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## BRIDGE MAINTENANCE BEST PRACTICE REPORT

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## Glossary

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<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials. See <a href="https://www.transportation.org/home/organization/">https://www.transportation.org/home/organization/</a></td>
</tr>
<tr>
<td>AASHTOWare</td>
<td>Software development unit of AASHTO. See <a href="https://www.aashtoware.org/about/organization/">https://www.aashtoware.org/about/organization/</a></td>
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<tr>
<td>BIGD</td>
<td>Bridge Inspection Guidance Document</td>
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<td>BMO</td>
<td>Bridge Maintenance Office</td>
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<tr>
<td>BMS</td>
<td>Bridge Management System</td>
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<tr>
<td>Bridgework</td>
<td>A commercial, Internet-based application for monitoring environmental events. See <a href="https://www.usengineeringsolutions.com/bridge-watch/">https://www.usengineeringsolutions.com/bridge-watch/</a></td>
</tr>
<tr>
<td>BrM</td>
<td>AASHTOWare Bridge Management (BrM) software. See <a href="http://aashtowarebridge.com/">http://aashtowarebridge.com/</a></td>
</tr>
<tr>
<td>BrR</td>
<td>AASHTOWare Bridge Design and Rating (BrR) software. See <a href="http://aashtowarebridge.com/">http://aashtowarebridge.com/</a></td>
</tr>
<tr>
<td>DelDOT</td>
<td>Delaware Department of Transportation</td>
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<tr>
<td>DOT</td>
<td>Department of Transportation</td>
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<tr>
<td>FHWA</td>
<td>Federal Highway Administration. See <a href="https://www.fhwa.dot.gov/about/">https://www.fhwa.dot.gov/about/</a></td>
</tr>
<tr>
<td>GCR</td>
<td>General Condition Ratings</td>
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<tr>
<td>HMMS</td>
<td>Highway Maintenance Management System</td>
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<tr>
<td>KYTC</td>
<td>Kentucky Transportation Cabinet</td>
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<tr>
<td>LRGD</td>
<td>Load Rating Guidance Document</td>
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<tr>
<td>MDOT</td>
<td>Michigan Department of Transportation</td>
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<tr>
<td>MiBridge</td>
<td>Bridge software application developed by the Michigan DOT</td>
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<tr>
<td>MnDOT</td>
<td>Minnesota Department of Transportation</td>
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<tr>
<td>MR&amp;R</td>
<td>Maintenance, repair and rehabilitation</td>
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<td>NBI</td>
<td>National Bridge Inventory, a bridge database maintained by the FHWA. See <a href="https://www.fhwa.dot.gov/bridge/nbi.cfm">https://www.fhwa.dot.gov/bridge/nbi.cfm</a></td>
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<td>NBIS</td>
<td>National Bridge Inspection Standards. See <a href="https://www.fhwa.dot.gov/bridge/nbis.cfm">https://www.fhwa.dot.gov/bridge/nbis.cfm</a></td>
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<td>NCDOT</td>
<td>North Carolina Department of Transportation</td>
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<td>NDE</td>
<td>Non-Destructive Evaluation</td>
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<td>Name / Abbreviation</td>
<td>Description</td>
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<td>OSOW</td>
<td>Oversize and Overweight</td>
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<td>PAR</td>
<td>Prompt Action Request</td>
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<td>POA</td>
<td>Plan of Action</td>
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<td>PRI</td>
<td>Priority Replacement Index</td>
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<td>QC</td>
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<td>RFA</td>
<td>Request for Action</td>
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<td>SCDOT</td>
<td>South Carolina Department of Transportation</td>
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<td>WIGINS</td>
<td>North Carolina DOT Bridge Inspection software</td>
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**EXECUTIVE SUMMARY**

At the request of the Governor of South Carolina, the Honorable Henry McMaster, South Carolina Department of Transportation (SCDOT) Secretary Christy A. Hall initiated an independent review of SCDOT’s protocol and procedures for inspecting and maintaining its 8,431 state-owned bridges with the overarching goal of assuring the public that all South Carolina bridges are safe and properly maintained. To ensure an objective evaluation, Secretary Hall obtained the assistance of the State Inspector General, Mr. Brian Lamkin, to conduct this evaluation in full partnership with SCDOT.

SCDOT has engaged the services of The Kercher Group, Inc. (Kercher) supported by Greenman Pedersen, Inc. (GPI) because of their considerable nationwide bridge subject matter expertise to conduct an independent evaluation. This evaluation, Bridge Maintenance Best Practices Study for the South Carolina Department of Transportation, focuses on seven (7) areas critical to ensuring bridge safety as follows:

1. Bridge Inspection Program
2. Bridge Load Rating Program
3. Bridge Management (Preservation/Rehabilitation/Replacement)
4. Bridge Maintenance and Priority Procedures
5. Scour Critical Bridge Management & Emergency Response
6. Oversize/Overweight Permitting Program
7. Coordination on Locally Owned Bridges

The Kercher/GPI team benchmarked SCDOT’s current practices in each of the above areas against eight (8) peer states and nationally identified best practices to determine areas for improvement in SCDOT’s programs. This evaluation summarizes SCDOT’s current practices, documents commendable or leading practices in SCDOT’s current programs, and identifies bridge maintenance related process improvements and initiatives currently under way. In view of Secretary Hall’s drive for continuous improvement, potential enhancements initiated in other states are also provided for SCDOT consideration. These commendable or leading practices along with potential enhancements are provided below.

**Conclusions**

All state and locally owned public bridges within South Carolina have been inspected within the past two years in accordance with the National Bridge Inspection Standards (NBIS) to ensure the safety of the motoring public. As detailed in this document, the consulting team found that SCDOT has appropriate business processes, practices, guidance materials and management tools in place to ensure that public bridges located within the state of South Carolina are routinely inspected, maintained and safe for the motoring public.

**Study Highlights**

Commendable/leading SCDOT practices and potential enhancement items for SCDOT to consider in each of the project review areas are summarized below:

**BRIDGE INSPECTION PROGRAM**

**Organization**

Commendable/leading SCDOT Practices include:

- Supplementing in-house bridge inspection teams with consultant bridge inspection teams to ensure inspection timeliness, while retaining in-house experience and capabilities to optimize program cost.
• Revising Human Resource classifications to address retention and better define the roles and responsibilities of team leaders and inspectors
• Using mobile technology for bridge inspection to improve data quality and accuracy
• Improving equipment accessibility by establishing and utilizing rental contracts

Enhancement Items for SCDOT to Consider:
• No singular “best” practice exists for organization placement and structure of the NBIS bridge inspection function
• Each state DOT must decide on the organization location and reporting structure that best meets its needs

Manuals and Guidance

Commendable/leading SCDOT Practices include:
• Developing a comprehensive, industry-leading practice bridge inspection guidance document to promote high quality and more consistent inspections
• Training bridge inspection staff in the use of the draft BIGD

Enhancement Items for SCDOT to Consider:
• Continue efforts to finalize and adopt the draft BIGD
• Consider identifying and requiring a certification or exam program for bridge inspectors, similar to those used by some peer states

Quality Control / Quality Assurance

Commendable/leading SCDOT Practices include:
• Including a comprehensive QC/QA section in the draft BIGD to enhance inspection information quality and consistency
• Requiring bridge inspection consultants to have an approved QC/QA plan prior to contracting is a leading practice

Enhancement Items for SCDOT to Consider:
• Leave the QC aspects of bridge inspection reports at the bridge inspection team level but shift to a process of using district-based peer reviews
  o For example, District 1 performs QC on District 2’s bridge inspection reports and District 2 performs QC on District 3’s bridge inspection reports, etc.
• Retain QA responsibility at the BMO for bridge inspection reporting but consider adding a BMO-based QA team to assist district bridge inspection teams in reviewing a sample of consultant-performed inspections

Data Collection Methodology

Commendable/leading SCDOT Practices include:
• Providing bridge inspectors technology that allows first person, real-time data entry is broadly considered as a data entry best practice
Supplying standard forms for collecting a variety of inspection and inspection-related QC/QA information in the draft BIGD

Providing standard forms in the BIGD for reporting critical deficiencies that use consistent terminology with the SCDOT Highway Maintenance Management System (HMMS) improves tracking and reporting efficiency

Enhancement Items for SCDOT to Consider:

- Continue efforts to deploy enhanced technologies for easier and more reliable first person, real-time data entry and information collection

BRIDGE LOAD RATING PROGRAM

Organization

Commendable/leading SCDOT Practices include:

- Supplementing in-house staff through contracts with qualified engineering consultants
- Including load rating task as part of bridge inspection consultant contracts

Enhancement Items for SCDOT to Consider:

- Strengthen resources to increase load rating capability and retain expertise to meet future needs, thereby, reducing costs and increasing efficiency

Manuals and Guidance

Commendable/leading SCDOT Practices include:

- Developing and implementing a comprehensive LRGD

Enhancement Items for SCDOT to Consider:

- Establish a minimum schedule to update the LRGD to ensure the document maintains its accuracy and relevance over time

Quality Control / Quality Assurance

Commendable/leading SCDOT Practices include:

- Developing a comprehensive QC/QA section in the LRGD
- Requiring consultants that perform load ratings to have an approved QC/QA plan in their scope of work
- Providing QC/QA review checklists and tracking documents in the LRGD

Enhancement Items for SCDOT to Consider:

- Strengthen expertise in performing load ratings through NHI training and on the job training

Software

Commendable/leading SCDOT Practices include:

- Adopting nationally accepted load rating software available through AASHTO
- Providing a listing of preferred load rating software products along with standard approval forms in the Load Rating Guidance Document
Enhancement Items for SCDOT to Consider:

- Ensure the most current AASHTOWare BrR software available is being used to increase the number of bridge types the software can load rate, which will increase the efficiency and effectiveness of the Hexagon OSOW software

**BRIDGE MANAGEMENT (PRESERVATION/REHABILITATION/REPLACEMENT)**

*Organization*

Commendable/leading SCDOT Practices include:

- Optimizing internal resources with consultant expertise for BMS development and implementation

Enhancement Items for SCDOT to Consider:

- Develop policies and procedures for a bridge program that is based on using a balanced approach of preservation, rehabilitation, and replacement projects
- Provide sufficient expert technical resources to fully leverage SCDOT's investment in a BMS

**Bridge Management Process & Procedures for Preservation/Rehabilitation/Replacement Bridge Projects**

Commendable/leading SCDOT Practices include:

- Implementing a 10-year plan for replacing 465 restricted and deficient bridges

Enhancement Items for SCDOT to Consider:

- Modify the existing capital and maintenance bridge programs to include an appropriate mix of preservation, rehabilitation, and replacement strategies that keep good and fair bridges in their condition state while prioritizing replacement of bridges in poor condition

**Use of Bridge Management System**

Commendable/leading SCDOT Practices include:

- Developing an advanced BMS

Enhancement Items for SCDOT to Consider:

- Continue to advance the development and implementation of BMS software and consider adopting the identified BMS best practices

**BRIDGE MAINTENANCE AND PRIORITY REPAIR PROCEDURES**

*Organization*

Commendable/leading SCDOT Practices include:

- Providing a proven ability to handle emergencies such as extreme storm events, flooding, and vehicle or vessel collisions
- Having some district maintenance crews capable of performing major repairs and replacing small bridges and culverts on secondary routes using standard plans
- Outsourcing the maintenance and management of specialty bridges

Enhancement Items for SCDOT to Consider:

- Create a manual for identifying standard bridge maintenance actions statewide
• Provide the National Highway Institute’s (NHI) two-week Bridge Maintenance course
• Expand asset maintenance contracting to include additional complex bridge structures that have specialized maintenance needs

**Priority Repairs**

**Commendable/leading SCDOT Practices include:**

• Currently implementing the enhanced critical deficiencies prioritization process as described in the draft BIGD
• Supplying detailed policies and processes in the Agency’s BIGD document to address critical deficiency prioritization, response, and tracking
• Providing excellent agency coordination and response to emergency situations such as hurricanes, natural disasters, vehicle or vessel impact damage, and discovery of advanced deterioration

**Enhancement Items for SCDOT to Consider:**

• Complete implementation of the critical deficiencies prioritization process described in the draft BIGD

**SCOUR CRITICAL BRIDGE MANAGEMENT & EMERGENCY RESPONSE**

**Organization**

**Commendable/leading SCDOT Practices include:**

• Incorporating full scour inspection guidance into the draft BIGD
• Utilizing and coordinate with an in-house Hydraulic Design Support team to perform hydraulic analysis
• Augmenting in-house staff with scour specific consultant inspection contracts for use statewide
• Identifying triggering events for scour re-evaluation and inclusion of these events in the draft BIGD

**Enhancement Items for SCDOT to Consider:**

• Schedule the underwater scour critical bridge inspections on a 48-month basis to coincide with a routine biennial NBIS bridge inspections
• Review each bridge-specific POA as part of the scope of work assigned to the underwater inspection consultant team

**Process for Addressing Bridge Emergencies**

**Commendable/leading SCDOT Practices include:**

• Incorporating full damage inspection guidance into the draft BIGD
• Incorporating full hurricane and storm inspection guidance into the draft BIGD
• Developing rapid deployment process for placing USGS stream flow gauges on several streams in advance of a hurricane or extreme rainfall event, where USGS does not have a permanent stream flow gauge installation
• Piloting the use of BridgeWatch, a commercially available, web-based, real-time, monitoring software solution, on 1600 bridges
• Developing a process for bridge closings in the draft BIGD that includes communication procedures and flowcharts
Enhancement Items for SCDOT to Consider:

- Include an emergency on-call/response section in the consultant bridge inspection contracts issued by the BMO
- Expand the use of USGS Water Alert service and BridgeWatch
- Include a pre-event assessment of the waterway for debris at the bridge piers or abutments, to be removed by district maintenance crews in advance of the storm
- Formalize policies and procedures for performing post-event evaluations to identify opportunities to improve responsiveness and effectiveness

**Cost-Effective Methods for Scour Prevention**

Commendable/leading SCDOT Practices include:

- Developing South Carolina bridge scour envelope curves in conjunction with the USGS

Enhancement Items for SCDOT to Consider:

- Develop a program for designing/developing scour countermeasures, including stream armoring and channel protection, for scour critical bridges that are not currently scheduled for bridge replacement and likely, will not be for the foreseeable future

**Oversize and Overweight Permitting Program**

**Organization**

Commendable/leading SCDOT Practices include:

- Issuing permits the same day as requested, which is industry best practice

Enhancement Items for SCDOT to Consider:

- Develop a succession plan to address long-term OSOW staffing needs

**Manual & Guidance**

Commendable/leading SCDOT Practices include:

- Providing an easily understood and navigated OSOW website

Enhancement Items for SCDOT to Consider:

- Develop permit application forms that can be completed electronically (e.g., in a writable “.pdf” format) to support direct submission to the SCDOT permit office

**Automation**

Commendable/leading SCDOT Practices include:

- Configuring the Hexagon commercial off-the-shelf permitting system to provide increased efficiencies and allow for easier updates across one software platform

Enhancement Items for SCDOT to Consider:

- Reach out to the states identified as Hexagon users (Louisiana, Oklahoma and Tennessee) for lessons learned on implementing and using this system
- Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to develop updated truck route maps
**Fee Structure**

Commendable/leading SCDOT Practices include:

- Returning permit fees to SCDOT to support the state funded bridge program

Enhancement Items for SCDOT to Consider:

- Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to identify opportunities to consolidate/simplify permit categories and to determine the fairness and equity of the fee structure

**Coordination on Locally Owned Bridges**

Organization

Commendable/leading SCDOT Practices include:

- Performing all bridge inspections and load ratings for all locally owned bridges consistent with those on the state network

- Supplementing in-house bridge inspection teams and load rating capabilities with use of consultants to ensure safety of locally owned bridges

- Performing all above services at no cost to the local agencies

Enhancement Items for SCDOT to Consider:

- Draft legislation, if appropriate, that clarifies and supports SCDOT’s responsibility and authority for inspection, load rating, posting restrictions or closing locally owned bridges

**Additional Comments**

Unless otherwise noted, all photographs included herein were provided courtesy of SCDOT.

The consulting team thanks all SCDOT, Federal Highway Administration (FHWA) and other state DOT personnel that participated in this project. SCDOT leadership and staff were extremely cooperative and responsive to all requests for information and documents. The consultants appreciate this opportunity to serve the SCDOT and the State of South Carolina.
BRIDGE MAINTENANCE BEST PRACTICE REPORT

Project Description

This is the project report of the Bridge Maintenance Best Practices Study for the SCDOT. This is an SCDOT-sponsored project, performed at the request of Governor Henry McMaster, and in cooperation with the South Carolina Office of Inspector General.

This report is the primary project deliverable and contains the results of a consultant-performed, independent review and analysis of SCDOT’s bridge inspection, maintenance and replacement programs. The intent of this report is to provide recommendations for improving or enhancing the existing programs based upon generally accepted industry best practice and to provide the proper assurances to the public regarding the integrity, structure and operation of the overall bridge program. SCDOT’s compliance with the federal NBIS ensures that public bridges located within the state of South Carolina are routinely inspected and safe.

The scope of work for this project identified the following five (5) primary tasks, each of which has several focus areas:

1. Establish a baseline of the current practices of SCDOT’s bridge inspection, maintenance and replacement programs.

2. Identify best-practices in bridge inspection, maintenance and replacement programs of other states with similar bridge inventories, in addition to best practices identified by the Federal Highway Administration (FHWA) that may improve the efficiency and effectiveness of the SCDOT programs. Specifically, the consultant team considered the following items:
   - Inspection Procedures
   - Load Rating Procedures
   - Oversize and Overweight Permitting
   - Maintenance (Clearing Flags & Load Posting)
   - Preservation
   - Rehabilitation
   - Replacement
   - Coordination on Locally Owned Bridges

3. Identify comparative statistics of SCDOT’s bridge inventory to national and regional data.

4. Recommend opportunities for improvements within the SCDOT Bridge Management and Replacement Program with regard to the roles, responsibilities and synchronization of efforts relating to bridge inspection, load rating and issuing of Oversize and Overweight permits including those designated as super-loads.

5. Identify the best practices and effective tools utilized by other state departments of transportation in support of bridge asset management. Specifically, management dashboards, quality control of data within the inventory, techniques for forecasting bridge investment needs, condition trend lines and conducting risk analysis.
**Approach**

**Initiate Project**
The consulting team initiated this project with an onsite meeting of the SCDOT Director of Maintenance and the SCDOT BMO team.

**Review Available Documents**
SCDOT promptly provided the consulting team with requested, relevant SCDOT materials. The consulting team reviewed this material, which helped inform the interview questionnaire, the selection of peer states and the other best practice research efforts.

**Develop Interview Questionnaire**
The consulting team developed a questionnaire for use in interviewing both SCDOT personnel and peer states. This document underwent multiple revisions, attempting to balance the desire for greater detail against a desire to encourage more peer state participation by minimizing their time commitment. These drafts were reviewed with the SCDOT project manager and the SCDOT project team for feedback and suggestions. A copy of the final version of this interview guide is found in Appendix B.

In most cases, interviews took between 1-2 hours. Most SCDOT interviews were conducted in-person while peer state interviews were conducted through a variety of approaches (in-person, telephone, Skype, etc.).

Because of the range of areas covered by the questionnaire, many of the people interviewed did not answer all questions and, in some cases, forwarded the interview guide to additional people within their respective agencies to provide specific details/information. In many cases, interviewees also supplemented their oral responses provided with supplemental material forwarded by email (or otherwise).

**Baseline SCDOT Practices**
Effectively, this entire project is organized around a benchmarking project effort, aimed at identifying where SCDOT could adopt practical enhancements to improve the efficiency or effectiveness of its bridge program. Accordingly, the first step in this project was to gain a full understanding of SCDOT current practices in each of the areas reviewed.

**Gather information**
The information gathering stage of the SCDOT baseline effort involved requesting and receiving the materials previously identified. Supplementing these initial requests were materials identified and provided by SCDOT personnel through the course of the interviews and other communications.

The consulting team reviewed the materials provided. Along with the interview information gathered, this information provided the basis of much of the analysis described in this report.

**Interview SCDOT Personnel**
As indicated, a significant number of SCDOT personnel were interviewed in support of this project. These included central office and district-based SCDOT personnel involved in bridge inspections and maintenance. Several field locations were visited as part of this project to help the consulting team understand the operating environment variables and challenges facing SCDOT personnel involved in performing their work. In all cases, SCDOT personnel were knowledgeable, cooperative and forthcoming with their responses, providing significant detail on the business processes and technologies used as well as the challenges faced in performing their duties.
Select Peer States for Review

The second step in a benchmarking effort is to determine the standards to be used for comparison. In this case, other state DOTs represent the obvious pool from which to draw. However, it is important to note that the consulting team’s benchmarking efforts were not limited to just state DOTs that were part of the peer state review effort. The consulting team also reached out to other state DOT contacts and reviewed relevant resource materials including a significant volume of state DOT bridge program information gathered by FHWA in support of various conference events and other initiatives.

Target DOTs for this benchmarking effort ideally would share as many similarities with SCDOT as possible yet ideally, also would be able to demonstrate “best” or “leading” practices in many of the areas covered by this project. As in any benchmarking effort that requires a significant effort to participate, the ability to secure subject cooperation tends to be a significant consideration.

Finalize Peer State List

Appendix C contains the results of this analysis for all 50 U.S. states, the District of Columbia and Puerto Rico. The consulting team suggested and SCDOT approved approaching eight (8) states to participate in the benchmarking effort, all of which agreed. These states and the major reasons for selection are described Table 1 below:

Table 1: Benchmarking Peer States

<table>
<thead>
<tr>
<th>State</th>
<th>Reason Included</th>
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<tbody>
<tr>
<td>Delaware</td>
<td>• High percentage of DOT owned bridges</td>
</tr>
<tr>
<td></td>
<td>• Coastal state</td>
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<tr>
<td></td>
<td>• Relatively mild climate</td>
</tr>
<tr>
<td>Florida</td>
<td>• Southern state</td>
</tr>
<tr>
<td></td>
<td>• Similar climate and large coastline</td>
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<tr>
<td></td>
<td>• Extensive experience with outsourcing inspection and maintenance to consultants</td>
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<tr>
<td>Georgia</td>
<td>• Direct neighbor</td>
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<tr>
<td></td>
<td>• Southern state</td>
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<td></td>
<td>• Similar climate</td>
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<td>• Comparable fuel tax rates</td>
</tr>
<tr>
<td>Michigan</td>
<td>• Record of success in improving bridge conditions over time</td>
</tr>
<tr>
<td></td>
<td>• Known for successful local agency coordination practices</td>
</tr>
<tr>
<td></td>
<td>• Considered by peers to be a bridge management system best practice state</td>
</tr>
<tr>
<td>New Jersey</td>
<td>• Large bridge program</td>
</tr>
<tr>
<td></td>
<td>• Coastal state</td>
</tr>
<tr>
<td></td>
<td>• Considered by peers as a bridge management system best practice state</td>
</tr>
<tr>
<td>North Carolina</td>
<td>• Direct neighbor</td>
</tr>
<tr>
<td></td>
<td>• Large program</td>
</tr>
<tr>
<td></td>
<td>• Large state-owned network</td>
</tr>
<tr>
<td></td>
<td>• Southern state</td>
</tr>
<tr>
<td></td>
<td>• Similar climate</td>
</tr>
<tr>
<td></td>
<td>• Considered by peers as a bridge management system best practice state</td>
</tr>
<tr>
<td>State</td>
<td>Reason Included</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Virginia      | • Coastal state  
                • Southern State  
                • Similar climate  
                • Large bridge program  
                • Large state-owned network  
                • Considered by peers as a bridge management system best practice state |
| West Virginia | • Large state-owned network  
                • High percentage of DOT-owned bridges  
                • Good reputation for bridge inspection program |

**Interview Peer States**

The interview guide was emailed to each participating DOT in advance to assist in identifying and gathering the information being sought. Most interviews took 1-2 hours and were conducted through a variety of approaches.

**Gather Information**

Most DOTs interviewed provided some amount of support material to supplement the information provided during the interviews. The consultants collected this information and shared it among the team using a project file-sharing site. This material was used to support project best practice benchmarking efforts, supplementing information gathered by the team from other resources.

**Perform Interviews**

As previously described, peer state interviews typically were not limited to a single conversation. As a result, compiling the information from the peer state outreach required aggregating multiple sources into the respective state DOT interview response form. In turn, these responses were compiled into tables that are organized by report review area, interview question and the responses by state. Appendix D contains this information.

**Identify Best Practices in all Review Areas**

The consulting team used the information gathered through the steps described above for the purpose of identifying practices for possible SCDOT adoption. This involved evaluating the efficiency and effectiveness of the current SCDOT approach to the alternative approaches identified through research and outreach.

**Enhancement Items for SCDOT to Consider**

The Enhancements provided in this document are intended to be viewed as options and alternatives for SCDOT to consider.

**Conclusions**

All state and locally owned public bridges within South Carolina have been inspected within the past two years in accordance with the National Bridge Inspection Standards (NBIS) to ensure the safety of the motoring public. As detailed in this document, the consulting team found that SCDOT has appropriate business processes, practices, guidance materials and management tools in place to ensure that public bridges located within the state of South Carolina are routinely inspected, maintained and safe for the motoring public.
Bridge Inspection Program

Topic Introduction

The NBIS are federal regulations that establish requirements for bridge inspection procedures, frequency of inspections, qualifications of personnel, reporting, and maintenance of the publicly owned bridge inventory. NBIS regulations apply to bridges or culverts that carry vehicular traffic and have an opening longer than 20 feet measured along the center of the roadway. The NBIS provides “minimum” standards for bridge inspection but most state DOTs provide additional or more detailed instruction in manuals, guidance documents and procedures, informational memorandums and periodic training.

A bridge inspection is an accurate and thorough assessment of each bridge’s condition to assure the structure remains safe, functional, and reliable. There are seven (7) basic types of bridge inspections:

1. Initial (inventory)
2. Routine (periodic)
3. In-depth
4. Damage
5. Fracture critical
6. Underwater
7. Special (interim)

These inspections are described in the American Association of Transportation Officials (AASHTO) Manual for Bridge Evaluation\(^1\) and the Federal Highway Administration’s (FHWA) Bridge Inspection Reference Manual\(^2\) (BIRM).

The NBIS requires that each state DOT have a bridge Inspection “Program Manager”, who is responsible for the NBIS bridge inspection program. The person must be a registered Professional Engineer or have at least ten (10) years of bridge inspection experience and have successfully completed an FHWA approved comprehensive bridge inspection training course. The bridge inspection program manager must have adequate authority over the NBIS program to successfully carry out his or her responsibilities.

Bridge inspections are led by a team leader, who is responsible for planning, preparing and performing the inspections of individual bridges as well as the day-to-day aspects of the inspection. The NBIS requires a team leader to be present during each initial, routine, in-depth, fracture critical and underwater inspection.

The team leader can be an engineer or non-engineer that meets the qualification requirements provided by the NBIS. These qualifications include education, professional registration or certification, experience and training.

Training to be a bridge inspector starts with the NHI’s \textit{Safety Inspection of In-Service Bridges} or equivalent FHWA approved bridge inspection training course, and includes on-the-job training led by the team leader. Refresher training is required at intervals set by the DOT. The bridge inspection program manager is responsible for setting policies and procedures including scheduling and tracking the required training for the bridge inspection staff.

Bridge inspection team members are responsible for assisting the team leader in day-to-day aspects of the inspection. While there are no specific federal training guidelines for members of the inspection team, these

\(^1\) https://store.transportation.org/Item/CollectionDetail?ID=179
personnel should have sufficient technical expertise (obtained through education and/or hands-on experience) to support the inspector in successfully completing the tasks at hand. The goal is for the team member to learn the correct inspection methods and to evaluate bridge components and elements consistently.

Bridge inspectors record findings of the inspection in a bridge inspection report, which should meet the following requirements:

- Be in a standard format
- Use nationally accepted condition ratings such as the NBI General Condition Ratings (GCR) or AASHTO Element Condition States
- Include photographs and descriptions of specific defects that are detailed, quantitative (where possible) and complete

A bridge inspection may take several hours to complete for a small bridge or culvert, or it may take several days (or weeks) for a large complex bridge. Equipment needed for bridge inspections may include ladders, boats, and access vehicles such as aerial lift “bucket” trucks, “platform” trucks, and under-bridge inspection “snooper” vehicles.

Bridge inspectors use a combination of simple and complex tools to support inspection analysis. Simple, Non-Destructive Evaluation (NDE) tools include the use of hammers or steel chain to “sound” for delamination in the concrete, evaluate certain materials, check structural details, and identify defects. Complex tools may be used as needed, and include ultrasonic testing equipment, which is used to find cracks in steel, or ground penetrating radar, that can evaluate the condition of bridge decks. NDE tools can help bridge inspectors find hidden defects that cannot be observed by visual inspection alone. NDE tools also can be used to identify material conditions that could lead to future defects and the need for expensive repairs.

The NBIS requires QC/QA procedures to maintain a high degree of accuracy and consistency in the highway bridge inspection program. Accuracy and consistency are important because the bridge inspection data is reported to FHWA and is the foundation for funding decisions and other infrastructure legislation at the national level. QC is the establishment and enforcement of procedures that are intended to maintain the quality of the inspection at or above a specific level. QA involves the use of sampling and other measures to assure the adequacy of quality control procedures. This information is used to verify or measure the quality level of the entire bridge inspection program. QA is a standardized process that is a check and verification of the QC process. An additional way QA can be accomplished is by the re-inspection of a sample bridges by an independent inspection team.

For example, in agencies where bridge inspections are performed by district or region-based bridge inspection teams, the QA program typically is performed by the central staff or its consultants. If the inspections are centralized at the headquarters level within the state, a consultant or a separate state bridge inspection team typically performs the QA program separately and independently from the unit performing the original inspection.

**Organization**

**Identify National and Peer Practices**

Organizational theory suggests that organizations centralize for efficiency and control and decentralize for flexibility and responsiveness. The tradeoffs between these approaches must consider the extent to which the functions in question are highly specialized in nature and need some degree of pooling of resources to avoid creating hard-to-maintain islands of expertise within an organization.

Nationally, most States use either centralized or decentralized organizational structures for NBIS bridge inspections based on what works best in each state. Several states use a hybrid organization by having one or more NBIS teams report directly to the central office in an otherwise, decentralized organization. State
organizational decisions are often based on geographic size of each state, number of bridges state and locally owned, delegation of authority and reporting structure, and other factors.

As described, peer states have experienced success using a variety of organization placement options for the bridge inspection function. Accordingly, no one approach can be considered singularly as “best practice”; rather, any of the described options can produce the target outcome if provided sufficient guidance and support. Bridge inspection teams in most of the peer states included in this study are field-based (decentralized, i.e., physically located within geographic districts, divisions or regions). Exceptions tend to be geographically smaller states (e.g., DE and NJ), which have their bridge inspection teams located at their respective DOT headquarters (centralized).

Michigan, Virginia and West Virginia have their bridge inspection teams reporting locally within the district or region’s maintenance chain of command. The remainder of the peer states have their inspection teams geographically dispersed but reporting to a central/headquarters-based group which may be within the Maintenance command structure or within another organizational unit. Similarly, the selection and oversight of consultants performing bridge inspection varies from state to state, some headquarters-based and some region-based.

From a national perspective, both Alabama and Louisiana have their bridge inspection teams located in their districts and reporting through their district chain of command, but they do have one or two inspection teams reporting to, and based out of, their central Bridge office. These inspection teams supplement district inspection teams during times of temporary staff shortages or when workload issues arise; they also assist the districts with priority findings and provide advice with maintenance repair methods and techniques. In Louisiana, its two teams also perform the QC.

Peer states tend to use a mix of consultants and in-house bridge inspection teams to perform the bridge inspection function as shown in Figure 1. Peer states also typically rely on the specialty engineering firms to perform underwater inspections. Georgia and West Virginia are the exceptions to both practices and self-perform both routine and underwater inspections.
Figure 1: Self-Performed Routine Bridge Inspection Rates

SCDOT Current Practices
The state is divided into seven (7) engineering districts (see Figure 2). Bridge inspection teams are district-based and report to the District Maintenance Engineer through the District Bridge Inspection Supervisor. When fully staffed, most districts have two or three inspection teams. Each two-member team includes a bridge inspection team leader and a bridge inspector. Historically, SCDOT inspection teams have been responsible for routine inspections of all bridges in the State, including bridges on the local system. The exception are the bridges that are being inspected as part of the management contract for movable and complex bridges (15 bridge systems in total).
The BMO is headquarters-based and falls within the organizational structure of the Director of Maintenance as a major program area. The BMO supports the bridge inspection staff and performs the QA function for the bridge inspection program. The BMO is in the process of contracting with consultant engineering firms to supplement SCDOT in-house bridge inspection staff. In addition, the BMO maintains contracts with specialty engineering firms for required underwater inspections.

**Commendable/leading SCDOT Practices include:**

- Supplementing in-house bridge inspection teams with consultant bridge inspection teams to ensure inspection timeliness, while retaining in-house experience and capabilities to optimize program cost
- Revising Human Resource classifications to address retention and better define the roles and responsibilities of team leaders and inspectors
- Using mobile technology for bridge inspection to improve data quality and accuracy
- Improving equipment accessibility by establishing and utilizing rental contracts
SCDOT’s strategic approach of using a blend of in-house bridge inspectors and consultant inspectors is aligned with most other peer states and is considered a best practice for optimizing resources.

Enhancement Items for SCDOT to Consider:

- No singular “best” practice exists for organization placement and structure of the NBIS bridge inspection function
- Each state DOT must decide on the organization location and reporting structure that best meets its needs

Manuals and Guidance

Identify National and Peer Practices

All peer states have a bridge inspection manual, either as a stand-alone document or included within their bridge design manual. The central bridge unit of each state typically has responsibility for updating and maintaining this document.

Training practices identified as particularly noteworthy include the following:

**West Virginia**

- Holds an annual Bridge Inspection Conference for all state bridge safety inspectors
- Conducts a state certification exam that all bridge safety inspectors must successfully pass before acting as a team leader
- Requires personnel to earn technical development hours towards an Associate of Applied Science (A.A.S.) in Highway Engineering Technology – Bridge degree program before being eligible for the higher Bridge Safety Inspector classifications
  - Funds tuition for up to two (2) classes per semester in the program

**Michigan**

- Requires a Field Proficiency Exam that all bridge inspection team leaders must successfully complete to be qualified as a bridge inspection team leader

**Indiana**

- Partnered with Purdue University to develop required bridge inspection [short] courses

SCDOT Current Practices

The BMO is completing the BIGD. The draft BIGD is comprehensive and reflects a compendium of leading policies, practices and procedures currently in industry use. SCDOT already is conducting inspections using the draft BIGD and is aggressively training its personnel to follow the revised processes and guidance statewide.

Commendable/leading SCDOT Practices include:

- Developing a comprehensive, industry-leading practice bridge inspection guidance document to promote high quality and more consistent inspections
- Training bridge inspection staff in the use of the draft BIGD

Enhancement Items for SCDOT to Consider:

- Continue efforts to finalize and adopt the draft BIGD
- Consider identifying and requiring a certification or exam program for bridge inspectors, similar to those used by some peer states
Quality Control / Quality Assurance

Identify National and Peer Practices
All peer states have QC/QA policies and practices included in their respective bridge inspection manuals, within their bridge design manuals or as a stand-alone document. Similarly, the central bridge office within each peer state also has responsibility for the updating and maintenance of the QC/QA elements in their respective manuals.

As noted previously, Louisiana has central office bridge inspection teams, which support QC/QA efforts and assist in maintaining overall bridge inspection report consistency.

SCDOT Current Practices
District-based bridge inspectors currently perform QC on their inspection reports. The current review process primarily is a check for completeness and a consistency on the NBI and element coding. QA is performed centrally from the BMO.

The draft BIGD provides enhanced QC/QA guidance and requirements for bridge inspection. It also defines QC/QA, outlines roles, and identifies responsibilities and review procedures. There are separate sections for in-house performed bridge inspections and for consultant-performed bridge inspections.

The draft BIGD defines the requirements for the inspection team’s qualifications and includes a QC/QA flow chart while also providing guidance on participation in and performing FHWA audits and reviews. The attachments section of the draft BIGD provides QC/QA forms for field reviews, independent inspections and district meetings. There are also tracking spreadsheets for QC/QA and inspection team qualifications.

Commendable/leading SCDOT Practices include:
- Including a comprehensive QC/QA section in the draft BIGD to enhance inspection information quality and consistency
- Requiring bridge inspection consultants to have an approved QC/QA plan prior to contracting is a leading practice

Enhancement Items for SCDOT to Consider:
- Leave the QC aspects of bridge inspection reports at the bridge inspection team level but shift to a process of using district-based peer reviews
  - For example, District 1 performs QC on District 2’s bridge inspection reports and District 2 performs QC on District 3’s bridge inspection reports, etc.
- Retain QA responsibility at the BMO for bridge inspection reporting but consider adding a BMO-based QA team to assist district bridge inspection teams in reviewing a sample of consultant-performed inspections

Data Collection Methodology

Identify National and Peer Practices
Many of the peer states use devices and technologies that support direct capture of field notes and pictures directly into bridge inspection forms, pre-populated from the previous inspection. This information typically is held on the mobile device until the device is synced with the agency network, and the records subsequently uploaded.

Once QC has been performed, these files are ready to be reviewed through the QA process. Ultimately, this information is uploaded as NBIS records.
**SCDOT Current Practices**

SCDOT provides electronic tablets to support the direct collection of bridge inspection data via its *Bridge Inspection Online* (BIO) application. However, most bridge inspectors currently collect information on paper forms during their field visits because of tablet durability concerns and network connectivity limitations. As a result, most bridge inspection data entry must be transcribed into the BIO application. This includes bridge element condition ratings with estimates (or measurements, if taken) and any specific element deterioration noted. Photos taken during the field visit also must be imported separately into the bridge inspection report. The field paper documents then are attached to the bridge inspection report as a PDF file.

SCDOT is aware of the current limitations of the existing BIO application, technology and multi-step nature of this process and is taking proactive measures to replace the application, the supporting technology and streamline the process. SCDOT has executed a procurement contract with *AASHTOWare* to develop a mobile application and bridge management system to address this need.

**Commendable/leading SCDOT Practices include:**

- Providing bridge inspectors technology that allows first person, real-time data entry is broadly considered as a data entry best practice
- Supplying standard forms for collecting a variety of inspection and inspection-related QC/QA information in the draft BIGD
- Providing standard forms in the BIGD for reporting critical deficiencies that use consistent terminology with the SCDOT Highway Maintenance Management System (HMMS) improves tracking and reporting efficiency

**Enhancement Items for SCDOT to Consider:**

- Continue efforts to deploy enhanced technologies for easier and more reliable first person, real-time data entry and information collection
**Bridge Load Rating Program**

**Topic Introduction**

The term “load rating” is used to define a series of actions that ensure a bridge is safe to carry the loads traveling on it. Determining how strong a bridge is to carry vehicular traffic, such as cars and trucks, is an extremely important aspect of any bridge program. Failure to properly determine load carrying capacity can have catastrophic results.

When bridges are closed or load restricted, significant public impacts can result such as long detours, which slow the efficient movement of goods and services. Therefore, identifying bridges that have reduced capacity and addressing them is a crucial component of an overall agency bridge program.

Bridges must be able to carry their own weight plus any additional loads. The bridge’s own weight is typically referred to as “dead load” whereas other loads such as cars and trucks are referred to as “live loads.” Live loads are those loads that are not continuously applied to the bridge. Besides cars and trucks, this can also be wind, snow and even the braking of trucks and cars.

Truck loading is divided into loads the bridge sees everyday like the typical eighteen-wheeler and special trucks that carry very heavy loads and only occasionally cross the bridge (see Figure 3). Often these special trucks have many axles (to distribute the load) and sometimes a police escort as they might be oversized or over height and might purposely move slowly to impart less load on a bridge.

![Figure 3: SCDOT Load Rating Diagram](image)

Load rating engineers use existing documentation such as the initial design and “as-built” construction plans to determine the capacity of the bridge. However, an important aspect of load rating a bridge is to see if any changes have occurred over the life of the bridge that might have reduced its ability to carry loads. These changes are documented through ongoing NBIS bridge inspections.

A common example of deterioration observed during routine NBIS inspections that would be considered during load rating might be a steel girder that has rusted over time. When a steel girder rusts, the resulting “section loss”
diminishes its ability to carry the loads for which it was originally designed. It is therefore imperative that the bridge inspection team document these types of changes through measurements and photography during their bridge inspection and include important details in the bridge inspection report. If necessary, field load testing utilizing strain gauges and other electronic “non-destructive” evaluation methods may be required to assess the load carrying capabilities of a bridge with deteriorated elements.

A load rating engineer typically performs analysis calculations to determine the capacity of the bridge. Sometimes this can be very minimal such as evaluating one bridge girder and the loads on it, then assessing how those loads affect the entire bridge. These load rating calculations may be performed by hand, utilizing a standard template or spreadsheet. The results of this type of analysis typically is very conservative.

Sometimes a “refined analysis” is used, which is a more sophisticated analysis that requires using highly complex computer software. A refined analysis takes longer and is more costly to perform. However, it provides a more accurate result. Occasionally, a refined analysis may indicate the strength of the bridge is adequate. In such cases, a structural rehabilitation/strengthening project and its accompanying costs are not required.

As previously noted, bridges also may be load-tested to help with the load rating. This typically involves driving trucks of known weight over the bridge and using gauges to measure the reactions in the load carrying members and at the supports.

Load rating is viewed by the FHWA as an extremely critical task with the requirement that all load rating engineers responsible for determining how much load a bridge can carry must be licensed professional engineers. Many states DOTs have an in-house load rating engineer who oversees DOT staff or consultants performing the load rating analysis. Load ratings are input into agency bridge management computer programs so that routes can be determined for movement of overweight trucks when requested via the oversize-overweight permitting process.

Organization

Identify National and Peer Practices
In most peer states, if the bridge inspection function resides in the district/region, then the load rating function also resides in the district/region. Georgia and Michigan are exceptions to this practice.

In peer states that perform load rating of bridges in the district/region, the central bridge offices typically have the capability to perform load ratings but usually are engaged in the quality assurance of load ratings, maintaining the load rating policies and procedures, and in evaluating software which can be used for load rating (or updates for software in use).

All peer states use consultants to assist them with load rating large, complex and truss bridges, though Georgia, North Carolina and West Virginia perform the majority (>80%) of the bridge load ratings with in-house staff. The remainder of the peer states use consultants to assist them to a varying degree (50%-75%).

SCDOT Current Practice
Currently, load ratings are performed by consultants, who are contracted by, and report to, the BMO. Load ratings are performed in accordance with the SCDOT LRGD and are typically performed under the following circumstances including:

- When a bridge is originally designed and then immediately updated upon completion of construction or reconstruction (if construction changes warrant)
- When bridge inspection teams note a suspected loss in load carrying capacity of a bridge component due to deterioration
- When damaged through vehicle impact or other extreme event
• When a trucking company submits a permit request to move a large, overweight vehicle over a bridge (or bridges)

In addition, FHWA recently issued guidance requiring that all bridges be load rated for a Special Hauling Vehicle and Emergency Vehicle. In order to meet this significant increase in bridge load rating needs, the BMO has engaged consultant engineering firms to perform the required load ratings.

**Commendable/leading SCDOT Practices include:**
- Supplementing in-house staff through contracts with qualified engineering consultants
- Including load rating task as part of bridge inspection consultant contracts

**Enhancement Items for SCDOT to Consider:**
- Strengthen resources to increase load rating capability and retain expertise to meet future needs, thereby, reducing costs and increasing efficiency

**Manuals and Guidance**

**Identify National and Peer Practices**
Most peer states have a load rating manual, either as a stand-alone document or included within their bridge design or bridge inspection manuals. The peer states who do not have a manual perform load ratings with in-house staff utilizing in-house guidance documents. Maintenance and updating of electronic load rating manuals and guidance documents are a function assigned to the central bridge offices of the peer states interviewed.

**SCDOT Current Practices**
The LRGD recently developed by SCDOT is comprehensive and reflects a compendium of best practice policies and procedures currently in use by industry. The LRGD provides all load raters with a common source document to utilize when developing bridge load ratings. It also provides documentation and standard load rating summary forms with a workbook guide explaining these summary forms and provides the logic and rationale utilized by SCDOT. The LRGD is invaluable to load raters as they develop bridge specific load ratings with respect to deterioration or overweight loads.

**Commendable/leading SCDOT Practices include:**
- Developing and implementing a comprehensive LRGD

**Enhancement Items for SCDOT to Consider:**
- Establish a minimum schedule to update the LRGD to ensure the document maintains its accuracy and relevance over time

**Quality Control/Quality Assurance**

**Identify National and Peer Practices**
All peer states have QC/QA guidance for bridge load rating included in either stand-alone load rating manuals or the load rating guidance sections of their bridge inspection or bridge design manuals. The maintenance and updating of bridge load rating guidance documents is typically a function assigned to agency central bridge offices.

**SCDOT Current Practices**
Bridge load rating QC/QA is currently performed by the consultant firms performing the load ratings, or if the new bridge is being designed by SCDOT, then the load rating and the QC/QA is being performed by the Preconstruction (design) unit.

Chapter 3 of the LRGD provides the guidance and requirements for QC/QA for bridge load ratings. It also outlines roles and responsibilities, and the associated review procedures. The LRGD defines the qualifications for load rating personnel including the Engineer of Record, who is required to be a licensed professional engineer in the
State of South Carolina. It specifically states the QC engineer and the QA engineer shall be independent from the individual performing the load rating. In the Chapter 3 Appendix, there is a QC review checklist and tracking sheet, and a QA review checklist and tracking sheet.

**Commendable/leading SCDOT Practices include:**
- Developing a comprehensive QC/QA section in the LRGD
- Requiring consultants that perform load ratings to have an approved QC/QA plan in their scope of work
- Providing QC/QA review checklists and tracking documents in the LRGD

**Enhancement Items for SCDOT to Consider:**
- Strengthen expertise in performing load ratings through NHI training and on the job training

**Software**

**Identify National and Peer Practices**
All of the peer states use a combination of available load rating software products. A majority of the states are using AASHTOWare Bridge Rating (BrR). All peer states also have an approved list of commercially available load rating software, including Microsoft EXCEL spreadsheets and PTC Mathcad.

**SCDOT Current Practices**
SCDOT requires its consultants performing load rating to use BrR version 6.8.3 load rating software for all structure types supported by this software. For those structure types which cannot be load rated using BrR, a list of preferred alternative software products is provided. Prior to using one of these software alternatives, the consultant must request approval from the BMO. Standard approval forms are provided in the LRGD. The LRGD approves Microsoft EXCEL spreadsheets or PTC Mathcad for use to load rate bridges; thus, they do not require separate approval by SCDOT prior to use.

**Commendable/leading SCDOT Practices include:**
- Adopting nationally accepted load rating software available through AASHTO
- Providing a listing of preferred load rating software products along with standard approval forms in the Load Rating Guidance Document

**Enhancement Items for SCDOT to Consider:**
- Ensure the most current AASHTOWare BrR software available is being used to increase the number of bridge types the software can load rate, which will increase the efficiency and effectiveness of the Hexagon OSOW software
Bridge Management (Preservation / Rehabilitation / Replacement)

Topic Introduction

This section of the report focuses on the SCDOT’s approach to managing the State’s system of bridges, which broadly is categorized as its BMS. A BMS is the combination of tools, processes, and procedures used to develop an optimal agency bridge program. However, “BMS” also refers the software/applications used by agencies to support this function. In either usage, an effective BMS enables an agency to make informed, data-driven, short- and long-term investment decisions across a range of work types.

Bridges are rated using the NBI GCR for the major components, which consist of deck, superstructure, or substructure. If the asset is a culvert with a span length of 20 feet or over, then it is also counted as a bridge and a GCR is assigned to the structure major components.

The GCR rating is an overall asset condition rating, which uses a 0 (failed) to 9 (excellent) scale as shown in Table 2.

<table>
<thead>
<tr>
<th>Rating Number</th>
<th>NBI Descriptor</th>
<th>Performance Measure Classification (23 CFR 490)</th>
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<tr>
<td>9</td>
<td>EXCELLENT CONDITION</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>VERY GOOD CONDITION</td>
<td>GOOD</td>
</tr>
<tr>
<td>7</td>
<td>GOOD CONDITION</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SATISFACTORY CONDITION</td>
<td>FAIR</td>
</tr>
<tr>
<td>5</td>
<td>FAIR CONDITION</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>POOR CONDITION</td>
<td>POOR</td>
</tr>
<tr>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>&quot;IMMINENT&quot; FAILURE CONDITION</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>FAILED CONDITION</td>
<td></td>
</tr>
</tbody>
</table>


The FHWA categorizes overall bridge condition as “good” when all the major components are rated 7 or above, “fair” when the lowest major component is rated 5 or 6, and “poor” when one or more of the major components are rated 4 or below.

The Federal Highway Administration broadly describes asset management as a strategic and systematic process of operating, maintaining, and improving physical assets with a focus on engineering and economic analysis based upon quality information. The objective of asset management is to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of a singular asset or network of assets at its minimum, practical cost.

The Federal Highway Bridge Preservation Guide categorizes bridge asset management into the following three categories as shown in Figure 4:

1. Replacement (also called reconstruction)
2. Rehabilitation
3. Preservation (also called preventive maintenance)

Preservation can be further categorized into cyclic maintenance and condition-based maintenance.

The FHWA preservation guide uses the following definitions for the corresponding actions:

- “Replacement” (reconstruction) refers to the total replacement of an existing bridge with a new facility constructed in the same general traffic corridor. Replacement projects are often done to bridges in “poor” condition where rehabilitation actions are no longer cost effective.

- “Rehabilitation” is major work required to restore the structural integrity of a bridge, as well as work necessary to correct major safety defects. Examples of bridge rehabilitation include partial or complete deck replacement, superstructure replacement, and substructure/culvert strengthening or partial/full replacement. Rehabilitation projects are often done to bridges when one or more of the major components are in poor condition.

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5 23 CFR 515.5 – Asset Management Definition
6 FHWA, Bridge Preservation Guide Maintaining a Resilient Infrastructure to Preserve Mobility, Spring 2018.
• “Preservation” (preventive maintenance) is a category of activities or strategies that extend the service life of highway bridges by applying cost effective treatments to bridge elements while they are in “good” or “fair” condition. Preservation activities present, reduce or delay future deterioration and defer large expenses in bridge rehabilitation or replacement.

BMS software is a tool for managing bridge programs using advanced concepts to prioritize and optimize program development and project selection. These systems require calibration with many user inputs as shown in the top boxes in Figure 5 that feed into the BMS application. The resulting outputs are used for program development, project planning, work recommendations, and short and long-term performance monitoring.

**Figure 5: Bridge Management System Flow Chart**

![Bridge Management System Flow Chart](image)

**Note:** “MR&R” stands for maintenance, repair and rehabilitation

**Organization**

**Identify National and Peer Practices**

Peer states organize the bridge management programs in a variety of ways. Selected examples include the following:

- Delaware has a bridge management engineer that manages the bridge program and a bridge management resource engineer that leads the development and implementation of the modeling side of their BMS Software. They have quarterly meetings between Bridge Management and Bridge Design staff to discuss project development. At these meetings, bridge management staff discuss concerns from recent inspections, and bridge design staff provide updates on projects. Projects that hit delays can sometimes have interim maintenance to extend life, and every bridge in critical condition is discussed.

- Michigan has a strong central office bridge management section that develops strategy to meet Department bridge goals, set annual objectives, and write the annual Call for Projects memo. The bridge management section has a section manager (the Bridge Management Engineer), a Bridge Management Systems engineer responsible for running their BMS, and multiple engineers to do bridge program management. Each of Michigan’s Regions (Districts) has a bridge engineer who is responsible for project
selection.

- New Jersey has several positions in the central office dedicated to bridge management and running their BMS software. Their program is managed centrally.
- Virginia has a bridge management section with multiple positions that develop bridge management policy, set project selection guidelines, and run their BMS. They work with their districts that select bridge projects given central office guidelines.

**SCDOT Current Practices**

SCDOT’s organizational structure for bridge management functions as a combination of central office and district responsibility. Central office staff maintain the bridge database, identify eligible bridges that meet the requirements of the replacement program, do preliminary engineering, and support the preparation of the Transportation Asset Management Plan (TAMP). The districts select projects and coordinate program delivery.

**Commendable/leading SCDOT Practices include:**

- Optimizing internal resources with consultant expertise for BMS development and implementation

**Enhancement Items for SCDOT to Consider:**

- Develop policies and procedures for a bridge program that is based on using a balanced approach of preservation, rehabilitation, and replacement projects
- Provide sufficient expert technical resources to fully leverage SCDOT’s investment in a BMS

**Bridge Management Process & Procedures for Preservation/Rehabilitation/Replacement**

**Identify National and Peer Practices**

Table 3 summarizes the projected 10-year percent spending by work type on National Highway System (NHS) bridges based upon data included in the 2019 TAMPs of SCDOT and the other DOTs interviewed as part of the peer benchmarking effort. The consulting team performed these calculations, based on the published TAMP projected spending data and the team’s interpretation of this information.

<table>
<thead>
<tr>
<th>State</th>
<th>Maintenance and Preservation</th>
<th>Rehabilitation</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>*87%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Florida</td>
<td></td>
<td>18%</td>
<td>82%</td>
</tr>
<tr>
<td>Georgia</td>
<td>3%</td>
<td>8%</td>
<td>89%</td>
</tr>
<tr>
<td>Michigan</td>
<td>23%</td>
<td>28%</td>
<td>49%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>39%</td>
<td>20%</td>
<td>41%</td>
</tr>
<tr>
<td>North Carolina</td>
<td>29%</td>
<td></td>
<td>71%</td>
</tr>
<tr>
<td>South Carolina</td>
<td>10%</td>
<td>19%</td>
<td>71%</td>
</tr>
<tr>
<td>Virginia (not available)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>17%</td>
<td>28%</td>
<td>56%</td>
</tr>
</tbody>
</table>

* Mix of maintenance, preservation and rehabilitation

As this table suggests, SCDOT’s projected bridge management spending by work type generally is consistent with the patterns of the other peer states. Specific observations include the following:
• Of the states providing maintenance and preservation spending projections, only Georgia is spending a smaller portion of its bridge program budget on preservation and rehabilitation versus full replacement than SCDOT.

• Though SCDOT’s rehabilitation spending share is third lowest of this peer group, the relative range of funding percentages is relatively smaller in this group.

• SCDOT’s projected 71% share of funding dedicated to bridge replacement is high, but similar to nearby states.

**Common or Notable Practices**

• All the peer states use NBI GCR condition as their primary performance indicators, using some form of “good”, “fair” and “poor” measures.

• Peer states differ in how they go about selecting bridge program projects, but all have a systematic process of categorizing preservation, rehabilitation, and replacement needs. This typically involves using NBI GCR ratings for the major components along with using expert judgement, spreadsheet tools and some use of a BMS software to make the initial prioritization and treatment selections.

• South Carolina, North Carolina, Virginia, and Delaware have a points-based ranking system to prioritize projects.

• Project selection often is an iterative process between the districts/divisions/regions and central office.

• North Carolina, Michigan, and Kentucky use field verification or detailed scopes to make final decision on the treatment used for a given bridge.

• North Carolina, Virginia, Michigan, and Kentucky have a separate budget and management process for large deck area and/or complex bridges. These structures are considered too important or costly to allow them to drop into poor condition.

**Additional highlights of the peer state bridge programs and project research follow:**

**North Carolina**

• NCDOT’s bridge preservation program was initiated by dedicating $10 Million budget for steel beam painting and deck overlays for interstate bridges

• BMS software (AgileAssets) is used to produce the initial project recommendations for preservation, rehabilitation and replacement

• Projects are prioritized using a Priority Replacement Index (PRI), which is a points-based system based on the following factors:
  - Consideration of deficiency points
  - Sufficiency rating
  - Deck superstructure and substructure ratings
  - Use of temporary shoring

• Preservation typically is done via selecting multiple projects along a corridor

**Virginia**

• Central office develops an initial project list using AASHTOWare BrM
• Prioritization is done using the agency’s State of Good Repair ranking system, based on the following factors:
  o Importance
  o Condition
  o Structural redundancy
  o Structural capacity
  o Cost effectiveness

New Jersey
• Central office directs the bridge program using spreadsheets, inspection data, and some AASHTOWare BrM information
• Projects are identified by NBI GCR of the deck, superstructure, substructure, or culvert
• Bridges rated in poor condition are reviewed to determine if strengthening or deck replacement or superstructure replacement could provide a desired service life extension (a target of roughly 40 years); otherwise, replace the bridge

Delaware
• DelDOT is currently modifying AASHTOWare BrM software to use a deficiency formula using the ratings identified in Figure 6. Note, B/C Ratio in the figure is Benefit-Cost Ratio.

Figure 6: Delaware Deficiency Formula Weighted Factors*

*“B/C Ratio” stands for benefit/cost ratio
Michigan

- Central office uses a MDOT-developed spreadsheet called *Bridge Condition Forecast System* to provide initial network level forecasts of bridge condition based on a given mix of fixes (preservation, rehabilitation, and replacement).
- Preservation project volume tends to be constrained by the number of bridges that can be closed in a year.
- MDOT districts make and manage actual budget allocation decisions:
  - Use preservation matrices to guide project selection.
  - Detailed scope review determines approach used.
  - Use of rehabilitation and replacement options are limited to bridge in “poor” condition unless specifically approved by the central office.
- Perform risk assessments to prioritize bridge rehabilitation or replacement projects over river crossings (see Figure 7).

*Figure 7: Michigan DOT Scour Risk Assessment Chart for Prioritizing Bridge Projects*
Case Study – Bridging Kentucky

Project research suggested that the experience of the State of Kentucky with its “Bridging Kentucky” program warranted its inclusion as a case study. “Bridging Kentucky” is an initiative by the Kentucky Transportation Cabinet (KYTC) to improve safety and soundness of Kentucky highway bridges, with a focus on protecting current structures. The objective of the program was to rehabilitate, repair, or replace more than 1,000 critical structures in six (6) years (2019 – 2024).

Among the more notable elements of this program is that it does not simply identify reconstruction (replacement) projects; instead, it uses a screening process that is based on agency rules to identify the appropriate treatment for each bridge. The information below describes the Bridging Kentucky decision process:

1. Bridges are reviewed for exclusion from the program. Disqualifying factors include the following:
   - Complex bridges
   - Major river bridges
   - Interstate bridges
   - Bridge projects with non-structural goals
   - Bridges that should be removed from the inventory, such as closed bridges that are no longer relevant to the community

2. “Level 1 screening” is the next step in the process. This involves a review of bridge NBI GCR information, inspector notes, load rating information, and inspection photos.

3. “Level 2 screening” is the following step, which involves the use of life-cycle cost analysis, deterioration modeling, posting information, element condition state data, rehabilitation activities and cost, and user costs.

4. Field verification is the final step, which determines if the right action for the bridge is rehabilitation or replacement.

Using the described screening process, the KYTC increased their bridge rehabilitation program by 40% with a corresponding, significant reduction in overall program costs

Bridge Management Best Practices

Using the information gathered through the project outreach, research and industry knowledge, the consulting team identified the following bridge management best practices as being particularly worthy of consideration and emulation:

- Developing a specific and comprehensive set of bridge management business processes to be followed by department staff
  - Establishing agency bridge preservation policy guidance.
  - Providing training and guidance for comparing repair and preservation options and preparing design plans and specifications for bridge preservation projects.
  - Providing outreach to the contractor community to increase their understanding and buy in of a greater emphasis on preservation and rehabilitation.

7 https://bridgingkentucky.com/
o Coordinating bridge program projects with the pavement and safety programs to minimize impacts to traffic while optimizing mobilization and traffic control expenditures on projects.

o Bundling preservation and rehabilitation projects along highway corridors for maximum efficiency.

o Using a data-driven screening process that incorporates the use of deterioration models, treatment strategies and decision trees to identify candidate bridge projects.

o Establishing decision trees or agency rules for preservation and rehabilitation treatments.

**SCDOT Current Practices**

At present, the SCDOT bridge management program includes a 10-year plan developed in 2017. This plan takes a bookend approach to address load restricted bridges across the state and in poor condition on the NHS. Replacement of load-restricted bridges is prioritized on objective and quantifiable criteria to rank bridge projects as per their cost benefit ratio in relation to the top ranked project. The criteria use the following factors:

- Structural condition
- Traffic status
- Average Daily Traffic (ADT)
- Percentage of Average Daily Truck Traffic (ADTT)
- Detour length

Once the pool of prospective bridge candidates has been ranked, the bridges are sorted by engineering district and sent to the district engineering administrators for the completion of a field review criteria. The districts score each bridge using the criteria listed below and return the results to the State Bridge Maintenance Engineer.

- Route continuity and river basin upgrades
- District repair feasibility
- Improved emergency services and emergency evacuation routes
- State Freight Network
- Strategic Corridor Network
- New schools and/or changes in bus routes
- Known commercial routes
- Future economic development (residential/commercial)

The points from the field review are added to the points received from the initial prioritization, and bridges are ranked from highest total score to the lowest total score. At this point, the Deputy Secretary of Engineering goes through an objective and quantifiable ranking process, which is reviewed and recommended by the Secretary of Transportation. The South Carolina Transportation Commission then reviews and approves bridge prioritization/rankings.

Upon commission approval, the bridge prioritization list is sent to the SCDOT Office of Preconstruction, which estimates project costs and looks at other considerations (such as the potential for a given bridge replacement to conflict with other projects under design or development). The proposed project delivery plan is submitted to the planning office to determine financial availability and then inserted into the Statewide Transportation Improvement Program.

**Figure 8** shows South Carolina NBI GCR condition trends over the past ten (10) years. Key points include the following:

- Bridges in condition 4 (poor) are decreasing over time while bridges in the condition level 8 (good) are increasing. This is reflective of SCDOT bridge replacement efforts.
Note: Bridges rated 2 or below are usually closed to the public. Repairs are made or the structure is replaced before reopening the bridge.

- Bridges in condition level 7 (good) are decreasing and condition 6 (fair) are increasing. In combination, this represents a trend of bridges moving between these categories, which suggests a need to increase the use preventive maintenance practices to slow that pattern.

- Bridges in condition level 5 (fair) were increasing for several years but now are mostly declining.

**Figure 8: SCDOT Bridge Condition Rating by NBI General Condition Rating**

As described previously, bridges rated 4 or below are considered in poor condition and are considered candidates for rehabilitation or replacement. These bridges are reviewed in greater detail to determine if a reduced load posting is appropriate. Bridges rated 5 or 6 are considered in fair condition and candidates for preventive maintenance. Bridges 7 or above are in good condition and may only have cyclic maintenance needs.

**Commendable/leading SCDOT Practices include:**
- Implementing a 10-year plan for replacing 465 restricted and deficient bridges

**Enhancement Items for SCDOT to Consider:**
- Modify the existing capital and maintenance bridge programs to include an appropriate mix of preservation, rehabilitation, and replacement strategies that keep good and fair bridges in their condition state while prioritizing replacement of bridges in poor condition
Use of Bridge Management Systems

Identify National and Peer Practices

To help agencies develop their BMS, the Transportation System Preservation Technical Services Program of the AASHTO created a Bridge Preservation BMS Working Group with the following objectives:

- Promote the development and/or adoption of best practices for BMS to extend the service life of bridges and demonstrate the value of preservation
- Develop general guidance and examples to help practitioners nationwide identify best practices for BMS that meets the needs of the agency and establish a process that makes implementation less intimidating
- Monitor and share the national development of management systems as they evolve

As part of its work, the BMS working group categorizes DOT bridge asset management maturity into three (3) stages: 1) Basic, 2) Intermediate and 3) Advanced, which is described as follows:

Basic
- Have accurate inventory and condition data that meets the needs of the agency
- Have goals and performance measures
- Monitor condition and performance trends
- Report on network bridge conditions with respect to agency goals and performance measures.

Intermediate
- Have deterioration models for bridge, major components, or elements
- Identify network-level preservation actions, quantities and costs
- Have a strategic plan that include short-and long-term budgets for the agencies’ major categories of work such as preservation, rehabilitation, and replacement
- Forecast future network bridge conditions and performance measures
- Perform gap analysis of target conditions versus desired goals
- Use data to support and validate agency rules for network level bridge preservation policies
- Effectively communicate recommendations and expected outcomes based on network level analysis

Advanced
- Find the most appropriate investment actions for individual bridges, based on element level inspection data, with an estimated cost for the work
- Indicate when the work should be done, utilizing benefit-cost analysis that can also include life-cycle cost and user cost analysis
- Prioritize and optimize projects and programs to achieve optimal network budget efficiencies, progress towards agency goals, reduction of risk, and coordination with other infrastructure work
- Preform scenario comparisons
- Produce reports that effectively communicate recommendations and expected outcomes based on bridge and/or element level analysis

All the peer states are working towards having an advanced BMS. Delaware, Florida, Georgia, Michigan, New Jersey, and Virginia all use the AASHTOWare BrM software. New Jersey is the only state in this group to have

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8 AASHTO Transportation System Preservation Technical Services Program Bridge Preservation Web Page: https://tsp2bridge.pavementpreservation.org/national-working-groups/#Bridge Preservation BMS Working Group
reached an advanced level of use with the AASHTOWare software to include running optimization scenarios. The other states are at various levels of intermediate development.

West Virginia uses Deighton dTIMS BMS software while North Carolina uses AgileAssets Structure Analyst BMS software. Both states utilize their BMS software to run optimization scenarios and use the results for their respective TAMPs.

**SCDOT Current Practices**
SCDOT does not currently use BMS software to manage their program; however, SCDOT recently initiated a project to begin using the AASHTOWare BrM software.

**Commendable/leading SCDOT Practices include:**
- Developing an advanced BMS

**Enhancement Items for SCDOT to Consider:**
- Continue to advance the development and implementation of BMS software and consider adopting the identified BMS best practices
Bridge Maintenance and Priority Repair Procedures

Topic Introduction

Bridge maintenance activities are actions or treatments done to a bridge to meet operational needs and/or to extend the service life of a bridge. These actions can be classified as preventive maintenance or routine maintenance.

Preventive maintenance (also called preservation) are actions that extend bridge service life through the application of cost-effective treatments to bridge elements while bridges are in good or fair condition. Preventive maintenance activities attempt to slow future deterioration and defer (or potentially avoid) the much larger costs associated with bridge rehabilitation or replacement that could result without such actions.

Routine maintenance is defined as activities performed in reaction to an event, season, or activities that are done for short-term operational needs that do not have preservation value. Examples of routine maintenance include cleaning drains, removing debris, repairing storm damage, or patching a concrete deck with asphalt.

Many preventive maintenance actions are eligible for federal funds, based on each agency’s agreement with their respective FHWA Division office. However, routine maintenance activities are not eligible for federal funds.

State and local bridge maintenance crews often complete a combination of routine and preventive maintenance. In some cases, bridge maintenance crews also have the capability to perform rehabilitation or replacement actions on small bridges and culverts.

A bridge inspection may identify a need for routine or preventive maintenance, which can be a high priority repair/action. Well-qualified bridge inspectors, sometimes supplemented with expert structural engineers, make the determination of the urgency of such actions.

The FHWA requires that certain needed repairs/actions, called “critical findings”, be reported to the FHWA and tracked to ensure that they are taken care of promptly. The FHWA defines a critical finding as “a structural or safety related deficiency that requires immediate follow-up inspection or action.” Similarly, the National Bridge Inspection Standards require that owners “assure that critical findings are addressed in a timely manner,” and must “notify the FHWA of the actions taken to resolve or monitor critical findings.”

For example, when a bridge load rating analysis concludes that load posting signs need to be installed (see Figure 9 for an SCDOT example), the agency should have

Figure 9: SCDOT Bridge Load Posting Sign

See “Bridge Management” report section for details on FHWA bridge condition rating designations.


Federal 23 CFR Part 650 - National Bridge Inspection Standards
process and procedure to ensure the sign is placed promptly. Currently, the FHWA requires posting signs be placed on the bridge as soon as possible but no later than 30 days after a load rating determines a need for such posting.\textsuperscript{13}

**Organization**

**Identify National and Peer Practices**

Maintenance and repair activities performed on bridges by peer states include a wide variety of activities. Variables tend to be internal capacity, training, and the preservation and repair needs of the respective agency’s bridges.

Typical bridge maintenance activities include concrete spall repairs, expansion joint repair or replacement, steel localized cleaning and painting, deck sealing, and cleaning and washing portions of bridges. More advanced self-performed maintenance practices identified through project outreach efforts included the following:

- Bearing alignment or replacement, placement of flexible overlays, concrete crack injection, correction of erosion issues, structural steel repairs, and shotcrete concrete repairs (Michigan, West Virginia and Virginia)
- Selective replacement of culverts and small bridges (South Carolina, North Carolina, Virginia and West Virginia)
- Dedicated maintenance crews for long-span signature bridges and movable bridges (South Carolina, Michigan and West Virginia)
- Centralized statewide bridge repair crew that can perform advanced repairs including straightening and repair of structural steel, repair of concrete structures, and placement of temporary supports (Michigan)

Additionally, many of the peer states utilize annual bridge maintenance contracts to perform the needed repairs or to supplement their in-house maintenance crews. For example, New Jersey is separated into three (3) regions, and each region annually issues two bridge maintenance contracts. One contract is for preventive (preservation) bridge repairs. This contract included candidate bridges and the required repairs are selected based on bridge inspection records using their BMS.

Like SCDOT, peer states, as well as other states contacted, usually contract out their steel bridge painting (coating) needs. The extensive preparations required (i.e., enclosures needed to capture blast medium, residue and provide climate-controlled environment for the new coating), training and the extensive personal protective equipment required for workers generally make repainting of bridges too expensive and impractical to perform in-house.

**Funding**

Bridge maintenance funding typically is included in most allocations to districts for the overall highway maintenance program. However, several noteworthy funding practices were identified during peer state interviews include the following:

- Dedicated budget for high priority bridge repairs (Delaware, Michigan, New Jersey and Virginia)
- Dedicated structure maintenance and structural painting fund (Delaware and New Jersey)

\textsuperscript{13} FHWA Memorandum, Timeframe for Installing Load Posting Signs at Bridges, April 17, 2019, [https://www.fhwa.dot.gov/bridge/nbis/190417.pdf](https://www.fhwa.dot.gov/bridge/nbis/190417.pdf)
• Asset maintenance contracts, similar to the one used by SCDOT for movable and some complex bridges, are extensively used in Florida and also selectively used in Virginia and Georgia

• Virginia has two (2) district-allocated funding practices of note:
  o Funding for complex and time-consuming maintenance activities which can be expended by either state personnel or by contract forces
  o Funding for bridge cleaning and painting, performed either by state personnel or contract forces

**Manuals and Policies**

Georgia, Michigan, and Virginia have bridge maintenance manuals of varying detail. West Virginia issues maintenance directives to provide direction and guidance. Georgia’s “Bridge Structure Maintenance and Rehabilitation Repair Manual” provides guidance on over 50 preventative and corrective maintenance activities. This manual was designed to address the most common types of bridge structure distress by outlining practical procedures for corrective and preventive maintenance, such as the full depth deck repair shown in Figure 10.

**Figure 10: Pictures from Minnesota Department of Transportation – Bridge Maintenance**

![Figure 10: Pictures from Minnesota Department of Transportation – Bridge Maintenance](https://www.dot.state.mn.us/bridge/maintenance-manual.html)

**Training**

For the peer states, bridge maintenance training is most often accomplished by on-the-job training. Other practices of note included the following:

• Michigan’s central bridge maintenance office provides training for new materials and procedures and schedules NHI Bridge Maintenance classes

• Virginia conducts a three (3) day workshop on a biennial basis in addition to *ad hoc* training

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- West Virginia provides bridge maintenance training in the form of fall protection, first aid/safety, traffic control certification, product specific classes, commercial drivers’ licenses, crane certification, and welding certification in addition to hosting NHI Bridge Maintenance training.

The Minnesota Department of Transportation (MnDOT) generally is recognized as a national leader for its bridge maintenance program. MnDOT’s “Bridge Maintenance Manual\textsuperscript{16}” and their Bridge Maintenance Academy Training Series includes the following elements:

- **Bridge Maintenance Academy I** is web-based training that provides bridge maintenance workers with an introduction to bridge components, bridge elements, design concepts, plan reading, concrete, safety, traffic control combined with an overview of bridge maintenance activities and practices.

- **Bridge Maintenance Academy II** is hands-on training that exposes bridge maintenance workers to forming, tying rebar, and pouring concrete for slabs and abutments; detecting, removing and patching delaminated area, installing stiffeners and/or diaphragms on structural steel members. This training also includes classroom presentations on concrete formwork, repairing structural steel, and placement of shotcrete.

- **Bridge Maintenance Academy III** (see Figure 11) includes hands-on training that exposes bridge maintenance workers to setting elastomeric bearings and steel beams; installing and bolting steel diaphragms; forming, tying rebar and pouring concrete for a reinforced concrete deck; installing strip seal expansion joint extrusions and glands; performing a full depth deck patch; performing strip seal gland repairs; placing cribbing and executing bridge jacking; as well as classroom presentations on strip seal expansion joint maintenance, bearing maintenance and bridge jacking considerations.

  ![Figure 11: Pictures from Minnesota Department of Transportation – Bridge Maintenance Academy\textsuperscript{17}](https://www.dot.state.mn.us/bridge/maintenance-manual.html)

**Placement of Load Posting signs**

Like SCDOT, most of the peer states track placement of bridge load posting signs. In Delaware, all posting signs are clearly recorded (with locations and pictures) in the inspection reports.


\textsuperscript{17} Pictures from “MnDOT Bridge Maintenance Academy,” a MnDOT presentation, [http://www.apwa-mn.org/userfiles/ckfiles/files/MnDOTSondagCooper.pdf](http://www.apwa-mn.org/userfiles/ckfiles/files/MnDOTSondagCooper.pdf)
In Michigan and Virginia, a photo showing the installed load posting sign must be uploaded into their BMS. As part of the inspection procedure, the inspector verifies that the sign is present and matches the recommended posting.

**SCDOT Current Practices**

SCDOT performs bridge maintenance activities in each of their seven (7) districts. While the maintenance activities performed vary between districts and crews, each district has maintenance crews and at least one (1) maintenance crew typically is identified as a bridge maintenance crew. SCDOT outsources maintenance and management of specialty bridges.

Bridge maintenance needs discovered during bridge inspections are entered into the agency HMMS, which is used to develop the district specific bridge maintenance priorities and track work performed.

**Manuals and Practices**

SCDOT’s maintenance crews and bridge inspectors are the agency’s “eyes and ears” for determining bridge maintenance and priority needs. Common bridge maintenance activities completed by SCDOT crews include the following:

- Deck patching and repair
- Crack sealing
- Deck expansion joint replacement
- Bridge railing and approach guardrail I repairs
- Clearing of debris in streams in advance of or following storms
- Load posting sign installation and replacement

Of note, most bridge maintenance crews are capable of replacing small bridges and culverts using standard plans. SCDOT contracts out steel bridge painting (coating) needs.

In addition to the “normal” bridge maintenance activities performed, the BMO in collaboration with the Districts has developed an excellent process for handling bridge emergencies. The resources of the bridge inspection teams, bridge maintenance staff, and use of emergency contracting procedures are leveraged to first assess conditions, and then effect repairs to ensure the safety of the motoring public, returning the bridge to full capacity as soon as possible.

**Training**

The training of the bridge maintenance staff is typically carried out through “on-the-job training.”

**Placement of Load Posting Signs**

District maintenance crews handle the placement of bridge posting signs when directed by the BMO. FHWA requires that once a posting sign is placed, a photograph is taken to provide documentation and placed in the bridge file.

**Commendable/leading SCDOT Practices include:**

Commendable practices for the SCDOT bridge maintenance program include the following:

- Providing a proven ability to handle emergencies such as extreme storm events, flooding, and vehicle or vessel collisions
- Having some district maintenance crews capable of performing major repairs and replacing small bridges and culverts on secondary routes using standard plans
• Outsourcing the maintenance and management of specialty bridges

**Enhancement Items for SCDOT to Consider:**

• Create a manual for identifying standard bridge maintenance actions statewide
• Provide the National Highway Institute’s (NHI) two-week Bridge Maintenance course
• Expand asset maintenance contracting to include additional complex bridge structures that have specialized maintenance needs

**Bridge Critical Findings and Priority Repairs**

**Identify National and Peer Practices**

In a 2011 report, “Critical Findings Review for the National Bridge Inspection Program”\(^{18}\), the FHWA found that “Areas of good practice include:

• Developing and communicating policy, definitions, and descriptions of critical findings and categorizing the deficiencies;
• Monthly schedule/audit reporting of critical findings;
• Automated critical findings notification systems; tracking critical findings; and
• Follow-up inspections/posting guidelines to close the loop on critical findings.”

Like SCDOT, several peer states have business processes and management systems that track and prioritize high priority bridge repair needs. As described below, North Carolina and Michigan rank high priority inspector findings with respect to urgency to do the repair, with the highest level being a critical finding that is reported to FHWA.

**Michigan** has a Request for Action (RFA) team that meets monthly to categorize and prioritize inspector findings, track progress of repairs or other needed action such as load rating, hands-on inspection, material testing, and status of design for the repairs. Priority repairs are categorized as follows:

• **Priority Level 1** – Emergency. Repairs are to be completed as soon as possible, either by the Statewide Bridge Repair Crew or emergency contract. A critical finding needs to be reported to the FHWA.
• **Priority Level 2** – Critical. Repairs are to be scheduled within 90 days, either by the statewide bridge crew or contract.
• **Priority Level 3** – Primary. Repairs are to be completed within 12 to 18 months.
• **Priority Level 4** – Non-Critical. The distress is non-critical, and repairs should be programmed through the normal call for projects process, or repairs made by routine maintenance.

A guidance document describes each of the priority levels and shows the make-up of the committee. The committee meets monthly to prioritize RFAs and track action items. Michigan DOT’s inspection management application, *MiBridge*, is used to track and manage RFAs, and provide performance reports on the RFA program.

**North Carolina** has a Prompt Action Request (PAR) process that prioritizes bridge repair needs as follows:

• **Critical Finding.** This requires a plan be developed within 10 days and repair done in 45 days.

• **Priority Maintenance.** The general expectation is the repair should be completed within a year.

• **Routine.** The repairs and timing of repair is determined by the District.

The PAR process is managed in NCDOT’s bridge inspection management system called WIGINS, where bridge managers can review all tiers anytime.

**SCDOT Current Practice**

SCDOT has a well-defined process for identifying, prioritizing, responding to and tracking bridge deficiencies as described in the draft BIGD19. Critical findings, as defined by the FHWA, are classified based on the following levels of severity:

- Urgent (color code red) require immediate bridge closure
- Restrictive (color code orange) require immediate bridge restriction such as lane and/or shoulder closure, or load restriction
- Serious (color code yellow) require immediate maintenance action

The draft BIGD provides procedures for identification, notification, follow-up, bridge closure, load rating and repair recommendation identification.

While the discovery, tracking and closure of Critical Findings are important to protect the traveling public, the occurrence rate of Critical Findings is generally low. Much more common are repair recommendations on the state’s bridge inventory to maintain bridges for years to come. SCDOT logs repair and maintenance recommendations in the HMMS. Repair recommendations are made based on the time frame in which the bridge owner should complete the recommended repair. SCDOT “flags” these maintenance and repair needs as follows:

- Priority A - Timeline for Work Completion once logged in HMMS is 30 calendar days
- Priority B - Timeline for Work Completion once logged in HMMS is 90 calendar days
- Priority C - Timeline for Work Completion once logged in HMMS is 365 calendar days

The draft BIGD provides examples of each type of priority flag to provide consistent process and procedure for common repair and maintenance needs.

**Commendable/leading SCDOT Practices include:**

- Currently implementing the enhanced critical deficiencies prioritization process as described in the draft BIGD
- Supplying detailed policies and processes in the Agency’s BIGD document to address critical deficiency prioritization, response, and tracking
- Providing excellent agency coordination and response to emergency situations such as hurricanes, natural disasters, vehicle or vessel impact damage, and discovery of advanced deterioration

**Enhancement Items for SCDOT to Consider:**

- Complete implementation of the critical deficiencies prioritization process described in the draft BIGD

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19 “Bridge Inspection Guidance Document” – Chapter 8, Deficiency Reporting
Scour Assessment & Emergency Response

Topic Introduction

Bridge scour is the erosion of sediment, such as sand and gravel in a streambed, riverbed or ocean inlet from around a bridge’s foundation, either at the abutment(s) or the pier(s). Scour holes, caused by swiftly moving water, can expose and undermine piles, footings, and other critical foundation elements, compromising the integrity of a structure.

In the United States, bridge scour is one of the three (3) main causes of bridge failure (the others being collision and overloading). It has been estimated that 60% of all bridge failures result from scour and other hydraulic-related causes. The USGS “Water-Resources Investigations Report 95-4009” identifies scour as the most common cause of highway bridge failure in the United States, where during the period of 1961-1976, 46 of 86 major documented bridge failures resulted from scour near piers.

The collapse of a bridge in upstate New York in the late 1980s led to the establishment of federal regulations requiring all bridges over water be inspected underwater so their foundations could be assessed. In the case of the New York bridge over the Schoharie Creek, the bridge’s foundation was such that as water scoured out material under the foundation it became unstable and failed, bringing down an entire portion of the bridge.

A bridge’s vulnerability to scour depends on many factors including its design, the type of channel bottom (bed) material, water velocity and how prone the waterway is to flood. To properly assess this vulnerability, engineers conduct a hydraulic analysis to determine how susceptible the bridge is to any of these opportunities for scour.

In addition to an analysis, bridge inspectors will perform an onsite assessment of field conditions, utilizing specialized underwater dive teams if required. For example, as part of this assessment, inspectors will typically observe and document how a river and/or stream channel tends to move and migrate naturally over time. These channel changes could result in more water being directed towards bridge foundations resulting in an increased susceptibility to the effects of scour.

One commonly observed example where the risk of scour is low is when a bridge foundation is constructed on bedrock. No matter how much water flows against it or around it, a bridge with this foundation design would not be susceptible to scour.

The FHWA has established guidelines for determining which bridges are susceptible to scour. These include a combination of field and analytical assessments. A hydraulic analysis is typical and requires a computer model assessment of how the water flows in and around the bridge foundations. If a bridge is susceptible to scour where it might cause a full or partial collapse, the bridge is defined as “Scour Critical.”

As noted above, scour around a bridge foundation can result in an emergent structural condition. Other prominent structural conditions can be the result of advanced structural deterioration, vehicle or vessel impact, vehicle overloading and fire to name a few of the natural and man-made events that can severely impact a bridge. Agency planning and response protocols for scour and other structural emergencies are generally similar in nature and will be discussed in this section.

Organization

Identify National and Peer Practices

All national and peer states have bridge scour assessment procedures. While Georgia and West Virginia self-perform underwater inspections, the remainder of peer states rely on a mixture of in-house and consultant staff.

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20 https://pubs.er.usgs.gov/publication/wri954009
to perform the top side and underwater scour assessment of their bridges. The peer states also use a combination of consultants and in-house hydraulic design staff to perform the necessary hydraulic analyses for determining scour criticality and potential mitigation measures. Most peer states schedule underwater inspections to coincide with a routine biennial NBIS bridge inspections but on a four-year frequency (48 months).

As required by FHWA, all states have developed a Plan of Action (POA) for all scour critical bridges. These POAs are reviewed as part of the normal NBIS bridge inspection process (24 months), or during each underwater bridge inspection (every 48 months), depending on the state specific agreement with their local FHWA office.

The peer states typically do not have broad categories of triggering events for re-evaluation of their scour critical bridges; however, most perform scour re-evaluation after significant storm events. Indicators used include either USGS stream gauges or BridgeWatch (a commercially available web-based, real-time, monitoring software solution), which is used by several of the peer states. Additionally, some states include specific triggering events within their bridge specific POA for their respective scour critical bridges for determining when to initiate a scour re-evaluation.

**SCDOT Current Practices**
Currently, scour assessments are conducted through a combination of in-house bridge inspection staff and consultants. The bridge inspectors perform the field assessment in conjunction with a consultant underwater inspection team.

This team performs an assessment of both the above water conditions and below water conditions of the bridge’s abutments, piers, and any scour mitigation features present such as rip-rap or concrete-based alternative material. The purpose is to determine if there have been any changes since the prior inspection. In addition, SCDOT’s in-house hydraulic design support team performs a hydraulic analysis of the waterway to determine such factors as the potential depth of scour, the scour critical velocity and stream bed mobility potential.

This “full scour” inspection or assessment, also known as an underwater inspection, is performed at intervals not to exceed 60 months but may be more frequent as determined by the district bridge inspection supervisor, the bridge inspection team leader, or the BMO. These procedures are outlined in the Scour POA developed for all scour critical bridges. The scour POA includes requirements (triggering events) as outlined in the draft BIGD.

Triggering events for bridge scour re-evaluation are normally identified during the biennial NBIS Inspection but may also be recommended by the district maintenance office or the BMO. Specifically, if any of the following observations are made a re-evaluation is performed:

- Channel changing course
- Evidence of erosion or scour around footings and embankments
- Large amounts of drift (debris) around substructure
- Evidence of riprap, bank protection removed or altered
- Stream work performed by others that might change the hydraulic characteristic at the bridge (such as dam removal upstream)
- Storm events

These conditions are included in Attachment 06 in the draft BIGD, “Bridge Scour – Item 113 Re-evaluation Form”.

**Commendable/leading SCDOT Practices include:**

- Incorporating full scour inspection guidance into the draft BIGD
- Utilizing and coordinate with an in-house Hydraulic Design Support team to perform hydraulic analysis
- Augmenting in-house staff with scour specific consultant inspection contracts for use statewide
- Identifying triggering events for scour re-evaluation and inclusion of these events in the draft BIGD

**Enhancement Items for SCDOT to Consider:**
- Schedule the underwater scour critical bridge inspections on a 48-month basis to coincide with a routine biennial NBIS bridge inspections
- Review each bridge-specific POA as part of the scope of work assigned to the underwater inspection consultant team

**Process for Addressing Bridge Emergencies**

**Identify National and Peer Practices**
All peer states have an emergency bridge assessment procedure whether for natural emergencies (hurricanes, flooding or other) or man-made emergencies (vehicle impact, vessel impact, fire or other). The peer states rely on a mixture of in-house and consultant staff to perform these emergency assessments. Generally, the “first call” is to in-house bridge inspection teams; however, some states have consultant inspection teams “on-call” as well for emergency bridge inspections, when the in-house resources cannot provide all of the services needed either due to lack of availability or technical expertise. All peer states have a communication procedure in place that utilizes cell phones, with a documentation process for those phone calls. Phone calls are typically documented through follow-up emails in a manner similar to SCDOT’s process.

**SCDOT Current Practices**
The recently developed draft BIGD is an excellent document and quite comprehensive. The document reflects a compendium of best practice policies and procedures currently in use by industry. In addition to scour assessment as described above, other “non-routine” bridge inspections are required due to vehicle (or vessel) impact, flooding (due to rainfall or hurricane) or as warranted by other structural conditions (e.g., pin & hangar connections, fatigue cracks, accelerated corrosion, etc.) as outlined in the draft BIGD.

The process for a damage inspection (outlined in Chapter 4.7.2 in the draft BIGD) includes an immediate assessment of the bridge to ensure the safety of the motoring public. If a bridge closure is warranted, the formal bridge closing procedure as outlined in Chapter 8.6 is followed. This procedure requires SCDOT staff to marshal the necessary resources (in-house and consultant) to fully inspect, evaluate and analyze the bridge and the damaged component(s). A specific repair/rehabilitation plan is then developed for the damaged structure. If the required repairs cannot be completed with in-house bridge maintenance crews, staff can engage selected contractors utilizing SCDOT’s emergency contractor selection process. This process allows repairs to be completed as expeditiously as possible and practical, to reopen the facility to an unrestricted condition. Due to the critical nature of these actions, all communications are performed via phone call with the parties identified in Chapter 8.6 of the draft BIGD, with follow-up e-mail documentation of the telephone conversations.

The process for an impending hurricane or extreme rainfall event (outlined in Chapter 4.10 in the draft BIGD), includes the deployment of stream flow gauges to the affected watershed(s). The BMO establishes the staging and deployment plan in conjunction with the District Bridge Inspection Supervisor and the bridge inspection teams. After the event, final deployment directives are issued to both topside and underwater inspection teams, focusing on the safety of the public with SCDOT maintenance crews barricading bridges for temporary closures until more extensive evaluations and/or repairs can be made. Specific attention is be paid to scour critical bridges during these post event assessments as required by the bridge POAs. Due to the critical nature of these actions, all communications are performed via phone call, with the parties identified in Chapter 8.6 of the draft BIGD, with follow-up e-mail documentation of the telephone conversations.
Commendable/leading SCDOT Practices include:

- Incorporating full damage inspection guidance into the draft BIGD
- Incorporating full hurricane and storm inspection guidance into the draft BIGD (Section 4.10)
- Developing a rapid deployment process for placing USGS stream flow gauges on several streams in advance of a hurricane or extreme rainfall event, where USGS does not have a permanent stream flow gauge installation
- Piloting the use of BridgeWatch, a commercially available, web-based, real-time, monitoring software solution, on 1600 bridges
- Developing a process for bridge closings in the draft BIGD that includes communication procedures and flowcharts

Enhancement Items for SCDOT to Consider:

- Include an emergency on-call/response section in the consultant bridge inspection contracts issued by the BMO
- Expand the use of USGS Water Alert service, based on flow rates at USGS gauges, and BridgeWatch, which is triggered by either flow rates or rainfall
- Include a pre-event assessment of the waterway for debris at the bridge piers or abutments, to be removed by district maintenance crews in advance of the storm
- Formalize policies and procedures for performing post-event evaluations to identify opportunities to improve responsiveness and effectiveness

Cost-Effective Methods for Scour Prevention

Identify National and Peer Practices

All of the peer states interviewed use a combination of state design, FHWA and U.S Army Corp of Engineers guidance, and USGS stream statistical data to develop new bridge designs that mitigate or eliminate the risk of scour. Based on the experience and observations of the consulting team, this is a common national practice as well. Most of the peer states develop scour countermeasure plans within their bridge maintenance, preservation, and/or rehabilitation programs. These scour countermeasures are developed for bridges that are in otherwise fair condition (need no major reconstruction) and will not be replaced in the foreseeable future. One peer state, New Jersey, developed several bridge specific countermeasure designs and bundled them together into one contract for construction.

SCDOT Current Practices

SCDOT’s Hydraulic Design Unit performs or oversees the hydraulic design for new bridges being constructed or reconstructed over waterways. If a consultant is developing the new bridge design over a waterway, the consultant will perform the hydraulic design, then the Hydraulic Design Unit will perform a quality review of that design. The Hydraulic Design Unit has developed excellent South Carolina specific design guidance in collaboration with USGS and uses FHWA, FEMA and U.S. Army Corp of Engineers guidance. This guidance includes bridge scour envelope curves specifically for South Carolina bridges. As scour critical bridges are programmed for replacement, the structural design is developed to eliminate the scour critical features, thereby reducing future risk.

Commendable/leading SCDOT Practices include:

- Developing South Carolina bridge scour envelope curves in conjunction with the USGS
Enhancement Items for SCDOT to Consider:

- Develop a program for designing/developing scour countermeasures, including stream armoring and channel protection, for scour critical bridges that are not currently scheduled for bridge replacement and likely, will not be for the foreseeable future.
Oversize and Overweight Permitting Program

Topic Introduction

Commercial vehicles and loads are generally of a size and weight that allows them to freely travel on our nation’s highways. However, some are too large and/or too heavy to operate on a highway without posing a safety risk or potentially damaging the transportation infrastructure.

A vehicle and load are considered oversized when the vehicle and the cargo it carries exceed the legal dimensions of length, width or height. This is defined by the applicable federal and/or state requirements in which the vehicle will be traveling. Of note, only states establish height requirements.

Weight limits may be based on a per axle basis, two or more closely spaced axles, tandem axle, Federal Bridge Formula\(^2\) or gross vehicle weight. The following definitions are used in conjunction with the Federal Bridge Formula:

- **Gross Weight**
  The weight of a vehicle combination and its load. The federal gross weight limit on the Interstate System is 80,000 pounds.

- **Single Axle Weight**
  The federal single axle weight limit on the Interstate System is 20,000 pounds.

- **Tandem Axle Weight**
  Tandem axle means two axles spaced not less than 40 inches nor more than 96 inches apart and having at least one common point of weight suspension. The federal tandem axle weight limit on the Interstate System is 34,000 pounds.

- **Consecutive Axle Weight**
  Federal law states that any consecutive two or more axles may not exceed the weight as computed by the formula even though the single axles, tandem axles, and gross weights are within the legal requirements.

\(^2\) The Bridge Formula establishes the maximum weight any set of axles on a motor vehicle may carry on the Interstate highway system, see [https://ops.fhwa.dot.gov/freight/publications/brdg_frm_wghts/](https://ops.fhwa.dot.gov/freight/publications/brdg_frm_wghts/)

Width and weight standards are set at maximums. The width standards generally require states to allow vehicles to be up to, but not exceed, 8-feet 6-inches wide. Similarly, the weight standards generally require states to allow vehicles to be up to, but not exceed, 80,000 pounds in total vehicle weight.
States cannot set lower width or weight maximums when these federal standards apply. Vehicles exceeding these width and weight standards may be considered oversize or overweight and require a state-issued permit before traveling through the respective areas. Some states such as North Carolina allow axle weight tolerances, e.g. 10% above the federal standards on non-Interstate routes for certain types of loads such as agricultural products without the requirement of a permit.

**Organization**

**Identify National and Peer Practices**

Nationally, the permitting maximum is 18 feet in width, 18 feet in height, 200 feet in length and 299,000 in weight. All peer states base their permits on the national clearance envelopes and the Federal Bridge Formula like SCDOT. However, the range of allowable values varies significantly by state as indicated below:

- Width clearances are from 14 feet to 16 feet
- Vertical clearances are from 14 feet to 18 feet
- Overall length limits range from 100 feet to 150 feet
- Loads vary from 115,000 lbs. to 250,000 lbs.

Peer states generally report proportional levels of increased permitting review intensity as loads approach the maximum allowed values.

**SCDOT Current Practices**

SCDOT’s OSOW permitting section reports to the Director of Maintenance and is physically located at SCDOT headquarters. In 2018, the OSOW Office processed over 85,000 permits. These permits generated approximately $3M in revenue, which is utilized to support the state funded bridge program.

South Carolina standards for size and weight mirror the FHWA requirements and match Figure 13. South Carolina Code of Law sets a maximum height of 13-feet 6-inches, with an exception of 14 feet for trucks carrying trucks.

South Carolina web publication, “Guidelines for Movement over South Carolina Highways of Oversize and Overweight (OSOW) Vehicles and Loads” provides detailed guidance on OSOW Office operations including fees, hours of operation and expectations of all parties. Among the more significant details in that document is a stated performance expectation that the OSOW Office will issue a permit the same day if the permit is submitted correctly before 2:00 PM. Exceptions include superloads defined as greater than 130,000 pounds, and loads over 16 feet wide and/or 16 feet high, which may take up to a maximum of five (5) business days for review and issuance.

**Commendable/leading SCDOT Practices include:**
- Issuing permits the same day as requested, which is industry best practice

**Enhancement Items for SCDOT to Consider:**
- Develop a succession plan to address long-term OSOW staffing needs

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22 South Carolina Code of Laws, SECTION 56-5-4060, see https://www.scstatehouse.gov/code/t56c005.php

Manuals and Guidance

Identify National and Peer Practices
All peer states have a link to their respective OSOW permits on their web page; however, not all links are as easily found as SCDOT’s. Some OSOW permits are issued by the Motor Vehicle Commission/Department. For most states with an automated OSOW permit process, the hauler is directed to a specific website for the permit.

SCDOT Current Practices
The SCDOT website for OSOW permits is well designed and understandable (see https://www.scdot.org/business/permits-osow.aspx and Figure 14). It is business friendly, allowing haulers to set up an escrow account and/or pay directly for permits with a credit card.

Figure 14: Image of SCDOT Oversize and Overweight Website

Specific permit applications are provided on the website. These applications can be submitted by e-mail, fax or mail. Single trip, multiple trip, and self-issue multiple trip, with or without OSOW truck route maps, are all clearly described. An interactive map is provided for haulers using local roads showing the local and SCDOT bridges that are posted with bridge load restrictions. Also, there are maps showing truck routes for trucks greater than 100,000 lbs. and including a truck network map for tandem tractor trailers.

Commendable/leading SCDOT Practices include:
- Providing an easily understood and navigated OSOW website

Enhancement Items for SCDOT to Consider:
- Develop permit application forms that can be completed electronically (e.g., in a writable “.pdf” format) to support direct submission to the SCDOT permit office
Automation

Identify National and Peer Practices

FHWA Report
A 2018 report prepared by FHWA titled, “Best Practices in Permitting Oversize and Overweight Vehicles”\(^\text{24}\) included the following statistics:

- 30 states used automated OSOW permit systems
- Seven (7) states were in the process of adopting an automated OSOW permit system
- 13 states indicated that they were not considering automating their OSOW permitting process

Of the 37 states identified as using (or actively pursuing) an automated OSOW permitting systems, the common systems were as follows:

- 17 states use *Bentley SuperLoad*
- 11 states use *ProMiles*
- Three (3) states use *Hexagon*
- Six (6) states use a “home-grown” system.

Peer States
Peer state outreach for this project include the following updates to the information in the referenced 2018 FHWA report:

- Delaware, Michigan and North Carolina are the only peer states that reported reviewing and issuing OSOW permits manually
  - Delaware is working with a consultant to install the Hexagon automated permit system
  - Michigan is using *Bentley SuperLoad* in the background of their manual permitting system
- Florida has developed their own automated permit system
- All other peer states are using either the Bentley SuperLoad permit system or the ProMiles permit system

In both the automated permit systems and the manual permit systems, thresholds exist on size and weight that when exceeded, require a manual review before the OSOW permit is issued. In all the peer states, these types of OSOW vehicles are considered superloads.

SCDOT Current Practices
The SCDOT permit office currently reviews and issues all permits manually. The BMO is working with a consultant to develop and install an automated permitting system. This customizable-off-the-shelf software (COTS) system is compatible with SCDOT’s load rating software.

Commendable/leading SCDOT Practices include:
- Configuring the *Hexagon* commercial off-the-shelf permitting system to provide increased efficiencies and allow for easier updates across one software platform

\(^{24}\) https://ops.fhwa.dot.gov/publications/fhwahop17061/index.htm
**Enhancement Items for SCDOT to Consider:**
- Reach out to the states identified as *Hexagon* users (Louisiana, Oklahoma and Tennessee) for lessons learned on implementing and using this system
- Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to develop updated truck route maps

**Fee Schedule**

**Identify National and Peer Practices**

In general, OSOW permit fees fall into the following categories:

- Single Trip
- Multiple Trip (Annual Basis)
- Special (homes, ocean borne, tow truck etc.)
- Superloads

Table 4 identifies the base fees for SCDOT and the peer states reviewed:

<table>
<thead>
<tr>
<th>STATE</th>
<th>SINGLE TRIP</th>
<th>MUTIPLE TRIP/YEAR</th>
<th>SPECIAL</th>
<th>SUPERLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Carolina</td>
<td>$30-$50</td>
<td>$100</td>
<td>$100 (House)</td>
<td>$100-$350</td>
</tr>
<tr>
<td>North Carolina</td>
<td>$12-$48</td>
<td>$100-$200</td>
<td>$100 (House)</td>
<td>$112</td>
</tr>
<tr>
<td>Virginia</td>
<td>$20-$30</td>
<td>$100-$500</td>
<td>$30-$100</td>
<td>$125-$500</td>
</tr>
<tr>
<td>Georgia</td>
<td>$30</td>
<td>$150-$500</td>
<td>$500 (Tow Truck)</td>
<td>$70-$500</td>
</tr>
<tr>
<td>Florida</td>
<td>$5-$25</td>
<td>$20-$540</td>
<td></td>
<td>$200-$500</td>
</tr>
<tr>
<td>West Virginia</td>
<td>$20</td>
<td>$150 (Ocean Borne)</td>
<td>$210</td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>$10-$20</td>
<td>$100 (Ocean Borne)</td>
<td>$60</td>
<td></td>
</tr>
<tr>
<td>Delaware</td>
<td>$30</td>
<td></td>
<td></td>
<td>$264</td>
</tr>
</tbody>
</table>

In addition to the base permit charged, SCDOT and the peer states also vary in terms of additional charges and fees that may apply. Examples include the following:

- South Carolina and New Jersey add a transaction fee for each permit ($10 in SC and $12 in NJ) but NJ also adds a 5% administration fee
- Florida adds a mileage fee ($0.25-$0.50/mile) on their Single Trip Permit
- West Virginia adds a bridge evaluation fee ranging from $150 - $750 depending on the number of bridges evaluated

In some of the peer states, OSOW permit fees are retained by the DOT; in others, permit fees go into the State’s general treasury. This diversity of practice also is true from a national perspective.
SCDOT Current Practices
As noted previously, the OSOW Office processed over 85,000 permits in 2018. These permits generated approximately $3M in annual revenue, which is returned to the SCDOT and utilized to support the state funded bridge program.

Commendable/leading SCDOT Practices include:
• Returning permit fees to SCDOT to support the state funded bridge program

Enhancement Items for SCDOT to Consider:
• Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to identify opportunities to consolidate/simplify permit categories and to determine the fairness and equity of the fee structure
Coordination on Locally Owned Bridges

Topic Introduction

Federal NBIS regulations apply to all structures defined as highway bridges located on public roads on or within each state’s borders. These regulations hold each state responsible for the bridge inspection and load ratings of all bridges regardless of ownership. Thus, each state DOT must inspect, or require the inspection of, all highway bridges located on its public roads. Further, each state DOT also must load rate, or requiring the load rating of, each bridge as to its safe load carrying capacity and must post restrictions (or close) the bridge when the maximum legal loads exceed that allowed under the operating legal load rating. Exceptions to the state DOT’s responsibility within its respective state boundaries are any federally owned bridges, which are the responsibility of the respective federal agencies.

Bridge inspections, load ratings, and posting or closure of these structures usually require coordination and the cooperation of the local owners. This arrangement generally works well and NBIS compliance is obtained. Yet, there are occasions when issues arise between the state and local entity that are difficult to resolve particularly when it comes to posting load restrictions and closures. To better ensure full NBIS compliance and public safety, several state governments have promulgated laws or regulations supporting their respective DOT’s authority over inspection, load rating, posting restrictions and closing of locally owned bridges.

South Carolina is different from most states in that the majority of public roads and bridges located within the state are the jurisdictional responsibility of the SCDOT. However, approximately 9% of publicly owned bridges are located on city and county road networks. These bridges are the focus of this report topic.

Organization

Identify National and Peer Practices

While coordination on locally owned bridges varies from state to state, among the peer review states, Delaware, Georgia, North Carolina and West Virginia are most aligned with the SCDOT in that they perform all or most of the inspections of their locally owned bridges. As shown in Figure 15 below, the percentage of locally owned bridges compared with state owned bridges varies significantly, which can essentially skew the overall work effort expended by the state’s respective bridge inspection staff on their local bridges.
With respect to the load rating of locally owned bridges, Delaware, North Carolina and West Virginia use their in-house DOT staff to load rate these bridges while all the other states utilize consultant load rating teams. It is worth noting that Delaware and West Virginia have relatively few local bridges (less than 2% of their total bridge inventory), thus the additional in-house DOT staff effort required is proportionally small.

All peer states require that local bridge inspections, load ratings and QC/QA programs follow their respective established manuals and procedures. Similarly, if any of these functions are performed by consultants, the consultants are required to have a QC/QA program in place that meets the requirements outlined in the state’s manuals and procedures. When using consultant QC/QA, the state DOT will also have a QA program in place for the consultant produced inspection reports or load ratings.

In much the same way as states choose to exercise “home rule” as it relates to federal programs, local jurisdictions often will choose home rule when it comes to state programs. Similar to SCDOT, in some instances the peer states noted a reluctance from local bridge owners with respect to load posting or closing local bridges. Like SCDOT, the peer states interviewed indicated that once the DOT clearly explained the critical nature of the condition of the local bridge, using common sense language, the local bridge owner typically agrees with the state.

Florida and Illinois are two examples of states with statutory authority over locally owned bridges to support their respective State DOTs. Florida may assess costs for posting and closing bridges when the local entity does not take action within a specific time frame. After a specified time, Illinois may apply more stringent requirements as noted below:

“Failure of a LPA [Local Public Agency] to comply may result in the withholding of Motor Fuel Tax (MFT) allotments and the district not approving current MFT expenditures, or other actions determined by the Department.”

The Florida statute and Illinois “Bureau of Local Roads and Streets Manual (Chapter 6)” are included in Appendix E.

**SCDOT Current Practice**

SCDOT is responsible for bridge inspection, load rating and posting (or closing) for 865 locally owned bridges as well as the 8,431 state owned bridges in South Carolina. According to the National Bridge Inventory (NBI), local bridges represent over 9% of the total number of bridges in South Carolina. These locally owned bridges are
predominantly located on low traffic volume county roads but may carry school bus and emergency vehicle traffic. A portion of state transportation funds are allocated annually to each county in the state through a legislatively designed formula. These funds are administered by a County Transportation Committee charged with the responsibility of developing a program of work that may include maintenance, rehabilitation or replacement of bridges in addition to roadway improvements on the local road network.

SCDOT bridge inspection teams inspect locally owned bridges every two (2) years, or more often if required depending on age and condition, in compliance with the NBIS requirements. If special inspections are needed due to deterioration, vehicle impact or flooding, SCDOT bridge inspectors perform these as well. Although most of these bridges do not require a formal underwater inspection, any underwater inspections that are required are performed by SCDOT’s consultants. SCDOT performs these services at no cost to the local entity.

As required by federal law, SCDOT also has responsibility for load rating locally owned bridges and requires the local owner to sign those local bridges for weight restrictions when required. According to SCDOT staff, cooperation and coordination with local agencies generally goes well. However, there have been occasions where the local agency does not accept or support the recommended load posting (or closing) due to impact on local travel patterns or other traffic, e.g. school buses. SCDOT has been responsive to these concerns, persuasive and ultimately successful but there are times when temporary load restrictions or even bridge closures must be implemented in order to comply with the NBIS. Importantly, the safety of the travelling public is always the first consideration in such situations. Because of federal requirements, when local owners are not responsive on these bridges that are not owned or maintained by SCDOT, this can lead to unfavorable reporting by FHWA on SCDOT’s bridge program – even if only temporarily. A definitive state law, or regulation, clarifying and supporting SCDOT’s responsibility and authority to post or close locally owned bridges could help ensure timely compliance in these situations while also streamlining the process.

From a bridge management perspective, SCDOT’s approach to locally owned bridges is consistent with its practices for state owned bridges. This is in keeping with SCDOT’s commitment to improving safety and mobility, maintaining and preserving existing transportation infrastructure, and increasing the efficiency and reliability of the road and bridge network for all users.

**SCDOT Progress/Commendable Practice**

- Performing all bridge inspections and load ratings for all locally owned bridges consistent with those on the state network
- Supplementing in-house bridge inspection teams and load rating capabilities with use of consultants to ensure safety of locally owned bridges
- Performing all above services at no cost to the local agencies

**Enhancement Items for SCDOT to Consider:**

- Draft legislation, if appropriate, that clarifies and supports SCDOT’s responsibility and authority for inspection, load rating, posting restrictions or closing locally owned bridges
## APPENDIXES

**Appendix A: Summary of Commendable Practices and Enhancements**

<table>
<thead>
<tr>
<th>Commendable SCDOT Practices include:</th>
<th>Enhancement Items to Consider:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BRIDGE INSPECTION</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
</tr>
<tr>
<td>• Supplementing in-house bridge inspection teams with consultant bridge inspection teams to ensure inspection timeliness, while retaining in-house experience and capabilities to optimize program cost</td>
<td>• No singular “best” practice exists for organization placement and structure of the NBIS bridge inspection function</td>
</tr>
<tr>
<td>• Revising Human Resource classifications to address retention and better define the roles and responsibilities of team leaders and inspectors</td>
<td>• Each state DOT must decide on the organization location and reporting structure that best meets its needs</td>
</tr>
<tr>
<td>• Using mobile technology for bridge inspection to improve data quality and accuracy</td>
<td></td>
</tr>
<tr>
<td>• Improving equipment accessibility by establishing and utilizing rental contracts</td>
<td></td>
</tr>
<tr>
<td><strong>Manuals and Guidance</strong></td>
<td></td>
</tr>
<tr>
<td>• Developing a comprehensive, industry-leading practice bridge inspection guidance document to promote high quality and more consistent inspections</td>
<td>• Continue efforts to finalize and adopt the draft BIGD</td>
</tr>
<tr>
<td>• Training bridge inspection staff in the use of the draft BIGD</td>
<td>• Consider identifying and requiring a certification or exam program for bridge inspectors, similar to those used by some peer states</td>
</tr>
<tr>
<td><strong>Quality Control / Quality Assurance</strong></td>
<td></td>
</tr>
<tr>
<td>• Including a comprehensive QC/QA section in the draft BIGD to enhance inspection information quality and consistency</td>
<td>• Leave the QC aspects of bridge inspection reports at the bridge inspection team level but shift to a process of using district-based peer reviews</td>
</tr>
<tr>
<td>• Requiring bridge inspection consultants to have an approved QC/QA plan prior to contracting is a leading practice</td>
<td>▪ For example, District 1 performs QC on District 2’s bridge inspection reports and District 2 performs QC on District 3’s bridge inspection reports, etc.</td>
</tr>
<tr>
<td></td>
<td>• Retain QA responsibility at the BMO for bridge inspection reporting but consider adding a BMO-based QA team to assist district bridge inspection teams in reviewing a sample of consultant-performed inspections</td>
</tr>
</tbody>
</table>
Commendable SCDOT Practices include:

<table>
<thead>
<tr>
<th>Data Collection Methodology</th>
<th>Enhancement Items to Consider:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Providing bridge inspectors technology that allows first person, real-time data entry is broadly considered as a data entry best practice</td>
<td>• Continue efforts to deploy enhanced technologies for easier and more reliable first person, real-time data entry and information collection</td>
</tr>
<tr>
<td>• Supplying standard forms for collecting a variety of inspection and inspection-related QC/QA information in the draft BIGD</td>
<td></td>
</tr>
<tr>
<td>• Providing standard forms in the BIGD for reporting critical deficiencies that use consistent terminology with the SCDOT Highway Maintenance Management System (HMMS) improves tracking and reporting efficiency</td>
<td></td>
</tr>
</tbody>
</table>

BRIDGE LOAD RATING

Organization

• Supplementing in-house staff through contracts with qualified engineering consultants
• Including load rating task as part of bridge inspection consultant contracts

Manuals and Guidance

• Developing and implementing a comprehensive LRGD

Quality Control / Quality Assurance

• Developing a comprehensive QC/QA section in the LRGD
• Requiring consultants that perform load ratings to have an approved QC/QA plan in their scope of work
• Providing QC/QA review checklists and tracking documents in the LRGD

• Strengthen resources to increase load rating capability and retain expertise to meet future needs, thereby, reducing costs and increasing efficiency

• Establish a minimum schedule to update the LRGD to ensure the document maintains its accuracy and relevance over time

• Strengthen expertise in performing load ratings through NHI training and on the job training
**Commendable SCDOT Practices include:**

### Software
- Adopting nationally accepted load rating software available through AASHTO
- Providing a listing of preferred load rating software products along with standard approval forms in the Load Rating Guidance Document

### BRIDGE MANAGEMENT

#### Organization
- Optimizing internal resources with consultant expertise for BMS development and implementation

### Bridge Management Process & Procedures for Preservation/Rehabilitation/Replacement Bridge Projects
- Implementing a 10-year plan for replacing 465 restricted and deficient bridges

### Use of Bridge Management System
- Developing an advanced BMS

### BRIDGE MAINTENANCE AND PRIORITY REPAIR PROCEDURES

#### Organization
- Providing a proven ability to handle emergencies such as extreme storm events, flooding, and vehicle or vessel collisions
- Having some district maintenance crews capable of performing major repairs and replacing small bridges and culverts on secondary routes using standard plans
- Outsourcing the maintenance and management of specialty bridges

**Enhancement Items to Consider:**

### Software
- Ensure the most current AASHTOWare BrR software available is being used to increase the number of bridge types the software can load rate, which will increase the efficiency and effectiveness of the Hexagon OSOW software

### BRIDGE MANAGEMENT

#### Organization
- Develop policies and procedures for a bridge program that is based on using a balanced approach of preservation, rehabilitation, and replacement projects
- Provide sufficient expert technical resources to fully leverage SCDOT’s investment in a BMS

### Bridge Management Process & Procedures for Preservation/Rehabilitation/Replacement Bridge Projects
- Modify the existing capital and maintenance bridge programs to include an appropriate mix of preservation, rehabilitation, and replacement strategies that keep good and fair bridges in their condition state while prioritizing replacement of bridges in poor condition

### Use of Bridge Management System
- Continue to advance the development and implementation of BMS software and consider adopting the identified BMS best practices

### BRIDGE MAINTENANCE AND PRIORITY REPAIR PROCEDURES

#### Organization
- Create a manual for identifying standard bridge maintenance actions statewide
- Provide the National Highway Institute’s (NHI) two-week Bridge Maintenance course
- Expand asset maintenance contracting to include additional complex bridge structures that have specialized maintenance needs
**Commendable SCDOT Practices include:**

<table>
<thead>
<tr>
<th>Priority Repairs</th>
<th>Enhancement Items to Consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Currently implementing the enhanced critical deficiencies prioritization process as described in the draft BIGD</td>
<td>• Complete implementation of the critical deficiencies prioritization process described in the draft BIGD</td>
</tr>
<tr>
<td>• Supplying detailed policies and processes in the Agency’s BIGD document to address critical deficiency prioritization, response, and tracking</td>
<td></td>
</tr>
<tr>
<td>• Providing excellent agency coordination and response to emergency situations such as hurricanes, natural disasters, vehicle or vessel impact damage, and discovery of advanced deterioration</td>
<td></td>
</tr>
</tbody>
</table>

**SCOUR CRITICAL BRIDGE MANAGEMENT & EMERGENCY RESPONSE**

**Organization**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incorporating full scour inspection guidance into the draft BIGD</td>
<td>• Schedule the underwater scour critical bridge inspections on a 48-month basis to coincide with a routine biennial NBIS bridge inspections</td>
</tr>
<tr>
<td>• Utilizing and coordinate with an in-house Hydraulic Design Support team to perform hydraulic analysis</td>
<td>• Review each bridge-specific POA as part of the scope of work assigned to the underwater inspection consultant team</td>
</tr>
<tr>
<td>• Augmenting in-house staff with scour specific consultant inspection contracts for use statewide</td>
<td></td>
</tr>
<tr>
<td>• Identifying triggering events for scour re-evaluation and inclusion of these events in the draft BIGD</td>
<td></td>
</tr>
</tbody>
</table>

**Process for Addressing Bridge Emergencies**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Incorporating full damage inspection guidance into the draft BIGD</td>
<td>• Include an emergency on-call/response section in the consultant bridge inspection contracts issued by the BMO</td>
</tr>
<tr>
<td>• Incorporating full hurricane and storm inspection guidance into the draft BIGD</td>
<td>• Expand the use of USGS Water Alert service and BridgeWatch</td>
</tr>
<tr>
<td>• Developing rapid deployment process for placing USGS stream flow gauges on several streams in advance of a hurricane or extreme rainfall event, where USGS does not have a permanent stream flow gauge installation</td>
<td>• Include a pre-event assessment of the waterway for debris at the bridge piers or abutments, to be removed by district maintenance crews in advance of the storm</td>
</tr>
<tr>
<td>• Piloting the use of BridgeWatch, a commercially available, web-based, real-time, monitoring software solution, on 1600 bridges</td>
<td>• Formalize policies and procedures for performing post-event evaluations to identify opportunities to improve responsiveness and effectiveness</td>
</tr>
<tr>
<td>• Developing a process for bridge closings in the draft BIGD that includes communication procedures and flowcharts</td>
<td></td>
</tr>
</tbody>
</table>
### Commendable SCDOT Practices include:

<table>
<thead>
<tr>
<th>Cost-Effective Methods for Scour Prevention</th>
<th>Enhancement Items to Consider:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Developing South Carolina bridge scour envelope curves in conjunction with the USGS</td>
<td>• Develop a program for designing/developing scour countermeasures, including stream armoring and channel protection, for scour critical bridges that are not currently scheduled for bridge replacement and likely, will not be for the foreseeable future</td>
</tr>
</tbody>
</table>

### Oversize Overweight Permitting Program

**Organization**
- Issuing permits the same day as requested is industry best practice

**Manual & Guidance**
- Providing an easily understood and navigated OSOW website

**Automation**
- Configuring the Hexagon commercial off-the-shelf permitting system to provide increased efficiencies and allow for easier updates across one software platform

### Fee Structure
- Returning permit fees to SCDOT to support the state funded bridge program

- Develop a succession plan to address long-term OSOW staffing needs

- Develop permit application forms that can be completed electronically (e.g., in a writable "*.pdf" format) to support direct submission to the SCDOT permit office

- Reach out to the states identified as Hexagon users (Louisiana, Oklahoma and Tennessee) for lessons learned on implementing and using this system

- Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to develop updated truck route maps

- Perform a biennial evaluation of the OSOW permits issued based on category (single trip, multiple trip, superload, etc.) to identify opportunities to consolidate/simplify permit categories and to determine the fairness and equity of the fee structure
Appendix B: Interview Guide
Appendix B – Peer States Interview Guide

Bridge Maintenance Best Practices Study—Interview Guidelines

PURPOSE: As part of the SCDOT’s Bridge Maintenance Best Practices Study, these Guidelines are intended to assist Kercher/GPI SMEs in conducting on-site benchmarking and best practice interviews with several willing State DOTs. Thank you in advance for your cooperation!

A. Agency Organizational Structure of Bridge Programs

1. DOT Maintenance Organization Structure
   a. Describe your bridge programs organization
      i. Centralized/decentralized?
      ii. Is an org chart available?
   b. Where in the organization is bridge inspection?
   c. Where in the organization is load rating?
   d. Where in the organization is hydraulics?
   e. Where in the organization is over-size/over-weight permits (OS/OW)?
   f. Where in the organization is bridge preventive maintenance?
   g. Where in the organization in bridge rehabilitation? Bridge replacement?
   h. If the DOT is not responsible for all bridges, please describe who is and their responsibilities (Inspection, Posting, Maintenance, etc.).

B. Bridge Inspection Program

1. Bridge Inspection Procedures for Department of Transportation (DOT) Owned and Maintained Bridges
   a. Total number of NBIS bridges
   b. Do your requirements for Team Leader (TL) exceed FHWA NBIS requirements for the various types of inspections? If so, how?
   c. Who performs routine inspections?
      i. Percent Bridge Inspections performed by DOT in-house
      ii. Percent Bridge Inspections performed by Consultant
   d. Who performs other type of bridge inspections?
      i. Complex Bridges
         1. DOT (in-house) inspector percentage
         2. Consultant inspector percentage
      ii. Fracture critical inspection
         1. DOT (in-house) inspector percentage
         2. Consultant inspector percentage
      iii. Underwater inspection
         1. DOT (in-house) inspector percentage
2. Consultant inspector percentage
   iv. Special inspections
      1. DOT (in-house) inspector percentage
      2. Consultant inspector percentage

   e. Is there bridge inspector guidance as to when to request hands-on inspection to examine suspect or hidden defects?

   f. What method(s) do you use to determine bridge inspection frequencies?
      i. Has your agency considered going to reliability-based bridge inspection frequencies for some bridges as shown in NCHRP REPORT 782 Proposed Guideline for Reliability-Based Bridge Inspection Practices? If yes, please describe.
         1. If yes, do you have FHWA approval for the reliability-based inspection process? If yes, can you share your approved procedure?

2. Staffing
   a. Where do bridge inspection teams report? (District or Central Office)

3. Funding
   a. What is your annual bridge inspection budget? In House and Consultant.

4. Manuals, Guidance, Procedures
   a. Do you have a bridge inspection manual? If yes, please provide link.
   b. Do you have a bridge inspection QA/QC manual? If yes, please provide link.
   c. Do you have a bridge element manual? If yes, please provide link.

5. Quality Assurance and Quality Control (QA/QC)
   a. Describe your bridge inspection quality control procedures.
   b. Describe your bridge inspection quality assurance program.

6. Training
   a. Describe your bridge inspector training program

7. Bridge Inspection/Equipment
   a. How many under bridge access vehicles (snooper) do you own? How many are rented?
   b. Does your agency have the ability to perform non-destructive evaluation? If yes, what methods do you “self” perform?
   c. Do you have boats, diving equipment, and certified diver bridge inspectors?

8. Bridge Inspection Data Collection Software
   a. What software tools does your agency use for collecting bridge inspections? Is it web-based? Is it tablet capable? Does it support detailed and quality bridge inspections? Please describe

9. What one or two changes would you make to your bridge inspection program if you had the authority to make such changes?

10. What do you consider is a best practice or practices in your bridge inspection program?
C. Bridge Load Rating Program

1. Who does bridge load ratings?
   a. Percent by DOT (in-house)
   b. Percent by Consultant
   c. Who performs complex bridge load ratings?
   d. How often do you update your load ratings?
   e. What are the triggers for updating load ratings?

2. Staffing
   a. What are the roles/composition of this group?

3. Funding
   a. Do you separately track costs for load rating? If so, what is your annual bridge load rating budget?

4. Manuals, Guidance, Procedures
   a. Do you have a bridge load rating manual or a documented load rating policy?
   b. Do you have written QA/QC Procedures for Load Ratings? If so, can you provide a link or copy?

5. Quality Assurance and Quality Control (QA/QC)
   a. Describe your bridge inspection quality control procedures.
   b. Describe your bridge inspection quality assurance program.

6. Training
   a. Do you have a formal or informal training program for load raters? If so, please describe.

7. Software
   a. What software does your agency use for load rating?
   b. Does your agency use different software for complex bridges?

8. What one or two changes would you make to your bridge load rating program if you had the authority to make such changes?

9. What do you consider is a best practice or practices in your bridge inspection program?

D. Scour Assessment/Hydraulics Program

1. Staffing
   a. What percentage of your scour evaluations are done in-house (DOT staff) versus by consultant?

2. Manuals, Guidance, Procedures
   a. Do you have written procedures for when and how to perform scour calculations that supplement the FHWA Hydraulic Engineering Circular (HEC) manuals? If so, can you provide a link or copy?
   b. Do the POAs identify when a scour critical bridge should be monitored or inspected during a flood event?
3. **Flood Event Procedures**
   a. Do you perform post flood inspections on scour critical bridges?
   b. Do you perform post flood inspections on non-scour critical bridges? If so, please describe you process/triggers.

4. **Scour Critical Bridge Management**
   a. What is your process to address/improve scour critical bridges, that are otherwise in fair to good condition, to remove them from the Scour Critical List?
   b. Do you have a risk-based approach to prioritize mitigation or replacement of scour critical bridges?

5. **How well is your scour program working?**

E. **Oversized / Overweight Permits (OS/OW) Program**

1. **Oversize/Overweight Permitting**
   a. Describe your OS/OW permit process –percentage consultant use, number of permits processed monthly, and budget.
   b. Do you charge applicants for performing super or mega load ratings?
   c. Do you have written procedures including QA/QC?
   d. Is your permit application process automated? If so, what software do you use and please provide a link.
   e. Are your load ratings calculated for each OS/OW permit or are certain truck configurations predetermined using moment and shear envelopes? If yes, how were these developed? What software do you use for OS/OW analysis?

2. How well is your OS/OW Permitting system working?
   a. Do you have a cost table for OSOW permits? If so, please provide.

3. **What one or two changes would you make to your oversize overweight permitting program if you had the authority to make such changes?**

4. **What do you consider is a best practice or practices in your OS/OW program?**

F. **Bridge Operations Program (Includes Maintenance and Repair Implementation including Clearing Flags and Signing for Load Posting)**

1. **Constraints / Authority**
   a. How does your agency respond to high priority repairs (DOT in-house bridge crews or on-call contractors)?
      i. What is a typical funding amount included in the annual budget for this type of repair?
   b. Do you have staff dedicated to assuring that bridge posting/closed signs are placed properly?

2. **Bridge Maintenance Budget**
   a. What is your bridge maintenance annual budget? Is funding allocated to Routine Maintenance and Preventive Maintenance separately?
b. Do you have dedicated bridge maintenance funds or do you have to compete for funding from a general maintenance fund?
c. Do you have any special programs to ensure proper maintenance is performed on significant structures? If so, how is that funded?

3. Manuals, Guidance, Procedures
   a. Do you have a bridge maintenance manual?

4. Training
   a. Do you provide bridge maintenance training?

5. What bridge maintenance and repair activities can your in-house staff perform?
   a. Crack sealing
   b. Patching
   c. Coatings
   d. Joint repair
   e. Other

6. Responding to Bridge Inspection findings
   a. Do you have a process to prioritize and implement inspector recommendations/findings? (Yes/No). If yes, please describe.
   b. Do you have a process to manage inspector recommendations/findings? (Yes/No) If yes, please describe.
   c. Who performs the corrective actions to address the recommended high priority and critical findings from Bridge Inspection; In-house maintenance crews or Contractor forces?
   d. What process do you use for following up on high priority and critical findings from bridge inspections (flags)?
   e. How are high priority repair and critical findings reported, programmed, repaired and closed out? Do you have a process? Is it written down?

7. What one or two changes would you make to your bridge operations program if you had the authority to make such changes?

8. What do you consider is a best practice or practices in your bridge operations program?

G. Bridge Management Program

1. Bridge Management System (BMS)
   a. Do you have an operating BMS?
      • Are you using the BMS for anything other than capturing the inventory data?
      • Can you do bridge condition or performance measure trend monitoring?
      • Do you have deterioration models for your BMS?
      • Are you able to forecast bridge condition? Network and/or bridge level?
      • Does your BMS currently provide project level recommendations for replacement, rehabilitation and preservation?
      • Are you able to do optimization and strategic investment planning?
• Is this information used to determine budget needs?
b. Do you collect element level data and is it being used for bridge management?
c. Do you have a written risk-based prioritization process for selecting bridge projects?
d. Do you report to senior management and/or the public with bridge performance dashboards?

2. Key Performance Indicators
   a. What key performance indicators or performance measures are used to evaluate the bridge program’s effectiveness in achieving the agencies bridge goals/objectives (aside from FHWA metrics)?

3. Bridge Project Selection
   a. Describe your current process for prioritizing projects for replacement, rehabilitation, preservation and maintenance.
   b. Do you have written procedures for project selection?
   c. How was the bridge program developed in your TAMP?
   d. Describe the scoping process for identifying potential bridges for preservation, rehabilitation and replacement projects.

4. Staffing
   a. Do you have a designated Bridge Preservation Engineer? More than one?

5. Bridge Capital Program Annual Budget (Projects that are let to contract)
   a. Rehabilitation and Replacement
   b. Preservation

6. Do you have an agreement with FHWA defining preservation work? If so, can you provide a copy?

7. What one or two changes would you make to your bridge management program if you had the authority to make such changes?

8. What do you consider is a best practice or practices in your bridge management program?

H. Coordination of Local Agency Bridge Program

1. Local Agency Organizational Structure
   a. Do local agency’s (counties, cities, townships) own and maintain highway bridges? (Yes/No)
   b. Do local agencies inspect bridges they own or maintain? (Yes/No)
   c. Do local agencies load rate bridges they own or maintain? (Yes/No)
   d. Do local agencies issue OS/OW permits? (Yes/No)

2. Local Agency Bridge Inspection
   a. Who does the routine bridge inspections for local owned highway bridges and
   b. Who conducts the QC/QA on these inspections?

3. Local Agency Bridge Load Rating
   a. Who load rates local agency bridges including complex structures?
   b. Who conducts the QC/QA on these load ratings?
4. **Who is responsible for maintenance, repair, rehabilitation, and replacement of local agency and other owner highway bridges?**
   a. Does the DOT have any responsibility for posting and/or closing local agency bridges? If so, are there state laws or local agreements authorizing DOT to take these actions?

5. **Does the DOT have legal authority in your state to self-perform and/or oversight of any of these activities for local agency or other owner bridges?**

6. **What one or two changes would you make to coordination of your local agency and/or other owner program if you had the authority to make such changes?**

7. **What do you consider is a best practice or practices in your coordination with local agency and/or other owner bridge programs?**
Appendix C: Peer State Answers to Interview Guide
### Appendix C - Peer State Interview responses

<table>
<thead>
<tr>
<th>Category</th>
<th>1. Bridge Inspection Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Number of Bridges Owned</td>
</tr>
<tr>
<td></td>
<td>State</td>
</tr>
<tr>
<td>Delaware</td>
<td>848 (NBI) / 827 (Interview)</td>
</tr>
<tr>
<td>Florida</td>
<td>7213</td>
</tr>
<tr>
<td>Georgia</td>
<td>6709</td>
</tr>
<tr>
<td>Category</td>
<td>1. Bridge Inspection Procedures</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Question</td>
<td>Number of Bridges Owned</td>
</tr>
<tr>
<td></td>
<td>State</td>
</tr>
<tr>
<td>New Jersey</td>
<td>2389</td>
</tr>
<tr>
<td>North Carolina</td>
<td>17012</td>
</tr>
</tbody>
</table>

Follow AASHTO guidance for all inspection types.

Starting with element inspections, all inspections required hands on, but now up close with measurements.
### Appendix C - Peer State Interview responses

#### 1. Bridge Inspection Procedures

<table>
<thead>
<tr>
<th>Question</th>
<th>Number of Bridges Owned</th>
<th>Who Performs Inspections (Percentage)</th>
<th>Hands On Inspection Guidance</th>
<th>Methods to Determine Bridge Inspection Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Routine</td>
<td>Complex Bridges</td>
<td>Fracture Critical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State</td>
<td>Local</td>
<td>Consultant</td>
</tr>
<tr>
<td>Virginia</td>
<td>12038 (NBII/192 Interview)</td>
<td>70%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>West Virginia</td>
<td>6993 (NBII) / 6977 (Interview)</td>
<td>99%</td>
<td>1%</td>
<td>14%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Do you use Reliability-Based Bridge Inspection Frequencies?</td>
<td>Are Bridge Inspection Team Leaders Engineers or Non-Engineers?</td>
<td>Where do bridge inspection teams report? (District or Central Office)</td>
<td>Annual Bridge Inspection Budget</td>
<td>Bridge Inspection Manual</td>
</tr>
<tr>
<td>Delaware</td>
<td>Have done for our non-NBI State length bridges. We have briefly evaluated it for our NBI length bridges back in 2010, but it didn't seem advantageous enough.</td>
<td>Both</td>
<td>Central Office</td>
<td>In-house not tracked. Consultant $4 Million.</td>
<td>Yes</td>
</tr>
<tr>
<td>Florida</td>
<td>Have approval to go to 48 month inspection cycle for certain bridge types that are considered low risk, but are not going to RBI at this time.</td>
<td>Both</td>
<td>Districts</td>
<td>Talk to John Clark in the Office of Maintenance Structures Section</td>
<td>Yes</td>
</tr>
<tr>
<td>Georgia</td>
<td>No</td>
<td>Central Office</td>
<td>GDOT Salaries approximately $4,000,000.00</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Michigan</td>
<td>Mostly engineers</td>
<td>Districts</td>
<td>Complex done by central office</td>
<td>$3 to $5 Million</td>
<td>Yes</td>
</tr>
</tbody>
</table>

2-week course. Refresher every 5 years. Doc in manual.

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>New Jersey</th>
<th>North Carolina</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Staffing</td>
<td>Do you use Reliability-Based Bridge Inspection Frequencies?</td>
<td>No. Follow AASHTO guidance for all inspection types.</td>
<td>Not at this time, but will consider for future. Plan on moving to risk based inspection frequencies. Methods for inspection frequency is typical 24 months and frequency is reduced for bridges in poor condition as recommended by the bridge inspector. Doing underwater inspections at 48 months.</td>
</tr>
<tr>
<td></td>
<td>Are Bridge Inspection Team Leaders Engineers or Non-Engineers?</td>
<td>Engineers</td>
<td>Typically non-engineers</td>
</tr>
<tr>
<td></td>
<td>Where do bridge inspection teams report?</td>
<td>Central Office</td>
<td>Work in Divisions (regions) but report to central office.</td>
</tr>
<tr>
<td></td>
<td>Annual Bridge Inspection Budget</td>
<td>$30 Million</td>
<td>$22 Million (but high for first time collecting elements.</td>
</tr>
<tr>
<td></td>
<td>Bridge Inspection Manual</td>
<td>Use the BRM</td>
<td>Working on</td>
</tr>
<tr>
<td></td>
<td>QA/QC Manual or Directives</td>
<td>Yes. Part of procedures manual</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Bridge Element Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>QC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>QA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Training</td>
<td>Describe your bridge inspector training program</td>
<td>Field monitoring of In House and Consultant projects (cross check field data with report and SIA/PONTIS. County/Agency monitoring every 4 years minimum.</td>
<td>QC is done for every inspection. It is reviewed by supervisor, then area superintendent review (two levels of review).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A percentage of reports (currently ad-hoc) selected for QA where the bridge is re-inspected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-week course. Refresher every 5 years. Doc in manual. After training, supervisor goes out with new inspector for first few inspections to confirm training. Follow federal requirements on training using NBI refresher course.</td>
</tr>
</tbody>
</table>

Appendix C - Peer State Interview responses
<table>
<thead>
<tr>
<th>Question</th>
<th>Virginia</th>
<th>West Virginia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you use Reliability-Based Bridge Inspection Frequencies?</td>
<td>Not yet, we are aware of the NCHRP Report, but have not assessed implementing any of the guidelines.</td>
<td>No consideration has been given to date towards going to reliability-based bridge inspection frequencies with respect to NCHRP Report 782.</td>
</tr>
<tr>
<td>Are Bridge Inspection Team Leaders Engineers or Non-Engineers?</td>
<td>Both Districts</td>
<td>Primarily non-engineers, but a few are engineers</td>
</tr>
<tr>
<td>Where do bridge inspection teams report?</td>
<td>Districts $30 million total with $20 million spent by Consultants and $10 million spent by State Forces</td>
<td>Districts $14.5 million for state inspectors, $6.2 million for consultant contracts</td>
</tr>
<tr>
<td>Annual Bridge Inspection Budget</td>
<td>Have a Policy Document</td>
<td>Yes</td>
</tr>
<tr>
<td>Bridge Inspection Manual</td>
<td>Have a Policy Document</td>
<td>Yes</td>
</tr>
<tr>
<td>QA/QC Manual or Directives</td>
<td>Yes</td>
<td>No. Use AASHTO BEIM</td>
</tr>
<tr>
<td>Bridge Element Manual</td>
<td>Part of the QA is perpetual due to an annual re-write of policy. CO does a sample of district inspections. The sample is not random. They intentionally choose bridges that they expect they might find a problem. If they find a problem, they expand the search to look for further similar problems. QA inspections are not punitive.</td>
<td>yes (have directive)</td>
</tr>
<tr>
<td>QC</td>
<td>QA</td>
<td>QA</td>
</tr>
<tr>
<td>QA</td>
<td>Describe your bridge inspector training program</td>
<td>State certified exam. Associate of Applied Science (A.A.S.) in Highway Engineering Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Question</td>
<td>7. Bridge Inspection/Equipment</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Delaware</td>
<td>1 in house UBIV/ Consultants rent their own. 1 bucket truck. Snooper is operated by DOT staff.</td>
<td>Under Bridge Inspection Vehicles:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florida</td>
<td>6 in house UBIV</td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td>2 currently UBIVs, 1 additional ordered.</td>
<td></td>
</tr>
<tr>
<td>Michigan</td>
<td>3 UBIVs</td>
<td></td>
</tr>
</tbody>
</table>

**Appendix C - Peer State Interview responses**

- **Delaware**
  - Under Bridge Inspection Vehicles: 1 in house UBIV/ Consultants rent their own. 1 bucket truck. Snooper is operated by DOT staff.
  - Diving Equipment: Yes, No
  - Certified Bridge Inspectors: Yes
  - Data Collection Software Used: BrM and custom INSPECT Program
  - Web Based: Capable of but IT does not allow
  - Tablet Capable: Yes, Yes
  - QC/QA Process: The one thing they do not have the authority to do is to add more positions. If they had the authority to add staff, they would have 4 – 2 man teams (8 inspectors) and 2 additional staff to assist with bridge maintenance projects.

- **Florida**
  - Under Bridge Inspection Vehicles: 6 in house UBIV
  - Diving Equipment: Yes
  - Certified Bridge Inspectors: BrM
  - Data Collection Software Used: Yes
  - Web Based: Capable of using AgileAssets. Moving to Inspect X
  - Tablet Capable: Yes

- **Georgia**
  - Under Bridge Inspection Vehicles: 2 currently UBIVs, 1 additional ordered.
  - Diving Equipment: Yes
  - Certified Bridge Inspectors: Currently AgileAssets. Moving to Inspect X
  - Data Collection Software Used: Yes
  - Web Based: Yes
  - Tablet Capable: Yes

- **Michigan**
  - Under Bridge Inspection Vehicles: 3 UBIVs
  - Diving Equipment: No
  - Certified Bridge Inspectors: In-house developed Mi-Bridge program
  - Data Collection Software Used: Yes
  - Web Based: No
  - Tablet Capable: Yes

- **QC/QA Process**
  - Delaware: Review of each bridge inspection report recommendation by the District’s Feasible Action Review Committee. This allows an evaluation of the inspection reports findings and doing the small repairs before they become Large Repairs. FDOT’s QC/QA process is good. FDOT’s process for emergency repairs, which allows with the approval of the Department’s Secretary, requesting telephone quotes from selected contractors instead of having to go through the normal design, bid build process.
  - Florida: Currently using AgileAssets. Moving to Inspect X (tablets use in the field, mobile app, etc)
  - Georgia: We are in process of automating QA/QC tracking, automating notifications, and increasing requirements to be a team leader.
  - Michigan: MiBridge is considered a best practice. The use of dashboards in tracking assignments. We are moving toward a test based qualified team leader certification.
<table>
<thead>
<tr>
<th>Question</th>
<th>New Jersey</th>
<th>North Carolina</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Bridge Inspection/Equipment</td>
<td>None. We get 3 bids from vendors (see attached list)</td>
<td>3 UBIVs</td>
</tr>
<tr>
<td>8. Bridge Inspection Data Collection Software</td>
<td>District Team Leaders and Senior Inspectors (in most cases) are trained in level 2 NDT techniques such as liquid penetrant and magnetic particle testing. The Central Office Materials Division maintains requirements and a list of qualified inspectors</td>
<td>Dye-pen and UT</td>
</tr>
<tr>
<td>9. Changes they would like to make to their program</td>
<td>AssetWise Asset Reliability Inspections by Bentley (CombIS).</td>
<td>In-house developed WIGINS Program</td>
</tr>
<tr>
<td>10. Activities the Agency considers Best Practice</td>
<td>YES – the system has customizable forms capable of meeting our inspection report requirements, stores all bridge inspection data (NBI &amp; NBE) and serves as our bridge file, meeting MAP-21 legislation.</td>
<td>Would adopt risk-based inspection frequencies and do more in-house inspections. When using consultants have fewer number of firms so less training needed. Have more bridge inspection equipment available.</td>
</tr>
<tr>
<td>Category</td>
<td>Own Rent</td>
<td>Own Rent</td>
</tr>
<tr>
<td>Category</td>
<td>7. Bridge Inspection/Equipment</td>
<td>8. Bridge Inspection Data Collection Software</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Question</td>
<td>Under Bridge Inspection Vehicles</td>
<td>Non-Destructive Evaluation (NDE)</td>
</tr>
<tr>
<td>Virginia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VDOT owns 2 machines. Many are rented – no exact count – but VDOT performs more than 10k safety inspections per year.</td>
<td>Yes. District Team Leaders and Senior Inspectors (in most cases) are trained in level 2 NDT techniques such as liquid penetrant and magnetic particle testing. The Central Office Materials Division maintains requirements and a list of qualified inspectors who can perform ultrasonic testing services. Most ultrasonic testing is outsourced. The Districts occasionally use other NDT such as eddy current, impact echo, Schmidt Hammer, rebar locator, etc. All complex NDT is outsourced (i.e. x-ray).</td>
<td>Yes. Virginia does not do underwater inspection in house.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>3 UBIVs</td>
<td>Dye-pen, UT, Mag Particle</td>
</tr>
<tr>
<td>We have an active project to procure and deploy a Digital Bridge Inspection Reporting application that will act as a front end to BrM. It will also enable tablet or mobile based data collection along with automated report development and other integrated workflows such as critical findings to improve oversight abilities related to workflow &amp; tracking for QA/QC of production activities. We are evaluating ways to integrate UAS technology and other advancements (i.e. 3D rendering, virtual and augmented reality, etc.). Looking for digital data collection to eliminate errors. Did an RFI and they are looking at different vendors. Important that they are keeping the same report structure for ease of use in all districts. CO will leave flexibility in the software for use by each District.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VDOT’s Consultant practice &amp; procedure review is robust, resulting in comprehensive manual/guidance updates that enhance deliverables. Additionally, we have overlapping QA oversight (e.g. multiple layers at district/CO, multiple report sources &amp; formats for scheduling/etc) that results in thorough programmatic controls. Decentralization can be a strength. They have a lot of standardization from the CO through policies, manuals, etc. The flexibility that is still permitted in the districts is a strength. Plus the districts each have a smaller amount of bridges and know their bridges well. VA thinks that 3000 bridges is a max to the number of bridges that a single report (office) can be responsible for.</td>
<td>Our A.A.S. Highway Engineering Technology – Bridge degree program, where each inspector ultimately earns an A.A.S. degree that is geared directly toward their daily job and is paid for by WVDOT, the narrative style of our inspection reports, and our QA/QC inspection and evaluation program.</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td>Routine In House</td>
<td>Consultant</td>
</tr>
<tr>
<td>Delaware</td>
<td>25% 75%</td>
<td>25% 75%</td>
</tr>
<tr>
<td>Georgia</td>
<td>1% 99%</td>
<td>0% 100%</td>
</tr>
<tr>
<td></td>
<td>Delaware</td>
<td>Georgia</td>
</tr>
<tr>
<td></td>
<td>Delaware</td>
<td>Georgia</td>
</tr>
<tr>
<td>Delaware</td>
<td>25% 75%</td>
<td>25% 75%</td>
</tr>
<tr>
<td>Georgia</td>
<td>1% 99%</td>
<td>0% 100%</td>
</tr>
<tr>
<td>Michigan</td>
<td>50% 50%</td>
<td>20% 80%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>50% 50%</td>
<td>0% 100%</td>
</tr>
<tr>
<td>North Carolina</td>
<td>100% 0%</td>
<td>50% 40%</td>
</tr>
<tr>
<td>Virginia</td>
<td>25% 75%</td>
<td>2% 99%</td>
</tr>
<tr>
<td>West Virginia</td>
<td>99% 1%</td>
<td>50% 70%</td>
</tr>
</tbody>
</table>
## Delaware

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>State</th>
<th>Question</th>
<th>Software Routine</th>
<th>Different Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>11</td>
<td>Delaware</td>
<td>Informal: the Delaware DOT load rating engineer provides classroom-style training for younger engineers as needed. Formal: NHI course, but nobody has attended in a while</td>
<td>BRASS</td>
<td>STAAD, MDX and other programs as used as needed.</td>
<td>Need to create a stand-alone bridge load rating manual</td>
<td>QC/QA Process</td>
</tr>
</tbody>
</table>

## Georgia

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>Informal</td>
<td>Currently the SBME is trying to obtain approval to develop a new load rating program through a University.</td>
<td>Ability to load rate substructures and be able to perform batch load rating down a highway corridor.</td>
</tr>
</tbody>
</table>

## Michigan

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michigan</td>
<td>Mostly on-the-job augmented by the Mich Tech Univ Center of Technology and Training, which does two load rating workshops per year for AASHTO BrR software, and series of webinars each year for certain topics. There have been workshops for LRFR and statewide workshops for local agencies and consultants. Also, bridge advisory when applicable.</td>
<td>AASHTOWare BrR</td>
<td>MDOT overload classification has worked very well for many years. Simple but effective. Creating the contract with STAP Training and reporting bugs for software. Purchase super site license for AASHTOWare BrR, as it promotes consistency.</td>
</tr>
</tbody>
</table>

## New Jersey

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Jersey</td>
<td>Yes. Load Rating team provides informal training sessions to in House staff.</td>
<td>Bentley LARS, PENNDOT programs, AASHTOWARE Virtis, STAAD</td>
<td>Developing QA/QC procedures and Developing a new load rating manual for all types bridges (Simple and Complex).</td>
</tr>
</tbody>
</table>

## North Carolina

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina</td>
<td>Training for load raters is on the job in the squad (Unit).</td>
<td>In-house developed software, also third party design and load rating software such as Conspan.</td>
<td>Provide a more systematic QA process for load rating.</td>
</tr>
</tbody>
</table>

## Virginia

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia</td>
<td>The training program is informal and consists of both OJT and scheduled courses through the VDOT Learning Center as they are made available. In previous years we have arranged various training courses for LRFD and LRFR topics. This year, we are hosting training in LARSA and DESCUS.</td>
<td>AASHTOWare BrR, DESCUS for curved steel girders and LARSA for finite element analysis.</td>
<td>Centralization of the load rating production efforts vs. having them currently spread across all Districts could enhance consistency, leverage efficiencies, reduce coordination costs and improve data accuracy. Each District would still be responsible for review and acceptance of the resulting data and for making posting determinations.</td>
</tr>
</tbody>
</table>

## West Virginia

<table>
<thead>
<tr>
<th>Question</th>
<th>Software</th>
<th>Changes They Would Like to Make to Their Program</th>
<th>Activities the Agency Considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Virginia</td>
<td>All load raters attend our annual Bridge Inspection Conference, sessions are conducted over a three day period that are geared toward structural evaluation. Otherwise, relatively informal, dependent on the position and location. Sometimes, district staff engineers train under the more seasoned evaluation engineer, but sometimes new hires must rely more heavily on guidance from the central office.</td>
<td>Bentley's LARS Bridge, also use AASHTOWare BrR and Midas Civil. Some in-house spreadsheets.</td>
<td>Evaluating our heavy permit suite for complex structures. For structures that were beyond the capabilities of our standard approved software (BrR and DESCUS), we required that additional load ratings be completed for carefully chosen vehicles to enable decisions on hauling permits. Please see pdf for these 8 special permit vehicles. This is not an issue with LARSA if it can be used.</td>
</tr>
</tbody>
</table>

**Note:**
1. I would consider our routine updates to bridge load ratings as one of our best practices, as well as our QA/QC Program. From exposure I've had to other state agencies, most have a hard time keeping up with updated load rating files. This could be attributed to other states not having jurisdiction over local/County bridges, versus WV/DE basically having all bridges in the state under jurisdiction.
2. We have good coordination between our inspection efforts and load rating efforts, based on almost all inspections being done in house. This is helpful at the local district office, as the inspection crews performing the inspections are typically under the supervision of the local evaluation/load rating engineer and District Bridge Engineer.
3. Our QA/QC program continues to grow and provide in-depth review and training to district load rating staff. We host a yearly conference where information and training are given to all statewide staff, and throughout the year district specific QA/QC meetings are held to review findings and provide hands-on training as needed.
<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Scour Critical Bridges</th>
<th>1. Scour POA Process</th>
<th>2. Scour Critical Bridge Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>State</td>
<td>Local</td>
<td>Do POAs identify when SC bridge should be monitored during flood?</td>
</tr>
<tr>
<td>Delaware</td>
<td>44</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Georgia</td>
<td>67</td>
<td>6</td>
<td>On all bridges regardless if scour critical or not.</td>
</tr>
<tr>
<td>Michigan</td>
<td>338</td>
<td>866</td>
<td>Yes. POA are part of MiBridge.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>136</td>
<td>265</td>
<td>Yes. As part of Scour POA, we monitor stream gauges associated with scour critical bridges during extreme rain events.</td>
</tr>
<tr>
<td>North Carolina</td>
<td>106</td>
<td>18</td>
<td>POA does not say when should be monitored for extreme flood event. Do by judgment.</td>
</tr>
<tr>
<td>Virginia</td>
<td>12</td>
<td>2</td>
<td>Yes – but generally it is unsafe to conduct the inspections during a flood event so if needed, remote monitoring (by local staff) may be utilized. Normally, inspections are done after the weather event has passed and conditions are safe for inspectors to access the site.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>102</td>
<td>4</td>
<td>Scour Critical Plan of Action is developed on a case-by-case basis for each individual structure and identifies at what frequency a particular bridge should be inspected for scour.</td>
</tr>
<tr>
<td>Category</td>
<td>Question</td>
<td>Delaware</td>
<td>Georgia</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>Do you have a risk-based approach to prioritize mitigation or replacement of SC bridges?</td>
<td>Scour critical bridges get additional points in the Deficiency formula that push it up the list. (See diagram below)</td>
<td>There only 44 scour critical bridge remaining. DelDOT is working to eliminate them through the Bridge Preservation and the general bridge replacement program.</td>
</tr>
<tr>
<td>Category</td>
<td>Question</td>
<td>Description of the OS/OW Process</td>
<td>Do you charge for permits requiring superload ratings?</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Delaware</td>
<td>Delaware processes over 50,000 OS/OW permits per year. DelDOT Bridge processes 400 OW permits per month. OS/OW program managed by Traffic section. OW permits come to Bridge. OS permits are processed by Traffic.</td>
<td>There is no fee for performing super or mega load ratings. Haulers often resubmit the same load with different axle configurations until they get an approved permit. Fees for permits are cheap and can be found in Section 3.2 of the OS/OW Hauling Permit Policy and Procedures Manual.</td>
<td>Yes. See link in 1b.</td>
</tr>
<tr>
<td>Georgia</td>
<td>Applications can be submitting online or by calling our permit department. Three full time DOT Permit Routers. Majority of the permits less than 150,000 lbs. are processed by our consultants in the remote permit office in Texas. About 15,000 permits per month.</td>
<td>Yes</td>
<td>Yes, See link in 1b.</td>
</tr>
<tr>
<td>Michigan</td>
<td>Utility permits section issues permits for standard axle configurations based on A-B-C-D overload classifications and/or width/height of load. There are 5 agents and 1 supervisor (6 total) who issue permits. All permits are issued by in-house staff. Michigan DOT has a customized, commercial off the shelf (COTS) permit software using Bentley Superload the web based interface is called the Michigan Transport Routing and Internet Permitting System (MiTRIP) which allows applicants to order oversize/overweight single trip and extended/annual permits.</td>
<td>No more than other permits, and not nearly enough to cover the cost of analysis.</td>
<td>We do have written procedures detailing the different requirements for acquiring permits and for acceptable rig. Our requirements can be found online <a href="http://www.dot.ga.gov/PS/Permits/OversizePermits">http://www.dot.ga.gov/PS/Permits/OversizePermits</a> We do not have a standalone QA/QC program, everything is done on a case by case basis as the need arises.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>There are 5 total DOT FTEs (3 administrative/clearance, 2 load) working on OS/OW permits. 0% consultant use. Approximately 10,000 permits processed per month. Fee structure: <a href="https://nj.gotpermits.com/njpass/Content/state/NJ/PublicMaterials/Fee-Schedule.pdf">https://nj.gotpermits.com/njpass/Content/state/NJ/PublicMaterials/Fee-Schedule.pdf</a></td>
<td>No</td>
<td>We do not currently have written procedures specifically for reviewing/possessing OS/OW permits. We do, however, have a variety of documentation available under “Reference Material” on the permitting website at <a href="https://nj.gotpermits.com/njpass/Home/Index#">https://nj.gotpermits.com/njpass/Home/Index#</a></td>
</tr>
<tr>
<td>North Carolina</td>
<td>Yes.</td>
<td>No, because comparing</td>
<td>No.</td>
</tr>
<tr>
<td>Virginia</td>
<td>We have 2 FTEs that are dedicated to the structural review of hauling permits plus a percentage of 3 more FTEs.</td>
<td>Our salaries are paid for by DMV which administers the permit program. So the charges come from the revenue generated by the permit fees.</td>
<td>We have instructions on how to use our spreadsheet, and we have the manuals for the various software packages.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>WVDOt employees two full-time technicians supervised by one full-time licensed engineer to oversee our OS/OW permit process out of our central office. OS/OW haulers log on to <a href="http://www.wv.GotPermits.com/wvpass/login.asp">www.wv.GotPermits.com/wvpass/login.asp</a> website and enter the route they wish to take. The route is analyzed by the Superload software and any structure with a dimensional or capacity violation is flagged for further investigation by the evaluation engineering staff in the appropriate district. The district evaluation staff will either approve, approve with conditions, or deny the permit. The number of permits issued in a given month varies greatly. However, in 2018 WVDOt issued 146,207 OS/OW permits and took in $10,280,982 in user fees.</td>
<td>Not at the current time.</td>
<td>Yes. WVDOt website has procedures and a list of permit agencies. Internal procedures are incorporated into the WVDOt Maintenance Manual.</td>
</tr>
</tbody>
</table>
**Appendix C - Peer State Interview responses**

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>2. How well is your OS/OW Permit Process Working?</th>
<th>3. Changes They Would Like to Make to Their Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>No – load ratings are not calculated for all OS/OW permit trucks. We use the FHWA Bridge Formula along with a screening process that includes using rating factors for 4 permit vehicles from the most recent load rating analysis for each bridge. If we can’t get the permit truck to successfully pass for the requested route using the bridge formula or the screening process, then we will perform a load rating analysis for that specific permit truck. The load raters are very efficient at processing the permits through the in-house developed programs. However, the number of permits continues to increase. The automated program will help and is much needed.</td>
<td>Link provided in 1b.</td>
<td>Completing the automated program is the top priority.</td>
</tr>
<tr>
<td>Georgia</td>
<td>We start analysis for loads grossing more than 180,000 lbs (Super load plus). Every load grossing less than that is evaluated based on the configuration requirement (number of axles, set up, and spacing); if the configuration falls within our guidelines, then the permit is issued without problems. The guidelines were developed based on what worked on our bridges (different analysis for different configurations in the past). Currently, we use the super load batch run option from our load rating program. It works fine.</td>
<td>Yes, located at <a href="https://gapros.dot.ga.gov/">https://gapros.dot.ga.gov/</a></td>
<td>Finding a way to link the load rating program to the permitting program. Which will eliminate the step of having to generate the bridge list and load file, then upload them to the load rating program to run the analysis.</td>
</tr>
<tr>
<td>Michigan</td>
<td>See the bridge analysis guide, there are many standard overload axle configurations that are rated for each bridge to produce the A-B-C-D classification. All bridges are rated using AASHTOWare B-H. Think pretty well. There are a handful of special loads annually requiring special analysis, otherwise the overload class system is quite efficient. Not a table, but the OS/OW permits section has the following website with permit costs: <a href="https://www.michigan.gov/mdot/0,4616,7-151-26662_26666_26679_27267,48606-182174--,00.html">https://www.michigan.gov/mdot/0,4616,7-151-26662_26666_26679_27267,48606-182174--,00.html</a> Cost for a single trip permit is as follows: Oversize $15.00, Oversize/Overweight $50.00 Cost for an extended permit is as follows: Oversize $30.00/12 month period, Overweight $100.00/12 month period</td>
<td>Convert all extended permit types to true annual permits. Have a seamless integration with all relevant data sources such as MiBridge databases, to feed live (or close to it) data into MiTrip and allow OS/OW permit applicants to login in straight to the application from MiLogin and not have to go through the Michigan Permit Gateway which is an extra step in the process, essentially I'd like to make it a better online shopping experience that is familiar to most</td>
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<td>New Jersey</td>
<td>Currently we do not calculate a rating for each bridge for each OS/OW configuration. We instead calculate an &quot;equivalent rating&quot;. Since we have the existing computed operating ratings for each legal load for each bridge as well as the bridge geometric data, a comparison is done between each legal load configuration/loading compared to the configuration/loading of the permit vehicle. This method is not ideal but it has been being applied conservatively until we are able to start performing ratings for each bridge / permit vehicle.</td>
<td>Working well</td>
<td>Currently our system is applying an &quot;equivalent rating&quot; to each permit vehicle based on a comparison between its configuration/loading and the configuration/operating ratings of the three legal loads in NJ. It has always been NDOT's intention to utilize the Superload system in collaboration with LARS Bridge in order to perform vehicle-specific ratings for as many bridges as possible along each route, but we have not yet linked our LARS files to Superload due to complications upgrading our load rating files to LARRF. We hope to begin testing LARS files with a limited number of Superload structures in the near future.</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Note: described above</td>
<td>Pretty good.</td>
<td>Process was reviewed and updated several years ago. Loose control over permitting when municipalities.</td>
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<tr>
<td>Virginia</td>
<td>Load ratings are calculated for each OS/OW permit. We use a spreadsheet to check by the moment comparison method and use BHR, DESCUS, or LARSA for in-depth analysis when required. The automated portion of the permitting (Superload) is only issuing 20% of the permits. The manual process is labor intensive, but routinely efficient, accurate and timely. Bentley system was in place around 2008. Going to put out an RFP to upgrade the OS/OW permitting program. They turn around permits in 3-4 hours typically.</td>
<td>Yes. <a href="https://njgotpermits.com/njpass/Content/state/NJ/PublicMaterials/Fee-Schedule.pdf">https://njgotpermits.com/njpass/Content/state/NJ/PublicMaterials/Fee-Schedule.pdf</a></td>
<td>Consolidation of the program to a single agency could simplify the complex system and data processes providing opportunities for better efficiency, reduced costs, improved data integrity and a more streamlined workflow with third party vendors hosting the hauling permit application.</td>
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<tr>
<td>West Virginia</td>
<td>Predetermined configurations are not utilized. Each truck configuration is calculated separately with a full analysis by the Superload software which utilizes Bentley LARS models that have incorporated any deficiencies current with the most recent inspection. We feel it is the best option we currently have available, but we continue to search for better options.</td>
<td>Yes (see attached).</td>
<td>Would like for automated permit procedure to have the capabilities of analyzing complex structures via finite element analysis, 3D modeling, etc. Would also like to see increased fines for OS/OW violators.</td>
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<td>Category</td>
<td>4. Activities the Agency Considers Best Practice</td>
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<td>Delaware</td>
<td>The in house Q-Permit program works pretty well. Also, DelDOT has consistency in reviews because only 2 people are processing permits. Despite the number of permits, most permits done the same day (3 day max allowable by state law)</td>
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<td>Georgia</td>
<td>Our permits turnaround time is very competitive. Some straight forward permits can be self-issued. We are very accessible to our customers</td>
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<td>Michigan</td>
<td>Michigan analyzes OS/OW permits by axle weight and spacing, which is an important consideration for Michigan because they allow very heavy legal and permit loads.</td>
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<tr>
<td>New Jersey</td>
<td>Approximately 85% of permits are system-issued without human intervention. That has resulted in a major time and cost savings from when 100% of permits required manual review prior to the implementation of the automated online program.</td>
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<tr>
<td>North Carolina</td>
<td>Capacity of bridge established each time bridge is load rated. New software being used linked WIGINS. Permit provides axle load and spacing, and software determines the capacity for each bridge, then calculate demand. If capacity is high enough, green, if within 10 percent above or below, then additional work done.</td>
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<tr>
<td>Virginia</td>
<td>Requiring before and after inspections for mega-loads when determined to be necessary and entering into a separate agreement with haulers for such outsized loads. Office of the Attorney General wrote the agreement. They are willing to share.</td>
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<tr>
<td>West Virginia</td>
<td>We perform daily QA/QC to ensure correctness of automated permit procedure. Excellent communication exists and is encouraged between permitting and load rating staff.</td>
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<td>Category</td>
<td>1. Constraints/Authority</td>
<td>2. Bridge Maintenance Budget</td>
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<td><strong>Question</strong></td>
<td>How does your agency respond to high priority repairs? (In-house crews or contractors?)</td>
<td>What is a typical budget amount for this type of repair?</td>
<td>Do you have staff dedicated to assure that posting/closed signs are placed properly?</td>
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<tr>
<td><strong>Delaware</strong></td>
<td>In-house or on-call structure maintenance contract, depending on the type of repair.</td>
<td>Varies, but we fund 5 separate on-call structure maintenance contracts Statewide for a total of ~$4.5M/year. Not all of this amount is for high priority repairs.</td>
<td>The Bridge Management Engineer reviews all postings. All posting signs are clearly recorded (with locations and pictures) in the inspection reports.</td>
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<td><strong>Georgia</strong></td>
<td>It can be either or depending on the emergency</td>
<td>Not tracked</td>
<td>This is through the Districts, so we don't know how many.</td>
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<tr>
<td><strong>Michigan</strong></td>
<td>Primarily by the Statewide Bridge crew that has ability to do steel repairs and place temporary supports. There also are as-needed contracts in place for contractors to be used if needed.</td>
<td>$0.75 million emergency contract fund and $8 to 10 million for RFAs, and $3M for special needs.</td>
<td>Region responsibility. It is required that a photo showing the placed load posting sign be uploaded in MiBridge. This was initiated as part of a FHWA agreed upon Plan of Action. Also, part of the inspection procedure is to verify that the sign is present and matches the recommended posting.</td>
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<td><strong>North Carolina</strong></td>
<td>Bridge inspector issues Prompt Action Request (PAR) need as; critical finding, priority maintenance, or routine. As per policy memo, if critical finding, action to be taken by Division within 10 days, they must respond with plan within 10 days and repair done in 45 days. Priority maintenance; general expectation with year. Routine maintenance up to Division. Central office tracks follow up on Critical findings. Used to follow-up also on Priority maintenance. All handled in WIGINS. Manager can review all tiers anytime.</td>
<td>Not known. Contained in Division overall maintenance program.</td>
<td>SIA group sends out notification for posting signs. Division staff are responsible to assure posting/closed signs are placed. Field operations does follow-up. SIA group sends letter by email and tracks. Letter sent to Division. Filed in the bridge. Signed off when action is completed. Email process vs a automated process</td>
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<tr>
<td><strong>Virginia</strong></td>
<td>We use both in-house crews and on-call contractors, as well as hired equipment contractors</td>
<td>$8M per year statewide</td>
<td>Yes, although this is no their sole responsibility</td>
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<td><strong>West Virginia</strong></td>
<td>Virtually all high priority repairs are responded to by state personnel. However, statewide contracts are sometimes available as a tool to utilize on-call contractors if necessary.</td>
<td>There is no budget specially allocated for this type of work. It is primarily funded with existing allocations.</td>
<td>Bridge safety inspectors are required to include photographs of all bridge restriction signs to be included in each inspection report.</td>
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<tr>
<td>Delaware</td>
<td>Do you have dedicated bridge maintenance funds or do you have to compete for funding from a general maintenance fund?</td>
<td>Yes – for our movable bridges. We have a 5-year open-end statewide movable bridge cyclical maintenance project. The funding is ~$9M over 5 years and is funded through our Bridge Maintenance pot of monies.</td>
<td>No.</td>
</tr>
<tr>
<td>Georgia</td>
<td>Dedicated.</td>
<td>We have a sole Master contract for our two cable stay bridges (covers preservation/rehab and inspection). It is funded out of my $5 million SR lump sum.</td>
<td>Yes. Along with the Bridge Repair manual.</td>
</tr>
<tr>
<td>Michigan</td>
<td>Must compete with other needs. There is a dedicated bridge preservation fund (2019 $39 Million) which is money allocated to bridge preventive maintenance done by contract.</td>
<td>There is a Big Bridge Committee that plans rehab activities for large or complex structures. This would include PM as well as rehab/replacement. There is a pot of money set aside for these bridges taken from the top of the overall bridge program budget. On average it amounts to $20 Million annually, but this covers replacement as well.</td>
<td>MDOT has a general Capital Preventive Maintenance (CPM) manual. It does not provide specific repair instructions.</td>
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<td>North Carolina</td>
<td>No.</td>
<td></td>
<td>Not known</td>
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<td>Virginia</td>
<td>Both. Each district bridge office gets a budget at the beginning of the fiscal year, but district bridge office reports to an overall maintenance manager who must redistribute funds throughout the year to meet goals and spending targets. We have developed a list of 25 “special structures” that include large, complex and important structures. It includes all movable bridges, all tunnels, and very large or complex bridges. We are in the process of developing a special budget and prioritization process for those structures.</td>
<td>Yes. Chapter 32 of VDOT’s Manual of the Structure and Bridge Division. See link below: Chapter 32 of VDOT’s Manual of the Structure &amp; Bridge Division.</td>
<td>Yes. We conduct a three day workshop on a biennial basis in addition to ad-hoc training.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Bridge maintenance funds are dedicated as described above. Special programs are not routinely allocated toward significant structures, although projects might be programmed and funded periodically to address needed repairs/renovations. No full-time employees are dedicated solely to high priority bridge repairs. The high priority repairs are assigned to one of our existing maintenance crews as needed. Policies are handled through bridge maintenance directives in lieu of a manual.</td>
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<td>Category</td>
<td>6. What bridge maintenance and repair activities can your in-house staff perform?</td>
<td>7. Responding to Bridge Inspection Findings</td>
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<tr>
<td>Question</td>
<td>Do you have a process to prioritize and implement inspector recommendations/findings?</td>
<td>Who performs the corrective actions to address the recommended high priority and critical findings from Bridge inspection?</td>
<td>What process do you use for following up on high priority and critical findings from bridge inspections (flags)?</td>
</tr>
<tr>
<td>Delaware</td>
<td>Cleaning, sealing concrete, spall repairs</td>
<td>Only for a few low priority actions that aren’t addressed through our Bridge Inspection Software or the standard NBI Elements. These few low priority actions are entered by the inspection team into Maximo (Maintenance Software) and assigned to the corresponding area maintenance yard.</td>
<td>Could be either or depending on the severity and complexity of the corrective action but is typically contractors except for replacing deteriorated/failed cmp culvert bridges.</td>
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<tr>
<td>Georgia</td>
<td>None, our staff only inspects and develops plans sets. The District staff can perform the following: Spall repairs (Deck, Super and Sub) Correction of Erosion issues Reconstruction of damaged concrete elements Joint repair</td>
<td>Yes. Highway Maintain Systems – Informs District of recommended work required on a bridge structure.</td>
<td>Both.</td>
</tr>
<tr>
<td>Michigan</td>
<td>Deck patching (both structural and for ride quality), beam end repairs, heat straightening, temp supports, sealing decks, epoxy overlays, epoxy injection, rocker bearing alignment, ... Counties are also contracted to do maintenance. They also assist bridge authorities (Michigan has three signature bridge long span bridge authorities, Mackinac Bridge, Blue Water Bridge, International Bridge.)</td>
<td>Yes. Michigan DOT has the Request For Action (RFA) process and Bridge RFA Coordination Committee. A guidance document for the committee is provided and is described in the presentation in following link: <a href="http://sp.maintenance.transportation.org/Documents/Michigan%20DOT%20Bridge%20Request%20For%20Action%20Process.pdf">http://sp.maintenance.transportation.org/Documents/Michigan%20DOT%20Bridge%20Request%20For%20Action%20Process.pdf</a></td>
<td>Statewide bridge crew, region or county maintenance crews, as-needed contractors, and bid contractors.</td>
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<td>North Carolina</td>
<td>Types of bridge maintenance activities done; repair concrete spalls, shotcrete, small pipe replacement, beam end painting, small bridge replacement. NCDOT does not do deck joints as much as they would like to.</td>
<td>Yes. Described above.</td>
<td>Depends upon work needed.</td>
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<td>Virginia</td>
<td>All actions from cleaning, patching, epoxy overlays, and full bridge replacement. Our bridge crews are capable of spot painting but generally do not perform recoating. We do not generally install concrete overlays.</td>
<td>Yes, but each district currently performs this prioritization in a unique fashion</td>
<td>Either/both depending on the need. The work is completed at the district level. Tracking is all done at the district level. The authority and accountability falls at the district level.</td>
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<tr>
<td>West Virginia</td>
<td>Steel fabrication and repair, concrete pouring and formwork, reinforcing bar installation, new bridge construction, deck replacement, retrofitting of bearing devices, expansion device replacement, cleaning and painting, concrete patching.</td>
<td>The District Bridge Engineer creates a list and prioritizes based off bridge inspection reports. However, if the finding meets certain criteria and deemed to be a critical finding, the deficiency and recommended repair is placed on the FHWA Critical Findings database where it is closed out once the needed repairs have been accomplished.</td>
<td>Primarily state personnel except in cases where repairs are extremely time consuming or specialized.</td>
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<tr>
<td>Category</td>
<td>8. Changes they would like to make to their program</td>
<td>9. Activities the Agency considers Best Practice</td>
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<td>Delaware</td>
<td>Bring back pile jacketing program. Start up a bridge washing program. Incorporate dedicated bridge crews (in-house) for each district. Develop a full Bridge Maintenance Section.</td>
<td>As a result of an incident report on I-495 in 2014 that was not directed to the Bridge Section, DelDOT initiated a High Priority Road Condition Process to address any notifications of concerns about bridges. DelDOT Bridge Personnel must respond to High Priority concerns immediately. All High Priority Road Conditions are tracked internally until they are closed out at the level of the Chief Engineer. Also, DelDOT follows up with the person who initiated the concern to notify them of how their concern was resolved.</td>
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<td>Georgia</td>
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<tr>
<td>Michigan</td>
<td>The underlying issue is lack of funding for the capital program. With appropriate funding, there would be less operational issues.</td>
<td>RFA process and committee and statewide bridge crew. Having reach-all available for inspection and repair. Able to do hands-on inspections. Also available for locals. Smaller reach-all less weight for locals. Everyone works well together and helps out.</td>
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<tr>
<td>Virginia</td>
<td>Have one bridge crew per district dedicated to five actions: Overlays, Joint elimination, Beam end coating, Beam end repairs, Culvert liners for steel culverts</td>
<td>Overlays, Joint elimination, Beam end coating, Beam end repairs, Culvert liners for steel culverts</td>
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<tr>
<td>West Virginia</td>
<td>Additional funding for bridge maintenance and replacement. Increase preventative maintenance activities with a dedicated funding source.</td>
<td>Our Transportation Apprenticeship Program encourages the career growth of each bridge maintenance employee by requiring additional training, certification, etc. in order to be classified into higher tiers within their classification series. This program has not only helped the employee, it has also helped the department to develop seasoned and well-rounded bridge maintenance employees.</td>
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<td>Category</td>
<td>1. Bridge Management System (BMS)</td>
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<td>Question</td>
<td>Do you have an operating BMS? Can you do bridge condition or performance measure trend monitoring? Do you have deterioration models for your BMS?</td>
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<tr>
<td>Delaware</td>
<td>Yes. AASHTO BrM. We are currently developing the program/software and we will be able accomplish this once implemented. Yes</td>
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<td>Florida</td>
<td>Yes. AASHTO BrM. Yes Yes</td>
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<td>Georgia</td>
<td>Yes. AASHTO BrM. Yes. Yes</td>
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<td>Michigan</td>
<td>Yes, AASHTOWare BrM and in-house developed tools; Bridge Condition Forecast Systems (BCFS) for doing network level forecasting of condition. Yes, through database queries and standard MiBridge reports. We are currently developing the program/software and we will be able accomplish this once implemented. Yes, for NBI General Condition Ratings (GCRs) and elements.</td>
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<td>New Jersey</td>
<td>Yes, we do have an operating BMS. It is BrM. Yes. We have developed excel-based historical NBI data tool, which has enabled us to create bridge condition trends (both by count and by deck area). It has helped us in monitoring performance measure typically grouped by the bridge owners, NHS and Non-NHS, and MPOs. Yes. We have developed both NBI Component as well as Element Level Deterioration models in BMS initially based on the expert judgement and solicitation process. Using BrM 6, we have calibrated initial deterioration rates using zero-fund optimization runs. In order to give realistic results, we have fine-tuned these models inside BrM couple of times. We are still working on validating these models specific to NJDOT conditions.</td>
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<td>Question</td>
<td>Do you have an operating BMS? Can you do bridge condition or performance measure trend monitoring? Do you have deterioration models for your BMS?</td>
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<tr>
<td>North Carolina</td>
<td>Working on. Yes. AgileAssets. Yes. Not satisfied with Agile optimization engine. We have do manually. Build custom report. Can do easier writing own SQL from bridge database. Performance measures are reduce SD and what is shown in TAMP. Yes, done by university research. Can show bridge by bridges and apply life-cycle analysis to set treatments.</td>
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<tr>
<td>Virginia</td>
<td>Yes, but not using a standard software package. We have developed all of the logical input components for a functional BMS, but our work is currently performed in customized spreadsheets. We are working to fully adopt the BrM software for our BMS system. Yes</td>
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<tr>
<td>West Virginia</td>
<td>Yes. Deighton DTIMS (latest version). Yes</td>
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Appendix C - Peer State Interview responses
### Appendix C - Peer State Interview responses

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<tr>
<th>Category</th>
<th>Question</th>
<th>Delaware</th>
<th>Florida</th>
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<th>Michigan</th>
<th>New Jersey</th>
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<tr>
<td></td>
<td>Are you able to forecast bridge condition? Network and/or bridge level?</td>
<td>We are currently developing the program/software and we will be able accomplish this once implemented.</td>
<td>Yes/Yes</td>
<td>Yes</td>
<td>Yes at the network level using BCF5 (spreadsheet) and using spreadsheets at the bridge level (more accurate at short term) based on processes in BrM but not yet implemented.</td>
<td>No, we have not manually forecast bridge condition. We have utilized Markovian as well as Weibull functions developed in BrM to perform both bridge level and network level forecasting on bridge condition. We have planned to enhance this process in BMS by improving this functionality in BrM 6.</td>
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<td>Does your BMS currently provide project level recommendations for replacement, rehabilitation and preservation?</td>
<td>The software has this capability, however, we don’t envision using this feature.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes.</td>
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<td>Are you able to do optimization and strategic investment planning?</td>
<td>We are currently developing the program/software and we will be able to optimize our forecasting analysis. Regarding the investment planning – this really falls to DelDOT’s Finance Section.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>BMS have not completed the implementation of the BrM 6 optimization functionality. Although we have set BrM 6 to do optimization and strategic investment planning on multiple test runs, we are not getting reasonable results at this time. This effort will be in accordance with New Jersey FHWA-complied TAMP (Transportation Asset Management Plan). We have manually performed Gap Analysis to figure out our bridge needs for the State of Good Repair versus Planned Funding.</td>
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<td>Category</td>
<td>Question</td>
<td>North Carolina</td>
<td>Virginia</td>
<td>West Virginia</td>
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<tr>
<td>Question</td>
<td>Are you able to forecast bridge condition? Network and/or bridge level?</td>
<td>Five year out, apply deterioration, deck, super and sub, and treat structure, what we find is we have so many just outside 5, when you apply deterioration, all of those drop into a lower condition rating. Huge amount of structures fall into 5 all at once. Another issue, interface is not set up to do level of service constraint, very well. If monetary, can identify okay. If LOS is objective the model does not do very well. They go year by year, and satisfy constraint. If year three not enough treatments, then will produce and error. Would like to go to probability deterioration.</td>
<td>Yes. It does it well. As long a decision trees are set up it does a good job. Set up treatments correctly is very important.</td>
<td>DTIMS model provides this, but review of model will be paramount.</td>
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<td></td>
<td>Does your BMS currently provide project level recommendations for replacement, rehabilitation and preservation?</td>
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<td>Are you able to do optimization and strategic investment planning?</td>
<td></td>
<td>Yes. But not a lot of buy-in yet for strategic planning. Trust factor and learn to understand the results</td>
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<td>Category</td>
<td>Question</td>
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<td>Florida</td>
<td>Georgia</td>
<td>Michigan</td>
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<td>Is this information used to determine budget needs?</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
<td>Yes.</td>
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<td>Do you collect element level data and is it being used for bridge management?</td>
<td>Yes. A Deficiency Formula is used. See Section D, question 2b for formula.</td>
<td>Being Developed</td>
<td>Yes.</td>
<td>BCFS and other in-house tools are used to determine budget needs at this time.</td>
<td>Yes. The approved strategies from BMS analyses are incorporated into budget needs through a process called &quot;pool-sheets&quot;. The results from pool sheets are fed into the Capital Program, which is updated annually, and the 10-year STIP, which is updated every 2 years. Capital Investment Strategies are also actively involved in this process.</td>
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<td>Do you have a risk-based prioritization process for selecting bridge projects?</td>
<td>Yes.</td>
<td>Being Developed</td>
<td>No.</td>
<td>Yes.</td>
<td>Yes.</td>
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<td>Do you report to senior management and/or the public with bridge performance dashboards?</td>
<td>Being Developed</td>
<td>Being Developed</td>
<td>No.</td>
<td>Yes.</td>
<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>We are currently developing the program/software and we will be able to accomplish this once implemented. We don’t plan to hang our hat completely on this, but will use it to get a general sense of future funding needs.</td>
<td>Currently we report percentage of bridges in excellent, good, fair and poor condition, by FDOT standards. 8 &amp; 9 = Excellent, 6 &amp; 7 = Good, 5 = Fair, 4 and below = Poor. (Based on lowest of Deck, Superstructure and Substructure. Also report number of bridges inspected, bridges replaced and funds spent on bridge replacement. These are reports and not dashboards. Reports go to senior management and the Florida Transportation Commission.</td>
<td>Yes. for river crossing there is calculated risk at the bridge level. While it doesn’t use a calculated scoring system, the bridge call for projects is built based on risk – we have a stricter goal for serious/critical bridges as well as for our higher importance routes (Interstate and Freeway).</td>
<td>Yes. The approved strategies from BMS analyses are incorporated into budget needs through a process called &quot;pool-sheets&quot;. The results from pool sheets are fed into the Capital Program, which is updated annually, and the 10-year STIP, which is updated every 2 years. Capital Investment Strategies are also actively involved in this process.</td>
<td>Yes. Public dashboard is available.</td>
<td>Yes. The risk-based prioritization process for project selection is done manually within the BMS. In order to achieve this prioritization, we have utilized historical data, asset management experts, structural engineering experts, and the current bridge inspection experts. Also, BrM 6 has the risk assessment module, which is developed and utilized based on the study done by our research partner to calculate initial risk values. The risk values are incorporated into utility function to perform multi-objective optimization analysis. Currently, we are not actively collecting risk data during our inspections; however, we are going to enhance this process in future where approved team leaders can modify the risk values as needed based on the field conditions.</td>
</tr>
<tr>
<td>Category</td>
<td>Question</td>
<td>North Carolina</td>
<td>Virginia</td>
<td>West Virginia</td>
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<tr>
<td></td>
<td>Is this information used to determine budget needs?</td>
<td>do outside of BMS&lt;br&gt; Budget for Capital bridge program for all systems, replacement bridge program, rehab can be either bridge program or preservation, preservation program, general maintenance&lt;br&gt; Bridge program STIP and general bridge program (state funded)&lt;br&gt; General maintenance done in-house. Maint allocated to each division. Do not use BMS for that. Based on current maint needs that are existing. Also look at past expenditures&lt;br&gt; Make recommendation for preservation budget.</td>
<td>Yes. Three years. Not being used for management yet. Do not have element modeling in BMS. They told me they are able to do. In 7.3 has. Schema set up to store element data.</td>
<td>We are in the initial stages. Information was used in TAMP creation to determine additional bridge funding required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you collect element level data and is it being used for bridge management?</td>
<td>yes. Three years. Not being used for management yet. Do not have element modeling in BMS. They told me they are able to do. In 7.3 has. Schema set up to store element data.</td>
<td>No, not by formula. It is considered through engineering knowledge and judgment. Going through candidate lists. Not doing cost benefit analysis yet.</td>
<td>Yes. Three years. Not being used for management yet. Do not have element modeling in BMS. They told me they are able to do. In 7.3 has. Schema set up to store element data.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Do you have a risk-based prioritization process for selecting bridge projects?</td>
<td>No, not by formula. It is considered through engineering knowledge and judgment. Going through candidate lists. Not doing cost benefit analysis yet.</td>
<td>Yes. Have internal dashboard and public showing percent SD and BHI (Bridge Health Index) and divided by three road systems (fund interstate, primary, secondary)</td>
<td>Not presently but risk is defined in TAMP.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Do you report to senior management and/or the public with bridge performance dashboards?</td>
<td>yes. Have internal dashboard and public showing percent SD and BHI (Bridge Health Index) and divided by three road systems (fund interstate, primary, secondary)</td>
<td>Yes. Have internal dashboard and public showing percent SD and BHI (Bridge Health Index) and divided by three road systems (fund interstate, primary, secondary)</td>
<td>Yes.</td>
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</tbody>
</table>

Appendix C - Peer State Interview responses
<table>
<thead>
<tr>
<th>Category</th>
<th>2. Key Performance Indicators</th>
<th>3. Bridge Project Selection</th>
<th>5. Bridge Capital Program Annual Budget (Projects that)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>a. What key performance indicators or performance measures are used to evaluate the bridge program's effectiveness in achieving the agencies bridge goals/objectives (aside from FHWA metrics)?</td>
<td>Describe your current process for prioritizing projects for replacement, rehabilitation, preservation and maintenance.</td>
<td>How was the bridge program developed in your TAMP?</td>
</tr>
<tr>
<td>Delaware</td>
<td>DeIDOT uses strictly NBI condition ratings to track bridge performance. DeIDOT tracks the condition of NB bridge deck area on the NHS and the overall condition of the bridge inventory. DeIDOT has a Bridge Inventory Dash Board. Condition of bridges as Good/Fair/Poor are tracked annually. Bridges are ranked for work using the Deficiency Formula. The Bridge Design and Bridge Management Sections meet quarterly to go through the list, track progress of projects, and make updates as necessary to ensure that the most critical bridges are getting worked on.</td>
<td>Link is below. <a href="https://delidot.gov/Publications/tam/p/pdfs/DeIDOT-Transportation-Asset">https://delidot.gov/Publications/tam/p/pdfs/DeIDOT-Transportation-Asset</a> Management-Plan-2019.pdf</td>
<td>Rehabilitation and Replacement $45M +/- Annually</td>
</tr>
<tr>
<td>Florida</td>
<td>Percent bridges in good condition (see previous answer). Percent of work orders completed on time. Bridge inspections completed on time. Project is elevated through management based on cost and criticality. From district bridge maintenance office to district production office to district secretary to state secretary</td>
<td>Followed FHWA guidelines.</td>
<td>$154M</td>
</tr>
<tr>
<td>Georgia</td>
<td>Percent bridge in Good or Poor condition. Strength and Condition</td>
<td>Currently we utilize spreadsheets and queries to determine projects, however GDOT has purchased the AASHTO BrM program and is beginning the process of utilization of that program (as per GDOT TAMP).</td>
<td>We are starting to implement BrM. We attempt to utilize 50 to 60% of our lump sum budgets to Rehab.</td>
</tr>
<tr>
<td>Michigan</td>
<td>Good, Fair Poor bridges on freeway and non-freeway similar to FHWA national performance measures except Michigan DOT does by bridge and not deck area. Deck Area on NHS in Good, Fair, Poor condition. The optimal balance between replacement, rehabilitation, and preventive maintenance is determined including current, project level commitments to meet condition goals. The funding is distributed between regions based on candidates. Prioritization within these limits is at discretion of the region and in coordination with the road program. Project selection is through the Call for projects annual process, which is reviewed by a team of bridge managers for conformance to the annual objectives.</td>
<td>Using in-house tools and AASHTOWare BrM.</td>
<td>$180 Million typical.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>We are using the FHWA required performance metrics, which are percentage of bridges in GOOD condition by deck area and the percentage of bridges in POOR condition by deck area. We are also using the same metrics by count. Other than this, our key performance indicators (KPI) is for the inspection program, which includes number of structures inspected every year by in-house staff and the consultant community. We are looking into adding more KPI based on bridge attributes such as age, importance, etc. Internally, we have been creating Bridge Fact Sheets for our inventory, and Fast Facts on our goals and objectives.</td>
<td>BMS uses manual process to evaluate prioritization which focus primarily on the bridge condition, and other factors such as risks (like scour, fatigue, flood, vehicle collision, etc.), route importance (e.g. interstate, major corridor, evacuation route, etc.), ADT (including percentage of truck traffic), current status of project phase, bridge type, other than bridge needs, etc. The Replacement and Rehabilitation programs uses historical condition data to prioritize projects, and further reviewed by the team made of experts from asset management, structural engineering, and current bridge inspection staff. Bridge Maintenance unit currently manages the Preservation and Maintenance programs which include priority repairs and preventive maintenance contracts. We are collaborating with Maintenance to develop a data-driven and planned Preservation program using BMS tools.</td>
<td>We utilized Consultant to develop our TAMP. As a part of FHWA compliance, we have been collecting NBI data statewide on all NBIS bridges on the NHS regardless of the ownership. For SFY 2018, the Bridge Capital Program Annual Budget for Rehabilitation and Replacement is about $214.34 Million</td>
</tr>
<tr>
<td>Category</td>
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<td>Describe your current process for prioritizing projects for replacement, rehabilitation, preservation and maintenance.</td>
<td>How was the bridge program developed in your TAMP?</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Performance measures are reduce SD and what is shown in TAMP.</td>
<td>NCDOT has a prioritization process with a lot of factors; PRI (priority ranking index) priority, rating index, Projects are selected in cooperation with central office and Division. Each Division has a program manager with knowledge of WIGINS. They are mandated to focus on SD bridges, PRI team selects candidates. Team includes BMS engineer, and 6 other people. Division bridge engineers, now what TAMP goals are and know GAP, look at goals. What to get to in time period.</td>
<td>Program reflected current practices. Projections of future conditions used element-level deterioration, recommended actions, budget constraints, and past actions to predict future conditions on NHS NBI structures. Work was performed in a customized spreadsheet.</td>
</tr>
<tr>
<td>Virginia</td>
<td>Condition</td>
<td>Construction program prioritizes according to a selection formula that includes parameters for risk, functionality, condition, cost-effectiveness, and importance. See link for explanation: Virginia’s State of Good Repair Process. Maintenance program provides more flexibility for district offices. We have our office practice (see response to item 4 of Section F of this survey), and our performance metrics. District bridge offices are expected to formulate plans that meet both metrics and office practice requirements.</td>
<td>Program reflected current practices. Projections of future conditions used element-level deterioration, recommended actions, budget constraints, and past actions to predict future conditions on NHS NBI structures. Work was performed in a customized spreadsheet.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Within the BMS, all key performance indicators are defined and modeled in DTIMS (see attached WVDOH Transportation Asset Management Plan).</td>
<td>District Bridge Engineer determines prioritization based on structure type and condition, average daily traffic, type of traffic, alternate detour length, etc. as funding is available.</td>
<td>Starting point for systematic prioritizations. Reliance will be given to BMS for prioritizations.</td>
</tr>
</tbody>
</table>
### Appendix C - Peer State Interview responses

<table>
<thead>
<tr>
<th>Category</th>
<th>6. Changes they would like to make to their program</th>
<th>7. Activities the Agency considers Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>Bridge Management side of things is ~$5.5M per year. Obtain additional staff to accommodate a full time Bridge Maintenance Squad. Currently, the Bridge Maintenance Engineer oversees the entire program with assistance from 2 engineer bridge inspectors as their schedule allows.</td>
<td>Quarterly meetings between Bridge Management and Bridge Design staff to discuss all projects is critical to ensuring that no bridge falls through the cracks. Bridge Management staff have the opportunity to discuss concerns from recent inspections. Bridge Design staff provides updates on projects. Projects that hit delays can sometimes have interim maintenance to extend life. Every bridge in critical condition is discussed.</td>
</tr>
<tr>
<td>Florida</td>
<td>$92M Increase staff funding</td>
<td>Inspection Program</td>
</tr>
<tr>
<td>Georgia</td>
<td>We attempt to utilize 40 to 50% of our lump sum budgets to Preservation</td>
<td></td>
</tr>
<tr>
<td>Michigan</td>
<td>$39 Million (2019) We are currently underfunded and cannot maintain bridge conditions. There is also significant underfunding of bridge in the local system. We are in process of making other changes such as BrM implementation.</td>
<td>We have a lot of people that have embraced a mix of fixes at every level of the organization. Through the RFA process and the fact that we include the regions in the call for projects process, proposed projects are reviewed by peers. Since funding allocations are impacted by the condition of all regions, the group has done well in holding each other accountable and in maintaining alignment.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>For SFY 2018, the Bridge Capital Program Annual Budget for Preservation is about $167.50 Million</td>
<td>I. Enhance interactions with Bridge Maintenance Unit to improve the Bridge Preservation/Preventive Maintenance Program. II. Increased technical staffing that are experts in Data Science</td>
</tr>
<tr>
<td>Category</td>
<td>Question</td>
<td>North Carolina</td>
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<tr>
<td></td>
<td>6. Changes they would like to make to their program</td>
<td>Would like more integration between what we capital program does and maintenance does. Would like real-time updating of what done and track cost. Don’t have enough experience right now. Better coordination of best practice among Divs. Improve algorithms and forecast models.</td>
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<tr>
<td></td>
<td>7. Activities the Agency considers Best Practice</td>
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Appendix C - Peer State Interview responses
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<th>Category</th>
<th>1. Local Agency Organizational Structure</th>
<th>2. Local Agency Bridge Inspection</th>
<th>3. Local Agency Load Rating</th>
<th>4. Do local agencies issue OS/OW permits? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Do local agency’s (counties, cities, townships) own and maintain highway bridges? (Yes/No)</td>
<td>Who does the routine bridge inspections for local owned highway bridges</td>
<td>Who conducts the QC/QA on these inspections?</td>
<td>Who load rates local agency bridges including complex structures?</td>
</tr>
<tr>
<td>Delaware</td>
<td>Yes. There are only 11 NBI local bridges</td>
<td>DeIDOT does all inspections.</td>
<td>DeIDOT does all QC/QA on these inspections</td>
<td>DeIDOT does the load ratings.</td>
</tr>
<tr>
<td>Florida</td>
<td>Yes</td>
<td>Consultants</td>
<td>State</td>
<td>Consultants</td>
</tr>
<tr>
<td>Georgia</td>
<td>Yes</td>
<td>GDOT BMU</td>
<td>GDOT BMU</td>
<td>GDOT BMU – thru consultant</td>
</tr>
<tr>
<td>Michigan</td>
<td>Yes</td>
<td>Vast majority by consultant, a few locals do it in-house.</td>
<td>QC and QA is done in accordance to the Michigan DOT Structures Inspection Manual. QA is done annually by a consultant contract.</td>
<td>Virtually all by consultant.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Yes</td>
<td>NJDOT selected Consultants</td>
<td>Consultant PM’s and NJDOT In House staff</td>
<td>Consultants</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Counties do not own bridges. Cities own some bridges. NCDOT inspects and load rates all bridges unless the municipality requests to do.</td>
<td>NCDOT</td>
<td>NCDOT</td>
<td>If the local agency inspects their bridges, they also become responsible for load rating, otherwise NCDOT</td>
</tr>
<tr>
<td>Category</td>
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<td>Who conducts the QC/QA on these inspections?</td>
<td>Who load rates local agency bridges including complex structures?</td>
</tr>
<tr>
<td>Virginia</td>
<td>Yes, some do, however, the State owns and maintains the vast majority of the Secondary routes within the Counties.</td>
<td>Most of the routine inspections for localities are performed by Consultants.</td>
<td>QA/QC is performed by the owner, however, where VDOT has oversight responsibilities (NBIS) we also perform QA/QC in accordance with our policies.</td>
<td>Most load ratings for locality owned bridges are performed by Consultants.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Yes, cities and townships. Structures located on county routes are maintained by the state.</td>
<td>WVDOT</td>
<td>WVDOT</td>
<td>WVDOT</td>
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<tr>
<td>Category</td>
<td>Question</td>
<td>Delaware</td>
<td>Florida</td>
<td>Georgia</td>
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<td>5. Who is responsible for maintenance, repair, rehabilitation, and replacement of local agency and other owner highway bridges?</td>
<td>The local agency is responsible for maintenance, repair, rehabilitation and replacement of locally owned bridges. DelDOT will work with the local agency to secure funding and assist with design and/or design plan reviews. The local agencies are responsible for posting and closing their bridges.</td>
<td>County maintain &amp; repair, DOT has legal responsibility to post/close local bridges</td>
<td>The Owners. GDOT may assist with replacement under several programs (such as low impact bridge replacement programs and LMIG).</td>
</tr>
<tr>
<td></td>
<td>7. Does the DOT have legal authority in your state to self-perform and/or oversight of any of these activities for local agency or other owner bridges?</td>
<td>Yes – regarding inspections.</td>
<td>No</td>
<td>Typically yes, but exception exists</td>
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<tr>
<td></td>
<td>8. Changes they would like to make to their program</td>
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<td></td>
<td>9. Activities the Agency considers Best Practice</td>
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<td>West Virginia</td>
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<tr>
<td></td>
<td>5. Who is responsible for maintenance, repair, rehabilitation, and</td>
<td>The owner, No.</td>
<td>The bridge owner (city, township, etc.) is responsible for maintaining any</td>
<td></td>
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<tr>
<td></td>
<td>replacement of local agency and other owner highway bridges?</td>
<td>VDOT has a legal right to perform bridge safety inspections for certain</td>
<td>bridge not owned by the state. WVDOT makes recommendations for repairing,</td>
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<td>localities that fail to perform them in a timely manner as required by</td>
<td>posting, and/or closing local agency bridges based on findings from inspections</td>
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<td>the NBIS. VDOT can recoup the costs by withholding portions of maintenance</td>
<td>we perform, however local agencies have the ultimate responsibility of posting</td>
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<td>allocations. They are proposing current legislation to allow them to bill</td>
<td>or closing their structures.</td>
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<tr>
<td></td>
<td>7. Does the DOT have legal authority in your state to self-perform and/or</td>
<td>? The FHWA appears to be working towards expansion of the NBIS regulations</td>
<td>No</td>
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<td></td>
<td>oversight of any of these activities for local agency or other owner</td>
<td>to encompass more bridges that are owned by instrumentalities or private</td>
<td>Require local agencies to fund any/all inspection and maintenance requirements.</td>
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<td>bridges?</td>
<td>entities. Legislation to authorize the State to enter upon such property</td>
<td>To have more formal agreements in place between state and local agencies.</td>
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<td></td>
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<td>and conduct bridge inspections required by Federal Law and to recoup</td>
<td>All local agency bridges are kept in accordance with NBIS requirements.</td>
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<td>associated costs may be needed to ensure the State is not held responsible</td>
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<td>for the inactions of others after reasonable efforts to facilitate their</td>
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<td>compliance are made by the State.</td>
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<td></td>
<td>8. Changes they would like to make to their program</td>
<td>VDOT has a Local Assistance Division that specializes in providing policy</td>
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<td></td>
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<td>and communication guidance for business interactions between the</td>
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<td></td>
<td></td>
<td>Department and localities.</td>
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Appendix D: Peer State Comparative Statistics
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<table>
<thead>
<tr>
<th>State</th>
<th>A DOT Budget/桥</th>
<th>Gas Tax/桥梁税</th>
<th>Bridge Data</th>
<th>Population</th>
<th>Land Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Carolina</td>
<td>909</td>
<td>3.4</td>
<td>26</td>
<td>689</td>
<td>5,841,127</td>
</tr>
<tr>
<td>Delaware</td>
<td>969</td>
<td>3.0</td>
<td>29</td>
<td>641</td>
<td>5,919,449</td>
</tr>
<tr>
<td>Florida</td>
<td>5,577</td>
<td>5.6</td>
<td>22</td>
<td>77,116</td>
<td>5,832,610</td>
</tr>
<tr>
<td>Georgia</td>
<td>45%</td>
<td>8.9</td>
<td>40</td>
<td>175</td>
<td>5,904,823</td>
</tr>
<tr>
<td>Michigan</td>
<td>40%</td>
<td>21.8</td>
<td>8.7</td>
<td>89</td>
<td>4,441</td>
</tr>
<tr>
<td>New Jersey</td>
<td>37%</td>
<td>3.7</td>
<td>1.3</td>
<td>34</td>
<td>2,370</td>
</tr>
<tr>
<td>North Carolina</td>
<td>92%</td>
<td>3.2</td>
<td>3.0</td>
<td>394</td>
<td>16,861</td>
</tr>
<tr>
<td>Virginia</td>
<td>86%</td>
<td>3.6</td>
<td>3.1</td>
<td>357</td>
<td>13,911</td>
</tr>
<tr>
<td>West Virginia</td>
<td>96%</td>
<td>3.5</td>
<td>3.4</td>
<td>49</td>
<td>8,890</td>
</tr>
<tr>
<td>Alabama</td>
<td>36%</td>
<td>9.1</td>
<td>3.3</td>
<td>167</td>
<td>7,534</td>
</tr>
<tr>
<td>Alaska</td>
<td>53%</td>
<td>422.5</td>
<td>43.0</td>
<td>560</td>
<td>1,976</td>
</tr>
<tr>
<td>Arizona</td>
<td>59%</td>
<td>24.0</td>
<td>14.2</td>
<td>438</td>
<td>1,105</td>
</tr>
<tr>
<td>Arkansas</td>
<td>57%</td>
<td>7.3</td>
<td>4.2</td>
<td>318</td>
<td>1,645</td>
</tr>
<tr>
<td>California</td>
<td>49%</td>
<td>1.3</td>
<td>6.5</td>
<td>661</td>
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<td>Montana</td>
<td>49%</td>
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</tr>
<tr>
<td>Nebraska</td>
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<td>5.0</td>
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<td>103.4</td>
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<td>53%</td>
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<td>3.8</td>
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<td>New Mexico</td>
<td>75%</td>
<td>40.9</td>
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<tr>
<td>New York</td>
<td>43%</td>
<td>7.3</td>
<td>3.1</td>
<td>49</td>
<td>7,487</td>
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<tr>
<td>North Dakota</td>
<td>26%</td>
<td>62.6</td>
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<td>17</td>
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<td>Ohio</td>
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<td>4.3</td>
<td>1.7</td>
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<td>Oregon</td>
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<td>36.2</td>
<td>1.2</td>
<td>20</td>
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<td>Pennsylvania</td>
<td>68%</td>
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<td>Rhode Island</td>
<td>28%</td>
<td>2.6</td>
<td>2.1</td>
<td>28</td>
<td>586</td>
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<td>South Dakota</td>
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<td>42.9</td>
<td>3.1</td>
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<td>Tennessee</td>
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<td>5.1</td>
<td>2.1</td>
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<td>Texas</td>
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<td>Utah</td>
<td>160%</td>
<td>47.0</td>
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<td>Vermont</td>
<td>40%</td>
<td>8.8</td>
<td>3.5</td>
<td>49</td>
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### Appendix D - Peer State Comparative Statistics

<table>
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<tr>
<th>State</th>
<th>A DOT Registered Bridges</th>
<th>Land and Water Area</th>
<th>2018 Population</th>
<th>Land Area</th>
<th>16% DOT Registered Bridges</th>
<th>Land and Water Area</th>
<th>2018 Population</th>
<th>Land Area</th>
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</thead>
<tbody>
<tr>
<td>Washington</td>
<td>40%</td>
<td>12.6</td>
<td>1,118</td>
<td>31</td>
<td>23</td>
<td>3</td>
<td>1,002</td>
<td>1,075</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>37%</td>
<td>12.6</td>
<td>1,118</td>
<td>31</td>
<td>23</td>
<td>3</td>
<td>1,002</td>
<td>1,075</td>
</tr>
<tr>
<td>Wyoming</td>
<td>63%</td>
<td>12.6</td>
<td>1,118</td>
<td>31</td>
<td>23</td>
<td>3</td>
<td>1,002</td>
<td>1,075</td>
</tr>
<tr>
<td>United States, total</td>
<td>10,766</td>
<td>283,176</td>
<td>937</td>
<td>31</td>
<td>23</td>
<td>3</td>
<td>1,002</td>
<td>1,075</td>
</tr>
<tr>
<td>U.S. total (incl. Puerto Rico)</td>
<td>12,385</td>
<td>283,176</td>
<td>937</td>
<td>31</td>
<td>23</td>
<td>3</td>
<td>1,002</td>
<td>1,075</td>
</tr>
</tbody>
</table>

NOTES: Some discrepancies exist between the total number of bridges reported in tables 1-5, 1-6, and 1-7 because of bridges not identified in one or more of the categories and other anomalies. Other state agency includes state parks, forests, reservations, and other state agencies. Local highway agency includes county, town or township, and city or municipal highway agencies. Other local agency includes local parks, forests, reservations, and other local agencies. Private includes highway bridges owned by railroads and other private entities. Details for each state may not add to totals because totals include bridges for which ownership is unknown.

Data Sources:
* Fuel Excise Tax" data was compiled January 1, 2019 and accessed at https://www.taxadmin.org/assets/docs/Research/Rates/mf.xls
* "Bridge Data" is from https://www.bts.gov/content/number-road-bridges-owner, Table 1-6: Number of Road Bridges by Owner: 2014; SCDOT bridge data updated with TAMP information
* "Bridge Area" and "Bridge Count" data is derived from https://www.fhwa.dot.gov/bridge/nbi/no10/owner.xlsx
* "2018 Population" estimates are from: U.S. Census Bureau, Population Division, Table 1. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2018 [NST-EST2018-01]
Appendix E: Sample Local Road Authority Statutes
Title XXVI, PUBLIC TRANSPORTATION

Chapter 335, STATE HIGHWAY SYSTEM

335.074 Safety inspection of bridges.—

(1) Those bridges having an opening measured along the center of the roadway of more than 20 feet between undercoppings of abutments or spring lines of arches or extreme ends of openings for multiple boxes and those bridges consisting of multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening are subject to inspection in accordance with the provisions of this section.

(2) At regular intervals as required by the Federal Highway Administration, each bridge on a public transportation facility shall be inspected for structural soundness and safety for the passage of traffic on such bridge. The thoroughness with which bridges are to be inspected shall depend on such factors as age, traffic characteristics, state of maintenance, and known deficiencies. The governmental entity responsible for maintenance of any such bridge is responsible for having inspections performed and reports prepared in accordance with this section.

(3)(a) Each bridge inspection required by subsection (2) shall be performed by an inspector who is qualified, as prescribed in subsection (4), who shall determine the load-carrying capacity and safety condition of the bridge.

(b) Each inspection shall be reported on a format designated by the department and forwarded to the department. A copy of such report shall also be provided to the local governmental entities in the jurisdictions of which the bridge is located. Data on a newly completed structure, or on any modification of an existing structure, which would alter previously submitted data on any inspection report shall be submitted to the department and the appropriate local governmental entities within 90 days of completion of the new construction or modification by the governmental entity having maintenance responsibility.

(c) The department shall maintain an inventory of bridges and appropriate records on the inspections of such bridges reported pursuant to this section.

(4)(a) An individual who inspects bridges and completes reports required by this section must possess the following minimum qualifications:

1. Be a registered professional engineer with expertise in civil engineering; or

2. Have a minimum of 5 years’ experience in bridge construction or maintenance inspection assignments in a responsible capacity and have completed a comprehensive training course approved by the department.

(b) An individual who executes reports required by this section shall be a registered professional engineer.

(5) Upon receipt of an inspection report that recommends reducing the weight, size, or speed limit on a bridge, the governmental entity having maintenance responsibility for the bridge must reduce the maximum limits for the bridge in accordance with the inspection report and shall post the limits in accordance with s. 316.555. The governmental entity must, within 30 days after receipt of an inspection report recommending lower limits, notify the department that the limitations have been implemented and the bridge has been posted accordingly. If the required actions are not taken within 30 days after receipt of an inspection report, the department shall post the limits on the bridge in accordance with the
recommendations in the inspection report.  

All costs incurred by the department in connection with providing notice of the bridge’s limitations or restrictions shall be assessed against and collected from the governmental entity having maintenance responsibility for the bridge. If an inspection report recommends closure of a bridge, the bridge shall be immediately closed. If the governmental entity does not close the bridge immediately upon receipt of an inspection report recommending closure, the department shall close the bridge.  

All costs incurred by the department in connection with the bridge closure shall be assessed against and collected from the governmental entity having maintenance responsibility for the bridge.  

Nothing in this subsection alters existing jurisdictional responsibilities for the operation and maintenance of bridges.

History.—ss. 1, 2, 3, ch. 69-271; ss. 23, 35, ch. 69-106; s. 1, ch. 75-137; s. 1, ch. 77-174; s. 40, ch. 84-309; s. 16, ch. 85-81; s. 94, ch. 92-152; s. 77, ch. 99-385; s. 21, ch. 2012-128; s. 25, ch. 2012-174; s. 3, ch. 2017-42.

Note.—As created by s. 25, ch. 2012-174. Section 21, ch. 2012-128, also created subsection (5), and that version used the words “limits have” instead of “bridge has.”

2Note.—As created by s. 25, ch. 2012-174. Section 21, ch. 2012-128, also created subsection (5), and that version used the word “The” instead of the word “All.”

3Note.—As created by s. 25, ch. 2012-174. Section 21, ch. 2012-128, also created subsection (5), and that version used the phrase “This subsection does not alter” instead of the phrase “Nothing in the subsection alters.”

Note.—Former s. 338.071.
Chapter 6

BRIDGE INVENTORY AND INSPECTIONS

BUREAU OF LOCAL ROADS AND STREETS MANUAL
## Chapter 6
### BRIDGE INVENTORY AND INSPECTIONS

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<td>6-3.02(b)</td>
<td>Re-inspection of Structures on File in ISIS</td>
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<td>LOAD RATING AND POSTING</td>
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<td>Responsibilities</td>
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<td>Load Rating by IDOT</td>
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<td>Load Rating by Others</td>
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<td>6-4.02(c)</td>
<td>Reporting</td>
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<td>Bridge Closure and Weight Limit Posting</td>
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<td>Bridge Closure and Weight Limit Posting Review</td>
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Chapter 6
BRIDGE INVENTORY AND INSPECTIONS

6-1 NATIONAL BRIDGE INSPECTION STANDARDS (NBIS)

6-1.01 General

The NBIS is the Federal regulation that establishes the requirements for a bridge inspection organization, inspection procedures, frequency of inspections, qualifications of personnel, and preparation and maintenance of a state bridge inventory. The NBIS applies to all structures defined as bridges carrying a roadway and open to the public. The bridge inspection program resulting from the NBIS is intended to detect structural and functional deficiencies in order to minimize the probability of structural failure and improve bridge traffic safety. The Federal Highway Administration (FHWA) has promulgated regulations to establish the applicable criteria that each state transportation department must meet, see 23 CFR, Part 650, Subpart C.

To properly implement the NBIS program requirements for local public agencies (LPAs) in Illinois, the Department relies on the LPA to perform the NBIS requirements for structures under its jurisdiction. All LPAs with jurisdiction of a structure eligible for inclusion in the National Bridge Inventory (NBI) must designate a Program Manager to ensure compliance with the NBIS and provide guidance and management of their bridge inventory. The designated Program Manager must meet the qualifications as described in Section 3 of the Structural Services Manual, maintained by the Bureau of Bridges and Structures (BBS). Statewide oversight of the LPA bridge inspection program is provided by the Statewide Program Manager in the Bridge Management Unit (BMU) of the BBS.

IDOT policies and procedures for Bridge Inspection are located in the BBS’ Structural Services Manual.

6-1.02 Definitions

The following definitions apply to the NBIS and its implementation:

1. Bridge. A structure, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening, measured along the center of the roadway of more than 20.0 ft (6.1 m) between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening. See Figure 6-1A for examples of various bridge openings.
2. **National Bridge Inspection Standards (NBIS).** The Federal regulations establishing requirements for a bridge inspection organization, for inspection procedures, frequency of inspections, qualifications of personnel, and preparation and maintenance of a state bridge inventory. The NBIS applies to all structures defined as bridges carrying roads open to the public.

3. **National Bridge Inventory (NBI).** The aggregation of structure inventory and appraisal data collected to fulfill the requirements of the NBIS, which require that each state prepare and maintain an inventory of all bridges subject to the NBIS.

4. **NBI Record.** Data that has been coded according to the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges (Guide)* for each structure carrying highway traffic or each inventory route which passes beneath a structure.
5. **Master Structure Report.** The representation of the data recorded and stored for each NBI record in accordance with the *Guide*.

6. **Sufficiency Rating.** A numerical value from 0.0 to 100.0 which indicates a bridge’s overall sufficiency to remain in service. The rating is calculated from the Structure Inventory and Appraisal (SI&A) data and reflects the following factors:
   - structural adequacy and safety,
   - serviceability and functional obsolescence,
   - essentiality for public use, and
   - any special considerations.
6-2 **BRIDGE INVENTORY**

6-2.01 **National Bridge Inventory (NBI)**

The NBI is a national program that requires each state to prepare and maintain an inventory of all bridges on public roads that are subject to the NBIS. The purpose is to maintain a national database of structures and applicable structural analyses data. This information is used by the FHWA to develop reports to submit to Congress on the status of the nation’s bridges, and by states in managing their bridge maintenance, rehabilitation, and replacement programs.

6-2.02 **Illinois Structure Information System (ISIS)**

IDOT maintains a computerized bridge inventory system, designated as the Illinois Structure Information System (ISIS). This is part of the Illinois Highway Information System (IHIS). The ISIS database system contains information required by the NBIS, including inspection data.

The ISIS data is available from the Structure Information Management System (SIMS). LPAs may obtain the database file of local bridges for each county from IDOT’s website and use the SIMS with the Microsoft Access database application program.

6-2.03 **Inventory Requirements**

The bridge inventory must include the following:

- all structures carrying public roads meeting the definition of a bridge, and
- all other structures where an opening length (measured along the centerline of the roadway) of less than or equal to 20.0 ft. (6.1 m) and involving a highway. These may be accepted into the system if prior approval is given by the Central Office of Planning and Programming – Data Collection Unit.

Structure numbers (SN) should be assigned and the inventory should be completed for non-highway, railroad and pedestrian structures over roads open to the public. This establishes the structure in the ISIS for inventorying its location, and vertical and horizontal clearances. NBIS inspections are not required for pedestrian structures. However, regular maintenance inspections are encouraged.

The responsibility for reporting the required information for the ISIS rests with the agency having jurisdiction of the road leading to and from the bridge. If there is no public road on the structure, the reporting responsibility rests with the agency having jurisdiction of the road under the structure.

6-2.04 **Structure Number (SN)**

Each structure is identified by a 7 digit SN composed of a 3 digit county number and a 4 digit structure sequence number. The county number can be found as Item 3 in the *Structure Information and Procedure (SIP) Manual*. The SIP Manual also provides additional information on the sequence number. The SN is assigned by the district or the maintaining agency from a block of numbers reserved for each agency. The SN is to be assigned prior to submittal of the
Preliminary Bridge Design and Hydraulic Report (PBDHR) or Type, Size & Location (TS&L) plans, as applicable, and shall be included in the ISIS to avoid possible duplicate use of the SN.

Data for deleted structures is retained in the ISIS and the SN shall never be used again. Similarly, a bridge constructed using any portion of the original substructure may keep its same SN. Completely new bridges erected at the same location on the same or new alignment that does not use any part of the old bridge will be assigned a new SN. Structures moved to a new location should receive a new SN. New structures may be assigned SNs using the next available SN by district scheme. There is no official statewide scheme for the assignment of SNs according to jurisdiction.

Once the maintaining agency and IDOT have agreed on a SN for a bridge, that SN is permanent and will not be changed for any reason even if there is a change in maintenance responsibility. This avoids confusion in record retrieval and retention. To make the bridge numbering system effective in the field, one SN tag should be painted or installed on each end of the bridge.

6-2.05 **ISIS Structure Reports**

Figure 6-2A presents the Structure Reports necessary to communicate information for entry into ISIS. The forms for the initial recording of inventory, route, and inspection information may be available from the district, copied from the SIP Manual, or printed from the Structure Information Management System (SIMS - County), which can be downloaded from the IDOT website. Forms for reporting changes and information on existing structures can be obtained directly from SIMS - County or from the IDOT website. Ensure the most recent SIMS – County files are downloaded prior to printing these reports.

6-2.06 ** Sufficiency Rating (SR)**

Based on the inventory, traffic, inspection, and load-rating data submitted to ISIS, the Department calculates a SR for each structure. The SR is between 0.0 and 100.0, with the lower numbers implying a higher priority of need for improvement.
<table>
<thead>
<tr>
<th>Report</th>
<th>Usage of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory/Status Initial Report (R105-I) (SIMS)</td>
<td>Reporting inventory and bridge status information to ISIS on new-to-system bridges.</td>
</tr>
<tr>
<td>Inventory Turnaround Report (S105) (SIMS)</td>
<td>Reporting revisions of inventory data to ISIS. The inspector should have this form or Forms S114 and S111 at each NBIS inspection.</td>
</tr>
<tr>
<td>Inspector’s Inventory Report (S114) (SIMS)</td>
<td>Form S114 is for reporting revisions of inventory data to ISIS. The inspector should have this form or Form S105 and Form S111 at each NBIS inspection.</td>
</tr>
<tr>
<td>Key Route/Construction Initial Report (R111-I) (SIMS)</td>
<td>Reporting route information to ISIS on new-to-system bridges.</td>
</tr>
<tr>
<td>Key Route Turnaround Report (S111) (SIMS)</td>
<td>Reporting revisions of key route data to ISIS. The inspector should have this form or Form S114 or S105 at each NBIS inspection.</td>
</tr>
<tr>
<td>Master Structure Report (S107) (SIMS)</td>
<td>Reports most information contained in ISIS for each bridge. This form is not for reporting revisions to the System. The inspector should have this form at each NBIS inspection.</td>
</tr>
<tr>
<td>Routine Bridge Inspection Report (BBS-BIR)</td>
<td>The BBS-BIR form is used for recording specific inspection notes and ratings for each bridge. The BBS-BIR is used for a single inspection and contains current ratings information. The inspector should have this form at each NBIS inspection and the signed original copy must be in the bridge file kept by the owner of the bridge.</td>
</tr>
<tr>
<td>Fracture Critical Inspection Form (BBS-BIR-FC1)</td>
<td>Form BBS-BIR-FC1 is used for recording results of Fracture Critical (FC) inspections. The inspection should have this form at each FC inspection.</td>
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<tr>
<td>Fracture Critical Member Inventory Form (BBS-BIR-FC2)</td>
<td>Form BBS-BIR-FC2 is used to record the FC Type, number of spans, and number of members in each FC bridge. The inspector should consult this form before each FC inspection, and the signed original must be in the bridge file kept by the owner of the bridge.</td>
</tr>
<tr>
<td>Underwater Bridge Inspection Report (BBS-BIR-UW1)</td>
<td>Form BBS-BIR-UW1 is used for recording results of Underwater (UW) inspections. The inspector should have this form at each UW inspection.</td>
</tr>
<tr>
<td>Special Inspection Report (BBS-SI-1)</td>
<td>Form BBS-SI-1 is used to record the Special Inspection Type Code and Condition Status for all bridges requiring a Special Inspection. The inspector should consult this form before each Special Inspection, and the signed original must be in the bridge file kept by the owner of the bridge.</td>
</tr>
<tr>
<td>Scour Critical Evaluation Coding Report (BBS SCE)</td>
<td>Form BBS SCE is used for reporting coding recommendations for Scour Critical Evaluations (ISIS Item 113).</td>
</tr>
<tr>
<td>Scour Critical Bridge Plan of Action (BBS 2680)</td>
<td>Form BBS 2680 is used to record actions to be taken to monitor scour critical or scour susceptible bridges during and after major storm events. The inspector should consult this form before each Routine Inspection and when a major storm event occurs. The form should be updated to reflect current field conditions and the signed original must be in the bridge file kept by the owner of the bridge.</td>
</tr>
<tr>
<td>Bridge Posting / Closure Review (BBS PCR)</td>
<td>Form BBS PCR is used for recording results of each Bridge Posting / Closure review inspection. The inspector should have this form at each review.</td>
</tr>
<tr>
<td>Bridge File Checklist (BBS BFC)</td>
<td>Form BBS BFC is used to document the contents of each official Bridge File and the location of required information that may be stored separately or electronically. The inspector should consult this form before each inspection, and the original copy must be in the bridge file kept by the owner of the bridge.</td>
</tr>
</tbody>
</table>

**Note:** All forms listed are available from **SIMS - County** or from the **IDOT website**. BBS and BIR forms may be found on the **IDOT website**.

**STRUCTURE REPORTS**

**Figure 6-2A**
6-2.07 Inventory Updates

IDOT is required to maintain and report on the accurate operational status of all bridges in the NBI. New bridges or any conditions that require revision of existing structure information must be reported to the district promptly. The district must include the revision in ISIS within 90 days after the change in status for LPA structures. The 90 days start when the structure is opened or reopened to unrestricted traffic or when other events occur that result in changes to inventory or inspection data for a structure.

Refer to the SIP Manual Item 41 for appropriate Bridge Status codes. NBIS requirements state that changes in Bridge Status must be entered in ISIS within 90 days of that change. When a LPA bridge is load posted (ISIS Codes 2-6), under staged construction (ISIS Code 7), closed for construction (ISIS Code A), or closed but anticipated to be rehabilitated or replaced within 5 years (ISIS Code B), the owner should report that change in Bridge Status to the district.

Structures with Bridge Status B for more than 5 years will be considered permanently closed and the Bridge Status will be changed to E or may be deleted. When structures are coded with Bridge Status 5 or 6 (Temporary Measures) for more than 5 years, the temporary measures become permanent for the structure. Condition Ratings, Load Ratings, and Bridge Status will be based on these measures. In addition, all inventory information should be updated as necessary.
6-3  BRIDGE INSPECTIONS

The bridge owner (LPA) must have a systematic strategy for conducting field inspections and reporting the findings. The inspection team must be led by a qualified Team Leader. The bridge inspection report should accurately and clearly record all findings and should include photographs of the overall structure and of any significant defects.

Per the NBIS, the owner of a bridge should have an individual bridge file for each structure. Counties may hold files on behalf of townships or other LPAs for which they provide services. In addition, the LPA, as the owner of the structure, must have a systematic means of entering, storing, and retrieving all bridge inspection data. The file should contain a full history of the structure.

A Bridge File Checklist (Form BBS BFC) must be maintained with each Bridge File. This form may be found on the IDOT website or by contacting the appropriate district office.

6-3.01  LPA Responsibility

6-3.01(a)  Publicly Owned Structures

In order to satisfy the requirements of the NBIS, the LPA is responsible for inspections of all structures on roads open to public travel that meet the definition of a bridge, see Section 3.1.2 in the Structural Services Manual for facilities under its jurisdictional responsibility. In addition, all closed structures are required to be inspected for proper closure by the LPA.

Though not required by the NBIS, for structures under their jurisdiction and responsibility that do not meet the definition of a bridge or are not carrying highway traffic, LPAs are strongly encouraged to perform regular inspections to ensure public safety.

The responsible LPA may perform the inspection with qualified in-house personnel or retain the services of a qualified inspector proficient in the performance of NBIS inspections. See Section 3.9.2 in the Structural Services Manual for Personnel Qualifications.

6-3.01(b)  Privately Owned Structures

Privately owned structures, and those owned by government agencies that are not highway agencies, carrying public roadways, are subject to inspection and inclusion in ISIS; see Section 6-2.02. Therefore, it is the responsibility of the owners of these structures to have timely inspections performed according to the provisions of the NBIS. The BBS BMU and the Local Bridge Unit (LBU) will work with the owner to:

- ensure the owner is aware when the NBI inspection is due, and
- obtain copies of the inspection forms to keep on file and for submission to the district for inclusion in ISIS.

In general, a LPA has a responsibility to post and warn the public of any hazards on a public highway carried by a structure. When it becomes apparent that the private owner (e.g., railroad, drainage or sanitary district, developer) of a bridge carrying a public highway will not or cannot
perform the safety inspections required by the NBIS, the LPA having jurisdiction over the public highway leading to the bridge is responsible for performing the necessary inspection. If the private owner also has jurisdiction of the road leading to the bridge (e.g., private business that allows customers to use the road), the LPA may need to consider closing the public road leading to the private road until an inspection is performed and the bridge is considered safe. The NBIS requirements are not directly applicable to privately owned structures, but owners are strongly encouraged to follow the requirements of the NBIS.

6-3.02 Reporting Requirements

This Section discusses the process for entering field inspection results into the ISIS. See Figure 6-2A for a list of inspection report forms.

6-3.02(a) New Structure, or Initial Inspection of Old Structure not in ISIS

The following applies:

1. Complete the Inventory / Status Initial Report (R105-I) and the Key Route / Construction Initial Report (R111-I) and submit copies to the district. If a bridge has been replaced, then also indicate in the submittal the SN of the replaced structure so the replaced bridge can be marked for deletion.

2. Complete the Bridge Inspection Report (Form BBS-BIR). The signed original of Form BBS-BIR is retained in the individual bridge file kept by the owner of the bridge. The Bridge Inspection Report (Form BBS-BIR) should be completed and a copy submitted to the district.

3. The Scour Critical Evaluation Coding Report (BBS SCE), if applicable, must be filled out and submitted at the same time as the other two initial reports if it has not been submitted previously.

4. The LPA should submit all reports within 90 days of opening the bridge to traffic to allow the district proper time to enter the data within the required timeframe.

6-3.02(b) Re-inspection of Structures on File in ISIS

The following applies:

1. Complete the Bridge Inspection Report (Form BBS-BIR).

2. Submit copies of Reports BBS-BIR and S105, and S114 if required, to the district. The LPA should submit the inspection report within 90 days of the inspection to allow the district proper time to enter the data within the required time frame.

6-3.02(c) Reconstruction of an Existing Structure

Any reconstruction, rehabilitation, or major repair of an existing bridge currently in ISIS should be recorded in the ISIS within 90 days of reopening the bridge to unrestricted traffic. Work that changes the inventory data of a bridge open to traffic must also be recorded within 90 days of the completion of the work. A bridge reconstructed using the same abutments or piers may
keep the same SN so long as the geometry, span lengths, etc. have not significantly changed. The following applies:

1. Complete Form BBS-BIR.
2. Revise and submit copies of Reports BBS-BIR and S105, and S114 if required, as described in Section 6-3.02(b).
6-4 LOAD RATING AND POSTING

6-4.01 Requirements

All bridges must be load rated to determine their load-carrying capacity. This includes the Inventory Rating Factor, Operating Rating Factor, and the ratings for the Illinois Legal Loads as defined in the Illinois Vehicle Code (625 ILCS 5/15-111). These ratings provide an indication of the bridge's capacity to safely resist the loads it is likely to be subjected to. This information assists in the determination of necessary load posting, the issuance of special overload permits, and the scheduling for rehabilitation or replacement. These ratings must be performed by IDOT or receive IDOT's concurrence, in accordance with 625 ILCS 5/15-317(b).

According to IDOT’s load rating policy, as described in Section 3.3.9 of the Structural Services Manual, re-evaluation of the load-carrying capacity must be performed when significant deterioration in structurally critical areas has occurred since the last rating. Such deterioration is typically indicated when the ISIS Superstructure (Item 59), Substructure (Item 60), or Culvert (Item 62) is reduced to a “4” or less, or when the Condition Rating of Deck (Item 58) falls to “3” or less.

In addition, load rating is performed at a maximum 10-year interval for bridges meeting any of the following criteria:

- a Condition Rating of “4” or less for Items 59, 60, or 62;
- a Condition Rating of “3” or less for Item 58;

Load rating of bridges not meeting the above criteria, although not specifically required, may be requested by the LPA.

6-4.02 Responsibilities

All bridges must be rated for load capacity by IDOT, or by a qualified Illinois Licensed Structural Engineer with IDOT’s concurrence. Generally, existing structures do not need to be load rated unless they have deteriorated, have been repaired or modified, have a modification to the wearing surface or meet the requirements in Section 6-4.01.

6-4.02(a) Load Rating by IDOT

IDOT will rate bridges at the request of the LPA or upon its own initiative. A request for rating should state any unusual or notable conditions. The LPA should provide a copy of the “as-built” construction plans or, if plans are not available, a dimensioned sketch of the bridge and its significant structural members. Representative photographs showing the overall condition and specific problem areas should also be included.

Rating requests may be made in writing through the district using Form BLR 06510. A representative of the BBS will schedule a field investigation of each structure to determine actual conditions of the bridge which affect the load-carrying capacity.
6-4.02(b) Load Rating by Others

Structure ratings performed by others must receive the concurrence of IDOT (BBS). A summary report for all bridges rated should detail the procedures, findings, inventory and operating ratings, and posting recommendations based on a field inspection and analysis performed by an Illinois Licensed Structural Engineer in accordance with provisions of the current AASHTO *Manual for Bridge Evaluation (MBE)*. The structural engineer’s seal must be affixed to the Structure Load Rating Summary (Form BBS 2795) along with computations and analysis model. Excerpts from detailed inspection reports or other similar submittals will not be accepted.

6-4.02(c) Reporting

The LPA should submit the summary report, original Form BBS 2795 and other attachments to the district for forwarding to the BBS. The LPA should accept the consultant’s findings prior to submittal of the report.

6-4.03 Bridge Closure and Weight Limit Posting

When a structure cannot carry legal loads, as defined in the Illinois Vehicle Code 625 ILCS 5/15-317, IDOT is required to ensure suitable signs are erected and maintained to inform the public of the maximum weight limit. The agency having jurisdiction over the roadway is responsible for the posting of signs, regardless of structure ownership or maintenance responsibility.

When IDOT determines a structure carrying traffic on a public road is not capable of carrying the legal loads as defined in 625 ILCS 5/15-111, it will inform the LPA. Upon notification from IDOT of a required load posting, the LPA shall erect signs as soon as possible and notify IDOT within 30 days that signs are in place, or within 14 days for closures.

Per 625 ILCS 5/15-317, the load posting signs must match the load posting requirements determined by the Department. Posting at a lower or higher level is not permitted. Likewise, a single posting level is not permitted when a combination posting level is required. The LBU should be contacted for re-evaluation if a combination posting level is required but the LPA believes a single posting level would be more appropriate for the structure location. See Figure 6-4A for bridge weight limit posting traffic control.

When a structure is to be closed, the LPA should immediately erect barricades that will prohibit traffic access to the structure. Those barricades are to remain in place until permanent closure measures can be installed. See Figure 6-4B for the proper permanent bridge closure traffic control. Additional information may also be found in the *Illinois Supplement to the Manual of Uniform Traffic Control Devices (IL MUTCD)*.

6-4.04 Bridge Closure and Weight Limit Posting Review

In accordance with the Illinois Vehicle Code, 625 ILCS 5/15-317, the districts annually monitor local bridges that are listed in the ISIS as requiring load postings or closure. The district will
notify the appropriate LPA when a bridge is not properly posted or closed by sending a letter (see Figure 6-4C for example) with a copy of the Bridge Posting / Closure Review (Form BBS PCR) by certified mail.

The LPA shall correct any signing in accordance with the \textit{ILMUTCD} or other deficiencies in a timely manner and notify the district within 30 days (see Figure 6-4D for example). All notifications to the district will include a signed copy of the BBS PCR form with photographs, preferably digital, certifying the deficiency at the bridge has been corrected. If the LPA is unable to complete the required corrections within 30 calendar days, they must provide the district with an estimated compliance date with justification. Failure of a LPA to comply may result in the withholding of Motor Fuel Tax (MFT) allotments and the district not approving current MFT expenditures, or other actions determined by the Department.
SIGNS FOR BRIDGE POSTINGS

- For Single Gross Weight Limit (R12-1)
- For Single Axle Weight Limit (R12-2)
- For Two Separate Weight Limits (R12-I101)
- For Three Separate Weight Limits (R12-I100)
- For Legal Load Only Weight Limits (R12-I108)

SIGNS HEIGHT AND OFFSET REQUIREMENTS

- ‘Single Weight Limit’ signs shall be located immediately in advance of the bridge.
- ‘Multiple Weight Limit’ signs shall be located within 500 feet in advance of the bridge.
- Additional weight limit signs may be installed in advance of the restriction with an ‘XX MILES AHEAD’ plaque to provide advance notice. Advanced signs should be installed near junctions where a driver could choose an alternate route with a minimum of inconvenience.
- ‘Legal Load Only’ signs shall be located immediately in advance of the bridge.

BRIDGE POSTING TRAFFIC CONTROL

Figure 6-4A
Notes:

1. See Section 2C.26 of the MUTCD. Multi-lane roads shall have W14 series signs with a minimum size of 36" x 36". Single lane roads may have signs of 30" x 30".

2. Use where ‘D’ exceeds 1500 ft. or where sight distance to the closure is less than 500 ft.

3. Where the point of closure is over 1 mile from the last cross road, an “X MILES AHEAD” plaque (W12-I101) may be used.

4. Type III Barricades with a "ROAD CLOSED" sign (R11-2) or a "ROAD ENDS" sign (R11-I100) with red object markers (OM4-1 or OM4-3) shall be used at the point of closure. Guardrail may be used in conjunction with barricades or “ROAD ENDS” sign (R11-I100). If used, barricades shall be retro-reflectorized red/white and permanently installed into the pavement. Any barriers used shall extend beyond the edge of shoulder. If practical, old pavement should be removed beyond the closure point or covered with dirt/rocks to minimize the illusion of the road continuing. Barricades or “ROAD ENDS” sign (R11-I100) should be installed at least 100 ft. In advance of broken pavement or dirt/rocks.

5. Object markers (OM4-1 or OM4-3) used in conjunction with a “ROAD ENDS” sign (R11-I100) shall be red and conform with Section 2C.66 of the MUTCD.

6. If a cross road or entrance is located near the road closure, the closure devices shall be outside the clear zone of the cross road or entrance.

7. If the bridge is under active construction, traffic control shall be in accordance with Part 6 of the MUTCD.
Dear [Name]:

In accordance with the *Illinois Vehicle Code* (625 ILCS 5/15-317), an inspection of all structures within your jurisdiction that are load posted or closed was recently conducted by this office. This inspection was done to ensure that all load posted structures are properly signed and closed structures are properly signed and barricaded. The following deficiencies of structures under your jurisdiction were noted during this inspection:

<table>
<thead>
<tr>
<th>Structure Number</th>
<th>Structure Status</th>
<th>Deficiency</th>
<th>Corrective Action to be Taken</th>
</tr>
</thead>
</table>

Please correct the deficiencies in a timely manner and notify this office in writing by completing and returning the attached Notice of Compliance form with digital photos within 30 calendar days from the date of this letter. If you are unable to complete the required corrections within the 30 calendar days, please provide this office with an estimated compliance date. Do not return the attached Notice of Compliance until the deficiencies have been corrected.

All signage must be in accordance with the *Illinois Supplement to the Manual of Uniform Traffic Control Devices (IL MUTCD)*. The ILMUTCD may be accessed using the IDOT website. When performing your regular maintenance procedures during warmer weather, please ensure that all signing is clearly visible and not blocked by the growth of foliage.

If you have any questions regarding this issue, please contact [Name] at [Contact Information].

Sincerely,

[Regional Engineer]

By: [Local Roads and Streets Engineer]

SAMPLE DISTRICT POSTING AND CLOSURE LETTER

Figure 6-4C
[Date]

[Regional Engineer Information]

Attn: Local Roads and Streets

[District Contact Information]

RE: NOTICE OF COMPLIANCE

I have completed the required corrections for the local posting / closure related discrepancies. Attached are photos of the corrections.

<table>
<thead>
<tr>
<th>Structure Number</th>
<th>Date Correction Completed</th>
</tr>
</thead>
</table>

Local Public Agency’s Signature

Title

County

Township / Municipality

SAMPLE POSTING AND CLOSURE COMPLIANCE LETTER

Figure 6-4D
## ACRONYMS

This is a summary of the acronyms used within this chapter.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>BBS</td>
<td>Bureau of Bridges &amp; Structures</td>
</tr>
<tr>
<td>BFC</td>
<td>Bridge File Checklist</td>
</tr>
<tr>
<td>BIR</td>
<td>Bridge Inspection Report</td>
</tr>
<tr>
<td>BMU</td>
<td>Bridge Management Unit</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>FC</td>
<td>Fracture Critical</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>Guide</td>
<td>Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges</td>
</tr>
<tr>
<td>IDOT</td>
<td>Illinois Department of Transportation</td>
</tr>
<tr>
<td>IHIS</td>
<td>Illinois Highway Information System</td>
</tr>
<tr>
<td>ILMUTCD</td>
<td><em>Illinois Supplement to the Manual of Uniform Traffic Control Devices</em></td>
</tr>
<tr>
<td>ILCS</td>
<td>Illinois Compiled Statutes</td>
</tr>
<tr>
<td>ISIS</td>
<td>Illinois Structure Information System</td>
</tr>
<tr>
<td>LBU</td>
<td>Local Bridge Unit</td>
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<tr>
<td>LPA</td>
<td>Local Public Agency</td>
</tr>
<tr>
<td>MBE</td>
<td>Manual for Bridge Evaluation</td>
</tr>
<tr>
<td>MFT</td>
<td>Motor Fuel Tax</td>
</tr>
<tr>
<td>NBI</td>
<td>National Bridge Inventory</td>
</tr>
<tr>
<td>NBIS</td>
<td>National Bridge Inspection Standards</td>
</tr>
<tr>
<td>PBDHR</td>
<td>Preliminary Bridge Design and Hydraulic Report</td>
</tr>
<tr>
<td>PCR</td>
<td>Posting/Closure Review</td>
</tr>
<tr>
<td>POA</td>
<td>Plan of Action</td>
</tr>
<tr>
<td>SI&amp;A</td>
<td>Structure Inventory and Appraisal</td>
</tr>
<tr>
<td>SCE</td>
<td>Scour Critical Evaluation</td>
</tr>
<tr>
<td>SIMS</td>
<td>Structure Information Management System</td>
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<tr>
<td>SIP</td>
<td>Structure Information and Procedure</td>
</tr>
<tr>
<td>SN</td>
<td>Structure Number</td>
</tr>
<tr>
<td>SR</td>
<td>Sufficiency Rating</td>
</tr>
<tr>
<td>TS&amp;L</td>
<td>Type, Size &amp; Location</td>
</tr>
<tr>
<td>UW</td>
<td>Underwater</td>
</tr>
</tbody>
</table>
6-6 REFERENCES

For information on the inventory, inspections, appraisals, etc. of structures both bridges and culverts review the applicable publications listed below:

1. 23 CFR - Part 650 - Subpart C
2. *Structural Services Manual*, IDOT
3. *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges*, FHWA
7. *Illinois Supplement to the Manual of Traffic Control Devices*, IDOT