with states to remediate bridge safety risks would not impact states' existing project approval authority as outlined in the *Intermodal Surface Transportation Efficiency Act of 1991* (ISTEA) and the *Transportation Equity Act for the 21st Century* (TEA-21).

Until FHWA implements systematic data-driven oversight, it has limited assurance that Federal oversight activities are addressing the Nation's most significant bridge safety risks. We are recommending that FHWA develop a comprehensive plan to routinely conduct systematic, data-driven analysis to identify and address higher priority bridge safety risks in coordination with states.

Lack of Accurate and Detailed Bridge Data at the Federal Level

Data inaccuracies in the NBI limited FHWA's oversight. FHWA and our office separately identified widespread data inaccuracies in the NBI due in part to limitations with FHWA's data validation program, which checks the accuracy of data states submit annually to update the NBI. FHWA found NBI data errors regarding steel deck truss bridges—the same type bridge as Minneapolis I-35W. Immediately after the I-35W collapse, when the U.S. Secretary of Transportation called on states to inspect all steel deck truss bridges, the NBI had records for 756 such bridges across the country. FHWA subsequently learned that the data for more than one-third of the 756 bridges were inaccurate. For example, data on structure or type of material were incorrect for more than 250 of the 756 bridges; states had previously closed 10 of the bridges and demolished 6 others; records on 2 bridges were duplicative; and some bridges were actually open to pedestrian

traffic only, not vehicles.[6] In a separate analysis, based on tests of 2004 NBI data, FHWA found data errors in 27 of the 55 data fields it analyzed for 25 states.[7]

Our limited analysis of the 2007 NBI data revealed that information on the method states used to determine operating load ratings was missing for 11 percent of National Highway System bridges.[8] This information is necessary to determine whether the load rating was calculated appropriately and to ensure compliance with FHWA policy. We reported in our March 2006 report that 40.5 percent of state load rating data did not match NBI load rating data for structurally deficient NHS bridges.[9]

Having accurate NBI data is essential for FHWA to perform effective data-driven oversight. States submit updated NBI bridge data annually and FHWA tests the data for errors using its data validation program. However, we found that states are not required to fix errors in a timely manner. As a result, FHWA may have to wait a year or longer for corrected data. In a recent example, a state submitted an unusable data file with widespread errors in April 2007. Because there is no requirement to fix errors in a timely manner, FHWA had to rely on the state's out-of-date NBI data submitted in April 2006 until it provided an acceptable data file in August 2008. Consequently, the effectiveness of FHWA's data-driven oversight was critically limited in that state. To address this problem, we are recommending the development of a requirement for states to correct promptly data errors found by FHWA's data validation program.

Lack of detailed bridge data limited efforts to identify bridge safety risks. FHWA officials informed us that they would be better able to identify and monitor nationwide bridge conditions if they had more detailed bridge data. FHWA relies on ratings of three components of a bridge to characterize its overall condition. FHWA obtains condition data along with other bridge inspection data from states annually when they submit updated NBI bridge data. According to FHWA, these ratings are vulnerable to subjective interpretations by bridge inspectors because they are not refined enough to produce reliable results.[10]

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[6] FHWA presentation, "The National Bridge Inventory (NBI) 'Issues of Concern'," January 13, 2008. FHWA did not specify the number of pedestrian bridges that were coded incorrectly.

[7] FHWA's analysis, "An Investigation of Data Quality within the National Bridge Inventory: Part II National Summary of Selected NBI Items," April 2006.

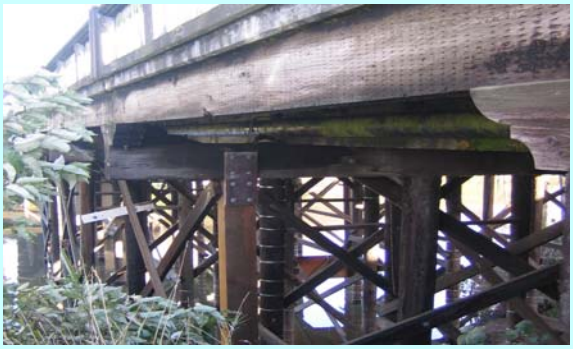
[8] Specifically, no code was provided for this NBI data field.

[9] The margin of error was +/- 8.9 percentage points.

[10] FHWA, "Reliability of Visual Inspection for Highway Bridges, Volume 1: Final Report," September 2001.

In contrast, 45 states, the District of Columbia, and Puerto Rico collect much more detailed data to characterize a bridge's condition, which is less subjective than NBI component ratings. This information is known collectively as *element-level data*. AASHTO's standards for element-level data define 106 elements. Figure 1 illustrates a bridge's substructure and table 1 below compares the same bridge's NBI condition data and element-level data. By having this more detailed data, FHWA could more accurately identify and assess bridge conditions nationwide, and better determine the appropriate levels of investment necessary to maintain and improve the Nation's bridges. FHWA submits a biennial report to Congress on the conditions and performance of the Nation's highways, bridges, and transit. The report's bridge investment estimates are developed using NBI data to determine bridge repair and rehabilitation needs. Because the NBI does not contain detailed element-level data, FHWA instead uses models to predict proxy element-level data for each bridge. Having element-level data would improve the accuracy of FHWA's estimates of the funding needed to maintain and improve the Nation's bridges.

Figure 1. A Bridge's Substructure*



Source: OIG

* The substructure supports the bridge's deck and superstructure elements like beams.

Table 1. NBI Bridge Condition Data Compared to Element-Level Data for a Bridge Substructure

NBI Bridge Condition Data	Element-Level Data
• One rating for the entire bridge substructure. • Poor rating indicates advanced section loss, deterioration, spalling, or scour.	• 20 data elements that describe the extent, nature, and severity of substructure deterioration. • 79 timber columns and 13 timber caps are in various states of decay, 4 reinforced concrete columns have moderate deterioration, 2 reinforced concrete caps have little or no deterioration, and 2 timber abutments have no decay.

Source: OIG analysis

AASHTO adopted the current standards for element-level data in 1995.[11] However, since then, many states have customized their use of element-level data. In its study of 22 states and the District of Columbia, FHWA found widespread

[11] AASHTO, *Guide for Commonly Recognized (CoRe) Structural Elements*, 1995.

variability in the elements used by states.[12] According to FHWA officials, the lack of uniformity in states' use of element-level data has impeded Federal efforts to collect and use element-level data as an oversight tool.

Several steps must be taken for FHWA to begin using element-level data effectively. First, new and updated element definitions are necessary to provide a uniform basis for the collection of element-level data. FHWA will have to coordinate with AASHTO to update the definitions in its 1995 standards. Second, states must begin adhering to the updated standards, which will require FHWA, through its rulemaking process, to incorporate them into the NBIS. Otherwise, the lack of uniformity in states' use will continue to prevent FHWA from using element-level data to identify and monitor nationwide bridge safety risks. Third, after updating the standards, FHWA must begin collecting element-level data through a process similar to how it obtains NBI data from states each year. Having completed these three steps, FHWA will be better positioned to identify nationwide bridge safety risks.

FHWA Could Strengthen Its Role in Expanding States' Use of Bridge Management Systems

States were not fully benefiting from bridge management systems in part because FHWA played a limited role in expanding states' use of them. These computerized systems can recommend bridge replacement and repair projects that, given limited resources, best address safety priorities. By using bridge management systems, such as the software program Pontis,[13] states can more effectively use their resources, preserve existing infrastructure, and best serve the traveling public.

At present, FHWA does not have statutory authority to require states to use bridge management systems. The *Intermodal Surface Transportation Efficiency Act of 1991* (ISTEA) directed states to implement bridge management systems and outlined the minimum components of an effective system. Subsequently, the *National Highway System Designation Act of 1995* repealed the mandate. According to the proposed *National Highway Bridge Reconstruction and Inspection Act of 2008*,[14] states would be required to develop and implement a bridge management system that meets the minimum components of an effective

[12] FHWA, "Assessment of the Use of CoRe and Non-CoRe Elements in Bridge Management Systems in Selected States," April 2006.

[13] Software program developed by FHWA and later adopted by AASHTO.

[14] The bill, H.R. 3999 (110th Congress), was passed by the House of Representatives on July 24, 2008. A Senate companion bill, S. 3338, was introduced on July 25, 2008 and placed on the Senate Legislative Calendar on September 23, 2008.

system established under current regulations[15] in order to receive funds from the Highway Bridge Program. Despite not having the statutory authority to require states to use bridge management systems, encouraging the use of bridge management systems is consistent with and supports FHWA's stewardship responsibilities.

The use of bridge management systems has varied widely—with many states not yet fully using all the planning and programming features that these systems offer to prioritize bridge work. According to FHWA, of the 39 states licensed to use the Pontis bridge management system as of September 2005, 5 used it comprehensively for inventory and inspection, project planning, and programming purposes. The other states used it less comprehensively. For example, 15 states used only the bridge inventory and inspection data collection function but not the planning and programming functions. During our interviews, California and Washington officials told us they used Pontis to perform deterioration modeling to assist with bridge preservation, while West Virginia had not used a system. Currently, West Virginia relies upon a set of limited criteria from its inventory to help prioritize bridges for replacement and repair.

In response to our March 2006 report, FHWA supported states' use of bridge management systems by conducting studies and providing technical assistance and training. For example, the National Highway Institute provides a multi-day Pontis training course, which includes an overview to acquaint executives with its benefits. FHWA personnel also provided customized training to states to address their specific needs in using Pontis. Additionally, FHWA highlights states' use of bridge management systems at bridge inspection program gatherings of state departments of transportation and Division Office bridge engineers.

However, FHWA can more actively encourage the use of bridge management systems by incorporating a targeted approach to providing assistance. FHWA should routinely collect and evaluate information on states' use of bridge management systems and offer assistance to those states most in need of help in implementing effective systems. For example, states that do not have a bridge management system, or others that have minimal system functions in place, should be targeted for technical assistance and training resources from FHWA. Given the benefits of using bridge management systems and FHWA's stewardship responsibilities, we are recommending that FHWA initiate a program to collect data regularly on states' use of bridge management systems, evaluate the data to identify those states most in need of assistance in implementing effective bridge

[15] The minimum components of an effective bridge management system were introduced in the *Intermodal Surface Transportation Efficiency Act of 1991* (ISTEA) and exist in current regulations. They include predicting deterioration and costs and performing short- and long-term budget forecasting. See 23 C.F.R. § 500.107.

management systems, and target them for technical assistance and training resources.

RECOMMENDATIONS

We recommend that the FHWA Administrator:

1. Develop and implement minimum requirements for data-driven, risk-based bridge oversight during bridge engineers' annual NBIS compliance reviews.

2. Develop a comprehensive plan to routinely conduct systematic, data-driven analysis to identify nationwide bridge safety risks, prioritize them, and target those higher priority risks for remediation in coordination with states. In implementing the plan:

    a. Direct the Office of Bridge Technology to routinely and systematically identify and prioritize nationwide bridge safety risks.

    b. Direct the Division Offices to work with states to remediate higher priority nationwide bridge safety risks.

3. Develop a requirement for states to correct promptly data inaccuracies found by FHWA's NBI data validation program.

4. Increase FHWA's use of element-level data by:

    a. Coordinating with AASHTO to update the standards for element-level data,

    b. Incorporating AASHTO's updated standards into the NBIS through the rulemaking process, and

    c. Developing and implementing a plan to collect element-level data after AASHTO's updated standards have been incorporated into the NBIS.

5. Initiate a program to collect data regularly on states' use of bridge management systems, evaluate the data to identify those states most in need of assistance in implementing effective bridge management systems, and target them for technical assistance and training resources.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided FHWA with our draft report on November 19, 2008. On December 22, 2008, FHWA provided us with its formal comments on the draft report (see appendix). FHWA concurred with all our recommendations, but noted

that its progress thus far should be taken in the context that it is still in the initial stages of its 3-year planned approach to assessing risk, utilizing the data reports, and conducting in-depth reviews. We acknowledge that FHWA's efforts are ongoing and commend its willingness to act in response to our recommendations. Going forward, it is critical that FHWA implement its planned actions in a timely, effective, and rigorous manner. FHWA plans to take the following specific actions in response to our recommendations.

Recommendation 1. Concur. By March 31, 2009, FHWA will develop a plan of action for incorporating minimum requirements into bridge engineers' annual NBIS compliance reviews.

OIG Response. FHWA's planned actions address the intent of our recommendation. However, we expect FHWA's forthcoming plan to be sufficiently detailed and to include clearly defined requirements and a time frame for their implementation.

Recommendation 2. Concur. By March 31, 2009, FHWA will develop a comprehensive plan to routinely conduct systematic, data-driven analysis to identify nationwide bridge safety risks, prioritize them, and target those higher priority risks for remediation. FHWA stated that it has developed and implemented a Risk Management Initiative that provides a consistent agencywide approach for the identification, assessment, prioritization, and response to risks. FHWA will direct the Office of Bridge Technology to follow the initiative's guidelines to identify and prioritize nationwide bridge safety risks. In addition, FHWA will direct the Division Offices to work with states to mitigate high priority bridge safety risks. FHWA will also reevaluate its agencywide approach to risk management and develop recommendations for improvement by the end of fiscal year 2009.

OIG Response. FHWA's planned actions meet the intent of our recommendation.

Recommendation 3. Concur. By March 31, 2009, FHWA will develop a plan of action to require states to correct promptly NBI data inaccuracies.

OIG Response. FHWA's planned action addresses the intent of our recommendation. However, we expect FHWA's forthcoming plan to include a clearly defined requirement for states to fix errors in a timely manner and a deadline for its implementation.

Recommendation 4. Concur. FHWA stated that a move to collecting and reporting element-level bridge inspection data involves many challenges. FHWA will address the first part of our recommendation related to updating the standards

by participating in an AASHTO task group that is developing changes to the data elements at the July 2009 AASHTO meeting of the Subcommittee on Bridges and Structures. Once AASHTO approves changes to the data elements, FHWA will address the second and third parts of our recommendation, including regulatory action and working with AASHTO to collect element-level data.

OIG Response. FHWA's planned actions address the intent of our recommendation. However, we request that FHWA provide us, as soon as possible, with target dates for actions related to the second and third parts of the recommendation.

Recommendation 5. Concur. By March 31, 2009, FHWA will develop a plan of action to provide targeted assistance to encourage and promote the implementation of effective bridge management systems in those states most in need of assistance.

OIG Response. FHWA's planned actions meet the intent of our recommendation.

ACTION REQUIRED

FHWA's actions taken and planned are reasonable and subject to the follow-up provisions in Department of Transportation Order 8000.1C. We appreciate the cooperation and assistance provided by FHWA representatives during our audit. If you have any questions concerning this report, please call me at (202) 366-5630.

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EXHIBIT A. SCOPE AND METHODOLOGY

We reviewed FHWA's actions to develop a data-driven, risk-based approach to the National Bridge Inspection Program to address bridge safety risks most in need of attention, including those related to load ratings and postings found in our March 2006 report. We also evaluated FHWA's actions in promoting the use of bridge management systems in response to our recommendation regarding the need for FHWA to evaluate greater use of these systems.

To perform the audit, we used two criteria from the NBI database to select 10 states for the standardized interviews of Division Office bridge engineers. The criteria identified states that have the most structurally deficient bridges with load rating and posting problems on the National Highway System (NHS). More specifically, these states had the largest sum of structurally deficient NHS bridges that (1) have operating ratings for which no load rating analysis was conducted and (2) have operating ratings that were less than 36 U.S. tons, but were not posted with weight limit signs. States should use an appropriate method of analysis in determining a bridge's operating rating to ensure the reliability of the reported rating.[16] Bridges that have operating ratings of less than 36 U.S. tons may not be able to carry typical legal traffic loads, in which case a weight limit sign should be posted. Under this approach, a bridge can be counted twice because it may have both load rating and posting problems as indicated by the above criteria. The 10 states with the largest sum of structurally deficient NHS bridges that met the above two criteria were Alabama, California, Iowa, Kansas, New York, Oregon, Pennsylvania, Texas, Washington, and West Virginia.

The criteria serve the purpose of potentially indicating which states are facing more serious problems related to load ratings and postings, but the criteria alone are not sufficient for identifying conclusively which states are facing the most serious problems. A conclusive identification would require conducting extensive in-depth field work, which was outside the scope of this audit. Further, the accuracy of NBI data is a potential limitation. As noted in our March 2006 report, we estimated that state load rating data for 40.5 percent of structurally deficient NHS bridges did not match the NBI. Despite its limitations, the NBI is the most comprehensive source of data on bridges nationwide.

As part of this audit, we interviewed Office of Bridge Technology staff in FHWA Headquarters, and staff members of FHWA's Resource Center, the Office of Asset Management, Bridge Management Information Systems Laboratory (part of FHWA Turner-Fairbank Highway Research Center), and the Office of Program

[16] FHWA policy memorandum, "Bridge Load Ratings for the National Bridge Inventory," November 5, 1993.

Administration. We also collected information from the National Highway Institute. We performed standardized in-depth, in-person interviews with FHWA Division Office bridge engineers and state bridge engineers in 3 of the 10 states we reviewed to obtain a more in-depth understanding of how FHWA's actions could facilitate the development of a data-driven, risk-based approach. For these in-depth interviews, we selected one state from within each grouping of the 10 states that identified load ratings and postings as a high, medium, or low risk as part of FHWA's load ratings and postings risk assessment. The three states included Oregon (high), California (medium/low), and Texas (low). As part of this field work, we accompanied state bridge engineers to examine bridges in each of the states we visited to better understand the process of conducting bridge inspections. For the other seven states, we conducted telephone interviews using a standardized questionnaire.

This performance audit was conducted from August 2007 through October 2008 in accordance with Generally Accepted Government Auditing Standards as prescribed by the Comptroller General of the United States. In assessing the reliability of computer-processed data within the NBI database, we conducted limited checks for accuracy and completeness but did not assess the validity of the NBI data. Though our current and prior audit work found shortcomings in the quality of the data, we determined that the data were sufficiently reliable for the purposes of helping to target our interviews and, together with other evidence, establish sufficient support to recommend that FHWA take corrective actions to address the widespread data inaccuracies discussed in this report.

For our limited checks on the reliability of NBI data, we analyzed the accuracy and completeness of NBI data for the following 6 of 123 data elements: (1) Item 41—Structure Open, Posted, or Closed to Traffic; (2) Item 63—Method Used to Determine Operating Rating; (3) Item 64—Operating Rating; (4) Item 65—Method Used to Determine Inventory Rating; (5) Item 66—Inventory Rating; and (6) Item 70—Bridge Posting. Our analyses were limited to quantifying the number and percentage of missing and out-of-range data for each data element. We compared these values by state to identify states that had a greater percentage of unacceptable data. We performed these analyses for several NBI data populations including non-NHS bridges, NHS bridges, bridges for which the NHS status was unknown, structurally deficient NHS bridges, and all bridges.

EXHIBIT B. NATIONAL BRIDGE INVENTORY LOAD RATING AND POSTING DATA REPORTS

In response to our March 2006 report, FHWA developed eight standard NBI data reports. These reports were made available to assist Division Office bridge engineers evaluate states' load rating and posting data. A ninth data report became operational in June 2008, and a tenth report continues to be under development. As stated in a February 22, 2007, FHWA memorandum, problem areas identified through these reports should be addressed during FHWA's annual NBIS compliance reviews. The following is a description of each report.

Report 1. Identifies bridges with an operating rating of less than 36 U.S. tons; but they have not been posted. The report identifies bridges that may be open to vehicles that are too heavy to cross.

Report 2. Identifies bridges with an operating rating of less than the maximum legal load; but they have not been posted. The report identifies bridges that may be open to vehicles that are too heavy to cross.

Report 3. Identifies bridges for which no operating rating analysis was performed. The report identifies bridges that may not be properly rated for their safe-load carrying capacity.

Report 4. Identifies bridges that have been recommended for posting; but they do not have legally implemented signs. The report identifies bridges that should be posted, but are not.

Report 5. Identifies bridges with a superstructure condition rating less than or equal to 4 (poor condition) and have not been posted. This report identifies bridges that may not have their deteriorated condition properly accounted for in their load rating.

Report 6. Identifies bridges with an operating rating of less than 3 U.S. tons; but open for service. The report identifies bridges that must be closed, but are not.

Report 7. Identifies bridges with a change in wearing surface, but no change in their operating rating. The report identifies bridges that may not have changes in the weight of the bridge properly accounted for in their load rating.

Report 8. Identifies bridges that have been reconstructed and report no change in their operating rating. The report identifies bridges that may not have the structural improvements following a reconstruction properly accounted for in their load rating.

Report 9—Operational as of June 2008. Identifies bridges with a change in superstructure, substructure, or culvert condition rating to 4 (poor condition) or less from a higher value with no change in their operating rating. Also identifies bridges with a change to a 2 or less from a higher structural evaluation appraisal rating with no change in their operating rating. The report identifies bridges that may not have their deteriorated condition properly accounted for in their load rating. Information about this report under development was provided to FHWA field offices in a March 20, 2008, memorandum regarding NBI standard reports.

Report 10—Under development. Identifies bridges that have been structurally deficient for 10 consecutive years. The report identifies bridges that should likely be programmed for replacement or rehabilitation.

EXHIBIT C. MAJOR CONTRIBUTORS TO THIS REPORT

Name	Title
Eric Mader	Program Director
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Petra Swartzlander	Statistician
Harriet Lambert	Writer-Editor

APPENDIX. MANAGEMENT COMMENTS

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **INFORMATION:** Federal Highway Administration (FHWA) Response to Office of Inspector General (OIG) Draft Report, "National Bridge Inspection Program: Assessment of FHWA's Implementation of Data-Driven, Risk-Based Oversight"

Date: December 22, 2008

From: Kenny E. O'Hare for Thomas J. Madison, Jr. Administrator

Reply to Attn. of: HIBT/HAIM

To: Calvin L. Scovel III
Inspector General (JA-40)

Thank you for the opportunity to review and comment on the OIG Draft Report, "National Bridge Inspection Program: Assessment of FHWA's Implementation of Data-Driven, Risk-Based Oversight." We concur with the recommendations and plan to implement actions in response as described herein.

The draft report indicates that the FHWA made limited progress in implementing data-driven, risk-based bridge oversight because of differences in how Division Bridge engineers used the standard data reports and conducted risk assessments on load rating and posting practices. To put this comment in proper context, it is important to note that the audit was initiated less than 6 months into our 3-year planned approach to assessing risk, utilizing the data reports, and conducting in-depth reviews.

Following are our comments and planned actions on the audit report recommendations:

Recommendation 1: "Develop and implement minimum requirements for data-driven, risk based bridge oversight during bridge engineers' annual NBIS compliance reviews."

Response: Concur with comments. The FHWA relies on the oversight provided by the division offices to assure that high-priority risks are being identified and addressed. Given the variations in program characteristics across the country, flexibility in the oversight approach is important. To the extent possible, the FHWA wants to be assured that risks are being addressed locally before they become a nationwide matter.

Our division offices routinely target their oversight activities to the areas of highest risk based on their local knowledge of the bridge inspection program. Nearly all divisions use data to assist in identifying program areas in need of closer monitoring and attention. Further, a State department of transportation in at least one of the States reviewed for this audit provides our Division Bridge Engineers with bridge data that is more timely than that which is provided through the National Bridge Inventory (NBI) process. For example, the Texas Division Office does not rely solely on the annual FHWA NBI Data Reports due to the time lag in receiving the national data. The Texas Department of Transportation (TxDOT) provides the Texas Division Office with monthly status data reports. These monthly reports give a real-time picture on bridges needing posting/closing and the progress on the posting/closing of these bridges. The TxDOT monthly data reports are similar to the eight Load Rating and Posting reports mentioned in Exhibit B of the draft report.

At the national level, the monitoring of scour evaluations serves as an excellent example of a data driven approach to our program oversight. Also, in response to the I-35W bridge collapse, FHWA used a data-driven approach to quickly assess problems with deck truss bridge types.

The FHWA has and will continue to undertake actions to address this recommendation. By March 31, 2009, the FHWA will evaluate options and develop a plan of action for incorporating the audit recommendation into the division offices' annual State bridge inspection program compliance review process. The evaluation of options will consider the National Bridge Inspection Standards (NBIS) Annual Program Review Summary Reports, NBI, Load Rating and Posting Reports, and the availability of resources within the FHWA.

Recommendation 2: "Develop a comprehensive plan to routinely conduct systematic, data-driven analysis to identify nationwide bridge safety risks, prioritize them, and target those higher priority risks for remediation in coordination with states. In implementing the plan:

a. Direct the Office of Bridge Technology to routinely and systematically identify and prioritize nationwide bridge safety risks.

b. Direct the Division Offices to work with states to remediate higher priority nationwide bridge safety risks."

Response: Concur with comments. The FHWA has developed and implemented a Risk Management Initiative that provides a consistent agencywide approach for the identification, assessment, prioritization, and response to risks. As part of this initiative, extensive guidance material has been developed that outlines the framework to be used by each unit office in completing individual risk assessments. The guidance allows appropriate flexibility for each unit office in identifying risks and outlines how they are to be rolled up to the headquarters level for identification of nationwide risk areas. The objectives of the initiative are to focus resources to maximize opportunities and minimize

events that threaten FHWA programs; efficiently manage program delivery to make informed decisions about the scope, approach, and intensity of our efforts; and improve communication to allow the agency to manage risks corporately. In response to your recommendation, we will direct the Office of Bridge Technology to follow the Risk Management Initiative guidelines, including an analysis of division office risk statements, to identify and prioritize nationwide bridge safety risks. In addition, we will direct the division offices to work with the States to mitigate the high priority bridge safety risks.

Due to a recent realignment of offices within FHWA, a new team will be assuming responsibility for the implementation of the FHWA Risk Management Initiative effective January 2009. In light of your recommendation, we will ask that this new team re-evaluate our Agency approach to risk management and provide recommendations for improvement to the FHWA Executive Director by the end of fiscal year 2009.

In addition, by March 31, 2009, the FHWA Office of Bridge Technology will define a comprehensive plan to routinely conduct systematic, data-driven analysis to identify nationwide bridge safety risks, prioritize them, and target those higher priority risks for remediation. The plan will consider analysis of division office risk statements in the areas of bridge, the NBIS Annual Program Review Summary Reports, NBI, Load Rating and Posting Reports, and the availability of resources within the FHWA.

Recommendation 3: "Develop a requirement for states to correct promptly data inaccuracies found by FHWA's NBI data validation program."

Response: Concur. The FHWA recognizes the importance of causing States to correct NBI data inaccuracies. By March 31, 2009, the FHWA will develop a plan of action for incorporating the audit recommendation into the FHWA's NBI data validation process. The evaluation of options will consider the NBI, existing data validation protocols, established dates of annual NBI submittals, frequency of bridge inspections, and the availability of resources within the FHWA.

Recommendation 4: "Increase FHWA's use of element-level data by:

a. Coordinating with AASHTO to update the standards for element level data,

b. Incorporating AASHTO's updated standards into the NBIS through the rulemaking process, and

c. Developing and implementing a plan to collect element-level data after AASHTO's updated standards have been incorporated into the NBIS."

Response: Concur with comments. A move toward the collection and reporting of element level bridge inspection data involves many challenges. In particular, bridge owners need to be convinced that there is sufficient benefit to the collection of the more detailed data in order to justify the increase in resources needed to initially identify and collect element level data. The cost to the FHWA, States, locals, and other Federal

bridge-owning agencies of moving to uniform collection, reporting, and use of element level inspection data is a major consideration.

The FHWA is currently participating in an American Association of State Highway and Transportation Officials (AASHTO) Task Group that has been tasked with the goal of developing the best approach to bridge condition assessment and implementing its use nationwide. The first objective of the group is to update the current Commonly Recognized (CoRe) elements. The Task Group has developed a roadmap that calls for the introduction of changes to the CoRe elements during the July 2009 meeting of the AASHTO Subcommittee on Bridges and Structures.

Once AASHTO approves changes to the CoRe elements, the FHWA will work with AASHTO to develop and implement a plan to collect element level data. The plan will consider the availability of resources to establish and maintain the element level database, regulatory action to require the collection and submittal of element data under the NBIS, and Office of Management and Budget approval of the data collection under the Paperwork Reduction Act.

Recommendation 5: "Initiate a program to collect data regularly on states' use of bridge management systems, evaluate the data to identify those states most in need of assistance in implementing effective bridge management systems, and target them for technical assistance and training resources."

Response: Concur with comments. The FHWA actively encourages States to use management systems, provides training on bridge management, and has undertaken a number of workshops focused on bridge inspection and management. The FHWA will continue to undertake actions to address this recommendation. By March 31, 2009, the FHWA will evaluate options and develop a plan of action for incorporating the audit recommendation into the FHWA's practices and procedures of targeted assistance to encourage and promote the implementation of effective bridge management systems. The evaluation of options will consider the availability of data and resources within the FHWA.

In closing, the FHWA expresses its appreciation and support of the OIG's efforts to further improve the National Bridge Inspection Program and the FHWA's oversight of the program. If you have any questions or comments regarding this response, please contact Mr. Thomas Everett at (202) 366-4675.

The following page contains the textual version of the table included in this document. The page was not in the original document but has been added to accommodate assistive technology.

National Bridge Inspection Program: Assessment of FHWA's Implementation of Data-Driven, Risk-Based Oversight

Section 508 Compliant Presentation

Table 1. NBI Bridge Condition Data Compared to Element-Level Data for a Bridge Substructure

NBI Bridge Condition Data

- One rating for the entire bridge substructure.
- Poor rating indicates advanced section loss, deterioration, spalling, or scour.

Element-Level Data

- 20 data elements that describe the extent, nature, and severity of substructure deterioration.
- 79 timber columns and 13 timber caps are in various states of decay, 4 reinforced concrete columns have moderate deterioration, 2 reinforced concrete caps have little or no deterioration, and 2 timber abutments have no decay.

Source: OIG analysis