ok RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52310306 Date 9/24/10 Initials CW Region (A B C D)

Site _____ Location approx. 0.6 S Johnson, on Forest Rd near intersection with HWY 44

Q_{100} = 856 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 856 (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

Bridge Width = 50 ft. Flow angle at bridge = 30 ° Abut. Skew = 30 ° Effective Skew = 0 °

Width (W_2) iteration = 50 Vert. Abut _____

Avg. flow depth at bridge, y_2 iteration = 3.4 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 50 ft* $q_2 = Q_2/W_2$ = 17.1 ft^2/s

Bridge Vel, V_2 = 5 ft/s Final $y_2 = q_2/V_2$ = 3.4 ft Δh = 0.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 3.9 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,

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

Water Surface Elev. = _____ ft

Low Steel Elev. = 7.4 ft

n (Channel) = 0.050

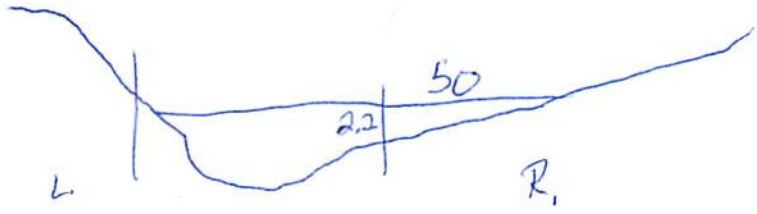
n (LOB) = 0.150

n (ROB) = 0.150

Pier Width = — ft

Pier Length = — ft

Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 50 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 50 ft Average right overbank flow depth, y_{rob} = 1.1 ft

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

x = _____ From Figure 9 W_2 (effective) = _____ ft y_{cs} = _____ ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) 2 = 0

Estimated bed material D_{50} = 0.30 ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = ~~4.39~~ ft/s 2.19

Critical approach velocity, $Vc = 11.52y_1^{1/6}D_{50}^{1/3}$ = 9.38 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.0256 ft If $D_{50} >= D_{c50}$, χ = 0.0

Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = — From Figure 10, y_{cs} = 0.0 ft

PGRM: Pier

PIER SCOUR CALCULATIONS

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

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

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0.0 ft right abutment, y_{aRT} = 1.1 ft

Shape coefficient K_1= ~~1.00~~ CW 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} = 0.0 and ψ_{RT} = 4.7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0.0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = ~~8.5~~ CW 7.0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52310306 Date 9/24/10 Initials CW Region (A B C D)

Site _____ Location approx 0.6 S Johnson, on Forest Rd near intersection with HWY 44

Q_{500} = 1275 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 1275 (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 = 50 ft. Flow angle at bridge = 30 ° Abut. Skew = 30 ° Effective Skew = 0 °

Width (W_2) iteration = 50 Vert. Abut.

Avg. flow depth at bridge, y_2 iteration = 4.2

Corrected channel width at bridge Section = W_2 times cos of flow angle = 50 ft* $q_2 = Q_2/W_2$ = 25.5 ft^2/s

Bridge Vel, V_2 = 6.0 ft/s Final $y_2 = q_2/V_2$ = 4.2 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 5.0 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. = _____ ft

n (Channel) = 0.050

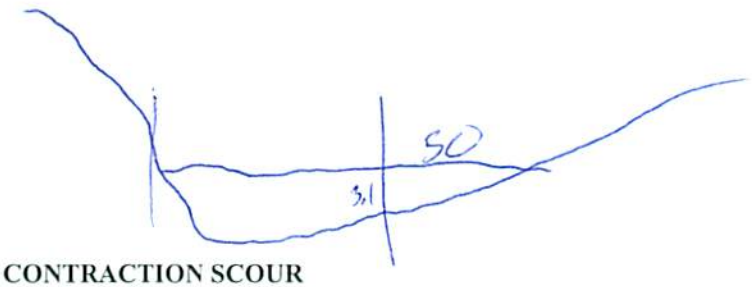
n (LOB) = 0.150

n (ROB) = 0.150

Pier Width = — ft

Pier Length = — ft

Piers for 500 yr = — ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 50 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 50 ft Average right overbank flow depth, y_{rob} = 1.55 ft

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

x = _____ From Figure 9 W_2 (effective) = _____ ft y_{cs} = _____ ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) 2=0

Estimated bed material D_{50} = 0.3 ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = 5.1 ft/s 2.55

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = 9.78 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.0356 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} = 0.0 ft

PIER SCOUR CALCULATIONS

PGRM: Pier

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

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 1.55 ft

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

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 0 and ψ_{RT} = 6.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.7 CW ft

9.6

Route Forest Rd Stream Rapid Creek MRM _____ Date 9/24/10 Initials CW

Bridge Structure No. 52310306 Location on Forest Rd, near intersection with HWY 44, 0.6S Johnson

GPS coordinates: N 44° 04' 23.3" W 103° 25' 55.8" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 335.56 sq. mi.

The average bottom of the main channel was 12.0 ft below top of guardrail at a point 28 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 856			Q_{500} = 1275		
Estimated flow passing through bridge	856			1275		
Estimated road overflow & overtopping						
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 X No ____Marginal

Evidence of past Scour? ____Yes X No ____Don't know

Debris Potential? X High ____Med ____Low

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

Riprap ____Yes ____No ____Don't know X NA

Spur Dike ____Yes ____No ____Don't know X NA

Other Large wing walls X Yes ____No ____Don't know ~~X~~ NA

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

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

Comments, Diagrams & orientation of digital photos

THICK Willows on ~~overbank~~ banks & overbanks

1244 - Bridge ID
45 - US from bridge
46 - US RB
47 - US LB
48 - US Face of bridge from XS
49 - R. Abut
50 - R. WW
51 - L. Abut
52 - L. WW
53 - Bed material

Summary of Results

	Q100	Q500
Bridge flow evaluated	856	1275
Flow depth at left abutment (yaLT), in feet	0.0	0.0
Flow depth at right abutment (yaRT), in feet	~~1.0~~ 1.1	1.55
Contraction scour depth (ycs), in feet	0.0	0.0
Pier scour depth (yps), in feet	~~0.0~~ ~~0.0~~ NA	~~0.0~~ NA
Left abutment scour depth (yas), in feet	~~3.~~ 0.0	0.0
Right abutment scour depth (yas), in feet	~~6.5~~ 7.0	~~av 11.7~~ 9.6
1Flow angle of attack	0°	0°

See Comments/Diagram for justification where required