

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Site Location:

Site ID: 83

Site Name: SR 37 over James River near Mitchell, SD

County: Sanborn

Nearest City: Mitchell

State: SD

Latitude: 435633

Longitude: 980149

USGS Station ID: 06477000

Route Number: 37

Route Class: State

Service Level: Mainline

Route Direction:

Highway Mile Point:

Stream Name: James River

River Mile:

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Publication:

Site Description:

The study site is located on the James River 20 miles north of the town of Mitchell on State Highway 37. The site is approximately 4.5 miles downstream from the USGS gaging station near Forestburg (06477000). High flow measurements for the Forestburg gaging station are actually made from the SR 37 bridge therefore a wire weight is installed on the upstream side of the bridge. The period of record for the station is from March 1920 to the current year, with an annual mean flow of 493 cfs, and an instantaneous peak flow of 25,600 cfs recorded on April 6, 1997. The SD USGS measured 17,100 cfs during the flood of April 2001 during which real-time bridge scour measurements were made at the site by the USGS National Bridge Scour Team. A manned boat was deployed during the April 2001 flood and detailed scour data was collected with a 1200 kHz ADCP

The site is located in a highly rural/agricultural landscape with moderate topographic relief. There was no roadoverlapping nor any relief bridges associated with the SR 37 bridge, therefore all of the flow in the James River contracted and passed through the bridge opening. The bridge is a concrete girder, three span structure supported by two groups of cylindrical piers (3 in each group) which are both founded on steel piles. The upper 10-15' of the bed is comprised of a sandy-silt followed by 10-20 ft of silty-clay.

Some of the information (slope in vicinity and drainage area) found in the stream data tab were taken from the description of the Forestburg gaging station and applied to the SR37 bridge due to its close proximity and similar basin

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

characteristics.

Elevation Reference

Datum: MSL

MSL (ft):

Description of Reference Elevation:

The datum of the site is 1208.34 ft above sea level, and the check bar elevation is 37.849 ft.

Stream Data

Drainage Area (sq mi):	13450	Floodplain Width:	Narrow
Slope in Vicinity(ft/ft):	.000104	Natural Levees:	
Flow Impact:	Straight	Apparent Incision:	None
Channel Evolution		Channel Boundary:	Alluvial
Armoring:		Banks Tree Cover:	Medium
Debris Frequency:	Rare	Sinuosity:	Meandering
Debris Effect:	None	Braiding:	None
Stream Size:	Medium	Anabranching:	None
Flow Habit:	Perennial	Bars:	Narrow
Bed Material:	Silt	Stream Width Variability:	Equiwidth
Valley Setting:	Moderate		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:			
Typical	0.08	0.034	0.065
Low:			

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1				USGS BM-54H Sampler	0.27	0.2	0.02				Unknown
2				USGS BM-54H Sampler	0.26	0.2	0.01				Unknown
3				USGS BM-54H Sampler	1.4	0.2	0.03				Unknown

Bed Material Comments

Measurement No: 1

Upstream of bridge, 3 samples collected from boat during low-flow at depth ~ 14 ft.

Results:

Size (mm)	8	4	2	1	.5	.25	.125	.062	.016	.004	.002
% < than	100	100	98.9	98.6	97.4	94.1	79.2	61.8	38.3	29.6	27.2

Measurement No: 2

Downstream of bridge, 3 samples collected from boat during low-flow at depth ~ 9 ft.

Results:

Size (mm)	8	4	2	1	.5	.25	.125	.062	.016	.004	.002
% < than	100	99.0	98.9	98.6	98.2	94.4	82.9	72.0	44.8	30.4	25.0

Measurement No: 3

3 samples collected from boat during low-flow in the bridge opening at a depth ~ 11 ft.

Results:

Size (mm)	8	4	2	1	.5	.25	.125	.062	.016	.004	.002
% < than	100	95.5	95.2	94.8	94.5	92.2	83.1	66.0	42.9	34.6	31.3

Bridge Data

Structure No: 56-150-176

Length(ft): 353

Width(ft): 42

Number of Spans: 3

Vertical Configuration: Sloping

Low Chord Elev (ft): 1232.6

Upper Chord Elev (ft): 1242.8

Overtopping Elev (ft): 1240.6

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Skew (degrees): -35

Guide Banks: None

Waterway Classification: Main

Year Built: 1992

Avg Daily Traffic:

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: Yes

Distance Between Centerlines:

Distance Between Pier Faces: 15.75

Bridge Description:

The structure is a prestressed girder bridge with 3 - 120' spans supported by two piers, both located in the main channel of the James River. Pier #1 is on the left, looking downstream, and is supported by 13 concrete pilings. Pier 2 is on the right and is also supported by 13 concrete pilings. The south and north abutments are each supported by 11 piles driven. The bridge has a 2.897% downhill grade in the northbound direction.

Abutment Data

Left Station: 35917.33

Right Station: 35567.83

Left Skew (deg): 0

Right Skew (deg) 0

Left Abutment Length (ft): 67

Right Abutment Length (ft) 67

Left Abutment to Channel Bank (ft):

Right Abutment to Channel Bank (ft):

Left Abutment Protection: None

Right Abutment Protection Other

Contracted Opening Type: III

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Embankment Skew (deg): -35
Embankment Slope (ft/ft): 0.09
Abutment Slope (ft/ft) 2
Wingwalls: No
Wingwall Angle (deg):

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	Pile Spacing(ft)
1		35	35802.83	Group	3	19.5
2		35	35682.33	Group	3	19.5

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	3.75	Round		51	Unknown	Piles
2	3.75	Round		51	Unknown	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1	1194.83	1190.83	10.5	Unknown	
2	1194.84	1190.84	10.5	Square	

Pier Description

Pier ID 1

Left pier when looking downstream, consists of 3 separate 3.75' diameter cylindrical piers.

Pier ID 2

Right pier when looking downstream, consists of 3 separate 3.75' diameter cylindrical piers.

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Pier Scour Data

Abutment Scour

Measurement Number	Abutment	Date	Time	US/DS	Scour Depth (ft)	Accuracy	Sediment Transport
1	Left	4/15/01	13:00	Upstream	4	2	Live-bed

Measurement Number	Velocity at Abut(ft/s)	Depth at Abut(ft)	Discharge Blocked(cfs)	Avg Velocity Blocked(ft/s)	Avg Depth Blocked(ft)
1	3.8	23.5	8200	2	6

Measurement Number	Embankment Length (ft)	Bed Material D50 (mm)	Sigma	Debris Effect
1	1500	Unknown		Insignificant

Abutment Scour Comments

MeasurementNo 1

Flow separation point on left valley wall was too far upstream to get a measurement and much of the floodplain flow re-entered the channel at a the section located one bridge-width upstream. A section was made with the ADCP along the left bank of the channel to cut-off the floodplain flow entering the channel and gain insight to the amount of discharge that was being blocked by the roadway embankment.

Contraction Scour

Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1	4/15/01	12:30	4/15/01	13:35		3

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1	1	4.2	13900	18	206

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1	3.5	6730	17.8	110	0.48

Measurement Number	Pier Contraction Ratio	Scour Location	Eccentricity	Sediment Transport	Bed Form	Debris Effects
1		Main Channel	0.05	Live-bed	Unknown	nsignifican

Measurement Number	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	Sigma Bed Material	Bed Material
1						Unknown

Contraction Scour Comments

Measurement No. 1

Detailed data of the bridge reach was collected during the flood with a manned boat and ADCP. Inspection of the "approach" section (one bridge width upstream) revealed a large discharge relative to that of the contracted opening. It was discovered that the blockage caused by the roadway embankment forced a majority of the left floodplain flow back into the main channel at the "approach" section. A cross section made further upstream showed much less discharge, which was consistent with channel discharge downstream of the bridge opening. Data from an ADCP section that cut-off the left floodplain flow accounted for all but 500 cfs of the difference in discharge between the "approach" section and the section further upstream. The section furthest upstream was used as the uncontracted section because it was most representative of the flow naturally carried by the main channel had the roadway embankment not be present. The widths and corresponding hydraulic characteristics for both the contracted and uncontracted sections are representative of the portion of the channel in which live-bed transport would be expected.

Stage and Discharge Data

Peak Discharge			Flow (cfs)	Peak Stage			Stage (ft)	Water Temp (C)	Return Period(yr)
year	mo	dy hr mi		year	mo	dy hr mi			
			17,100				1227.04	45	
		12:30	15,200			13:00	1224.2		

Hydrograph

BSDMS Summary Report

83 SR 37 over James River near Mitchell, SD

Supporting Files

SR37_DetailExample.doc - detailed summary of the site and data collection during the April, 2001 flood.
SR37.lpk - contour plot of detailed bathymetry data collected during April, 2001 flood, displayed in AmTec's Tecplot software package.
SD37Contour.pdf - contour plot of detailed bathymetry data collected during April, 2001 flood in a PDF format.

Site Photos:

DSCN0003.jpg - DSCN0008.jpg & DSCN0034.jpg - DSCN0053.jpg - Photos taken during April, 2001 flood, description of each photo is documented in SR37_Photos.doc Word file.

SR370021.jpg - SR370037.jpg - Photos taken during October, 2001 low-flow survey, description for each is documented in Post-Flood_Photos.doc Microsoft Word file.

SR37(TopoQuad).jpg - Topo map of bridge reach
SR37.jpg - Descriptive Digital Ortho Quad image of the bridge site

SR37(ADCP_Data).xls - Excel file with multiple worksheets containing ADCP depth integrated velocities collected during April, 2001 flood.

Surveyed Sections:

SR37_(DS_Hec-Ras).xls - Excel spreadsheet containing surveyed data for the exit section used in a HEC-RAS model of the reach.
SR37_(US_Hec-Ras).xls - Excel spreadsheet containing surveyed data for the approach section used in a HEC-RAS model of the reach.
DS_Face.xls - Excel spreadsheet containing surveyed data for the downstream bridge face.
US_Face.xls - Excel spreadsheet containing surveyed data for the upstream bridge face.
HEC-RAS_Summary.xls - Excel spreadsheet summarizing the elev. and stationing for all sections in the HEC-RAS model of the reach.
GrainSizeDist.xls - Bed material grain size distribution for the site, determined by analysis of samples collected during post-flood survey.