FHWA Bridge Scour Program

Michigan Bridge Scour Workshop

Big Rapids, Michigan
March 10, 2009
FHWA Bridge Scour Program

- Why Scour
- History
- Current Status
- POA Highlights
- Future Direction
Why A Scour Program?

- Floods Occur in Your Community
Why A Scour Program?

- Floods Damage Roads
Why A Scour Program?

- Floods Damage Bridges
Why A Scour Program?

- 1973 – 23 bridge failures in Illinois
- 1985 – 73 bridges destroyed in Pennsylvania, Virginia & WV
- 1987 – 17 bridges damaged or destroyed New York and New England
Why A Scour Program?

- 1993 – 23 bridge failures in upper Mississippi River basin
- 1994 – 500 bridges failed in Georgia
Why A Scour Program?

Hydraulic Issues ➔ 50 to 70% All Bridge Failures
History of FHWA Scour Program

- **Research**
  - 1940’s – Laursen
  - 1950’s – FHWA and CSU
  - 1950’s – Mississippi and Alabama and CSU

- **Technical Guidance**
  - 1978 – FHWA HDS 1 Chapter 7
  - 1984 – FHWA-RD-84-100
Impetus of FHWA Scour Program

- 1987 - Schoharie Creek I-90 Bridge Failure
Program Formalized - 1988

- FHWA Technical Advisory T5140.20
  - Interim Guidelines for Evaluating Bridges for Scour

- NBIS Item 113
  - Evaluate bridges for Scour
Additional Failure

- 1989 – Hatchie River TN Bridge Failure
Updated Guidance - 1990

- HEC 18
  - Interim Guidance Updated
    - Phase I – Screening
    - Phase II - Scour evaluations

- Semi-annual progress reports
Updated Guidance - 1991

- Technical Advisory T5140.23
  - Evaluating Scour at Bridges
  - 5 Components of Scour Program

http://www fhwa dot gov/legsregs/directives/techadvs/t514023 htm
1. Evaluation by Interdisciplinary Team

- Hydraulic
- Geotech
- Structural
Technical Advisory T5140.23

2. New Bridges

- Hydraulic Analysis
  - Withstand 100 year flood
  - Not fail with superflood (>100 year)

- Geotechnical Analysis
  - Assume scour prism removed
3. Existing Bridges

- Identify Risk of Failure
  - Initial Screening and Prioritization
- Scour Evaluation
  - Scour Observed
  - Theoretical Scour (HEC 18)
4. Plan of Action

- Monitor
  - Inspections and Closures
  - During and After Floods

- Install Hydraulic or Structural Countermeasure
  - Schedule
  - Design
5. Bridge Inspectors

- Training
- Record Information
  - Condition of Bridge and Stream
  - Cross-sections
    - Compare with previous
- Communication if concerns
5. Bridge Inspectors

- NHI 135047
  - Stream Stability and Scour at Highway Bridges for Bridge Inspectors
  
Previous Deadlines

- March 31, 1991 – Screening Completed

- January 1997 – Evaluations Completed
  - Exempt Tidal
  - Exempt Unknowns (except Interstate)
Previous Deadlines

- 1998 – Begin Evaluating Tidal “T”s
- 1998 – Reminder about POAs
Countermeasures

- 1997 – HEC 23
  - Countermeasure Matrix
  - Design Guides

- Demo 98 Projects
  - Fixed and portable scour instrumentation
Update to Item 113

- 2001 – Clarification of Item 113
  - 7 – Countermeasure Installed but not Designed or Installed Correctly – Monitor

- 0, 1, 2 – Change Item 60 to Correspond
Revision to NBIS

- 2005 – Revision to NBIS
  - 23 CFR 650.313(e)
    - Identify Scour Critical Bridges
    - Develop POA for known and potential deficiencies
      - Monitor
      - Address Critical Findings
    - Implement POA
      - Monitor according to plan
Funding

- **Pre 1998 – Bridge Funds**
  - Inspection
  - Scour Evaluations and POAs

- **1998 – TEA-21 – Bridge Funds**
  - Inspection
  - Scour Evaluations and POAs
  - Countermeasures, only on eligible bridges

- **2005 – SAFETEA-LU – Bridge Funds**
  - Inspection
  - Scour Evaluations and POAs
  - Countermeasures (preventative maintenance)
Current Status of FHWA Scour Program

- January 4, 2008 Memo
  - Target Dates to Comply with NBIS
    - Complete Evaluations – November 2008
    - Develop POAs – November 2008 and 2009
    - Implement POAs – April 2009 and 2010
  - Michigan Division and MDOT have agreed on acceptable completion date
Technical Guidance

- HEC 18 – 4th Ed – 2001
  - Evaluating Scour at Bridges
- HEC 20 – 3rd Ed – 2001
  - Stream Stability at Highway Structures
- HEC 23 – 2nd Ed – 2001
  - Bridge Scour and Stream Instability Countermeasure Experience, Selection, and Design Guidance
- HEC 25 – 2nd Ed – 2008
  - Highways in the Coastal Environment
- POA Template – 2007
Training

- NHI 135046
  - Stream Instability and Scour at Highway Bridges

- NHI 135047
  - Stream Instability and Scour at Highway Bridges for Inspectors

- NHI 135048
  - Countermeasure Design for Scour and Stream Instability

- NHI 135082
  - Highways in the Coastal Environment

- NHI 135085
  - POA for Scour Critical Bridges (Web-based)
POA Required

- T 5140.23
- 23CFR 650.313e
  - Identify Scour Critical Bridges
  - Develop Plan
    - Monitor Known and Potential Deficiencies
    - Address Critical Findings
  - Implement Plan
    - Monitor according to Plan
POA Template

- FHWA Template

- MDOT
  - Template in MBIS
Components of POA

- Plan to Monitor Known and Potential Deficiencies
  - Who, What, When, and Where Monitor?

- Plan to Address Critical Findings
  - Replace Bridge
  - Countermeasures (HEC 23)
Plan to Monitor

- Who will inspect bridge?
  - During Flood
  - After Flood
  - Who Notify
  - Authority to Act
Plan to Monitor

- What Look For?
  - Scour
    - Limits
  - Bridge Movement
    - Vibration
    - Rotation of members
    - Dip in Roadway
  - Countermeasure in Place
  - Instrumentation Functional
Plan to Monitor

- What Look For?
Plan to Monitor

- **When Inspect?**
  - Water Level
  - Flow
  - During/After
  - Periodically/Continuously
Plan to Monitor

- Where Inspect?
  - Bridge Location Information
  - Scour Critical Bridges Identified
    - Maps
    - GIS
Plan to Monitor - Action

- Close Bridge
  - When Close
  - Who has Authority
  - Notification
    - Internally
    - Local Officials
    - Media
  - Document
  - Detour
Plan to Monitor - Action

- Detour Map
Plan to Monitor - Action

- Reopen Bridge
  - When Reopen
  - Who has Authority
  - Notification
    - Internally
    - Local Officials
    - Media
  - Document
Address Critical Findings

- Replace Bridge
  - Timeframe
    - Temporary Countermeasures
    - Monitoring
Address Critical Findings

- Countermeasures (HEC 23)
  - River Training Structures
    - Spurs
    - Bendway Weirs
    - Drop Structures
    - Retards
    - Jacks
Address Critical Findings

- Countermeasures
  - Armoring
    - Riprap
    - Articulated Blocks
Address Critical Findings

- Countermeasures
  - Structural
    - Crutch Piles
    - Sacrificial Piles/Dolphins
    - Lengthen Bridge
Address Critical Findings

- Countermeasures
  - Monitoring
    - Fixed Instrumentation
    - Portable Instrumentation
Buy In

- Signatures
  - Author
  - Supervisor
  - Governmental Officials
Maintenance and Implementation

- Periodic Review
  - Check Names and Phone Numbers
  - Review Actions Taken After Emergency
  - Check Status of Countermeasures

- Training
  - Emergency Planning Exercises

- Completed – change coding
Future of FHWA Scour Program

- Update Guidance
  - HEC 23

- Update Training
  - NHI 135047

- Research
Research

- Turner Fairbanks Lab
  - Optimum Bridge Deck Shapes to Minimize Pressure Flow Scour
  - Effects of Water Flow and Shaking on Scouring of Bridge Piers
  - Pier Scour Countermeasures Using Fluidic Devices
Research

- NCHRP
  - Project 20-05
    - Monitoring Scour Critical Bridges
  - Project 24-07(2)
    - Countermeasures to Protect Bridge Piers from Scour
  - Project 24-15(2)
    - Abutment Scour in Cohesive Materials
  - Project 24-20
    - Prediction of Scour at Bridge Abutments
  - Project 24-26
    - Effects of Debris on Bridge Pier Scour
  - Project 24-29
    - Scour at Bridge Foundations on Rock
  - Project 24-32
    - Scour at Wide Piers and Long Skewed Piers
Unknown Foundations

- January 9, 2008 – Memo
  - Target Completion for Evaluations – November 2010
  - POAs if not evaluated

- Developing Guidance
  - Met with various states
  - Compiling Guidance
  - Website
Thanks!!!

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