

# BSDMS Summary Report

88 US 2 over Beaver Creek Overflow 9 Miles West of Saco. MT

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## Site Location:

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<b>Site ID:</b>	88	
<b>Site Name:</b>	US 2 over Beaver Creek Overflow 9 Miles West of Saco. MT	
<b>County:</b>	Phillips	
<b>Nearest City:</b>	Saco	<b>Contact:</b>
<b>State:</b>	MT	Steve Holnbeck
<b>Latitude:</b>	482818	USGS, Montana District
<b>Longitude:</b>	1073145	(406) 457-5929
<b>USGS Station ID:</b>		holnbeck@usgs.gov
<b>Route Number:</b>	2	or
<b>Route Class:</b>	US	Chad Wagner
<b>Service Level:</b>	Mainline	USGS, North Carolina District
<b>Route Direction:</b>	NA	(919) 571-4021
<b>Highway Mile Point:</b>		cwagner@usgs.gov
<b>Stream Name:</b>	Beaver Creek	
<b>River Mile:</b>		
		<b>Publication:</b>
		An unpublished level-2 analysis
		was performed by Montana USGS and
		is planned for submittal to MDT
		(January 1994) under the title:
		"Analysis of Scour Potential for
		Bridge Structure No.
		P00001490+05771 Beaver Creek
		Overflow and Stock 9 Miles West of
		Saco, MT"

## Site Description:

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The overflow bridge 9 miles west of Saco, is one of three openings that convey water of Beaver Creek through US Highway 2 during high-runoff periods. This site is located on the left overbank floodplain of Beaver Creek, which flows northeast out of the Little Rocky Mountains in the Highline Country of Montana. No clearly-defined main channel exists and the floodplain consists of densely-vegetated erosion resistant pasture and rangeland. No peak-discharge data are available at the bridge site, but indirect measurements on Beaver Creek indicated that the magnitude of the September 1986 flood was approximately a 100-year return period event. High water marks surveyed after the 1986 flood suggest that the peak stage at the bridge was 92.89 ft. Inspection of the surrounding area and a lack of evidence of additional scour following the 1986 flood, the floodplain is presumed to be stable and clear-water scour is likely to occur at the bridge.

The magnitude of the 100- and 500-year floods for Beaver Creek are 13,500 and 20,700 cfs, respectively. Step-backwater calculations (WSPRO) at the bridge for the 100-year discharge indicated that the overflow bridge 9 miles west of Saco would carry 16% of the total Beaver Creek discharge (2,180 cfs) as free-surface flow. For discharges greater than the 100-year flood, step-backwater calculations showed that the road would be overtopped east of the bridge. For the 500-year flood, it was estimated that the road overflow would carry approximately 3,960 cfs and the bridge would carry the same percentage of the flow for the remainder of the 500-year flood (2,680 cfs). A level 2 scour analysis was conducted on the site using the WSPRO computer model and the 100- and 500-year discharges.

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The results of the WSPRO hydraulic characteristics are summarized below:

## WSPRO Hydraulic Results:

Uncontracted Section 100-yr  
Average Velocity = .49 ft/s Depth = 3.95  
Main Channel K = 369110 Left K = 0 Right K = 0

Bridge Section 100-yr  
Worst Case K-tube velocity = 6.95 area = 15.7 sq. ft.

Uncontracted Section 500-yr  
Average velocity = .46 ft/s Depth = 5.2 ft  
Main Channel K=582823 Left K=0 Right K=0

Bridge Section 500-yr  
Worst Case K-tube = 5.9 area = 22.7 sq ft

## Elevation Reference

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**Datum:** Local

**MSL (ft):** 2104.2

### Description of Reference Elevation:

The datum for the surveys is an RM#3 (chiseled X) located on the left upstream concrete abutment. The local datum elevation of RM#3 = 96.15 ft.

## Stream Data

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<b>Drainage Area (sq mi):</b>	1327	<b>Floodplain Width:</b>	Wide
<b>Slope in Vicinity(ft/ft):</b>	.000145	<b>Natural Levees:</b>	Unknown
<b>Flow Impact:</b>	Straight	<b>Apparent Incision:</b>	None
<b>Channel Evolution</b>	Unknown	<b>Channel Boundary:</b>	Alluvial
<b>Armoring:</b>	None	<b>Banks Tree Cover:</b>	Low
<b>Debris Frequency:</b>	None	<b>Sinuosity:</b>	Straight
<b>Debris Effect:</b>	None	<b>Braiding:</b>	None
<b>Stream Size:</b>	Small	<b>Anabranching:</b>	None
<b>Flow Habit:</b>	Ephemeral	<b>Bars:</b>	Unknown
<b>Bed Material:</b>	Silt	<b>Stream Width Variability:</b>	Unknown
<b>Valley Setting:</b>	Low		

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## Roughness Data

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### Manning's n Values

	Left Overbank	Channel	Right Overbank
High:			
Typical	0.045	0.05	0.045
Low:			

## Bed Material

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Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1				grab on bed	25	16	0.001				Cohesive

### Bed Material Comments

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Measurement No: 1

50 ft upstream of bridge, able to make a ribbon in hand with the wet sample.

Results:

Size (mm)	32	16	8	4	2	1	.5	.25	.125	.062	.032		
.016	.008	.004	.002										
% < than	100	84.6	79.8	75.9	75.1	74.2	73.6	70.0	65.4	63.0	62.0	61.1	56.8
56.2	55.0												

## Bridge Data

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Structure No: P00001490+05771

Length(ft): 90

Width(ft): 40

Number of Spans: 4

Vertical Configuration: Sloping

Low Chord Elev (ft): 94.94

Upper Chord Elev (ft): 95.05

Overtopping Elev (ft): 96.95

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Relief

Year Built: 1968

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**Avg Daily Traffic:**

**Plans on File:** Yes

**Parallel Bridges** No

**Upstream/Downstream:** N/A

**Continuous Abutment:** 0

**Distance Between Centerlines:**

**Distance Between Pier Faces:**

## **Bridge Description:**

Piers are numbered from left to right, #1 being the left-most line of piers (looking downstream) and #3 being the right-most line of piers. There are three separate cylindrical piers at each numbered line of piers, positioned at the upstream, centerline and downstream portion of the bridge. Each of the nine piers are resting on 5.5 ft x 5.5 ft footers, which are supported by concrete piles. The abutments are constructed with a 1.5:1 slope and are riprapped.

## **Abutment Data**

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**Left Station:**

**Right Station:**

**Left Skew (deg):** 0

**Right Skew (deg)** 0

**Left Abutment Length (ft):** 100

**Right Abutment Length (ft)** 100

**Left Abutment to Channel Bank (ft):**

**Right Abutment to Channel Bank (ft):**

**Left Abutment Protection:** Riprap

**Right Abutment Protection** Riprap

**Contracted Opening Type:** III

**Embankment Skew (deg):** 0

**Embankment Slope (ft/ft):** 1.5

**Abutment Slope (ft/ft)** 1.5

**Wingwalls:** No

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Wingwall Angle (deg):

## Pier Data

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Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	File Spacing(ft)
1	29	0		Group		
2	45	0		Group		
3	61	0		Group		

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	2	Cylindrical			None	Piles
2	2	Cylindrical			None	Piles
3	2	Cylindrical			None	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1	87.68	85.18	5.5	Square	
2	87.67	85.17	5.5	Square	
3	87.16	85.16	5.5	Square	

## Pier Description

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Pier ID 1

There are three piers at location #1, positioned at the upstream, centerline and downstream portion of the bridge. None of the three piers are skewed to one another, but rather positioned in a straight line, parallel to the flow.

Pier ID 2

There are three piers at location #2, positioned at the upstream, centerline and downstream portion of the bridge. None of the three piers are skewed to one another, but rather positioned in a straight line, parallel to the flow.

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Pier ID 3

There are three piers at location #3, positioned at the upstream, centerline and downstream portion of the bridge. None of the three piers are skewed to one another, but rather positioned in a straight line, parrallel to the flow.

## Pier Scour Data

Pier ID	Date	Time	USOrDS
1			
2			
3			

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							2	0
2								0
3								0

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

PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)
1				
2				
3				

## Pier Scour Comments

Pier ID	1	Time:	US/DS:
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WSPRO Results:

100-yr (HEC-18)	Qbridge (cfs)	K1	K2	K3	a	Y1 (ft)	V1 (ft)	Fr	Ys (fps)	(ft)
2,180	1.0	1.0	1.1	2.0	5.41	6.95	.53	4.7		

500-yr (HEC-18)	Qbridge (cfs)	K1	K2	K3	a	Y1 (ft)	V1 (ft)	Fr	Ys (fps)	(ft)
2,680	1.0	1.0	1.1	2.0	7.09	5.90	.39	4.7		



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MeasurementNo 1

No evidence of abutment scour found during post-flood survey.

100-yr Left Abutment

Ae Qe Ve a' Ya Fr Ys  
1973 940 .48 515 3.83 .04 (\*) ft

(\*) - Because velocity and Froude number are relatively small, abutment scour is presumed to not occur.

500-yr Left Abutment

Ae Qe Ve a' Ya Fr Ys  
2616 1174 .45 515 5.08 .04 (\*) ft

(\*) - Because velocity and Froude number are relatively small, abutment scour is presumed to not occur.

MeasurementNo 2

100-yr Right Abutment

Ae Qe Ve a' Ya Fr Ys  
2099 1030 0.49 527 3.98 .04 (\*) ft

(\*) - Because velocity and Froude number are relatively small, abutment scour is presumed to not occur.

500-yr Right Abutment

Ae Qe Ve a' Ya Fr Ys  
2764 1266 0.46 527 5.24 .04 (\*) ft

(\*) - Because velocity and Froude number are relatively small, abutment scour is presumed to not occur.

## ContractionScour

Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1						3.25

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1	0.5				

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1					

Measurement Number	Pier Contraction Ratio	Scour Location	Eccentricity	Sediment Transport	Bed Form	Debris Effects
1		Floodplain		Clear-water	Unknown	nsignifican

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

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1

Unknown

## Contraction Scour Comments

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### Measurement No. 1

The cont. scour depth entered in the database was determined from analysis of the surveyed cross-sections collected during the 9/17 - 9/18/01 post-flood survey.

WSPRO Results: 500- yr Clear-  
Water Calculations Y1=5.20 D50=.59 Dm = .74 W2=81.0 Ys = 0 ft 100-  
yr Clear-Water Calculations Y1=3.95 D50=.59 Dm=.74 W2=81.0 Ys=0  
ft ----- WSPRO contraction scour calculations were based on the  
bridge conditions after the 1986 flood, which prompted the MTDOT to lined the  
section through the bridge with riprap, hence the very large D50 and Dm  
values. The grain size distribution found in this section and in the bed  
material section are representative of the material that was present prior to  
the 1986 flood. Since clear-water scour is assumed to take place and no other  
event has occurred since 1986 that forced the overflow bridge to convey water,  
post-flood surveys of the section provided a reasonable estimate of the scour  
that occurred during the 1986 flood. The scour depths specified in this  
section were determined from these post-flood surveys.

## Stage and Discharge Data

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Peak Discharge					Flow (cfs)	Peak Stage					Stage (ft)	Water Temp (C)	Return Period(yr)
year	mo	dy	hr	mi		Qacc	year	mo	dy	hr			
					20,700								500
					13,500								100

## Hydrograph

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### Supporting Files

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Bvr9saco.xls - Excel worksheet with survey data (September 18, 2001) and the resulting plot of bathymetric profiles used to estimate depth of scour during the 1986 flood.

bvr7AND9saco.dwg - AutoCad file of the surveyed points collected during the 9/17-9/18/01 data collection trip. File contains both overflow bridges of Beaver Creek.

Bvr9saco.dxf - AutoCad file of 9/17-9/18/01 survey in a .dxf file format.

Bvr9saco.txt - ASCII file of the data points collected at the overflow bridge 9 miles W of Saco during the 9/17-9/18/01 survey.

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Photos of the Site (P000 prefix; .jpg format):

#	Description
1071.	From bridge, looking downstream at the extent of contraction scour
1072.	From bridge, looking upstream at approach section
1073.	Under bridge, looking upstream between #1 and #2 piers.
1074.	Under bridge, looking downstream at pier #2
1075.	Under bridge, looking downstream
1076.	Under bridge, looking downstream at pier #1
1077.	Under bridge, looking upstream at pier #1 and #2
1078.	Under bridge, looking upstream at pier #3 and #2
1079.	Looking U/S (8/20/91)
1080.	Looking D/S (8/20/91)
1081.	Panoramic view looking D/S (8/20/91)