OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 25300061 Date 7/13/12 Initials RGT Region (A B C D) [D circled]

Site ____________ Location 0.7 mi S, 0.6 mi W of Crestbard on 361 Ave

Q_{100} = Qs 967 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 967 (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 = 67 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 62.96 ft* $q_2 = Q_2/W_2$ = ~~15.4~~ ft^2/s

Bridge Vel, V_2 = ~~[illegible]~~ ft/s Final $y_2 = q_2/V_2$ = ~~[illegible]~~ 7.7 ft Δh = ~~[illegible]~~ 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.8 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. = 0-0.9 ft

Low Steel Elev. = 7.9 ft

n (Channel) = 0.040

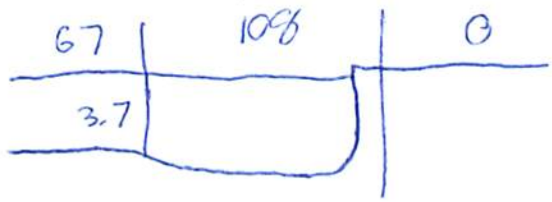
n (LOB) = 0.035

n (ROB) = ~~[illegible]~~ 0.025

Pier Width = 0 ft

Pier Length = 0 ft

\# Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 108 ft

Width of left overbank flow at approach, W_{lob} = 67 ft Average left overbank flow depth, y_{lob} = 3.7 ft

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

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

x = 8.32 From Figure 9 W_2 (effective) = 63 ft y_{cs} = 9.2 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) [section crossed out]

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

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = ________ 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, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = ________ From Figure 10, y_{cs} = ________ ft

PIER SCOUR CALCULATIONS

PGRM: Pier [section crossed out]

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} = 3.7 ft right abutment, y_{aRT} = 0 ft

Shape coefficient K_1= 1.00 for vertical-wall, 0.82 for ~~vertical-wall with wingwalls~~, 0.55 for spill-through [0.82 circled]

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 12.7 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 19 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 25300061 Date 7/13/12 Initials Kow Region (A B C (D))

Site ______ Location 0.7 mi S, 0.6 mi W of Cresbard on 361 Ave

Q_{500} = Q_{C}, 2090 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1020 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 67 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 62.96 ft* $q_2 = Q_2/W_2$ = 16.2 ft^2/s

Bridge Vel, V_2 = 2.1 ft/s Final $y_2 = q_2/V_2$ = 7.9 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8 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. = 0-0.9 ft

Low Steel Elev. = 7.9 ft

n (Channel) = 0.040

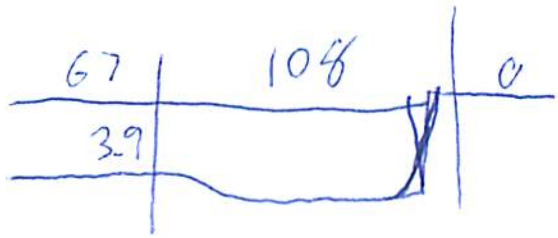
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 500 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 108 ft

Width of left overbank flow at approach, W_{lob} = 67 ft Average left overbank flow depth, y_{lob} = 3.9 ft

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

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

x = 8.66 From Figure 9 W_2 (effective) = 63 ft y_{cs} = 9.5 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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ______ 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} = 3.9 ft ~~right abutment~~, y_{aRT} = 0 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} = 13.1 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 19.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

98.96028
45.15611

98° 57' 37"
45° 9' 21.996

oute 361 Ave Stream North Fork Snake Ck MRM________ Date 7/13/12 Initials RAT

ridge Structure No. 25300061 Location 0.7mi S, 0.6 mi W of Cresbard on 361 Ave

PS coordinates: N 45° 9' 21.6'' W 98° 57' 37.8'' taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27_____

rainage area = 481.54 sq. mi.

he average bottom of the main channel was 13.1 ft below top of guardrail at a point 28 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

lows	Q_{100} = ~~Q~~ Q5 967			~~Q_{500}~~ = Q10 2090		
Estimated flow passing through bridge	967			1020		
Estimated road overflow & overtopping	0			1070		
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	

7/2

2	195
5	967
10	2090
25	4550
50	7260
100	10900
500	23300

Riprap at abutments? ___Yes ___No X Marginal

Evidence of past Scour? X Yes ___No ___Don't know minor contraction

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 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

1). left OB
2). main channel
3). right OB,
4-5). right abutment
6-7). left abutment
8). debris
9). main channel

Summary of Results

	~~Q100~~ Q5	~~Q500~~ Q10
Bridge flow evaluated	967	1020
Flow depth at left abutment (yaLT), in feet	3.7	3.9
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	9.2	9.5
Pier scour depth (yps), in feet	N/A	N/A
Left abutment scour depth (yas), in feet	19	19.5
Right abutment scour depth (yas), in feet	0	0
1Flow angle of attack	20	20

See Comments/Diagram for justification where required