BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

Site Location:

Site ID: 77

Site Name: Middle Fork Crow River at S.R. 4 near Manannah, MN

County: Meeker

Nearest City: Manannah

State: MN

Latitude: 451448

Longitude: 0944017

USGS Station ID:

Route Number: 4

Route Class: State

Service Level: Mainline

Route Direction: NA

Highway Mile Point:

Stream Name: Middle Fork Crow River

River Mile:

Contact:

David Mueller
U.S. Geological Survey
9818 Bluegrass Parkway
Louisville, KY 40299

Publication:

Mueller, D.S., and Hitchcock, H.A., 1998, Scour measurements at contracted highway crossings in Minnesota, 1997: ASCE, Water Resources Engineering '98, Memphis, TN, p. 210-215.

Site Description:

S.R. 4 runs north and south through low relief terrain of pastures and meadows, with some areas of woody vegetation. The nearest town of Manannah is located to the northwest. According to the MnDOT bridge plan notes, "The channel appears to have been dredged and straightened. No records at courthouse of it being a public ditch." The channel in 1997 still appear unusually straight, but banks were well vegetated and appeared stable. There is no gaging station near this site, but according to the bridge plans, local residents reported a historic high water of 1124.9 ft MSL, which occurred in the spring of 1952. The current bridge built in 1955 apparently replaced a smaller bridge (having an opening of only about 25 ft), which was located about 20 ft upstream. The construction plans indicated that the contractor was to clean out the channel and dress slopes to the section shown in the plans, for a distance of 60 ft both sides of the highway centerline. The design cross section had a bottom width of 26 ft at an elevation of 1115.25 ft MSL with side slopes of 2:1.

Data collected in 1997 was collected after the flood peak had passed. The time of the peak is not known but based on highwater marks the peak appeared to be at 1122.1 ft MSL, approximately 1.86 ft higher than the stage of 1120.25 ft MSL measured of April 4, 1997.

Elevation Reference

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

Datum: MSL

MSL (ft):

Description of Reference Elevation:

All elevations and stages are referenced to mean sea level, based on the elevation of the finished bridge deck.

Stream Data

Drainage Area (sq mi):		**Floodplain Width:**	Wide
Slope in Vicinity(ft/ft):	0.001	**Natural Levees:**	Unknown
Flow Impact:	Straight	**Apparent Incision:**	None
Channel Evolution	Restabilization	**Channel Boundary:**	Alluvial
Armoring:	Unknown	**Banks Tree Cover:**	Low
Debris Frequency:	Unknown	**Sinuosity:**	Straight
Debris Effect:	Contraction	**Braiding:**	None
Stream Size:	Small	**Anabranching:**	None
Flow Habit:	Perennial	**Bars:**	Narrow
Bed Material:	Unknown	**Stream Width Variability:**	Equiwidth
Valley Setting:	Low		

Roughness Data

Manning's n Values

	Left Overbank	Channel	Right Overbank
High:			
Typical		0.03	
Low:			

Bed Material

Measurement Number	Yr	Mo	Dy	Sampler	D95 (mm)	D84 (mm)	D50 (mm)	D16 (mm)	SP	Shape	Cohesion
1									2.65		Unknown

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

Bed Material Comments

Measurement No: 1

No sieve information for bed material samples was available. The low-water survey completed in July 1997 noted that the bottom was composed of firm rock and gravel and was uneven. The bridge plans did not contain lithologic logs but did contain some penetration values, suggesting that there was no bed rock in the area.

Bridge Data

Structure No: 6853

Length(ft): 35

Width(ft): 34.5

Number of Spans: 1

Vertical Configuration: Horizontal

Low Chord Elev (ft): 1128.8

Upper Chord Elev (ft): 1128.8

Overtopping Elev (ft): 1132

Skew (degrees): 0

Guide Banks: None

Waterway Classification: Main

Year Built: 1955

Avg Daily Traffic: 890

Plans on File: Yes

Parallel Bridges No

Upstream/Downstream: N/A

Continuous Abutment: No

Distance Between Centerlines:

Distance Between Pier Faces:

Bridge Description:

This bridge is a single-span structure with 45 degree wing-walls both upstream and downstream. The bridge opening is smaller than both the upstream and downstream channel top widths. The wing walls extend out to the width of the upstream and downstream channels. The bridge and wing walls are aligned with the channel.

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

Abutment Data

Left Station: 0

Right Station: 35

Left Skew (deg): 0

Right Skew (deg) 0

Left Abutment Length (ft): 38.25

Right Abutment Length (ft) 38.25

Left Abutment to Channel Bank (ft): 0

Right Abutment to Channel Bank (ft): 0

Left Abutment Protection:

Right Abutment Protection

Contracted Opening Type: IV

Embankment Skew (deg): 0

Embankment Slope (ft/ft): 2

Abutment Slope (ft/ft) 0

Wingwalls: Yes

Wingwall Angle (deg): 45

Pier Data

Pier Scour Data

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

Abutment Scour

Measurement Number	Abutment	Date	Time	US/DS	Scour Depth (ft)	Accuracy	Sediment Transport
1		4/8/97		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

ContractionScour

Measurement Number	Contracted Date	Contracted Time	Uncontracted Date	Uncontracted Time	US/DS	Scour Depth(ft)
1	4/8/97	16:00	4/8/97			1.5

Measurement Number	Accuracy	Contracted Avg Vel(ft/s)	Contracted Discharge(cfs)	Contracted Depth(ft)	Contracted Width(ft)
1	1	4.4	646		20

Measurement Number	Uncontracted Avg Vel(ft/s)	Uncontracted Discharge(cfs)	Uncontracted Depth(ft)	Uncontracted Width(ft)	Channel Contraction Ratio
1		646		30	

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

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

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

Contraction Scour Comments

Measurement No. 1

There was no apparent scour at the bridge, either abutment or contraction scour, despite the contraction present at the bridge. However, there was a scoured area about a channel width downstream from the bridge. This could have been caused by the flow contracted through the bridge opening, which may have reached a maximum contraction downstream from the bridge. This however, was not the flow pattern observed on 4-8-97. The configuration of this scour hole and the channel upstream and downstream from the bridge was nearly identical on 4-8-97 and in July 1997.

The contraction scour reference surface was determined by computing the average bottom elevation of the each cross section collected on 4-8-97. The scour area was located between 55 and 70 ft downstream. Thus the sections near the hole were not used in the average. The average elevation was about 1114.7 ft MSL. The minimum average bottom elevation of a cross section was 1113.2 ft MSL. Thus, the depth of scour was 1.5 ft. Due to the variability of streambed elevation the accuracy is only about 1 ft, with the majority of the error attributed to determining the reference surface. A thalweg profile also showed a scour 1.5 ft.

There was about 0.1 ft of fall through the bridge on 4-8-97.

Analysis of cross sections collected on 4-8-97

Location	Avg. Bot. Elev.	Bottom width	Top width
US 113	1114.95	30	55
US 78	1114.75	24	56
US 52	1114.5	30	50
US 24	1114.26	29	37
US 15	1114.83	20	35
DS 15	1115.29	18	35
DS 55	1113.86	30	60
DS 70	1113.16	--	70
DS 115	1115.6	--	67

The typical bottom widths for the upstream and bridge opening are reported as the uncontracted and contracted widths. The average velocity in the contracted section is the average velocity in the bridge opening. No other criteria are reported due to the unusual configuration of the scour and the possibility that the scour hole could be a result of something other than the bridge contraction.

BSDMS Summary Report

77 Middle Fork Crow River at S.R. 4 near Manannah, MN

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)
							1997	4				1122		
1997	4	8	16:00		646		1997	4	8	16:00		L120.25		

Hydrograph

Supporting Files

SR4CR.xls - Excel 97 workbook containing the following worksheets:
Summary - Summary of basic site and scour data
Note: All ranges are from right to left. The LOC is the approximate distance upstream from the centerline of the highway. All elevations are in ft MSL.
VEL-4897 - Discharge measurement notes from 4-8-97
VEL-71497 - Discharge measurement notes from 7-14-97
US98-4897 - Cross section 98 ft upstream from bridge collected on 4-8-97
US75-71497 - Cross section 75 ft upstream from bridge collected on 7-14-97
US63-4897 - Cross section 63 ft upstream from bridge collected on 4-8-97
US37-4897 - Cross section 37 ft upstream from bridge collected on 4-8-97
US25-71497 - Cross section 25 ft upstream from bridge collected on 7-14-97
US9-4897 - Cross section collected 9 ft upstream from bridge collected on 4-8-97
US0-4897 - Cross section collected at the upstream edge of the bridge on 4-8-97
US0-71497 - Cross section collected at the u/s edge of the bridge on 7-14-97
USLW-4897 - Section collected along the left wing wall from 10 ft under the bridge to the upstream end of the wing wall, collected on 4-8-97
USRW-4897 - Section collected along the right wing wall from 10 ft under the bridge to the upstream end of the wing wall, collected on 4-8-97
DS0-4897 - Cross section at the downstream edge of the bridge on 4-8-97
DS17-4897 - Cross section 17 ft downstream from bridge collected on 4-8-97
DS23-71497 - Cross secton 23 ft downstream from bridge collected on 7-14-97
DS40-4897 - Cross section 40 ft downstream from bridge collected on 4-8-97
DS50-71497 - Cross section 50 ft downstream from bridge collected on 7-14-97
DS55-4897 - Cross section 55 ft downstream from bridge collected on 4-8-97
DS100-4897 - Cross section 100 ft downstream from bridge collected on 4-8-97
DS100-71497 - Cross section 100 ft d/s from bridge collected on 7-14-97

DS-4897.jpg - Photo looking downstream taken on 4-8-97

DS-71497.jpg - Photo looking downstream taken on 7-14-97
DS-BRG-4897.jpg - Photo of the downstream side of the bridge taken on 4-8-97
US-4897.jpg - Photo looking upstream taken on 4-8-97
US-71497.jpg - Photo looking upstream taken on 7-14-97
US-BRG-4897 - Photo looking at the upstream side of the bridge taken on 4-8-97
Brg_Plan_1.jpg - Scan of the bridge plans showing old bridge and site drawing
Brg_Plan_2.jpg - Scan of bridge plans showing bridge dimensions
Aerial.jpg - Satellite image of the study site from TerraServer
Topo.jpg - Scan of the USGS topographic map