

# BSDMS Summary Report

87 US 2 over Beaver Creek Overflow 7 Miles West of Saco. MT

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## Site Location:

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<b>Site ID:</b>	87	
<b>Site Name:</b>	US 2 over Beaver Creek Overflow 7 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>	482829	USGS, Montana District
<b>Longitude:</b>	1073009	(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, Kentucky District
<b>Route Direction:</b>	NA	(502) 493-1912
<b>Highway Mile Point:</b>		cwagner@usgs.gov
<b>Stream Name:</b>	Beaver Creek	
<b>River Mile:</b>		

### Publication:

An unpublished level-2 analysis was performed by Montana USGS and is planned for submittal to MDT (January - 1994) under the title: "Analysis of Scour Potential for Bridge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. P00001491+08241 Beaver Creek Overflow 7 Miles West of Saco, MT"

January - 1994

## Site Description:

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The overflow bridge 7 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 92.35 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 7 miles west of Saco would carry 34% of the total Beaver Creek discharge (4,570 cfs) as unsubmerged pressure flow. For discharges greater than the 100-year flood, step-backwater calculations showed that the road would be overtopped near the bridge, and it was estimated the the bridge would carry the same percentage of the flow for the 500-year flood (5,690 cfs). A level 2 scour analysis was conducted on the site using the WSPRO computer model and the 100- and 500-year discharges.

The results of the WSPRO hydraulic characteristics are summarized below:

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## WSPRO Hydraulic Results:

Uncontracted Section 100-yr  
Average Velocity = .75 ft/s Depth = 5.24  
Main Channel K = 607596 Left K = 0 Right K = 0

Bridge Section 100-yr  
Worst Case K-tube velocity = 8.26 area = 27.7 sq. ft.

Uncontracted Section 500-yr  
Average velocity = .77 ft/s Depth = 6.33 ft  
Main Channel K=833666 Left K=0 Right K=0

Bridge Section 500-yr  
Worst Case K-tube = 10.29 area = 27.7 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#2 (chiseled X) located on the left upstream concrete abutment. The local datum elevation of RM#2 = 94.40 ft.

## Stream Data

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<b>Drainage Area</b> (sq mi):	1327	<b>Floodplain Width:</b>	Wide
<b>Slope in</b> <b>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>	Partial	<b>Banks Tree Cover:</b>	Low
<b>Debris Frequency:</b>	None	<b>Sinuosity:</b>	Unknown
<b>Debris Effect:</b>	None	<b>Braiding:</b>	None
<b>Stream Size:</b>	Unknown	<b>Anabranching:</b>	None
<b>Flow Habit:</b>	Ephemeral	<b>Bars:</b>	Unknown
<b>Bed Material:</b>	Silt	<b>Stream Width</b> <b>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: P00001491+08241

Length(ft): 90

Width(ft): 40

Number of Spans: 4

Vertical Configuration: Sloping

Low Chord Elev (ft): 93.25

Upper Chord Elev (ft): 94.5

Overtopping Elev (ft): 95.08

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:** 0

**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:** Yes

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Wingwall Angle (deg):

## Pier Data

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

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	2	cyindrical			Unknown	Piles
2	2	cyindrical			Unknown	Piles
3	2	cyindrical			Unknown	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1	85.84	83.34	5.5	Square	
2	85.84	83.34	5.5	Square	
3	85.83	83.33	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, parrallel 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, parrallel 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, parallel to the flow.

## Pier Scour Data

Pier ID	Date	Time	USOrDS
1			
2			Upstream
3			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							2	0
2	1	0.25					2	0
3	0.5	0.25						0

PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects
1	Clear-water	Unknown	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:			
WSPRO Results:										
100-yr (HEC-18)										
Qbridge (cfs)	K1	K2	K3	a	Y1	V1 (ft)	Fr	Ys (fps)	(ft)	
4,570	1.0	1.0	1.1	2.0	11.54	8.26	.43	5.6		
500-yr (HEC-18)										
Qbridge (cfs)	K1	K2	K3	a	Y1	V1 (ft)	Fr	Ys (fps)	(ft)	
5,690	1.0	1.0	1.1	2.0	11.54	10.29	.53	6.2		

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Pier ID 2 Time: US/DS: Upstream

The pier 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:

100-yr (HEC-18)

Qbridge	K1	K2	K3	a	Y1	V1	Fr	Ys	
(cfs)					(ft)	(ft)		(fps)	(ft)
4,570	1.0	1.0	1.1	2.0	11.54	8.26	.43	5.6	

500-yr (HEC-18)

Qbridge	K1	K2	K3	a	Y1	V1	Fr	Ys	
(cfs)					(ft)	(ft)		(fps)	(ft)
5,690	1.0	1.0	1.1	2.0	11.54	10.29	.53	6.2	

Pier ID 3 Time: US/DS: Upstream

The pier 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:

100-yr (HEC-18)

Qbridge	K1	K2	K3	a	Y1	V1	Fr	Ys	
(cfs)					(ft)	(ft)		(fps)	(ft)
4,570	1.0	1.0	1.1	2.0	11.54	8.26	.43	5.6	

500-yr (HEC-18)

Qbridge	K1	K2	K3	a	Y1	V1	Fr	Ys	
(cfs)					(ft)	(ft)		(fps)	(ft)
5,690	1.0	1.0	1.1	2.0	11.54	10.29	.53	6.2	

## Abutment Scour

Measurement Number	Abutment	Date	Time	US/DS	Scour Depth (ft)	Accuracy	Sediment Transport
1	Left			Unknown	0	0	Clear-water
2	Right			Unknown	0	0	Clear-water

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

Measurement Number	Embankment Length (ft)	Bed Material	D50 (mm)	Sigma	Debris Effect
1		Unknown	0.001		Insignificant
2		Unknown			Insignificant

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## Abutment Scour Comments

MeasurementNo 1

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

100-yr Left Abutment

Ae	Qe	Ve	a'	Ya	Fr	Ys
2509	1896	.76	470	5.34	.06	(*) 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
3027	2355	.78	470.5	6.43	.05	(*) 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
3077	2264	0.74	605	5.09	.06	(*) 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
3742	2838	0.76	605.7	6.18	.05	(*) ft

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

## Contraction Scour

Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1						4.5

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

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

## Contraction Scour Comments

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=6.33 D50=.59 Dm=.74  
W2=83.0 Ys = 0 ft 100-yr Clear-Water Calculations Y1=5.24  
D50=.59 Dm=.74 W2=83 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

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

## Hydrograph

## Supporting Files

BVR7Saco.xls - Excel worksheet with survey data (September 18, 2001) and the resulting plot of bathymetry 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 the Beaver Creek.

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Bvr7saco.dxf - AutoCad file of 9/17-9/18/01 survey in a .dxf file format.

Bvr7saco.txt - ASCII file of the data points collected at the overflow bridge 7 miles W of Saco during the 9/17-9/18/01 survey.

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

#	Description
1063.	Under bridge looking upstream, cow carcass adds to scenery and aroma of site.
1064.	Under bridge looking downstream between line of piers #2 and #3.
1065.	Upstream of bridge, looking downstream
1066.	Chad Wagner collects bed material sample at upstream approach section
1067.	Picture of bed material sample hole
1068.	From bridge looking downstream at the extent of contraction scour
1069.	same as 1068