BSDMS Summary Report

80 Chariton River near Prairie Hill, MO

Site Location:

Site ID: 80

Site Name: Chariton River near Prairie Hill, MO

County: Chariton

Nearest City: Prairie Hill

State: MO

Latitude: 393225

Longitude: 0924723

USGS Station ID: 06905500

Route Number: 129

Route Class: State

Service Level: Mainline

Route Direction: North

Highway Mile Point: 11.73

Stream Name: Chariton River

River Mile: 19.6

Contact:

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Publication:

Site Description:

The study site is located on the Chariton River at mile 11.73 of State Route 129, about 9 miles north of the town of Salisbury (at the intersection of State Route 129 and U.S. Route 24), and about 18 mile south of the intersection of State Route 129 and U.S. Route 36. The Chariton River basin above the bridge covers approximately 1,870 square miles, and is partially regulated by Rathbun Lake in Iowa (station 06903880) built in 1969. The period of record for this station is from October 1928 to the current year, with an annual mean flow of 1,273 cfs, and an instantaneous peak flow of 33,600 cfs recorded on May 27, 1996 (stage 22.33 ft, gage datum).

The structure number for this site is L-344. The Missouri Dept of Transportation (MoDOT) built the current bridge in 1949 and channelized the Chariton River, replacing a structure over the old channel on the current right floodplain. The channel has been regularly dredged, evidenced by the dredge piles observed on both banks.

Structure L-344 consists of 60'-70'-70'-60' continuous I-beam spans supported by three dual-conical concrete column piers with partial web walls, and spill-through abutments. The piers and the abutments are founded on piling; the pier piling is driven to an elevation of 585-590 ft, and the abutment piling is driven to an elevation of 607 ft. The right abutment extends into the channel, whereas the left abutment is set back about 35 feet from the top of the left bank. Both the left bank and the right abutment are covered with large chunks of concrete debris and riprap.

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Apparently due to channelization, this site is prone to catch drift. Several of the flood measurement on record indicate a large debris drift pileup on the central pier and the consequent scour that occurs as a result of the raft. Several measurements of scour have occurred at this site, by Larry Becker and by Dave Mueller/Rick Huizinga et.al. The propensity to catch debris and the resulting scour are what make this site an interesting case study.

A review of flood measurement notes seems to indicate that this site does not experience substantial scour of any form when there is no debris raft. The bed elevations in these cases are consistently steady, matching the ground line at the time of construction of L-344 and a channel survey taken in November 1999 during low flow. The only change in the channel from the time of construction is a widening and lateral migration of the channel. The channel configuration--with the dredge banks on either side and low road embankments on both floodplains--is such that for flows less than bank-full, flow direction is straight through the bridge opening with little contraction of flow, resulting in no contraction scour and minimal pier scour. For greater than bank-full flows, flow direction (in the roadway ditches upstream and downstream of the bridge) is observed to be AWAY from the channel into the floodplains, again resulting in no contraction scour and minimal pier scour. However, for floods where a debris raft forms on the central pier, the bed elevations drop by as much as 20 feet in what appears to be a combination of contraction scour (caused by the reduced flow area due to the raft) and local scour effects caused by the raft and pier.

Elevation Reference

Datum: Gage

MSL (ft): 632.05

Description of Reference Elevation:

Bridge data elevations are taken from MoDOT plans, but are consistent with gage datum.

Stream Data

Drainage Area (sq mi):	1870	**Floodplain Width:**	Wide
Slope in Vicinity(ft/ft):	0.000325	**Natural Levees:**	Little
Flow Impact:	Straight	**Apparent Incision:**	None
Channel Evolution	Constructed	**Channel Boundary:**	Alluvial
Armoring:	None	**Banks Tree Cover:**	Medium
Debris Frequency:	Frequent	**Sinuosity:**	Straight
Debris Effect:	Both	**Braiding:**	Locally
Stream Size:	Medium	**Anabranching:**	None
Flow Habit:	Perennial	**Bars:**	Wide

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Bed Material: Sand

Stream Width Variability: Equiwidth

Valley Setting: Low

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:	0.075	0.045	0.075
Typical	0.06	0.035	0.06
Low:	0.045	0.03	0.045

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1				Grab on Bed	0.73	0.5	0.32	0.18	2.65		Mildly
2				Grab on Overbank	0.26	0.2	0.09		2.65		Cohesive

Bed Material Comments

Measurement No: 1

Diameters taken from a VA analysis of a grab sample from the bed at low flow.
Results:

Size (mm)	1.00	0.500	0.250	0.125	0.062
% < than	100.0	85.1	34.5	1.7	0.8

Measurement No: 2

Diameters taken from VA analysis of a grab sample from the left overbank.
Results:

Size (mm)	1.00	0.500	0.250	0.125	0.062
% < than	100.0	98.0	94.1	65.9	34.3

Bridge Data

Structure No: L-344

Length(ft): 264

Width(ft): 24.5

Number of Spans: 4

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Vertical Configuration: Horizontal

Low Chord Elev (ft): 657.85

Upper Chord Elev (ft): 664.25

Overtopping Elev (ft): 652.17

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Main

Year Built: 1949

Avg Daily Traffic: 600

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: No

Distance Between Centerlines:

Distance Between Pier Faces:

Bridge Description:

Structure L-344 consists of 60'-70'-70'-60' continuous I-beam spans supported by three dual-conical concrete column piers with partial web walls, and spill-through abutments. The piers and the abutments are founded on piling; the pier piling is driven to an elevation of 585-590 ft, and the abutment piling is driven to an elevation of 607 ft.

Abutment Data

Left Station: 0

Right Station: 264.75

Left Skew (deg): 0

Right Skew (deg) 0

Left Abutment Length (ft): 24.5

Right Abutment Length (ft) 24.5

Left Abutment to Channel Bank (ft): 35

Right Abutment to Channel Bank (ft): -10

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Left Abutment Protection:	None
Right Abutment Protection	Riprap
Contracted Opening Type:	III
Embankment Skew (deg):	0
Embankment Slope (ft/ft):	1.5
Abutment Slope (ft/ft)	2
Wingwalls:	No
Wingwall Angle (deg):	0

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	Pile Spacing(ft)
1	61.75	0		Single		
2	113.75	0		Single		
3	201.75	0		Single		

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	4.625	Round		24.625	None	Piles
2	4.31	Round		24.75	None	Piles
3	4.625	Round		24.625	None	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1	623.5	619	9	Square	590
2	623	619	11.5	Square	586
3	623.5	619	9	Square	591

Pier Description

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Pier ID 1

Dual concrete columns with partial web walls. Each column, from bottom up: 9' x 6' x 4.5' (WxLxH) footings over 6 concrete piles (30' average in place); cylindrical sub-column 4.625' in diameter and 11.5' high with conical column above tapering from 4.625' to 3' in 19.625'; 3.5' x 23.5' x 2' cap; webwall from elevation 642.0' to cap.

Pier ID 2

Dual concrete columns with partial web walls. Each column, from bottom up: 11.5' x 9' x 4.5' (WxLxH) seal course over 9 concrete piles (34' average in place); footing of 7.5' x 6.5' x 3'; conical column tapering from 5.375' to 3' in 28.6'; 3.5' x 23.5' x 2' cap; webwall from elevation 635.0' to cap.

Pier ID 3

Dual concrete columns with partial web walls. Each column, from bottom up: 9' x 6' x 4.5' (WxLxH) footings over 6 concrete piles (28' average in place); cylindrical sub-column 4.625' in diameter and 11.5' high with conical column above tapering from 4.625' to 3' in 19.625'; 3.5' x 23.5' x 2' cap; webwall from elevation 642.0' to cap.

Pier Scour Data

Pier ID	Date	Time	USOrDS
2	3/29/60		Upstream
2	4/22/73		Upstream
2	5/8/78		Upstream
2	7/8/93		Upstream
2	5/24/95		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)
2	15.3	0.5			7.2	15.4	9.58	0
2	17.1	0.5			5.33	19.1	13.28	0
2	19.2	0.5			7.03	18	13.36	0
2	21.1	0.5			8	17.1	14.34	0
2	12.8	0.5			6.84	18.2	7.23	0

PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects
2	Live-bed	Non-Cohesive	Unknown				Substantial
2	Live-bed	Non-Cohesive	Unknown				Substantial
2	Live-bed	Unknown	Unknown				Substantial

2	Live-bed	Unknown	Unknown	Substantial
2	Live-bed	Unknown	Unknown	Substantial

PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)
2	0.73	0.5	0.32	0.18
2	0.73	0.5	0.32	0.18
2	0.73	0.5	0.32	0.18
2	0.73	0.5	0.32	0.18
2	0.73	0.5	0.32	0.18

Pier Scour Comments

Pier ID 2 **Time:** **US/DS:** Upstream

These values represent computed pier scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The effective pier diameter is calculated using Melville & Dongel (1992) wherein the effect of a debris raft is converted to an effective pier diameter based on the thickness of the raft (assumed to be the approach depth divided by 3.4 = (15.4/3.4) = 4.53) and the diameter of the raft (approximated from discharge notes as 44 feet). The computed contraction scour was 1.2 feet, for a total scour of 16.5 feet. The actual measured total scour on this date was 17.2 feet (depth below "equilibrium bed" from measurement notes).

Pier ID 2 **Time:** **US/DS:** Upstream

These values represent computed pier scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The effective pier diameter is calculated using Melville & Dongel (1992) wherein the effect of a debris raft is converted to an effective pier diameter based on the thickness of the raft (assumed to be the approach depth divided by 3.4 = (19.1/3.4) = 5.62) and the diameter of the raft (approximated from discharge notes as 70 feet). The computed contraction scour was 0.0 feet, for a total scour of 17.1 feet. The actual measured total scour on this date was 17.1 feet (depth below "equilibrium bed" from measurement notes).

Pier ID 2 **Time:** **US/DS:** Upstream

These values represent computed pier scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The effective pier diameter is calculated using Melville & Dongel (1992) wherein the effect of a debris raft is converted to an effective pier diameter based on the thickness of the raft (assumed to be the approach depth divided by 3.4 = (18.0/3.4) = 5.30) and the diameter of the raft (approximated from discharge notes as 70 feet). The computed contraction scour was 0.0 feet, for a total scour of 19.2 feet. The actual measured total scour on this date was 20.0 feet (depth below "equilibrium bed" from measurement notes).

Pier ID 2 **Time:** **US/DS:** Upstream

These values represent computed pier scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The effective pier diameter is calculated using Melville & Dongel (1992) wherein the effect of a debris raft is converted to an effective pier diameter based on the thickness of the raft (assumed to be the approach depth divided by 3.4 = (17.1/3.4) = 5.03) and the diameter of the raft (approximated from discharge notes as 70 feet). The computed contraction scour was 0.4 feet, for a total scour of 21.5 feet. The actual measured total scour on this date was 20.0 feet (depth below "equilibrium bed" from measurement notes).

Pier ID 2 **Time:** **US/DS:** Upstream

These values represent computed pier scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The effective pier diameter is calculated using Melville & Dongel (1992) wherein the effect of a debris raft is converted to an effective pier diameter based on the thickness of the raft (assumed to be the approach depth divided by 3.4 = (19.1/3.4) = 5.62) and the diameter of the raft (approximated from discharge notes as 70 feet). The computed contraction scour was 0.0 feet, for a total scour of 12.8 feet. The actual measured total scour on this date was 11.8 feet (depth below "equilibrium bed" from measurement notes).

Abutment Scour

Measurement Number	Abutment	Date	Time	US/DS	Scour Depth (ft)	Accuracy	Sediment Transport
1				Unknown	0	0	Unknown

Measurement Number	Velocity at Abut(ft/s)	Depth at Abut(ft)	Discharge Blocked(cfs)	Avg Velocity Blocked(ft/s)	Avg Depth Blocked(ft)
1					

Measurement Number	Embankment Length (ft)	Bed Material	D50 (mm)	Sigma	Debris Effect
1		Unknown			Unknown

Abutment Scour Comments

MeasurementNo 1

Substantial road overflow areas on both floodplains and dredge banks on both tops of banks preclude abutment scour. No measurement or computations of abutment scour were made

ContractionScour

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Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1	3/29/60		3/29/60			1.2
2	4/22/73		4/22/73			-6.8
3	5/8/78		5/8/78			-2.3
4	7/8/93		7/8/93			0.4
5	5/24/95		5/24/95			-3.1

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1		6.49	18176	17.1	163.7
2		4.94	17339	20.9	167.8
3		6.68	21330	19.7	162
4		7.45	22578	18.8	160.9
5		6.36	20579	20	161.9

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1	5.7	17952	15.7	200	0.818
2	7.46	28324	19	200	0.839
3	7.29	26351	18.1	200	0.81
4	6.88	23913	17.4	200	0.804
5	7.34	26795	18.3	200	0.81

Measurement Number	Pier Contraction Ratio	Scour Location	Eccent-ricity	Sediment Transport	Bed Form	Debris Effects
1		Main Channel		Live-bed	Unknown	Substantial
2		Main Channel		Live-bed	Unknown	Substantial
3		Main Channel		Live-bed	Unknown	Substantial
4		Main Channel		Live-bed	Unknown	Substantial

5		Main Channel		Live-bed	Unknown	Substantial

Measurement Number	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	Sigma Bed Material	Bed Material
1						Unknown
2						Unknown
3						Unknown
4						Unknown
5						Unknown

Contraction Scour Comments

Measurement No. 1

These values represent computed contraction scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The computed pier scour was 15.3 feet, for a total scour of 16.5 feet. The actual measured total scour on this date was 17.2 feet (from measurement notes).

Measurement No. 2

These values represent computed contraction scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The computed pier scour was 17.1 feet, for a total scour of 17.1 feet. The actual measured total scour on this date was 17.1 feet (from measurement notes).

Measurement No. 3

These values represent computed contraction scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The computed pier scour was 19.2 feet, for a total scour of 19.2 feet. The actual measured total scour on this date was 20.0 feet (from measurement notes).

Measurement No. 4

These values represent computed contraction scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The computed pier scour was 21.1 feet, for a total scour of 21.5 feet. The actual measured total scour on this date was 20.0 feet (from measurement notes).

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Measurement No. 5

These values represent computed contraction scour from an "equilibrium bed" elevation (established in Nov, 1999, based on survey and historical data). The computed pier scour was 12.8 feet, for a total scour of 12.8 feet. The actual measured total scour on this date was 11.8 feet (from measurement notes).

Stage and Discharge Data

Peak Discharge					Flow		Peak Stage					Stage	Water	Return
year	mo	dy	hr	mi	(cfs)	Qacc	year	mo	dy	hr	mi	(ft)	Temp (C)	Period(yr)
					28200							653.97		41.67
					31300							653.89		83.3
					24300							653.01		15.4
					27500							651.31		33.3
					18200							650.51		4.5

Hydrograph

Supporting Files