OK RT check

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 54239000 Date 7/19/12 Initials RaT Region (A B C D)

Site _____ Location 1 mi W of Randolph on 149 St

Q_{100} = Q10 765 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 765 (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 = 41 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

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 = 33.59 ft* $q_2 = Q_2/W_2$ = 22.8 ft^2/s

Bridge Vel, V_2 = 2.4 ft/s Final $y_2 = q_2/V_2$ = 9.5 ft Δh = ~~9.6~~ 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.6 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. = dry ft

Low Steel Elev. = 10.7 ft

n (Channel) = 0.040

n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1 ft

Pier Length = 1 ft

Piers for 100 yr = 1 ft

5.4 to right

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 170 ft 5.4 2.9/6.3 left 1.5

Width of left overbank flow at approach, W_{lob} = 41 ft Average left overbank flow depth, y_{lob} = 2.3 ft

Width of right overbank flow at approach, W_{rob} = 16 ft Average right overbank flow depth, y_{rob} = ~~9.6~~ 2.1 ft

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

x = 41.6 From Figure 9 W_2 (effective) = 32.6 ft y_{cs} = 29.3 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.14 Using pier width a on Figure 11, ξ = 4.9 Pier scour y_{ps} = 3.6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.5 ft right abutment, y_{aRT} = 2.1 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} = 6.3 and ψ_{RT} = 8.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 9.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.9 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58239000 Date 7/18/12 Initials RAT Region (A B C (D))

Site _____ Location 1 mi W of Randolph on 148 St

Q_{500} = Q_{25} 1530 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 964 (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 = 41 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

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 = 33.59 ft* $q_2 = Q_2/W_2$ = 28.7 ft^2/s

Bridge Vel, V_2 = 2.7 ft/s Final $y_2 = q_2/V_2$ = 10.7 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.8 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. = dry ft

Low Steel Elev. = 10.7 ft

n (Channel) = 0.040

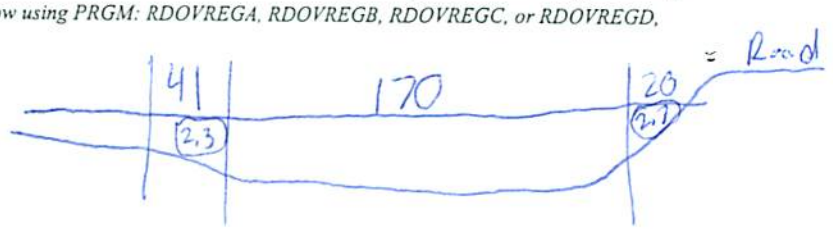
n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1 ft

Pier Length = 1 ft

Piers for 500 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 170 ft

Width of left overbank flow at approach, W_{lob} = 41 ft Average left overbank flow depth, y_{lob} = 2.3 ft

Width of right overbank flow at approach, W_{rob} = 20 ft Average right overbank flow depth, y_{rob} = 2.7 ft

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

x = 47.51 From Figure 9 W_2 (effective) = 32.6 ft y_{cs} = 32.5 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, $V_1 = Q_{500}/(y_1W_1)$ = _____ 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

Froude # at bridge = 0.15 Using pier width a on Figure 11, ξ = 4.9 Pier scour y_{ps} = 3.6 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.3 ft right abutment, y_{aRT} = 2.7 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} = 9.4 and ψ_{RT} = 11

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 16.4 ft

Route 148 St Stream _____ MRM _____ Date 7/18/12 Initials RaT

Bridge Structure No. 58239000 Location 1 mi W of Randolph on 148St

GPS coordinates: N 45° 14' 28.3"
W 98° 13' 39.3"

taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 73.99 sq. mi.

The average bottom of the main channel was 14.4 ft below top of guardrail at a point 23 ft from left abutment.

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

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2	192
5	693
10	1360
25	2470
50	3650
100	5120
500	9770

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = Q_{10} 765			Q_{500} = Q_{25} 964		
Estimated flow passing through bridge	765			964		
Estimated road overflow & overtopping	0			564		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		\		\		
Chance of Pressure flow		\		\		
Armored appearance to channel		\			\	
Lateral instability of channel		\			\	

7/2

2	95.7
5	386
10	765
25	1530
50	2330
100	3340
500	6650

Riprap at abutments? ____Yes ____No X Marginal some ptg/abutment scour

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 X No ____Don't know ____NA

Other _____ X Yes ____No ____Don't know ____NA

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

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

Comments, Diagrams & orientation of digital photos 10-11)

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

Other drainage
Notes. -Nearby resident informed that this area floods due to snowmelt every year & installed a secondary pipe to divert flow. Not confident it'll be enough. About 6ft diameter.

Note contraction scour profile estimate approx. 14 ft from left abutment

Summary of Results

	Q_{100} Q_{10}	Q_{500} Q_{25}
Bridge flow evaluated	765	964
Flow depth at left abutment (yaLT), in feet	1.5	2.3
Flow depth at right abutment (yaRT), in feet	2.1	2.7
Contraction scour depth (ycs), in feet	29.3	32.5
Pier scour depth (yps), in feet	3.6	3.6
Left abutment scour depth (yas), in feet	9.3	14
Right abutment scour depth (yas), in feet	12.9	16.4
1Flow angle of attack	35	35

See Comments/Diagram for justification where required