ok Pat

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 24338080 Date 9-21-12 Initials RFT Region (A (B) C D)

Site _____ Location 0.6 mi E of HWY 18 on 279 St

$Q_{100}^{max\ scour}$ 2116 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 2116 (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 = 15 ° Effective Skew = 5 °

Width (W_2) iteration = 54 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 7.4 _____ _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 53.79 ft* $q_2 = Q_2/W_2$ = 39.3 ft^2/s

Bridge Vel, V_2 = 5.3 ft/s Final $y_2 = q_2/V_2$ = 7.4 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.0 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. = ≈-0.3 ft

Low Steel Elev. = 7.4 ft

n (Channel) = .027

n (LOB) = 0.30

n (ROB) = 0.33

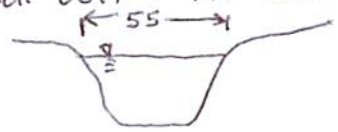
Pier Width = NA ft

Pier Length = NA ft

Piers for 100 yr = 0 ft

Because this is an irrigation canal, it doesn't have a "natural" drainage area and the flows from StreamStats are too small. Assume road/canal overflow occurs at y ≈ 7.4' and do single analysis of Q = 2116

this is a man-made canal with no overbanks



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 55 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 = 0.18 From Figure 9 W_2 (effective) = 53.8 ft y_{cs} = 0.3 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, $V_1 = Q_{100}/(y_1W_1)$ = _____ 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} = 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. 24338080 Date _____ Initials_____ Region (A (B) C D)

Site _____ Location 0.6 mi E of HWY 18 on 279 St

Q_{500} = _____ by: drainage area ratio_____ flood freq. anal. _____ regional regression eq. ____

Bridge discharge (Q_2) = _____ (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 = _____ft. Flow angle at bridge = _____° Abut. Skew = _____° Effective Skew = _____°

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 = _____ft* $q_2 = Q_2/W_2$ = _____ft^2/s

Bridge Vel, V_2 = _____ft/s Final $y_2 = q_2/V_2$ = _____ft Δh = _____ft

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

Low Steel Elev. = _____ ft

n (Channel) = _____

n (LOB) = _____

n (ROB) = _____

Pier Width = _____ ft

Pier Length = _____ ft

Piers for 500 yr = _____ ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = _____ft

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

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

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

x = _____ From Figure 9 W_2 (effective) =_____ft y_{cs} = _____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} = _____ft right abutment, y_{aRT} = _____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} = _____ and ψ_{RT} = _____

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

Route 279 St Stream Angostura Main Canal MRM _____ Date _____ Initials _____

Bridge Structure No. 24338080 Location 0.6 mi E of HWY 18 on 279 St

GPS coordinates: N 43° 21.699' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 103° 23.099' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = undefined sq. mi.

The average bottom of the main channel was 11.7 ft below top of guardrail at a point 14 ft from left abutment.

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

8/23

2	69.2
5	187
10	307
25	495
50	668
100	873
500	1490

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} max scour 2116			Q_{500} =		
Estimated flow passing through bridge	2116					
Estimated road overflow & overtopping	0					
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		✓				
Chance of Pressure flow		✓				
Armored appearance to channel		✓				
Lateral instability of channel		✓				

7/2 0.37

2	27.5
5	75.3
10	125
25	202
50	275
100	360
500	620

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 X	Cobbles ____	Boulders ____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

canal sides show gravel, but soil between is fine

Comments, Diagrams & orientation of digital photos

Str. no.
approach from bridge
LOB from bridge
ROB from bridge
Bridge from approach
Rt. abut.
left abut.

Summary of Results

	Q~~100~~ max scour	Q500
Bridge flow evaluated	2116	
Flow depth at left abutment (yaLT), in feet	0	
Flow depth at right abutment (yaRT), in feet	0	
Contraction scour depth (ycs), in feet	0.3	
Pier scour depth (yps), in feet	NA	
Left abutment scour depth (yas), in feet	0	
Right abutment scour depth (yas), in feet	0	
1Flow angle of attack	20° (50 eff)	

See Comments/Diagram for justification where required