BSDMS Summary Report

93 Galvin Road Overflow Bridge for the Chehalis River near Centralia,

Site Location:

Site ID: 93

Site Name: Galvin Road Overflow Bridge for the Chehalis River near Centralia, WA

County: Lewis

Nearest City: Centralia

State: WA

Latitude: 464409

Longitude: 1230108

USGS Station ID:

Route Number:

Route Class: County

Service Level: Mainline

Route Direction: NA

Highway Mile Point:

Stream Name: Chehalis River

River Mile: 64.08

Contact:

Chad Wagner
USGS - North Carolina District
cwagner@usgs.gov
(919) 571-4021
or
Rod Lakey, Senior Engineer
Lewis County Department of Public Works
350 N. Market Boulevard
Chehalis, WA 98532
(360) 740-1123

Publication:

Site Description:

The Galvin Road Overflow bridge is approximately 2.5 miles northwest of the town of Centralia, WA and serves as a relief opening on the east floodplain of the Chehalis River during high-flow events (figure 1). The current bridge at the site is 382 feet (ft) long and consists of 10 spans supported on 11 piers. A low spot in the embankment fill 500 ft east of the bridge overtops during major floods and prevents pressure flow at the overflow bridge. The main channel of the Chehalis River is 1200 ft west of the Overflow bridge and is spanned by a 400 ft concrete bridge. The main bridge, Overflow bridge, and low spot in the fill are the only places where flood flows can pass to downstream of Galvin Road. The bridge was damaged on February 9, 1996, when the Chehalis River experienced a major flood. The flood produced a massive scour hole under the western one-third of the bridge and undermined the timber piles of one intermediate pier, which caused the bridge deck to sag 18 inches. A USGS gaging station (12027500) on the Chehalis River at Grand Mound has been operational four miles downstream of the Galvin Road Overflow bridge from 1929 - 2002.

The Chehalis River is a fine- to medium-grained sand channel with a wide floodplain in the vicinity of the Galvin Road overflow bridge. The Galvin site is more complicated than most other bridge sites in the area because of a wide flood plain, upstream overbank flow diversion, off-channel storage and backwater effects from the downstream reaches of the Chehalis River. The backwater effects stems from an adverse channel gradient in the vicinity of the bridge crossing. Rather than a uniformly sloping channel in the downstream direction, the main channel of the

Chehalis River between river miles 61.7 and 62.9 (the Galvin Road bridge is located at river mile 64.08) has an adverse slope of .0005 ft/ft. The adverse slope of the channel in the vicinity of Galvin Road is attributed to an abrupt narrowing (pinch) of the Chehalis River valley topography approximately 3.5 river miles downstream of the Galvin Road crossing. The severe pinch in the river valley creates backwater during high flow events and leads to frequent flooding of Centralia and Interstate 5. Under most hydraulic conditions, the backwater created by the downstream adverse channel slope is just as or more severe than the backwater caused by the Galvin Road overflow bridge contraction.

Three hydraulic reports involving the Galvin Road Overflow bridge were developed prior to the 1996 flood: 1) FEMA Flood Insurance Study Report for Unincorporated Lewis County (FEMA, 1991); 2) Galvin Road Overflow Bridge Hydraulics Study dated November 1986 by Robert E. Meyer Consultants (REM 1986); 3) a second Galvin Road Overflow Bridge Hydraulics Study dated October 1991, also by REM (1991). The purpose of the November 1986 study was to provide Lewis County with the hydraulic information necessary to select a replacement design for the Galvin Road Overflow bridge. Due to the bridge being within FEMA's regulatory floodway, a hydraulic study had to be completed to show that the new bridge would not increase the 100-yr flood water surface elevation. REM developed a HEC-2 model of the Chehalis River and used it to show that with minor channel bed excavation, the overflow bridge could be shortened from 530 ft to about 360 ft and still meet FEMA's requirements. In 1991, a 382 ft long bridge was selected and REM completed a second study, which showed that the proposed bridge satisfied FEMA's no increase requirement (Northwest Hydraulic Consultants 1996).

The REM studies were restricted to satisfying FEMA's no increase requirement, and did not give a realistic picture of the hydraulic conditions that could develop during major flood, and did not accurately address scour as a potential problem at the site. A review of the HEC-2 input and output by Northwest Hydraulic Consultants prior to the 1996 flood revealed several problems. The major problem involved the use of non-representative Manning's n roughness coefficients in the vicinity of the bridge. The REM model used an n value of 0.015 for the main channel of the Chehalis River and 0.104 for the Overflow bridge opening. The n value is too low in the main channel and too high for the overflow waterway; reasonable values for both model sections range from 0.03 - 0.05. This, along with other problems in the model, caused the model to significantly underestimate the flow through the Overflow bridge. The REM output indicated that for the FEMA 100-yr flood (56,000 cubic feet per second (cfs)), less than 3,800 cfs was conveyed through the overflow and average velocities were less than 1 foot per second (fps). A simplified HEC-2 model of the site was developed by Northwest Hydraulic Consultants using surveyed high-water marks and cross-sections from the 1996 flood. The model developed from field data showed that 25,000 to 30,000 cfs passed under the overflow bridge with average velocities ranging from 8 to 10 fps.

The hydrologic event responsible for the 1996 flood was an intense winter storm that hit southwestern Washington. The peak discharge that was measured during the 1996 flood was approximately 74,900 cfs on February 9. Northwest Hydraulic Consultants conducted a flood frequency analysis on the historical data (1929-1996) from the Grand Mound gaging station. Estimates of the 100- and 500-year discharges are 73,600 cfs and 99,800 cfs, respectively. The existing FEMA flood insurance study lists the 100-yr and 500-yr discharges as 56,000 cfs and 70,000 cfs; however these were based upon a shorter period of record (1929-1976). From surveyed high-water marks of the February 9, 1996 flood, it appears that 45,000 to 50,000 cfs remained in the Chehalis River main channel and 25,000 to 30,000 cfs passed through the Overflow bridge. As the floodplain flow approached the new Overflow bridge, the new western approach fill significantly blocked the flow and intensified the contraction and velocities at the left (western) portion of the Overflow bridge

Elevation Reference

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Datum: MSL

MSL (ft):

Description of Reference Elevation:

The elevations reported were taken from the Galvin Road overflow bridge plans.

Stream Data

Drainage Area (sq mi):	675	**Floodplain Width:**	Narrow
Slope in Vicinity(ft/ft):	.00074	**Natural Levees:**	Unknown
Flow Impact:	Straight	**Apparent Incision:**	None
Channel Evolution	Unknown	**Channel Boundary:**	Alluvial
Armoring:	Partial	**Banks Tree Cover:**	Low
Debris Frequency:	Unknown	**Sinuosity:**	Meandering
Debris Effect:	Unknown	**Braiding:**	None
Stream Size:	Wide	**Anabranching:**	Generally
Flow Habit:	Perennial	**Bars:**	Unknown
Bed Material:	Sand	**Stream Width Variability:**	Unknown
Valley Setting:	Low		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:	0.05	0.05	0.05
Typical	0.03	0.03	0.03
Low:			

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1											Unknown

Bed Material Comments

Measurement No: 1

From the soil logs for four test holes the bed material in the top layer consists of 6 to 10 feet of fine to medium sand underlain by 4 to 10 feet of coarser material, composed of 50% sand and 50% gravel up to 2.5-in size. No bed material samples were collected for the study.

Bridge Data

Structure No: 112

Length(ft): 382

Width(ft): 28

Number of Spans: 10

Vertical Configuration: Sloping

Low Chord Elev (ft): 161.8

Upper Chord Elev (ft): 163.8

Overtopping Elev (ft): 165.6

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Relief

Year Built: 1993

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:

The Galvin Road Overflow bridge (structure #112) was constructed in 1993 and replaced a previous 530 ft long bridge at the same location. The current bridge is 382 ft long and consists of ten composite glue-lam timber/concrete spans supported by 11 piers. When the previous bridge was removed and replaced by the new shorter structure, the west approach fill was extended

146 feet and greatly increased the contraction of the floodplain flow path. Piers 1 and 11 at the ends of the bridge are completely buried in the approach fills. Piers 2 and 10 are intermediate piers. The approach fills at the ends of the bridge are 15 to 20 ft high and block the floodplain. The end slopes of both approach fills are sloped 1.5H to 1V and protected by riprap (D50 = 12 inches).

Abutment Data

Left Station: 6805.04

Right Station: 6422.96

Left Skew (deg): 0

Right Skew (deg) 0

Left Abutment Length (ft): 60

Right Abutment Length (ft) 60

Left Abutment to Channel Bank (ft): 0

Right Abutment to Channel Bank (ft): 0

Left Abutment Protection: Riprap

Right Abutment Protection Riprap

Contracted Opening Type: III

Embankment Skew (deg): 0

Embankment Slope (ft/ft): 6.75

Abutment Slope (ft/ft) 1.5

Wingwalls: Yes

Wingwall Angle (deg): 45

Pier Data

Pier ID	Bridge Station(ft)	Alignment	Highway Station	PierType	# Of Piles	Pile Spacing(ft)
1	0	0	6422.96	Group	5	7.19
10	343.04	0	6766	Group	6	5.75
11	382.08	0	6805.04	Group	5	7.19

2	39.04	0	6462	Group	6	5.75
3	77.04	0	6500	Group	6	5.75
4	115.04	0	6538	Group	6	5.75
5	153.04	0	6576	Group	6	5.75
6	191.04	0	6614	Group	6	5.75
7	229.04	0	6652	Unknown	6	5.75
8	267.04	0	6690	Group	6	5.75
9	305.04	0	6728	Group	6	5.75

Pier ID	Pier Width(ft)	Pier Shape	Shape Factor	Length(ft)	Protection	Foundation
1	1.42	Round		28	None	Piles
10	0.67	Round		28.75	None	Piles
11	1.42	Round		28	None	Piles
2	0.67	Round		28.75	None	Piles
3	5.75	Round		28.75	None	Piles
4	0.67	Round		28.75	None	Piles
5	0.67	Round		28.75	None	Piles
6	0.67	Round		28.75	None	Piles
7	0.67	Round		28.75	None	Piles
8	0.67	Round		28.75	None	Piles
9	0.67	Round		28.75	None	Piles

Pier ID	Top Elevation(ft)	Bottom Elevation(ft)	Foot or Pile Cap Width(ft)	Cap Shape	Pile Tip Elevation(ft)
1				Unknown	142.1
10				Unknown	135.8
11				Unknown	139.9
2				Unknown	136.6
3				Unknown	137.4
4				Unknown	137.6

5	Unknown	137.8
6	Unknown	138.8
7	Unknown	138.9
8	Unknown	137.7
9	Unknown	137.7

Pier Description

Pier ID 1

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 10

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 11

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 2

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 3

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 4

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 5

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 6

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 7

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 8

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier ID 9

The piers are numbered from right to left, looking downstream and consist of a group of 5-6 creosoted timber piles. The piles do not have foundations but rather driven into the bed material until refusal (penetration averaged 12.3 feet).

Pier Scour Data

Pier ID	Date	Time	USOrDS
9			

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)
9								0

PierID	Sediment Transport	Bed Material	BedForm	Trough (ft)	Crest (ft)	Sigma	Debris Effects
9	Unknown	Unknown	Unknown				Unknown

PierID	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)
9				

Pier Scour Comments

Pier ID 9 **Time:** **US/DS:**

Although local pier scour around the base of the piles may have contributed to the total scour depth and failure of the piles, it was determined by NHC to be insignificant compared to the contraction scour. Therefore, no measurement or computations of abutment scour were made at the Galvin Road overflow bridge.

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

No measurement or computations of abutment scour were made at the Galvin Road overflow bridge.

ContractionScour

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

1	2/9/1996	2/9/1996	3
2	2/9/1996	2/9/1996	3

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1	1	7.6	25000	9.31	359
2	2	9.1	30000	9.33	360

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1	2.7	13990	6.31	400	
2	3	16600	6.33	400	

Measurement Number	Pier Contraction Ratio	Scour Location	Eccent-ricity	Sediment Transport	Bed Form	Debris Effects
1		Floodplain		Clear-water	Unknown	Unknown
2		Floodplain		Clear-water	Unknown	Unknown

Measurement Number	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	Sigma Bed Material	Bed Material
1						Non-Cohesive
2						Non-Cohesive

Contraction Scour Comments

Measurement No. 1

The reported scour depth was taken from post-flood observations at the site. The maximum scour was 14 ft around pier #8. The contracted and uncontracted scour parameters reported in the database were taken from the HEC-2 model developed following the flood utilizing surveyd high-water marks. The model developed from field data showed that 25,000 to 30,000 cfs passed through the overflow bridge; the hydraulic parameters for measurement 1 are representative of the conveyance of 25,000 cfs. -- The contraction at this site is most notably attributed to the severe constriction in the floodplain flow width created by extending the western approach fill 146 feet to accommodate the new shorter Galvin Road overflow bridge. Although the hydraulic analysis for the new bridge revealed that the shorter structure would meet the Federal Emergency Management Agency’s (FEMA) requirement of less than 1-foot increase in the floodplain depth, the analysis did not consider the potential for scour.

Measurement No. 2

The reported scour depth was taken from post-flood observations at the site. The contracted and uncontracted scour parameters reported in the database were taken from the HEC-2 model developed following the flood utilizing surveyd high-water marks. The model developed from field data showed that 25,000 to 30,000 cfs passed through the overflow bridge; the hydraulic parameters for measurement 1 are representative of the conveyance of 30,000 cfs. -- The contraction at this site is most notably attributed to the severe constriction in the floodplain flow width created by extending the western approach fill 146 feet to accommodate the new shorter Galvin Road overflow bridge. Although the hydraulic analysis for the new bridge revealed that the shorter structure would meet the Federal Emergency Management Agency's (FEMA) requirement of less than 1-foot increase in the floodplain depth, the analysis did not consider the potential for scour.

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)
					74900							160.8		100

Hydrograph

Supporting Files

Northwest Hydarulic Consultants, 1996, Galvin Road Overflow Bridge Failure Scour and Hydraulic Investigation, Report prepared for Lewis County Department of Public Works. Tukwila, Wash. 9 p.

Robert E. Meyer Consultants, Inc., 1986, Bridge Hydrualics Study for Galvin Overflow Bridge and Scheuber Road Bridge Chehalis River, Washington, Report prepared for Lewis County Department of Public Works. Beaverton, Oregon. 22 p.

Robert E. Meyer Consultants, Inc., 1991, Bridge Hydrualics Study for Galvin Overflow Bridge and Scheuber Road Bridge Chehalis River, Washington, Report prepared for Lewis County Department of Public Works. Beaverton, Oregon. 20 p.

Photo2.jpg - Looking east across upstream face of Galvin Road Overflow Bridge for Chehalis River near Centralia, WA on 2/9/1996.
Photo3.jpg - Looking east at Pier 10 (foreground) and Pier 9 (the pier that failed) of Galvin Road Overflow Bridge, 2/9/1996.
Photo4.jpg - Looking east along downstream side of Galvin Road overflow bridge into scour hole during dewatering.
Photo5.jpg - Looking downstream (north) to the Galvin Road overflow bridge.
Photo6.jpg - Looking east at failed pier #9 following the February 1996

flood.
Photo7.jpg - Looking upstream at left abutment and area of failure from downstream of bridge.
Photo8.jpg - Looking downstream at piers 8, 9 (the pier that failed) and 10 following the February 1996 flood.
Photo10.jpg - Looking west toward sag in bridge deck (from bridge deck) due to failure of pier #9 during the February 1996 flood.

GalvinRdFlowPatterns.jpg - Sketch of flow patterns and HEC-2 model sections through Galvin Road overflow bridge during February 1996 flood.

GalvinRdScourHole.jpg - Plan and profile plots of scour hole location at Galvin Road overflow bridge for the Chehalis River, Centralia, WA.

ChehalisMap.jpg - Location and topographic map of Galvin Road Overflow bridge site.

AerialPhoto.jpg - Aerial photo of the Gavin Road Overflow bridge site taken in 1990