

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

Site Location:

Site ID: 32

Site Name: Gallatin River at U.S. 191 near Gallatin Gateway, MT

County: Gallatin

Nearest City: Gallatin Gateway

State: MT

Latitude: 453119

Longitude: 1111458

USGS Station ID: 6043500

Route Number: 191

Route Class: US

Service Level: Mainline

Route Direction: NA

Highway Mile Point: 70.461

Stream Name: Gallatin River

River Mile:

Contact:
Stephen R. Holnbeck or Charles Parrett (406)449-5263
U.S. Geological Survey
301 South Park Ave., Fed. Bldg.
Rm 428
Helena, MT 59626

Publication:
An unpublished level-2 analysis was performed by USGS and submitted to MDT (April 1992) under the title: "Analysis of scour potential for bridge structure no. P00050070+04611 Gallatin River 5M S Gallatin Gateway, MT".

Site Description:

The site is 5 miles south of Gallatin Gateway, Montana. The bridge is at the mouth of the Gallatin canyon, where the alluvial characteristics of the stream change rather abruptly. Upstream from the bridge, the river meanders through the canyon in a high-elevation alpine environment, is a sequence of pools and riffles, and is neither braided nor anabranching. Downstream from the bridge, the river exits the canyon and enters the Gallatin valley, where the river becomes generally braided and anabranching. Annual-peak-discharge data were collected for 60 years at the USGS streamflow-gaging station "Gallatin River near Gallatin Gateway, Montana" (06043500). Selected flood-frequency data (personal comm. Robert J. Omang, 1992) for the site are as follows:

Station Number	Drainage Area (Sq. Mi.)	100-year (cfs)	500-year (cfs)
06043500	825	10,700	12,700

The largest recorded peak discharge at the gage was 9,270 cubic feet per second (cfs) in 1971. Peak discharges of similar magnitude also occurred in 1970 (9,240 cfs) and 1974 (9,100 cfs). The 100-year and 500-year peak discharges at the U.S. 191 bridge were assumed to equal the values at the gage because the two locations are in close proximity to one another. Although the watershed has been subjected to recent fires and land-use changes, their overall effect on basin sediment yields is believed to be relatively minor.

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

The watershed is thus presumed to be fairly stable in terms of sediment yield and channel-change potential. The USGS gaging-station history describes the stream in the vicinity of the gage (06043500) as "very stable". Rating-curve shifts were found to be on the order of a few tenths of a foot. Channel-geometry data for this file are referenced from left edge of water (LEW) to right edge of water (REW)--thus, pier stationing needs to be used to reference sections to each other. Because of the high degree of armoring, the surface layer of the streambed is believed to be most representative for evaluating scour. Gradation of the material was estimated using a random-count procedure, and the sample was obtained within an area close to the downstream face of the bridge opening. Based on field observations, scour measurements, rating-curve shifts, and a level-2 analysis, general scour and contraction scour do not appear to be a factor at the site. Although level-2 calculations indicate a potential for abutment scour, actual scour would probably be less than predicted by the Froelich equation (generally recognized to estimate abutment scour conservatively high) and would require discharge much greater than what has been observed during the project to date.

Elevation Reference

Datum: MSL

MSL (ft):

Description of Reference Elevation:

Benchmark is US Coast and Geodetic Survey monument number G160 (1960), equal to elevation 5,129.271.

Stream Data

Drainage Area (sq mi):	825	Floodplain Width:	Narrow
Slope in Vicinity(ft/ft):	0.0063	Natural Levees:	Little
Flow Impact:	Straight	Apparent Incision:	Apparent
Channel Evolution	Unknown	Channel Boundary:	Alluvial
Armoring:	High	Banks Tree Cover:	Medium
Debris Frequency:	Occasional	Sinuosity:	Sinuuous
Debris Effect:	Local	Braiding:	None
Stream Size:	Medium	Anabranching:	None
Flow Habit:	Perennial	Bars:	Narrow
Bed Material:	Cobbles	Stream Width Variability:	Equiwidth
Valley Setting:	High		

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:	0.1	0.045	0.045
Typical	0.1	0.045	0.045
Low:	0.1	0.045	0.045

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1	1991	11	0	Hand	330	230	95	38	2.65		Non-Cohesive

Bed Material Comments

Measurement No: 1

Bridge Data

Structure No: P00050070+04611

Length(ft): 252

Width(ft): 40

Number of Spans: 3

Vertical Configuration: Sloping

Low Chord Elev (ft): 5121.54

Upper Chord Elev (ft): 5123.05

Overtopping Elev (ft): 5126.05

Skew (degrees): -40

Guide Banks: None

Waterway Classification: Unknown

Year Built: 1958

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

Avg Daily Traffic:

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: No

Distance Between Centerlines:

Distance Between Pier Faces:

Bridge Description:

The bridge is a three-span concrete deck with two concrete piers providing support between the two abutments. Data describing piers, abutments, and other longitudinal and vertical features are based on USGS survey work for measuring on-site scour, to perform a level-2 analysis, and to perform beta-level verification of the BRISTARS model using scour-related data from the site (planned). In the past 30 years, the bridge has been subjected to three large floods having magnitudes of at least 85% of the 100-year peak flow (Q100). There is no evidence, however, of scour-induced foundation or structural problems. The bridge length described here is based on the opening available for conveyance and may not agree with drawings.

Abutment Data

Left Station: 0

Right Station: 252

Left Skew (deg): -40

Right Skew (deg) -40

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: III

Embankment Skew (deg): -40

Embankment Slope (ft/ft): 1.5

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

Abutment Slope (ft/ft) 1.5
 Wingwalls: No
 Wingwall Angle (deg): 0

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	Pile Spacing(ft)
1	80	40	0	Single		
2	180	40	0	Single		

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	3.3	Sharp		39.3	None	Poured
2	3.4	Sharp		39.5	None	Poured

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1	5097.68	5091.68	8.5	Square	
2	5097.43	5091.43	9.5	Square	

Pier Description

Pier ID 1

Because piers are tapered, pier width and length are based on avg exposed pier during 6/6/91 flooding. Stationing is based on field measurements and does not relate to bridge plans. Pier elevations relate to datum of MDT dwg. 3870, which closely approximates datum used in survey of sections (+/- 0.2 ft).

Pier ID 2

See description for pier 1. Also pier 2 has been observed to experience the most scour. Channel-geometry data (10/23/91) at exit and app sections were used to estimate reference surface at bridge for determining scour depth at pier 2 and to confirm lack of thalweg influence and lack of contraction scour.

Pier Scour Data

Pier ID	Date	Time	USOrDS
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BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

1	6/6/91	13:35	Upstream
1	6/18/92	14:45	Upstream
1	6/23/93	0:00	Upstream
2	6/6/91	13:35	Upstream
2	6/18/92	14:45	Upstream
2	6/23/93	0:00	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)
1	0.8	0.3	6.5	15	8.4	4.8	3.4	3
1	1.2	0.3	12.1	19	5.1	3.3	3.4	3
1	1.9	0.3	8.3	23	6.2	3.4	3.4	3
2	5.5	0.5	4.1	44	10.6	5.5	3.4	3
2	4.6	0.5	5.3	44	7	3.7	3.4	3
2	4.5	0.5	5.7	48	7	3.8	3.4	3

PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects
1	Clear-water	Non-cohesive	Unknown			2.5	Insignificant
1	Clear-water	Non-cohesive	Unknown			2.5	Insignificant
1	Clear-water	Non-cohesive	Unknown			2.5	Insignificant
2	Clear-water	Non-cohesive	Unknown			2.5	Insignificant
2	Clear-water	Non-cohesive	Unknown			2.5	Insignificant
2	Clear-water	Non-cohesive	Unknown			2.5	Insignificant

PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)
1	330	230	95	38
1	330	230	95	38
1	330	230	95	38
2	330	230	95	38
2	330	230	95	38
2	330	230	95	38

Pier Scour Comments

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

Pier ID 1 **Time:** 13:35 **US/DS:** Upstream

Measurement made from bridge w/sounding wt and reel. Effective pier width is avg at WSEL and at reference surface used to measure to base of scour hole. Approach velocity was estimated using surveyed channel-geometry data, streamflow data, and REW and LEW elevations input to HP2 option of WSPRO.

Pier ID 1 **Time:** 14:45 **US/DS:** Upstream

See 6/6/91 description for P1.

Pier ID 1 **Time:** 0:00 **US/DS:** Upstream

See 6/6/91 description for P1.

Pier ID 2 **Time:** 13:35 **US/DS:** Upstream

See description for P1 for 6/6/91. Reference surface for determining scour at P2 is estimated using 10/23/91 data for exit and approach overlaid on bridge section data for 6/6/91. Data for exit and approach sections dated 10/7/92 demonstrate no change in channel geometry for the two sections.

Pier ID 2 **Time:** 14:45 **US/DS:** Upstream

See 6/18/92 description for P1. See 6/6/91 description for P2 for discussion of how reference surface was estimated for determining scour depth.

Pier ID 2 **Time:** 0:00 **US/DS:** Upstream

See 6/23/93 description for P1. See 6/6/91 description for P2 for discussion of how reference surface was estimated for determining scour depth.

Abutment Scour

Contraction Scour

BSDMS Summary Report

32 Gallatin River at U.S. 191 near Gallatin Gateway, MT

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)
1993	6	23		0	3360	(none)						0		2
1992	10	7		0	431	85						0		
1992	6	18	14:45	45	2930	90						0		2
1991	10	22		0	351	85						0		
1991	6	6	13:35	35	6420	90	1991	6	6	13:35	35			5

Hydrograph

Hydrograph	Year	Month	Day	Hr	Min	Sec	Stage(ft)	Discharge
Number								(cfs)

Supporting Files
