



U.S. Department
of Transportation
Federal Highway
Administration

Memorandum

Subject: **INFORMATION**: Additional Guidance for
Assessment of Bridges Over Waterways
with Unknown Foundations

Date: October 29, 2009

In Reply Refer To:
HIBT-20

From: /s/ *Original Signed by*
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To: Associate Administrator for RD&T
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This memorandum presents technical guidance on conducting risk-based assessments for bridges over waterways with unknown foundations. Attachment "A" provides an example procedure for categorizing bridges and conducting assessments. Please note that this is one example. Several bridge owners are using other acceptable methods to assess bridges with unknown foundations. This guidance is meant to support ongoing efforts and not to supersede them.

Bridges with unknown foundations represent a subset of bridges over waterways that have not been evaluated for scour. This definition was clarified in our June 3, 2009, memorandum to ensure that bridge owners clearly understand the issue as it relates to the scour program. The unknown foundations team members defined an approach for addressing this subset of bridges that:

1. Assists owners in developing and implementing risk-based procedures to determine enough about a bridges foundations to conduct a scour evaluation;
2. Moves the bridge into the scour program for evaluation if the owner is comfortable with the risk-based assessment of the bridge foundations (this is the equivalent of recoding the bridge to a 6);
3. Recodes the bridge accordingly after evaluation for scour vulnerability.



The goal of this approach is to reduce, not eliminate the inventory of bridges coded U in Item 113 of Recording and Coding Guide for the Structure Inventory and Appraisal for the Nations Bridges (Coding Guide). There will be an inventory of bridges that remain coded U because sufficient information could not be obtained to advise recoding. The guidance herein, and appended, offers a rational approach to determining enough about a bridges foundation to conduct a scour evaluation or appropriately address bridges that will remain coded U.

For bridges that will remain coded U, owners should develop and implement a plan of action (POA), until properly designed countermeasures are installed to protect the bridge foundations or until the bridge is replaced. Attachment “B” provides guidance on developing POAs for bridges that will remain coded U in Item 113.

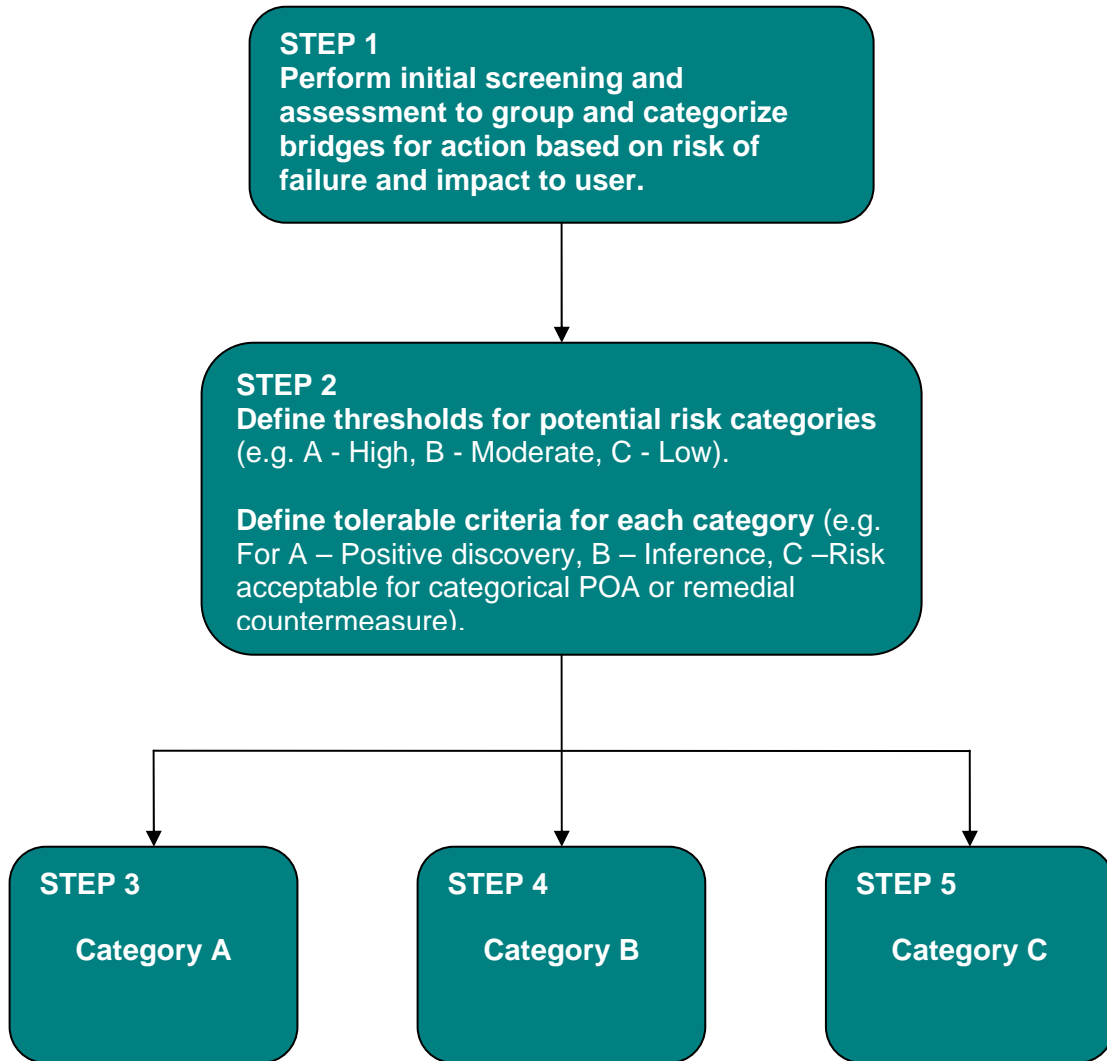
The team is currently developing Web-based and instructor led training to assist owners with some of the more difficult aspects of the unknown foundations initiative. Specifically, we will be focusing assistance on grouping and categorizing bridges, defining the risk for these owner defined groups, and developing and implementing POAs for bridges remaining with code U in Item 113.

This memorandum with the attachments will be posted on the unknown foundations Website. All information related to the unknown foundations initiative is housed at this location. It can be accessed at <http://www.fhwa.dot.gov/unknownfoundations/>. If you have any questions, please contact Mr. Silas C. Nichols at (202) 366-1554.

Attachments

ATTACHMENT "A"

Example Risk-Based Assessment for Bridges with Unknown Foundations with Commentary



***Note: Refer to Commentary for more complete flowchart descriptions.**

STEP 3
Category A

Perform refined quantitative risk assessment and further prioritize bridges. An example method is detailed in NCHRP Web Only Document 107.

Collect available bridge data (e.g.)

- Bridge Inspection Reports
- Scour Evaluation Reports
- Plans
- Pile Driving Records
- Other

Are the as-built foundation dimensions shown in the data collected?

No

Investigate and Evaluate Foundation Depth of Embedment (Positive Discovery)

Yes

Does the available data contain Scour design information?

No

Then, use the foundation dimensions to complete the Scour Evaluation and recode in Item 113

Yes

Check scour evaluation and recode in Item 113

Conduct scour evaluation and recode bridge in Item 113

Yes

Can scour evaluation be completed?

No

Develop & implement a Plan of Action for the "U" coded bridge (see commentary)

STEP 4
Category B

Perform refined quantitative risk assessment and further prioritize bridges.

Are the as-built foundation dimensions shown in the data collected?

No

Assume foundation characteristics using inference methods.
(See commentary)

Yes

Does the available data contain scour design information?

No

Use the foundation dimensions to complete the scour evaluation and recode bridge in Item 113.

Yes

Recode Item 113 for the bridge.

Conduct scour evaluation & recode bridge in Item 113.

Yes

Are the inferred foundation dimensions adequate to assess scour?

No

Investigate & evaluate Foundation Depth
(Positive Discovery)

Yes

Is Foundation Discovery necessary based on risk assessment?

No

Yes

Can scour evaluation be completed?

No

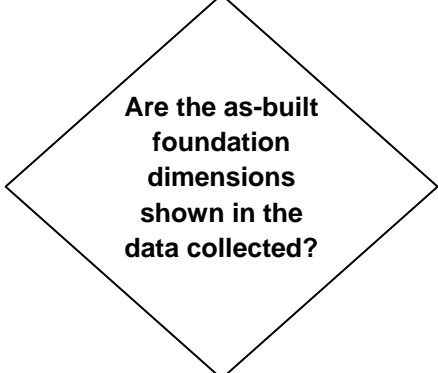
Develop & implement a Plan of Action for the "U" coded bridge.
(See commentary)

Yes

Use the foundation dimensions to complete the scour evaluation and recode bridge in Item 113

STEP 5
Category C

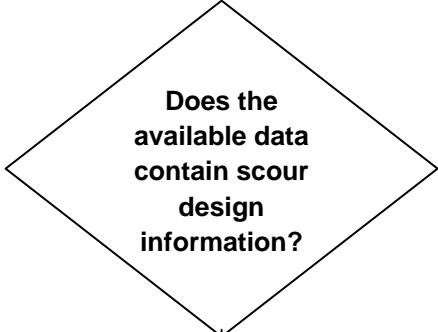
Perform refined quantitative risk assessment and further prioritize bridges.



No

Assume foundation characteristics using inference methods.
(See commentary)

Yes



No

Use the foundation dimensions to complete the scour evaluation and recode bridge in Item 113.

Yes

Recode Item 113 for the bridge.



Yes

Conduct scour evaluation & recode bridge in Item 113.

No

Develop & implement a Plan of Action for the "U" coded bridge.
(See commentary)

COMMENTARY

Example Risk-Based Assessment for Bridges with Unknown Foundations

NOTE: This commentary is meant to be used with the example flow chart for risk-based assessment for bridges with unknown foundations.

The accompanying flow charts presented by FHWA are provided as example guidance for conducting a risk-based assessment for determining the necessary foundation characteristics for conducting a scour evaluation. It is the responsibility of the bridge owners and agencies that maintain their bridge inventories to manage the population of bridges coded “U” for Item 113 of the NBI.

Owners should understand that there are several approaches that have been implemented for assessing unknown bridge foundations, and for conducting scour evaluations on bridges with unknown foundations. Owners should evaluate and select assessment and evaluation approaches after careful consideration of their bridge inventory.

STEP 1

The intent of this first step is to confirm that bridges coded “U” are coded correctly and to group bridges into categories for prioritization and action. This effort should consider replacement schedule and cost, structure type (e.g. simple span), hydrology, geomorphology, and estimated storm and scour effects. This action was presented in our [January 9, 2008 memorandum](#) and should be underway or complete for most bridge owners.

In addition, the owner should consider using easily obtainable and reliable indicators for this purpose. Information contained in the NBI may be used for this purpose, including but not limited to the following:

- a. Functional Classification of Inventory Route (Item 26);
- b. Bypass, Detour Length (Item 19);
- c. Designated Level of Service (Item 5c)
- d. Year Built (Item 27);
- e. Average Daily Traffic (Item 29);
- f. Year of Average Daily Traffic (Item 30);
- g. Navigation Clearances (Items 39 & 40);
- h. Condition Ratings (Items 58-62);
- i. Waterway Adequacy (Item 71);
- j. STRAHNET Highway Designation (Item 100);
- k. Average Daily Truck Traffic (Item 109); and
- l. Designated National Network (Item 110).

A relative numeric rating system is an example of a simplified approach to readily distinguish and group bridges for further action. Indicators of risk can be defined, rated individually or in aggregate, weighted according to their perceived significance, and summed in some fashion to get the numeric

rating. Alternatively, a more rigorous risk-based approach may be used for initial categorization, and subsequent refined assessment of scour failure risk. An example of a relatively rigorous approach is detailed in [NCHRP Web Only Document 107](#); however numerous examples of risk-based approaches are identified in literature. Please refer to the reference list for risk-based management on the [Unknown Foundations website](#).

STEP 2

Thresholds will need to be established in order to distinguish relative risk and to establish a corresponding protocol. FHWA should work with bridge owners in identifying how risk and threshold levels could be defined; however, **determination of relative risk and thresholds levels must be established by the bridge owners.**

Bridges should be grouped into categories corresponding to risk. For the accompanying flow-chart, categories corresponding to A - High, B - Moderate and C - Low are shown. Additional categories may be assigned to allow further categorization and prioritization based on readily inferred conditions and observed performance during a major event. For example, a category might be created for simple-span structures of low risk with a designated plan of action (POA).

STEP 3

Category A is limited by owner-defined acceptable or tolerable risk criteria. For the example flow-chart presented, Category A bridges represent a high risk, and are restricted to positive discovery of foundation characteristics necessary for scour evaluation.

For bridges in this category, owners will need to establish means for positively identifying foundation type, location and depth such that a scour evaluation for the bridge can be conducted. This may involve invasive techniques, such as test pits, or non destructive evaluation techniques.

STEP 4

Category B is limited by owner-defined acceptable or tolerable risk criteria. For the example flow-chart presented, Category B bridges represent a moderate risk. For this category, risk-based assessments to infer or assume necessary foundation characteristics for scour evaluation are allowed. **Inferences and assumptions must be justified within an acceptable degree of engineering confidence for the purposes of scour evaluation.**

For bridges in this category, if the degree of confidence for inference or assumption is not high enough to warrant recoding the bridge from “U” in Item 113, a decision will need to be made by the owner to require positive discovery of the necessary foundation characteristics or to develop and implement an appropriate POA.

STEP 5

Category C is limited by owner-defined acceptable or tolerable risk criteria. For the example flow-chart presented, Category C bridges represent a low risk. For this category, risk-based assessments to infer or assume necessary foundation characteristics for scour evaluation are allowed. **Inferences and assumptions must be justified within an acceptable degree of engineering confidence for the purposes of scour evaluation.**

For bridges in this category, if the degree of confidence for inference or assumption is not high enough to warrant recoding, a POA will need to be developed and implemented.

DETERMINATION OF FOUNDATION CHARACTERISTICS USING INFERENCE METHODS

For bridges not grouped or categorized as high risk, it may be more cost-effective and efficient for owners to use alternate methods for inferring foundation characteristics necessary for scour evaluation. An example of an inference method is considering known foundations of similar bridges in age, construction, geology or location, and inferring that if the bridges are similar, the foundations are as well. The [Unknown Foundations Website](#) is being populated with a number of examples for assessing unknown bridge foundations without going through positive discovery using NDT, borings or test pits.

Bridge owners should evaluate inference methods carefully prior to use to ensure that risk potential for the bridge is adequately quantified and addressed.

PLANS OF ACTION FOR BRIDGES WITH UNKNOWN FOUNDATIONS

FHWA has previously provided guidance for owners on how to develop and implement a POA for scour critical bridges. An owner has a few options for development of a POA for bridges with unknown foundations and additional guidance is presented in Appendix “B.”

ATTACHMENT “B”

Guidance for Developing and Implementing Plans of Action for Bridges with Unknown Foundations

The National Bridge Inspection Standards (NBIS) regulation, 23 CFR 650.313, requires that bridge owners identify bridges that are scour critical (coded 0, 1, 2, or 3 in Item 113) and to prepare a plan of action (POA) to monitor known and potential deficiencies. Bridge owners have been working on completing evaluations to determine which bridges over waterways are vulnerable to scour.

Bridges coded U for Item 113 represent a unique subset of bridges that were exempted from being evaluated for scour vulnerability due to the lack of a process and guidance that would have allowed owners to determine the necessary foundation characteristics. The FHWA has provided several risk-based methods for assessing bridges with unknown foundations. However, there may still be an inventory of bridges coded U for which a scour evaluation can not be completed.

Owners should anticipate that bridges reported as having a code “U” after November 2010 will require development and implementation of a POA, until properly designed countermeasures are installed to protect the bridge foundations or until the bridge is replaced. The Coding Guide currently recommends development and implementation of a POA for existing bridges having a code “U.”

FHWA has previously provided guidance for owners on development and implementation of POA’s for bridges determined to be scour critical. For bridges with unknown foundations, an owner has two options for development of a POA:

1. A bridge coded U in Item 113 can simply be changed to a scour critical code (e.g., 3) for the NBI and subjected to a POA as described for scour critical bridges.
2. A bridge may remain coded U in Item 113 with a POA developed based on a risk assessment, and owner defined criteria considering known information about the bridge.

The POA for a bridge that remains coded U in Item 113 may be different than for a bridge determined to be scour critical. The POA developed should be based on the known information of the bridge and the owner determined risk from scour. The POA for a bridge over waterways with unknown foundations should contain minimum requirements commensurate to the consequences of loss of service of the structure to ensure a reasonable level of safety to the traveling public.

The steps below provide assistance to bridge owners in developing a POA for a bridge coded U in Item 113.

STEP 1:

Assess bridges with unknown foundations in accordance with guidance provided in this memorandum and examples provided on the [Unknown Foundations Website](#). For bridges that remain coded U in Item 113 after a risk-based assessment, FHWA recommends that a POA be developed based on the risk categories defined by bridge owners during initial categorization and grouping (e.g. A - High Risk, B - Moderate Risk, C - Low Risk).

STEP 2:

Develop a POA based upon the defined risk category that considers safety to the traveling public and the consequences of loss of service of the structure. The POA may be less detailed than for a scour critical bridge based on the defined risk categories, but it should contain elements that protect users during and after a scour event, and provide a proactive plan for addressing the bridge scour concerns in the future. Examples for lowest and highest risk categories are below.

Lowest Risk Categories

*Assumes that the bridge has performed well and has no history of scour related problems

For bridges considered as low risk, plans of action may be as simple as monitoring bridges for scour during routine biennial inspections and after major events.

If scour or a rainfall event has been observed in excess of predetermined monitoring triggers, then the bridge should be considered for an in-depth foundation investigation. Any information on observed or inspected conditions would be identified on the bridge inspection report so that inspectors could monitor the bridge for changes.

Highest Risk Categories

*Assumes that the bridge has performed satisfactorily, but because of owner defined criteria, it has been identified as high risk

Plans of actions may be similar to those for bridges determined to be scour critical. At a minimum, the bridge should be monitored on a more frequent basis than a bridge in a moderate to low risk category. Also, a bridge in this category should be considered for an in-depth foundation investigation if any significant changes in streambed occur, and scheduled for timely design and construction of a new bridge or countermeasures to make the bridge safe from scour and stream instability.

STEP 3:

Coordinate a global action plan for all bridges coded U in Item 113 within a state or region, whether assessed through this guidance or not. The plan should:

- Identify the scour critical and unknown foundation bridges;
- Define major events or a monitoring triggers; and
- Provide information for requesting technical assistance or conducting an in-depth foundation investigation.

Owners should monitor and verify that the process of implementing POAs is working satisfactorily. The global action plan for developing and implementing POAs should be revisited and updated as necessary.