RECLAMATION

Managing Water in the West

Technical Report No. ENV-2019-019

Bridge Scour Screening Guidelines

Policy and Administration Office
Asset Management Division

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, CO

January 2019

Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Cover photo: I-90 bridge failure over Schoharie Creek in 1987.

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Policy and Administration Office

Asset Management Division

Peer Review Certification: This document has been peer reviewed and is believed to be in accordance with the service agreement and standards of the profession.

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Contents

Acronyms

BOR	U.S. Bureau of Reclamation
NHI	National Highway Institute
FHWA	Federal Highway Administration
NBIS	National Bridge Inspection Standards
HEC	Hydraulic Engineering Circular
NBI	National Bridge Inventory
POA	Plan of Action
CA	Consequence Analysis

Introduction

The most common cause of bridge failures in the United States is from floods scouring bed material from around bridge foundations (HEC-18). The term ‘scour’ refers to the erosion of the sediment surrounding a bridge foundation (piers and abutments) caused by flowing water. The Federal requirements for bridge inspection are set forth in the National Bridge Inspection Standards (NBIS), which require bridge owners to maintain a bridge inspection program that includes procedures for bridge scour screening and plans of action for scour critical bridges (69 FR 74419, 2004). The primary purpose of the NBIS is to identify and assess existing bridge deficiencies to help ensure public safety.

Although new bridges follow comprehensive scour analysis procedures, every existing Type I bridge (any highway bridge located on a public road) should be assessed for its vulnerability to floods in order to determine the prudent measures to be taken. Many bridges have been assessed for scour, but the scour screening process utilized has not been consistent among the different Bureau of Reclamation (BOR) Regions. Establishing a set of scour screening guidelines will help ensure this consistency moving forward and, primarily, determine if the bridge being assessed is considered scour critical. A scour critical bridge is one in which scour has created an unstable foundation making it vulnerable to failure.

The guidelines presented herein are largely based on the coding requirements from the 1991 Federal Highway Administration (FHWA) Technical Advisory T5140.23 (1991) in conjunction with information from FHWA’s HEC-18 Manual ‘Evaluating Scour at Bridges’ (HEC-18), which should be referred to. The intent of this coding guidance is to help provide systematic consistency during the scour screening process.

Scour Screening

Scour screening is designed to determine the scour susceptibility of all existing Type I bridges in order to set priorities for assigning limited resources. Performing a complete and quantitative scour analysis on every BOR bridge would be cost prohibitive. Instead, existing bridges should be qualitatively evaluated through an office screening process that is linked with field data. The screening will consider all relevant documents on the structure including plans, inspection reports, maintenance history, and flood history. This procedure will result in determination of the bridge’s scour susceptibility code rating. Typical things evaluated when assigning a scour code include the channel bed material and planform history, types of scour susceptible features on the bridge, and any previous inspection documentation regarding potential scour observations. Follow-up field visits shall be conducted on a subset of bridges where adequate documentation is not available and where scour susceptibility is deemed greater.

Bridges that have had a comprehensive scour analysis performed do not need a scour screening if the calculated scour is fully documented.

Scour Screening Team Qualifications

Due to the amount of judgement that is inherent with scour, all scour screenings must be completed under an established internal review policy with the screener having completed the National Highway Institute (NHI) 3-day class entitled 'Stream Stability and Scour at Highway Bridges', course number 135046. This course, which should be refreshed on a 5 year cycle, covers the prevention of hydraulic-related bridge failures, with course participants receiving training in conducting a stream stability classification and qualitative analysis of stream response as well as making estimates of scour at a bridge opening. The majority of the material covered in this class comes from a suite of inter-relationship HEC manuals (HEC-18, HEC-20, and HEC-23). In addition, the screener needs to be a certified Team Leader according to the NBIS or a licensed Professional Engineer. The reviewer needs to be a licensed Professional Engineer and ideally have some familiarity with the bridge being screened.

Scour Coding Guidance

The original bridge scour coding guidance from the FHWA has been re-worded to be more applicable to the bridges in the BOR inventory. The following scour codes should be used for evaluating National Bridge Inventory (NBI) Item 113: Scour Critical Bridges. It's important to note that the coding guidance provided herein is intended to help provide consistency when applying engineering judgement during the evaluation. However, every screening evaluation needs to be supported by a field assessment and should not solely be based on this guidance.

Bridges are considered *scour critical* if their code rating is 3 or less, and *non-scour critical* with a rating of 4 or greater with the exception of a bridge code rating of 6, which is deemed *scour inconclusive*.

Code Descriptions

N: Bridge does not cross a defined waterway.

9: Bridge foundation elements bearing on dry land well above flood water stage (above 100-year flood water surface elevation).

8: Bridge foundation determined to be stable either by design depth or the material type it is anchored into. A stable bridge foundation can be deep in scour susceptible material, or shallow in scour resistant material (i.e. concrete or bedrock). Any observed existing scour is considered minimal, and well above the top of the footings/piles. This will be a typical code assigned to bridges in fair-to-good condition over concrete-lined canals.

7: Sufficient scour countermeasures have been successfully implemented (through a plan of action) to reduce the probability of bridge failure during a flood. Countermeasures need to be evaluated during each inspection to ensure continued functionality.

6: The presence/absence of scour at the bridge has not been documented, or the extent of scour relative to the foundation depth is inconclusive. More information should be gathered to make a scour status determination. If the foundation type is unknown, it should conservatively be assumed to be a shallow foundation. **A code rating of 6 is meant to be a temporary designation. Enough information should be gathered to re-assess the scour coding within 6 months of the original screening.**

5: Bridge foundation determined to be stable either by design depth, the material type it is anchored into, or repeat cross section surveys. A stable bridge foundation can be deep in scour susceptible material, or shallow in scour resistant material (i.e. bedrock). Any observed existing scour is considered minimal, and within the limits of the footings/piles. Even if the bridge has an unknown (assumed shallow) foundation but has repeat cross section surveys that have not significantly changed from the as-built conditions, or channel conditions that are not susceptible to scour, it could be assumed that the foundation is stable and be assigned this code.

4: A field inspection or repeat cross section surveys reveals moderate scour occurring at the bridge, but the (known) foundation is still considered stable with minimal (less than 5%) undermining. Action may be required to protect any exposed foundations. If moderate scour occurred after a small flood, concern about future scour potential should be noted, whereas if moderate scour occurred after a large flood, then only monitoring may be needed. This code relies heavily on engineering judgement in order to deem what is considered to be a moderate level of scour, which can be different for deep versus shallow foundations.

3: A field inspection or repeat cross section surveys reveals scour resulting in minor (5-20%) undermining of the (known) foundation that could lead to instability. This code should also be assigned to a bridge with an unknown foundation if the documented scour at the bridge would have the potential to undermine a shallow foundation. The bridge can later be re-coded to non-scour critical if a deep foundation is discovered for which the undermining from the scour would be considered minimal (less than 5%).

2: A field inspection or repeat cross section surveys reveals extensive scour resulting in active (greater than 20%) undermining of the (known) foundation to the point that the bridge foundation is considered unstable even though bridge failure does not yet appear imminent.

1: A field inspection or repeat cross section surveys reveals serious undermining of the (known) foundation to the point that bridge failure appears imminent. Bridges coded 1 must be closed immediately.

0: Bridge has failed due to scour.

It can be seen that the bridge foundation is a primary influencing factor in determining the vulnerability to scour damage and subsequently assigning a scour code. Although scour can undermine any foundation type, deep foundations such as long piles (typically greater than 15 to 20 ft) or drilled shafts are generally considered to have low vulnerability to scour, while shallow foundations such as spread footings, short piles (typically less than 15 to 20 ft), sills, or cribs are generally considered as having a high vulnerability to scour.

Rivers are natural, dynamic systems, responding to a variety of ever-changing variables. Therefore, when evaluating the stability of bridges crossing these features, it's important to also understand the channel morphology and how it relates to channel stability. A study of the plan and profile of a stream is very useful in understanding stream morphology (HEC-20). A lot can be gleamed about the channels relative stability by looking at the planform and associated characteristics such as valley setting, floodplains, pattern, sinuosity, width variability, etc. Having a better understanding of the lateral channel stability in combination with the current state of the bridge foundation stability should help to further inform the scour code rating.

Consequence Analysis

In 2012, FHWA put out a memorandum providing guidance on applying risk concepts and data utilization to develop strategies for conducting scour evaluations (Appendix A). Risk of any event (in this case bridge failure) is a product of the likelihood and consequence. Likelihood is incorporated into the code rating. Therefore, one way to incorporate risk concepts into the scour screening process is through performing a Consequence Analysis (CA). A CA assumes bridge failure has occurred, and evaluates the consequences of that failure in order to determine the bridge significance on the environment, transportation, and public safety. The CA is a qualitative assessment that relies on local input from field office staff who are knowledgeable about the area and bridge. The final assessment places the bridge into a low or high consequence category rating.

In performing a CA, the bridge screener compares bridge importance and the consequence of failure against a suite of operational characteristics specific to the bridge and surrounding facilities (data). These characteristics may include such things as functional classification, average daily traffic, emergency service needs, community connectivity, economic significance, etc. In documenting the CA, the following should be considered at a minimum:

- Does the bridge provide access to significant Reclamation infrastructure (high hazard dam, power plant, pumping plant, etc.)?
- Does the bridge provide sole access to any private property/residences?
- Does the bridge provide recreation opportunities?
- Is the bridge used as a trucking route?
- Is the average daily traffic count across the bridge greater than 50?
- Is there a significant economic cost to the public if the bridge failed?
- Are there any threatened or endangered species that could be adversely affected by the bridge failing? Is there a significant environmental cost associated with the bridge failing?
- Does the bridge have historical significance?

If the answer to any of the above questions is yes, the bridge should be considered as having a high consequence of failure, otherwise a low consequence can be assumed.

A CA should be performed on all scour critical bridges (code rating 3 or less) whose outcome is used to inform a Plan of Action (discussed in subsequent section). It's important to note that a low consequence rating cannot be used to re-code the bridge as being non-scour critical.

Plan of Action

A Plan of Action (POA) is used to mitigate risks of bridges identified as scour critical. Each POA documents what should be done regarding monitoring, repairing, or replacing the bridge, but does not include design. POA's are site specific, individually developed, commiserate to the outcome of the CA, and serve two primary purposes. 1) Establishes a systematic process of monitoring and closing bridges to ensure public safety during a significant flood and criteria for inspection and re-opening after a flood, and 2) Assists bridge owners to program and prioritize the design and installation of scour countermeasures to protect scour critical bridges from flood damage.

The POA is developed after the Consequence Analysis is completed, which can be used to inform the type of POA. A scour critical bridge with a low consequence of failure (low risk) would indicate the need for setting up a simplified POA. This type of POA typically recommends and implements a monitoring program for the bridge without the need for direct interference such as installation of scour countermeasures. However, if a cost:benefit analysis shows that a bridge failure would cost more than the proposed countermeasure(s), then countermeasure installation could be included. A simplified POA should include information with regards to physical site identification, hydrologic and hydraulic characteristics, persons responsible for decision making and communication, trigger mechanisms for closure to traffic, detour routes, etc. It's important to note that monitoring is not a long-term solution and does not change the bridge rating code considering a direct action isn't being taken.

Conversely, a scour critical bridge with a high consequence of failure (high risk) should have a comprehensive POA. This type of POA typically recommends more active-based, long term decisions such as repair through the installation of structural or hydraulic countermeasures, or even bridge replacement. For scour countermeasures, the POA should develop and implement one (or more) of three categories; monitoring, hydraulic, and structural. If countermeasures are specified, another scour screening should be performed after their installation. A scour critical bridge can be upgraded in code rating only if appropriate scour countermeasures are in place. Countermeasures should be inspected during all subsequent routine bridge inspections to confirm they are functioning appropriately. A comprehensive POA for a scour critical bridge would also likely include the recommendation of performing a comprehensive scour analysis, which is discussed in a proceeding section. The detailed development of a POA is outside the scope of these guidelines, but standardized templates have been developed by FHWA and are available for use (Appendix B).

Scour Screening Process

The overall scour screening process has assessment components that need to be performed in a certain order or not at all depending on outcome. And they not only feed into each other, but also inform the subsequent level of component analysis needed in certain circumstances. A flowchart depicting the scour screening process is shown in Figure 1.

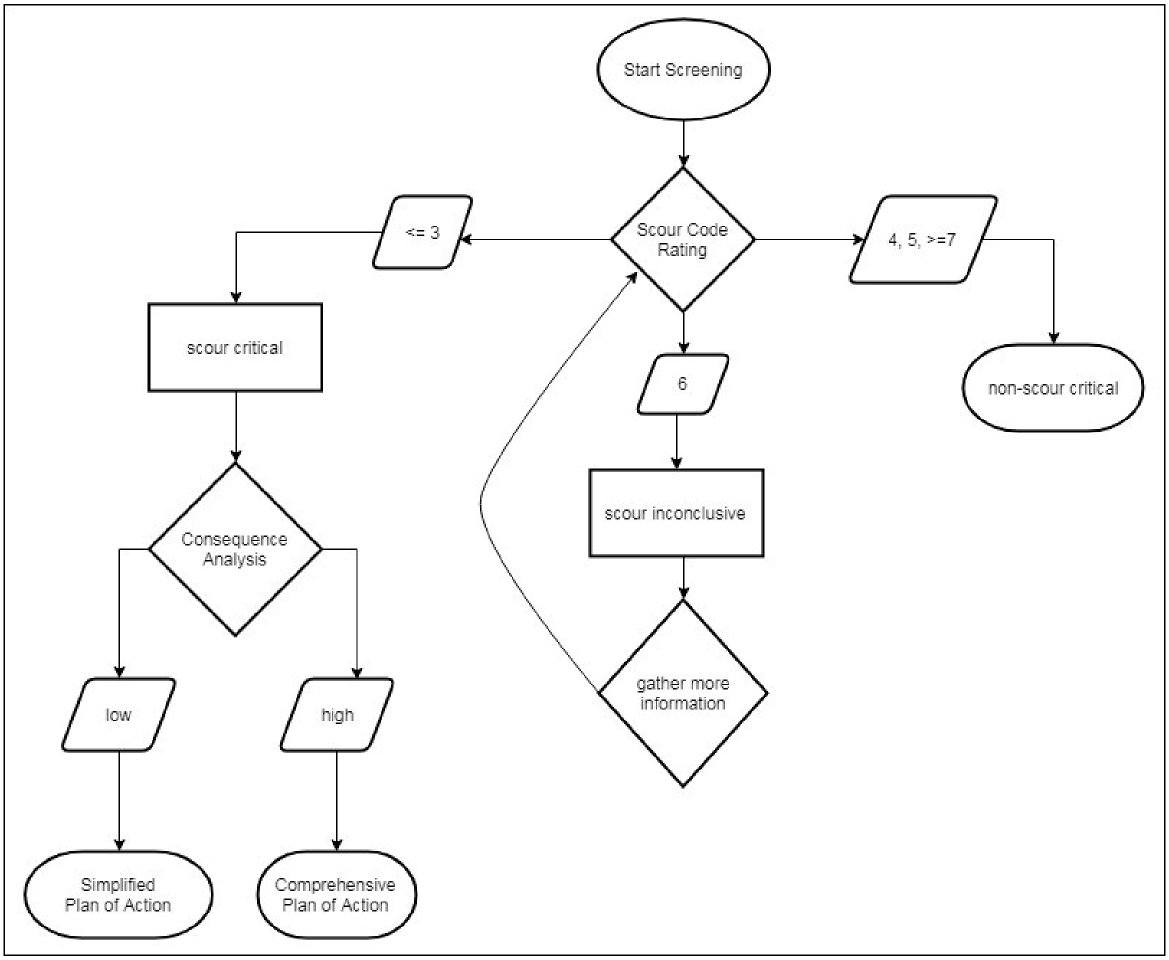


Figure 1. Scour screening process flowchart.

Scour Analysis

One of the recommended actions in a comprehensive POA could be to perform a quantitative scour analysis, which is a site specific detailed study of the bridge hydraulics and corresponding channel morphology to determine its vulnerability to foundation scour and stream stability issues at the bridge. HEC-18 ('Evaluating Scour at Bridges') details the current state-of-practice for estimating the total scour at bridges along with the evaluation of channel stability and should be referred to. This analysis must be performed by a hydraulic engineer.

Routine Field Inspection Scour Check

When it comes to evaluating scour at a bridge, observing the channel conditions is equally as important as observing the bridge conditions. These would include such things as the general planform, longitudinal bed slope, bed material size and composition, variations in vegetation, bank slopes and erosion indicators, etc., and should be included as part of each field inspection. In addition, repeat cross section surveys at the bridge should be performed with each field inspection along with ground photographs and descriptions that will yield informative scour trends.

After the initial scour screening and/or scour analysis has been completed, future routine inspections need to check that the code rating is still valid and should be conducted according to the NBIS. The routine inspections will primarily be checking if any new scour has occurred or if any scour countermeasures have been installed and how they are performing. If the potential scour and/or countermeasures are below the water surface at the time of the inspection and not visible, an underwater inspection should be performed through depth sounding, probing, snorkeling, or diving. Each routine inspection report should include a statement about the current scour code rating and whether or not it is still valid based on the current condition of the bridge. An example scour screening report template is included in Appendix C.

References

Arneson, L.A., Zevenbergen, L.W., Lagasse, P.F., and P.E. Clopper. Evaluating Scour at Bridges: Fifth Edition. U.S. Department of Transportation. Federal Highway Administration. Hydraulic Engineering Circular No. 18 (HEC-18). Publication No. FHWA-HIF-12-003. April 2012.

Federal Register, Vol. 69, No. 239. Rules and Regulations. FHWA Docket No. FHWA-2001 8954. Pg. 74419. December 14, 2004.

Technical Advisory. Evaluating Scour at Bridges. T5140.23. U.S. Department of Transportation. Federal Highway Administration. October 28, 1991.

Appendix A

Guidance Memorandum on Applying Risk Based, Data Driven Decision-Making Process to the FHWA Scour Program

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **<u>INFORMATION</u>**: Guidance on Applying Risk Based, Data Driven Decision-Making Process to the FHWA Scour Program

Date: April 9, 2012

/s/ Original signed by

From: M. Myint Lwin, P.E., S.E.
Director, Office of Bridge Technology

In Reply Refer To: HIBT-20

To: Directors of Field Services
Federal Lands Highway Division Engineers
Division Administrators

Purpose

In 2011, FHWA implemented a risk-based, data-driven (risk & data) National Bridge Inspection Program (NBIP) oversight process. Building on this process, this memorandum provides guidance on applying risk concepts and data utilization to develop strategies for conducting scour evaluations, addressing unknown foundations, developing Plans of Action (POA) and selecting reasonable and appropriate countermeasures for scour critical bridges and bridges with unknown foundations. Collectively, these activities are referred to as the FHWA Scour Program.

The Office of Bridge Technology and FHWA National Hydraulics Team will host a series of webinars in support of implementing and deploying risk & data strategies in the Scour Program. The first priority for the deployment effort will engage appropriate division office staff. Deployment to State DOTs and other bridge owners will follow in spring and summer of 2012.

Background and Discussion

The FHWA strives to enhance bridge safety while improving bridge owners' effective use of resources in managing those bridges needing scour evaluation, classified as having unknown foundations, or determined to be scour critical. The regulations found in 23 CFR 650 Subpart

C "National Bridge Inspection Standards (NBIS)" require a POA for all scour critical bridges. In a January 9, 2008, Policy Memorandum, FHWA advised bridge owners that bridges with unknown foundations would be assumed to be scour critical after November 2010, and therefore also require a POA.

A quandary faced by bridge owners in effectively complying with FHWA's Scour Program is determining the appropriate prioritization and level of effort. The risk & data utilization strategy assists bridge owners in establishing a process in managing bridges with known or potential deficiencies attributed to scour and provides the bridge owner a systematic means to prioritize and apply resources towards those bridges that could pose the greatest threat to public safety and/or disruption of vital services. The bridge owner may compare bridge importance and likelihood/consequence of failure (risk) against a suite of operational characteristics specific to the facility (data).

Characteristics for prioritization may include, but not be limited to, functional classification, average daily traffic, emergency service needs, community connectivity, or evacuation and recovery needs. The bridge owner may incorporate capital expenditure factors such as scour countermeasure cost compared to cost of structure replacement.

Additional factors may include remaining life expectancy or a funded replacement schedule.

Applying Risk & Data Strategies to Elements of the Scour Program

Scour Evaluation Element: A risk & data strategy facilitates both the priority and level of analysis required for those bridges that have not yet received a scour evaluation.

Clearly, the highest priority would be to ensure that all bridges on the Interstate system meet this basic Scour Program requirement. Additionally, FHWA would expect application of hydraulic modeling (as described in HEC-18 and HEC-20) to these Interstate bridges to estimate scour depths and determine bridge and substructure scour impact. However, at a small local bridge, with low ADT (and not considered to be a critical route) may only necessitate stream stability and assessment approaches (as described in HEC-20) to evaluate scour.

Scour Critical Element: All scour critical bridges shall have a POA until such time that the bridge can be recoded as not scour critical. The POA should develop and implement one (or more) of three categories of scour countermeasures; monitoring, hydraulic, and structural. The risk & data strategy can be applied to developing an appropriate POA. Bridges with greatest risk may warrant installation of structural or hydraulic countermeasures or even replacement. The POA identifies specific criteria and deadlines for implementation of structural or hydraulic countermeasures. Bridges that present lesser risk may be considered candidates for a POA with a monitoring countermeasure component. (Note that bridges with monitoring countermeasures remain scour critical).

The monitoring based POA should include information with regards to physical site identification, hydrologic and hydraulic characteristics, persons responsible for decision making and communication, trigger mechanisms for closure to traffic, detour routes, etc.

Unknown Foundation Element: A bridge identified as having unknown foundation in Item 113 of the NBI would incorporate a risk or consequence of failure determination to establish need for further investigation in identifying actual foundation conditions. Risk & data strategies would be used to identify those bridges having sufficiently high risk that would then be candidates for Non-Destructive Test (NDT) evaluation or possible replacement. A bridge having unknown foundation and low level risk may have the required POA consist of a monitoring scour countermeasure.

Summary

Under the NBIP oversight process, any plan of corrective action relative to the Scour Program should look for opportunities to apply risk & data strategies. The NBIP oversight process has considered past scour related information, schedules, and other data (e.g., schedule dates for evaluating scour critical bridge's, development of POA's and implementation of POA's) previously housed in earlier data bases (i.e., B-Simple and Attachment C). This memorandum rescinds requirements of reporting and maintaining data in those older data bases. The NBIP metrics reviews and resulting plans of corrective actions (PCAs) will be used for determination of compliance.

Please direct any questions to Dave Henderson (dave.henderson@dot.gov), (202) 493-0520, or Joe Krolak (joe.krolak@dot.gov), (202) 366-4611.

Appendix B

Plan of Action Standardized Template from FHWA

SCOUR CRITICAL BRIDGE - PLAN OF ACTION

1. GENERAL INFORMATION

Structure number: _____	City, County, State: _____	Waterway: _____
Structure name: _____	State highway or facility carried: _____	Owner: _____

Year built: ____	Year rebuilt: ____	Bridge replacement plans (if scheduled): _____ Anticipated opening date: _____

Structure type: ☐ Bridge ☐ Culvert
Structure size and description: _____

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

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

Bridge ADT: _____	Year/ADT: _____	% Trucks: _____

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

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, pager, email):

Date: _____

Concurrences on POA (name, title, agency/organization, telephone, pager, email):

POA updated by (name, title, agency, organization): _____ **Date of update:** ___
Items update: _____

POA to be updated every _____ **months by (name, title, agency/organization):**_____

Date of next update:_____

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: _____

d. Scour History: _____

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			
Item 113	Scour Critical		
Item 60	Substructure		
Item 61	Channel & Channel Protection		
Item 71	Waterway Adequacy		
Comments: (drift, scour holes, etc. - depict in sketches in Section 10)		_____	_____

6. MONITORING PROGRAM

☐ **Regular Inspection Program** ☐ w/surveyed cross sections
Items to Watch: _____
☐ **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. measured from _____ ☐ 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 _____ days

Frequency of post-flood monitoring: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other: _____

Criteria for termination of flood monitoring: _____

Criteria for termination of post-flood monitoring:

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: _____

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

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 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: _____

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

Criteria for re-opening the bridge: _____

Agency and person responsible for re-opening the bridge after inspection: _____

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): _____

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: _____**

Appendix C

Scour Screening Report Template

RECLAMATION

Managing Water in the West

Scour Screening Report

BRIDGE NAME
RECLAMATION REGION, AREA/FIELD OFFICE
WATER BODY, COUNTY, STATE
NBI #: RBI #:

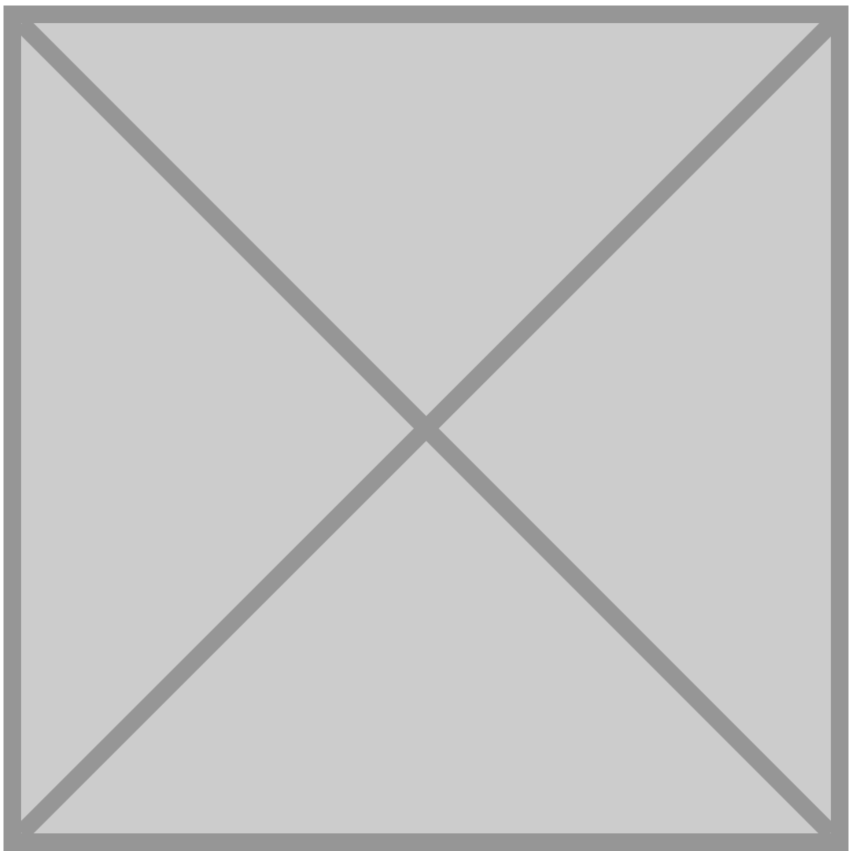


Figure placeholder: Cover photo of bridge being screened.

U.S. Department of the Interior
Bureau of Reclamation

Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Scour Screening Report

BRIDGE NAME
RECLAMATION REGION, AREA/FIELD OFFICE
WATER BODY, COUNTY, STATE
NBI #: RBI #:

____
Prepared by: XXXXX
Title, Group

____
Reviewed by: XXXX
Title, Group

Bridge Description and Use

- Date of construction
- Design drawings (plan and profile)
- Descriptive image(s), including views of deck and of river level
- Summary of bridge modification history
- Date and magnitude of largest flood since construction
- Current bridge condition
- Current bridge use

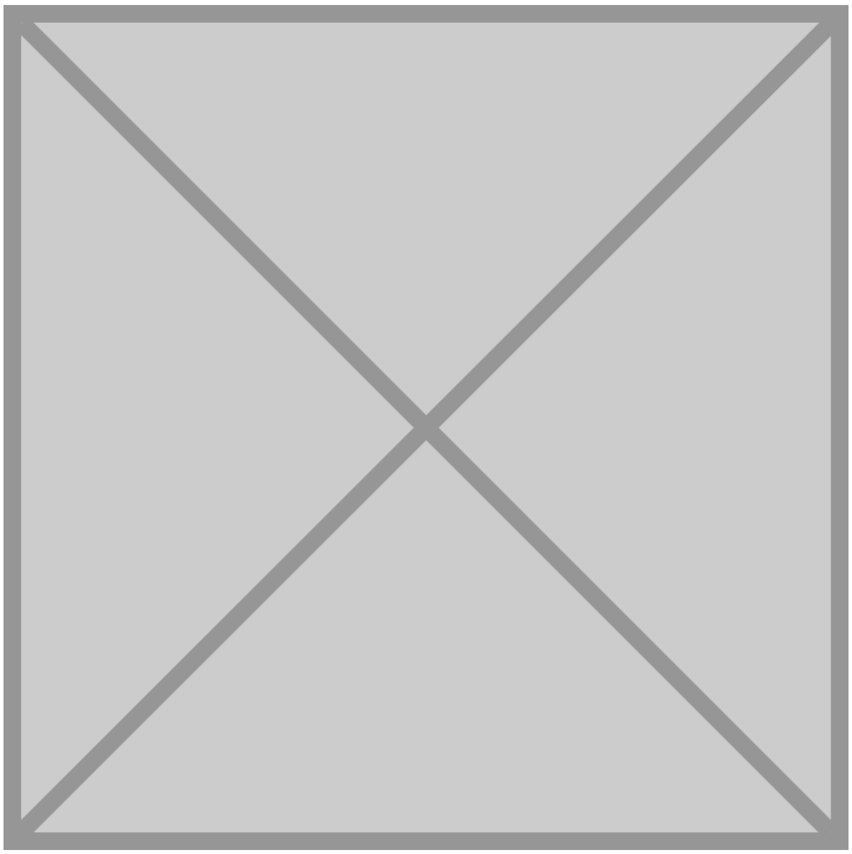


Figure placeholder

Bridge Location

- Latitude and Longitude
- Aerial Image showing location of bridge relative to river planform

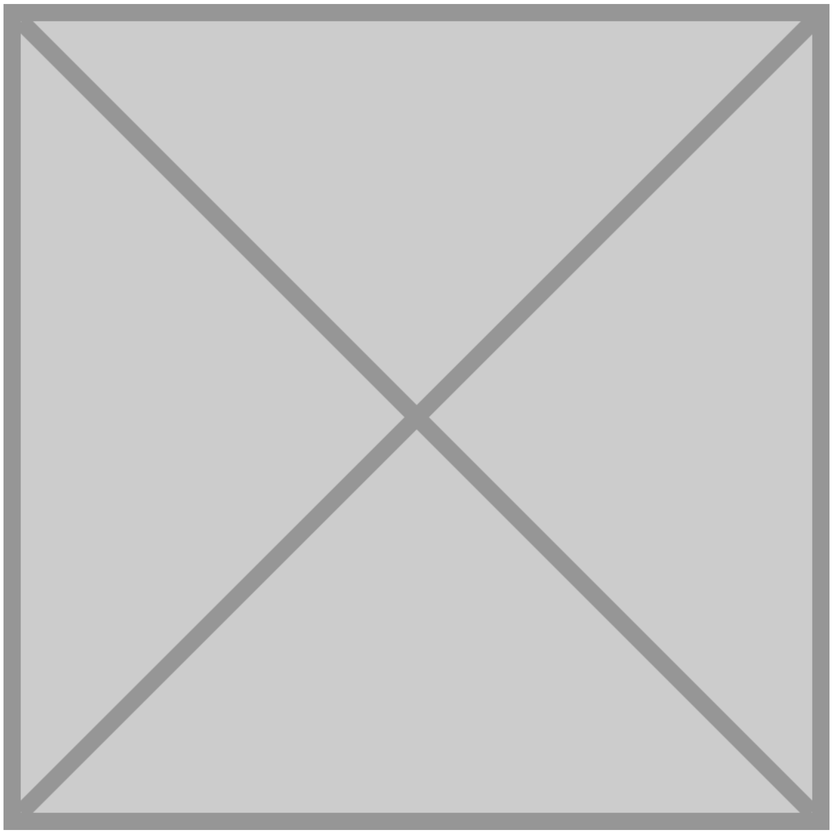


Figure placeholder

Channel Description and Lateral Migration

- Photos (up and downstream of channels and banks)
- Note channel morphology
    - Valley setting
    - Floodplains
    - Sinuosity
    - Pattern
- Is there a width variability?
- Bed and bank material description
- Add numeric rating of channel from last inspection report and compare rating over time
- Note location of bridge relative to meander planform
    - Is bridge located on or downstream of a bend on an actively migrating river?
    - Is bridge located upstream of a bend or along a straight reach?
- Are there signs of bank erosion?
- Are repeat cross section surveys available that might indicate localized lateral and/or vertical instability?
- Are there historic land use changes?
- Document past channel migration, if any, from aerial photograph history

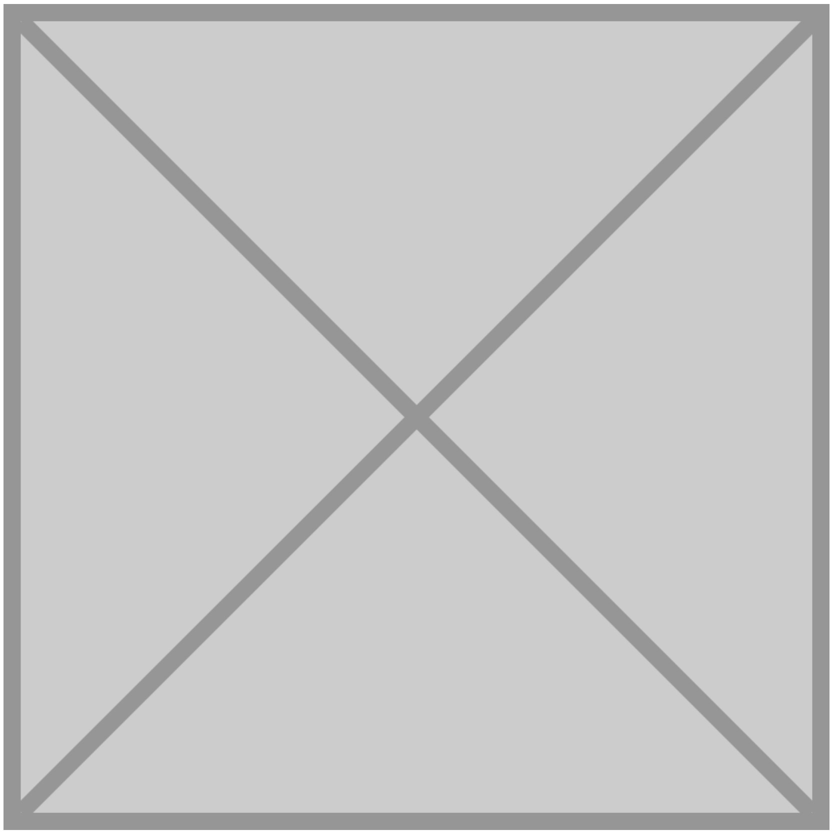
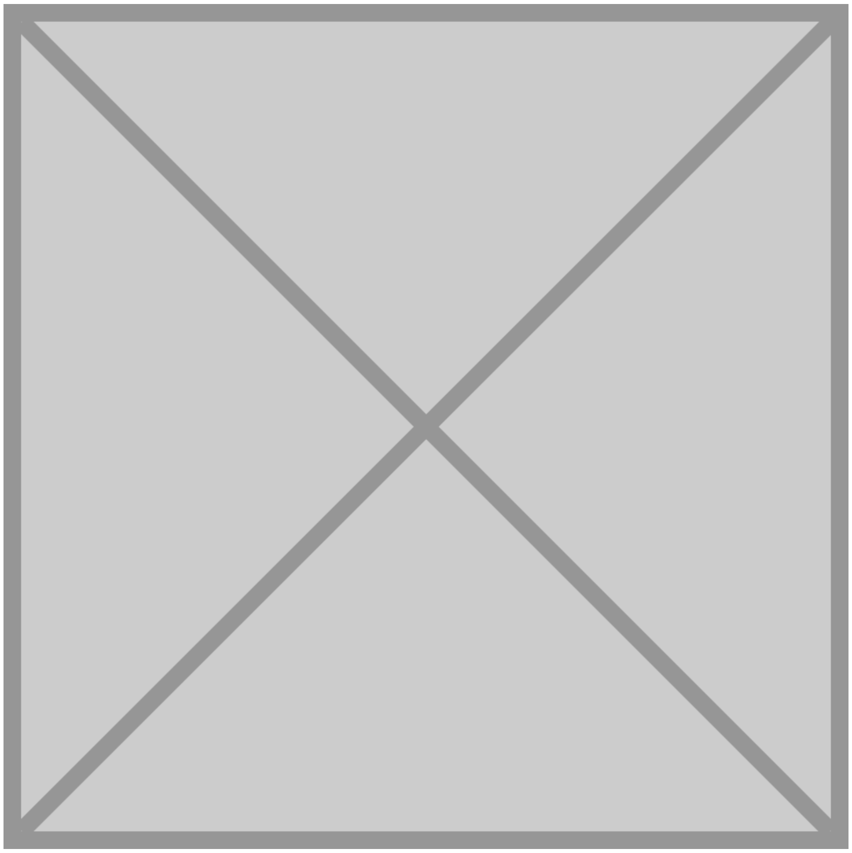


Figure placeholder

Pier Condition

- Description of pier type
- Numeric rating of substructure from last inspection report and compare rating over time
- Scour at pier (depth, severity)
- Photographs of pier and stream/canal bed



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Embankment and Abutment Condition

- Embankment material and condition
- Add numeric rating of substructure from last inspection report and compare rating over time
- Abutment description and condition
- Photographs, especially at intersection of abutment and channel

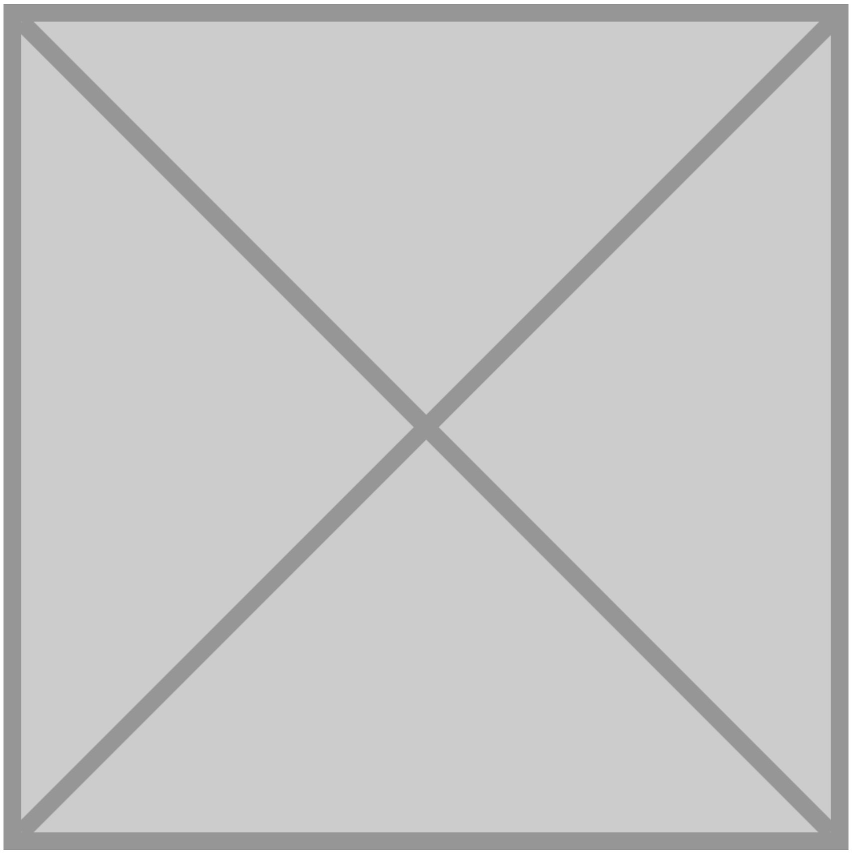

Figure placeholder

Surface and Abutment Drainage

- Runoff drainage from approach road and along embankment slope around abutments
- Signs of scour or erosion along embankment or near connection between approach road and bridge deck
- Photographs

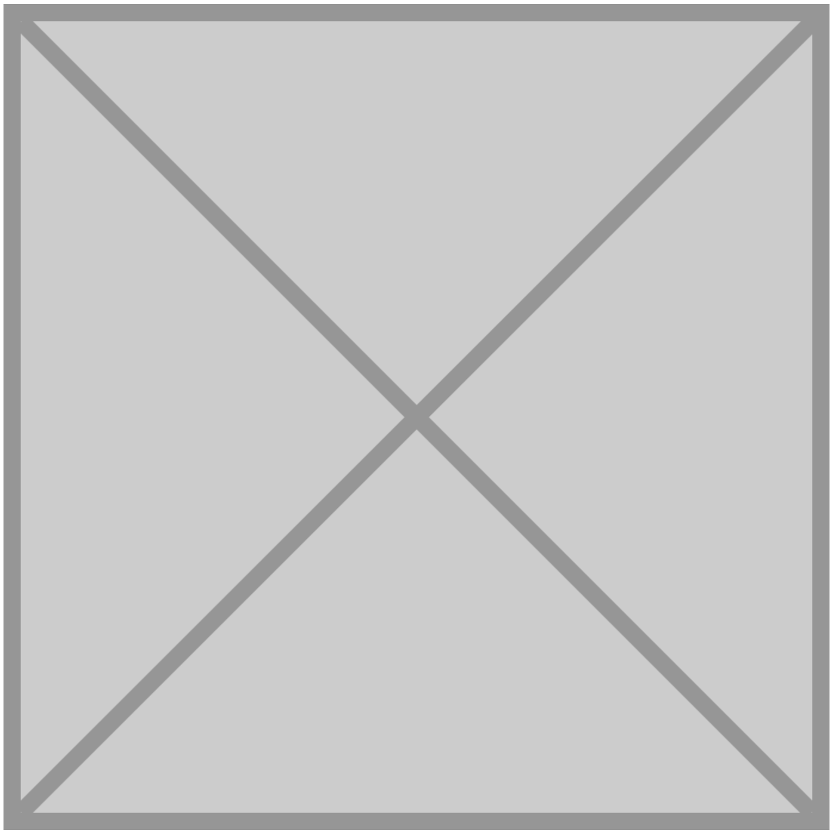

Figure placeholder

Scour Code and Description

- Provide numeric code, code narrative, and rationale

Consequence Analysis (if Scour Critical)

- High or low risk bridge based on intensity of use and available detours

Plan of Action (if Scour Critical)

- Steps to be taken to address re-screening code 6 bridges and for code 3 and lower (scour critical) bridges. Plans of action may also be created for non-scour critical bridges where scour on bed or banks is a concern but bridge failure is not imminent.

Documentation

- List available documents on which the scour screening was conducted
    - As-Built Drawings: YEARS
    - Bridge Inspection Reports: YEARS
    - Underwater Inspection Report: YEARS
    - Scour Countermeasure Design report: YEAR