OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58087170 Date 6/9/10 Initials CW Region (A B C (D))

Site ____________ Location 2.2 W Ashton

Q_{100} = 17700 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 13732 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 186 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = 186 ________ ________

Avg. flow depth at bridge, y_2 iteration = 20.4 > 17.8 → RD Overflow

Corrected channel width at bridge Section = W_2 times cos of flow angle = 183.17 ft* $q_2 = Q_2/W_2$ = 75 ft²/s

Bridge Vel, V_2 = 4.2 ft/s Final $y_2 = q_2/V_2$ = 17.8 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 18.2 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,

Water Surface Elev. = ________ ft

Low Steel Elev. = 17.8 ft

n (Channel) = 0.033

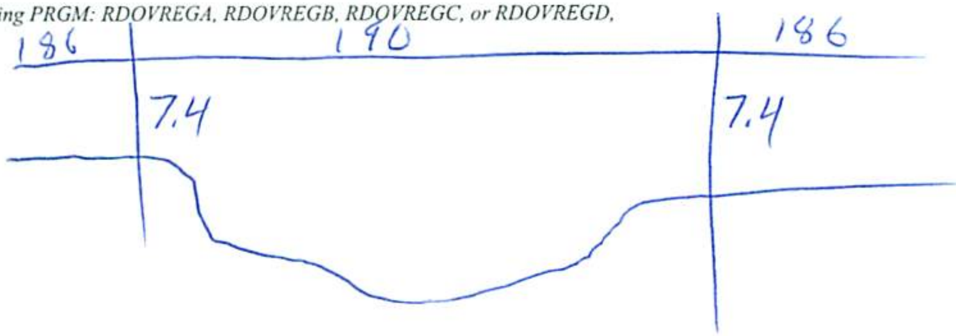
n (LOB) = 0.047

n (ROB) = 0.025

Pier Width = 1.85 ft

Pier Length = 1.85 ft

Piers for 100 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 190 ft

Width of left overbank flow at approach, W_{lob} = 186 ft Average left overbank flow depth, y_{lob} = 7.4 ft

Width of right overbank flow at approach, W_{rob} = 186 ft Average right overbank flow depth, y_{rob} = 7.4 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

x = 10.16 From Figure 9 W_2 (effective) = 175.8 ft y_{cs} = 11.1 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = ________ ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1)$ = ________ ft/s

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = ________ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = ________ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1[q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = ________ From Figure 10, y_{cs} = ________ ft

PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.18 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 5.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 7.4 ft right abutment, y_{aRT} = 7.4 ft

Shape coefficient K_1= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, (0.55 for spill-through)

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 19.3 and ψ_{RT} = 19.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 19.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 19.3 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58087170 Date 6/9/10 Initials CW Region (A B C (D))

Site ____________ Location 2.2 W Ashton

Q_{500} = 43600 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 13732 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 186 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = 186 ____ ____ ____

Avg. flow depth at bridge, y_2 iteration = RD overflow ____ ____

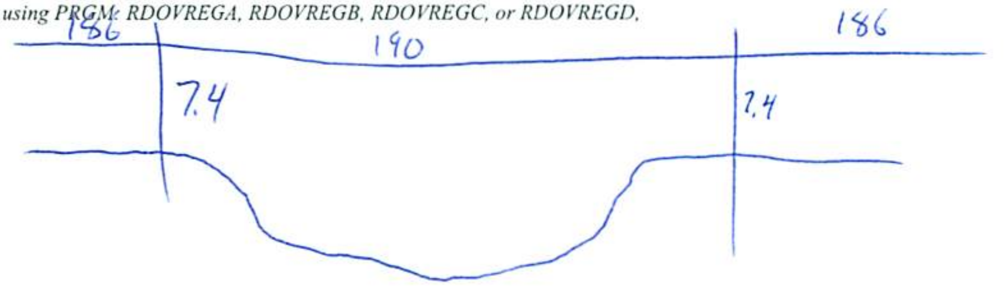
Corrected channel width at bridge Section = W_2 times cos of flow angle = 183.17 ft* $q_2 = Q_2/W_2$ = 75 ft^2/s

Bridge Vel, V_2 = 4.2 ft/s Final $y_2 = q_2/V_2$ = 17.8 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 18.2 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.



Water Surface Elev. = ____ ft

Low Steel Elev. = 18.5 ft

n (Channel) = 0.033

n (LOB) = 0.047

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Pier Width = 1.85 ft

Pier Length = 1.85 ft

\# Piers for 500 yr = 4 ft

CONTRACTION SCOUR

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PGRM: CWCSNEW

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Estimated bed material D_{50} = ____ ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = ____ ft/s

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = ____ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = ____ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = ____ From Figure 10, y_{cs} = ____ ft

PIER SCOUR CALCULATIONS

PGRM: Pie

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.18 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 5.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 7.4 ft right abutment, y_{aRT} = 7.4 ft

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Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 19.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 19.3 ft

Route 166 St Stream Snake Creek MRM ________ Date 6/19/10 Initials CM

Bridge Structure No. 58087170 Location 2.2 W Ashton

GPS coordinates: N 44° 59' 56.6" taken from: USL abutment X centerline of ⇑ MRM end ____

W 98° 32' 18.0" Datum of coordinates: WGS84 X NAD27____

Drainage area = 2058.74 sq. mi.

The average bottom of the main channel was 21.7 ft below top of guardrail at a point 52 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ✓ drainage area ratio ____regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 17700			Q_{500} = 43600		
Estimated flow passing through bridge	13732			13732		
Estimated road overflow & overtopping	3968			29868		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping	X			X		
Chance of Pressure flow	X			X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

Riprap at abutments? ____Yes ____No X Marginal

Evidence of past Scour? X Yes ____No ____Don't know

Debris Potential? ____High ____Med X Low

Does scour countermeasure(s) appear to have been designed?

Riprap	____Yes	X No	____Don't know	____NA
Spur Dike	____Yes	____No	____Don't know	X NA
Other ____________	____Yes	____No	____Don't know	X NA

Bed Material Classification Based on Median Particle Size (D_{50})

Material	Silt/Clay X	Sand____	Gravel____	Cobbles____	Boulders____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

Comments, Diagrams & orientation of digital photos

1642 - ID
43 - US
44 - US RB
45 - US LB
46 - L. Abut & Piers
47 - L. Abut
48 - US Face of bridge
49 - "
50 - R. Abut
51 - ROB
52 - LOB

Summary of Results

	Q100	Q500
Bridge flow evaluated	~~173~~ 13732	13732
Flow depth at left abutment (yaLT), in feet	7.4	7.4
Flow depth at right abutment (yaRT), in feet	7.4	7.4
Contraction scour depth (ycs), in feet	11.1	11.1
Pier scour depth (yps), in feet	5.8	5.8
Left abutment scour depth (yas), in feet	19.3	19.3
Right abutment scour depth (yas), in feet	19.3	19.3
1Flow angle of attack	10	10

See Comments/Diagram for justification where required