OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52830307 Date 8/11/11 Initials CL Region (A [✓ B] C D)

Site ____________ Location 0.3 mi N of Exit 101 on Jensen Rd

Q_{100} = 13600 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 12694 (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 = 96 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 96 ____ ____ ____

Avg. flow depth at bridge, y_2 iteration = 14.5 ⇒ > LS ____ ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 96 ft* $q_2 = Q_2/W_2$ = 132.2 ft²/s

Bridge Vel, V_2 = 9.4 ft/s Final $y_2 = q_2/V_2$ = 14 ft Δh = 1.8 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 15.8 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. = ____ ft

Low Steel Elev. = 14.0 ft

n (Channel) = 0.045

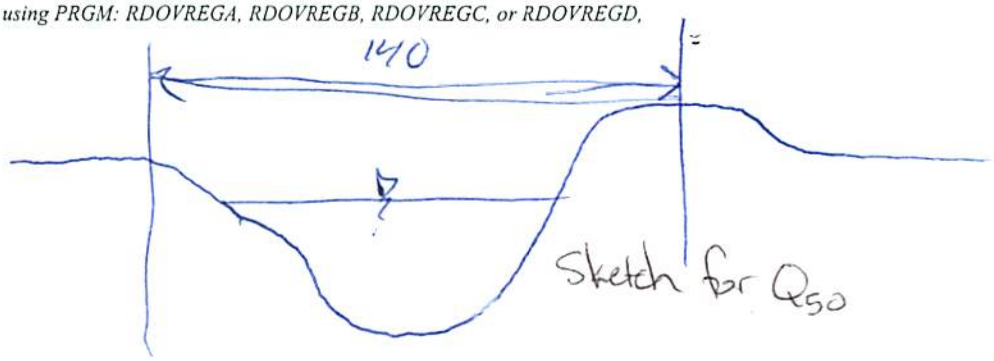
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.0 ft

Pier Length = 2.0 ft

\# Piers for 100 yr = 2 ft



Q50 CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 140 ft

Width of left overbank flow at approach, W_{lob} = ~~0.0~~ ft 96 Average left overbank flow depth, y_{lob} = ~~0.0~~ 1.2 ft

Width of right overbank flow at approach, W_{rob} = 0.0 ft Average right overbank flow depth, y_{rob} = 0.0 ft

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

x = ~~8.24~~ 8.53 From Figure 9 W_2 (effective) = 92 ft y_{cs} = ~~9.1~~ 9.4 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, $V_1 = Q_{100}/(y_1W_1)$ = ____ 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

L/a ratio = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.44 Using pier width a on Figure 11, ξ = 8.0 Pier scour y_{ps} = 7.1 ft

Q50 ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = ~~0.0~~ 1.2 ft right abutment, y_{aRT} = 0.0 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} = ~~0.0~~ 5.1 and ψ_{RT} = 0.0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = ~~0.0~~ 5.1 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0.0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52830307 Date 5/11/11 Initials Cw Region (A [✓ B] C D)

Site ______ Location 0.3 mi N of Exit 101 on Jensen Rd

Q50 ~~Q_{500}~~= 8860 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 4460 (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 = 96 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 96

Avg. flow depth at bridge, y_2 iteration = 11.6 → Vert Wall

Corrected channel width at bridge Section = W_2 times cos of flow angle = 96 ft* $q_2 = Q_2/W_2$ = 12.3 ft^2/s

Bridge Vel, V_2 = 4.0 ft/s Final $y_2 = q_2/V_2$ = 11.6 ft Δh = 1.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.9 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,

Water Surface Elev. = ____ ft

Low Steel Elev. = 14.0 ft

n (Channel) = 0.045

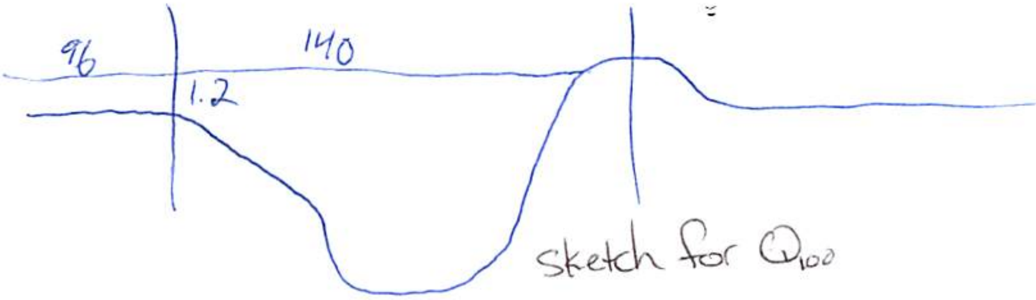
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.0 ft

Pier Length = 2.0 ft

\# Piers for 500 yr = 2 ft



~~Q100~~ CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 140 ft

Width of left overbank flow at approach, W_{lob} = ~~96~~ 9 ft Average left overbank flow depth, y_{lob} = ~~1.2~~ 0.0 ft

Width of right overbank flow at approach, W_{rob} = 0.0 ft Average right overbank flow depth, y_{rob} = 0.0 ft

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

x = ~~7.06~~ 6.73 From Figure 9 W_2 (effective) = 92 ft y_{cs} = ~~7.9~~ 7.5 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

PIER SCOUR CALCULATIONS

PGRM: Pie

L/a ratio = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.41 Using pier width a on Figure 11, ξ = 8.0 Pier scour y_{ps} = 2.0 ft

Q100 ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = ~~1.2~~0 ft right abutment, y_{aRT} = 0.0 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} = ~~5.1~~ 0 and ψ_{RT} = 0.0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = ~~5.1~~ 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0.0 ft

Route Jensen Rd Stream Bull Ck MRM ____ Date 8/11/11 Initials Cy

Bridge Structure No. 52830307 Location 0.3 mi N of Exit 10 on Jensen Rd

GPS coordinates: N 44° 04' 20.3" taken from: [✓ USL abutment] centerline of ⇑ MRM end ____
W 102° 23' 13.2" Datum of coordinates: [✓ WGS84] NAD27____

Drainage area = 51.48 sq. mi.

The average bottom of the main channel was 18.0 ft below top of guardrail at a point 29 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 13600			~~Q_{500}~~ = Q_{50} = 8860		
Estimated flow passing through bridge	12694			8860		
Estimated road overflow & overtopping	906			—		
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	

Peak Calc'd 8/1

Pk2	297
5	1200
10	2520
25	5470
50	8860
100	13600
500	31500

Riprap at abutments? [✓ Yes] ____No ____Marginal

Evidence of past Scour? ____Yes [✓ No] ____Don't know

Debris Potential? [✓ High] ____Med ____Low

Does scour countermeasure(s) appear to have been designed?

Riprap ____Yes ____No [✓ Don't know] ____NA

Spur Dike [✓ Yes] ____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____	Cobbles____	Boulders____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

Comments, Diagrams & orientation of digital photos

1907 - 1P
04 - US ~~[illegible]~~
09 - US RB/Spur dike
10 - US LB
11 - R. Abut
12 - L. Abut
13 - US Face
14 - Spur dike

Summary of Results

	Q100	~~Q500~~ Q50
Bridge flow evaluated	12694	8860
Flow depth at left abutment (yaLT), in feet	~~0.0~~ 1.2	~~1.2~~ 0
Flow depth at right abutment (yaRT), in feet	0.0	0.0
Contraction scour depth (ycs), in feet	~~[illegible]~~ ~~9.1~~ ~~[illegible]~~ 9.4	7.5 ~~7.9~~ ~~[illegible]~~
Pier scour depth (yps), in feet	7.1	7.0
Left abutment scour depth (yas), in feet	~~0.0~~ 5.1	~~5.1~~ 0
Right abutment scour depth (yas), in feet	0.0	0.0
1Flow angle of attack	0	0

See Comments/Diagram for justification where required

1 5 9 10
3600
2694
906