OK by RFT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52433314 Date 9/21/12 Initials DLR Region (A B C D)

Site _____ Location ~~Creek~~ Creek Dr + Drainage Ditch in RC

Q_{100} = Q_{low} 2918 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2918 (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 = 54 ft. Flow angle at bridge = 20 ° Abut. Skew = 20 ° Effective Skew = 0 °

Width (W_2) iteration = _____ _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = _____ _____ _____ 54

Corrected channel width at bridge Section = W_2 times cos of flow angle = ~~54.74~~ 54 ft* $q_2 = Q_2/W_2$ = ~~57.5~~ 54 ft^2/s

Bridge Vel, V_2 = 8.4 ft/s Final $y_2 = q_2/V_2$ = 6.4 ft Δh = 1.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.9 ~~8.02~~ 5.4 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. = 0-0.3 ft

Low Steel Elev. = 6.4 ft

n (Channel) = 0.045

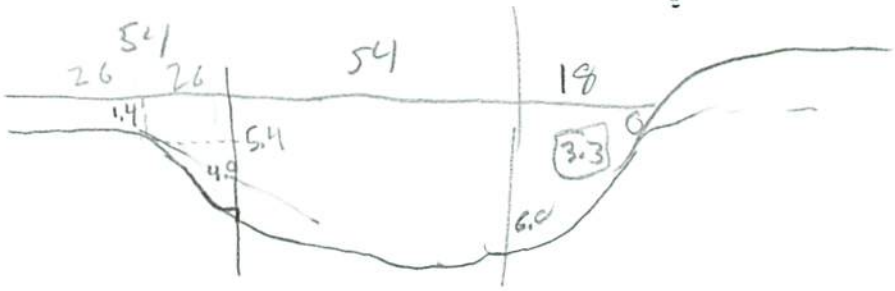
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = X ft

Pier Length = X ft

Piers for 100 yr = X ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 54 ft (54·0.5)·2/3 + (1.4)·1/3

Width of left overbank flow at approach, W_{lob} = 54 ft Average left overbank flow depth, y_{lob} = 2.3 ft

Width of right overbank flow at approach, W_{rob} = 18 ft Average right overbank flow depth, y_{rob} = 3.3 ft

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

PGRM: CWCSNEW

x = 5.06 / 2.44 From Figure 9 W_2 (effective) = ~~50.7~~ 54 ft y_{cs} = 3.0 ft

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = _____ ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = _____ 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} = 2.3 ft right abutment, y_{aRT} = 3.3 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} = 12

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 17.1 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 21.9 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52433314 Date 9/21/12 Initials RAL Region (A B C D)

Site _____ Location Creek Dr & Drainage Ditch

Q_{500} = 556 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 556 (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 = 54 ft. Flow angle at bridge = 20 ° Abut. Skew = 20 ° 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 = 54 ft* $q_2 = Q_2/W_2$ = 10.3 ft^2/s

Bridge Vel, V_2 = 4 ft/s Final $y_2 = q_2/V_2$ = 2.6 ft Δh = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 2.9 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,

6.4
-5.4
1.0

Water Surface Elev. = 0-0.3 ft

Low Steel Elev. = 6.4 ft

n (Channel) = 0.045

n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = X ft

Pier Length = X ft

Piers for 500 yr = X ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 54 ft

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

Width of right overbank flow at approach, W_{rob} = 6 ft Average right overbank flow depth, y_{rob} = 1.0 ft

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

x = 0.08 From Figure 9 W_2 (effective) = 54 ft y_{cs} = 0.1 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 = _____ 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} = 0 ft right abutment, y_{aRT} = 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} = 0 and ψ_{RT} = 4.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 7.5 ft

103.1966
44.06232

Jo → E St. Pat - Creek

Route Creek Dr Stream Drainage Ditch MRM _____ Date 9/21/12 Initials LaT

Bridge Structure No. 5243334 Location Creek Dr & Drainage Ditch

GPS coordinates: N 41° 31' 44.1" W 103° 11' 11.6" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 3.28 sq. mi.

The average bottom of the main channel was 10.6 ft below top of guardrail at a point 21 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q_{100}~~ Qlow steel			Q_{500} = 556		
Estimated flow passing through bridge				556		
Estimated road overflow & overtopping				0		
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	

7/3

2	13.1
5	40.2
10	69.9
25	127
50	193
100	277
500	556

Riprap at abutments? ____Yes X No ____Marginal minor abutment

Evidence of past Scour? X Yes ____No ____Don't know some contraction

Debris Potential? ____High ____Med X Low

Note: Flow much < than bridge design. Evaluated @ Qsoe and low steel Flows.

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	✓ 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

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

Summary of Results

	~~Q100~~ Qlow steel	Q500
Bridge flow evaluated	296	556
Flow depth at left abutment (yaLT), in feet	2.3	0
Flow depth at right abutment (yaRT), in feet	3.3	1.0
Contraction scour depth (ycs), in feet	3	0.1
Pier scour depth (yps), in feet	X	X
Left abutment scour depth (yas), in feet	17.1	0
Right abutment scour depth (yas), in feet	21.9	7.6
1Flow angle of attack	0	0

See Comments/Diagram for justification where required