SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 55151250 Date 10-11-11 Initials RT Region (A B (C) D)

Site _____ Location From Peever, 1E, 2N, 1.1E

Q_{100} = 3160 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 2590 (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 = 39 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 39 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 11.5 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 39 ft* $q_2 = Q_2/W_2$ = 66.4 ft²/s

Bridge Vel, V_2 = 5.8 ft/s Final $y_2 = q_2/V_2$ = 11.5 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.2 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,

low point east of road is just below bridge deck (10.9')
Bridge will not pass est. Q_{100}. Assume Q_{max} scour occurs at 11.5', or Q ≈ 2590

Water Surface Elev. = 0.7 ft

Low Steel Elev. = 9.3 ft

n (Channel) = .028

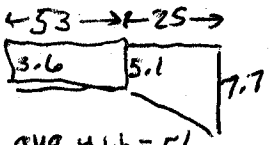
n (LOB) = .028

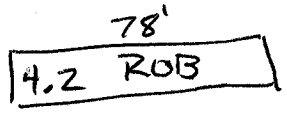
n (ROB) = .028

Pier Width = ____ ft

Pier Length = ____ ft

Piers for 100 yr = 0 ft





CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 66 ft

Width of left overbank flow at approach, W_{lob} = 78 ft Average left overbank flow depth, y_{lob} = 5.0 ft

Width of right overbank flow at approach, W_{rob} = 78 ft Average right overbank flow depth, y_{rob} = 4.2 ft

2 bridge widths

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

x = 18.09 From Figure 9 W_2 (effective) = 39 ft y_{cs} = 16.7 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 = _____ 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} = 5.0 ft right abutment, y_{aRT} = 4.2 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 and ψ_{RT} = 13.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 22.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 20.3 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 55151250 Date _____ Initials_____ Region (A B C D)

Site _____ Location _____

Q_{500} = 5180 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

$Q_{max\ scour} < Q_{100}$

see top sheet

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 125th St Stream Jorgenson River MRM _____ Date _____ Initials _____

Bridge Structure No. 55151250 Location from Peever, 1E, 2N, 1.1E

GPS coordinates: N 45° 34.342' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 96° 54.902' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = 131.21 (cont.) sq. mi.

The average bottom of the main channel was 14 ft below top of guardrail at a point 9 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 3160			Q_{500} = 5180		
Estimated flow passing through bridge	2590					
Estimated road overflow & overtopping	570					
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping			✓	✓		
Chance of Pressure flow	✓			✓		
Armored appearance to channel		✓			✓	
Lateral instability of channel			✓			✓

Riprap at abutments? ____Yes ____No X Marginal

Evidence of past Scour? X Yes ____No ____Don't know contraction scour pool under bridge, right wingwall scour

Debris Potential? ____High ____Med X Low no piers

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____	Sand X	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

Based on trash line on right overbank, water level was close to low steel this spring or summer.

Photos

Structure number
Bridge section from approach
left overbank
right overbank
approach from bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	2590	
Flow depth at left abutment (yaLT), in feet	5	
Flow depth at right abutment (yaRT), in feet	4.2	
Contraction scour depth (ycs), in feet	16.7	
Pier scour depth (yps), in feet	NA	
Left abutment scour depth (yas), in feet	22.4	
Right abutment scour depth (yas), in feet	20.3	
1Flow angle of attack	0°	

See Comments/Diagram for justification where required

Basin Characteristics from Provisional StreamStats 10-7-11

Cont. D.A. = 131.21

PII = 0.92

100% Subregion A

Manually Calculated Peaks

Q_{100} = 3160 cfs

Q_{500} = 5180 cfs