OK RT

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 68119196 Date 5/28/12 Initials RAL Region ( A B C D )

Site _____ Location Marne Ck & Locust St in Yankton

$Q_{100}$ = Qso 1490 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = 1490 (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 = 52 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° 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 = 52 ft* $q_2 = Q_2/W_2$ = 28.7 $ft^2/s$

Bridge Vel, $V_2$ = 3.9 ft/s Final $y_2 = q_2/V_2$ = 7.6 ft $\Delta h$ = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.9 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. = 0 ft

Low Steel Elev. = ~~10~~ 7.5 ft 16.3

n (Channel) = 0.050

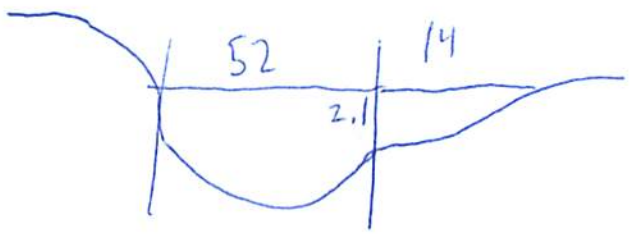
n (LOB) = 0.013

n (ROB) = 0.035

Pier Width = 0 ft

Pier Length = 0 ft

# Piers for 100 yr = 0 ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 52 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, $W_{rob}$ = 14 ft Average right overbank flow depth, $y_{rob}$ = 2.1 ft

3.1 - 2/3 6.2/3 2.1

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

x = 0.47 From Figure 9 $W_2$ (effective) = 52 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, $\xi$ = _____ Pier scour $y_{ps}$ = _____ ft

PGRM: Abutment

### ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT}$ = 0 ft right abutment, $y_{aRT}$ = 2.1 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, $\psi_{LT}$ = 0 and $\psi_{RT}$ = 8.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.9 ft

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 68119196 Date 5/25/12 Initials RaT Region ( A B C D )

Site _____ Location Marne Ck & Locust St in Yankton

$Q_{500}$ = Q100 2120 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = 15000 (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 = 52 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° 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 = 52 ft* $q_2 = Q_2/W_2$ = 30.5 $ft^2/s$

Bridge Vel, $V_2$ = 3.9 ft/s Final $y_2 = q_2/V_2$ = 7.8 ft $\Delta h$ = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.1 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 ft

Low Steel Elev. = 7.8 ft

n (Channel) = 0.056

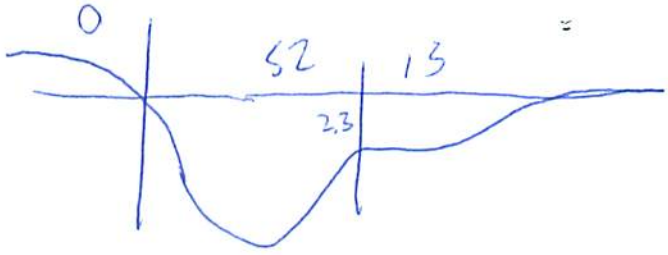
n (LOB) = 0.013

n (ROB) = 0.025

Pier Width = 0 ft

Pier Length = 0 ft

# Piers for 500 yr = 0 ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 52 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, $W_{rob}$ = 15 ft Average right overbank flow depth, $y_{rob}$ = 2.3 ft

3.4, 2/3 = 0.6/3 = 2.3

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

$x$ = 0.57 From Figure 9 $W_2$ (effective) = 52 ft $y_{cs}$ = 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, $V_1 = Q_{500}/(y_1 W_1)$ = _____ 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

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, $\xi$ = _____ Pier scour $y_{ps}$ = _____ ft

PGRM: Abutment

### ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT}$ = 0 ft right abutment, $y_{aRT}$ = 2.3 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, $\psi_{LT}$ = 0 and $\psi_{RT}$ = 9.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 14 ft

Route Locust St Stream Marne Ck MRM _____ Date ~~5/26/12~~ 5/29/12 Initials Rat

Bridge Structure No. 68119196 Location Marne Ck & Locust St in Yankton

GPS coordinates: N 42° 53' 10.1" W 97° 23' 58.9" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 22.4 sq. mi.

The average bottom of the main channel was 16.3 ft below top of guardrail at a point 21 ft from left abutment.

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

8/26

| | |
|---|---|
| 2 | 80.5 |
| 5 | 279 |
| 10 | 524 |
| 25 | 1000 |
| 50 | 1490 |
| 100 | 2120 |
| 500 | 4170 |

## MISCELLANEOUS CONSIDERATIONS

| Flows | $Q_{\sim\sim}^{50}{}_{100}$ = 1490 | | | $Q_{\sim\sim}^{100}{}_{500}$ = 2120 | | |
|---|---|---|---|---|---|---|
| Estimated flow passing through bridge | 1490 | | | 1585 | | |
| Estimated road overflow & overtopping | 0 | | | 530 | | |
| Consideration | Yes | No | Possibly | Yes | No | Possibly |
| Chance of overtopping | | X | | X | | |
| Chance of Pressure flow | | | X | X | | ~~X~~ |
| Armored appearance to channel | | X | | | X | |
| Lateral instability of channel | | X | | | X | |

5/29

| | |
|---|---|
| 2 | 80.5 |
| 5 | 279 |
| 10 | 524 |
| 25 | 1000 |
| 50 | 1490 |
| 100 | 2120 |
| 500 | 4170 |

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? ~~X~~ Yes ~~X~~ No ____Don't know

Debris Potential? ____High ____Med X Low

~~X~~ Yes ~~X~~ No ____Don't know

malmost dry abutment & contraction scour

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 _____ | X Yes | ~~X~~ No | ____Don't know | ____NA |

concrete walkway

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

1). main channel
2). abutment scour (left)
3) left abut
4). left abut
5). right abut
6) right abut
7). pier scour
8). right OB
9) left OB
10) left OB
11). right OB

Summary of Results

| | ~~Q100~~ 50 | ~~Q500~~ 100 |
|---|---|---|
| Bridge flow evaluated | 1490 | 1585 |
| Flow depth at left abutment (yaLT), in feet | 0 | 0 |
| Flow depth at right abutment (yaRT), in feet | 2.1 | 2.3 |
| Contraction scour depth (ycs), in feet | 0.6 | 1 |
| Pier scour depth (yps), in feet | ~~0~~ NA | ~~0~~ NA |
| Left abutment scour depth (yas), in feet | 0 | 0 |
| Right abutment scour depth (yas), in feet | 12.9 | 14 |
| 1Flow angle of attack | 0 | 0 |

See Comments/Diagram for justification where required