OK TCT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 07241270 Date 7/20/12 Initials RA Region (A B C D)

Site ____ Location 1 mi E of Tacoma Park on 127 St

Q_{100} = Qs 1120 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1120 (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 = 78 ft. Flow angle at bridge = ~~10~~ 15° Abut. Skew = 15 ° 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 = ~~75.3~~ 78 ft* $q_2 = Q_2/W_2$ = ~~14.6~~ 14.4 ft^2/s

Bridge Vel, V_2 = 1.9 ft/s Final $y_2 = q_2/V_2$ = 7.4 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.5 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. = 0.6-1.5 ft

Low Steel Elev. = 6.2 ft

n (Channel) = 0.025

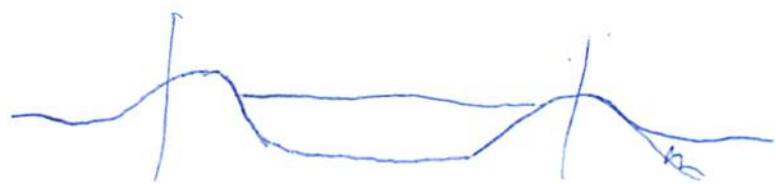
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.7 ft

Pier Length = 1.7 ft

\# Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 78 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} = 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 = 0.34 From Figure 9 W_2 (effective) = 74.6 ft y_{cs} = 0.6 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, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ____ 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 = 0.12 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 5.1 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0 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} = 0 and ψ_{RT} = 0

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

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 07241270 Date 7/20/12 Initials RaT Region (A B C (D))

Site ______ Location 1 mi E of Tacoma St on 127 St

Q_{500} = Q10 2280 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = ~~1833~~ 1356 (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 = 78 ft. Flow angle at bridge = ~~18~~ 15° Abut. Skew = 15~~0~~ ° Effective Skew = ~~10~~ 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 = ~~75.62~~ 78 ft* $q_2 = Q_2/W_2$ = 17.4 ft^2/s

Bridge Vel, V_2 = 2.1 ft/s Final $y_2 = q_2/V_2$ = 8.2 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.3 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. = 0.6+1.5 ft

Low Steel Elev. = 8.2 ft

n (Channel) = 0.025

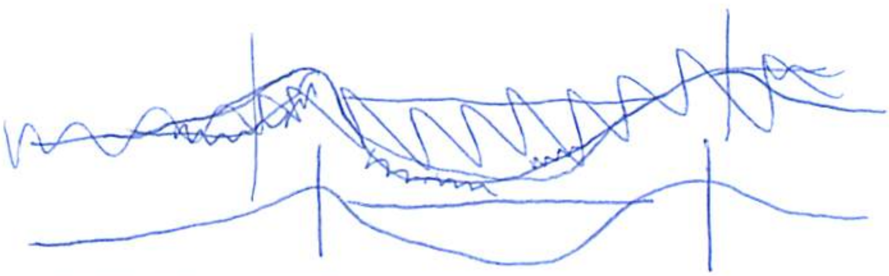
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.7 ft

Pier Length = 1.7 ft

\# Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 78 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} = 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 = 0.38 From Figure 9 W_2 (effective) = 74.6 ft y_{cs} = 0.6 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, $V_1 = Q_{500}/(y_1 W_1)$ = ____ 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: Pier

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

Froude # at bridge = 0.13 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 5.2 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0 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} = 0 and ψ_{RT} = 0

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

98.22591
45.54524

45° 32' 42.864"
98° 13' 33.276"

Route 127 St Stream Crow Ck Ditch MRM ______ Date 7/20/12 Initials RaT
Bridge Structure No. 07241270 Location 1 mi E of Tacoma Park on 127 St
GPS coordinates: N 45° 32' 43.1" taken from: USL abutment X centerline of ⇑ MRM end ______
W 98° 13' 33.3" Datum of coordinates: WGS84 X NAD27 ______
Drainage area = 897.62 sq. mi.
The average bottom of the main channel was 11.9 ft below top of guardrail at a point 35 ft from left abutment.
Method used to determine flood flows: ____Freq. Anal. ____drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = Q5 1120			Q_{500} = Q10 2280		
Estimated flow passing through bridge	1120			1356		
Estimated road overflow & overtopping	0			924		
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	

7/12	
2	271
5	1120
10	2280
25	4720
50	7360
100	10500
500	22700

Riprap at abutments? ____Yes ____No X Marginal Only on right abutment
Evidence of past Scour? X Yes ____No ____Don't know minor pier/abutment/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 embankment along abutments. X 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). pier
5). pier scour
6-7). right abutment
8-9). left abutment
10). main channel

Summary of Results

	Q100 Q5	Q500 Q10
Bridge flow evaluated	1120	1356
Flow depth at left abutment (yaLT), in feet	0	0
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	0.6	0.6
Pier scour depth (yps), in feet	5.1	5.2
Left abutment scour depth (yas), in feet	0	0
Right abutment scour depth (yas), in feet	0	0
1Flow angle of attack	0	0

See Comments/Diagram for justification where required