U.S. Department of Transportation
Federal Highway Administration

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November 9, 2021

Arkansas Department of Transportation
Bridge Inspection Program Assessment
Final Report

Lorie H. Tudor, P.E.
Director
Arkansas Department of Transportation
P.O. Box 2261
Little Rock, AR 72209

Dear Ms. Tudor:

Attached is the ARDOT Bridge Inspection Program Assessment Final Report. The report documents improvement opportunity recommendations, supporting discussions, and commendable practices resulting from the assessment performed by an FHWA team at your request.

The purpose of the assessment was to review ARDOT's policies, procedures, and standard operating practices used to administer the requirements of the National Bridge Inspection Standards (NBIS). The Team identified improvement opportunities to enhance quality and improve the effectiveness in performing and managing bridge inspections and follow-up actions. Additionally, the Team identified ARDOT commendable practices that improve efficiency and effectiveness in their bridge inspection program. These commendable practices are summarized in the report and should be continually supported to ensure success.

The Team acknowledges that ARDOT's policies, procedures, and standard operating practices for bridge inspection are administered by qualified and conscientious personnel dedicated to the delivery and quality improvement of their program. Additionally, the Team extends our sincere appreciation to ARDOT's personnel for taking the time to be involved in this assessment. This assessment could only be successfully completed through their cooperation and assistance.

The FHWA Arkansas Division Office will coordinate follow-up actions with ARDOT in the coming days.

Sincerely yours,

/s/ Larry O'Donnell

Larry O'Donnell, P.E.
Assessment Team Lead

Enclosure

Federal Highway Administration
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cc:
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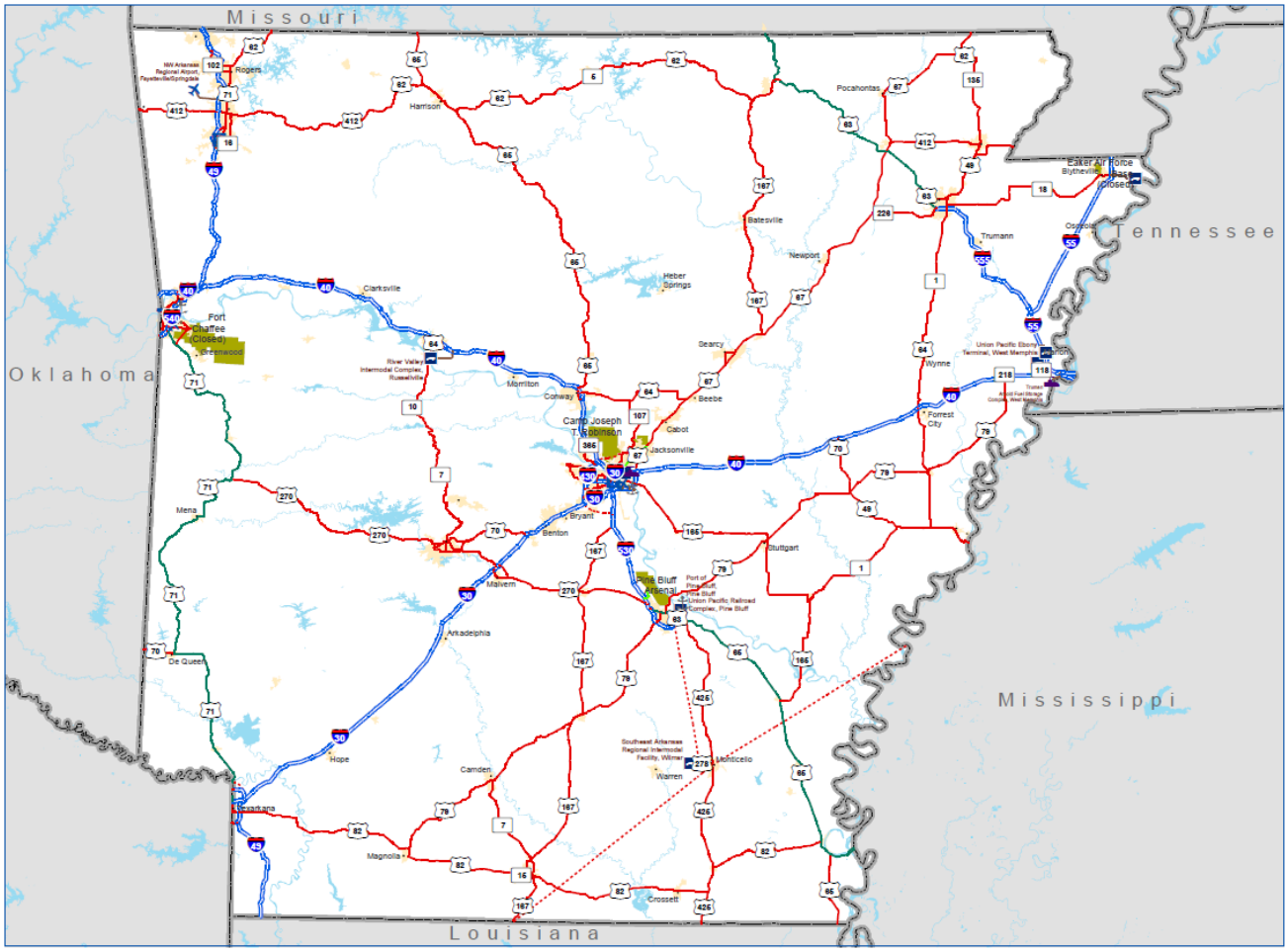
BRIDGE INSPECTION PROGRAM ASSESSMENT

ARKANSAS DEPARTMENT OF TRANSPORTATION

FINAL REPORT



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November 8, 2021

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ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ARDOT	Arkansas Department of Transportation
BIM	Bridge Inspection Manual, ARDOT
BIP	Bridge Inspection Program
BIRM	Bridge Inspector's Reference Manual, FHWA
CF	Critical Finding
CFR	Code of Federal Regulations
DCE	District Construction Engineer
DME	District Maintenance Engineer
FCM	Fracture Critical Member
FHWA	Federal Highway Administration
HBM	Heavy Bridge Maintenance
LRPM	Load Rating and Posting Manual, ARDOT
MBE	Manual for Bridge Evaluation, AASHTO
MS	Mississippi
NBI	National Bridge Inventory, FHWA
NBIP	National Bridge Inspection Program
NBIS	National Bridge Inspection Standards
NHS	National Highway System
PE	Professional Engineer
PT	Dye Penetrant Testing
POA	Plan of Action
QC	Quality Control
QA	Quality Assurance
TN	Tennessee
UBIT	Under Bridge Inspection Truck
UWI	Underwater Inspection

EXECUTIVE SUMMARY

This Bridge Inspection Program Assessment was performed by the Federal Highway Administration (FHWA) at the request of the Arkansas Department of Transportation (ARDOT). The purpose of the assessment was to review ARDOT's policies, procedures, and standard operating practices used to administer the requirements of the National Bridge Inspection Standards (NBIS), identify improvement opportunities, and highlight commendable practices. The assessment began on May 24, 2021 and on-site field reviews were completed on July 22, 2021.

This report documents the improvement opportunity recommendations and commendable practices resulting from the assessment performed by an FHWA team (Team). The Team included Larry O'Donnell and Anwar Ahmad from the Resource Center, Tom Drda from the Office of Bridges and Structures, and Scott Stotlemeyer from the Missouri Division.

ARDOT's policies, procedures, and standard operating practices for bridge inspection are administered by qualified and conscientious personnel dedicated to the delivery and quality improvement of their program.

The Team identified improvement opportunities to enhance quality and improve the effectiveness in performing and managing bridge inspections and follow-up actions. These improvement opportunities are grouped into the following broad categories: Quality Control (QC) and Quality Assurance (QA), Inspection Procedures, Load Rating and Posting Procedures, Scour Appraisals, and Inspection Resources. The prioritized improvement opportunity recommendations are summarized as follows and discussed further in the report. Some of the improvement opportunity recommendations are interrelated and should not be treated as mutually exclusive.

Quality Control and Quality Assurance

Recommendation 1. Document and implement updates to QC and QA procedures that include the following.

- Independent QC review of inspection and load rating documentation by qualified personnel other than just the inspection team members or load rater.
- QC procedures for a qualified engineer on site during inspections of complex and major bridges.
- More robust QC inspection review procedures performed by the District Construction Engineers (DCEs) and District Maintenance Engineers (DMEs), and additional review of district QC practices by Heavy Bridge Maintenance (HBM).
- QA procedures for review of statewide inspection teams.
- Core training curriculum and certifications needed for inspection personnel based on inspection types and bridge complexity.

- Periodic statewide training/meetings for bridge inspection personnel (i.e., HBM, load rating, bridge management, DCEs and DMEs, and district inspection and maintenance staff) to discuss as a group: bridge inspection issues, results of QC and QA reviews, requirements, expectations, useful practices, and changes in policies or procedures.
- QC and QA procedures for InspectX data (i.e., Structure Inventory and Appraisal (SI&A) data and supporting bridge record/file data).

Inspection Procedures

Recommendation 2. Enhance inspection procedures for bridges with fracture critical members (FCMs), bridges with underwater members, and complex and major bridges. Include details in the procedures as described in the FHWA Bridge Inspector's Reference Manual (BIRM) and American Association of State Highway and Transportation Officials (AASHTO) Manual for Bridge Evaluation (MBE).

Recommendation 3. Evaluate all bridges over water and determine which bridges have members requiring an NBIS underwater inspection (UWI).

Recommendation 4. Update InspectX data management system to maintain more complete bridge records and implement a standard file naming convention for inclusion of supporting files that includes a brief description and a more meaningful date in the filename, to facilitate access by all users.

Recommendation 5. Involve select representatives from HBM staff, DCEs, DMEs, and inspectors in development and implementation of proposed changes to procedures and policies. Include clearer communication protocols between HBM, DCEs, DMEs, and inspectors regarding policy, procedure guidance, and direction.

Recommendation 6. Evaluate and adjust priority definitions for maintenance needs in terms of expected and achievable completion time frames.

Recommendation 7. Report, to the FHWA National Bridge Inventory (NBI), the actual inspection frequencies ARDOT expects NBIS inspection types to be performed.

Recommendation 8. Develop and implement improved procedures to clearly differentiate FCM inspection findings from Routine inspection findings, to facilitate access by all InspectX users, when results of the inspection types are combined in the same report.

Recommendation 9. Routinely communicate the importance of the bridge inspection program requirements, expectations, and procedure changes to local agency bridge owners. Establish recurring presentations at Municipal League meetings or other common meetings regularly attended by local agency bridge owners.

Load Rating and Posting Procedures

Recommendation 10. Ensure load ratings for all bridges are done adequately and appropriately. Consider having consultant professional engineering services available to perform load ratings on complex, major, and other bridges as needed.

Recommendation 11. Ensure all legal vehicular loads are adequately addressed by ARDOT load rating models.

Recommendation 12. Update and implement reporting protocols to ensure load ratings and required load postings are completed timely and adequately for all bridges.

Recommendation 13. Consistently utilize a load rating summary sheet for each bridge; identifying the controlling members, primary member conditions, assumptions, and posting requirements, when applicable, and have it readily available in the InspectX Files tab to facilitate access by all users.

Recommendation 14. Develop and implement procedures for engineering personnel to perform inspections to capture and document the necessary information for performing a load rating or structural review when there is a change in condition to primary load carrying members, which may impact load capacity, or develop and periodically deliver training to inspectors on inspection documentation required for a load rating or structural review.

Scour Appraisals

Recommendation 15. Ensure that all bridges over water have a documented scour appraisal in InspectX to facilitate access by all users.

- Form a multi-disciplinary scour appraisal team to update scour appraisals when warranted, and review and update scour plans of action (POA), when applicable, to indicate storm events, stream elevations, or flows that trigger scour monitoring.
- More clearly indicate the responsibility for implementing the scour POAs and performing the scour monitoring.
- Update and implement a more consistent process for documenting scour monitoring.

Inspection Resources

Recommendation 16. Develop and implement a process for use of on-call professional engineering consultant contracts for inspection program support. Evaluate bridge inspectors' workload with addition of major overhead sign structures and high mast lighting inspections by district bridge inspection teams and consider consultant services for the inspection of highway tunnels, especially complex tunnels, in place of district bridge inspection teams.

Recommendation 17. Establish inspection program performance measures that indicate accomplishments and develop reports and tools to assess program needs.

Recommendation 18. Conduct a facilitated organizational structure study of staffing needs, roles, and responsibilities, and make necessary realignments of staff responsibilities.

Several commendable practices that are efficient and effective in ARDOT's bridge inspection program were identified during the assessment. These practices should be continually supported to ensure success. These commendable practices are summarized as follows.

Commendable Practice 1. Researching, adopting, and integrating technologies to supplement safety inspection activities such as unmanned aerial systems (i.e., drones), timber micro-drilling, and underwater side-scan sonar.

Commendable Practice 2. The ARDOT bridge inspection program includes knowledgeable, experienced, and qualified staff that administer ARDOT's bridge inspection program.

Commendable Practice 3. Availability of multiple under-bridge inspection access equipment trucks (UBIT) in each district and Central Office that can be shared as needed.

Commendable Practice 4. Field inspection resource sharing (i.e., equipment and personnel) provided by HBM to districts and districts to HBM.

Commendable Practice 5. Load posting certification process for local agencies, and local agency posting support provided by the districts. Local owners can secure load posting materials from ARDOT at a reduced cost if program procedures are followed. Notably, District 3 prepares the documents for the locals and hand carries the documents to them for their signature.

Commendable Practice 6. DCEs and DMEs are required to be licensed professional engineers (PE), with successful completion of comprehensive bridge inspection training, and provide support to district bridge inspectors as needed.

Commendable Practice 7. QA inspections performed by statewide inspection crews for bridges inspected by the districts.

Commendable Practice 8. Rotation of district inspection teams for Routine inspections so a bridge is not regularly inspected by the same inspection team.

Commendable Practice 9. Use of an automated load permitting and routing system.

Commendable Practice 10. Intent to maintain all inspection and inventory records electronically in the InspectX data management system.

Commendable Practice 11. Tracking bridge maintenance needs in the InspectX data management system.

Commendable Practice 12. Bridge maintenance crews have the skills and abilities to maintain and repair bridges and replace small structures.

Commendable Practice 13. Ability of maintenance personnel to react quickly for emergency repairs.

Commendable Practice 14. Inspectors are recruited through the State's bridge maintenance and construction programs.

Commendable Practice 15. Utilization of enthusiastic, dedicated, and skillful bridge inspection personnel willing to perform difficult tasks.

Commendable Practice 16. ARDOT has been maintaining the inventory, and performing inspections, load ratings, and scour appraisals for bridges on state, city, and county public highway systems since 1979. Having one entity (i.e., ARDOT) perform these functions of the bridge inspection program promotes uniformity and consistency throughout the program.

Commendable Practice 17. NBIS Form IIIB Guidelines for detailing the vertical and horizontal clearances for highways or railroads that pass under the bridge. These values are used to code National Bridge Inventory (NBI) Items 54 – Minimum Vertical Underclearance, 55 – Minimum Lateral Underclearance on Right, 56 – Minimum Lateral Underclearance on Left, and 69 – Underclearances Vertical and Horizontal.

Commendable Practice 18. Bridge Scour Plan of Action – Event Monitoring Form.

INTRODUCTION

Background

The Silver Bridge in Point Pleasant, West Virginia, collapsed on December 15, 1967. It was an eyebar chain suspension bridge with a main span of 700 feet. The collapse killed 46 people and initiated Congressional action that led to the National Bridge Inspection Program (NBIP). The purpose of the NBIP was to ensure the "proper safety inspection and evaluation of all highway bridges."

The FHWA bridge inspection program regulation resulted from the Federal-Aid Highway Act of 1968 that required the Secretary of Transportation to establish the National Bridge Inspection Standards (NBIS). The goal of the NBIS was to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public.

The 1968 Federal-Aid Highway Act directed the States to maintain an inventory of Federal-aid highway system bridges. After the Surface Transportation Assistance Act of 1978 was passed, NBIS requirements were extended to bridges greater than 20 feet on all public roads. The Surface Transportation and Uniform Relocation Assistance Act

of 1987 expanded bridge inspection programs to include special inspection procedures for fracture critical members and underwater inspection.

The current NBIS regulation (23 CFR 650, subpart C) became effective January 13, 2005. The AASHTO Manual for Bridge Evaluation (MBE), First Edition, 2008 was incorporated by reference into the NBIS and became effective January 25, 2010. The NBIS requires each State Transportation Department to inspect, or cause to be inspected, all highway bridges located on public roads that are fully or partially located within the State's boundaries, except for bridges that are owned by Federal agencies. Additionally, each State Transportation Department must include a bridge inspection organization that is responsible for: agency-wide bridge inspection policies and procedures, quality assurance and quality control, preparation and maintenance of a bridge inventory, bridge inspections, reports, and load ratings.

According to the 2021 National Bridge Inventory (NBI), there are 12,941 bridges in Arkansas with an average age of 43 years. Approximately 48% are classified as good, 47% fair, and 5% poor. See Appendix G for further details.

Bridges represent one of the highest unit investments of all elements of the highway system. Additionally, bridge deficiencies can present one of the greatest dangers of all potential highway failures for disruption of community welfare and loss of life. Furthermore, as bridge conditions worsen, the cost to inspect, preserve, or replace bridges, along with potential impacts to traffic from detours due to load restrictions or closures, increases. Therefore, the bridge inspection program is essential to an agency for:

- Maintaining public safety and confidence by locating, documenting, and addressing structural safety concerns,
- Protecting public investment by providing prioritized maintenance, repair, and rehabilitation recommendations,
- Maintaining a desired level of service by addressing functional improvements,
- Providing bridge program managers with accurate structural condition assessment information, which can support programmatic decisions for the use of limited funding, and
- Fulfilling the State's legal responsibilities for performing inspections, preparing reports, and determining load ratings in accordance with the NBIS and AASHTO MBE.

Purpose

At the request of the ARDOT, an FHWA team performed an assessment of ARDOT's bridge inspection program. The Team included Larry O'Donnell and Anwar Ahmad from the Resource Center, Tom Drda from the Office of Bridges and Structures, and Scott Stotlemeyer from the Missouri Division. The purpose of the assessment was to review

ARDOT's policies, procedures, and standard operating practices used to administer the requirements of the NBIS.

Scope

The Team reviewed ARDOT's documented policies, procedures, standard operating practices, and systems utilized to support their bridge inspection program. This included ARDOT's Bridge Inspection Manual (BIM), Load Rating and Posting Manual (LRPM), Local Government Procedures for Compliance with The National Bridge Inspection Standards (Local Government Procedures), personnel classification specifications (i.e., qualifications), and InspectX data management system (i.e., electronic bridge record/files). See References section for a more complete list.

Interviews were conducted by the Team with selected ARDOT leadership and bridge inspection staff, as well as their bridge inspection consultant personnel that are responsible for, or have been delegated, the function for managing or performing inspections, determining bridge condition ratings and assessments, preparing reports or handling bridge inspection program deliverables. This included the State Maintenance Engineer, State Heavy Bridge Maintenance Engineer, Senior Heavy Bridge Maintenance Engineer, Staff Heavy Bridge Maintenance Engineer, Heavy Bridge Maintenance Engineer, Statewide Bridge Inspectors, Statewide Assistant Bridge Inspectors, Bridge Load Rating Engineer, Bridge Management Assistant Section Head, Bridge Management Analyst, Consultant (underwater dive inspections), District Construction Engineers, District Bridge Inspectors and Assistants, Equipment Operator (i.e., UBIT driver), Heavy Bridge Maintenance Superintendent, Local Project Administration - Staff Program Management Engineer, and District Maintenance Engineers.

Bridge file reviews for 33 bridges were performed by the Team on a selection of bridges that included complex and major bridges, bridges with FCMs, and common bridge types. These reviews included an assessment of applicable inspection reports, inspection procedures, load ratings, scour appraisals, NBI data, maintenance recommendations, and other supporting data. See Table 1 for the list of bridges.

Cursory field reviews were performed by the Team on 12 of the 33 bridges along with a review of the latest routine, fracture critical, underwater, and special inspection reports as applicable. See Table 2 for the list of bridges.

Table 1. Bridge file reviews.

Structure # NBI Item 8	Facility Carried NBI Item 7	Features Intersected NBI Item 6A
A1210	State Highway 23	Arkansas River & Uprr
A5960	I 49 SB Benton 1	New Hope Rd/ Osage Creek
M0231	SH 8 S-6 LM 9.92	W FORK TULIP CK RELIEF
M1829	Sh118/Sec-3/L10.60	Chatman Branch
M3714	SH 187 Carroll	LEATHERWOOD CREEK
M4001	SH 230-10- LM 1.09	DITCH
1257	US 61-03- LM 19.01	DITCH NO 30
2271	I- 55	MISS RIVER & CORD 312
2475	SH 7-10 Log 2.32	SOUTH FORK SALINE RIVER
2718	SH 135-05- LM 4.45	LOCUST CREEK
2859	US 62-20- LM 11.71	DITCH NO 13
3084	US 49-02- LM 8.71	HURRICANE CREEK
3170	SH 38 Log 9.41	PIGEON ROOST CR.
3442	SH 10-SEC 8	COMMERCE SHERMAN STS.
3510	MAIN STREET	I 630-SEC 21 Log 0.46
3518	SH 134SEC.01-17.18	MAIN DITCH
3929	State Highway 38	White River-Prairie Co.
4394	Cr-803/Z-F/L-5.09	Larkin Creek
5141	I 40-SEC 52	MISS RVR CR CI ST RR
5499	SH 8-14 LM 18.45	Bayou Bartholomew
6381	SH 128-SEC 10	OUACHITA RIVER
6795	Us-79/Sec-18/L2.77	Cutoff Bayou
6803	SH 7 -SEC. 15	I 40 -SEC. 22
6957	SH 14-14- LM 5.93	DRAINAGE DITCH NO. 10
7292	US 70-District 6	SH10SH100 ARKRIV-Pulaski
13129	CR42/Fulton County	SPRING RIVER
17179	UNION CR 33 ZONE D	DRY CREEK
20534	CR280-C (911=508)	HENDERSON CREEK
21049	CR 48/County Line	Canal
21446	CR 67-I (911= 481)	PAYNE CREEK
22690	Union CR 31 Z-K	Union Cornie Bayou Rel.
22828	County Line Rd-CR	Canal
22849	Sequoyah Ranch – A	N Fork of Cadron Creek

Table 2. Bridge field reviews.

Structure # NBI Item 8	Facility Carried NBI Item 7	Features Intersected NBI Item 6A
M1829	Sh118/Sec-3/L10.60	Chatman Branch
M4001	SH 230-10- LM 1.09	DITCH
1257	US 61-03- LM 19.01	DITCH NO 30
2271	I- 55	MISS RIVER & CORD 312
2718	SH 135-05- LM 4.45	LOCUST CREEK
3170	SH 38 Log 9.41	PIGEON ROOST CR.
3442	SH 10-SEC 8	COMMERCE SHERMAN STS.
3510	MAIN STREET	I 630-SEC 21 Log 0.46
5141	I 40-SEC 52	MISS RVR CR CI ST RR
7292	US 70-District 6	SH10SH100 ARKRIV-Pulaski
21446	CR 67-I (911= 481)	PAYNE CREEK
22849	Sequoyah Ranch – A	N Fork of Cadron Creek

ARDOT's HBM section staff and the Team also discussed the preliminary results of ARDOT's internal investigation of inspections performed on the Hernando de Soto Bridge, Interstate 40 over the Mississippi River. The discussions were formative in the report recommendations.

Objectives

Identify and document opportunities for improvement to policies, procedures, and standard operating practices that enhance quality and improve effectiveness in performing and managing bridge safety inspections and follow-up actions. Identify and highlight commendable practices for sharing with other agencies.

OPPORTUNITIES FOR IMPROVEMENT

The Team identified opportunities for improvement that will enhance quality and improve effectiveness in performing and managing bridge inspections and follow-up actions. These opportunities for improvement were grouped into the following broad categories: QC and QA, Inspection Procedures, Load Rating and Posting Procedures, Scour Appraisals, and Inspection Resources. Some of the opportunity for improvement recommendations are interrelated and should not be treated as mutually exclusive. The following presents the opportunity for improvement recommendations and discussions resulting from the assessment.

Quality Control and Quality Assurance

The NBIS indicates the State bridge inspection organization must have a qualified program manager who has been delegated responsibility for statewide QC and QA.

Additionally, the NBIS indicates the State is to assure systematic QC and QA procedures are used to maintain a high degree of accuracy and consistency in the inspection program, which include periodic field review of inspection teams, periodic bridge inspection refresher training for program managers and team leaders, and independent review of inspection reports and computations.

The NBIS defines QC as "procedures that are intended to maintain the quality of a bridge inspection and load rating at or above a specified level." Whereas, the ARDOT BIM defines QC as "the enforcement of procedures that are intended to maintain the caliber of bridge inspection and documentation at or above the NBIS standard. QC is the responsibility of every person involved in the daily activities of the bridge inspection program."

The NBIS defines QA as "the use of sampling and other measures to assure the adequacy of QC procedures in order to verify or measure the quality level of the entire bridge inspection and load rating program." Whereas, the ARDOT BIM defines QA as "a measurement of the level and consistency of the overall program. QA measures the quality and uniformity of the inspection and documentation, and identifies specific items or procedures in the program where clarification, revision, or additional training is needed."

The AASHTO MBE indicates, "to maintain the accuracy and consistency of inspections and load ratings, bridge inspection programs need to have appropriate QC and QA measures in place. QC procedures are intended to maintain the quality of the bridge inspections, bridge data, scour evaluations, and load ratings, and are usually performed continuously within the bridge inspection teams or units performing these functions. QC procedures can vary depending on the structural and scour conditions of a bridge with increased level of review commensurate with increased deterioration of bridge conditions. QA procedures are used to verify the adequacy of the quality control procedures to meet or exceed the standards established by the program manager. QA procedures are usually performed independently of the bridge inspection and load rating teams on a sample of their work."

Furthermore, the AASHTO MBE indicates that "a documented quality control plan may include qualifications (education, certifications or registrations, training, and years and type of experience) for the program manager, bridge inspection personnel, and load rating personnel."

According to the ARDOT BIM and interviews, the HBM section maintains documentation of the qualifications and training for all bridge inspection personnel. This section also maintains the ARDOT BIM and updates the BIM as directed by the Bridge Inspection Committee and/or State Bridge Inspection Program Manager.

Recommendation 1. Document and implement updates to QC and QA procedures that include the following.

- Independent QC review of inspection and load rating documentation by qualified personnel other than just the inspection team members or load rater.
- QC procedures for a qualified engineer on site during inspections of complex and major bridges.
- More robust QC inspection review procedures performed by the DCEs and DMEs, and additional review of district QC practices by HBM.
- QA procedures for review of statewide inspection teams.
- Core training curriculum and certifications needed for inspection personnel based on inspection types and bridge complexity.
- Periodic statewide training/meetings for bridge inspection personnel (i.e., HBM, load rating, bridge management, DCEs and DMEs, and district inspection and maintenance staff) to discuss as a group: bridge inspection issues, results of QC and QA reviews, requirements, expectations, useful practices, and changes in policies or procedures.
- QC and QA procedures for InspectX data (i.e., Structure Inventory and Appraisal (SI&A) data and supporting bridge record/file data).

Discussion 1. As part of QC, the ARDOT BIM indicates, "either the Assistant Bridge Inspector or Inspector is to review the inspection information entered by the other team member. The following items are the minimum required for the review of an inspection:

- Review NBI Items 90, 91, 92, and 93 (Inspection dates and Frequencies) for completeness and accuracy.
- For state bridges, a bridge layout and a cross-section view shall be stored as a pdf file in the Asset Files/Plans tab.
- Photos should be included for:
  - Bridge looking down roadway (Routine Inspections)
  - Elevation view of bridge and set as the default image (Routine Inspections)
  - Posting and clearance signs (Routine & Under Record Clearance Inspections)
  - Maintenance items that warrant either a "CF", "A" or "B" priority
  - Conditions that rate 4 or lower on the NBI scale
  - Elements that rate Condition State 4: "Severe"
  - Repaired bridge elements
  - Deck on a state bridge representing "typical" deck conditions showing both top and bottom of deck
- Photos for roadway and elevation views are included in the Asset (Manager Files)

- Review ARDOT Agency Tab for accuracy and verify an email is included for Local Owners
- Review Under Records Tab for accuracy
- Review Element Inspection Tab for accuracy for State bridges and Local bridges on NHS
- If inspection is late, the proper documentation has been entered into the Late Reason drop down box on the ARDOT Agency Form
- Maintenance items have been entered if required
- Attach any drawings, plans or files that support the inspection under the appropriate tabs
- Verify that the inspection schedule has been updated for the next inspector
- Verify that any “Special Inspections” left in the schedule are necessary and removed if not
- Verify that NBI Items 58 [Deck], 59 [Superstructure], 60 [Substructure], or 62 [Culvert] correlate well with the Element Conditions and the Maintenance Items”

According to the ARDOT LRPM, QC and QA reviews are performed to “maintain a consistent quality of load ratings and postings. The Staff Structures Engineer or their qualified designee is responsible for making three QC reviews per month of each Rating Engineer’s load ratings. Bridges shall be randomly selected from ratings performed in the previous month. The QC review shall be documented on the QC Review form and archived at SAN1\Pontis_Docs\Ratings\Quality Control\. A QA review shall be made to verify that required QC load rating reviews have been made and follow the specified procedures to ensure quality load ratings. The QA review shall be made by the Division Head of the Bridge Division each quarter. The QA review shall be documented on the QA Review form and archived at SAN1\Pontis_Docs\Ratings\Quality Assurance\.”

The Team acknowledged the review of three load ratings a month per load rater, indicated in the ARDOT LRPM, as a QC type of review since the reviews are completed by a staff member within the load rating unit. However, a QC review would typically be performed for each load rating and would have the reviewer indicated on the load rating or load rating summary. Documentation of appropriately completed QC and QA reviews should be included in InspectX, since ARDOT’s intent of InspectX is to serve as the bridge record/file for each bridge.

During interviews, it was indicated to the Team that scour appraisal updating has been delegated to a member of the Bridge Load Rating section within the Bridge Division and there are no current procedures in the ARDOT BIM to address the QC or QA of new, existing, or updated scour appraisals.

The ARDOT BIM does not indicate the need for any specialized inspector qualifications, experience, training, or certifications beyond the minimum required of

a Team Leader by the NBIS, other than a commercial driver's license. Additionally, the criteria for a complex or major bridge is not addressed, and the inspection procedures for major bridges and/or bridges with FCMs also did not indicate any additional inspector credentials. Due to the more significant risks of impacts to the traveling public from closures of complex or major bridges, the Team recommends a registered professional engineer be on site for the inspection of complex and major bridges and the inspection procedures and QC procedures clearly reflect their role and responsibility.

From field and file reviews, the Team identified several bridges with missing elements from the element data or should have used more appropriate elements. Furthermore, the SI&A within the inspection reports did not indicate the appropriate code for the reference feature below the bridge (NBI Items 54A and 55A) and/or had erroneous data (NBI Items 54B and 55B). Additionally, for bridges over water, issues were identified with the codes used for Navigation Control (NBI Item 38) and Pier or Abutment Protection (NBI Item 111). Furthermore, there were issues identified in the accuracy of the Average Daily Truck Traffic (NBI Item 109) data.

According to the ARDOT BIM, the DCEs were designated "District Bridge Inspection Engineers", the person responsible for coordinating and monitoring the inspection program at the district level, in January 1985. The DCEs were designated "District Bridge Inspection Program Managers" in May 2011. Additionally, the ARDOT BIM indicates the "District Bridge Construction Engineer" serves as the "Local Program Manager", supervises the inspection process, and is responsible for the accuracy of the reports. The accuracy and consistency of the inspection and documentation is vital because it not only impacts programming and management of the bridge inventory, but also affects public safety.

According to the ARDOT BIM, the DCE is to "make periodic bridge site visits (i.e., one bridge per quarter/per inspection team) at various locations to compare report results and observed field conditions. The QA inspections of the same structure are to be kept to a minimum unless the rating has changed. The DCEs are to assess the accuracy of NBI Items 58 – Deck, 59 – Superstructure, and 60 – Substructure and determine if appropriate notes and photographs have been provided. Any discrepancies between the report and observed conditions are to be resolved with the Bridge Inspector. The QA inspection and its documentation are to be completed and turned in by the end of the month following the quarter in which the inspection was completed." It is also recommended by the ARDOT BIM that "the majority of inspections reviewed be selected from those structures that have at least one of the following.

- A significant change in the condition rating(s) since the last inspection
- A designation of structurally deficient or functionally obsolete
- FCM bridges
- Posted bridges"

The State bridges are also to receive additional scrutiny by the DME when a maintenance item is evaluated and set to either “Monitor” or “Assigned” for the status.

During the interviews it was noted by the Team that QC reviews of inspection reports by the DCEs are typically only reviews of the NBI component condition ratings and maintenance needs identified for each inspection and not the entire report. Additionally, the DCE does not appear to be identified in InspectX as a reviewer for inspections but should be. This limited QC review is not expected to ensure the accuracy of reports for which the DCE is responsible. Furthermore, the DCEs indicated they have very limited time to dedicate to their QC inspection role as the local program manager due their extensive role and responsibilities for construction within the districts.

The Team recognized that the DCEs are typically reviewing only the NBI component condition ratings, associated notes, and maintenance needs. See ARDOT examples in Appendix C. These reviews by the DCEs would typically be considered QC reviews, not QA reviews, as the DCE is directly involved in the inspection process at the district. Although this is a good practice, the QA review process should be performed by staff or consultants that are not directly part of the inspection production process. The use of statewide teams to perform QA of the district inspections is a method that would be considered QA as they are not directly part of the inspection production at the districts.

According to the ARDOT BIM, “Routine inspections in the district bridge inventory are to be alternated between district bridge inspection teams. The DCE may implement an alternate procedure of rotating through a minimum of 30% of the inventory. To ensure the Routine inspection of bridges within the district bridge inventory is alternated between bridge inspection teams, the HBM section is to make a check each January of the percent of rotation within each district.” The Team recommends that the rotation of inspection teams for Routine and FCM inspections should occur for both the district inspection teams and the statewide inspection teams and should be included in the ARDOT BIM.

It was indicated during interviews that it is not a common practice for the DMEs to participate in the field reviews by the DCEs and the DCEs often do the field reviews alone, which the Team recognized as cause for concern for safety of the DCE. The Team suggests that someone accompany the DCEs on field reviews, which should be the DME, but could be any district staff.

According to the ARDOT BIM, “the statewide inspection teams, assigned to the HBM section in the Central Office, perform QA re-inspections of approximately 4% of the districts’ inspections yearly.” The Team observed that summaries of statewide teams’ findings are limited and could be made clearer as to their concurrence with the findings from their review in comparison to the district’s. See Appendix D for ARDOT statewide QA summary examples.

According to the ARDOT BIM, “the re-inspections by the QA Inspection Teams are to occur within a few months of the district’s inspection to limit possible changes in bridge condition.” The QA Inspection Teams are to rate NBI Items 58 – Deck, 59 – Superstructure, 60 – Substructure, or 62 – Culvert and note any maintenance items they would rate as a priority “B” or higher (e.g., CF or A). In addition to these items the QA teams are to verify several NBI items. See Table 3.

Table 3. NBI items verified during QA reviews by statewide teams.

NBI Items	NBI Items
NBI 001: State Code	NBI 043B: Struc. Type, Main: Type Des./Con.
NBI 002: Highway Agency District	NBI 044A: Struc. Type, Appr. Spans: Mat./Des.
NBI 003: County (Parish) Code	NBI 044B: Struc. Type, Appr. Spans: Type Des/Con.
NBI 006: Feature Intersected	NBI 045: Number of Spans in Main Unit
NBI 007: Facility Carried by Structure	NBI 046: Number of Approach Spans
NBI 008: Structure Number	NBI 047: Inventory Route, Total Horizontal Clearance
NBI 009: Location	NBI 048: Length of Maximum Span
NBI 010: Minimum Vertical Clearance	NBI 049: Structure Length
NBI 016: Latitude	NBI 050A: Curb or Sidewalk Width: Left Side
NBI 017: Longitude	NBI 050B: Curb or Sidewalk Width: Right Side
NBI 028A: Lanes on the Structure	NBI 051: Bridge Roadway Width, Curb-To-Curb
NBI 028B: Lanes Under the Structure	NBI 052: Deck Width, Out-To-Out
NBI 032: Approach Roadway Width	NBI 053: Min. Vert. Clearance OVER Bridge Roadway
NBI 033: Bridge Median	NBI 054A: Min. Vert. Under Clearance: Ref. Feature
NBI 034: Skew	NBI 054B: Minimum Vertical Under Clearance
NBI 035: Structure Flared	NBI 055A: Min. Lat. Under Clearance on Rt.: Ref. Feat.
NBI 036A: Traffic Safety Feat.: BR. Railings	NBI 055B: Min. Lat. Under Clr. on Rt.: Min. Lat. Under Clr.
NBI 036B: Traffic Safety Features: Transitions	NBI 056: Minimum Lateral Under Clearance on Left
NBI 036C: Traf. Safety Feat.: Appr. Guardrail	NBI 061: Channel and Channel Protection
NBI 036D: Traf. Safety Feat.: Appr. Grail. Ends	NBI 071: Waterway Adequacy
NBI 041: Struc. Open, Posted, Closed to Traf.	NBI 072: Approach Roadway Alignment
NBI 042A: Type of Service: ON Bridge	NBI 107: Deck Structure Type
NBI 042B: Type of Service: UNDER Bridge	NBI 108A: Type of Wearing Surface
NBI 043A: Struc. Type, Main: Kind Mat./Des.	NBI 112: NBIS Bridge Length

Once the re-inspections are completed for a district, Central Office personnel are to review the inspections and compare them with the district’s inspections. Variances of more than one for NBI items 58, 59, 60, and 62 condition ratings are to be investigated along with maintenance items noted “B” or worse (i.e., CF or A) not noted in the district’s inspection. A closeout training session is to be held with each district to review results. As indicated to the Team in the interviews, attendance by the DCE and DME at these closeout sessions varied. The Team recommends DCE and DME attendance be required at closeout sessions based on their roles and responsibilities for the inspection program at the districts.

From interviews, it was indicated to the Team that statewide inspection teams perform inspections on major bridges across the State which are typically more complex bridges. However, the Team did not find indications in the ARDOT BIM of formalized procedures for performing QA reviews of inspections performed by the statewide inspection teams and no independent QC review of inspection reports, beyond maintenance needs, by persons other than the inspection team members.

According to the ARDOT BIM, "the Bridge Inspection Committee schedules appropriate periodic refresher training as needed. Refresher training could include National Highway Institute (NHI) training, in-house training, webinars, on-line training, or any other training approved by the Bridge Inspection Committee. Bridge Inspectors and Program Managers are to attend this training every three years. Bridge Inspection Program personnel are to provide the Program Manager documentation of additional relevant training that may be completed beyond mandatory training. The Program Manager maintains a list of relevant training successfully completed by Bridge Inspectors, Assistant Bridge Inspectors and Program Managers."

From interviews, it was indicated that bridge inspection program personnel desire to be brought all together with their peers for formalized training to discuss bridge inspection issues, results of QC and QA reviews, changes in policies or procedures, and inspection lessons learned. Furthermore, inspection personnel were not aware of any additional required core training or certifications needed based on inspection types and bridge complexity.

According to the ARDOT BIM, "the Central Office conducts checks on the data from the bridge inspection database and discrepancies are investigated and resolved. Procedural recommendations for improvements are made to the Bridge Inspection Committee or to the Program Manager where common errors are found. The following is a list of data checks, from the ARDOT BIM, to be performed by the Central Office.

- Annually – Rotation of recent Routine Inspections – percentage.
- Monthly – Maintenance items in "Open" status for over 30 days.
- Monthly – Maintenance items in "Repair Complete" status for over 30 days.
- Monthly – Posting at beginning and ending both match calculated posting and is not closed.
- Monthly – Ensure bridges that should be posted are coded "P" in NBI Item 41.
- Monthly – Maintenance items must have completion date if completed.
- Monthly – Alert Inspector if number of distinct bridges to check in any of the next 6 months exceeds 30.
- Monthly – For posted bridges, check to ensure 2 routines are scheduled for 24 months frequency but offset by 12 months in the schedule.

- Monthly – If bridge condition is Poor (58, 59, 60, 62 <= 4), ensure routine scheduled for 24 months offset by 12 months with an Other Special Recurring set at 24 months.
- Weekly – Bridges have inspection scheduled. If NBI item 5a = 1, then Routine; otherwise Underclearance.
- Weekly – Bridges have an active inspector assigned.
- Monthly – Check that NBIS bridges have a Routine Inspection set for either 24 or 48 months.
- Monthly - Check that FCM inspections are set for 24-month.
- Monthly - Check that bridges that have a maintenance need, and that are not owned by the state, have owner email address."

The Team acknowledged that although these ARDOT data checks help with monitoring the inspection process, there are additional QC data checks that should be reflected in the QC procedures that should be completed for each inspection report before data is accepted. A common computer-aided data check process is to run the FHWA NBI Data Checks and the NBI Element File Check before data acceptance. The details for these checks can be found at the FHWA website https://www.fhwa.dot.gov/bridge/nbi.cfm. Although these are basic checks, there are other refined data consistency cross-reference checks that can be developed and utilized to improve consistency and accuracy of the data. QA for the data can be established by review of the data from a sample of bridge inspections for a particular timeframe by a qualified person designated within the QA procedures.

Inspection Procedures

The NBIS indicates the State's bridge inspection organization must have a qualified program manager who has been delegated responsibility for statewide bridge inspection policies and procedures.

According to the ARDOT BIM, the State Heavy Bridge Maintenance Engineer is designated the "Bridge Inspection Program Manager" and the Staff Heavy Bridge Maintenance Engineer is designated the "Assistant Bridge Inspection Program Manager." Additionally, the DCEs are designated the "District Bridge Inspection Program Managers."

The Team determined through the review of ARDOT's BIM and personnel interviews that the roles and responsibilities of the DCEs are not equivalent to the functions of an NBIS "program manager."

Recommendation 2. Enhance inspection procedures for bridges with FCMs, bridges with underwater members, and complex and major bridges. Include details in the procedures as described in the FHWA BIRM and AASHTO MBE.

Discussion 2: The NBIS requires the State to identify bridges with FCMs and bridges requiring underwater inspection.

According to the FHWA BIRM and the AASHTO MBE, the following items should be addressed, either in the bridge specific inspection procedures, or by referring to general inspection procedures.

- Identify each of the critical members to be inspected (e.g., FCMs, past repairs, underwater elements, complex features, fatigue prone details, scour countermeasures) on plan sheets, drawings, or sketches.
- Identify special access needs (e.g., interior of box girders) or equipment necessary to gain the access required to inspect the features (e.g., under bridge inspection trucks, lifts, traveler system, climbing).
- Describe the inspection method(s) and frequency to be used for the elements. For example, “Visually inspect all identified FCMs at arm’s length for cracks, deterioration, missing bolts, loose connections, broken welds… using PT to verify the existence of suspected cracks.”
- Address required proximity to details, such as “arm’s length” or “hands-on.”
- Identify special qualifications required of inspection personnel by the program manager, if any (e.g. successfully passed fracture critical course, certified electrician for movable bridge electrical components, qualified bridge inspection diver).

Other items that may be addressed depending on each unique situation might include.

- Special contacting procedures prior to inspection (e.g., Coast Guard, security, operations personnel, emergency services).
- Safety concerns (e.g., snakes, bats, alligators, vagrants, other wildlife).
- Best time of year to inspect the bridge considering lake draw down, canal dry time, snow, ice, and bird nesting seasons.
- Anything else the program manager wants the inspection team leader to be aware of in preparation for the inspection.
- Any special requirements to ensure inspector and public safety, including a traffic management plan, are also included.

Similar information on inspection procedures can be found in Section 4: Inspection Procedures of the AASHTO MBE.

Bridges with FCMs

The NBIS defines an FCM as “a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse.”

For bridges with FCMs, the NBIS requires the State to "identify the location of FCMs, describe the FCM inspection frequency and procedures, include this information in the bridge inspection records, and inspect FCMs according to these procedures." Additionally, the NBIS defines a FCM inspection as "a hands-on inspection of a FCM or member components that may include visual and other non-destructive evaluation." The NBIS further defines a hands-on inspection as "an inspection within arms-length of the component. Inspection uses visual techniques that may be supplemented by non-destructive testing."

The ARDOT BIM indicates that an FCM "is a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse. Bridges that contain fracture critical members are fracture critical bridges." Furthermore, the ARDOT BIM indicates that fracture critical bridges are "non-redundant steel bridges such that failure of a single steel tension member or tension component could be expected to result in collapse of the structure. On most FC bridges only the FC elements will require inspection on a yearly basis while the other elements of the bridge can be inspected on the normal cycle as deemed applicable for the particular bridge."

Additionally, the ARDOT BIM indicates that an FCM inspection "is a close-up, hands-on inspection performed on bridges with fracture critical details. Fracture Critical inspections shall be limited to the bridge components in question with a full Routine (NBI) inspection not being necessary unless it is scheduled." Furthermore, the ARDOT BIM indicates that an FCM inspection "is a recurring inspection with Item 92A set for 24 months but scheduled for 12 months or less."

The ARDOT BIM indicates that the objective of an FCM inspection "is to evaluate, by means of standard bridge inspection procedures the condition of those portions of a bridge that are considered Fracture Critical (FC). Types of bridges considered fracture critical by ARDOT include, but not limited to, all trusses, one or two girders per span bridges, pin and hangers on two girder bridges, steel framed bent cap bridges, suspension bridges, railroad car bridges, and steel tied arch bridges."

The ARDOT BIM also indicates that an FCM inspection procedure "is required for any bridge with a FCM and the procedure is to be attached in the Asset Details/Asset Files/Fracture Critical tab." The procedure document is to include the following:

- "A description of the fracture critical aspects of the structure
- Equipment and procedures required to access each FCM, and
- Tools necessary for inspection, including any special equipment such as non-destructive testing devices."

Also, the ARDOT BIM indicates that referenced photos and a MicroStation framing plan drawing or schematic labeling of each FCM location is to be "linked at the same location with an elevation view required for trusses."

Upon completion of the FCM inspection procedure, the Inspector is to "inform the HBM Section that the procedure is available for review." An Engineer from the HBM section is to "verify that all FCMs have been identified and properly labeled." Once the procedure has been approved, the Engineer is to "record the approval."

ARDOT Form III is to be "used to list all FCMs, the inspection method used and the current condition factor at the time of inspection." This form is to be "linked in the InspectX database under Picture/Files and Fracture Critical tab."

InspectX is ARDOT's bridge data management system implemented in January 2020 and is intended to maintain all inspection and inventory records for each bridge electronically. The ARDOT BIM indicates that asset files are to be "attached under 'Asset Files' for bridges with FCMs (i.e., Asset Fracture Critical) include: Fracture Critical Procedure, Fracture Critical Drawing, Fracture Reference Photo, Blank Fracture Critical Inspection Report, and Blank Pin Document (if FCM)."

The Team observed through field and file review of bridges with FCMs that one- or two-page inspection procedure documents had brief information and a MicroStation drawing file (*.dgn) of the bridge with FCMs highlighted in red. The content of the procedures did not consistently reflect the content requirements from the ARDOT BIM, or the content indicated in the FHWA BIRM and AASHTO MBE. It was also not clear if the procedures had been reviewed and approved by an Engineer from HBM, or how the approval is recorded. See Appendix A for ARDOT examples. Furthermore, drawings (*.dgn file) of steel bents were reviewed for bridge #03442 that indicated steel section loss locations and notes but did not identify any members of the bents as FCMs.

Bridges with Underwater Members

The NBIS requires the State to "identify bridges requiring underwater inspection." For these bridges, the NBIS requires the State to "identify the location of underwater elements and include a description of the underwater elements, the inspection frequency, and the procedures in the inspection records for each bridge, and to inspect those elements according to these procedures." The NBIS defines an underwater inspection as "an inspection of the underwater portion of a bridge substructure and the surrounding channel, which cannot be inspected visually at low water by wading or probing, generally requiring diving or other appropriate techniques."

The ARDOT BIM indicates an UWI "is a recurring inspection with an inspection interval of 60 months or less and UWI (i.e., by divers) are performed by consultants." The UWI information is entered by the Central Office. The ARDOT BIM also indicates that an UWI "is an evaluation of those portions of a bridge below the water line that meet one or more of the following conditions."

- "Bridge without fully encased steel piles and continuously submerged which are not able to be inspected by normal observations.

- Structures where observed deterioration or misalignment above the waterline is thought to be caused by deterioration or distress below the waterline.
- Structures that appear to have significant problems below the waterline as determined by an Underwater Type 2 Inspection and are deemed necessary to make a supplemental inspection by a diver.
- Damage by accident or natural forces where detailed results will not be revealed by other types of inspection.
- Bridges that have high traffic volumes exceeding 10,000 and crossing major rivers such as the Arkansas, St. Francis, and White River."

The ARDOT BIM indicates that an Underwater Type 2 Inspection "is a recurring inspection that is ideally scheduled with the Routine inspection and during low water conditions when possible. All NBIS bridges crossing water and having a minimum of 3 tons load limit are included except for culverts with NBI Item 113 – Scour Critical Bridges with a code greater than 4." A channel profile is to be "provided for bridges where the channel and/or overbank material is an erodible material." All bridges requiring an Underwater Type 2 Inspection are to be "inspected every 60 months or more frequently if judged necessary due to eroding water or detrimental conditions." This type of inspection is used when underwater evaluation is made for:

- "Channel depth or profile by means of soundings using an electronic depth finder, measured probe, or measured line with weight, and
- Conditions of submerged substructure elements while wading, using a close visual or tactile (hands on) examination and/or probing of the elements and adjacent streambed."

Complex and Major Bridges

For complex bridges, the NBIS requires the State to "identify specialized inspection procedures, and additional inspector training and experience required to inspect these bridges, and to inspect these bridges according to those procedures." A complex bridge is defined by the NBIS as "movable, suspension, cable stayed, and other bridges with unusual characteristics."

Using the NBIS definition of complex bridge, the 2021 NBI indicates three complex bridges: two - suspension, and one - cable-stayed. There is one complex bridge in District 2, one in District 5, and one in District 9. The Team recommends that the ARDOT BIM specifically define criteria for ARDOT's complex bridges and address their related inspection procedures.

During interviews it was indicated that there are over 60 bridges ARDOT considers "major bridges" that are inspected by statewide inspection teams. It was further indicated during interviews that these bridges are typically truss bridges over the Mississippi and Arkansas rivers. Bridge #02271 (I-55 over MS River) and #05141

(I-40 over MS River) are examples of ARDOT's "major bridges" that have FCMs, and underwater substructure members needing UWI. The Team recommends the ARDOT BIM specifically define criteria for ARDOT's "major bridges" and address their related inspection procedures.

Recommendation 3. Evaluate all bridges over water and determine which bridges have members requiring an NBIS UWI.

Discussion 3. Refer to previous discussion regarding NBIS and ARDOT BIM UWI definitions and requirements.

The ARDOT BIM indicates that an "Inspector" is to "submit any bridge that meets one of the conditions listed for a Dive bridge to the HBM section to be evaluated for an Underwater (Dive) Inspection." "If after evaluation the bridge is found not to warrant a dive inspection, the HBM section" is to "document the reasons for not diving the bridge in the "Scour Tab" of the asset." "The Mississippi River and Red River crossings will be excluded from this case due to the nature of the extremely high water velocities and other dangerous conditions, but Underwater Type 2 Inspections are to be conducted."

The Team observed through file and field reviews that the ARDOT BIM criteria exclude bridges that should require an NBIS UWI. It is common for states to establish typical water depths at which underwater portions of a bridge substructure require an NBIS UWI (e.g., greater than 4 or 5 feet). Also, indicating the water surface elevation or water depth in the channel cross-section drawings is a recommended practice.

According to the 2021 NBI, there are 11,691 bridges in Arkansas that cross over waterways and only 35 (0.3%) indicate a need for an NBIS UWI. See Table 4. Of the 35 bridges, one bridge has an NBIS UWI interval of 36-months, two at 48-months, and 32 at 60-months.

Table 4. Bridges requiring NBIS UWI. Arkansas comparison with neighboring states.

State	Bridges	Bridges Over Water	Bridges with UWI	Bridges Over Water with UWI (%)
Arkansas	12,670	11,691	35	0.30
Louisiana	12,375	11,002	1,720	15.63
Mississippi	15,856	14,498	478	3.30
Missouri	24,075	21,374	380	1.78
Oklahoma	22,559	20,508	76	0.37
Tennessee	19,863	17,172	577	3.36

2021 FHWA NBI data. NBI Item 42B (Type of service under bridge) = 5, 6, 7, 8, or 9.
NBI Item 92B (Underwater Inspection) = Y.
NBI Item 41 (Open, Posted, or Closed) ≠ K.

Bridge #03170 was one of the bridges field reviewed that had substructure members in water depths over 7 ft. See Figure 1. ARDOT inspectors on-site during the field review indicated this was the typical water depth for the crossing. The current and previous Underwater Type 2 inspections available to the Team through InspectX did not indicate the water depths in the report or the soundings (i.e. cross-sections). The Team acknowledged that substructure members in this water depth would commonly require an NBIS UWI. However, the data supplied by ARDOT to the NBI did not indicate an NBIS UWI was required for this bridge. Additionally, the ARDOT criteria inappropriately exclude bridges with substructure members located in the Mississippi River such as bridge #02271, I-55 over the Mississippi River and bridge #05141, I-40 over Mississippi River, and the Red River. Additionally, from interviews, it was indicated that there are bridges with members in 10 to 15 feet of water that are not currently receiving an NBIS UWI.

Figure 1. Bridge #03170. Reinforced concrete (RC) channel beam supported by RC pile bents with RC caps. Maximum water depth approximately 7 ft. on 7/20/2021.

Recommendation 4. Update InspectX data management system to maintain more complete bridge records and files and implement a standard file naming convention for supporting files that includes a brief description and a more meaningful date in the filename to facilitate access by all users.

Discussion 4. The NBIS requires the State to prepare bridge files as described in the AASHTO MBE and to maintain reports on the results of bridge inspections together with notations of any action taken to address the findings of such inspections. Additionally, the NBIS requires the State to maintain relevant maintenance and inspection data to allow assessment of current bridge conditions and to record the findings and results of bridge inspections on standard State forms.

According to the AASHTO MBE, “information is organized in a file for each bridge.” Additionally, “the bridge file includes a description of the characteristics and conditions of the structure; calculations for determining scour vulnerability (if over water); a determination of the load-carrying capacity, including computations substantiating reduced load limits; and details of any damage and alterations or repairs to the structure.” Furthermore, “the information in a bridge file provides a cumulative history of the structure that is useful to review prior to conducting a bridge inspection, rating, or evaluation.” Finally, “the information in a bridge file may exist electronically, on paper, or in external documents appropriately referenced within each bridge file or manual”, and “the external documents may apply to multiple bridges and exist in various locations.” The following specific bridge information is typically included: general file information, field inspection information, critical findings and actions taken, waterway information, significant correspondence, other inspection procedures or requirements, load rating and posting documentation, and scour assessment and scour POA. Refer to Section 2: Bridge Files and Documentation of the AASHTO MBE for further details.

InspectX is ARDOT’s bridge data management system implemented in January 2020 and is intended to maintain all inspection and inventory records for each bridge electronically. For each bridge, there are tabs that present specific information about the bridge: Summary, Inspection, Schedule, Files, Maintenance, and History. See Figures 2 through 7 for screen shots of the tabs.

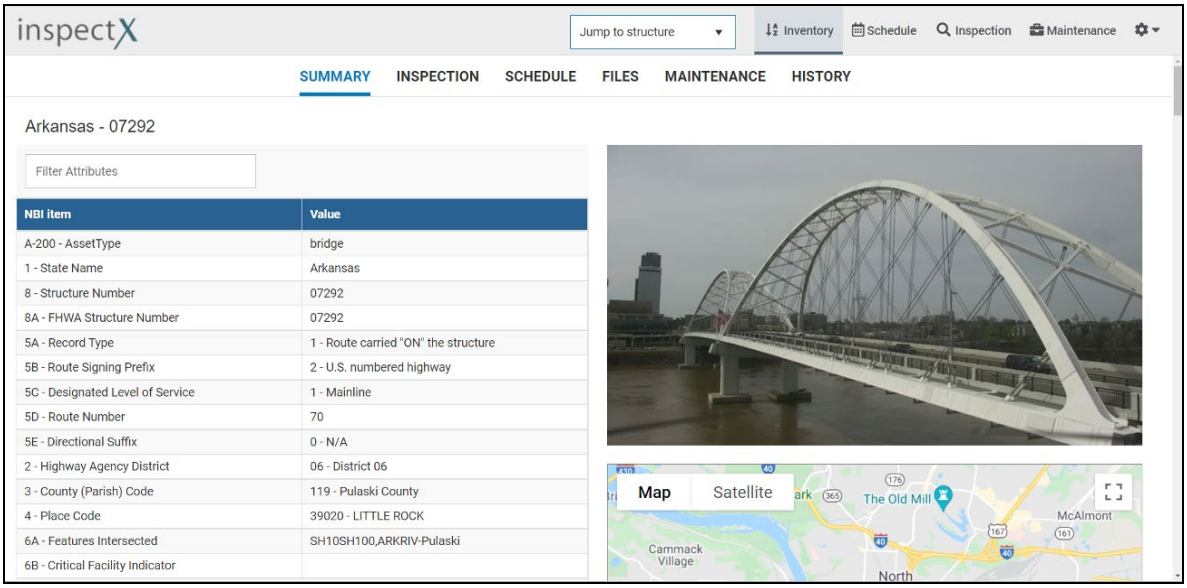


Figure 2. InspectX 2.4.2. Screen shot of Summary tab with SI&A data, bridge photo, and location map.

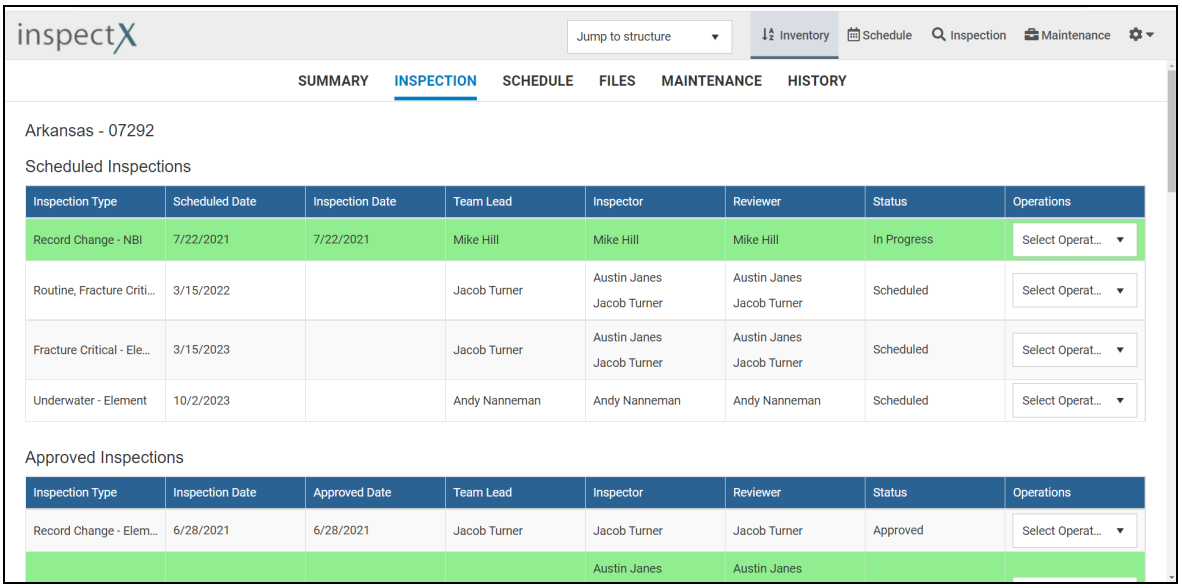


Figure 3. InspectX 2.4.2. Screen shot of Inspection tab showing list of scheduled and approved inspections.

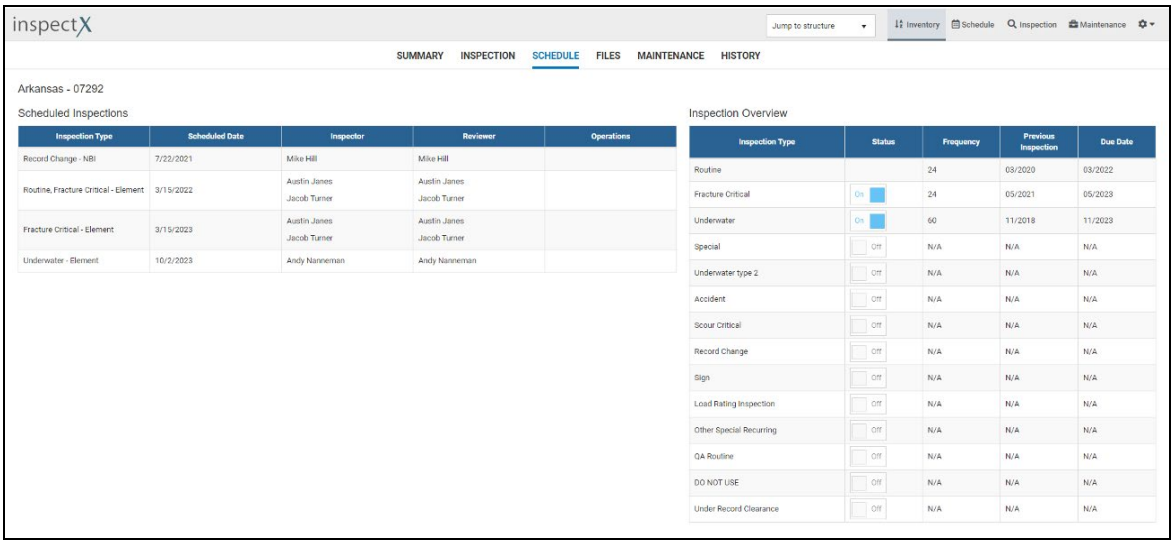


Figure 4. InspectX 2.4.2. Screen shot of Schedule tab showing list of scheduled inspections and overview of inspection types required and inspection frequency.

The Team observed many files under the InspectX Files tab did not have a description and several had “No Name” as the filename for several bridge files reviewed. Additionally, there was an upload time shown for the files, but it was not clear if the date was the appropriate date for information in the file. A standard file naming convention should be developed and implemented that includes a clearer description of the file content and more representative date (e.g., 07292 Channel Cross Sections 20210121.xlsx). See Figure 5.

According to the ARDOT LRPM, “for bridges with posting recommendation changes, a Maintenance Need in InspectTech [i.e., InspectX] will be created by an Inspector for monitoring follow up.”

According to the ARDOT LRPM, for State-owned bridges, “the Staff Structures Engineer or their designee is to notify the district involved by telephone and the State Program Manager, the State Bridge Engineer, State Maintenance Engineer, and the District Engineer by email. Correspondence is archived as an Adobe Portable Document Format (PDF) file in SAN1\Pontis_Docs\Ratings\District xx\BridgeNo\InspectionDate\ with the rating documentation and attached as a “Other File” in InspectTech [i.e., InspectX].” For bridges not owned by the State, the Staff Structures Engineer or his designee is to notify the DCE by email and telephone. The District representative is to immediately notify the Owner. The Owner of the structure is to be notified by certified mail with a letter signed by the State Bridge Engineer. Correspondence is archived as an Adobe PDF file to SAN1\Pontis_Docs\Ratings\District xx\BridgeNo\InspectionDate\ with the rating documentation and attached as an “Other File” in InspectTech [i.e., InspectX].”

The Team believes now that ARDOT is using InspectX as their bridge record/file system, this type of correspondence is significant and should be stored and maintained in InspectX, likely under the Files tab for the bridge asset. See Figure 5.

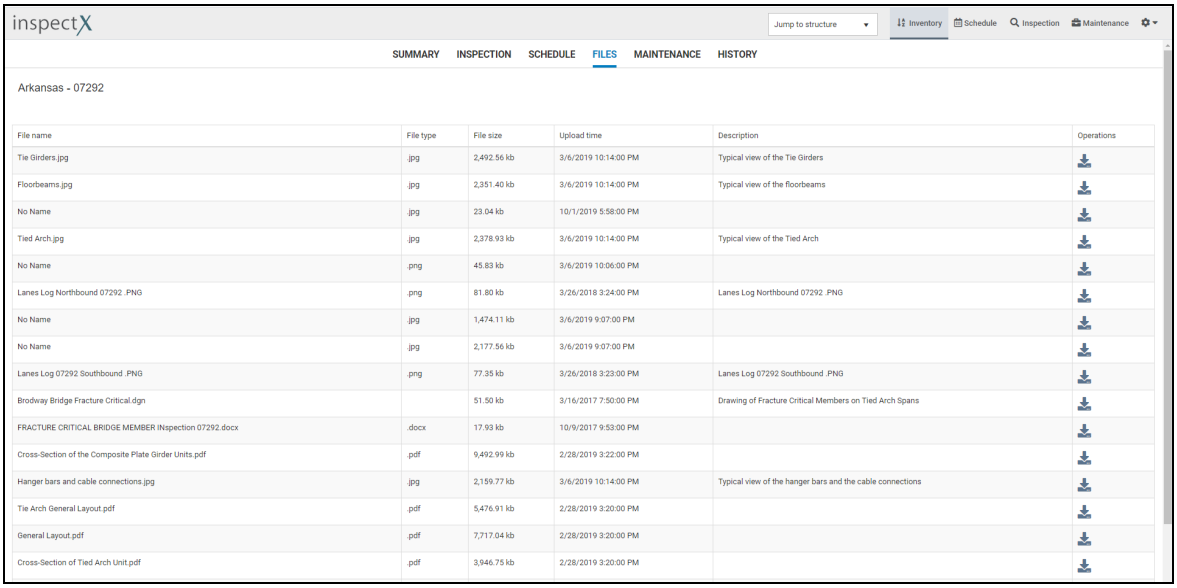


Figure 5. InspectX 2.4.2. Screen shot of Files tab showing list of stored files.

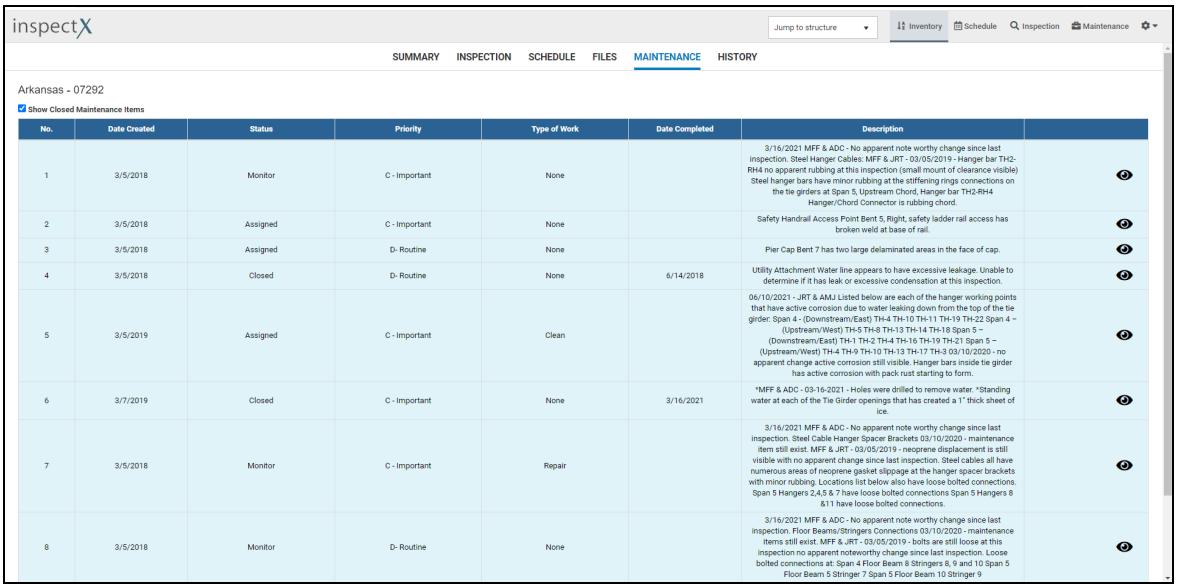


Figure 6. InspectX 2.4.2. Screen shot of Maintenance tab showing list of maintenance needs, date created, priority, work type, date completed, and description. (Guest rights do not allow viewing of maintenance need remarks but are shown in an inspection report when the report is downloaded.)

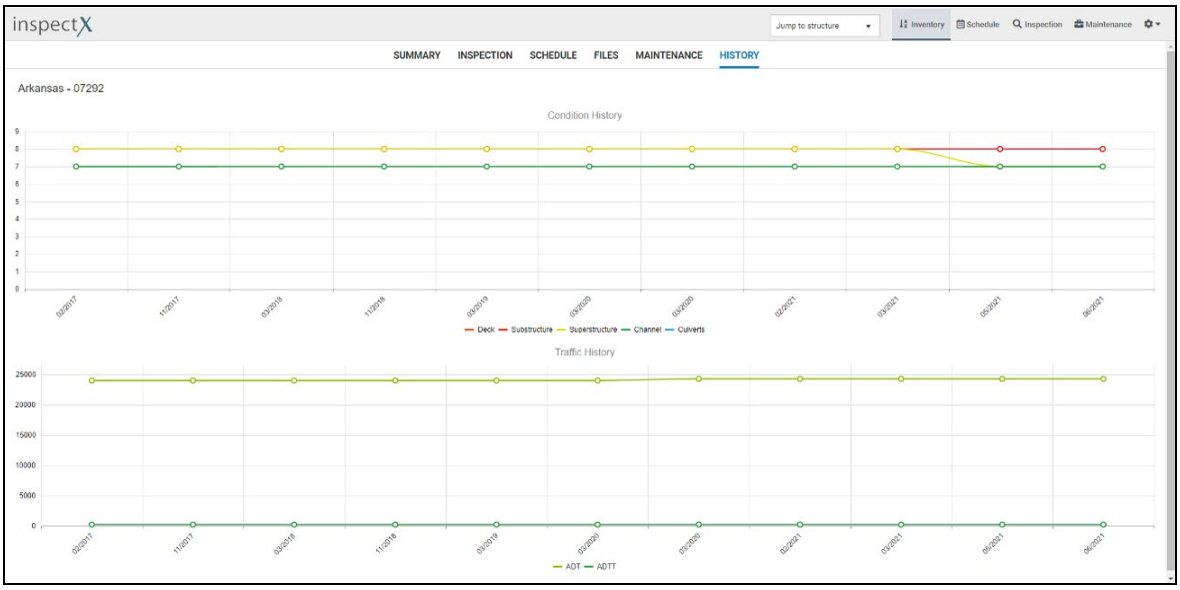


Figure 7. InspectX 2.4.2. Screen shot of History tab showing bridge deck, superstructure, substructure, channel, and culvert condition (when applicable), and traffic history.

The ARDOT BIM indicates the following information should be included in InspectX as “Asset Files.”

- “Asset Fracture Critical: Fracture Critical Procedure, Fracture Critical Drawing, Fracture Reference Photo, Blank Fracture Critical Inspection Report, Blank Pin Document (if FCM)
- Asset Plans: Layout PDF (Multiple Layout sheets can be formed into one document), Cross-section PDF (Multiple Cross-sections can be formed into one document)
- Asset Sketch: Underwater Type 2 inspection drawing and/or channel soundings, combine to show multiple profiles (from separate inspections), most updated under clearance drawing, most updated grid deck drawing
- Asset Other Files: Lanes Log Lane Closure, Pin Document (if not FCM), AHP Request form”

Additionally, the ARDOT BIM indicates photo assignments and where to attach photos in InspectX.

- “Inventory (roadway) – Inspection Direction
- Elevation - General Observation – #1 photo in InspectX
- Load Posting Signs – NBI 41 Posting
- Typical Deck – NBI 58 Deck
- Typical soffit/under surface – NBI 58 Deck
- Fracture Critical photos – Put in fracture critical procedure and attach to asset. Attach photos to their relative location. Photos of two girder system, attach to super.
- All others – Assign to same item that you normally do. All photos will have to have a photo assignment to be included in the report. If you have a photo that does not fit as an NBI, Element, Defect or Maintenance, assign the photo to the General Observation.”

For state bridges, the ARDOT BIM indicates that “a bridge layout and a cross-section view shall be stored as a pdf file in the Asset Files/Plans tab.”

Inspections, according to the ARDOT BIM, should include photos for:

- “Bridge looking down roadway (Routine Inspections)
- Elevation view of bridge and set as the default image (Routine Inspections)
- Posting and clearance signs (Routine & Under Record Clearance Inspections)
- Maintenance items that warrant either a “CF”, “A” or “B” priority
- Conditions that rate 4 or lower on the NBI scale
- Elements that rate a Condition State 4: “Severe”
- Repaired bridge elements

- Deck on a state bridge representing “typical” deck conditions showing both top and bottom of deck
- Photos for roadway and elevation views are included in the Asset (Manager Files)”

Additional information is provided in the ARDOT BIM for use of InspectX in the field such as:

- Underwater Type 2 Notes – record in the substructure (NBI Item 60) notes
- Maintenance Need – record comments in the deficiencies, record status change comments in the comments box, assign each maintenance item to a bridge component
- Posting Problems – Type of work: posting issue, Component: approach

There are several forms indicated in the ARDOT BIM and referred to as NBIS Form Guidelines.

- NBIS Form IIA Guidelines – used for describing the condition of hanger and pin assemblies on articulated and suspended spans.
- NBIS Form III Guidelines – used for notes/drawings that are not covered in other forms such as soundings, FCM items, wearing thickness, etc. Form III is to be used to detail elevation and cross sections of the truss and detail more complicated truss members.
- NBIS Form IIIB Guidelines – used for detailing the vertical and horizontal clearance for a highway or railroad passing under the bridge. These values are used to code NBI Items 54, 55, 56, and 69.
- NBIS Form IV Guidelines – used to help describe the superstructure and substructure when contract plans are not available and it’s necessary to draw and detail the bridge.
- NBIS Form IVA Guidelines – used for describing the different members of a truss.
- NBIS Form VIII Guidelines – used by local governments to report completed repairs on city/county bridges to the districts.

For scour critical bridges, the ARDOT BIM indicates that the scour POA should be “attached in Asset Details/Asset Files/Scour tab.” The Team observed from the bridge file reviews (e.g., Bridge #03170), the scour POA file, when available, was found in the Files tab in InspectX. See Figure 8.

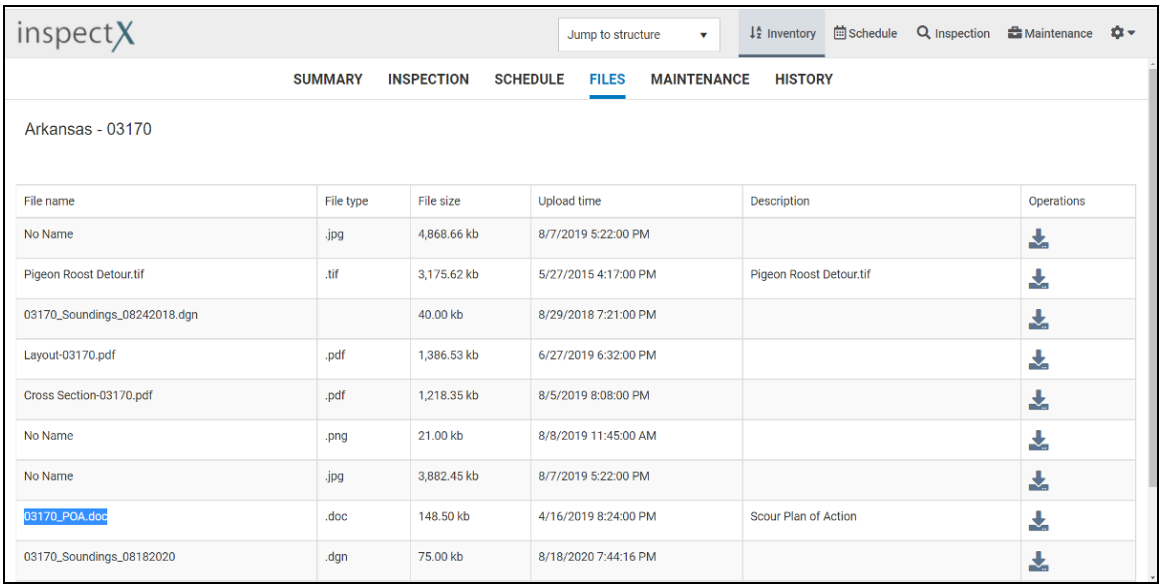


Figure 8. InspectX 2.4.2. Screen shot of Files tab for Bridge #03170 showing scour POA document file.

The Team observed for some bridges reviewed as part of this assessment, the forms and other referenced files identified above were not found, were not viewable, or if attached to an inspection report were not included in the inspection report when downloaded from InspectX. Additionally, from interviews, it was determined that inspectors were not familiar with where to find NBI UWI reports for bridges in their district to review prior to performing their inspections.

From interviews, ARDOT personnel indicated it was their intent to use InspectX to store and maintain a bridge record/file for each bridge. From the Team's file and field reviews, the Team acknowledged ARDOT's intent as a work in progress, since InspectX was just started in January 2020.

Recommendation 5. Involve select representatives from HBM staff, DCEs, DMEs, and inspectors in development and implementation of proposed changes to policies and procedures. Include clearer communication protocols between HBM, DCEs, DMEs, and inspectors regarding policy, procedure guidance, and direction.

Discussion 5. From interviews of inspection staff across the State, it was conveyed to the Team that there have been many policy or procedure changes implemented through email and it was difficult for inspectors to keep track of the changes and then subsequently certify that they understood the changes. Additionally, there was concern that inspection staff did not have an opportunity to provide input on the changes, there was inadequate discussion to support the changes, and additional clarity was often needed for implementation. The Team recognized that this level of input and interaction is not always possible but should be considered when making periodic updates to ARDOT manuals such as the BIM, LRPM, and Local Government Procedures Manual.

The Team also recognized that although the NBIS indicates the program manager is responsible for statewide procedures, input from other inspection program staff charged with implementing proposed changes to procedures can be helpful with implementation efficiencies. Developing and implementing changes to procedures by committee can be challenging but the final product can be better received when inspection staff know their peers were involved with the development and implementation.

According to the NBIS, the program manager is the individual in charge of the program that has been assigned or delegated the duties and responsibilities for bridge inspection, reporting, and inventory. The program manager provides overall leadership and is available to inspection team leaders to provide guidance.

According to the ARDOT BIM, the State HBM Engineer is the NBIS program manager. However, the ARDOT BIM also indicates that the DCEs are considered local program managers.

From interviews, it was indicated to the Team that the DCE is the least likely to be approached for policy and guidance by district inspectors and there are various staff in HBM that are contacted by inspectors for policy and guidance.

Recommendation 6. Evaluate and adjust priority definitions for maintenance needs in terms of expected and achievable completion timeframes.

Discussion 6. The NBIS requires the State to follow-up on CFs by establishing "statewide procedures to assure that critical findings are addressed in a timely manner," and to "periodically notify the FHWA of the actions taken to resolve or monitor critical findings." The NBIS defines a critical finding as a "structural or safety related deficiency that requires immediate follow-up inspection or action."

The ARDOT BIM addresses their critical finding procedures. Critical findings are documented and tracked through their maintenance needs process and priority codes (i.e., Priority Code "CF"). When follow-up inspections are utilized by ARDOT for a critical finding the ARDOT BIM indicates that "a critical findings should be looked at intervals not exceeding 12 months" and "this can be achieved with a special inspection." The Team recognized that using a special inspection with an interval not exceeding 12 months is not an appropriate action to resolve a CF and modifications to ARDOT's CF procedures are needed.

The ARDOT BIM describes the headings for maintenance needs that are found under the InspectX Maintenance tab for each bridge. The headings include:

- "Date Reported – The date the Maintenance Item was created or changed.
- Priority – The ranking of significance of the Maintenance Item.
- Type of Work – Used to identify Posting safety issues and tracking of preservation activities by Central Office.

- Component – Part of the bridge that the maintenance need is associated with.
- Deficiency Description – Describe the location of deficiency and a description of it.
- Work Description – Describe how the deficiency was repaired.
- Date Repairs Completed – The date the repairs were completed or if not known; the date when repairs were observed, or District was notified.
- Maintenance Comments – Any additional comments that do not fit other note areas."

Also included in the ARDOT BIM are the maintenance need priority codes with expected completion timeframes that include:

- "CF = Critical Finding; action goal of 2 weeks
- A = Safety Deficiency; requires prompt action
- B = Pressing; within 6 months
- C = Important; within 12 months
- D = Routine; within 24 months
- G = General/Preventive Maintenance"

The Team did not see a clear distinction between the ARDOT Priority Code "A" and Priority Code "CF" as both meet the NBIS definition of a CF. Therefore, both codes should have an expectation for immediate follow-up inspection or action.

Additionally, the Team recognized that ARDOT implements load posting or lowering of load posting as a means of addressing some CFs but chooses to leave the priority for the maintenance need as Priority CF. This can be mistaken as not being addressed promptly when considering the maintenance need creation date. Closing out the CF maintenance need and creating a new maintenance need with an applicable code (i.e., B or C) when additional actions are planned (e.g., repairs) should be considered.

According to the ARDOT BIM, DCEs were designated "District Bridge Inspection Program Managers" in May 2011. As part of this designation, the DCEs are responsible for reviewing the maintenance needs identified and entered in InspectX by the inspectors. The DCEs are to provide follow-up on maintenance needs for local owned bridges and the DMEs are to provide follow-up on State-owned bridges.

As indicated to the Team by inspection and maintenance staff during interviews, it is common that Priority B – Pressing (i.e., completion within 6 months) maintenance needs cannot all be addressed within the expected completion timeframe due to excessive workload for addressing Priority CF, Priority A – Safety Deficiency, and

other emergency actions. This was also validated through the file and field reviews for bridges reviewed during the assessment for Priority B maintenance needs. Additionally, it was indicated that Priority C (within 12 months) and Priority D (within 24 months) do not get completed unless they can be combined with a higher priority maintenance need, and that does not necessarily get completed. Therefore, the Team recommends that the benefit of using six different priority codes, along with more realistic and achievable completion timeframes should be evaluated, or additional resources should be considered to address the backlog of maintenance needs.

According to the ARDOT BIM, if the CF priority could warrant a change in the load posting, the DCE is to immediately send an email to the Bridge Division - Rating Section for further analysis. If the finding necessitates a reduced load posting, the Rating Section is to immediately notify the District who will then address it if it is a state bridge or forward on to the local bridge owner. It is the responsibility of the DME to see that all CF priorities on state bridges are assigned and the assignment noted in the inspection software. The DME is to follow the progress of the State CF priority to completion and see that corrective actions are entered into InspectX. For bridges inspected by the statewide inspectors, the DME duties are fulfilled by the Staff Heavy Bridge Maintenance Engineer.

The Team did not find additional guidance in the ARDOT BIM that specifically addressed conditions that could warrant a change in the load posting to provide more consistency between inspectors. Modifications to the ARDOT BIM should be considered to improve procedures such as adding photo examples of condition that led to load posting changes, general component condition thresholds, or element condition thresholds.

According to the ARDOT BIM, if a CF priority involves a locally owned bridge, the owner of the bridge is to be promptly notified verbally and with an official notification letter by either certified mail or email marked delivery receipt. In addition, the local owner is to receive an email with a Maintenance Needs report generated from the inspection software every month until completed and recorded in InspectX. After action has been completed, the local bridge owner is to complete the Maintenance Needs report (or Form VIII) and submit it to the District. The DCE is to enter the returned information in InspectX. The Form VIII is to be scanned and attached to one of the completed Maintenance Items. If the local owner reports the critical finding completed, then the date completed is to be entered and the Maintenance Item marked completed in InspectX. Any action the owner reported is to be included in the note for the Maintenance Item. If a posting issue is reported complete, NBI Item 41 is to be updated with a record change inspection.

Furthermore, the ARDOT BIM indicates all critical findings (State and Local) are to have remarks in the “Maintenance Comments” within two weeks of becoming active. This could include an assignment of a crew or noting that the local owner has been informed. Additionally, all critical findings are to be monitored and tracked

by the HBM section. An Engineer is to review each critical finding and document the review in the Maintenance Comments field of InspectX.

According to ARDOT's Local Government Procedures Manual, each month, a reminder is to be sent from ARDOT to the email address on file for any bridge with a maintenance need that is not completed for a priority "CF", or priority "A" load posting deficiency. The Team recognized that this procedure would not meet the intent of the NBIS for follow-up to CFs, especially for CFs that happen to show up on consecutive monthly reminders. Therefore, ARDOT should pursue the authority to take immediate follow-up action to address CFs on local owned bridges when immediate action is not taken by the local bridge owner.

There were concerns found by the Team during the field review for bridge #01257 that indicated an issue with the implementation of the critical finding follow-up procedures, timeliness in updating load restrictions, and delay in addressing priority B (within 6 months) maintenance needs. Part of the issue stems from the process for creating and tracking maintenance needs within InspectX when an initial maintenance need's priority changes, but the original maintenance need creation date remains the same.

Recommendation 7. Report, to the FHWA NBI, the actual inspection frequencies ARDOT expects NBIS inspection types to be performed.

Discussion 7. For Routine inspections the NBIS indicates that "certain bridges require inspection at less than 24-month intervals." The State is required to "establish criteria to determine the level and frequency to which these bridges are inspected considering such factors as age, traffic characteristics, and known deficiencies."

According to the ARDOT BIM, "weight posted bridges will be required to be inspected at least annually and photographs taken to verify the posting status." For posted bridges, the Central Office is to "check monthly to ensure two Routine inspections are scheduled for 24 months frequency but offset by 12 months in the schedule." According to this procedure, the Team recognized that weight posted bridges should be receiving a Routine inspection every 12 months. The data reported by ARDOT to the NBI, shown in Table 5, does not reflect this procedure as 1,269 weight posted bridges have a Routine inspection interval of 24 months, and according to ARDOT procedures it should be 12 months. The data reported to FHWA should reflect the frequency for which ARDOT procedures require the Routine inspections to be performed (i.e., 12 months for weight posted bridges).

Table 5. Routine inspection intervals for weight posted bridges.

Routine Inspection Interval (NBI Item 91)	Weight Posted Bridges (NBI Item 41 = P)
24-months	1,269
12-months	66
6-months	1
Total	1,336

2021 FHWA NBI.

Additionally, the ARDOT BIM indicates if a bridge is in poor condition (NBI items 58, 59, 60, 62 <= 4), then the Routine inspection is scheduled for 24 months offset by 12 months with an Other Special Recurring inspection set at 24 months. For “poor” bridges, the Central Office is to check monthly to ensure routine inspections are scheduled for 24 months offset by 12 months with an Other Special Recurring set at 24 months. According to this procedure, the Team recognized that bridges in “poor” condition should be receiving a Routine inspection every 24 months and an Other Special Recurring inspection every 24 months but offset 12 months from the Routine inspection. The data reported by ARDOT to the NBI, shown in Table 6, does not reflect this procedure as 621 poor bridges have a Routine inspection interval of 24 months and 334 do not have an Other Special inspection required. The data reported to FHWA should reflect the frequency for which ARDOT procedures require the Routine inspections and Other Special inspections to be performed.

Table 6. Routine and special inspection intervals for poor bridges.

Routine Inspection Interval (NBI Item 91)	Poor Bridges
24-months	621
12-months	22
6-months	1
Total	644
Routine Inspection Interval 24-months Special Inspection Interval (NBI Item 92C)	
0-months	334
3-months	2
6-months	20
12-months	20
24-months	242
48-months	2
60-months	1
Total	621

2021 FHWA NBI. Poor Bridge: NBI Items 58, 59, 60, or 62 ≤ 4.
Not closed: NBI Item 41 ≠ K. Not open to traffic: NBI Item 41 ≠ G

Similarly, for NBIS UWI, the NBIS indicates, “certain underwater structural elements require inspection at less than 60-month intervals.” The State is required to, “establish criteria to determine the level and frequency to which these members are inspected considering such factors as construction material, environment, age, scour characteristics, condition rating from past inspections and known deficiencies.”

The data reported by ARDOT to the NBI, shown in Table 7, indicates there are three bridges requiring an UWI interval less than 60 months. However, the Team did not find any specific guidance in the ARDOT BIM for consistent application of UWI intervals less than 60 months.

Table 7. UWI intervals.

UWI Interval (NBI Item 92B)	Bridges
60-months	32
48-months	2
36-months	1
Total	35

2021 FHWA NBI data. Not closed: NBI Item 41 ≠ K.
Not open to traffic: NBI Item 41 ≠ G.

For FCM inspections, the NBIS indicates, “certain FCMs require inspection at less than 24-month intervals”, and the State is required to, “establish criteria to determine the level and frequency to which these members are inspected considering such factors as age, traffic characteristics, and known deficiencies.”

For FCM inspections, the ARDOT BIM indicates that these inspections are a “recurring inspection with [NBI] Item 92A set for 24 months but scheduled for 12 months or less.” Furthermore, the BIM indicates that FCM inspections are, “limited to the bridge components in question with a full Routine (NBI) inspection not necessary unless it is scheduled.” The Team recognized that FCM inspections should be occurring at an inspection interval of 12 months or less. However, the data reported by ARDOT to the NBI, shown in Table 8, does not reflect this procedure as 717 bridges have an FCM inspection interval of 24 months or more. The data reported to FHWA should reflect the frequency for which ARDOT procedures require the FCM inspections to be performed (i.e., 12 months or less).

Table 8. FCM inspection intervals.

FCM Inspection Interval (NBI Item 92A)	Bridges
25-months	1
24-months	716
12-months	44
Total	761

2021 FHWA NBI data. Not closed: NBI Item 41 ≠ K.
Not open to traffic: NBI Item 41 ≠ G.

For in-depth and special inspections, the NBIS requires the State to, "establish criteria to determine the level and frequency of these inspections." The NBIS defines a special inspection as, "an inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency."

The ARDOT BIM defines an Other Special Recurring inspection as, "a recurring inspection for a known or suspected deficiency that does not fall under another category. This inspection is performed between the Routine (NBI) inspections. In general, only those elements on the bridge that precipitated the inspection will be assessed (i.e., a full [Routine] inspection is not required at this time). When scheduling an Other Special Recurring Inspection, a comment is added in the comment box explaining why the inspection is being performed. An Other Special Recurring Inspection is coded under NBI Item 92C as an Other Special Inspection only when it is for a known deficiency (i.e., scour critical, structurally deficient, etc.). NBI Item 92C is to be set to 24 months but the date scheduled as often as needed."

ARDOT allows the opinion of the inspector to solely determine if a bridge requires a more frequent inspection and to reduce the frequency of scheduling as necessary.

To enhance ARDOT's bridge inspection scheduling and bridge inspection teams' workload, the Team suggests ARDOT consider application of the "NCHRP Report 782 - Proposed Guideline for Reliability-Based Bridge Inspection Practices," which outlines a methodology to develop a risk-based approach for determining bridge inspection intervals. Refer to the June 8, 2018 FHWA memo for guidance regarding risk-based interval determination for routine bridge inspections.

Recommendation 8. Develop and implement improved procedures to clearly differentiate the FCM inspection findings from Routine inspection findings, to facilitate access by all InspectX users, when results of the inspection types are combined in the same report.

Discussion 8. The Team observed through file and field reviews that inspection types performed at the same time had the results documented in the same inspection report. An example is the December 2, 2019 inspection report for Bridge #02771 that included findings from an Underwater Type 2, Fracture Critical, and Routine inspection, or the September 3, 2019 inspection report for Bridge #05141 that included findings from Routine, Fracture Critical, and Under Record Clearance inspections.

For example, the December 2, 2019 inspection report for Bridge #02771 downloaded from InspectX contained a cover photo, location map, SI&A data, element data, photos, Inspection Comments section, and Substructure Notes section. There was no Deck Notes section, Superstructure Notes section, or Maintenance Needs included.

According to the ARDOT BIM, Form III is to be "used to list all fracture critical elements, the inspection method used and the current condition factor at the time of

inspection". "Form III shall be linked in the InspectX database under Picture/Files and Fracture Critical tab." Form III is also to be used for notes/drawings that are not covered in other forms such as soundings, FCM items, and wearing surface thickness. Furthermore, Form IIA is for describing the condition of Hanger and Pin Assemblies on Articulated and Suspended Spans. The spans and joints are to be numbered according to the drawing at the bottom of Form IIA. The beams are to be numbered from left to right looking toward increasing "log mile" and comments and remarks are to be used as much as possible. The Team did not find a Form III for the December 2019 inspection and the most current was from a December 2016 for Bridge #02771. See ARDOT examples of Form III in Appendix B.

The Team suggests that providing access to inspection report attachments for all users of InspectX and more consistent use of Form III with more detailed FCM member identification would improve clarity within inspection reports with combined findings from FCM and Routine inspections.

Recommendation 9. Routinely communicate the importance of the bridge inspection program requirements, expectations, and procedure changes to local agency bridge owners. Establish recurring presentations at Municipal League meetings or other common meetings regularly attended by local agency bridge owners.

Discussion 9. The 2010 Arkansas Code, § 27-85-101 - Conservation of bridges, indicates "the administrators of the various public highway, road, and street systems shall make every effort to conserve the safe function of the bridges under their jurisdiction pursuant to the findings and recommendations of the bridge safety inspections by the bridge inspection teams of the Arkansas State Highway and Transportation Department [ARDOT] in accord with the national bridge inspection standards published in the Federal Register."

It is commendable that ARDOT provides inspection and load rating services for local agency bridge owners, and informs them of maintenance needs, critical findings, load restrictions, closures, and even provides further support for load posting signs. However, according to the ARDOT Local Government Procedures Manual, each local government with bridge length structures is ultimately responsible for the safety of bridges in their jurisdiction. Furthermore, if a bridge is not capable of safely supporting legal loads, the owner is responsible for advising the traveling public of any weight restrictions within two days of notification, and if a bridge cannot safely support a 3-ton vehicle, it is the owner's responsibility to close the bridge until it is adequately strengthened or replaced.

From the interviews, it was indicated to the Team there is significantly varying levels of bridge knowledge and expertise, and frequent turnover in the local agency bridge owner contacts (i.e., County Judges). Additionally, the Team recognized it is likely interactions with the local agency are limited to when significant bridge issues need to be resolved. Therefore, it would be beneficial to routinely communicate the importance of the bridge inspection program requirements and expectations (e.g., maintenance, load posting, load posting certification, closing, scour monitoring –

event reports, data for new bridges, etc.) to local agency bridge owners through presentations at meetings regularly attended by local agency bridge owners.

Load Rating and Posting Procedures

The NBIS defines a load rating as "the determination of the live load carrying capacity of a bridge using bridge plans and supplemented by information gathered from a field inspection." Additionally, a legal load is defined as the "maximum legal load for each vehicle configuration permitted by law for the State in which the bridge is located."

The NBIS requires the State to include a bridge inspection organization responsible for load ratings and must have a qualified program manager who has been delegated responsibility for bridge load ratings. Furthermore, according to the NBIS, "the individual charged with the overall responsibility for load rating bridges must be a registered professional engineer."

The State Heavy Bridge Maintenance Engineer is designated the Bridge Inspection Program Manager and the position requires an AR PE license in addition to other NBIS program manager qualifications.

The Structures Inventory and Rating section in the Bridge Division performs the load rating function utilizing information gathered by the Bridge Inspectors. The Staff Structures Engineer in this section is responsible for load rating and recommended posting of bridges. The position requires an AR PE license. Furthermore, ARDOT has an agreement with local owners to perform inspection and load rating of bridges on the State and locally owned public road systems.

The NBIS requires that "each bridge be load rated to determine its safe load carrying capacity in accordance with the AASHTO MBE and to post or restrict the bridge in accordance with the AASHTO MBE or in accordance with State law, when the maximum unrestricted legal loads or State routine permit loads exceed that allowed under the operating rating or equivalent rating factor." The NBIS defines the operating rating as "the maximum permissible live load to which the structure may be subjected for the load configuration used in the rating."

According to the ARDOT LRPM, "AR state statutes define the maximum axle loads that can be used on highways without securing a permit." Furthermore, ARDOT "allows a bridge to be rated by engineering judgement if it cannot be rated by current calculation methods. These types may include masonry members or uniquely designed bridges."

Recommendation 10. Ensure load ratings of all bridges are done adequately and appropriately. Consider having professional engineering consultant services available to perform load ratings on complex, major, and other bridges as needed.

Discussion 10. From interviews, field, and file reviews there were indications that all complex and major bridges do not have complete load ratings that consider all state legal vehicle loads.

From interviews, and shown in the ARDOT LRPM, it was indicated that the ARDOT Load Rating section primarily uses LARS BRIDGE software to perform load ratings and utilizes 35 different load models. Other ARDOT acceptable software tools include, BAR7, BRASS Suite, STRUDL, and STAAD. For bridge length culverts, ARDOT prefers BRASS Culvert and BOX5/BXLRFD (PennDOT), or Excel spreadsheets are used. Additionally, ARDOT does not have access to any refined analysis tools to allow them to use finite element analysis. Furthermore, they have not completed Emergency Vehicle (EV) load ratings for all NBIS bridges.

According to the data reported by ARDOT to the NBI, shown in Table 9, there are 3 bridges with no load rating analysis or evaluation performed. There are 28 bridges where field evaluation and documented engineering judgement was used. For these 28 bridges, shown in Table 10, there are 17 steel bridges where measurements should be obtained to perform a load rating. The data excludes bridges that are closed or not open to traffic.

Table 9. Operating Rating Method for Arkansas bridges.

Operating Method (NBI Item 63)	Bridges
0 - Field evaluation and documented engineering judgment	28
1 - Load Factor (LF)	11801
2 - Allowable Stress (AS)	314
3 - Load and Resistance Factor (LRFR)	541
4 - Load Testing	1
5 - No rating analysis or evaluation performed	3
6 - Load Factor (LF) rating reported by rating factor (RF) method using MS18 loading.	2
7 - Allowable Stress (AS) rating reported by rating factor (RF) method using MS18 loading.	0
8 - Load and Resistance Factor Rating (LRFR) rating reported by rating factor (RF) method using HL-93 loadings.	0
A - Assigned rating based on Load Factor Design (LFD) reported in metric tons	14
B - Assigned ratings based on Allowable Stress Design (ASD) reported in metric tons	0
C - Assigned ratings based on Load and Resistance Factor Design (LRFD) reported in metric tons	6
D - Assigned rating based on Load Factor Design (LFD) reported by rating factor (RF) using MS18 loading	0
E - Assigned ratings based on Allowable Stress Design (ASD) reported by rating	0
F - Assigned ratings based on Load and Resistance Factor Design (LRFD) reported by rating factor (RF) using HL93 loadings	0

2021 FHWA NBI Data. Not closed: NBI Item 41 ≠ K. Not open to traffic: NBI Item 41 ≠ G.

Table 10. Structure Material codes for Arkansas bridges with Operating Method code 0.

Structure Material (NBI Item 43A)	Bridges
1 - Concrete	10
3 - Steel	14
4 - Steel continuous	3
8 - Masonry	1

2021 FHWA NBI Data. Operating Method: NBI Item 63 = 0.
Not closed: NBI Item 41 ≠ K. Not open to traffic: NBI Item 41 ≠ G.

Recommendation 11. Ensure all legal vehicular loads are adequately addressed by ARDOT load rating models.

Discussion 11. From interviews and review of the ARDOT LRPM, there were indications that the load models used currently by ARDOT for load rating may not envelop all state legal vehicular loads and although a parametric study was completed in August 2018, changes to load rating vehicles and procedures are still being considered.

More recent changes to AR size and weight laws should be considered to ensure all legal loads are enveloped by the load models, and recommendations from the parametric study are still valid or need updated. Examples of legal vehicular loads in AR size and weight laws that should be considered in updates to the parametric study include:

- Vehicles, or combination vehicles for hauling compacted seed cotton.
- A truck tractor and single semi-trailer combination with five (5) axles hauling sand, gravel, rock, or crushed stone and vehicles or combinations of vehicles with five (5) axles hauling unfinished and unprocessed farm products, forest products, or other products of the soil that are exempt from the federal bridge formula.
- Vehicles, or combinations of vehicles, with five (5) axles hauling unfinished and unprocessed farm products, forest products, or other products of the soil.

Recommendation 12. Update and implement reporting protocols to ensure load ratings and required load postings are completed timely and adequately for all bridges.

Discussion 12. From field and file reviews, there were indications that load ratings that resulted in the lowering of load postings were not getting completed in a timely fashion. An example being Bridge #01257.

According to the LRPM, “if the current rating analysis for any bridge was performed more than ten years prior to the current inspection date, a new rating analysis will be performed. Bridges are prioritized for rating based on level of use, importance, condition, and changes made to the bridge.” Refer to the Appendix in the ARDOT LRPM for further details of the prioritization rationale.

Recommendation 13. Consistently utilize a load rating summary sheet for each bridge; identifying the controlling members, primary member conditions, assumptions, and posting requirements, when applicable, and have it readily available in the InspectX Files tab to facilitate access by all users.

Discussion 13. Typically, a load rating summary sheet is to be attached to a Load Rating inspection, but was not readily viewable by the Team in InspectX due to guest user rights. For the summary sheets that were made available for review outside of InspectX, the Team identified instances of load rating summary sheets that did not identify controlling members, primary member conditions, and necessary assumptions. Having this information readily available to inspectors is beneficial for their subsequent inspections.

According to the ARDOT LRPM, the following items are to be "electronically signed showing the rater's name and the date of the rating and saved on the Pontis Docs folder at: (san1\Pontis_Docs\Ratings\District xx\BridgeNo\InspectionDate\) using a descriptive file name for documentation reference."

- "A copy of the data set for the input file (Data Set report in LARS BRIDGE)
- An analysis output report for:
  - The Critical Element(s) Summary (For LARS Bridge, the Critical Member report)
  - The summary report for each member (For LARS Bridge, the Member Summary report)
  - For structures with a truss span, include the Truss Summary Report in addition to the Critical Element Summary.
- A copy of the SI&A data (the "National Bridge Inventory" report in InspectTech [InspectX])
- The Load Rating Summary Sheet. Information regarding assumptions and justification for decisions made during the Load Rating Process, and simple calculations used in the analysis as reference for later inquiries or ratings should be included in a separate document."

Recommendation 14. Develop and implement procedures for engineering personnel to perform inspections to capture and document the necessary information for performing a load rating or structural review when there is a change in condition to primary load carrying members, which may impact load capacity, or develop and periodically deliver training to inspectors on inspection documentation required for a load rating or structural review.

Discussion 14. During interviews it was indicated too frequently that there was a need for load rating engineers to request additional information from inspectors to complete load ratings. Additionally, it was indicated that load rating engineers do not participate in field inspections. However, it was conveyed to the Team, "If at

any time, the presence of a load rating engineer is needed at a bridge inspection, a load rating engineer will be available."

The Team recognized there are instances when engineering judgment may be necessary and prudent for determining if a structural review is needed or when a load rating needs updating. In those instances, bridge inspection notation by technicians may not be enough information to adequately support using judgment and a site visit by engineers is needed. This is especially applicable for bridges with concrete members without plans, and timber members that commonly decay from the inside out. There are many states that utilize technicians for bridge inspections, but when conditions reach a certain threshold (e.g. primary load carrying member in poor or worse condition), an engineering inspection team visits the bridge to confirm the reported conditions and gather any additional information they need to complete their structural review or load rating calculations. An example is Illinois. Other states require engineers as bridge inspection team leaders such as California, New York, and Washington.

Scour Appraisals

The NBIS requires the State to "identify bridges that are scour critical" and "prepare a plan of action to monitor known and potential deficiencies and to address critical findings." Furthermore, the State is required to "monitor bridges that are scour critical in accordance with the plan." Scour is defined in the NBIS as "erosion of streambed or bank material due to flowing water; often considered as being localized around piers and abutments of bridges." A scour critical bridge is defined in the NBIS as "a bridge with a foundation element that has been determined to be unstable for the observed or evaluated scour condition."

According to the data reported by ARDOT to the NBI, as shown in Table 11, there are two bridges that have not been evaluated for scour as indicated by code "6" in NBI Item 113. These two bridges need evaluated. There are 43 scour critical bridges indicated by code "3" and 68 bridges with unknown foundations indicated by code "U." These bridges require a scour POA. Although the Team did not confirm the existence of POAs for all applicable bridges, it is expected that these bridges have scour POAs.

Table 11. NBI Scour Critical Bridge codes for Arkansas bridges.

Scour Critical Bridge Codes (NBI Item 113)	Bridges	POA Required
N – not over water	979	
U	68	Yes
T	0	
9	8	
8	4776	
7	199	
6 – Needs evaluation	2	
5	6622	
4	13	

Scour Critical Bridge Codes (NBI Item 113)	Bridges	POA Required
3 – Scour critical	43	Yes
2 – Scour critical	0	Yes
1 – Scour critical	0	Yes
0 – Scour critical	0	Yes

2021 FHWA NBI data. Not closed: NBI Item 41 ≠ K. Not open to traffic: NBI Item 41 ≠ G.

According to the ARDOT BIM, "the POA for a scour critical bridge should be attached in Asset Details/Asset Files/Scour tab." However, the ARDOT BIM also indicates, "the scour POA for a scour critical bridge is located under Files and the Scour tab in the bridge inspection software." The Team reviewed scour POAs that were available for download from the InspectX Files tab for the selected file and field review bridges. See examples of ARDOT updated scour POAs in Appendix E.

According to the ARDOT BIM, "scour prone bridges (NBI Item 113) with [an appraisal] rating of less than 5 will require an 'Underwater Type 2' inspection with a frequency (Item 92C) of 24 months but is to be scheduled for every 12 months. An Underwater Type 2 can also be coded as Other Special (Item 92C) when a bent is scour prone or scour critical." According to the data reported by ARDOT to the NBI, as shown in Table 12, there are 56 bridges considered "scour prone" by ARDOT (NBI Item 113 code < 5), and 25 do not indicate a need for an Other Special inspection (NBI Item 92C). The Team acknowledged that the data reported to the FHWA should reflect the frequency for which ARDOT procedures require the Other Special inspections to be performed (i.e., 12 months for "scour prone" bridges).

Table 12. Other special inspections for scour prone bridges.

Scour Critical Bridge Codes (NBI Item 113)	Bridges
4 – field review indicates action required	13
3 – scour critical	43
2 – scour critical	0
1 – scour critical	0
0 – scour critical	0
Total	56
Other Special Inspection Intervals (NBI Item 92C)	
0-months	25
12-months	5
24-months	26
Total	56

2021 FHWA NBI. Not closed: NBI Item 41 ≠ K. Not open to traffic: NBI Item 41 ≠ G.

The ARDOT BIM also indicates, "soundings around piers and bents should be made on all bridges subject to scour from swift running water or where previous flooding has occurred. If, in the estimation of the District Bridge Inspection Engineer [i.e., DCE], scour could be a problem for a certain bridge during a flood, the DCE is to call for soundings from the bridge side, cat-walk, or the bridge inspection unit." The BIM further indicates, "scour POA Inspections may use underwater inspection methods

(probe/profile/wade) but they are for a specific purpose. If the inspection is documented as a Scour POA Inspection, then there is no need to also document it as an Underwater Type 2 inspection. If the bridge is scour critical and an Underwater Type 2 Inspection is performed, then there is a known (or suspected) deficiency and the inspection date is to be coded as Other Special Inspection (NBI - 92C)."

According to the ARDOT Local Government Manual, an ARDOT representative should have previously met with the administrator of each owner having scour critical/susceptible bridges to explain the responsibility of assessing a bridge for a high water event that could affect the stability of the bridge and a copy of the scour POA, which details the procedures to follow for the affected bridges, should have been provided. The manual also indicates, if a scour monitoring event occurs, the local owner is expected to record the actions taken at the bridge using a copy of the Scour POA Event Report and then submit it to the DCE for processing and archiving in the inspection record. Additionally, the manual indicates that bridge structure details are very beneficial in determining a bridge's safe load capacity or scour susceptibility, and therefore, these details are to be provided to the DCE to use in the bridge evaluation for bridges constructed by the local government staff or on a project contracted solely by the local government.

Recommendation 15. Ensure that all bridges over water have a documented scour appraisal in InspectX to facilitate access by all users.

- Form a multi-disciplinary scour appraisal team to update scour appraisals when warranted, and review and update scour plans of action (POA), when applicable, to indicate storm events, stream elevations, or flows that trigger scour monitoring.
- More clearly indicate the responsibility for implementing the scour POAs and performing the scour monitoring.
- Update and implement a more consistent process for documenting scour monitoring.

Discussion 15. From interviews, it was indicated that there is one person in the Bridge Load Rating section of the Bridge Division that has been delegated the responsibility of scour appraisals even though their primary role, responsibility, and experience is load rating and permitting.

According to the ARDOT BIM, "the inspector should not enter a value for NBI Item 113 for new bridges. The inspector will inform the Staff Structures Engineer in the Bridge Division Rating Section for initial coding of Item 113 of a new bridge." Additionally, the BIM indicates, "if an inspector finds evidence of scour critical conditions, this should be documented in the inspection and reported to the Staff Structures Engineer in the Bridge Division Rating Section for reevaluation." Next, the BIM indicates, "if an inspector finds evidence that scour countermeasures, such as riprap dumped next to a pier or bent, were placed at a bridge, this should be documented in the inspection and reported to an Engineer in the Bridge Division Rating Section for reevaluation." Finally, the BIM indicates, "future changes to the

initial coding of Item 113 are to be made only by an engineer in the Bridge Division Rating Section."

The Team acknowledged, scour appraisals are typically performed by a multidisciplinary team of hydraulic, geotechnical, and structural engineers (Scour Appraisal Team) based on appraised scour vulnerability as described in HEC-18, Evaluating Scour at Bridges; HEC-23, Bridge Scour and Stream Instability Countermeasures; and HEC-20, Stream Stability at Highway Structures. FHWA Hydraulic Technical Advisories, manuals, and software can be found at: https://www.fhwa.dot.gov/engineering/hydraulics/index.cfm.

Responsibility for performing Routine inspections in the districts is periodically rotated amongst the inspection teams. From interviews, this seems to have caused confusion as to the District Bridge Inspector's roles and responsibility for performing scour monitoring inspections in accordance with scour POAs for scour critical bridges or bridges with unknown foundations.

According to the ARDOT BIM, "if the scour POA calls for an inspection at a regular interval then that inspection should be coded as an Underwater Type 2 Inspection rather than a Scour POA Inspection. The Scour POA Inspection is a one-time unscheduled inspection (or documentation) that will be performed as necessary whenever directed by the scour POA after a triggering event. Requirements for the inspection can be found in the Scour POA. The Scour POA Inspection was created to track when an action is taken based on the scour POA. The Event Monitoring Form that must be filled out to satisfy the scour POA should be scanned and attached to the inspection report in the Scour Tab located in the Pictures/Files. If it is a Local Bridge, then the form will be the only thing in the report and a note should be made in the 'Comments' section when creating the report." The comment is to read "Documenting local action only." See Appendix E for ARDOT examples of updated scour POAs.

Inspection Resources

From interviews and review of ARDOT documentation by the Team, there are 24 district inspection teams within the 10 ARDOT district offices. See Figure 9. These 24 district inspection teams perform various inspection types on over 12,690 NBI bridges. See Figure 10. Additionally, there are three statewide inspection teams in HBM that perform various inspection types for over 60 major NBI bridges that reportedly cross over the Mississippi and Arkansas rivers.

Each district office has a UBIT that is utilized to provide access to bridge members for inspection within arms-reach when needed. The age and capability of the district UBITs varies and there are two UBITs that reportedly should be replaced. There are additional UBITs for HBM that are utilized by the statewide inspection teams to also provide access to bridge members for inspection within arms-reach when needed.

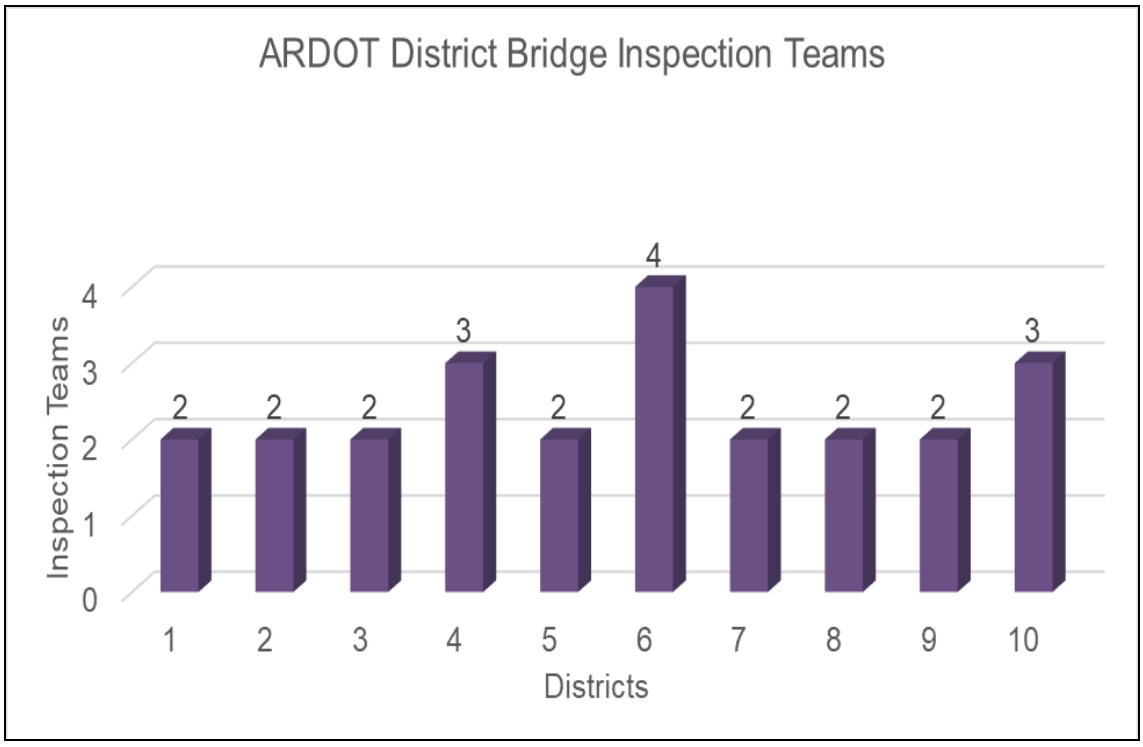
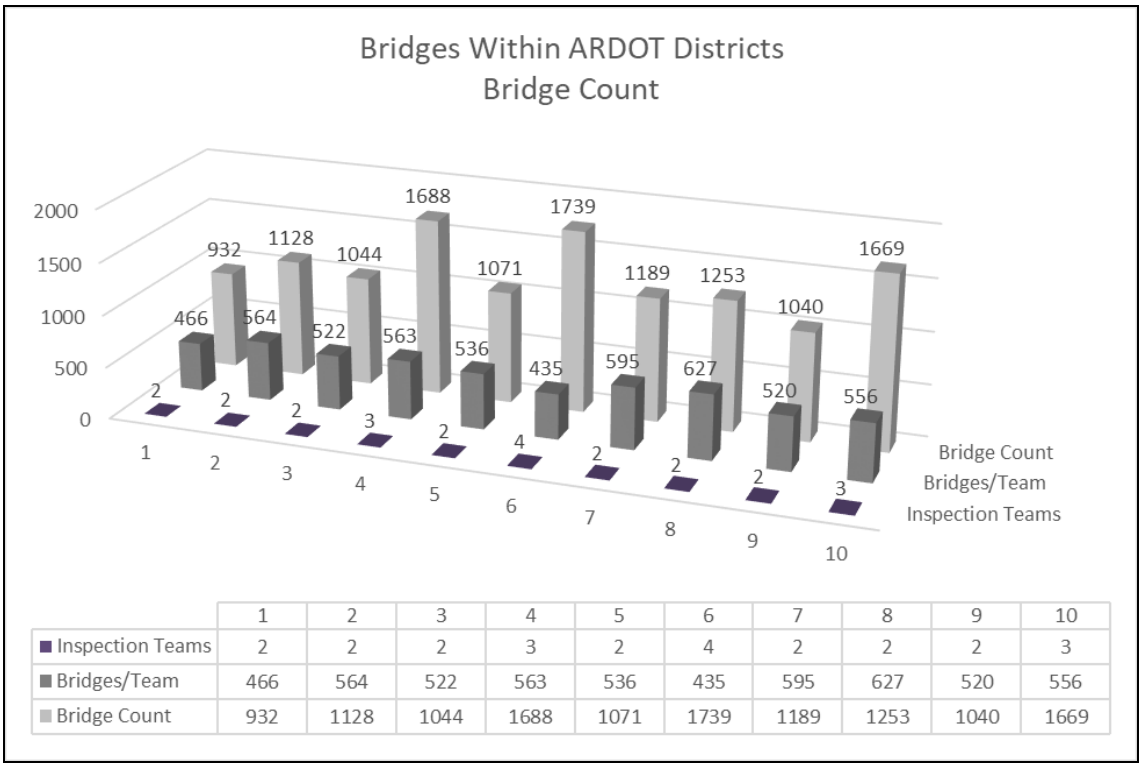


Figure 9. ARDOT district bridge inspection teams.



	1	2	3	4	5	6	7	8	9	10
Inspection Teams	2	2	2	3	2	4	2	2	2	3
Bridges/Team	466	564	522	563	536	435	595	627	520	556
Bridge Count	932	1128	1044	1688	1071	1739	1189	1253	1040	1669

Figure 10. Bridges within ARDOT districts and bridges per district inspection team*. (*Data does not exclude the over 60 major bridges inspected by the two statewide teams and does not include the two statewide teams in the bridges/team values.)

Recommendation 16. Develop and implement a process for use of on-call professional engineering consultant contracts for inspection program support. Evaluate bridge inspectors' workload with addition of major overhead sign structures and high mast lighting inspections by district bridge inspection teams and consider consultant services for the inspection of highway tunnels, especially complex tunnels, in place of district bridge inspection teams.

Discussion 16. During interviews it was indicated that due to personnel illness, vacations, and schedule interruptions due to weather (e.g., flooding, winter storms – snow and ice duties) there are often needs for inspection support to maintain inspection schedules. Also indicated was the districts and statewide teams can provide each other some backup support, but there are occasions when additional inspection resources are needed. Similarly, the Load Rating section, also responsible for permitting and now scour appraisals, have occasional needs for additional support.

The Team acknowledged it is common in other states to have on-call professional engineering consultant contracts to support state forces when needed to maintain inspection schedules, update load ratings, provide QA services, or update scour appraisals and scour POAs when applicable.

The ARDOT BIM indicates that Routine inspections will be performed for major sign structures every four years after the inventory inspection, except for bridge mounted sign structures that will be inspected at a minimum of two years. The BIM also indicates that Special inspections will be performed after major wind events or when traffic incidents may have damaged the structure.

The ARDOT BIM indicates that Routine inspections will be performed for high mast light poles greater than 95 feet every four years after the inventory inspection. The BIM also indicates that Special inspections will be performed after major wind events or when traffic incidents may have damaged the structure.

During interviews it was indicated that the district bridge inspection teams are responsible for performing the required inspections for major sign structures and high mast light poles, and any maintenance is also the responsibility of the districts.

The Team believes the use of district bridge inspection teams to perform inspections for major sign structures and high mast light poles may not be the best use of their limited time and resources when their primary focus should be on safety inspection of in-service bridges.

During interviews, it was indicated to the Team that there is one complex tunnel in District 4 and the district bridge inspectors have been delegated the responsibility for inspecting the tunnel, which can reportedly take one month to complete.

The Team acknowledged that typically, complex tunnels have lighting and ventilation systems that need personnel with significant mechanical and electrical

systems experience, which the bridge inspection teams do not reportedly have. As such, complex tunnel inspection would be a candidate for contract services to allow more time for district bridge inspectors to focus on bridge inspection of the State and districts' significantly greater inventory of bridges.

Recommendation 17. Establish standard inspection program performance measures that indicate accomplishments and develop standard reports and tools to assess program needs.

Discussion 17. Although InspectX has customizable dashboards for the Inventory, Schedule, Inspection and Maintenance tabs, no standard bridge inspection program performance measures or reports were identified through interviews or review of the ARDOT BIM. The Team acknowledged that having standardized performance measures and reports can be helpful in monitoring the inspection program and identifying program needs that can be better communicated and supported when making requests to leadership, which are often related to inspection resources.

The Team also acknowledged that some states have implemented their own tracking and reporting of performance related to the FHWA NBIP oversight metrics. Additionally, it is common to look at bridge deck area per inspection team along with bridge conditions, as bridges with more deck area take more time to inspect and bridges in poor condition take longer to inspect and document than those in good or fair condition. Furthermore, it would be beneficial to evaluate measures in terms of UBIT utilization and bridges needing this specialized equipment.

Recommendation 18. Conduct a facilitated organizational structure study of staff roles and responsibilities and make necessary realignments of staff responsibilities.

Discussion 18. The ARDOT BIM addressed roles and responsibilities of bridge inspection and load rating personnel, but during interviews it was noted there are some tasks that could be performed more efficiently by others to support the bridge inspectors, such as development and updating of MicroStation drawings and inspection data entry. The Team believes this would allow more time for the inspection teams to perform inspections and perform reviews of the inspection reports and supporting data.

Additionally, from the interviews and within the ARDOT BIM there were indications where some responsibilities should be addressed at the district level by the DCE but are elevated to the HBM section and to various staff within the HBM section.

The Team acknowledged that different organizational structures could accomplish the same NBIS requirements. However, it was noted during interviews that the load rating and scour appraisals occur in the Bridge Division which is separate from the Maintenance Division where the HBM section and the NBIS program manager are located. See Figure 11.

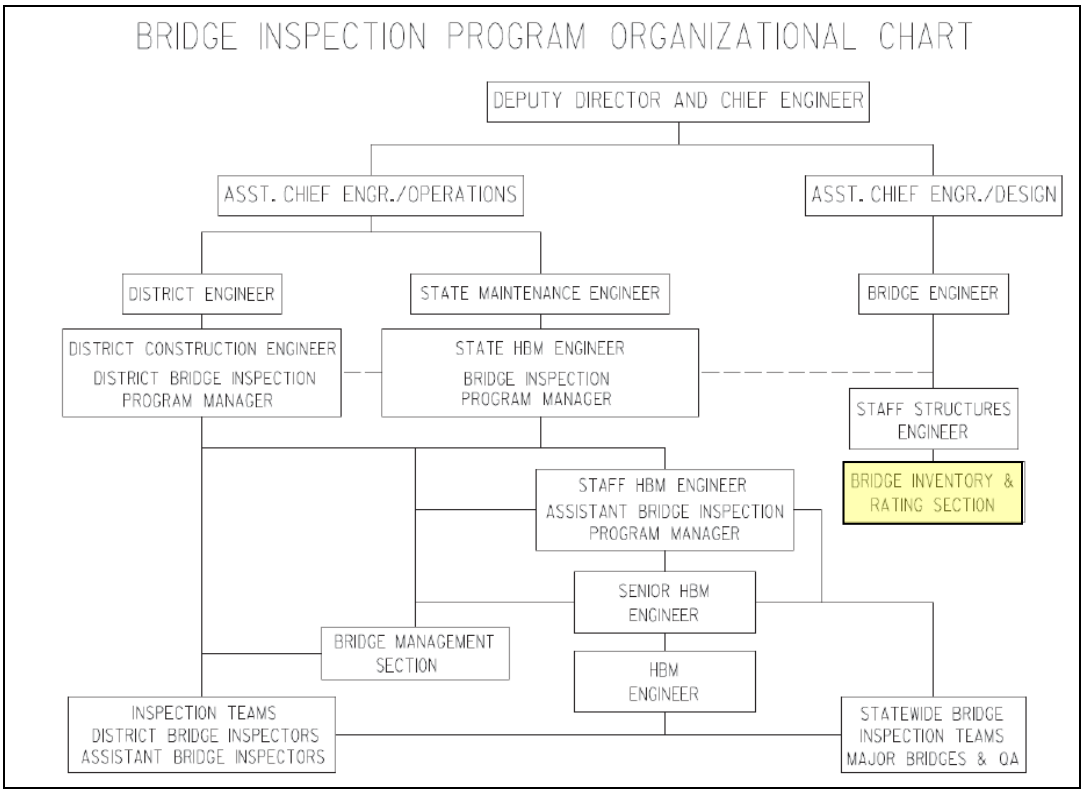


Figure 11. ARDOT Bridge Inspection Program Organizational Chart.

Through interviews, the Team recognized inconsistent roles and responsibilities for setup and takedown of work zones during inspections performed by statewide inspection teams and district inspection teams. From interviews, statewide inspection teams are responsible for setup and takedown of their work zones whereas district inspection teams commonly have district traffic personnel setup and takedown their work zones when needed. There were mixed responses from the statewide inspection teams regarding their responsibility for work zones, particularly on high-volume, higher-speed roadways.

The Team suggests that inspectors' time would be better utilized preparing for the inspection and focusing on the needs of the inspection than on making sure they have setup the work zone appropriately. Work zone setup on high-volume, higher-speed roadways should be the responsibility of personnel well trained and experienced in the maintenance of traffic who perform that type of work regularly.

Also, the interviews indicated that it was common practice to not use truck mounted crash attenuators within the work zones when inspecting with the UBITs. The UBITs and the personnel that utilize them are valuable resources that need to be better protected. It is common practice in other states to utilize truck mounted crash attenuators within the work zones when inspecting with UBITs. Additionally, it is a good practice to include the work zone setup in the inspection procedures, particularly for complex or major bridges that typically carry higher volumes of

passenger and truck traffic and may have more intricate traffic patterns with merging lanes from on and off ramps.

COMMENDABLE PRACTICES

Several commendable practices were identified during the assessment that improve efficiency and effectiveness in administration of ARDOT's bridge inspection program and should be continually supported to ensure success. The following is a summary of commendable practices.

Commendable Practice 1. Researching, adopting, and integrating technologies to supplement safety inspection activities such as unmanned aerial systems (i.e., drones), timber micro-drilling, and underwater side-scan sonar.

Commendable Practice 2. The ARDOT bridge inspection program includes knowledgeable, experienced, and qualified staff that administer ARDOT's bridge inspection program.

Commendable Practice 3. Availability of multiple under-bridge inspection access equipment trucks (UBIT) in each district and Central Office that can be shared as needed.

Commendable Practice 4. Field inspection resource sharing (i.e., equipment and personnel) provided by HBM to districts and districts to HBM.

Commendable Practice 5. Load posting certification process for local agencies, and local agency posting support provided by the districts. Local owners can secure load posting materials from ARDOT at a reduced cost if program procedures are followed. Notably, District 3 prepares the documents for the locals and hand carries the documents to them for their signature.

Commendable Practice 6. DCEs and DME are required to be licensed professional engineers (PE), with successful completion of comprehensive bridge inspection training, and provide support to district bridge inspectors as needed.

Commendable Practice 7. QA inspections performed by statewide inspection crews for bridges inspected by the districts.

Commendable Practice 8. Rotation of district inspection teams for Routine inspections so a bridge is not regularly inspected by the same inspection team.

Commendable Practice 9. Use of an automated load permitting and routing system.

Commendable Practice 10. Intent to maintain all inspection and inventory records electronically in the InspectX data management system.

Commendable Practice 11. Tracking bridge maintenance needs in the InspectX data management system.

Commendable Practice 12. Bridge maintenance crews have the skills and abilities to maintain and repair bridges and replace small structures.

Commendable Practice 13. Ability of maintenance personnel to react quickly for emergency repairs.

Commendable Practice 14. Inspectors are recruited through the State's bridge maintenance and construction programs.

Commendable Practice 15. Utilization of enthusiastic, dedicated, and skillful bridge inspection personnel willing to perform difficult tasks.

Commendable Practice 16. ARDOT has been maintaining the inventory, and performing inspections, load ratings, and scour appraisals for bridges on state, city, and county public highway systems since 1979. Having one entity (i.e., ARDOT) perform these functions of the bridge inspection program promotes uniformity and consistency throughout the program.

Commendable Practice 17. NBIS Form IIIB Guidelines for detailing the vertical and horizontal clearances for highways or railroads that pass under the bridge. These values are used to code NBI Items 54 – Minimum Vertical Underclearance, 55 – Minimum Lateral Underclearance on Right, 56 – Minimum Lateral Underclearance on Left, and 69 – Underclearances Vertical and Horizontal.

Commendable Practice 18. Bridge Scour Plan of Action – Event Monitoring Form.

POTENTIAL BENEFITS

Opportunity for improvement recommendations were provided to enhance the bridge inspection program in Arkansas. Many of the recommendations are interrelated in that implementing one may help implement another. For example, implementation of the recommendations presented for QC and QA and personnel resources will help support implementation of improved inspection procedures.

Documentation and implementation of improved procedures will lead to enhanced consistency in program administration, improved succession planning, higher quality data, well trained and experienced inspectors, more efficient and effective processes, and more informed managers with the tools to make timelier and cost-effective decisions.

Documentation and implementation of improved QC and QA processes is a major part of a statewide bridge inspection program. QC helps improve the accuracy of the data and QA helps improve and verify its consistency. These two factors are essential as

ARDOT continues forward with their management systems to identify and program bridges that need maintenance, preservation, rehabilitation, and replacement.

An agency's most important resource is its employees. Establishing clearer career paths and succession plans is expected to help attract and retain well trained, experienced, and qualified personnel that are essential to the success of an agency's bridge inspection program.

Developing and maintaining a more formal training program can help achieve an improved bridge inspection program. The training program can identify the personnel with the proper training and those still in need of training. This can help with succession planning by knowing who has the required qualifications, specialized experience, or certifications. It will also help to identify needed training courses and to program funding for training delivery.

CONCLUSION

The FHWA Team reviewed ARDOT's policies, procedures, and standard operating practices used to administer the requirements of the NBIS; interviewed ARDOT and engineering consultant personnel that are responsible for managing or performing bridge inspections, preparing reports, performing scour appraisals, and determining ratings; and performed file reviews for 33 bridges and field reviews for 12 of the 33 bridges.

Opportunities for improvement were identified in the report and recommendations were provided to enhance quality and improve effectiveness in performing and managing the bridge inspection program. Continued emphasis on the importance of the bridge inspection program and the implementation of the recommendations provided herein are expected to aid ARDOT in providing safe and effective bridges that meet the needs of the traveling public and the requirements of the NBIS.

Several commendable practices were also identified within the report. These practices improve efficiency and effectiveness in administration of ARDOT's bridge inspection program. These practices should be continually supported to ensure success.

ARDOT's policies, procedures, and standard operating practices for bridge inspection are administered by qualified and conscientious personnel that are dedicated to the delivery and quality improvement of their program. When recommended improvements are incorporated in the bridge inspection program, inspection quality will be significantly enhanced, thus continuing to ensure public safety.

REFERENCES

- 23 U.S.C. 144 – National Bridge and Tunnel Inventory and Inspection Standards
- 23 CFR 650C – National Bridge Inspection Standards
- FHWA Bridge Inspector's Reference Manual (BIRM), 2012
- FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, December 1995
  - Errata, June 2012
  - Errata February 2018
- AASHTO Manual for Bridge Evaluation
- AASHTO Manual for Bridge Element Inspection
- ARDOT bridge inspection related manuals, policies, and procedures:
  - Bridge Inspection Manual, Edition 2020, June 16, 2020
  - Local Government Procedures for Compliance With The National Bridge Inspection Standards, September 2020
  - Load Rating and Posting Manual, October 2018
  - InspectX data management system (electronic bridge record/files), 2020
  - Bridge Inspection Program Organizational Chart, 2021
  - State Maintenance Engineer Classification Specifications (i.e. qualifications)
  - State Heavy Bridge Maintenance (HBM) Engineer Classification Specifications (i.e. qualifications)
  - Senior HBM Engineer Classification Specifications (i.e. qualifications)
  - HBM Engineer Classification Specifications (i.e. qualifications)
  - Advanced HBM Engineer Classification Specifications (i.e. qualifications)
  - Staff HBM Engineer Classification Specifications (i.e. qualifications)
  - HBM Superintendent Classification Specifications (i.e. qualifications)
  - Statewide Bridge Inspector Classification Specifications (i.e. qualifications), November 16, 2016
  - Bridge Management Assistant Section Head Classification Specifications (i.e. qualifications)
  - Bridge Management Analyst Classification Specifications (i.e. qualifications)
  - Senior Structures Engineer Classification Specifications (i.e. qualifications)
  - Staff Structures Engineer Classification Specifications (i.e. qualifications)
  - District Construction Engineer Classification Specifications (i.e. qualifications)
  - District Maintenance Engineer Classification Specifications (i.e. qualifications)
  - District Bridge Inspector Classification Specifications (i.e. qualifications), January 26, 2016
  - Assistant Bridge Inspector Classification Specifications (i.e. qualifications), January 26, 2016
  - Lead Bridge Repairer Classification Specifications (i.e. qualifications)
  - Ultrasound inspection of pins in pin and hanger assembly with attached photos and plans to inspect all pins (not just in FCMs), October 10, 2013
  - Load posting and posting numbers, August 18, 2020
  - Changing of agency fields A19-A24 related to posting limit signs, January 7,2021

- Issues with load raters having difficulty finding information needed to properly rate a bridge: update drawings, dates in maintenance needs, post repair photos, clear captions on photos, July 8, 2020

APPENDIX A – ARDOT FCM Inspection Procedure Examples

Fracture Critical Inspection Procedure
Bridge # 03442
Bridge was built in 1963. The bridge has welded Steel caps and columns with steel I-Beams and Stringers.
Inspected all welded and bolted connection using flashlight, pit gauge and wire brush, Preformed Inspection with a rented Man lift

FRACTURE CRITICAL INSPECTION PROCEDURE
BROADWAY STREET BRIDGE OVER THE ARKANSAS RIVER BR# 07292
LITTLE ROCK

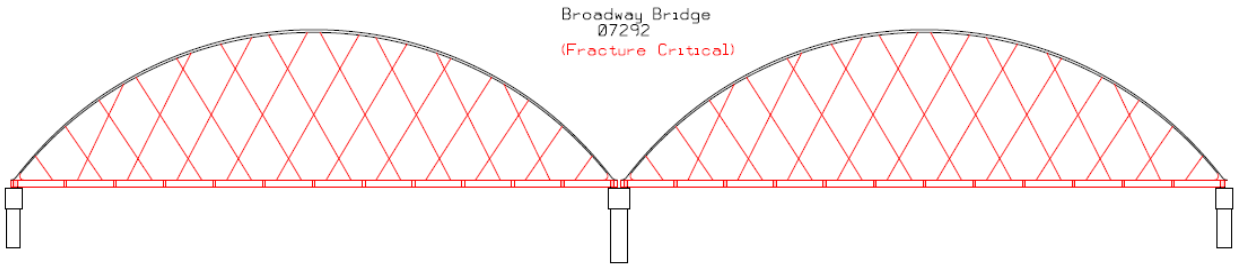
The navigational spans on the Arkansas River Broadway Street, Bridge No. 07292 at Little Rock, are steel tied arch spans.

The fracture critical hangers and Tie-Girders and all tension members are designated in red on the FC Procedure drawing. Hands on Visual method of inspections shall be performed. Tie girder access doors at Bents 4, 5 and 6 can be accessed with a 2402 key and will be crawled through for the inspection of the insides of the Tie-Girder sections.

The Go Pro on an extendable pole will be used to inspect the outsides of the upstream tie girders and floor beam connections. The Go pro video will be linked in the report under the video tab. Lower connections of Arch cables/hanger connections can be inspected by walking on the tie girders and from the deck.

The lower pin connections will be visually inspected on a two-year frequency. Upper connections and pins will be inspected every six years with the use of the 125' man lift in the center lanes of the deck. Visual aids (binoculars) will be used during the inspection when man lift is not used.

Floor beam connections and undersurface can be inspected using Under Bridge Inspection Unit 9233 on the downstream side only due to the lack of clearance.



FRACTURE CRITICAL & COMPLEX BRIDGE INSPECTION PROCEDURE
MISSISSIPPI RIVER BRIDGE NO. 05141
INTO MEMPHIS

Construction of the I-40 Mississippi River Bridge No. 05141 into Memphis was completed in 1973. The total length is 9435.4 feet and the out-to-out width is 89 feet. The longest span is 900 feet and the top of the tied arch truss is approximately 175 feet above the roadway surface.

The fracture critical portions of the Mississippi River Bridge are the girder floor beam system on spans W21 through W27, the box girder floor beam system on spans W28 through W32, and the main channel two span tied arch truss system.

Fracture critical tension members and areas are designated in red on FC Procedure drawing.

Most of the designated members are accessed using an underbridge inspection unit, catwalks, walking through the interior of the box girders, and walking the upper top chord of the tied arch truss.

In 1979, the I-24 Bridge over the Ohio River between Kentucky and Illinois was closed due to cracks found in main members and tie girders of the tied arch spans. An electro slag welding process was used during construction of this bridge. The I-40 Mississippi River Bridge was constructed with the same process.

In 1982, MAGNAFLUX Quality Services, a Division of MAGNAFLUX Corporation completed nondestructive examinations on the welds of the box girders in spans W28 through W32, and on the tie chords of the tied arch spans. Close visual examinations are made of these welds during each inspection.

In the past, ARDOT has been unable to access and visually inspect the inside of the upper connections of the main span tied arch truss. Therefore in 2010, Tennessee retained the engineering firm Modjeski & Masters to clean and inspect the upper members of tied arch truss.

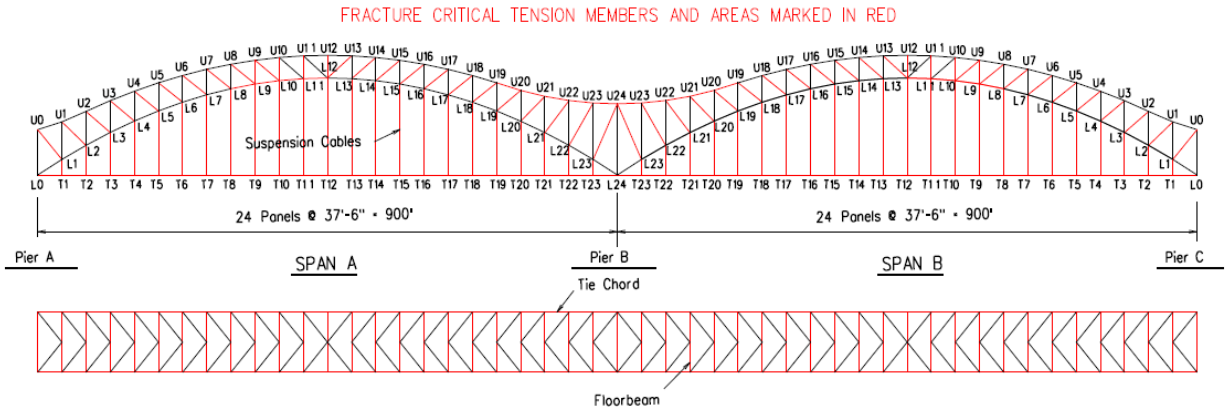
During the yearly Fracture Critical Inspection, areas of the bridge inspected are mostly limited to only the tension steel members whose failure might result in the collapse of the bridge. This includes the arch truss tie chord at hanger connections. These will be accessed by an optical scope through drain holes to determine if any access seal plates should be removed for closer inspection. Additionally, one access seal plate in the westbound direction and one access seal plate in the eastbound direction will be opened for closer inspection on a 24-month frequency.

Additionally, during the yearly Fracture Critical Inspection, the top chord of the arch span shall be walked and all members (tension & compression) of the upper truss will be visually inspected.

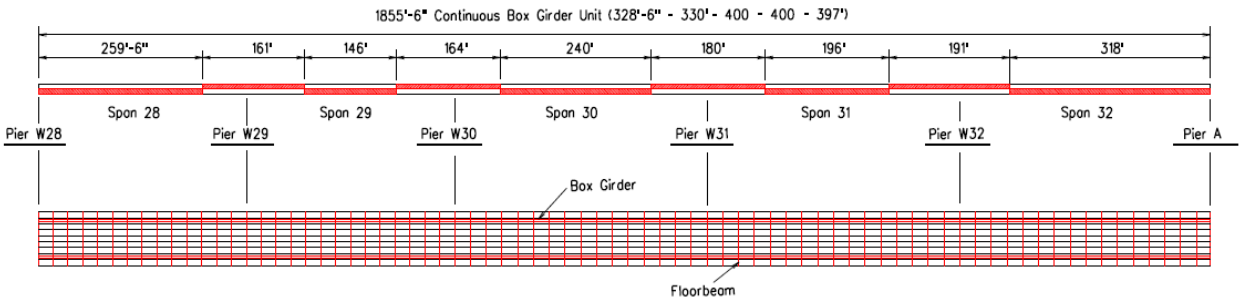
An Engineer from ARDOT Heavy Bridge Maintenance will visit the bridge site during the inspection and review the inspection report as a means of Quality Assurance (QA) for this bridge. The Engineer will meet with the Bridge Inspector and explain about what he or she should look for.

Beginning in 2012, AHTD will secure the services of an engineering firm to give a hands-on inspection of the tied arch truss members above the roadway ever two years or until a catwalk is installed to provide access for AHTD bridge inspectors.

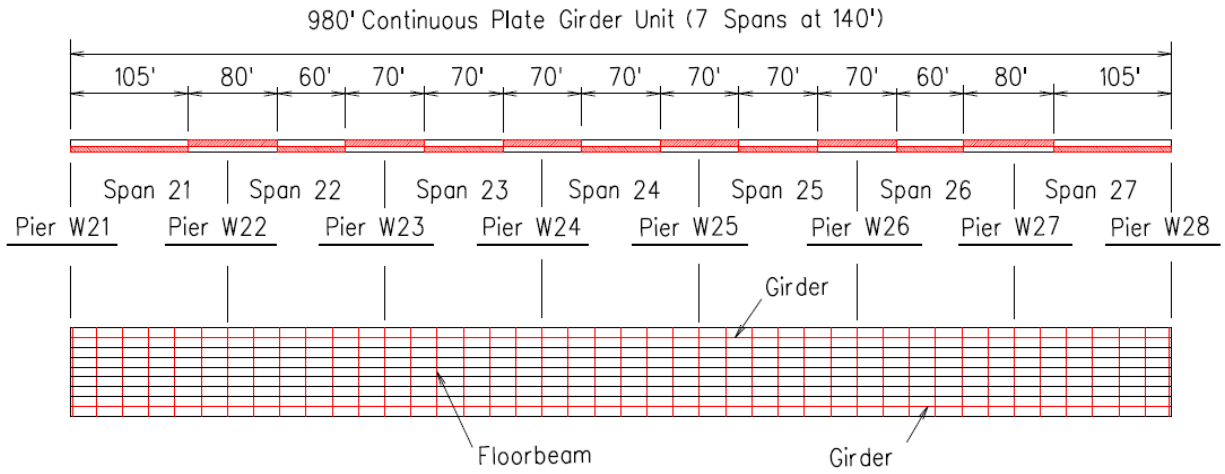
Additional area of special interest is the seismic bearing retrofits (Friction Pendulum Bearings @ W28-W32) that have been installed. Closely monitor the condition of the high strength grout around the base of the bearings and the condition of the rubber seal protecting the bearing.
An Engineer from ARDOT Heavy Bridge Maintenance will visit the bridge site during the inspection and review the inspection report as a means of Quality Assurance (QA) for this bridge.



MISSISSIPPI RIVER BRIDGE NO. 05141



FRACTURE CRITICAL TENSION MEMBERS AND AREAS MARKED IN RED



FRACTURE CRITICAL INSPECTION PROCEDURE
MISSISSIPPI RIVER BRIDGE NO. 02271
AT WEST MEMPHIS

Spans 1 through 5 on the Mississippi River Bridge No. 02271 at West Memphis are comprised of through continuous truss units. The center portion of Span 2 has a 431.134' truss section suspended by pins and hangers. Spans 3 and 4 have cantilever truss sections suspended by pins and hangers.

Spans 6 and 7 are through truss simple spans. Spans 8 and 9 are deck truss simple spans.

Approach Spans 10 through 17 are comprised of 2 girder simple plate girder spans.

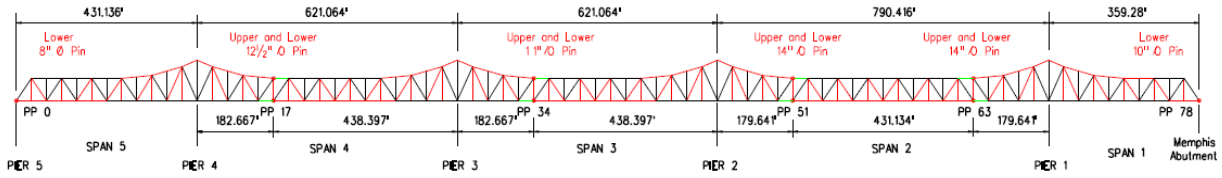
All truss floor beams and plate girder floor beams are fracture critical.

Fracture critical truss tension members are designated in red on FC Procedure drawing. These members are accessed using a bucket truck, man-lift, or underbridge inspection unit.

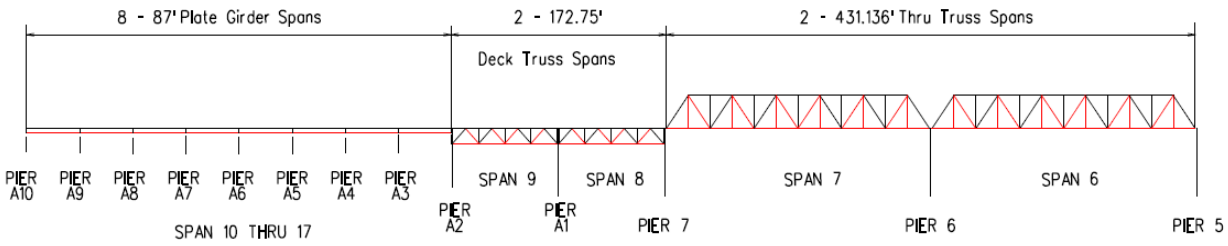
All pins are visually inspected each year. (Pending) The lower pins at PP 0 and PP 78 will be inspected with ultrasonic testing equipment during the bi-yearly routine inspection. Remove caps on ends of pins to access the ends of pins.

The 2 girder spans shall receive a hands-on visual inspection. Tension areas are designated in red on the FC Procedure drawing.

FRACTURE CRITICAL MEMBERS MARKED IN RED



MISSISSIPPI RIVER BRIDGE NO. 02271



FRACTURE CRITICAL MEMBERS MARKED IN RED

APPENDIX B – ARDOT Form III Examples for FCM Inspections

FRACTURE CRITICAL BRIDGE MEMBER INSPECTION		
BRIDGE MEMBER OR ELEMENT	**TYPE INSPECTION**	**CONDITION RATING**
MAIN THRU TRUSS SPAN #1		
UPPER CHORDS	HANDS ON VISUAL	6
LOWER CHORDS	HANDS ON VISUAL	5
Floor Beams	HANDS ON VISUAL	5
	THRU TRUSS SPANS #2	
UPPER CHORDS	HANDS ON VISUAL	6
LOWER CHORDS	HANDS ON VISUAL	5
Floor Beams	HANDS ON VISUAL	5
THRU TRUSS SPANS #3		
UPPER CHORDS	HANDS ON VISUAL	6
LOWER CHORDS	HANDS ON VISUAL	5
Floor Beams	HANDS ON VISUAL	5
	DECK TRUSS SPANS #1	
UPPER CHORDS	HANDS ON VISUAL	6
LOWER CHORDS	HANDS ON VISUAL	5
Floor Beams	HANDS ON VISUAL	5
	DECK TRUSS SPANS #2	
UPPER CHORDS	HANDS ON VISUAL	6
LOWER CHORDS	HANDS ON VISUAL	5
Floor Beams	HANDS ON VISUAL	5
	2 GIRDER/FLOORBEAM	
2 GIRDER SYSTEM	HANDS ON VISUAL	6
Floor Beams	HANDS ON VISUAL	5

BRIDGE MAINTENANCE NEEDS / ACTIVITY LOG

Inspected by M. Frazier
K. Milligan

NBIS – FORM III

Date 12/01/2016

Dist 01 **Co** 18-CRITTENDEN **Rte** 55 **Sect** 11/0 **Log** 0.001 **Bridge** 02271

FRACTURE CRITICAL INSPECTION

THRU-TRUSS # 1 (Main Span)
SUPERSTRUCTURE:

TOP CHORD

BOTTOM CHORD:

VERTICALS:

DIAGONALS:

FLOORBEAMS:

WINDLOCKS:

BRIDGE INSPECTION REPORT
NBIS – FORM III

Inspected by M. Frazier
K. Milligan
Date 12/01/2016
Dist 01 **Co** 18-CRITTENDEN **Rte** 55 **Sect** 11/0 **Log** 0.001 **Bridge** 02271

THRU-TRUSS #2
SUPERSTRUCTURE:

TOP CHORD:

BOTTOM CHORD:

VERTICALS:

DIAGONALS:

FLOORBEAMS:

BRIDGE INSPECTION REPORT

Inspected by M. Frazier
K. Milligan

NBIS – FORM III

Date 12/01/2016

Dist 01 Co 18-CRITTENDEN Rte 55 Sect 11/0 Log 0.001 Bridge 02271

THRU TRUSS #3
SUPERSTRUCTURE:

TOP CHORD:

BOTTOM CHORD:

VERTICALS:

DIAGONALS:

FLOORBEAMS:

BRIDGE INSPECTION REPORT

Inspected by M. Frazier
K. Milligan

NBIS – FORM III

Date 12/01/2016

Dist 01 Co 18-CRITTENDEN Rte 55 Sect 11/0 Log 0.001 Bridge 02271

DECK TRUSS #1
SUPERSTRUCTURE:

TOP CHORD:

BOTTOM CHORD:

VERTICALS:
.

DIAGONALS:

FLOORBEAMS:

DECK TRUSS #2
SUPERSTRUCTURE:

TOP CHORD:
.

BOTTOM CHORD:
.

VERTICALS:

DIAGONALS:

FLOORBEAMS:

APPROACH SPANS, A3 – A10, STEEL DECK GIRDER

SUPERSTRUCTURE:

GIRDERS:

FLOORBEAMS:

OTHER NON FRACTURE CRITICAL DEFICIENCIES NOTED DURING THIS INSPECTION:

(MAIN SPANS)

THRU-TRUSS # 1, 2 & 3

PORTALS:

THRU-TRUSS # 1

LATERAL BRACING:

.

STRINGERS:

THRU-TRUSS #2

STRINGERS:

THRU-TRUSS #3

LATERAL BRACING:

.

STRINGERS:

(APPROACH SPANS)

DECK TRUSS #1

SUPERSTRUCTURE:

STRINGERS:

SWAY BRACING:

DECK TRUSS #2

SUPERSTRUCTURE:

STRINGERS:

SWAY BRACING:

FRACTURE CRITICAL BRIDGE MEMBER INSPECTION

BRIDGE MEMBER OR ELEMENT	TYPE INSPECTION	CONDITION RATING
Painted Steel Thru Arch	Visual hands on	6
Painted steel tie girder	Visual hands on	6
Steel hanger cables	Visual hands on	6
Painted steel open girder	Visual hands on	5
Painted steel closed box girder.	Visual hands on	6
Painted steel Floor Beams	Visual hands on	6
Painted steel Pier Cap	Visual hands on	6

BRIDGE MAINTENANCE NEEDS / ACTIVITY LOG

Inspected by M. Frazier
J. Turner

NBIS – FORM III

Date 09/03/2019

Dist 01 Co 18-CRITTENDEN Rte 40 Sect 52/0 Log 283.92 Bridge 05141

PAINTED STEEL, CLOSED BOX GIRDER, TWO GIRDER SYSTEM, SPANS W28 – W32

SUPERSTRUCTURE:

NORTH BOX GIRDER (GIRDER # 1)
The interior of the girder showed no signs of distress. All welds were in good condition with no cracks found. Paint system was sound and protecting the surface of the steel. Vertical web stiffeners have been installed on the exterior of the web with horizontal tensioning rods running through the girders ahead and back of the each pier. Lateral bracing connections to the girder have been reinforced. Minor surface corrosion at the portals scattered throughout. Access door at Pier W28 and Pier A were closed and secured with padlocks.

SOUTH BOX GIRDER (GIRDER # 2)
The interior of the girder showed no signs of distress. All welds were in good condition with no cracks found. A slight buckle in the web was found at Span 31W, Bay 4, 4' – 5' up from the bottom and 12" ahead of a vertical web stiffener on the downstream face. All bolts at the field connections were in place and secure. Vertical web stiffeners have been installed on the exterior of the web with horizontal tensioning rods running through the girders ahead and back of the each pier. Lateral bracing connections have also been reinforced. Access door at Pier W28 and Pier A were closed and secured with padlocks.

STRINGERS:
Fatigue cracks that were found in the welds at the diaphragm connection plate, have been repaired and appear to be functioning as intended at this inspection. These cracks started in the fabrication weld at the top and bottom of the Connection plate and are progressing along the weld. No apparent visible cracks at this inspection.

PAINTED STEEL FLOOR BEAMS:
Floor beams in the past have had cracking in the cantilever coped areas contract forces has made repairs to the cracks, repairs appear to be functioning as intended at this inspection. These were located in the box girder section, all other floor beams has no apparent visible cracks at this inspection.

PAINTED STEEL THRU ARCH:
Thru arch is in fair condition with minor surface rust starting to form. Upper lateral bracing has active corrosion with section loss due to pigeon dung debris. There were no apparent visible cracks at this inspection.

PAINTED STEEL TIE GIRDER: Isolated areas of corrosion in the bolted connections, minor paint deterioration no apparent visible cracks at this inspection.

HANGER CABLES:
Span A and B, Lt. and Rt. hanger cables have minor damage to the paint system. This condition is typical. Minor rust around the pin at the lower connections. Paint is peeling and chalking at the lower pin connections. Typical condition.

BRIDGE MAINTENANCE NEEDS / ACTIVITY LOG
Inspected by M. Frazier NBIS – FORM III
J. Turner
Date 09/03/2019
Dist 01 Co 18-CRITTENDEN Rte 40 Sect 52/0 Log 283.92 Bridge 05141

FLOORBEAMS:
Sp. B, FB @ T-22, Lt: The end of the floor beam has active corrosion at the lateral brace gusset plate connection.
Pier C, Ahead, FB @ Pier, Lt: Paint failed on bottom flange of FB. Minor surface corrosion.
Active corrosion is occurring to the top flanges at the following locations. (Expansion joints)
Sp. A, FB @ T-4
Sp. A, FB @ T-8
Sp. A, FB @ T-12
Sp. A, FB @ T-16
Sp. A, FB @ T-21
Sp. B, FB @ T-21
Sp. B, FB @ T-16
Sp. B, FB @ T-12
Sp. B, FB @ T-8
Sp. B, FB @ T-4

LOWER LATERAL BRACING:
Heavy pigeon debris inside the ends of the square structural steel tubular braces.
Span B, Between FB 15-16: Bottom flange of lateral brace is deformed.

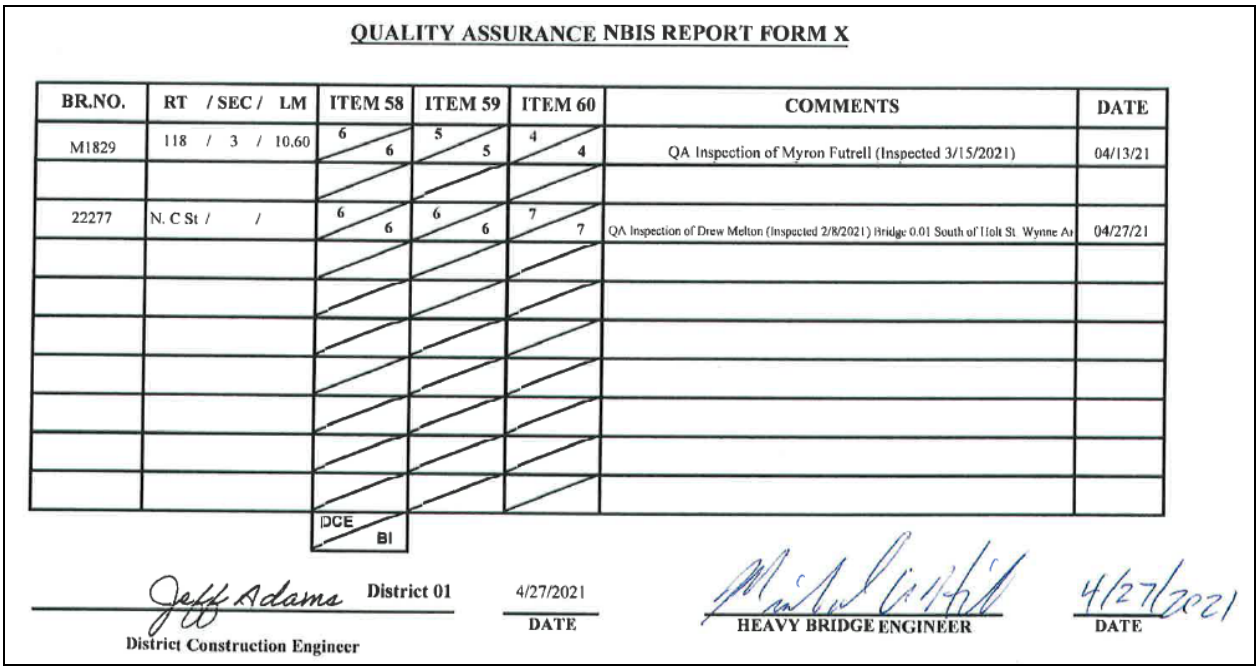
STRINGERS:
Note: Stringers are designated A thru H, J, K. Floor beams are numbered T1 thru T23 at Span A, and T23 to T1 at Span B, Layout is from West to East.

Stringer bearings are corroded, top flange is corroding and the deck is floating above stringers at the following locations. Live loads are also causing impact at these locations. Top flanges of the diaphragms are also corroding at these locations.
Span A, Stringer G, Between FB 11-12: 1" crack at top of diaphragm connection.
Span A, FB 12, Str. J: Stringer bearing is deformed due to pack rust.
Span A, FB @ T- 4.
Span A, FB @ T- 8.
Span A, FB @ T-12.
Span A, FB @ T-16.
Span A, FB @ T-21.
Span B, FB @ T-21.
Span B, FB @ T-16.
Span B, FB @ T-12.
Span B, FB @ T- 4.

Painted Steel Pier Cap
-Pier W21 steel cap has active corrosion with flaking rust and measurable section loss that ranges bet
3/16" - 1/2"
- 1/2 “

BRIDGE MAINTENANCE NEEDS / ACTIVITY LOG
Inspected by M. Frazier NBIS – FORM III
J. Turner
Date 09/03/2019
Dist 01 Co 18-CRITTENDEN Rte 40 Sect 52/0 Log 283.92 Bridge 05141

APPENDIX C – District QA Review Examples



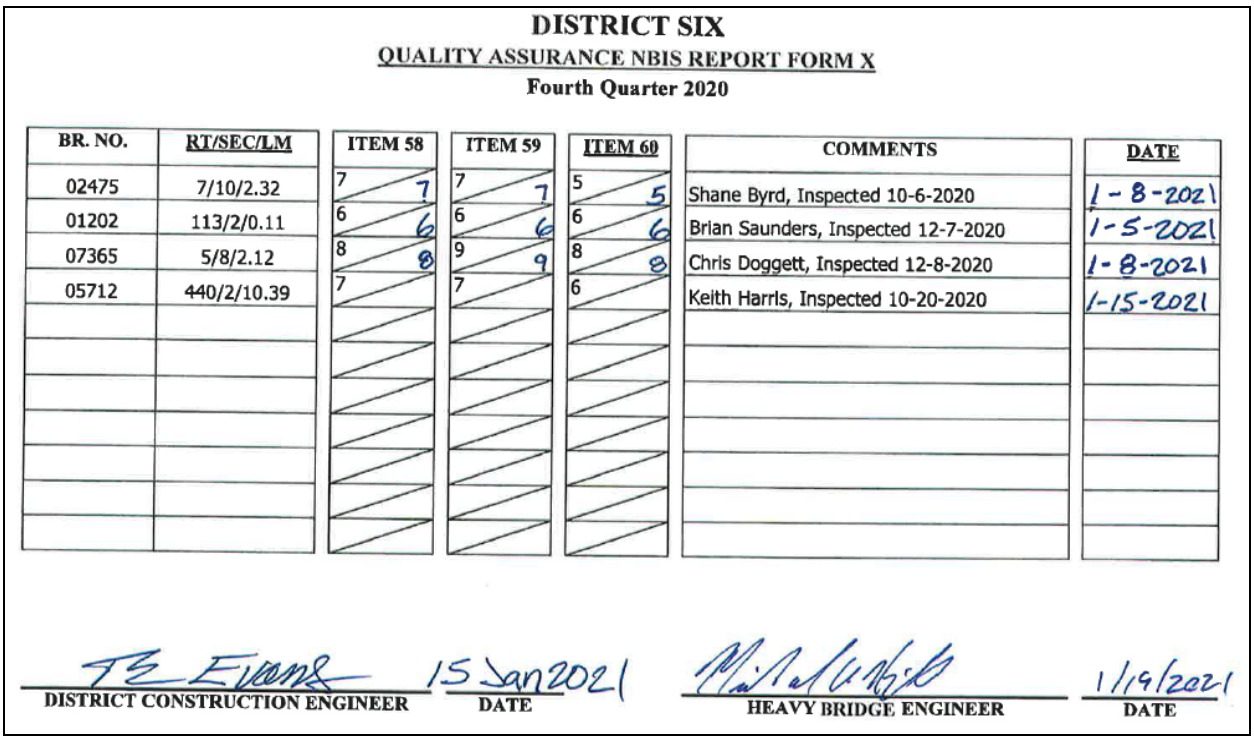
QUALITY ASSURANCE NBIS REPORT FORM X

BR.NO.	RT / SEC / LM	ITEM 58	ITEM 59	ITEM 60	COMMENTS	DATE
M1829	118 / 3 / 10.60	6 / 6	5 / 5	4 / 4	QA Inspection of Myron Futrell (Inspected 3/15/2021)	04/13/21
22277	N. C St / /	6 / 6	6 / 6	7 / 7	QA Inspection of Drew Melton (Inspected 2/8/2021) Bridge 0.01 South of Holt St Wynne Ar	04/27/21
		DCE / BI				

Jeff Adams District 01 — District Construction Engineer — 4/27/2021 DATE

HEAVY BRIDGE ENGINEER — 4/27/2021 DATE

Figure 12. Bridge #M1829, District 1.



DISTRICT SIX

QUALITY ASSURANCE NBIS REPORT FORM X

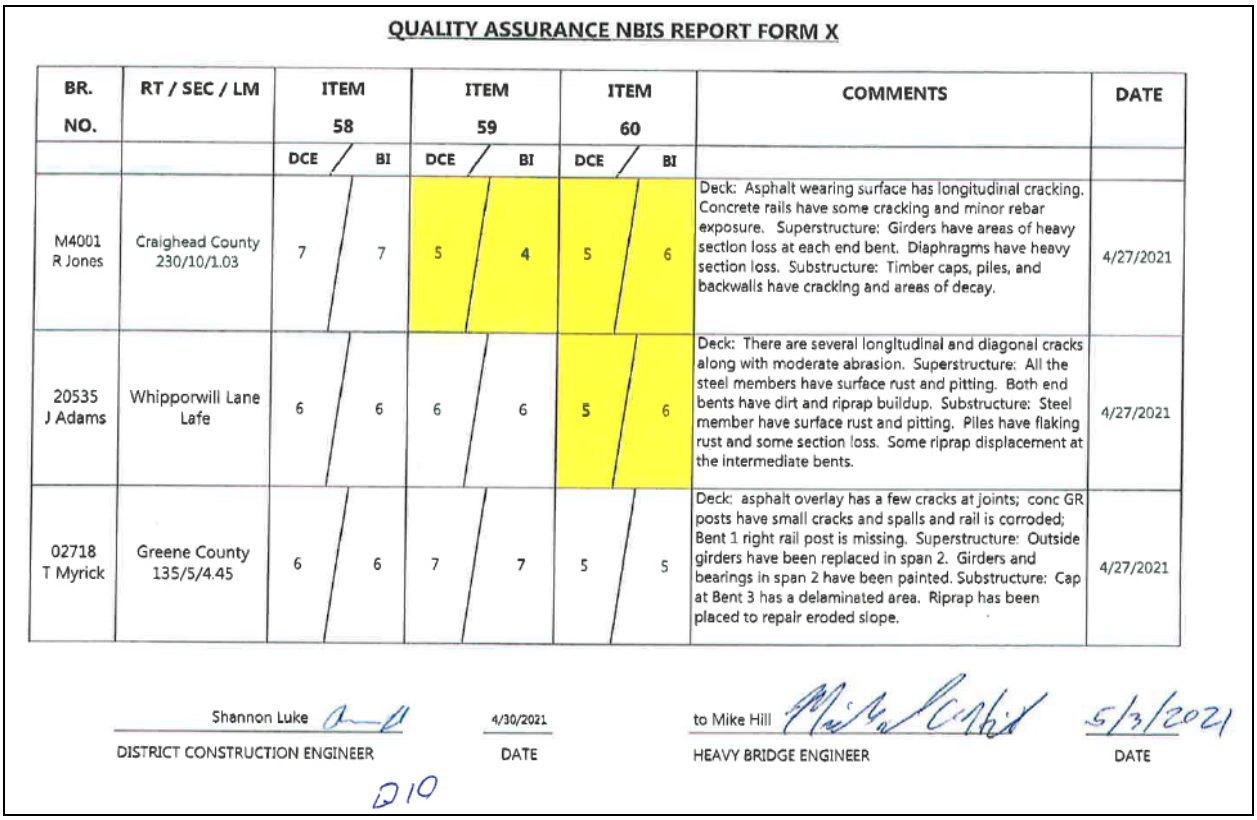
Fourth Quarter 2020

BR. NO.	RT/SEC/LM	ITEM 58	ITEM 59	ITEM 60	COMMENTS	DATE
02475	7/10/2.32	7 / 7	7 / 7	5 / 5	Shane Byrd, Inspected 10-6-2020	1-8-2021
01202	113/2/0.11	6 / 6	6 / 6	6 / 6	Brian Saunders, Inspected 12-7-2020	1-5-2021
07365	5/8/2.12	8 / 8	9 / 9	8 / 8	Chris Doggett, Inspected 12-8-2020	1-8-2021
05712	440/2/10.39	7	7	6	Keith Harris, Inspected 10-20-2020	1-15-2021

T E Evans — DISTRICT CONSTRUCTION ENGINEER — 15 Jan 2021 DATE

HEAVY BRIDGE ENGINEER — 1/19/2021 DATE

Figure 13. Bridge #02475, District 6.



QUALITY ASSURANCE NBIS REPORT FORM X

BR. NO.	RT / SEC / LM	ITEM 58 DCE	ITEM 58 BI	ITEM 59 DCE	ITEM 59 BI	ITEM 60 DCE	ITEM 60 BI	COMMENTS	DATE
M4001 R Jones	Craighead County 230/10/1.03	7	7	5	4	5	6	Deck: Asphalt wearing surface has longitudinal cracking. Concrete rails have some cracking and minor rebar exposure. Superstructure: Girders have areas of heavy section loss at each end bent. Diaphragms have heavy section loss. Substructure: Timber caps, piles, and backwalls have cracking and areas of decay.	4/27/2021
20535 J Adams	Whipporwill Lane Lafe	6	6	6	6	5	6	Deck: There are several longitudinal and diagonal cracks along with moderate abrasion. Superstructure: All the steel members have surface rust and pitting. Both end bents have dirt and riprap buildup. Substructure: Steel member have surface rust and pitting. Piles have flaking rust and some section loss. Some riprap displacement at the intermediate bents.	4/27/2021
02718 T Myrick	Greene County 135/5/4.45	6	6	7	7	5	5	Deck: asphalt overlay has a few cracks at joints; conc GR posts have small cracks and spalls and rail is corroded; Bent 1 right rail post is missing. Superstructure: Outside girders have been replaced in span 2. Girders and bearings in span 2 have been painted. Substructure: Cap at Bent 3 has a delaminated area. Riprap has been placed to repair eroded slope.	4/27/2021

Shannon Luke — DISTRICT CONSTRUCTION ENGINEER — 4/30/2021 DATE

to Mike Hill — HEAVY BRIDGE ENGINEER — 5/3/2021 DATE

D10

Figure 14. Bridge #M4001 and #02718, District 10.

APPENDIX D – Statewide QA Inspector's Summary Examples

District 8 QA Inspectors Summary 2019

- Bridge 04390
  - Item 59 superstructure, weathering steel beams, judging from photos beam ends have some minor corrosion, looks like a NBI of an 8.

- Bridge 05361
  - Concrete bridge rail, District photos indicate spalls on top of bridge rail.

- Bridge 05362
  - Deck, District photos indicate several feet of CS3 cracks.
  - Deck, judging from photos 83% in abrasion is too hard.
  - Fixed and moveable bearings, District notes indicate some bearings have minor rust, CS2

- Bridge 05363
  - Deck measurements, 30.833*140=4317.
  - Cap measurements, 31*3=93 Drawing #14945
  - Abutment measurements,35*2=70
  - Concrete bridge rail measurements,140*2=280
  - Caps, judging from photos some spall, delamination, patch could be added.

- Bridge 05768
  - Cap measurements,40*3=120. Drawing #22137
  - Joint measurements, 28/cos35+2.833 for curbs *3=111

- Bridge 06803
  - Item 52 out to out should be 73.2.
  - Plans indicate compression joints.
  - Compression joints, not wrong but district has twice the amount of leaking.

- Bridge 06812
  - Item 52 should be 78.5.
  - Plans indicate compression joints. Job #080122 drawing # 41422

- Bridge 06929
  - Concrete bridge rail, Photos indicate cracks in railing.

- Bridge 13006
  - Item 51 out to out there is a 3' differences between QA and District measurements.

- Bridge A7095
  - Pourable Joint, Plans indicate this is an integral abutment, there are no joints on this structure
  - Abutment measurements, 65.167*2=130 (Job N. 080306, Drawing N. 49051,49058)
  - R.C. Deck, Photos indicate some CS2 sealable cracking on this structure.
  - Elastomeric bearings, Plans indicate 15 bearings. (Job #080306 drawing # 49060)
  - RC Bridge Rail, photos indicate efflorescence cracks.

- Bridge B7095
  - Pourable Joint, Plans indicate this is an integral abutment, there are no joints on this structure
  - Abutment measurements, 65.167*2=130 (Job N. 080306, Drawing N. 49051,49058)
  - Concrete bridge rail, Photos indicate efflorescence cracks.

- Bridge M0141
  - R.C. Deck measurements, 26.5*84=2226’ (Drawing N. 5491,5492)
  - R.C. Pier Wall measurements, 14.5*2=29
  - R.C. Abutment measurements, 37.0833*2=74’
  - Elevation photos should be used for the cover page
  - Abutment, Photo and notes indicate 2’ of under mining, also there is 1 exposed pile.

- Bridge M0142
  - R.C. Deck measurements, 26.5*84=2226’ (Drawing N. 5491,5492)
  - R.C. Pier Wall measurements, 14.5*2=29
  - R.C. Abutment measurements, 37.0833*2=74’
  - Elevation photos should be used for the cover page
  - Pourable joints have no quantity.
  - Abutment has 45 CS4 in scour looks a little hard.
  - Item (58) Deck, this structure not having any defects on the deck, an NBI rating should be an 8 or 9.

- Bridge M0143
  - R.C. Deck measurements, 26.5*84=2226’ (Drawing N.8783)
  - R.C. Abutment measurements, 53.7604*2=108’ (Drawing N. 5367,5368)

- Bridge M2146
  - Abutment measurements, 69+54=123
  - R.C. Pier Cap drawing indicate, (21*2=42, 23.2*2=46) 42+46=88’
  - Open Girders, Notes and photos indicate a lot of CS2 corrosion
  - Joints, Photos indicate joints at intermitted bents

APPENDIX E – ARDOT Updated Scour POA Examples

UNKNOWN FOUNDATION BRIDGE - PLAN OF ACTION

1. GENERAL INFORMATION

Structure number: 22849	**City, County, State:** Van Buren County, Arkansas	**Waterway:** North fork of Cadron Creek
Structure name: N/A	**State highway or facility carried:** Sequoyah Ranch Road, Zone A., LM 1.13	**Owner:** Van Buren County
Year built: 1980	**Year rebuilt:** N/A	**Bridge replacement plans (if scheduled):** N/A **Anticipated opening date:** _____

Structure type: ☒ Bridge ☐ Culvert
Structure size and description: 90 ft long: 2 steel spans on concrete bents.

Foundations: ☐ Known, type: _____ Depth: _____ ☒ Unknown

Subsurface soil information (*check all that apply*): ☒ Non-cohesive ☐ Cohesive ☐ Rock

Bridge ADT: 211	**Year/ADT:** 2018	**% Trucks:** 1

Does the bridge provide service to emergency facilities and/or an evacuation route (Y/N)? N
If so, describe: _____

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, pager, email):
Dale Heft, Advanced Structures Engineer, Arkansas Department of Transportation
Date: 6/27/12

Concurrences on POA (name, title, agency/organization, telephone, pager, email):
Dale James, Van Buren County Judge; (501) 745-2443

POA updated by (name, title, agency, organization): Tambra Herman, Senior Structures Engineer, Arkansas Department of Transportation, 501-569-2486, Tambra.Herman@ardot.gov
Date of update: 2-5-2021
Items update: ADT, year of ADT, inspection dates

POA to be reviewed every 24 **months by (name, title, agency/organization):** Tambra Herman, Senior Structures Engineer, Arkansas Department of Transportation

Date of next update:2/5/2023

3. SCOUR VULNERABILITY

a. Current Item 113 Code: ☐ 3 ☐ 2 ☐ 1 Other: U

b. Source of Scour Critical Code: ☒ Observed ☐ Assessment ☐ Calculated Other: _____

c. Scour Evaluation Summary: Based on inspection history, the bridge couldn't be assessed safely into a non-scour critical coding. Therefore, Item 113 was given a "U".

d. Scour History: Abutment # 1 - **Abutment is leaning approx. 9 ¾ inches on left side and approx. 4 ½ inches on right side. Approx. 6 ft. of top of abutment has moderate to major cracking and spalling (rebar exposed). Spalling appears to be due to abutment rotating toward pier # 2.** Pier # 2 - **Moderate undermining of footing::There is erosion under each side of approach roadway at abutment. # 1. Erosion is approx. 3 ft. under roadway at each side of bridge. Also there is erosion under right side of approach roadway at abutment. # 3. Erosion is approx. 2 ft. under roadway past corrugated metal headwall. 15 yards of concrete poured to protect bent.(2019)**

4. RECOMMENDED ACTION(S) (see Sections 6 and 7)

	Recommended		Implemented	
a. Increased Inspection Frequency	☐ Yes	☒ No	☒ Yes	☐ No
b. Fixed Monitoring Device(s)	☐ Yes	☒ No	☐ Yes	☐ No
c. Flood Monitoring Program	☒ Yes	☐ No	☒ Yes	☐ No
d. Hydraulic/Structural Countermeasures	☐ Yes	☒ No	☐ Yes	☐ No

5. NBI CODING INFORMATION

	Current	Previous
Inspection date	**11/18/2020**	**7/17/18**
Item 113 Scour Critical	**U**	**U**
Item 60 Substructure	**4**	**4**
Item 61 Channel & Channel Protection	**6**	**6**
Item 71 Waterway Adequacy	**6**	**6**
Comments: (drift, scour holes, etc. - depict in sketches in Section 10)		**15 yards of concrete poured**

6. MONITORING PROGRAM

☒ **Regular Inspection Program** ☐w/surveyed cross sections
Items to Watch: Scour at abutments & bents
☐ **Increased Inspection Frequency of __ mo.** ☐w/surveyed cross sections
Items to Watch: _____

☐ **Underwater Inspection Required**
Items to Watch: _____
☐ **Increased Underwater Inspection Frequency of __ mo.**
Items to Watch: _____

☐ **Fixed Monitoring Device(s)**
Type of Instrument: _____

Installation location(s): _____
Sample Interval: ☐ 30 min. ☐ 1 hr. ☐ 6 hrs. ☐ 12 hrs. ☐ Other: _____
Frequency of data download and review: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other _____
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevations(s) for each pier/abutment:_____
Survey ties: _____
Criteria of termination for fixed monitoring: _____

☒ **Flood Monitoring Program**
Type: ☒ Visual inspection
☐ Instrument (*check all that apply*):
☐ Portable ☐ Geophysical ☐ Sonar ☐ Other: _____
Flood monitoring required: ☐ Yes ☒ No
Flood monitoring event defined by (*check all that apply*):
☐ Discharge _____ ☐ Stage _____
☒ Elev. Water surface **Bankfull** (**see Attachment G)**
☐ Rainfall _____ (in/mm) per _____ (hour)
☐ Flood forecasting information: _____
☐ Flood warning system:
Frequency of flood monitoring: ☐1 hr. ☐3 hrs. ☐6 hrs. ☐ Other: _____
Post-flood monitoring required: ☐ No ☒Yes, within 2 days
Frequency of post-flood monitoring: ☐Daily ☐Weekly ☐Monthly ☒Other: Once Criteria for termination of flood monitoring: _____
Criteria for termination of post-flood monitoring: Assure Bridge Stability
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevation(s) for each pier/abutment: _____

Note: Additional details for action(s) required may be included in Section 8.
Action(s) required if scour alert elevation detected (*include notification and closure procedures*): _____
Action(s) required if scour critical elevation detected (*include notification and closure procedures*): _____

Agency and department responsible for monitoring: ARDOT District 8 Inspection teams will evaluate the bridge conditions during regular inspections, but Van Buren County is responsible for monitoring the bridge any time the water elevations have risen to the "bankfull" stage noted in this document.

Contact person (*include name, title, telephone, pager, e-mail*): See county contact above

7. COUNTERMEASURE RECOMMENDATIONS

Prioritize alternatives below. Include information on any hydraulic, structural or monitoring countermeasures.

☒ **Only monitoring required (see Section 6 and Section 10 – Attachment G)**
Estimated cost $_____

☐ **Structural/hydraulic countermeasures considered (see Section 10, Attachment F):**

Priority Ranking	Estimated cost
(1) _____	$ _____
(2) _____	$ _____
(3) _____	$ _____
(4) _____	$ _____
(5) _____	$ _____

Basis for the selection of the preferred scour countermeasure: _____

Countermeasure implementation project type:

Agency and department responsible for countermeasure program (if different from Section 6 contact for monitoring): _____

Contact person (*include name, title, telephone, pager, e-mail*): _____

Target design completion date: _____

Target construction completion date: _____

Countermeasures already completed: _____

8. BRIDGE CLOSURE PLAN

Scour monitoring criteria for consideration of bridge closure:

☐ Water surface elevation reaches _____ at _____
☐ Overtopping road or structure
☐ Scour measurement results / Monitoring device (See Section 6)
☒ Observed structure movement / Settlement
☐ Discharge: _____ cfs/cms
☐ Flood forecast: _____
☐ Other: ☐ Debris accumulation ☐ Movement of riprap/other armor protection
☐ Loss of road embankment

Emergency repair plans (*include source(s), contact(s), cost, installation directions*): _____

Agency and department responsible for closure: Van Buren County

Contact persons (name, title, agency/organization, telephone, pager, email): _____

Criteria for re-opening the bridge: Restoration to stable condition

Agency and person responsible for re-opening the bridge after inspection: Van Buren County

9. DETOUR ROUTE

Detour route description (route number, from/to, distance from bridge, etc.) - Include map in Section 10, Attachment E.

Bridges on Detour Route:

Bridge Number	Waterway	Sufficiency Rating/ Load Limitations	Item 113 Code

Traffic control equipment (detour signing and barriers) and location(s):

Additional considerations or critical issues (susceptibility to overtopping, limited waterway adequacy, lane restrictions, etc.) : _____

News release, other public notice (include authorized person(s), information to be provided and limitations): None

10. ATTACHMENTS

Please indicate which materials are being submitted with this POA:

☐ **Attachment A: Boring logs and/or other subsurface information**

☐ **Attachment B: Cross sections from current and previous inspection reports**

☐ **Attachment C: Bridge elevation showing existing streambed, foundation depth(s) and observed and/or calculated scour depths**

☐ **Attachment D: Plan view showing location of scour holes, debris, etc.**

☐ **Attachment E: Map showing detour route(s)**

☐ **Attachment F: Supporting documentation, calculations, estimates and conceptual designs for scour countermeasures.**

☒ **Attachment G: Photos**

☐ **Attachment H: Other information:**

Attachment G:
The red line on the photo below indicates “bank full water surface elevation”, which is the trigger for scour monitoring for any significant settling or movement of bents.


07/23/2014

SCOUR CRITICAL BRIDGE - PLAN OF ACTION

1. GENERAL INFORMATION

Structure number: 03170	**County, State:** Lonoke County, Arkansas	**Waterway:** Pigeon Roost Creek
Structure name: N/A	**State highway or facility carried:** SH 38, Sec 00, LM 9.41	**Owner:** ARDOT
Year built: 1958	**Year rebuilt:** n/a	**Bridge replacement plans(if scheduled):** **Anticipated opening date:** n/a

Structure type: ☒ Bridge ☐ Culvert
Structure size and description: 98'-5 1/2"long: Concrete Pile Bents

Foundations: ☒ Known, Concrete Pile Bents (Bent 1 thru 6) Depth Typ. 38' long

Subsurface soil information (*check all that apply*): ☒ Cohesive Firm clay.

Bridge ADT: 2600	**Year/ADT:** 2018	**% Trucks:** 1

Does the bridge provide service to emergency facilities and/or an evacuation route (Y/N)? Y
If so, describe: Located on main route between Butlerville and Hickory Plains.

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, pager, email):
Dale Heft Advanced Structures Engineer, Arkansas Department of Transportation
Date: 7/15/13

Concurrences on POA (name, title, agency/organization, telephone, pager, email):
Tony Evans, Dist. 6 Construction Engineer; (501)569-2169 Tony.Evans@ardot.gov

POA updated by (name, title, agency, organization): Tambra Herman, Senior Structures Engineer, Arkansas Department of Transportation, 501-569-2486 **Date of update:** 4/21/2020
Items update: ADT, Year of ADT, ArDOT personnel responsible for updates, inspection dates

POA to be updated every 24 **months by (name, title, agency/organization):** Tambra Herman, Senior Structures Engineer, Arkansas Department of Transportation, 501-569-2486

Date of next update:4/21/2022

3. SCOUR VULNERABILITY

a. Current Item 113 Code: ☒ 3 ☐ 2 ☐ 1 Other:

b. Source of Scour Critical Code: ☒ Observed ☐ Assessment ☒ Calculated Other: _____

c. Scour Evaluation Summary: Based on calculated scour Item 113 was assigned a "3".

d. Scour History: Channel has insignificant scour. The problem with this bridge is that scour continues to undermine the end bent cap. In 2003, it appeared to be stabilized with riprap. However,

this bridge could become problematic if the approaches were to settle.

4. RECOMMENDED ACTION(S) (see Sections 6 and 7)

	Recommended		Implemented	
a. Increased Inspection Frequency	☐ Yes	☒ No	☐ Yes	☒ No
b. Fixed Monitoring Device(s)	☐ Yes	☒ No	☐ Yes	☐ No
c. Flood Monitoring Program	☒ Yes	☐ No	☒ Yes	☐ No
d. Hydraulic/Structural Countermeasures	☐ Yes	☒ No	☐ Yes	☐ No

5. NBI CODING INFORMATION

	Current	Previous
Inspection date	**8/7/19**	**8/28/18**
Item 113 Scour Critical	**3**	**3**
Item 60 Substructure	**6**	**5**
Item 61 Channel & Channel Protection	**5**	**5**
Item 71 Waterway Adequacy	**8**	**8**
Comments: (drift, scour holes, etc. - depict in sketches in Section 10)		

6. MONITORING PROGRAM

☒ **Regular Inspection Program** ☒w/surveyed cross sections
Items to Watch: Check end slopes and riprap annually for signs of change.. Take soundings from abutment to abutment on upstream and downstream
☐ **Increased Inspection Frequency of __ mo.** ☐w/surveyed cross sections
Items to Watch: _____
☐ **Underwater Inspection Required**
Items to Watch: _____
☐ **Increased Underwater Inspection Frequency of __ mo.**
Items to Watch: _____
☐ **Fixed Monitoring Device(s)**
Type of Instrument: _____
Installation location(s): _____
Sample Interval: ☐ 30 min. ☐ 1 hr. ☐ 6 hrs. ☐ 12 hrs. ☐ Other: _____
Frequency of data download and review: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other _____
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevations(s) for each pier/abutment:_____
Survey ties: _____

☒ **Flood Monitoring Program**
Type: ☒ Visual inspection
☒ Instrument (*check all that apply*):
☐ Portable ☐ Geophysical ☐ Sonar ☐ Other: _____
Flood monitoring required: ☐ Yes ☒ No
Flood monitoring event defined by (*check all that apply*):
☐ Discharge _____
☒ Stage Q25 215' Water surface Elev. on layout
☐ Rainfall _____ (in/mm) per _____ (hour)
☐ Flood forecasting information: _____
☐ Flood warning system: Flood warning
Frequency of flood monitoring: ☐1 hr. ☐3 hrs. ☐6 hrs. ☒ Other: Post-flood only
Post-flood monitoring required: ☐ No ☒Yes, within 2 days
Frequency of post-flood monitoring: ☐Daily ☐Weekly ☐Monthly ☒Other: Once Criteria for termination of flood monitoring: _____
Criteria for termination of post-flood monitoring: Bridge is stable
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevation(s) for each pier/abutment: _____

Note: Additional details for action(s) required may be included in Section 8.
Action(s) required if scour alert elevation detected (*include notification and closure procedures*): _____
Action(s) required if scour critical elevation detected (*include notification and closure procedures*): _____

Agency and department responsible for monitoring: ARDOT District 6 Inspection teams

Contact person (*include name, title, telephone, pager, e-mail*): Tony Evans, Dist. 6 Construction Engineer; (501)569-2169 Tony.Evans@ardot.gov

7. COUNTERMEASURE RECOMMENDATIONS

Prioritize alternatives below. Include information on any hydraulic, structural or monitoring countermeasures.

☒ **Only monitoring required (see Section 6 and Section 10 – Attachment F)**
Estimated cost $_____

☐ **Structural/hydraulic countermeasures considered (see Section 10, Attachment F):**

Priority Ranking	**Estimated cost**
(1) _____	$ _____
(2) _____	$ _____
(3) _____	$ _____
(4) _____	$ _____
(5) _____	$ _____

Basis for the selection of the preferred scour countermeasure: _____

Countermeasure implementation project type:
☐ Proposed Construction Project ☐ Maintenance Project
☐ Programmed Construction - Project Lead Agency:
☐ Bridge Bureau ☐ Road Design ☐ Other _____

Agency and department responsible for countermeasure program (if different from Section 6 contact for monitoring): _____

Contact person (*include name, title, telephone, pager, e-mail*): _____

Target design completion date: _____

Target construction completion date: _____

Countermeasures already completed: _____

8. BRIDGE CLOSURE PLAN

Scour monitoring criteria for consideration of bridge closure:
☐ Water surface elevation reaches _____ at _____
☐ Overtopping road or structure
☐ Scour measurement results / Monitoring device (See Section 6)
☒ Observed significant structure movement / Settlement
☐ Discharge: _____ cfs/cms
☐ Flood forecast: _____
☐ Other: ☐ Debris accumulation ☐ Movement of riprap/other armor protection
☐ Loss of road embankment

Emergency repair plans (*include source(s), contact(s), cost, installation directions*): _____

Agency and department responsible for closure: ARDOT Dist. 6

Contact persons (name, title, agency/organization, telephone, pager, email): Tony Evans, Dist. 6 Construction Engineer; (501)569-2169 Tony.Evans@ardot.gov

Criteria for re-opening the bridge: Restoration to stable condition

Agency and person responsible for re-opening the bridge after inspection: ARDOT Dist. 6

9. DETOUR ROUTE

Detour route description See attached map and bridge list.

Bridges on Detour Route:

Bridge Number	Waterway	Sufficiency Rating/ Load Limitations	Item 113 Code

Traffic control equipment (detour signing and barriers) and location(s):

Additional considerations or critical issues (susceptibility to overtopping, limited waterway adequacy, lane restrictions, etc.) : _____

News release, other public notice (include authorized person(s), information to be provided and limitations): AHTD Public Affairs office

10. ATTACHMENTS

Please indicate which materials are being submitted with this POA:

☒ **Attachment A: Boring logs and/or other subsurface information**

☒ **Attachment B: Cross sections from current and previous inspection reports**

☐ **Attachment C: Bridge elevation showing existing streambed, foundation depth(s) and observed and/or calculated scour depths**

☐ **Attachment D: Plan view showing location of scour holes, debris, etc.**

☒ **Attachment E: Map showing detour route(s)**

☐ **Attachment F: Supporting documentation, calculations, estimates and conceptual designs**

for scour countermeasures.

☐ **Attachment G: Photos**

☒ **Attachment H: Other information: List of bridges encountered on detour route.**

APPENDIX F – Bridge Scour Plan of Action – Event Monitoring Form

ARDOT Bridge No.: _____ Route carried: _____

Waterway crossed: _____

Description of data entered for the Scour Monitoring Event Report items below:
Inspected by: *(name of person who performed the action(s) identified in the POA)*

Date: *(date of bridge monitoring to perform actions identified in POA)*

Triggering event description: *(Significant rainfall that raises water elevation to "Q25" or "Bank full" level)*

High water: *(Q25 or approximate "Bank full" water surface elevation, reference mark)*

Action taken: *(description of actions performed at bridge; if accessible, for example: soundings taken, closed bridge, notified owner of action need, verified bridge stability…)*

Length of time out of service: *(if any…)*

Damage: *(approach washout, abutment or pier settlement, wing wall damage, if any …)*

Repairs: *(if any…)*

Repair cost(s): *(if any…)*

Opened to traffic: *(full, partial-one lane, load restrictions, emergency only …)*

Date opened: *(if closed…)* **Approved by:**

IMPORTANT: Place a copy of the completed/updated monitoring history document in the bridge file after each triggering event

Scour Monitoring Event Report

Inspected by:_____ Date:_____

Triggering event description:_____

High water:_____

Action taken:_____

Length of time out of service:_____

Damage:_____

Repairs:_____

Repair cost(s):_____

Opened to traffic:_____

Date opened:_____ Approved by:_____

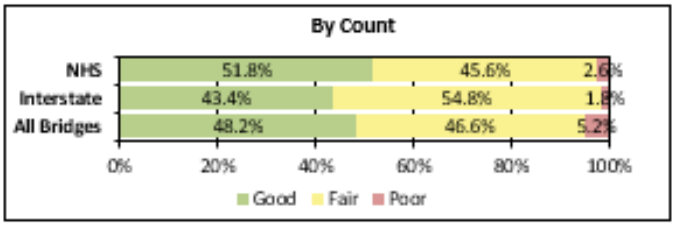
APPENDIX G - 2021 OVERVIEW OF BRIDGES IN ARKANSAS - Executive Summary of Bridge Information from the National Bridge Inventory

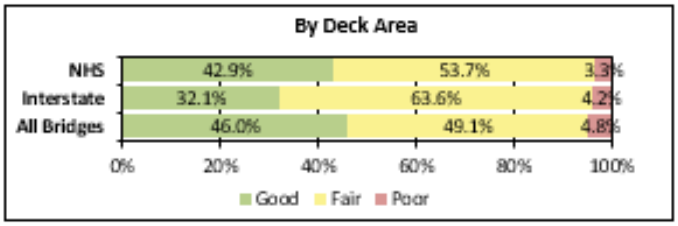
2021 OVERVIEW OF BRIDGES IN ARKANSAS

Executive Summary of Bridge Information from the National Bridge Inventory
(Highway Bridges Only)

"Area" refers to the deck area in square meters as described in 23 CFR Part 490, Subpart D – National Performance Management Measures for Assessing Bridge Condition.

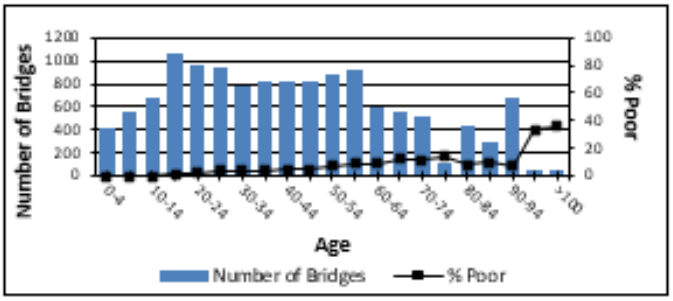
	Count					Deck Area (SqM)				
CATEGORY	State	Local	Federal/ Tribal	Other	% of Total	State	Local	Federal/ Tribal	Other	% of Total
Interstate	903	0	0	0	7.0%	1,679,846	0	0	0	24.6%
Other Arterial	3,112	325	6	1	26.6%	2,782,149	131,009	47,611	110	43.3%
Collector	3,149	2,145	7	0	41.0%	1,152,713	456,158	21,797	0	23.9%
Local	228	2,888	175	2	25.4%	101,214	443,924	20,689	158	8.3%
TOTAL	**7,392**	**5,358**	**188**	**3**	**100.0%**	**5,715,922**	**1,031,092**	**90,097**	**268**	**100.0%**
NHS	2,293	8	0	0	17.8%	3,351,175	8,939	0	0	49.1%
Non-NHS	5,099	5,350	188	3	82.2%	2,364,747	1,022,152	90,097	268	50.9%





Summary - All Bridges (includes Federal/Tribal)

		State		National	
	Avg. Age	43.0 yrs		45.4 yrs	
Count	Total	12,941		619,622	
	Good	6,234	48.2%	278,128	44.9%
	Poor	679	5.2%	43,586	7.0%
Area (SqM)	Total	6,837,378		398,580,883	
	Good	3,147,183	46.0%	172,959,545	43.4%
	Poor	330,845	4.8%	20,213,559	5.1%



NHS Bridges (includes Federal/Tribal)

		State		National	
	Avg. Age	43.3 yrs		44.9 yrs	
Count	Total	2,301		146,073	
	Good	1,192	51.8%	65,749	45.0%
	Poor	59	2.6%	4,481	3.1%
Area (SqM)	Total	3,360,114		230,100,216	
	Good	1,442,623	42.9%	94,731,407	41.2%
	Poor	112,140	3.3%	9,667,397	4.2%

Interstate Bridges (includes Federal/Tribal)

		State		National	
	Avg. Age	40.3 yrs		45.4 yrs	
Count	Total	903		58,515	
	Good	392	43.4%	23,243	39.7%
	Poor	16	1.8%	1,662	2.8%
Area (SqM)	Total	1,679,846		105,654,081	
	Good	539,488	32.1%	38,779,644	36.7%
	Poor	71,381	4.2%	4,397,902	4.2%

State-Owned Bridges (Item 22 = 01, 11, 21, 31)

		State		National	
	Avg. Age	48.5 yrs		47.0 yrs	
Count	Total	7,392		298,855	
	Good	3,519	47.6%	131,213	43.9%
	Poor	385	5.2%	13,751	4.6%
Area (SqM)	Total	5,715,922		303,695,029	
	Good	2,539,154	44.4%	129,292,514	42.6%
	Poor	275,806	4.8%	13,376,100	4.4%

Locally-Owned Bridges (Item 22 = 02, 03, 04, 12, 25, 32)

		State		National	
	Avg. Age	35.2 yrs		43.7 yrs	
Count	Total	5,358		308,446	
	Good	2,634	49.2%	141,593	45.9%
	Poor	282	5.3%	28,803	9.3%
Area (SqM)	Total	1,031,092		90,926,220	
	Good	597,758	58.0%	42,248,889	46.5%
	Poor	52,463	5.1%	6,538,603	7.2%

Federally & Tribally Submitted Bridges

		State		National	
	Avg. Age	46.5 yrs		45.4 yrs	
Count	Total	188		11,091	
	Good	81	43.1%	4,922	44.4%
	Poor	12	6.4%	769	6.9%
Area (SqM)	Total	90,097		3,012,911	
	Good	10,272	11.4%	1,066,536	35.4%
	Poor	2,577	2.9%	175,035	5.8%

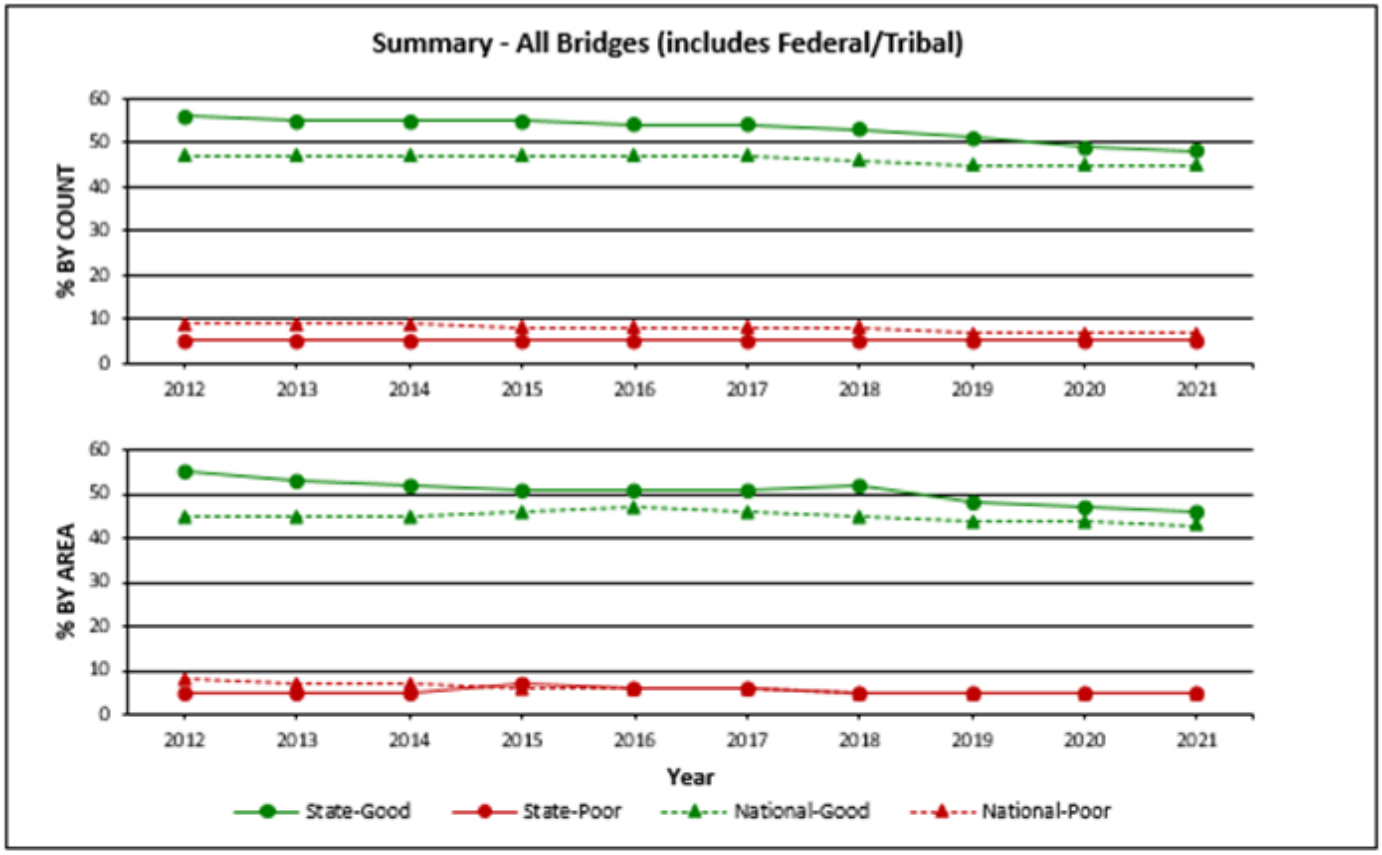
Other Bridges (Item 22 = 26, 27, 80)

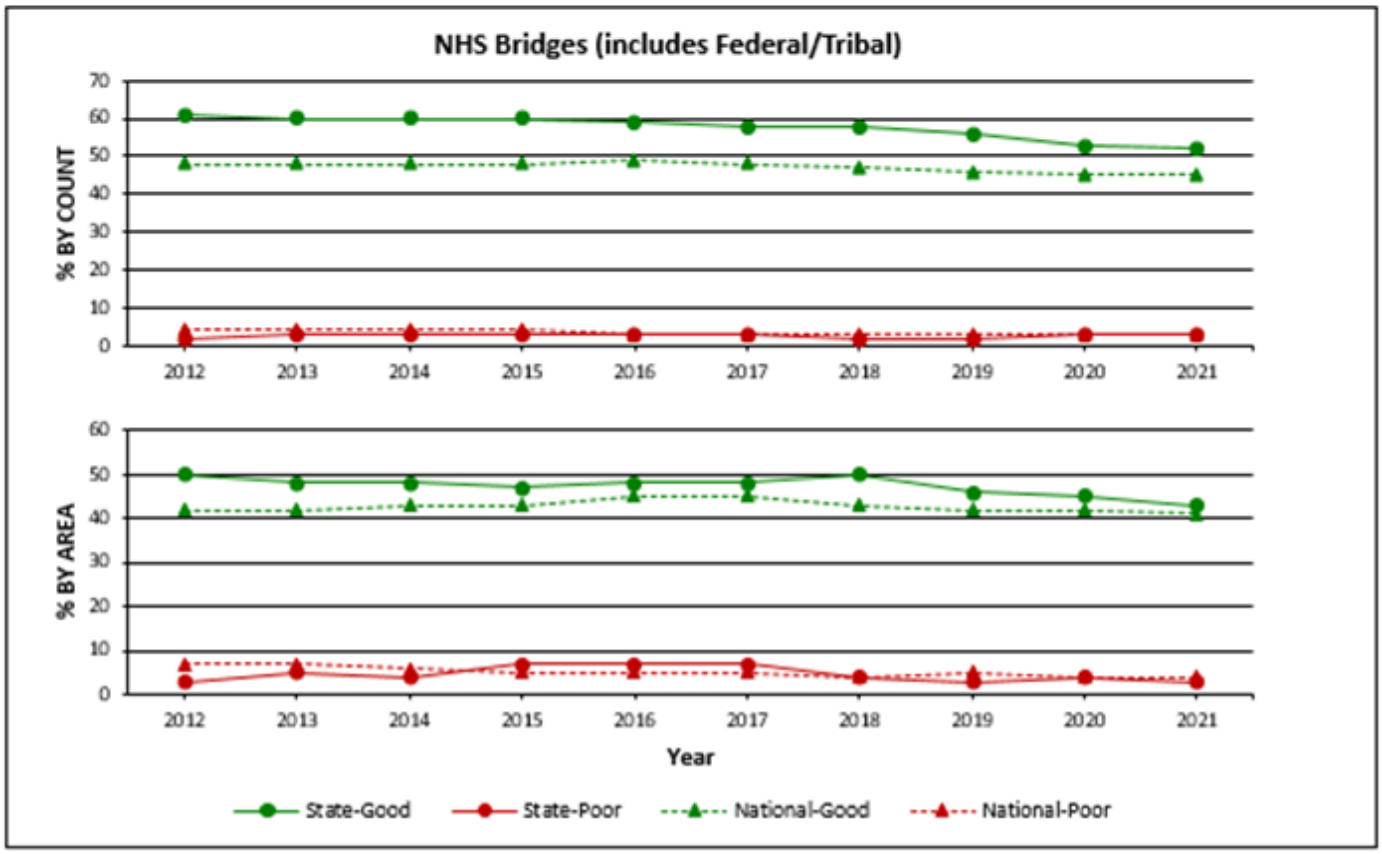
		State		National	
	Avg. Age	26.0 yrs		60.6 yrs	
Count	Total	3		1,199	
	Good	0	0.0%	378	31.5%
	Poor	0	0.0%	261	21.8%
Area (SqM)	Total	268		936,379	
	Good	0	0.0%	348,705	37.2%
	Poor	0	0.0%	118,538	12.7%

2021 OVERVIEW OF BRIDGES IN ARKANSAS

Executive Summary of Bridge Information from the National Bridge Inventory
(Highway Bridges Only)

"Area" refers to the deck area in square meters as described in 23 CFR Part 490, Subpart D – National Performance Management Measures for Assessing Bridge Condition.





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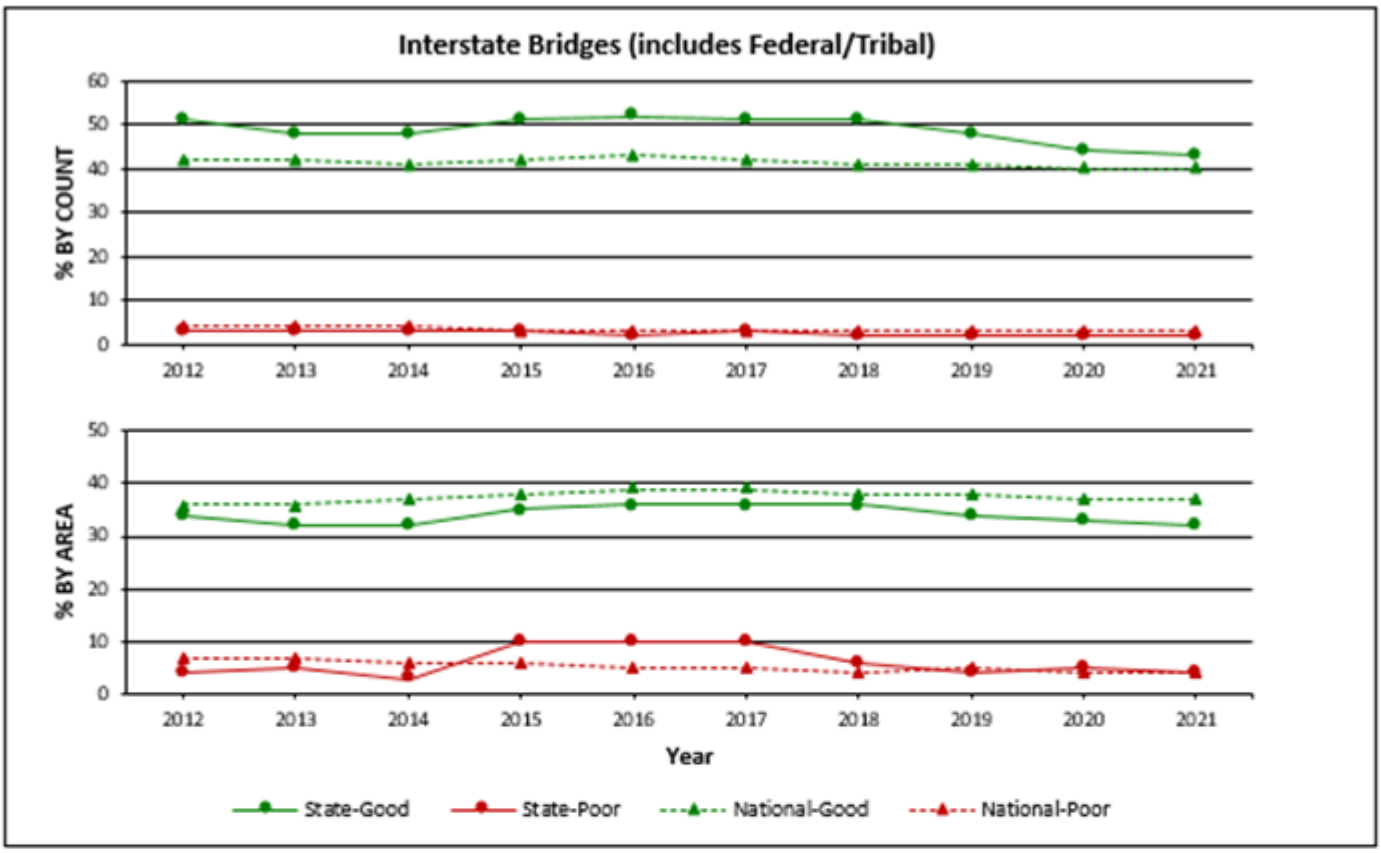

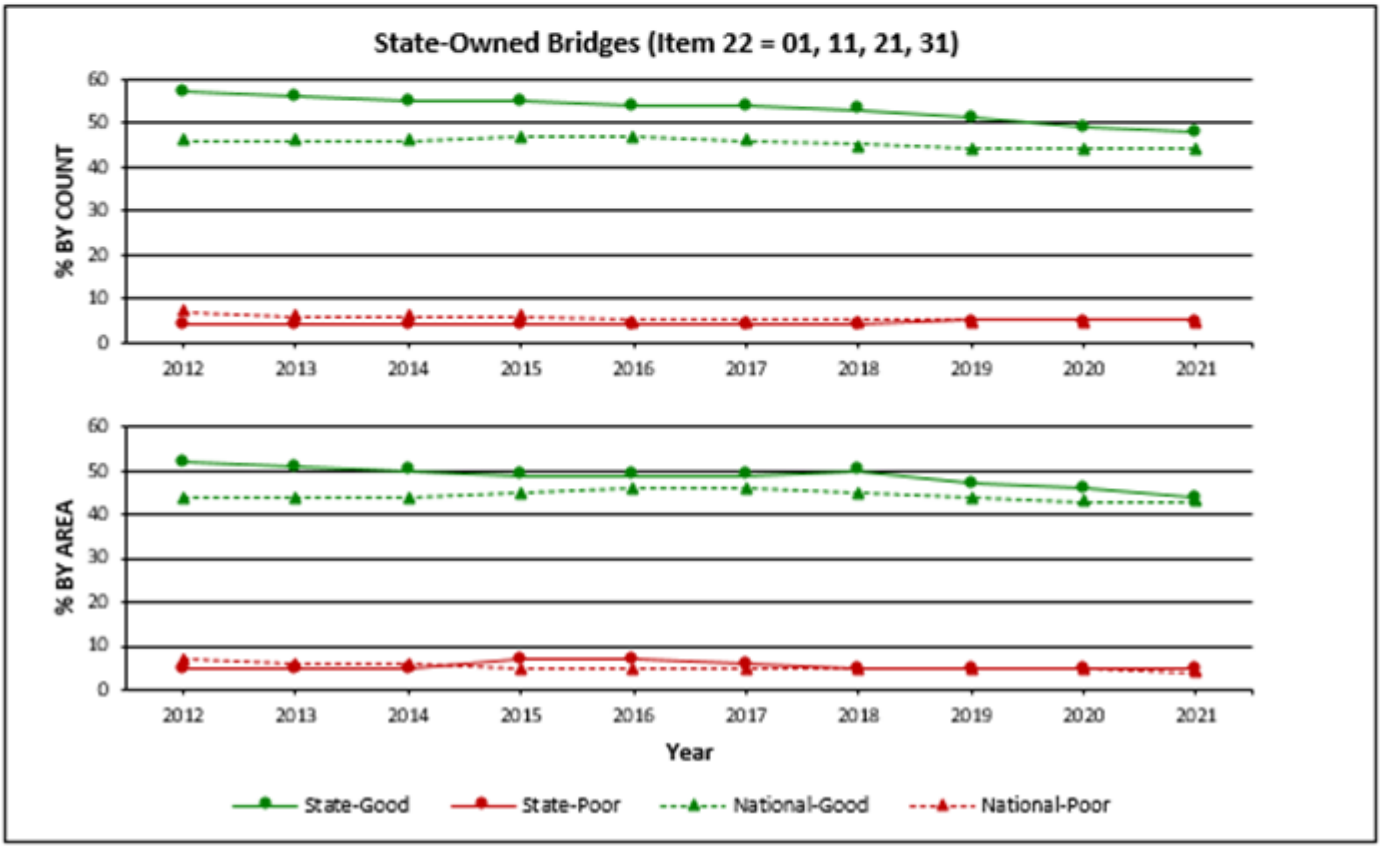

"Area" refers to the deck area in square meters as described in 23 CFR Part 490, Subpart D – National Performance Management Measures for Assessing Bridge Condition.