

INDOT BRIDGE INSPECTION MANUAL

PART 6

SCOUR

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

Table of Contents

6-1.0 SCOUR	2
6-1.01 BRIDGE SCOUR EVALUATION PROCEDURES FOR STATE BRIDGES	2
6-1.01(01) Scour Critical Identification	2
6-1.01(02) Scour Plan of Action for State Bridges.....	2
6-1.02 BRIDGE SCOUR EVALUATION PROCEDURES FOR LOCAL PUBLIC AGENCY BRIDGES.....	5
6-1.02(01) Introduction	5
6-1.02(02) Initial Screening Process.....	5
6-1.03 SCOUR ASSESSMENT/SCOUR ANALYSIS PROCEDURES.....	5
6-1.04 SCOUR RATINGS DURING FIELD REVIEWS.....	8
6-1.05 BRIDGE SCOUR PLAN OF ACTION (POA) PROCEDURES	8

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

6-1.0 SCOUR

6-1.01 Bridge Scour Evaluation Procedures for State Bridges

6-1.01(01) Scour Critical Identification

1. Bridge scour vulnerability shall be evaluated and appraised by the INDOT Division of Hydraulics and consulting firms per Chapter 203 of the Indiana Design Manual.
2. NBI Item #113 shall be coded in BIAS by INDOT Bridge Inspectors based on field conditions and/or the result of a scour analysis provided by the INDOT Division of Hydraulics.

6-1.01(02) Scour Plan of Action for State Bridges

A Scour Plan of Action (POA) is required for all Indiana bridges (both State Bridges and LPA Bridges) that have NBI Item # 113 (Scour Critical Bridges) coded 3 or less.

The Scour POA shall be created for each scour critical State Bridge by the District Bridge Inspection Supervisor. The Scour POA shall then be approved by the Bridge Inspection Area Engineer and shall be maintained within the BIAS bridge file for future inspections. The Scour POA template is provided in the Appendix and shall be used for creating the Scour POA for all scour critical State Bridges.

The approved Scour POA for each scour critical bridge shall be updated by the responsible INDOT-Certified bridge inspection team leader following each routine inspection after completing the routine inspection report, but prior to final approval of the report. Before the routine inspection report is approved, the District Bridge Inspection Supervisor shall review the updated Scour POA, and any changes shall be communicated to the district bridge inspection team and other district and central office INDOT personnel as may be required.

6-1.01(03) Initial Scour Inspection Following Trigger Event

An Initial Scour Inspection shall be carried out when the triggering event is either detected, reported, or measured at or near a State Bridge identified as a scour critical bridge.

The scour trigger event for all scour critical State Bridges shall be defined using one of the following three mechanism:

1. Any rainfall event reported at either a USGS or other approved rainfall measuring station either at or near the scour critical bridge that results in 2.5 inches or more of rain in a 24-hour period.
2. When the 50-year flow rate or flood stage (Q_{50}) reported at either a USGS or other approved stream gauge measuring station placed either on the channel at the scour critical bridge or nearby is exceeded. If this trigger event option is selected, the District Bridge

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

Inspection Supervisor shall coordinate with the INDOT Hydraulics Department to establish an appropriate and measurable Q₅₀ reporting criteria individually for each scour critical bridge.

3. Upon notification of a significant flood event (such as notification that the roadway with one or more scour critical bridges has been closed due to high water) from a recognized and acceptable INDOT Central Office, INDOT District or Subdistrict Office, or County Emergency Management Authority.

Once the trigger event has been either detected, reported, or measured, the District Bridge Inspection Supervisor shall be notified, and an initial scour inspection shall be carried out as soon as feasible.

Resources:

The National Water Information System Web Interface of the U.S. Geological Survey Website is an available resource to bridge inspectors for obtaining current water data. Bridge Inspectors should click on Indiana on the interactive map.

The Water Information Web Interface website is:

<https://waterdata.usgs.gov/nwis/rt>.

For a map of real-time streamflow conditions, Bridge Inspectors should click on the Interactive Indiana Map for a full page view. Bridge Inspectors may then select any of the available stream gauge stations for detailed information collected from that station, including summary, hydrograph, peak, forecast, and rating information. Water Alert email and text message alerts can be set up for any individual station.

Bridge inspectors can obtain precipitation measurements by selecting the “Current Conditions” button, then selecting the “Indiana Precipitation Table” in the Predefined displays and grouping the table by County.

The precipitation website is:

https://waterdata.usgs.gov/in/nwis/current/?type=precip&group_key=county_cd

Precipitation stations may be shown on a map view by selecting the appropriate button. Selecting the individual station number provides additional precipitation data.

If the conditions observed during the initial scour inspection determine that either no appreciable scour has occurred, or that any scour action that has occurred has not resulted in any adverse effects to the bridge or any of its scour critical components, or that any observed effects are not detrimental and can be corrected by INDOT maintenance forces, then no additional monitoring is required.

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

6-1.01(04) Bridge Scour Monitoring

If conditions during the initial scour inspection are present that do not allow the inspectors to satisfactorily complete their scour inspection during one visit (such as high water that has not receded or high water flow velocity), or if the triggered scour event resulted in adverse effects to any or all scour critical components, or created conditions that threaten the stability or safety of the bridge to public use, then Bridge Scour Monitoring shall be actively carried out through one or more additional inspections. The additional inspections shall be done at intervals established by the District Bridge Inspection District Supervisor and shall be documented in the Scour POA. All observations, measurements, or other actions required during the additional inspections related to the current triggered scour event shall be documented in the Bridge Scour Monitoring Log. The Bridge Scour Monitoring Log template is provided in the Appendix and shall be used for logging all bridge scour monitoring actions done on all scour critical State Bridges. The bridge scour monitoring actions reported in the Scour POA shall include:

1. Monitoring methodology (visual, channel soundings, probing, etc.)
2. Monitoring History and Comments
3. Monitoring Termination Criteria

Subsequent bridge scour monitoring events triggered during future rainfall events shall use separate Bridge Scour Monitoring Logs.

6-1.01(05) Scour Inspection Report

After the conclusion of each triggering event for a scour critical State Bridge, whether the scour critical bridge was monitored or if no monitoring was required, the responsible bridge inspection team leader shall create a Scour inspection report in BIAS that includes:

1. Location Map
2. Narrative paragraph(s) in the Executive Summary describing the scour triggering event, conditions observed, and recommendations for corrective action as warranted
3. National Bridge Inventory form
4. Pictures taken of bridge, the bridge approaches from each end, channel upstream and downstream views, each of the bridge's scour critical components as observed during the initial scour inspection and all subsequent monitoring inspections as a result of the scour triggering event, and other photographs as appropriate
5. Completed and Updated Scour Plan of Action
6. Completed Bridge Scour Monitoring Log (if monitoring was carried out)

The completed Scour Inspection Report shall be submitted to the District Bridge Inspection Supervisor for review and approval.

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

6-1.02 Bridge Scour Evaluation Procedures for Local Public Agency Bridges

6-1.02(01) Introduction

The expected outcome of the procedure outlined herein is to determine an accurate NBI Item # 113 scour critical rating for each Local Public Agency (LPA) Bridge based on existing documents, field conditions, and engineering judgment, or to determine what documents are needed for an accurate NBI Item # 113 scour critical rating. This process is to be completed utilizing an appropriate combination of office and field reviews. Office reviews shall include, at minimum, a review of the available online bridge files from INDOT and interviews with County staff. It may also include reviewing historical bridge files in the County files that not available online from INDOT. It is anticipated the field reviews would be accomplished concurrently during a routine bridge inspection cycle. The “Scour Evaluator” is responsible for the overall scour evaluation and is required to sign the forms. The “Scour Evaluator” shall be a licensed Indiana Professional Engineer and INDOT-Certified Bridge Inspection Team Leader. It is preferred that these scour evaluation procedures be conducted by a multi-disciplinary team knowledgeable in hydraulic, geotechnical, bridge design, and bridge inspection procedures.

6-1.02(02) Initial Screening Process

Screen each LPA Bridge utilizing the INITIAL SCOUR SCREENING PROCEDURE FOR LOCAL PUBLIC AGENCIES form in Appendix 6A. LPA Bridges with multiple foundations should analyze the worst case. Answer each question and assign either a NA or a Scour Critical Evaluation Rating (NBI Item # 113) per the form. Sign and date the form; then upload the completed form to INDOT’s electronic bridge file. If the assigned Scour Critical Evaluation Rating (NBI Item # 113) from the INITIAL SCOUR SCREENING PROCEDURE FOR LOCAL PUBLIC AGENCIES equals N, 9, or 8; the INDOT Scour Evaluation Procedure is complete for that LPA Bridge.

If the INITIAL SCOUR SCREENING PROCEDURE FOR LOCAL PUBLIC AGENCIES equals NA, the Scour Critical Evaluation Rating (NBI Item # 113) shall not be determined through the Initial Screening Process and the LPA Bridge must be either assessed or analyzed per the Scour Assessment/Scour Analysis Procedures.

6-1.03 Scour Assessment/Scour Analysis Procedures

Utilize the following procedures to determine whether the LPA Bridge will be assessed via the
September 2020

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES form in Appendix 6B_or analyzed in accordance with Hydraulic Engineering Circular 18 (HEC-18) in order to assign a Scour Critical Evaluation Rating (NBI Item # 113). See Appendix 6C for HEC-18 guidance.

1. For LPA Bridges with **KNOWN** foundations, identify each bridge as either Moderate Risk or Low Risk. Moderate Risk Bridges are those that cross the rivers and streams identified on the map in Appendix 6D_or as identified by the Inspection Team Leader. Low Risk bridges are all other bridges.
 - a. Analyze each Moderate Risk Bridge by utilizing the procedures in HEC-18 to assign a Scour Critical Evaluation Rating (NBI Item # 113). Additional guidance is in Appendix 6C.
 - b. Assess or Analyze each Low Risk Bridge by either of the following methods:
 - i. Utilize the SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES form in Appendix 6B_to assign a Scour Critical Evaluation Rating (NBI Item # 113). Answer each question by circling the appropriate answer and, if applicable, assign a Scour Critical Evaluation Rating (NBI Item # 113) per the form. Sign and date the form; then upload the completed form to INDOT's electronic bridge file location. Or:
 - ii. Utilize procedures in HEC-18 to assign a Scour Critical Evaluation Rating (NBI Item # 113).
2. For LPA Bridges with **UNKNOWN** foundations, identify each bridge as either Moderate Risk or Low Risk. Moderate Risk Bridges are those that cross the rivers and streams identified on the map in Appendix 6D_or as identified by the Inspection Team Leader. Low Risk bridges are all other bridges. Use one of the following methods.
 - a. Assign a Scour Critical Evaluation Rating (NBI Item # 113) = "U" and develop a Scour POA, or:
 - b. Analyze each Moderate Risk Bridges by utilizing the procedures in HEC-18 to assign a Scour Critical Evaluation Rating (NBI Item # 113). Additional guidance is in Appendix 6C.
 - c. Determine the foundation type by either of the following methods:
 - i. Use NDE to determine foundation type, OR
 - ii. Infer foundation information based on similar bridges in county built in similar timeframe or year of construction (see FHWA guidance: <http://www.fhwa.dot.gov/unknownfoundations/>); if using inference, document the methodology used.
 - d. Assess or Analyze each Low Risk Bridge by either of the following methods:
 - i. Utilize the SCOUR ASSESSMENT PROCEDURE FOR LOCAL PUBLIC AGENCIES form in Appendix 6B_to assign a Scour Critical Evaluation Rating (NBI Item # 113). Answer each question by circling the appropriate answer and, if applicable, assign a Scour

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

Critical Rating (NBI Item # 113) per the form. Sign and date the form; then upload the completed form to INDOT's electronic bridge file location. Or:

- ii. Utilize procedures in HEC-18 to assign a Scour Critical Evaluation Rating (NBI Item # 113). Additional guidance is in Appendix 6C.

Infer foundation information based on similar bridges in county built in similar timeframe or year of construction; if using inference, document the methodology used. The following assumptions can be used in lieu of inference:

1. If rock is near surface, spread footings can be assumed.
2. If the top of the spread footing can be located for probing or other means, the bottom of the spread footing can assume to be 3' lower than the top of the footing.
3. If the foundation is unknown, and the pile length cannot be reasonably assured, then treat the bridge as if it is supported on spread footing.

All LPA Bridges with Scour Critical Evaluation Rating (NBI Item # 113) = 0, 1, 2, or 3 are defined as Scour Critical, and a Scour Plan of Action (POA) shall be developed and implemented for each LPA Bridge defined as Scour Critical or with a Scour Critical Evaluation Rating (NBI Item # 113) = U. LPA Bridges not defined as Scour Critical are monitored for scour during routine inspections.

6-1.03. A Definitions:

- **“No signs or history of scour”**: in performing the office and field reviews outlined in the INTRODUCTION, scour was not reported.
- **“Significant scour on Spread Footings”**: any portion of spread footing with more than 1' depth exposure. **“Significant Scour on Piles”**:
 - **End bent/ Abutment with spill slopes**: any exposure of piles deeper than 4' below cap.
 - **Vertical faced abutments**: any exposure of piles.
 - **Interior pile bent/drilled shaft**: any exposure of piles deeper than 3' below normal channel bottom.
 - **Interior bent/pier with footing or mudsill**: any exposure of piles.
- **“Appropriately sized scour countermeasures”**: determination is based on existing study or an engineering judgment. The following should be considered:
 - If the current scour countermeasures are damaged, then they might not be appropriately sized.
 - Class I vs Class II or concrete underpin based on stream velocity.

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

- Length of service.

- **“Stream banks unstable”:** A stream bank is considered unstable when it is susceptible to erosion (the process by which the land’s surface is worn away by actions of wind, water, ice, and gravity). If the bank is bare, or rills, gullies, or channels are forming, then the bank is considered unstable. Look for bank sloughing, undermining, evidence of lateral movement, or damage to bank stabilization measures. It is also important to look up and down the stream (approximately 200’) for side channels feeding into the primary stream below the bridge for bank stability. Consider NBIS Item 61 as a mean to confirm stream stability conditions.

6-1.04 Scour Ratings During Field Reviews

The most recent FHWA memo regarding Scour Critical Evaluation Rating (Item 113) can be found on the FHWA website.

6-1.05 Bridge Scour Plan of Action (POA) Procedures

Bridge Scour Plans of Action (POAs) are plans that document the action to be taken during a triggering event for scour critical bridges. Scour POAs are required for any bridge with a scour critical rating (NBI Item # 113) of U, 3, or 2. LPA Bridges with a scour critical rating (NBI Item # 113) of 1 or 0 shall be closed and will require either replacement or installation of designed scour countermeasures depending on the condition of the bridge before they can be re-rated and opened to traffic. If the re-rating of these bridges results in a rating (item 113) of U, 3, or 2, a Scour POA shall still be developed. Appendix 6E contains a Scour POA template that will be used for all scour critical State Bridges. A Scour POA created for a LPA Bridge shall be modified to include current responsible bridge inspection team leaders and appropriate local government officials.

Bridge owners are encouraged to mitigate scour risk by installing properly designed countermeasures at bridges. The installation of properly designed scour countermeasures allows NBI Item # 113 to be coded to reflect that the bridge is no longer scour critical and does not require a Scour POA. FHWA Hydraulic Engineering Circular number 23 provides guidance to properly design scour countermeasures.

The bridge owners or their designated representative shall define the scour triggering event to implement the Scour POA for each bridge identified as being a scour critical bridge. The designated representative of the bridge owner shall be an Indiana Licensed Professional Engineer

BRIDGE INSPECTION MANUAL

PART 6: BRIDGE INSPECTION

and an INDOT-certified bridge inspection team leader.

The scour triggering event criteria specified in the Bridge Inspection Manual for State-owned scour critical bridges may be used for LPA Bridges identified as scour critical. Other scour triggering event criteria may be used if they can easily be determined.

An Initial Scour Inspection shall be carried out for each or all LPA Bridge identified as a scour critical bridge when the triggering event criteria is either detected, reported, or measured at each applicable bridge. If the conditions observed during the initial scour inspection determine that no appreciable scour has occurred, or that any scour action that has occurred has not resulted in any adverse to the bridge or any of its scour critical components, or that any observed effects are not detrimental and can be corrected by the bridge owner's maintenance forces, then no further monitoring triggered by that event may be necessary.

The Scour POA shall specify if a monitoring plan can or should be used for the bridge during a flood event or if the bridge will be closed at the triggering event. The monitoring plan shall include what bridge components will be monitored and the frequency that it will be monitored. The name of the responsible person monitoring and maintaining the monitoring log must be included in the monitoring plan.

The closure plan needs to include what will trigger closure. Triggers for closure may be events such as a flood warning, stream reaching bank full condition, water reaching the low structure elevation, road overflow, signs of bridge movement, etc. It needs to include who to contact to get the closure implemented. At a minimum, for local agencies, the County Engineer or County Highway Supervisor shall be notified. The monitoring plan needs to include the name and phone number of that the appropriate contact person(s). The monitoring plan shall also include what bridge components need to be inspected before reopening the bridge. It may require that the flood water recedes before the inspection can take place.

Appendix 6F contains the form that owners should use to document their actions to monitor or close scour critical bridges during triggering events.

The Scour POA and monitoring log (if required) shall be uploaded to BIAS as part of the bridge file.

The Scour POA shall be updated every 24 months, preferably in conjunction with completing the routine inspection report.