~~Re-do wrong Q values used~~ ~~OK RT~~ OK RT

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50232140 Date 6/19/12 Initials RAT Region ( A B (C) D )

Site ______ Location 2.2 mi E of Renner Corner on 258St

$Q_{100}$ = 3990 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = 3990 (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 = 108 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width ($W_2$) iteration = 108 74 ~~[illegible]~~ 88 84

Avg. flow depth at bridge, $y_2$ iteration = 8.5 ~~[illegible]~~ ~~9.4~~ 10.2 9.4 9.6

Corrected channel width at bridge Section = $W_2$ times cos of flow angle = 84 ft* $q_2 = Q_2/W_2$ = 46.2 $ft^2/s$

Bridge Vel, $V_2$ = 4.8 ft/s Final $y_2 = q_2/V_2$ = 9.6 ft $\Delta h$ = 0.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.1 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. = 0-1.0 ft

Low Steel Elev. = 13.4 ft

n (Channel) = 0.033

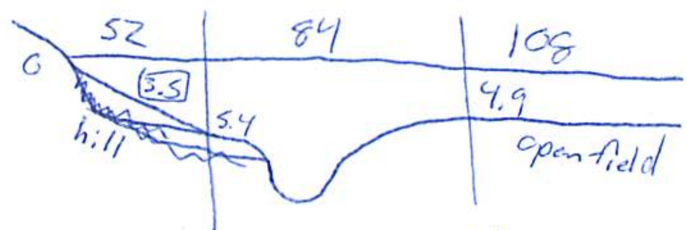
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 2.35 ft

Pier Length = 2.35 ft

# Piers for 100 yr = 2 ft




### CONTRACTION SCOUR

PGRM: Contract

5.4·2/3 = 10.4/3 = 3.5

Width of main channel at approach section $W_1$ = 84 ft

Width of left overbank flow at approach, $W_{lob}$ = 52 ft Average left overbank flow depth, $y_{lob}$ = ~~2.7~~ 3.5 ft

Width of right overbank flow at approach, $W_{rob}$ = 108 ft Average right overbank flow depth, $y_{rob}$ = 4.9 ft

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

$x$ = 6.38 From Figure 9 $W_2$ (effective) = 79.3 ft $y_{cs}$ = 7.1 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, $V_1 = Q_{100}/(y_1W_1)$ = ____ ft/s

Critical approach velocity, $V_c = 11.17y_1^{1/6}D_{50}^{1/3}$ = ____ 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 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.27 Using pier width a on Figure 11, $\xi$ = 9.1 Pier scour $y_{ps}$ = 7.5 ft

### ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, $y_{aLT}$ = 3.5 ft right abutment, $y_{aRT}$ = 4.9 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, $\psi_{LT}$ = 12.4 and $\psi_{RT}$ = 14.8

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 14.8 ft

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50232140 Date 6/19/12 Initials RAT Region ( A B (C) D )

Site ______ Location 2.2 mi E of Renner Corner on 258 St

$Q_{500}$ = 5890 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = ______ (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 = 108 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width ($W_2$) iteration = 108 91 94 ______

Avg. flow depth at bridge, $y_2$ iteration = 10.4 11.3 11.2 ______

Corrected channel width at bridge Section = $W_2$ times cos of flow angle = 94 ft* $q_2 = Q_2/W_2$ = 62.6 $ft^2/s$

Bridge Vel, $V_2$ = 5.6 ft/s Final $y_2 = q_2/V_2$ = 11.2 ft $\Delta h$ = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11.8 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. = 0-1.0 ft

Low Steel Elev. = 13.4 ft

n (Channel) = 0.033

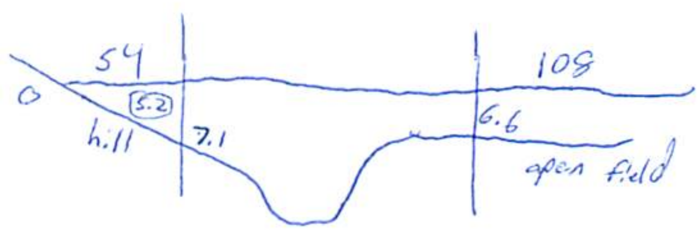
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 2.33 ft

Pier Length = 2.33 ft

# Piers for 500 yr = 2 ft




PGRM: Contract

### CONTRACTION SCOUR

Width of main channel at approach section $W_1$ = ~~8~~ 94 ft

Width of left overbank flow at approach, $W_{lob}$ = 54 ft Average left overbank flow depth, $y_{lob}$ = 5.2 ft

Width of right overbank flow at approach, $W_{rob}$ = 108 ft Average right overbank flow depth, $y_{rob}$ = 6.6 ft

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

$x$ = 8.58 From Figure 9 $W_2$ (effective) = 89.3 ft $y_{cs}$ = 9.5 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

PGRM: Pier

### PIER SCOUR CALCULATIONS

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

Froude # at bridge = 0.29 Using pier width a on Figure 11, $\xi$ = 9.1 Pier scour $y_{ps}$ = 7.6 ft

PGRM: Abutment

### ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT}$ = 5.2 ft right abutment, $y_{aRT}$ = 6.6 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, $\psi_{LT}$ = 15.4 and $\psi_{RT}$ = 17.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = ~~17.9~~ 17.9 ft

96° 40' 3.432''
43° 38' 43.08''

96.66762
43.6453

Route 256 St Stream ______ MRM ______ Date 6/19/12 Initials RAT

Bridge Structure No. 50232140 Location 2.2 mi E of Renner Corner on 258 St

GPS coordinates: N 43° 39' 43.3" W 96° 40' 3.4" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27 ______ ← correct location

Drainage area = 24.7 sq. mi.

The average bottom of the main channel was ok 17.4 ft below top of guardrail at a point 73 ft from left abutment.

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

6/15

| | |
|---|---|
| 2 | 419 |
| 5 | 1030 |
| 10 | 1570 |
| 25 | 2400 |
| 50 | 3100 |
| 100 | 3850 |
| 500 | 5880 |

### MISCELLANEOUS CONSIDERATIONS

| Flows | $Q_{100}$ = | 3880 | | $Q_{500}$ = | 5880 | |
|---|---|---|---|---|---|---|
| Estimated flow passing through bridge | | 3880 | | | 5880 | |
| Estimated road overflow & overtopping | | 0 | | | 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 | |

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know minor contraction is all.

Debris Potential? ____High ____Med X Low

wrong Q values

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

Riprap X Yes ____No ____Don't know ____NA rose quartz on upstream abutment

Spur Dike ____Yes X No ____Don't know ____NA

Other ____________ ____Yes X No ____Don't know ____NA

Bed Material Classification Based on Median Particle Size ($D_{50}$)

| Material | Silt/Clay X | 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

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

Summary of Results

| | Q100 | Q500 |
|---|---|---|
| Bridge flow evaluated | 3880 | 5880 |
| Flow depth at left abutment (yaLT), in feet | 3.5 | 5.2 |
| Flow depth at right abutment (yaRT), in feet | 4.9 | 6.6 |
| Contraction scour depth (ycs), in feet | 7.1 | 9.5 |
| Pier scour depth (yps), in feet | 7.5 | 7.6 |
| Left abutment scour depth (yas), in feet | ~~12.5~~ 12.4 | 15.4 |
| Right abutment scour depth (yas), in feet | 14.5 | 17.9 |
| 1Flow angle of attack | 0 | 0 |

See Comments/Diagram for justification where required