ok RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 39125041 Date 9/4/12 Initials RaT Region (A B C D)

Site _____ Location 7.4 mi E of Bancroft on 200st

Q_{100} = _____ by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = _____ (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 = _____ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = _____ _____ _____ _____

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

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

Bridge Vel, V_2 = _____ft/s Final $y_2 = q_2/V_2$ = _____ft Δh = _____ft

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

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

Water Surface Elev. = 3.5 ft

Low Steel Elev. = 71 ft

n (Channel) = _____

n (LOB) = _____

n (ROB) = _____

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 100 yr = 0 ft

Assuming north-south flow

Site is likely impounded 4ft water w/ little flow

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = _____ft

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

Width of right overbank flow at approach, W_{rob} = _____ft Average right overbank flow depth, y_{rob} = _____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)

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

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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

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} = _____ft right abutment, y_{aRT} = _____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} = _____ and ψ_{RT} = _____

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

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 39128041 Date 9/4/17 Initials RAT Region (A B C D)

Site _____ Location 7.4 mi E of Bancroft on 200 st

Q_{500} = _____ by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ___

Bridge discharge (Q_2) = _____ (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 = _____ft. Flow angle at bridge = _____° Abut. Skew = _____° Effective Skew = _____°

Width (W_2) iteration = _____ _____ _____ _____

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

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

Bridge Vel, V_2 = _____ft/s Final $y_2 = q_2/V_2$ = _____ft Δh = _____ft

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

n (Channel) = _____

n (LOB) = _____

n (ROB) = _____

Pier Width = _____ ft

Pier Length = _____ ft

Piers for 500 yr = _____ ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = _____ft

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

Width of right overbank flow at approach, W_{rob} = _____ft Average right overbank flow depth, y_{rob} = _____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)

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

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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 = _____ 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} = _____ft right abutment, y_{aRT} = _____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} = _____ and ψ_{RT} = _____

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

44° 29' 01.6756"
97° 35' 55"

44.483521
97.598633

Route _____ Stream _____ MRM _____ Date 8/4/12 Initials RAL

Bridge Structure No. 39128011 Location 7.4 mi E of Bancroft on 200 St

GPS coordinates: N 44° 29' 00.6" W 97° 35' 55.2" taken from: USL abutment X centerline of ⍓ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 79.5 sq. mi.

The average bottom of the main channel was 11.4 ft below top of guardrail at a point 36 ft from left abutment.

Method used to determine flood flows: ___Freq. Anal. ___drainage area ratio X regional regression equations.

8/11/12
Ryan Thompson

Rpi	
2	227
5	635
10	1040
25	1690
50	2250
100	2950
500	4750

set DAcontrib = DAtot

Peaks are probably over-estimate and would be attenuated by lake

MISCELLANEOUS CONSIDERATIONS

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

Riprap at abutments? X Yes ___No ___Marginal outside of abutments only

Evidence of past Scour? X Yes ___No X Don't know inside of abutment walls

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	X No	___Don't know	___NA
Other _____	___Yes	X No	___Don't know	___NA

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

Material	Silt/Clay	Sand	Gravel	Cobbles	Boulders
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

likely silt

Comments, Diagrams & orientation of digital photos

1). Main channel
2). right abutment
3). left abutment

Summary of Results

	Q100	Q500
Bridge flow evaluated		
Flow depth at left abutment (yaLT), in feet		
Flow depth at right abutment (yaRT), in feet		
Contraction scour depth (ycs), in feet		
Pier scour depth (yps), in feet		
Left abutment scour depth (yas), in feet		
Right abutment scour depth (yas), in feet		
1Flow angle of attack		

See Comments/Diagram for justification where required