OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58190023 Date 7/18/12 Initials RWT Region (A B C (D))

Site 5030 Location from Brentford, 3.8 N, Mud Creek

Q_{100} = ~~3400 7200~~ by: drainage area ratio ~~____~~ flood freq. anal. _____ regional regression eq. X

Bridge discharge (Q_2) = ~~7200~~ 5030 (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 = 223 ft. Flow angle at bridge = 5 ° Abut. Skew = 6 ° Effective Skew = 5 °

Width (W_2) iteration = ________ ________ ________ ________

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

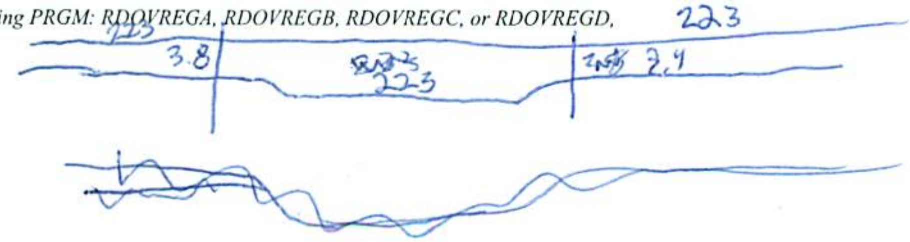
Corrected channel width at bridge Section = W_2 times cos of flow angle = 222.15 ft* $q_2 = Q_2/W_2$ = ~~32.4~~ 22.6 ft^2/s

Bridge Vel, V_2 = ~~2.8~~ 2.4 ft/s Final $y_2 = q_2/V_2$ = ~~11.4~~ 9.4 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = ~~11.5~~ 9.5 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 ft

Low Steel Elev. = ~~____~~ 11.1 ft

n (Channel) = ~~0.040~~ 0.033

n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2 ft

Pier Length = 2 ft

\# Piers for 100 yr = 3 ft

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

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ~~223~~ ft 223

Width of left overbank flow at approach, W_{lob} = ~~223~~ ft 223 Average left overbank flow depth, y_{lob} = 3.8 ft

Width of right overbank flow at approach, W_{rob} = ~~223~~ ft 223 Average right overbank flow depth, y_{rob} = ~~2.5~~ 3.4 ft

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

x = 3.97 From Figure 9 W_2 (effective) = 216.2 ft y_{cs} = 4.6 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, $V_c = 11.52 y_1^{1/6} D_{50}^{1/3}$ = __________ 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 = 8 Pier scour y_{ps} = 5.9 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.8 ft right abutment, y_{aRT} = 3.4 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} = 12.9 and ψ_{RT} = 12.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.2 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58190023 Date 7/18/12 Initials RJT Region (A B C (D)

Site 7200 Location from Brentford, 3.8 N

Q_{500} = Q100 ~~7900~~ 14500 by: drainage area ratio ~~✓~~ flood freq. anal. _____ regional regression eq. X

Bridge discharge (Q_2) = ~~10465~~ 6935 (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 = 223 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

Width (W_2) iteration = _____ _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = _____ _____ _____ _____ 30.8

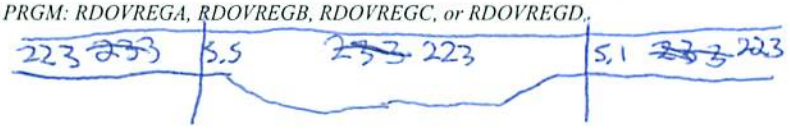
Corrected channel width at bridge Section = W_2 times cos of flow angle = 222.15 ft* $q_2 = Q_2/W_2$ = ~~45.0~~ ~~45.0~~ ft²/s

Bridge Vel, V_2 = ~~2.3~~ 2.8 ft/s Final $y_2 = q_2/V_2$ = ~~13.1~~ 11.1 ft Δh = 0.~~1~~ ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = ~~13.2~~ 11.2 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. = 0 ft

Low Steel Elev. = ~~[illegible]~~ 11.1 ft

n (Channel) = ~~0.033~~ 0.033

n (LOB) = 0.035 ~~0.030~~

n (ROB) = 0.035

Pier Width = 2.0 ft

Pier Length = 2.0 ft

Piers for 500 yr = 3 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ~~223~~ ft 223

Width of left overbank flow at approach, W_{lob} = ~~233~~ ft 223 Average left overbank flow depth, y_{lob} = 5.5 ft

Width of right overbank flow at approach, W_{rob} = ~~236~~ ft 223 Average right overbank flow depth, y_{rob} = 5.1 ft

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

x = 6.62 From Figure 9 W_2 (effective) = 216.2 ft y_{cs} = 7.4 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, $Vc = 11.52y_1^{1/6}D_{50}^{1/3}$ = _____ 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

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 = 6 Pier scour y_{ps} = 6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 5.5 ft right abutment, y_{aRT} = 5.1 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} = 15.9 and ψ_{RT} = 15.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15.2 ft

Route 395 Ave Stream Mud Creek MRM _____ Date 7/18/12 Initials TAT

Bridge Structure No. 58190023 Location At from Brentford, 3.8 N

GPS coordinates: N 45° 12' 40.91" W 98° 19' 45.91" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 ____

Drainage area = ~~652~~ 563 sq. mi. 563.27

The average bottom of the main channel was 16.6 ft below top of guardrail at a point 53 ft from left abutment.

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

Q50 5030

MISCELLANEOUS CONSIDERATIONS

Q100 7200

Flows	~~Q100~~ = 5030 ~~7200~~			~~Q500~~ = ~~7920~~ 14300		
Estimated flow passing through bridge	5030			~~7200~~ 6835		
Estimated road overflow & overtopping	0			~~0~~ 3534		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X		~~X~~		X
Chance of Pressure flow		X		X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

7/2

2	243
5	893
10	1710
25	3330
50	5030
100	7200
500	14300

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know ~~Some~~ minor pier/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 abut
2). main channel
3). right abut
4). pier
5-6). right abutment
7-8). left abutment
9). pier scour
10). main channel

Summary of Results

	~~Q100~~ Q50	~~Q500~~ Q100
Bridge flow evaluated	5030	6835
Flow depth at left abutment (yaLT), in feet	3.8	5.5
Flow depth at right abutment (yaRT), in feet	3.4	5.1
Contraction scour depth (ycs), in feet	4.6	7.4
Pier scour depth (yps), in feet	5.9	6
Left abutment scour depth (yas), in feet	12.9	15.9
Right abutment scour depth (yas), in feet	12.2	15.2
1Flow angle of attack	5	5

See Comments/Diagram for justification where required