



Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois/62764

May 19, 1993

National Bridge Inspection Standards (NBIS)
Scour Critical Bridge Evaluation
Local Agency Bridge Design

COUNTY ENGINEERS/SUPERINTENDENT OF HIGHWAYS
MUNICIPAL ENGINEERS
CONSULTING ENGINEERS

#93-12

This letter supplements Letter #92-11 that instituted the departmental local bridge scour policy. The attached "SCOUR CRITICAL EVALUATION FOR LOCAL ROAD BRIDGES" replaces the similarly titled attachment to that numbered letter.

The most significant revision eliminates the special certification for scour design. That requirement formerly comprised Section 1.c. - Design Guidelines and Certification. The standard plan certification statements and professional seals will imply that all AASHTO and Department bridge scour design specifications and policies have been addressed.

Other revisions to the policy further clarify the basic parameters for scour evaluation and more closely align wording with supporting FHWA documents. These revisions include reference to:

- intervals and definitions for "design" and "check" floods.
- interpretation of scour depth calculation results.
- use of the "superflood" as the only criteria for evaluating existing structures for scour.

Also attached are revised coding instructions for the Scour Critical Analysis Rating, Item 113 of the Illinois Structure Information System. This temporarily replaces the coding instructions for Item 113 currently in the Structure Information and Procedure Manual (SIP). The official revision will be included with the next SIP Manual update later this year.

Questions may be directed to Tim Souther, Local Bridge Unit, phone (217)785-8748.

Very truly yours,

A handwritten signature in cursive script that reads "Bill Sunley".

William T. Sunley, P.E.
Engineer of Local Roads and Streets

cc-
District Engineers

SCOUR CRITICAL EVALUATION
FOR
LOCAL ROAD BRIDGES

1. BRIDGE DESIGN.

a. New and Replacement Structures.

New structures must be designed so that all foundation units are stable for scour, following the FHWA Technical Advisory - T5140.23, Evaluating Scour at Bridges, without the need for additional monitoring. This will result in a design at the level of the 100-year flood. The process also requires checking for scour resulting from a superflood about the magnitude of a 500-year event.

The structure should have a ratio of ultimate to applied loads (factor of safety) greater than one (1) when the scour prism resulting from the superflood is removed. Illinois Structure Information System (ISIS) Item 113 - "Scour Critical Analysis Rating" codings corresponding to such a design are as follows:

- "9" -Bridges with all foundation units above floodwaters.
- "8" -Bridge foundations evaluated as stable for scour.

The scour evaluation consists of completing a study to determine the stability of the proposed bridge, following T5140.23 and Hydraulic Engineering Circular 18, Evaluating Scour at Bridges (HEC 18). The study should incorporate a procedure that allows engineering judgment to assess as low risk those bridges where scour will clearly not be a problem.

When scour analysis calculations are judged necessary, perform the analysis using the equations in HEC 18. Understand that the HEC 18 equations were developed for non-cohesive sand and gravel streambeds. When field conditions vary from these conditions, considerable engineering judgment will be required to arrive at a reasonable conclusion.

While the requirements of the Technical Advisory are not directly applicable to culverts, their design should insure stability under flood conditions. All culverts will receive an Item 113 rating of "8".

b. Bridge Rehabilitation.

Streambed scour must be addressed in the design of bridge rehabilitation projects essentially the same as for new bridges (see the second paragraph of Section 1.a.). If the evaluation suggests potential problems due to scour, mitigating countermeasures must be designed and installed. Besides the Item 113 ratings allowed for new bridges, rehabilitated bridges also may be coded "7" - "Countermeasures installed to correct a previously existing problem with scour."

c. Special Design Considerations.

Calculated depths due to local scour should not be included in the scour critical analysis for abutments. The applicable equations in HEC 18 are judged by FHWA to be unreliable. Spill-through type abutments with adequate slope protection will be considered satisfactory in meeting the scour design requirements.

In situations where closed abutments cannot be avoided, scour depths will be determined using the HEC 18 equations for contraction scour. Give close attention to any potential problems caused by stream and soil instability. Closed abutments should be placed no closer to the main channel than the top of bank. Alternatively, if that is not possible, measures such as guide banks or spur dikes may be provided to redirect flood flows ahead of the structure.

2. EVALUATION OF EXISTING STRUCTURES.

a. Phasing and Timetable.

The Illinois Bridge Scour Evaluation Program for existing local agency structures consists of Phases 1 through 4 as follows:

Phase 1 - Screening of all bridges over water into High Priority (Group 1) and "Low Priority" (Group 2) categories for scour evaluation.

Targeted completion date - December 31, 1991

Phase 2 - Evaluation of "Group 1" bridges.

Targeted completion date - (Varies based on the number of Group 1 bridges for which an agency is responsible):

| <u>Total Agency Group 1 Bridges</u> | <u>Targeted Completion Date</u> |
|-------------------------------------|---------------------------------|
| 1 - 10 | December 31, 1992 |
| 11 - 30 | December 31, 1993 |
| Over 30 | December 31, 1994 |

Phase 3 and 4 - Set priorities and evaluate Group 2 bridges.

Targeted completion date - January 1, 1997

b. Method of Evaluation.

The scour evaluation consists of a study to determine the stability of a bridge for a superflood about the magnitude of a 500-year flood. The study must follow T5140.23 and HEC 18. The structure should have a ratio of ultimate to applied loads (factor of safety) greater than one (1) when the scour prism resulting from the superflood is removed.

The study should incorporate a procedure that allows engineering judgment to be used to assess as low risk, those bridges where scour is clearly not a problem. When a scour

analysis is judged necessary, the equations in HEC 18 must be used. Understand that the equations published in HEC 18 were developed for non-cohesive sand and gravel streambeds. When the site varies from these conditions, considerable engineering judgment will be required to arrive at a reasonable conclusion.

c. Evaluator Qualifications.

The evaluation may be performed by the local agency engineer or a qualified engineering consultant. An interdisciplinary engineering team of bridge, hydraulic, and geotechnical specialists, as described in T5140.23, should be engaged for scour critical evaluation as warranted. The need for such an interdisciplinary team will be determined based on the professional judgment of the local agency engineer.

d. Exclusions.

(1) Scour at Abutments.

The HEC 18 equations for local scour at abutments should not be used, as the results are unreliable. Scour critical analysis for abutments shall consider contraction scour depth, and potential for long-term scour.

Spill through abutments will not require scour critical analysis if the foreslopes are adequately protected against erosion. Code Item 113 "4" or less when abutment foreslopes are significantly eroded by channel encroachment.

(2) Unknown Foundations.

Substructure units for which type or depth cannot be determined are exempted from scour critical analysis calculations. This may be the case when no records exist from plans or other contract documents showing the approximate pile lengths or the presence of spread footings. However, scour problems at such bridges should be noted during inspections and countermeasures installed as deemed necessary.

(3) Culverts.

Culverts receive an Item 113 rating of "8". While HEC 18 is not directly applicable to culverts, scour can have detrimental effects on them. Any such evidence must be noted on inspection reports and any necessary countermeasures installed.

SCOUR CRITICAL ANALYSIS RATING (ITEM 113)
CODING DESCRIPTIONS

| <u>CODING</u> | <u>DESCRIPTION</u> |
|---------------|---|
| Blank | Bridge not over waterway. |
| 9 | Bridge foundations (including piles) well above flood water elevations. No special monitoring for scour is required. |
| 8 | Bridge foundations evaluated as stable for scour. No special monitoring for scour is needed. The following cases apply: <ul style="list-style-type: none">- Calculated scour is above top of footing (Example A).- Pile bent substructures with adequate soil support remaining after calculated scour has occurred.- Structures assessed as stable for scour and not requiring scour analysis. |
| 7 | Countermeasures have been installed to correct a previously existing problem with scour. Bridge is not scour critical. Special monitoring may be required. For state-maintained structures the appropriate underwater inspection category, Item 93B5, should be coded. If no special monitoring is required, Item 93B5, need not be encoded. |
| 6 | Scour calculation/evaluation has not been made. <u>(Use only to describe case where bridge has not yet been evaluated for scour potential.)</u> |
| 5 | Bridge foundations determined to be stable for calculated scour conditions; scour within limits of footing or piles (Example B). Monitoring following significant storms may be established at the direction of the scour evaluation team. For state-maintained structures when special monitoring is required Item 93B5 is to be coded to include Underwater Category 1. |
| 4 | Bridge foundations determined to be stable for calculated scour conditions; field review indicates action is required to protect exposed foundations from effects of additional erosion and corrosion. Monitoring on a yearly basis and following significant storms is required. For state-maintained structures Item 93B5 is to be coded to include Underwater Category 1. (Example C). |

(continued)

SCOUR CRITICAL ANALYSIS RATING (ITEM 113)
CODING DESCRIPTIONS

| <u>CODING</u> | <u>DESCRIPTION</u> |
|---------------|--|
| 3 | <p>Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions:</p> <ul style="list-style-type: none">- Scour within limits of footing or piles. (Example B)- Scour below spread-footing base or pile tips. <p>Monitoring on a yearly basis and following significant storms is required. For state-maintained structures Item 93B5 is to be coded to include Underwater Category 1.</p> |
| 2 | <p>Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations. Immediate action is required to provide scour countermeasures.</p> |
| 1 | <p>Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.</p> |
| 0 | <p>Bridge is scour critical. Bridge has failed and is closed to traffic.</p> |

5/4/93