OK RT

check

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 30250208 Date 7/9/12 Initials RJ Region (A B (C) D)

Site ____________ Location 7.1 mi N of Vayland on 369 Ave

Q_{100} = 5250 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 5250 (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 = 84 ft. Flow angle at bridge = 30 ° Abut. Skew = 0 ° Effective Skew = 30 °

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 = 72.75 ft* $q_2 = Q_2/W_2$ = 72.2 ft^2/s

Bridge Vel, V_2 = 6 ft/s Final $y_2 = q_2/V_2$ = 12 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.7 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. = 3.0-4.1 ft

Low Steel Elev. = 14.2 ft 2.05 1.73

n (Channel) = 0.045

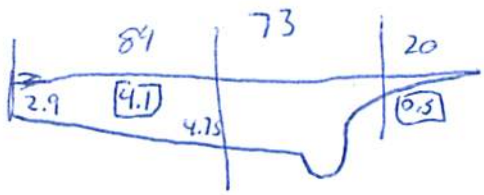
n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1.75 ft

Pier Length = 1.75 ft

\# Piers for 100 yr = 2 ft



5.4
2.5

CONTRACTION SCOUR

PGRM: Contract

4.75 → 2.9
→ 5.4
7.25

Width of main channel at approach section W_1 = ~~84~~ 73 ft

Width of left overbank flow at approach, W_{lob} = 84 ft Average left overbank flow depth, y_{lob} = 4.1 ft

Width of right overbank flow at approach, W_{rob} = 20 ft Average right overbank flow depth, y_{rob} = 0.5 ft

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

x = 3.72 From Figure 9 W_2 (effective) = 69.3 ft y_{cs} = 4.3 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, $V_1 = Q_{100}/(y_1 W_1)$ = ______ 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1.

Froude # at bridge = 0.31 Using pier width a on Figure 11, ξ = 7.2 Pier scour y_{ps} = 6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 4.1 ft right abutment, y_{aRT} = 0.5 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} = 13.4 and ψ_{RT} = 2.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 13.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 2.3 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 30250208 Date 7/9/12 Initials RaT Region (A B (C) D)

Site ________ Location 7.1 mi. N of Wayland on 369 Ave

Q_{500} = 10800 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 7375 (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 = 84 ft. Flow angle at bridge = 30 ° Abut. Skew = 0 ° Effective Skew = 30 °

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 = 72.75 ft* $q_2 = Q_2/W_2$ = 101.4 ft²/s

Bridge Vel, V_2 = 7.1 ft/s Final $y_2 = q_2/V_2$ = 14.2 ft Δh = 1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 15.2 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. = ~~34~~ 3.0 -4.1 ft

Low Steel Elev. = 14.2 ft

n (Channel) = 0.045

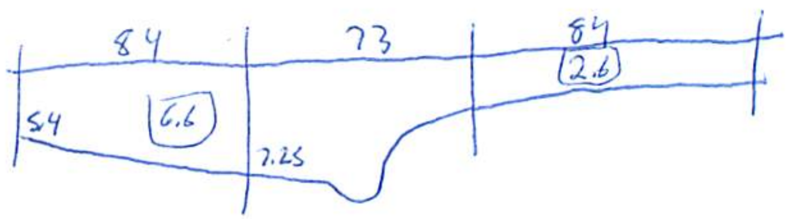
n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1.75 ft

Pier Length = 1.75 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 73 ft

Width of left overbank flow at approach, W_{lob} = 384 ft Average left overbank flow depth, y_{lob} = 6.6 ft

Width of right overbank flow at approach, W_{rob} = 84 ft Average right overbank flow depth, y_{rob} = 2.6 ft

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

x = 8.18 From Figure 9 W_2 (effective) = 69.3 ft y_{cs} = 9 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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ________ 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.33 Using pier width a on Figure 11, ξ = 7.2 Pier scour y_{ps} = 6.1 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 6.6 ft right abutment, y_{aRT} = 2.6 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, ψ_{LT} = 17.9 and ψ_{RT} = 10.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 17.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 10.6 ft

98° 48' 27"
44° 35' 42.972"

98.8075
44.59527

Route 369 Ave Stream Turtle Ck MRM________ Date 7/9/12 Initials RT

Bridge Structure No. 30250208 Location 7.1 mi N of Vayland on 369 Ave

GPS coordinates: N 44° 35' 39.9" W 98° 48' 26.5" taken from: USL abutment ✓ centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27_____

Drainage area = 137.95 sq. mi.

The average bottom of the main channel was 18.0 ft below top of guardrail at a point 43 ft from left abutment.

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

6/20
8/24.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 5250			Q_{500} = 10800		
Estimated flow passing through bridge	5250			7375		
Estimated road overflow & overtopping	0			3425		
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	

2	125
5	545
10	1120
25	2310
50	3590
100	5250
500	10800

~~Mostly on left~~, vast majority on left.

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know

Debris Potential? ____High ____Med X Low

noticeable pier & contraction. Very heavy scour on left abutment. Hard to tell through pictures but scoured under abutment. Riprap/concrete has been placed in the spot

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

Riprap X Yes ____No ____Don't know ____NA

Spur Dike ____Yes X No ____Don't know ____NA

Other ________________ ____Yes X No ____Don't know ____NA

- rose quartz on left abutment. also appears to have additional concrete where previous scour occurred

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

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

Summary of Results

	Q100	Q500
Bridge flow evaluated	5250	7375
Flow depth at left abutment (yaLT), in feet	4.1	6.6
Flow depth at right abutment (yaRT), in feet	0.5	2.6
Contraction scour depth (ycs), in feet	4.3	9
Pier scour depth (yps), in feet	6	6.1 6.1
Left abutment scour depth (yas), in feet	13.4	17.9
Right abutment scour depth (yas), in feet	2.3	10.6
1Flow angle of attack	30	30

See Comments/Diagram for justification where required