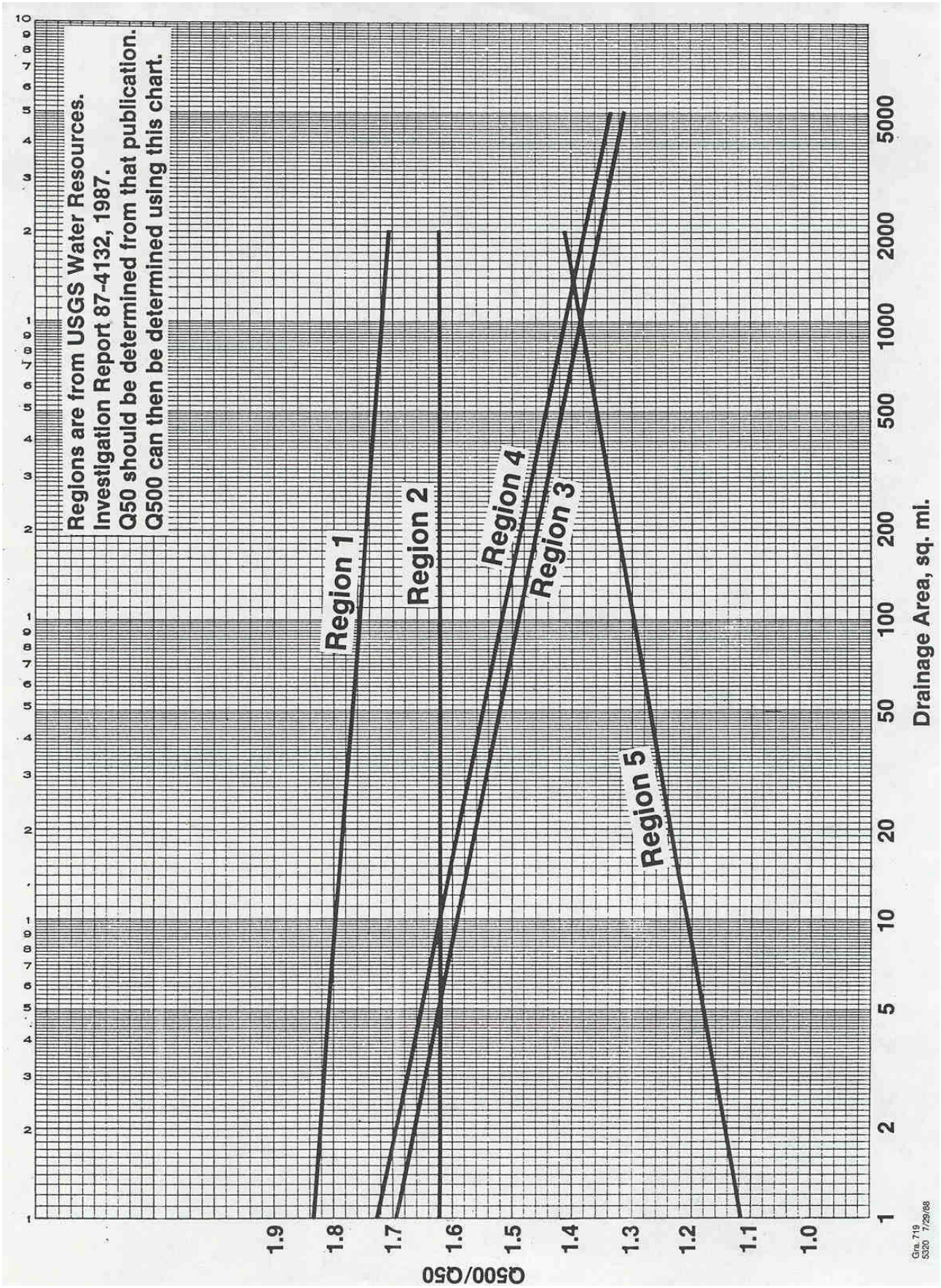
Guidelines For Preliminary Design Of Bridges And Culverts

Appendix B

Bridges


Regions are from USGS Water Resources.
Investigation Report 87-4132, 1987.
Q50 should be determined from that publication.
Q500 can then be determined using this chart.
Region 1
Region 2
Region 3
Region 4
Region 5
Q500/Q50
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
Drainage Area, sq. mi.
1
2
5
10
20
50
100
200
500
1000
2000
5000
Gra. 719
S320 7/29/88

Iowa Flood Profile Reports
Prepared by the U.S. Geological Survey

The number of each report below corresponds to the number shown on the map. Copies of these reports are available upon request from the Iowa District office (319-337-4191). This list and map may also be found at http://iowa.usgs.gov/

1) Schwob, H.H., 1963, Cedar River Basin floods: Iowa Highway Research Board Bulletin No. 27, 59 p.

2) Schwob, H.H., and Meyers, R.E., 1965, The 1965 Mississippi River flood in Iowa: U.S. Geological Survey Open-File Report, 46 p.

3) Schwob, H.H., 1966, Little Sioux River Basin floods: U.S. Geological Survey Open-File Report, 60 p.

4) ____1967, Floods on Otter Creek in Linn County, Iowa: U.S. Geological Survey Open-File Report, 22 p.

5) ____1968, Flood of June 7, 1967, in the Wapsinonoc Creek Basin, Iowa: U.S. Geological Survey Open-File Report, 21 p.

6) U.S. Geological Survey, 1968, Flood profile study, Squaw Creek, Linn County, Iowa, U.S. Geological Survey Open-File Report, 13 p.

7) Schwob, H.H., 1970, Floods in the upper Des Moines River Basin, Iowa: U.S. Geological Survey Open-File Report, 49 p.

8) ____1970, Flood profile study, Morgan Creek, Linn County, Iowa: U.S. Geological Survey Open-File Report, 16 p.

9) ____1970, Flood of March 3, 1970, on Old Mans Creek, Johnson County, Iowa: U.S. Geological Survey Open-File Report, 9 p.

10) ____1970, Flood profile study, Hoosier Creek, Linn County, Iowa: U.S. Geological Survey Open-File Report, 18 p.

11) ____1971, Floods in the Wapsipinicon River Basin, Iowa: U.S. Geological Survey Open-File Report, 52 p.

12) Heinitz, A.J., 1973, Floods in the Iowa River Basin upstream from Coralville Lake, Iowa: U.S. Geological Survey Open-File Report, 75 p.

13) ____1973, Flood of August 2, 1972, in the Little Maquoketa River Basin, Dubuque County, Iowa: U.S. Geological Survey Open-File Report, 28 p.

14) ____1973, Floods in the Rock River Basin, Iowa: U.S. Geological Survey Open-File Report, 74 p.

15) Lara, O.G., and Heinitz, A.J., 1976, Flood of June 27, 1975 in City of Ames, Iowa: U.S. Geological Survey Open-File Report, 56 p.

16) Heinitz, A.J., 1977, Floods in the Big Creek Basin, Linn County, Iowa, U.S. Geological Survey Open-File Report 77-209, 35 p.

17) Heinitz, A.J., and Wiitala, S.W., 1978, Floods in the Skunk River Basin, Iowa: U.S. Geological Survey Open-File Report 79-272, 80 p.

18) Heinitz, A.J., 1979, Supplement to floods in the upper Des Moines River Basin, Iowa: U.S. Geological Survey Open-File Report 79-1486, 6 p.

19) ____1980, Floods in the Raccoon River Basin, Iowa: U.S. Geological Survey Open-File Report 80-162, 110 p.

20) Heinitz, A.J., and Riddle, D.E., 1981, Floods in the English River Basin, Iowa: U.S. Geological Survey Open-File Report 81-67, 61 p.

21) Heinitz, A.J., 1986, Floods in south-central Iowa: U.S. Geological Survey Open-File Report 85-100, 95 p.

22) ____1986, Floods of June-July, 1982, in Iowa: U.S. Geological Survey Open-File Report 85-151, 18 p.

23) ____1986, Floods in the Floyd River Basin, Iowa: U.S. Geological Survey Open-File Report 86-476, 61 p.

24) Eash, D.A., and Heinitz, A.J., 1991, Floods in the Nishnabotna River Basin, Iowa: U.S. Geological Survey Open-File Report 91-171, 118 p.

25) Baebenroth, R.W., and Schaap, B.D., 1992, Floods of 1986 and 1990 in the Raccoon River Basin, west-central Iowa: U.S. Geological Survey Open-File Report 92-94, 144 p.

26) Barnes, K.K., and Eash, D.A., 1994, Flood of June 17, 1990, in the Clear Creek Basin, east-central Iowa: U.S. Geological Survey Open-File Report 94-78, 21 p.

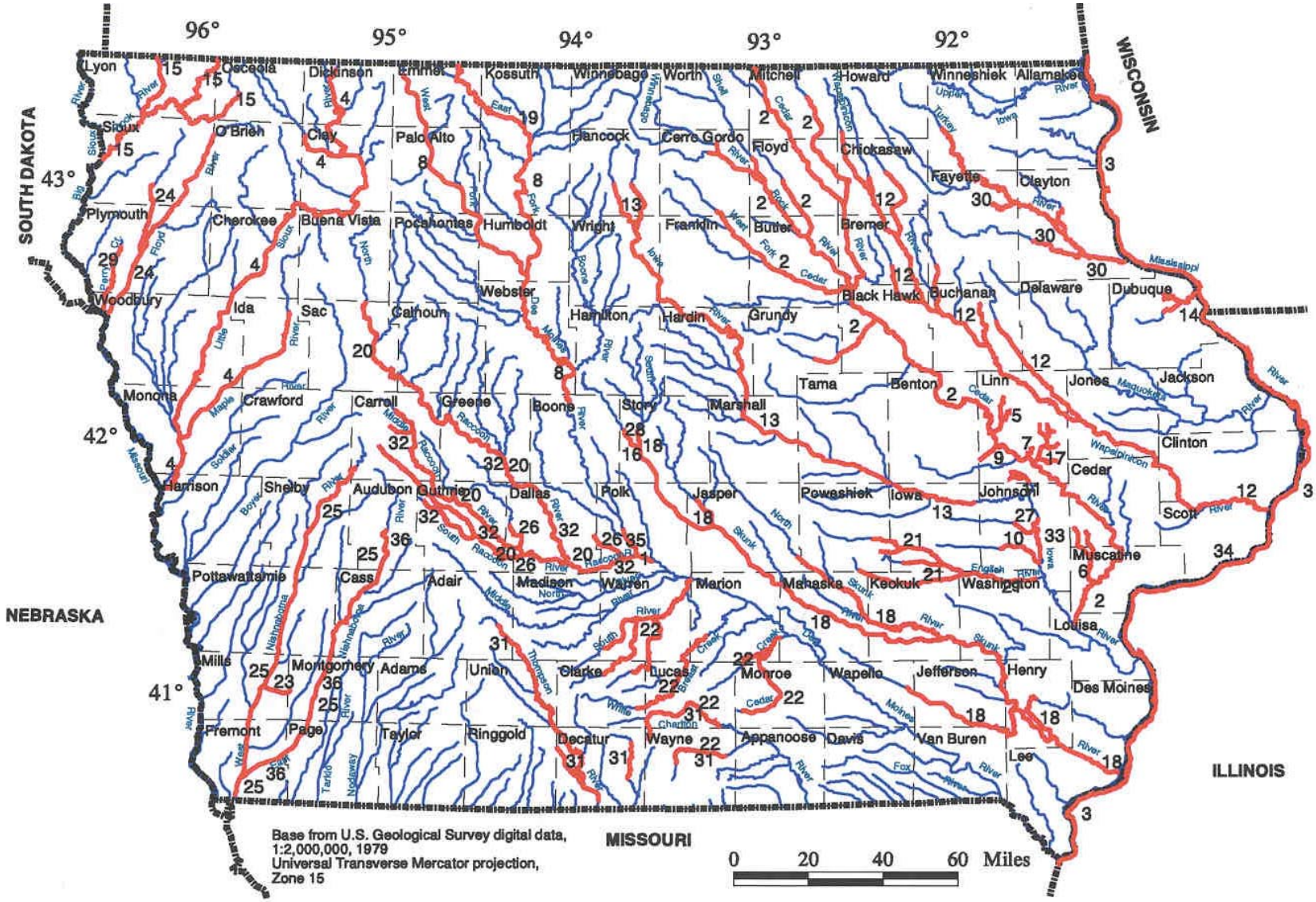
27) Einhellig, R.F., and Eash, D.A., 1996, Floods of June 17, 1990, and July 9, 1993, along Squaw Creek and the South Skunk River in Ames, Iowa, and vicinity: U.S. Geological Survey Open-File Report 96-249, 34 p.

28) Eash, D.A., 1996, Flood of May 19, 1990, along Perry Creek in Plymouth and Woodbury Counties, Iowa: U.S. Geological Survey Open-File Report 96-476, 39 p.

29) Eash, D.A., and Koppensteiner, B.A., 1996, Floods of July 12, 1972, March 19, 1979, and June 15, 1991, in the Turkey River Basin, northeast Iowa: U.S. Geological Survey Open-File Report 96-560, 55 p.

30) ____1997, Floods of September 15-16, 1992, in the Thompson, Weldon, and Chariton River Basins, south-central Iowa: U.S. Geological Survey Open-File Report 97-122, 68 p.

31) ____1997, Flood of July 9-11, 1993, in the Raccoon River Basin, west-central Iowa: U.S. Geological Survey Open-File Report 97-557, 117p.



RIVER REACHES IN IOWA WHERE WATER-SURFACE ELEVATIONS FOR MEASURED FLOOD EVENTS AND/OR THEORETICAL FLOOD FREQUENCIES HAVE BEEN PROFILED IN REPORTS PREPARED BY THE U.S. GEOLOGICAL SURVEY

(Numbers alongside highlighted (red) river reaches reference flood-profile reports on attached list.)

Corps of Engineers Flood Plain Information Studies

	Stream	County	District	Date of Completion
1	Indian and Dry Creeks at Cedar Rapids	Linn County	Rock Island	December 1964
2	Duck Creek at Davenport and Bettendorf	Scott County	Rock Island	July 1965
3	Prairie Creek at Cedar Rapids	Linn County	Rock Island	February 1966
4	Skunk River and Squaw Creek at Ames	Story County	Rock Island	June 1966
5	Cedar River	Linn County	Rock Island	October 1967
6	*Badger Creek, Odebolt Creek, and Maple River at Ida Grove	Ida County	Omaha	April 1968
7	Black Hawk Creek	Black Hawk County	Rock Island	December 1968
8	East Fork Hundred and Two River at Bedford	Taylor County	Kansas City	January 1969
9	Mississippi River	Scott and Muscatine Counties	Rock Island	June 1969
10	Des Moines River at Des Moines	Polk County	Rock Island	April 1970
11	North Raccoon River at Sac City	Sac County	Rock Island	June 1970
12	Cedar River, Evansdale, Waterloo, and Cedar Falls	Black Hawk County	Rock Island	June 1970
13	*Crow Creek at Bettendorf	Scott County	Rock Island	May 1971
14	Little Sioux River, Ocheyedan River, and Muddy Creek at Spencer	Clay County	Omaha	June 1971
15	Wapsinonoc Creek at West Liberty	Muscatine County	Rock Island	June 1971
16	Wapsipinicon River and Malone Creek at Independence	Buchanan County	Rock Island	June 1972
17	*Mad Creek at Muscatine	Muscatine County	Rock Island	December 1972
18	Mississippi River	Clinton and Jackson Counties	Rock Island	June 1973
19	Winnebago River and tributaries at Forest City	Hancock and Winnebago Counties	Rock Island	June 1973
20	North Fork Maquoketa River and tributaries at Dyersville	Delaware County	Rock Island	June 1973
21	Perry Creek at Sioux City	Woodbury County	Omaha	October 1973
22	Winnebago River at Mason City	Cerro Gordo County	Rock Island	June 1974
23	Willow Creek and tributaries at Mason City	Cerro Gordo County	Rock Island	June 1974
24	Mississippi River	Clayton, Dubuque, and Jackson Counties	Rock Island	October 1974
25	Mississippi River	Lee, Des Moines, and Louisa Counties	Rock Island	October 1974
26	Skunk River north of Ames	Story County	Rock Island	June 1975
27	Nodaway River and North Branch at Clarinda	Page County	Kansas City	November 1975

* Special Flood Hazard Investigation Report

Standard Continuous Concrete Slab Bridge Lengths

English Units		
Total Bridge Length, ft	**End Spans, ft**	**Interior Span, ft**
70-0	21-0	28-0
80-0	24-6	31-0
90-0	27-6	35-0
100-0	30-6	39-0
110-0	33-6	43-0
120-0	36-6	47-0
130-0	39-6	51-0

Metric Units		
Total Bridge Length, mm	**End Spans, mm**	**Interior Span, mm**
21 000	6 400	8 200
24 000	7 300	9 400
27 000	8 200	10 600
30 000	9 100	11 800
33 000	10 000	13 000
36 000	11 000	14 000
39 000	12 000	15 000

Standard Prestressed Concrete Beam Lengths

Nominal Length, feet					
Beam type	**A**	**B**	**C**	**D**	**BT**
Beam depth, ft	**2-8**	**3-3**	**3-9**	**4-6**	**6-0**
	30-0	30-0	30-0	35-0	120-0
	34-2	34-2	34-2	40-0	125-0
	38-4	38-4	38-4	45-0	130-0
	42-6	42-6	42-6	50-0	135-0
	46-8	46-8	46-8	55-0	140-0
	50-10	50-10	50-10	60-0	
	55-0	55-0	55-0	65-0	
		59-2	59-2	70-0	
		63-4	63-4	75-0	
		67-6	67-6	80-0	
			71-8	85-0	
			75-10	90-0	
			80-0	95-0	
				100-0	
				105-0	
				110-0	
				115-0	
				120-0	

Nominal Length, mm					
Beam type	**A**	**B**	**C**	**D**	**BT**
Beam depth, mm	**810**	**990**	**1140**	**1370**	**1200**
	9 500	9 500	9 500	11 000	36 500
	11 000	11 000	11 000	12 500	38 000
	12 500	12 500	12 500	14 000	39 500
	14 000	14 000	14 000	15 500	41 000
	15 500	15 500	15 500	17 000	42 500
	17 000	17 000	17 000	18 500	
		18 500	18 500	20 000	
		20 000	20 000	21 500	
			21 500	23 000	
			23 000	24 500	
			24 500	26 000	
				27 500	
				29 000	
				30 500	
				32 000	
				33 500	
				35 000	
				36 500	

The normal distance from centerline-of-beam-bearing to centerline-of-pier is 9 inches (250 mm) for the A-D series. This distance is 12 inches (300 mm) for the BT series. Exceptions to this requires approval from the Office of Bridges and Structures.

Determining Wing Dike Lengths

The use of wing dikes (also called spur dikes or guide banks) shall be considered at any bridge site that has appreciable overbank discharge. Wing dikes help minimize backwater and scour effects. Refer to IDOT's Office of Design Standard RL-3 for specific details on slopes, dimensions and other notes. Items that need to be specified for RL-3 include Length and Station Location.

Generally, the top of dike elevation will be the same as the abutment berm elevation. However, if this berm elevation is much higher than the Q_{50} or Q_{100} elevations, a lower wing dike elevation may be specified.

The following guidelines provide assistance in determining appropriate wing dike lengths. "Long" and "Short" refer to the longer and shorter wing dikes necessary on skewed bridges as shown on RL-3. If obtaining right of way for the recommended length is a problem at a bridge site, a shortened wing dike is preferred over no dike.

Wing Dike Lengths, in feet (meters)							
Bridge Length, feet (meters)	Bridge Skew						
	0 deg.	15 deg.		30 deg.		45 deg.	
	Equal	Long	Short	Long	Short	Long	Short
< 150 (45)	40 (12)	45 (14)	40 (12)	60 (18)	40 (12)	85 (26)	40 (12)
150-180 (45-55)	50 (16)	60 (19)	50 (16)	80 (24)	50 (16)	120 (36)	50 (16)
180-210 (55-65)	65 (20)	75 (23)	65 (20)	100 (30)	65 (20)	150 (45)	65 (20)
210-240 (65-75)	80 (24)	95 (28)	80 (24)	120 (36)	80 (24)	180 (54)	80 (24)
> 240 (75)	95 (28)	105 (32)	95 (28)	140 (42)	95 (28)	205 (63)	95 (28)

Checklist for Situation Plan
for Bridges

General

_____ Benchmark description
_____ Vertical curve data
_____ Horizontal curve data
_____ Traffic estimate
_____ Hydraulic data table
_____ Location table
_____ Minimum vertical clearance table. (Actual minimum elevation location shown on Plan View.)
_____ Beam type, span lengths in Title Block
_____ Skew angle of actual design shown in Title Block
_____ Project number, file number, design number, CADD file name
_____ Typical approach roadway drawing showing actual traveled lane widths
_____ Scale bar (shown on the preliminary Situation Plan but will be removed in Final Design during the development of the final Situation Plan).
_____ North arrow
_____ Staging details
_____ DNR or 404 Permit numbers
_____ Engineering certification notes and signature for structures needing DNR Flood Plain Permit
_____ Note: "All units are in XXX unless otherwise noted."

Plan View

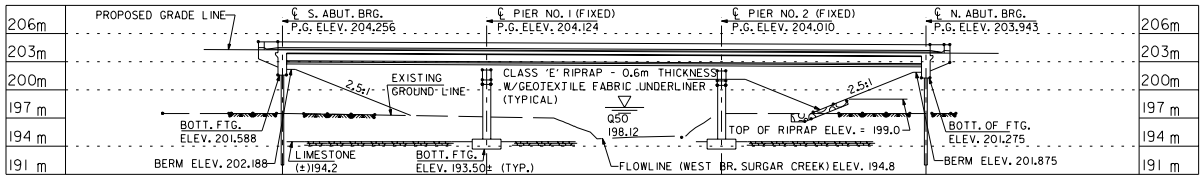
_____ Label "Situation Plan"
_____ Ground elevations, contours, and topography. Label contour elevations.
_____ Existing utilities, fencelines, tiles, etc.
_____ Existing streambank and edge of water
_____ Stream name and direction of flow
_____ Existing structures, including description and design number, if known
_____ Proposed span lengths and total bridge length (centerline-to-centerline abutments)
_____ Proposed stations of center of piers and centerline of abutments
_____ Label all centerlines
_____ Actual intersecting skew angle of two roads shown on plan view.
_____ POT stationing of roadway construction centerline intersection
_____ Centerline elevations
_____ Proposed embankment and channel shaping
_____ Label stationing on at least two "tic" marks in the plan view
_____ Actual minimum vertical clearance location
_____ Actual minimum clear zone (distance and location)
_____ Actual minimum clear distance from center of railroad tracks to face of pier
_____ Pipe or box culverts adjacent to or under bridge

_____ Future proposed work by others (e.g., bike trail, ramp, etc.)
_____ Proposed guardrail
_____ Arrows for direction of traffic for overhead bridge plans
_____ Location and designation of soil test holes
_____ Check that all text and dimensioning is legible and not placed on top of other text or features such as riprap details or contour lines
_____ Slope protection (e.g., macadam, concrete)
_____ Label type, location and limits of features such as riprap, wing dikes, and channel changes. Provide typical cross section.

Longitudinal Section

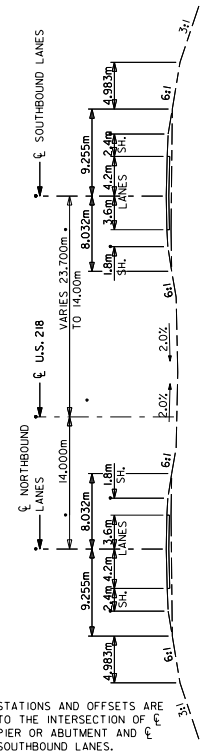
_____ Existing ground line and proposed grade line shown and labeled
_____ Existing substructure, including piling (from old plans)
_____ Profile grade elevations at center of piers and centerline of abutments
_____ Berm elevations at abutments
_____ Berm slope labeled (e.g., 2.5:1 Normal)
_____ Slope protection (e.g., macadam, concrete, riprap)
_____ Streambed elevation
_____ 50-year highwater elevation (without backwater)
_____ Actual minimum vertical clearance distance and location
_____ Calculated 100-year scour elevation (adjusted to account for actual soils information, if available)
_____ Approximate pier footing elevations for bridges over railroads

BENCH MARK NO.527 STA. 161+77.99 LT. 63.89m
ELEV. 204.546, CUT SQUARE ON TOP OF BARRIER
RAIL @ S.E. CORNER OF BRIDGE.

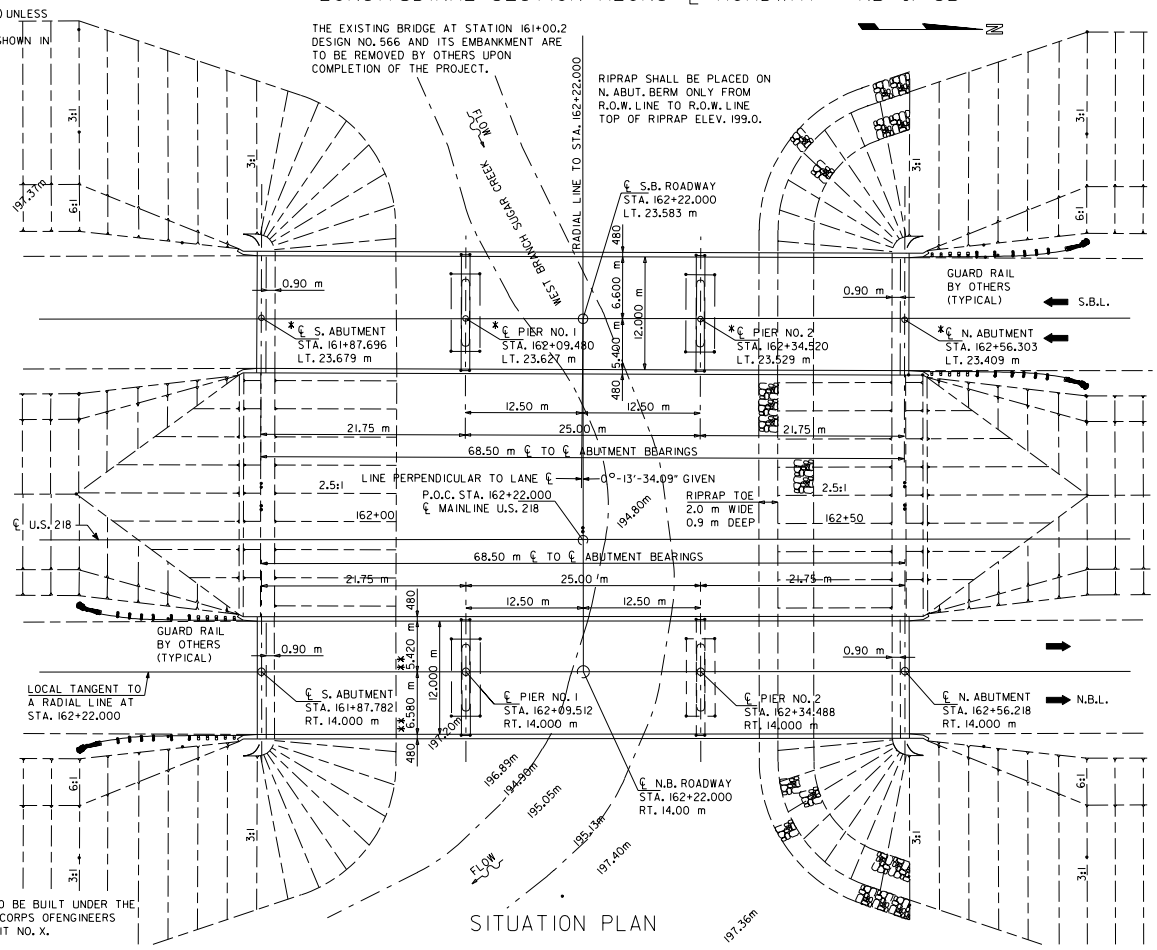


LONGITUDINAL SECTION ALONG ℄ ROADWAY - NB & SB

NOTES:
ALL DIMENSIONS ARE IN MILLIMETERS (mm) UNLESS NOTED OTHERWISE.
ALL ELEVATIONS ON THESE PLANS ARE SHOWN IN METERS.



TYPICAL APPROACH SECTION
LOOKING SOUTH



SITUATION PLAN

*STATIONS AND OFFSETS ARE TO THE INTERSECTION OF ℄ PIER OR ABUTMENT AND ℄ SOUTHBOUND LANES.

**DECK WIDTH OFFSETS ARE TO THE LOCAL TANGENT.

THIS STRUCTURE IS TO BE BUILT UNDER THE CONDITIONS OF ARMY CORPS OFENGINEERS 404 NATIONWIDE PERMIT NO. X.

PROPOSED GRADE ON U.S. 218

G1 = -0.915% G2 = +1.250%

PI STA 163+20 VC = 340 m
PI ELEV 203.000

U.S. 218 CURVE DATA

Δ = 1°-35'-25.64" LT.
D = 0°-22'-55.10"
T = 208.204m
L = 416.380m
E = 1.445m
R = 15000.000m
e = NONE
P.I. STA. 163+71.001
P.C. STA. 161+62.797
P.T. STA. 165+79.177

HYDRAULIC DATA

DRAINAGE AREA= 40.15 SQ. KILOMETERS (R)
STREAM SLOPE= 1.0 mm/m
Q50= 86.5 m^3/s
NATURAL STAGE= 198.12
STAGE W/BACKWATER= 198.28
Q100= 103.1 m^3/s
NATURAL STAGE= 198.25
STAGE W/BACKWATER= 198.43
CALCULATED SCOUR ELEV. = (±)194.2 (LIMESTONE)
Q500= 137.0 m^3/s
NATURAL STAGE= 198.75

TRAFFIC ESTIMATE

A.D.T. = 4850 VPD (1999)
A.D.T. = 6345 VPD (2023)
29% TRUCKS

LOCATION

U.S. 218
T-69N R-6W
SECTION 33
MARION TOWNSHIP
LEE COUNTY

0 METERS 25

PRELIMINARY

DESIGN FOR 0° SKEW

DUAL 68.50m×12.00m PRETENSIONED PRESTRESSED CONCRETE BEAM BRIDGES

21.75 m END SPANS 25.00 m CENTER SPAN

SITUATION PLAN

STATION: 162+22.000 M.L. = CENTERLINE WEST BRANCH SUGAR CREEK

LEE COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

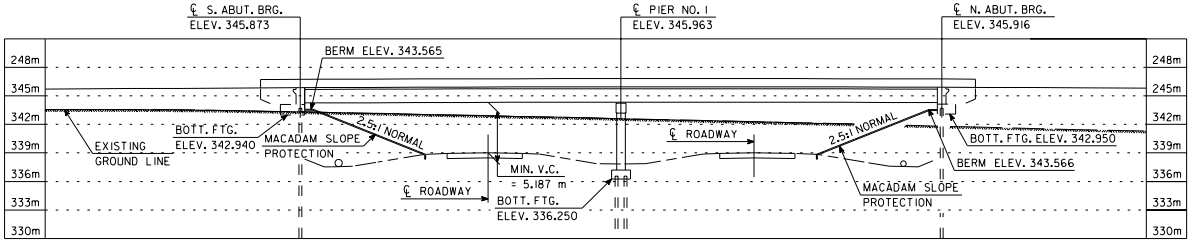
DESIGN SHEET NO. ____ OF ____ FILE NO. 29447 DESIGN NO. 801

DESIGNED BY T.E.H. CHECKED BY
DETAILED BY ROD CADD FILE

LEE COUNTY | PROJECT NUMBER NHS-218-1(39)--19-56 | SHEET NUMBER

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXX

BENCH MARK NO. 529 STA. 273+93.042 LT. 32.72 ELEV. 340.752
SET RR SPIKE SOUTH SIDE OF POWER POLE



LONGITUDINAL SECTION ALONG ℄ D-35

PROPOSED GRADE ON D-35

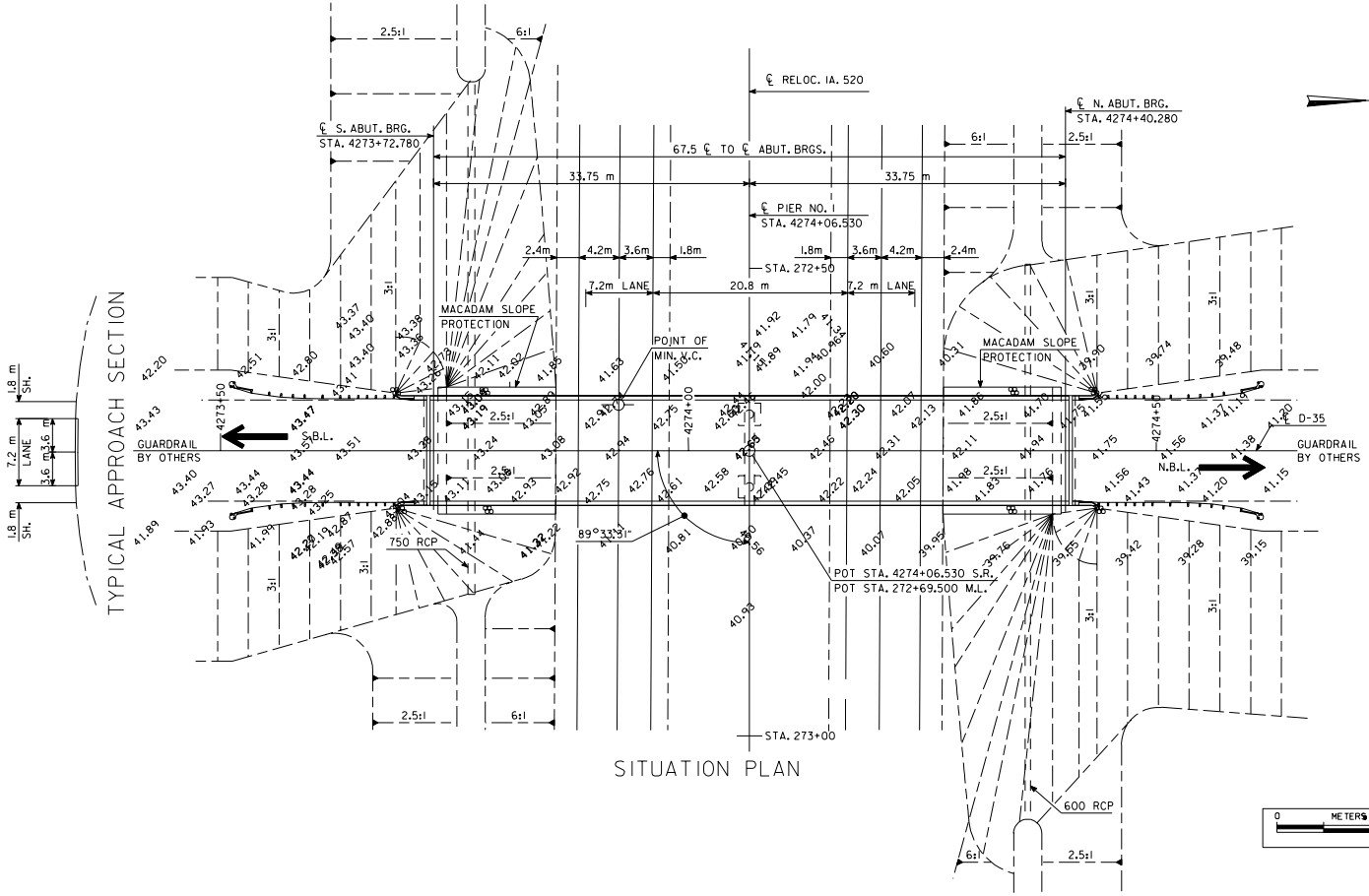
2.860% -2.577%

P.I. STA. 4274+00.000
P.I. EL = 349.015
V.C. = 450 m

PROPOSED GRADE ON RELOC. IA. 520

+0.004% -.360%

P.I. STA. 270+00.000
P.I. EL = 340.000
V.C. = 300 m



SITUATION PLAN

NOTES:
ALL DIMENSIONS IN MILLIMETERS (mm) UNLESS NOTED OTHERWISE.
ALL ELEVATIONS ON THESE PLANS SHOWN IN METERS.
ADD 300 METERS TO ALL SPOT ELEVATIONS.

MINIMUM VERTICAL CLEARANCE

OVERHEAD STATION= 4273+92.567 LT. 4.90 m
OVERHEAD ELEVATION= 345.854 m
DEPTH OF SUPERSTRUCTURE= 1.620 m
UNDERPASS STATION= 272+64.708 RT. 14.00 m
UNDERPASS ELEVATION= 339.047 m
MINIMUM VERTICAL CLEARANCE= 5.187 m

TRAFFIC ESTIMATE

RELOC. IA. 520.	D-35
2002: 4090 ADT	2002: < 750 ADT
2022: 5730 ADT	
20% TRUCKS	

LOCATION

STEAM BOAT ROCK
D-35 OVER RELOC. IA. 520
T-88N R-20W
SECTION 14/23
JACKSON TOWNSHIP
HARDIN COUNTY

PRELIMINARY

DESIGN FOR 0°26'29" SKEW (L.A.)

67.5 m x 10.8 m PRESTRESSED CONC. BEAM BRIDGE

2 - 33.75 m SPANS

SITUATION PLAN

STATION: 272+69.500 M.L. = STATION 4274+06.530 S.R.

HARDIN COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. ____ OF ____ FILE NO. 29212 DESIGN NO. 699

DESIGNED BY DMR	CHECKED BY	HARDIN COUNTY	PROJECT NUMBER	SHEET NUMBER
DETAILED BY PJH	CADD FILE		NHS-520-5(56)--19-42	

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXX