ok RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 19345165 Date 6/2/12 Initials RaT Region (A B C D)

Site _____ Location 0.5mi N of HWY 12 on 446 Ave

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 = 77 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

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"

7.0 - 11.4

Water Surface Elev. = 7.4 ft

Low Steel Elev. = _____ ft

n (Channel) = _____

n (LOB) = _____

n (ROB) = _____

Pier Width = _____ ft

Pier Length = _____ ft

Piers for 100 yr = _____ ft

11.1
5.9
6.3

Site is impounded.
Water level >7ft with little noticeable flow. Level 1.5 analysis is not adequate.

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

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

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 1934 5165 Date 6/2/12 Initials EA Region (A B C D)

Site _____ Location 0.5 mi N of HWY 12 on 446

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

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: Pie

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

45° 20' 55.11"
97° 16' 35.364"

97.27659
45.34865

Route _____ Stream _____ MRM _____ Date 8/2/12 Initials RaT

Bridge Structure No. 19345165 Location 0.5 mi N of HWY 12 on 446

GPS coordinates: N45° 20' 54.5" taken from: USL abutment X centerline of ⍓ MRM end _____

W97° 16' 35.9" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 68.3 sq. mi.

The average bottom of the main channel was 12.1 ft below top of guardrail at a point 54 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ____drainage area ratio X regional regression equations.

8/1/12

Ryan	Thompson
2	151
5	439
10	729
25	1200
50	1650
100	2140
500	3500

$DA_{contrib} = DA_{tot}$

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

Evidence of past Scour? X Yes ____No ____Don't know lots of contraction, water level from 2ft to >11ft

Debris Potential? ____High ____Med X Low

Does scour countermeasure(s) appear to have been designed? rose quartz on/around abutments

Riprap X Yes ____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. Lots of Cobbles

Comments, Diagrams & orientation of digital photos

1). left CB
2). main channel
3). right CB
4). main channel

Note: current water level is greater than low steel. Unsure if there is a pier or the low steel point. Abutments appear vertical but the change in depth at each abutment suggests a spill through

Note: Appears to be a steel barrier along left abutment holding riprap/dirt in place.

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

Est. W_p = 594' low steel 6.2

N_{ch} = 0.048

N_L = 0.060

N_R = 0.030