

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Site Location:

Site ID:	57	
Site Name:	Mississippi River at S.R. 51/150 at Chester, Ill.	
County:	Randolph	
Nearest City:	Chester	Contact:
State:	IL	David S. Mueller
Latitude:	375410	U.S. Geological Survey
Longitude:	895010	9818 Bluegrass Parkway
USGS Station ID:		Louisville, KY 40299
Route Number:	51/150	
Route Class:	State	Publication:
Service Level:	Mainline	Mueller, D.S., Landers, M.N., and
Route Direction:	NA	Fischer, E.E., 1995, Scour
Highway Mile Point:		measurements at bridge sites
Stream Name:	Mississippi River	during the 1993 upper Mississippi
River Mile:		River basin flood: Transportation
		Research Record, no. 1483, p. 47-
		55.

Site Description:

Detailed bridge-scour measurements were made at the State Route 51/150 crossing of the Mississippi River at Chester, Illinois; at river mile 109.9 above the Ohio River and about 70 river miles south of St. Louis Missouri. This highway is numbered as Missouri State Route 51, and Illinois State Route 150. The USGS has operated a discharge gaging station (USGS Station No. 07020500) at this site since 1942 and river stage records have been recorded at this site since 1891. The datum of the gage is 341.05 feet above NGVD 1929 datum (MSL). Periodic bed-material samples and daily suspended-sediment samples were obtained at the gage during the flood.

The Mississippi River drainage area at this site is 708,600 sq. mi. The Mississippi River flows at the eastern (Illinois) edge of its flood plain in the study reach. The Illinois bank rises steeply at slopes of 0.1 to 0.7 ft/ft from the main channel to about 280 ft above normal river levels. The main channel is fairly straight in the study reach. There is a gradual bend to the left about 2.5 miles upstream, a very gradual bend to the right at the bridge, and a gradual bend left about 2 miles downstream. The main channel is about 1700 feet wide at the bridge and averages about 2200 feet wide over a 4-mile reach centered at the bridge. The annual average daily discharge at this site is 198,700 cfs.

Elevation Reference

Datum: MSL

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

MSL (ft):

Description of Reference Elevation:

All elevations are presented in ft reference to MSL.

The gage datum at Chester is 341.05 ft MSL and all reference to stages refer to this datum.

Horizontal positioning of the data were accomplished with a range-azimuth tracking system. The coordinates are a local grid in feet.

Stream Data

Drainage Area (sq mi):	708600	Floodplain Width:	Wide
Slope in Vicinity(ft/ft):	0.0003	Natural Levees:	Unknown
Flow Impact:	Straight	Apparent Incision:	None
Channel Evolution	Unknown	Channel Boundary:	Alluvial
Armoring:	None	Banks Tree Cover:	Low
Debris Frequency:	Rare	Sinuosity:	Sinuuous
Debris Effect:	None	Braiding:	None
Stream Size:	Wide	Anabranching:	None
Flow Habit:	Perennial	Bars:	Narrow
Bed Material:	Sand	Stream Width Variability:	Equiwidth
Valley Setting:	Moderate		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:			
Typical			
Low:			

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1	1993	8	1		2.62	2.2	1.19	0.78	2.65		Non-Cohesive
2	1993	8	12		5.01	4.1	1.08	0.65	2.65		Non-Cohesive

Bed Material Comments

Measurement No: 1

Measurement No: 2

Bridge Data

Structure No:

Length(ft): 2826

Width(ft): 22

Number of Spans: 13

Vertical Configuration: Curvilinear

Low Chord Elev (ft):

Upper Chord Elev (ft):

Overtopping Elev (ft):

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Main

Year Built: 1940

Avg Daily Traffic:

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: No

Distance Between Centerlines:

Distance Between Pier Faces:

Bridge Description:

The SR 51/150 bridge is 2826 feet long. Pile bents 1 through 8 and pier 9 are located on the Missouri bank; Piers 10, 11, and 12 are located in the main channel; Pier 13 is located at the edge of the main channel, Illinois side; and Pile bent 14 is located on the Illinois overbank. The two spans from piers 10 to pier 12 are 670 feet each and are further supported by an overhead truss. An underdeck truss runs between bent 8 and pier 10 and between pier 12 and bent 14. The bridge was built around 1940 and was damaged by a tornado in 1944.

Abutment Data

Left Station: 0

Right Station: 0

Left Skew (deg):

Right Skew (deg)

Left Abutment Length (ft):

Right Abutment Length (ft)

Left Abutment to Channel Bank (ft):

Right Abutment to Channel Bank (ft):

Left Abutment Protection:

Right Abutment Protection

Contracted Opening Type: Unknown

Embankment Skew (deg):

Embankment Slope (ft/ft):

Abutment Slope (ft/ft)

Wingwalls: Yes

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Wingwall Angle (deg):

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	File Spacing(ft)
10	1972.65			Single		
11	1301.98			Single		
12	631.24			Single		

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
10	12	Square		42	Unknown	Poured
11	15	Square		38	None	Poured
12	12	Unknown		42	Unknown	Poured

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
10	325	243	16	Square	
11	325	265	24	Square	
12	325	314	16	Square	

Pier Description

Pier ID 10

Pier 10 has a rectangular, caisson footing 46 feet long by 16 feet wide with it's base at elevation 243.0 feet and extending up to elevation 325.0. From the top of the caisson a solid, round nosed section 42 feet long by 12 feet wide rises to elevation 360.0. The nose of the pier is circular with a 6 foot radius. Two tapered columns extend from elevation 360 to the bridge deck (elevation 431.08). The columns are connected by a continuous web from elevation 360.0 to 382.5 feet. The columns are tapered and measure 9 feet wide at their base (elevation 360), and 6.5 feet wide at elevation 431.08 feet. The columns have a stepped, square face which will be classified as square.

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Pier ID 11

Pier 11 has a rectangular, caisson footing 52.5 feet long by 24 feet wide with it's base at elevation 256.0 feet and extending up to elevation 325.0. From the top of the caisson a solid, round nosed section 48.5 feet long by 18 feet wide rises to elevation 360.0. The nose of the pier is circular with a 9.0 foot radius. Two tapered columns extend from elevation 360 to the bridge deck (elevation 440.1). The columns are connected by a continuous, 3.5 foot wide web from elevation 360.0 to 382.5 feet. The columns are tapered and measure 15 feet wide at their base (elevation 360), and 11 feet wide at elevation 403.0 feet. The columns have a stepped, square face which will be classified as square.

Pier ID 12

Pier 12 has a rectangular, caisson footing 46 feet long by 16 feet wide with it's base at elevation 314.0 feet and extending up to elevation 325.0. From the top of the caisson a solid, round nosed section 42 feet long by 12 feet wide rises to elevation 360.0. The nose of the pier is circular with a 6 foot radius. Two tapered columns extend from elevation 360 to the bridge deck (elevation 441.651). The columns are connected by a continuous web from elevation 360.0 to 382.5 feet. The columns are tapered and measure 9 feet wide at their base (elevation 360), and 6.5 feet wide at elevation 441.65 feet. The columns have a stepped, square face which will be classified as square.

Pier Scour Data

Pier ID	Date	Time	USOrDS					
11	8/3/93		Upstream					
11	8/12/93		Upstream					
11	9/13/93		Upstream					
Pier ID	Scour Depth	Accuracy (ft)	Side Slope (ft/ft)	TopWidth (ft)	Apprch Vel (ft/s)	Apprch Depth(ft)	Effective Pier Width	Skew to Flow(deg)
11	23.3	2			7.97	73.9	13	11
11	20.4	2			6.56	73.4	13.5	4
11	21.4	2			6.03	54.8	15.4	4
PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects	
11	Live-bed	Non-cohesive	Dune			2.08	Insignificant	
11	Live-bed	Non-cohesive	Dune			2.08	Insignificant	
11	Live-bed	Non-cohesive	Unknown			2.08	Insignificant	
PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)				
11	4.2	1.3	0.6	0.3				
11	4.2	1.3	0.6	0.3				
11	4.2	1.3	0.6	0.3				

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Pier Scour Comments

Pier ID 11 Time: US/DS: Upstream

Water surface elevation - 388.4. The reference elevation was determined to be 314.5 after careful analysis of contour plots of the detailed data. The minimum bed elevation was 291.2. The volume of the scour hole was computed to be 113260 cu. ft. The pier width varies with the depth, and its depth-weighted average width thus increase with decreasing depth. Exposed portions of the pier below the local-scour reference surface elevation were not used in computing the pier width. The location of the maximum scour depth is at the upstream left corner of the pier, as expected because of the slight skew of the flow. Scour did not develop along the left side of the pier even with a skew of 11 degrees.

Pier ID 11 Time: US/DS: Upstream

Water-surface elevation - 386.4. The reference elevation was determined to be 313 after careful analysis of contour plots of the detailed data. The minimum bed elevation was 292.6. The volume of the scour hole was computed to be 126282 cu. ft. The pier width varies with the depth, and its depth-weighted average width thus increase with decreasing depth. Exposed portions of the pier below the local-scour reference surface elevation were not used in computing the pier width. The location of the maximum scour depth is at the upstream left corner of the pier, as expected because of the slight skew of the flow.

Pier ID 11 Time: US/DS: Upstream

Water-surface elevation - 372.6. The reference elevation was determined to be 317.8 after careful analysis of contour plots of the detailed data. The minimum bed elevation was 296.4. The volume of the scour hole was computed to be 149830 cu. ft. The pier width varies with the depth, and its depth-weighted average width thus increase with decreasing depth. Exposed portions of the pier below the local-scour reference surface elevation were not used in computing the pier width. The location of the maximum scour depth is at the upstream left corner of the pier, as expected because of the slight skew of the flow.

Abutment Scour

Contraction Scour

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.

Stage and Discharge Data

Peak Discharge					Flow (cfs)	Qacc	Peak Stage					Stage (ft)	Water Temp (C)	Return Period(yr)
year	mo	dy	hr	mi			year	mo	dy	hr	mi			
1993	8	6			950000		1993	8	6			390.64	26	100

Hydrograph

Supporting Files

Chester.xls - Excel 97 workbook containing the following worksheets
Hydrograph - stage and discharge hydrograph at Chester, Illinois
080593 - bathymetric data collected on 8-5-93
081293 - bathymetric data collected on 8-12-93
091393 - bathymetric data collected on 9-13-93
AerialPhoto93.jpg - Photograph of bridge from airplane during the flood.
Borings.jpg
DataCollection.jpg - Photograph of USGS boat collecting data under the bridge.
FlowPier11.jpg - Photograph of flow around pier 11 during the flood.
Chester.dxf - dxf file of bridge in local coordinate system
Pier11.jpg - scan of pier details of pier 11 from bridge plans
Pier1012.jpg - scan of pier details for piers 10 and 12 from bridge plans
Profile.jpg - scan of bridge profile from bridge plans
Topo.jpg - scan of USGS topographic map covering study area

The following figures were scanned from Holmes, R.R., Jr., 1993, Sediment transport in the lower Missouri and the central Mississippi Rivers, June 26 through September 14: U.S. Geological Survey Circular 1120-I.

Figure4.jpg - Discharge and suspended sediment hydrographs
Table5.jpg - Miscellaneous hydraulic and sediment characteristics
Figure5.jpg - Bedload estimates
Figure8.jpg - Bed-material size distributions

BSDMS Summary Report

57 Mississippi River at S.R. 51/150 at Chester, Ill.
