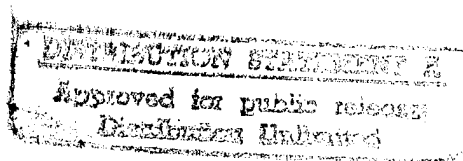




US Army Corps
of Engineers
St. Paul District

ANALYSIS OF SUMMER FLOOD 1993 LOWER SHEYENNE RIVER BASIN

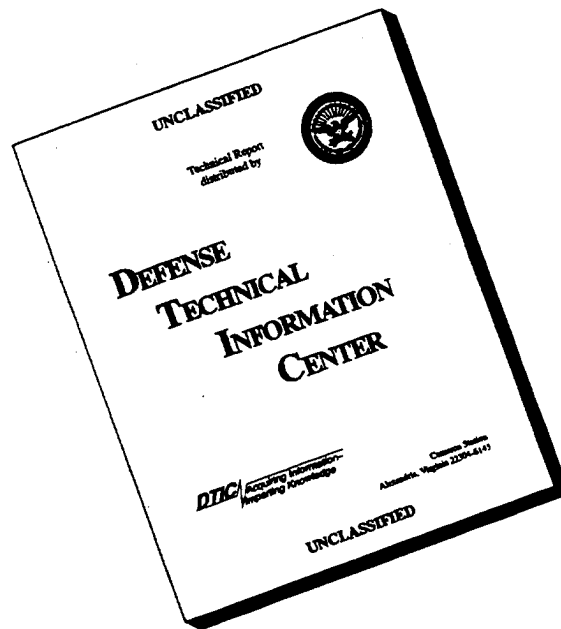


MARCH 1994

19960212 222

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188 Exp. Date: Jun 30, 1986	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION US Army Corps of Engineers, St Paul District		6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code)			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) 190 5th St. East St Paul, MN 55101-1638			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
11. TITLE (Include Security Classification) ANALYSIS OF 1993 SUMMER FLOOD, LOWER SHEYENNE RIVER BASIN.					
12. PERSONAL AUTHOR(S)					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) 9403	
15. PAGE COUNT					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Floods		
			Levees		
			Sheyenne River Basin		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
In July, 1993 there were two periods of heavy rain over the watershed of the Maple, Rush, Lower Rush and Sheyenne Rivers. The first event on July 15 and 16th, caused significant runoff, and caused the Horace and West Fargo Levee and Diversion projects to perform for the second time since their completion. This report summarizes the findings of a detailed hydrologic and hydraulic analysis of the 1993 summer flood, and the effects of Horace and West Fargo Levee and Diversion projects on the area downstream of the projects. Flood peak discharges for summer 1993 and summer 1975 are given.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS				21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL				22b. TELEPHONE (Include Area Code) 22c. OFFICE SYMBOL	

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

**ANALYSIS OF 1993 SUMMER FLOOD
LOWER SHEYENNE RIVER BASIN**

**Sheyenne River Flood Control Project
St. Paul District Corps of Engineers**

March 1994

ANALYSIS OF SUMMER FLOOD 1993
LOWER SHEYENNE RIVER BASIN, NORTH DAKOTA

TABLE OF CONTENTS

<u>Item</u>	<u>Page</u>
TITLE PAGE	i
TABLE OF CONTENTS	ii
TEXT OF REPORT	1
	<u>Title</u>
I. EXECUTIVE SUMMARY	1
A. Introduction	1
B. Downstream Flow Effects	1
C. West Fargo/Harwood Water Surface Elevation and Discharge Comparison	1
D. 1975 and 1993 High water Mark and Discharge Comparison	2
E. Conclusion	2
II. INTRODUCTION	3
III. FLOOD RECONSTRUCTION	3
A. Drainage Area Description	3
B. Storm Description	4
C. Precipitation Analysis	5
D. Streamflow	6
E. Unit Hydrograph and Loss Rate Optimization	7
F. Rainfall-Runoff Model (HEC-1)	9
G. Model Verification	9
H. Model Results and Runoff Evaluation	9
IV. 1993 STORM COMPARED TO 1975 STORM	9
V. EFFECTS OF WEST FARGO AND HORACE LEVEE AND DIVERSION PROJECTS ON AREAS NORTH OF WEST FARGO	10
A. Available Data	10
B. Analysis	10
C. Diversion Channel Effect on Inflow	12
D. With- and Without-Project Effects Downstream	12
E. Project Channel Design Verification	13
F. Control Structure Design Verification	14
G. Harwood and West Fargo Water Surface Elevation Adjustment	15
1. Harwood Adjustment	15
2. West Fargo Adjustment	16
H. West Fargo/Harwood Water Surface Elevation and Discharge Comparison	17
I. Backwater Affects at West Fargo	17
J. Basin and Statewide Flood Levels for 1993 Flood Event	17
VI. 1975 AND 1993 HIGH WATER MARK AND DISCHARGE COMPARISON	17
A. Discharge Comparison	17
B. High Water Mark Comparison	18
VII. CONCLUSIONS	21
VIII. REFERENCES	22

TABLE OF CONTENTS (continued)

TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	BASIN AVERAGE PRECIPITATION	6
2	U.S.G.S. FLOW DATA	6
3	HEC-1 INPUT PARAMETERS	8
4	ROUTING REACHES	11
5	SHEYENNE, MAPLE AND RUSH RIVERS, PEAK DISCHARGES, JULY 1975 AND JULY/AUGUST 1993	18
6	SHEYENNE RIVER, DRAIN 21, AND TOTAL DISCHARGES FOR 1975 AT 12TH AVENUE, NORTH, IN WEST FARGO	18
7	JULY 1975 AND JULY/AUGUST 1993 HIGH WATER MARK COMPARISON	20

PLATES

<u>Number</u>	<u>Title</u>
1	SHEYENNE RIVER, WEST FARGO DIVERSION, WITH- AND WITHOUT-PROJECT COMPARISON
2	SHEYENNE RIVER AT W.FARGO AND HARWOOD, DISCHARGES AND ELEVATIONS
3	DRAINAGE AREAS
4	PROJECT FEATURES WITH MODEL INDEX LOCATIONS
5	AVERAGE WEATHER PATTERNS OVER THE UNITED STATES FOR JULY 15-16, 1993
6	AREAL DISTRIBUTION OF RAINFALL FOR THE JULY 15-16, 1993 STORM IN NORTH DAKOTA, SOUTH DAKOTA, AND MINNESOTA
7	ISOHYETAL MAP, STORM 13-19 JULY 1993
8	ISOHYETAL MAP, STORM 13-19 JULY 1993
9	ISOHYETAL MAP, STORM 21-29 JULY 1993
10	ISOHYETAL MAP, STORM 21-29 JULY 1993
11	RAIN GAGE NETWORK
12	THIESSEN POLYGON
13	MASS RAINFALL CURVES, JULY AND AUGUST 1993
14	MAPLE RIVER AT ENDERLIN, UNIT HYDROGRAPH OPTIMIZATION

TABLE OF CONTENTS (continued)

PLATES

<u>Number</u>	<u>Title</u>
15	RUSH RIVER AT AMENIA, UNIT HYDROGRAPH OPTIMIZATION
16	STREAM NETWORK MODEL SCHEMATIC
17	LOWER SHEYENNE RIVER, MODEL VERIFICATION
18	SHEYENNE RIVER AT I-29, FLOW COMPARISON, SHEYENNE AND MAPLE RIVERS
19	SHEYENNE RIVER AT I-29, FLOW COMPARISON, JULY 1993
20	SHEYENNE RIVER AT I-29, FLOW COMPARISON AUGUST 1993
21	ISOHYETAL MAP OF THE JUNE-JULY 1975 STORM ON THE SHEYENNE RIVER BASIN
22	SHEYENNE RIVER, U.S.G.S. MEASURED FLOWS
23	SHEYENNE RIVER, COMPARISON OF COMPUTED AND MEASURED FLOW AT 12 AVENUE, NORTH
24	SHEYENNE RIVER, WEST FARGO DIVERSION, INFLOW/OUTFLOW COMPARISON
25	SHEYENNE RIVER AT DRAIN 21 CONFLUENCE COMPARED TO PUMPED FLOW
26	SHEYENNE RIVER ABOVE HORACE, DISCHARGE RATING CURVE, JUST ABOVE HORACE DIVERSION INLET STRUCTURE, POINT A
27	HORACE DIVERSION CHANNEL, DISCHARGE RATING CURVE, BOX CULVERT BRIDGE JUST DOWNSTREAM OF POINT D
28	HORACE DIVERSION CHANNEL, DISCHARGE RATING CURVE, BOX CULVERT BRIDGE AT POINT F
29	HORACE DIVERSION CHANNEL, DISCHARGE RATING CURVE, BOX CULVERT BRIDGE JUST UPSTREAM OF POINT G
30	WEST FARGO DIVERSION CHANNEL, DISCHARGE RATING CURVE, COUNTY HIGHWAY 17 BRIDGE JUST UPSTREAM OF POINT D
31	WEST FARGO DIVERSION CHANNEL, DISCHARGE RATING CURVE, I-94 EASTBOUND BRIDGE AT POINT I
32	WEST FARGO DIVERSION CHANNEL, DISCHARGE RATING CURVE, 12TH AVENUE, NORTH, BRIDGE, (NEW U.S.G.S. GAGE) AT POINT J
33	DRAIN 21, DISCHARGE RATING CURVE, 19TH AVENUE, NORTH, BRIDGE
34	SHEYENNE RIVER, DISCHARGE RATING CURVE, 19TH AVENUE, NORTH, BRIDGE

TABLE OF CONTENTS (continued)

PLATES

<u>Number</u>	<u>Title</u>
35	SHEYENNE RIVER INFLOW DISCHARGE VERSUS HORACE DIVERSION INLET STRUCTURE DIVERTED DISCHARGE
36	WEST FARGO DIVERSION INFLOW DISCHARGE VERSUS DRAIN 21 OUTLET STRUCTURE DIVERTED STRUCTURE
37	SHEYENNE RIVER AT WEST FARGO (12TH AVENUE, NORTH) HARWOOD AND I-29
38	WEST FARGO DIVERSION AT 12TH AVENUE, NORTH, ADJUSTED OBSERVED WATER SURFACE ELEVATION VERSUS DISCHARGE
39	REFERENCE POINT LOCATIONS
40	HISTORIC WATER SURFACE PROFILES, SHEYENNE RIVER

APPENDICES

<u>Number</u>	<u>Title</u>	<u>Page</u>
A	SUMMER FLOOD 1993, OBSERVED WATER SURFACE ELEVATIONS BY USACE PERSONNEL AND OBSERVED WATER SURFACE ELEVATIONS BY MOORE ENGINEERING AND U.S. GEOLOGICAL SURVEY; MEASURED FLOWS, GAGE HEIGHTS, ADJUSTED GAGE HEIGHTS AND ELEVATION DATA	A-1
B	MAPLE RIVER AT ENDERLIN, ND; DISCHARGES AND GAGE HEIGHTS	B-1
C	RUSH RIVER AT AMENIA, ND; DISCHARGES AND GAGE HEIGHTS	C-1

I. EXECUTIVE SUMMARY

A. Introduction

During July, 1993, there were two periods of heavy rain over the watersheds of the Maple, Rush, Lower Rush, and Sheyenne Rivers. The first event was the most severe and occurred on the 15th and 16th of July. The second event occurred on the 24th and 27th of July. The first event caused significant runoff on the Maple, Rush, Lower Rush, and Sheyenne River, and caused the Horace and West Fargo Levee and Diversion projects to perform for the second time since their completion. Very high flood levels in the Harwood area located downstream of the diversion projects generated concern from those who reside downstream of the projects about the effect the projects may have had on flows from the Sheyenne River and corresponding flood levels from West Fargo through Harwood.

This report summarizes the findings of a detailed hydrologic and hydraulic analysis of the 1993 summer flood on the Lower Sheyenne River and of the effects of the Horace and West Fargo Levee and Diversion projects on the area downstream of the projects. The concerns of the downstream residents are addressed through an analysis of the Horace and West Fargo Levee and Diversion projects' effects on flows and corresponding flood levels downstream. An account of the peak flood stages in the Harwood area is discussed through a comparison of West Fargo and Harwood flows and water surface elevations. The relative severity of this 1993 summer flood is compared with the 1975 summer flood for the area north of West Fargo.

B. Downstream Flow Effects

Computer simulations were made using a U.S. Army Corps of Engineers (USACE) water surface profile model (HEC-2) and streamflow routing model (HEC-1) to simulate the operation of the Horace and West Fargo Levee and Diversion projects. Flows measured upstream of the Horace diversion structure by the U.S. Geological Survey were routed through the system for the with- and without-project condition. The routing technique used storage-outflow relationships for the designated reaches that were provided by the HEC-2 model. PLATE 1 shows the without-project flows compared to the with-project flows at the Burlington Northern Bridge downstream of the confluence with Drain 21 and the Sheyenne River. The results of this simulation show that the Horace and West Fargo Levee and Diversion projects had virtually no effect on the downstream flows and; therefore, no effect on the downstream flood levels.

C. West Fargo/Harwood Water Surface Elevation and Discharge Comparison

The primary cause of peak flood stages in the Harwood area was backwater from runoff from the Maple, Rush and Lower Rush Rivers with the Maple River contributing the most flow. The peak observed water surface elevation at both West Fargo and Harwood occurred more than two weeks before the Sheyenne River reached its peak discharge at West Fargo. However, the peak observed water surface elevations at both locations occurred when the Sheyenne River at I-29 (which included the flows of the Maple, Rush, and Lower Rush Rivers) was at or very near its peak discharge. As shown in the upper right graph on PLATE 2, the peak discharge at I-29 is about 4500 cfs more than the corresponding discharge at West Fargo. This additional 4500 cfs discharge is runoff from the Maple River. The two left hand graphs on PLATE 2 show that the water surface elevation at both West Fargo and Harwood had decreased by the time the Sheyenne River at West Fargo had reached its peak flow. At West Fargo, the water surface elevation decreased by about 1.3 feet and at Harwood the water surface elevation decreased by about 4.4 feet. These points indicate that the peak water surface elevation at West Fargo was due in part to backwater from downstream conditions, largely caused by the Maple, Rush and Lower Rush River flows.

D. 1975 & 1993 High Water Mark & Discharge Comparison

The peak flood levels for the 1975 and 1993 summer floods between Harwood and West Fargo are compared in the following table. The 1993 flood was generally about 0.5 feet lower than the 1975 flood for the reach downstream of West Fargo. Note that the County Highway 22 and 12th Avenue North high water marks were adjusted based on the results of surveys during and after the flood.

JULY 1975 & JULY 1993 HIGH WATER MARK COMPARISON

Location (1)	July 1975	July 1993
U.S. Hwy. 81	889.37	889.37
I-29	889.46	889.15
Cty. Hwy. 22	892.03	891.56
Cty. Hwy. 17	~894.1	893.62
Township Road	894.71	--
Township Road	896.75	--
BNRR Bridge	897.54	--
19th Ave. No.	898.47	898.17
12th Ave. No.	899.44	899.09

(1) - Refer to TABLE 7 and PLATE 39 for location of reference points.

E. Conclusion

In summary, there are three main conclusions from this analysis:

1. The hydraulic analysis combined with the hydrologic analysis indicates that the Sheyenne River discharge downstream of the project is essentially the same for with- and without-project conditions, and that the Horace and West Fargo Levee and Diversion Channel Projects did not make conditions worse at Harwood.
2. The primary cause of peak flood stages in the Harwood area was runoff from the Maple River and backwater effects from the Rush and Lower Rush Rivers.
3. The 1975 summer event was more severe on the Lower Sheyenne River in terms of peak flood levels than the 1993 summer event.

II. INTRODUCTION

During the month of July 1993, heavy rains fell over the watersheds of the Rush, Maple, and Sheyenne River. There were two heavy rain periods during July. The first event occurred on the 15th and 16th of July with the majority of the rain occurring over 10 hours. The second event occurred on the 24th and 25th of July. It was the first event that induced significant runoff on the Maple, Rush, and Sheyenne River causing major flooding along the Maple River and the Lower Sheyenne River. The Horace and West Fargo Levee and Diversion projects, which were completed in the fall of 1992, went into operation for this event.

This report describes the storm events and reconstructs the runoff as it occurred in the Lower Sheyenne River Basin. Heavy runoff downstream of the Horace and West Fargo flood control projects from the Rush, Maple, and Sheyenne River caused major flood problems in the vicinity of Harwood. This flooding generated concern from those who reside downstream of the project about the impact the project may have had on flows from the Sheyenne River and corresponding level of the flood waters through Harwood. This report addresses those concerns and presents the Horace and West Fargo Levee and Diversion projects' impacts on flows and corresponding flood levels. The relative severity of this event is compared to the 1975 summer event in terms of water surface profiles and discharges.

III. FLOOD RECONSTRUCTION

To reconstruct the flood of 1993 on the Maple, Rush, and Lower Sheyenne River Basins, extensive data was collected and analyzed. Precipitation data was provided by the National Weather Service office in Bismarck, ND and the Atmospheric Resource Board of the North Dakota State Water Commission. Flow data was provided by the North Dakota office of the United States Geological Survey (USGS). The primary tool used for the reconstruction was the U.S. Army Corps of Engineers' (USACE) rainfall-runoff computer model (HEC-1) (reference 1). Information required for this simulation is described in the succeeding paragraphs.

A. Drainage Area Description

PLATE 3 shows the drainage areas above the mouth of the Sheyenne River in North Dakota. The Maple, Rush, and Lower Rush Rivers are tributary to the Sheyenne River and have their confluence near the confluence of the Sheyenne River and Red River of the North. The drainage areas of the Sheyenne, Maple, Rush, and Lower Rush Rivers are 6,900, 1,566, 172, and 66 square miles, respectively. Flows on the Sheyenne River are regulated by Baldhill Dam above Valley City, ND. PLATE 3 shows the major drainage area subdivided at pertinent locations. For the Sheyenne River Basin, the subdivide is at the USGS gaging station on the Sheyenne River above the inlet structure for the Horace diversion near Horace. The Maple Basin is subdivided at the USGS gaging station at Enderlin, ND and the Rush River Basin is subdivided at the USGS gaging station near Amenia, ND. The drainage area above Enderlin and Amenia is 843 and 116 square miles respectively. Of the 843 square miles above Enderlin, the USGS lists 796 square miles as contributing.

Harwood, ND is located adjacent to the Sheyenne River and is situated below the confluence with the Maple River but immediately upstream of the confluence with the Rush and Lower Rush Rivers. As a result, this river reach experiences backwater effects from the Red River as well as the Rush and Lower Rush Rivers.

The West Fargo and Horace Levee and Diversion projects are located on the lower portion of the Sheyenne River and extends from near Horace through the City of West Fargo, ND. The Maple River confluence and the City of Harwood, ND are downstream from the project. PLATE 4 shows a more detailed plan view of the diversion project which was essentially completed in 1992.

B. Storm Description

The primary storm that caused substantial runoff occurred from 15 July to 16 July 1993. The following is a meteorological description of this event that was gleaned from a U.S. Geological Survey (USGS) report on the precipitation in the Upper Mississippi River Basin in 1993 (reference 2).

During July 15-16, 1993, thunderstorms that produced large amounts of rain moved slowly from western North Dakota to west-central Minnesota. Urban and stream flooding were considerable along this path. Meteorological conditions that caused these rains were part of the overall pattern responsible for heavy rains in the upper Midwest throughout the summer.

Average weather patterns over the North-Central United States during the July 15-16 storm are depicted in PLATE 5. A warm front extended across northern South Dakota while an area of warm, moist air was drawn over the front on southerly winds of 5 to 15 miles per hour by a developing low-pressure system over Montana. Thunderstorms formed in south-central North Dakota by late evening of July 14 and produced moderate amounts of rain before the storms moved quickly towards the northeast. However, the weather patterns that produced heavy rainfall remained in place. A cold front entered North Dakota from Montana during the morning of July 15 and increased atmospheric instability. A series of vorticity maxima collided over Bismarck. Thunderstorms formed and produced large amounts of rain and considerable flooding. The storms moved slowly towards the east at only 10 to 15 miles per hour, which permitted large amounts of rain to fall. The continued flow of moisture from the south over the warm front and the lifting caused by the western cold front maintained the large rainfalls. Intense rain continued along a 50-mile wide path from Bismarck to Fargo, North Dakota, and into west-central Minnesota during the early hours of July 16. Rainfall reports of 4 to 7 inches were common along this path (PLATE 6.) Bismarck had a record 24-hour rainfall total of 5.27 inches by the afternoon of July 16. Officially, the greatest rainfall total from North Dakota was 7.25 inches at Jamestown. The greatest rainfall observed in Minnesota was an unofficial total of 7.50 inches at Callaway. (reference 2)

The isohyetal map shown on PLATE 6 depicts an overall interstate view of the 15-16 July storm. PLATE 7 shows this same storm but with expanded days from 13 to 19 July. This isohyetal map is more specific for the region covering the Sheyenne, Maple, and Rush Basins with isolines in 1 inch increments. PLATE 8 shows yet another more defined isohyetal map for the same period (13-19 July). This more detailed map was used in the hydrologic analysis that is described in later sections of this report. The isohyetal maps on PLATE 7 and 8 are based on an extensive rain gage network shown on PLATE 11 and described in the section of this report entitled Precipitation Analysis.

The isohyetal maps show that the Maple, Lower Rush, and the lower portion of the Rush Basins received the most significant amount of rainfall compared with the portion that fell over the Sheyenne River Basin. Up to seven inches fell in this period near Baldhill Dam and more than five inches fell over nearly the entire Maple Basin. The major storm track ran eastward directly centered over the Maple Basin toward Fargo, ND. Lesser amounts fell north and south. The Sheyenne River Basin below Baldhill Dam received lesser amount of rain although it was enough to generate moderate runoff.

PLATE 9 and PLATE 10 show the storm isohyetal map for the period 21-29 July, which includes another major rainstorm on 24-25 July. These maps show that the

second event was not as severe as the first event over the respective basins, however; substantial rain did fall on the north end of the Maple River Basin and on the Upper Sheyenne River Basin upstream of Baldhill Dam. The second event followed a similar storm track as the first. Enough rainfall occurred with the wet antecedent moisture conditions to generate a second peak on the Maple, Sheyenne, Rush and Lower Rush Basins. Although the second peak was not as pronounced as the first it did add to the flooding on the Lower Sheyenne Basin.

C. Precipitation Analysis

The runoff from the Sheyenne River was directly measured at the USGS gaging station in West Fargo at 12th Ave N and routed downstream using the HEC-1 model (see later description in report). Therefore, a rainfall-runoff simulation was not necessary to determine the contribution of flow to the Harwood area from the Lower Sheyenne River. Because the lower portion of the Rush and Maple River as well as the Lower Rush River are not gaged, a rainfall simulation was made for these ungaged areas to determine their contribution of runoff to the Sheyenne River.

Basin average precipitation was determined from available rain gages in the region. PLATE 11 shows the available rain gage network which includes 38 National Weather Service (NWS) stations and 84 stations registered with the Atmospheric Resource Board (ARB). Of the 38 NWS stations, 7 are continuous recording stations that provide hourly precipitation values. The remaining are nonrecording that provide daily precipitation values. The ARB stations are all nonrecording and provide daily values.

These stations were screened to identify representative stations for basin average precipitation computations. PLATE 12 shows those stations that were finally identified. The Thiessen Polygon method was the selected method for basin average precipitation computation. These polygons are shown in PLATE 12 along with respective drainage areas within each subdrainage area. Of the 15 selected stations, 9 are NWS stations and 6 are ARB stations.

Three recording stations were identified that could possibly be used for temporal distribution of the rainfall. They are Baldhill, Fargo, and Kindred. During the 13-16 July storm, the Baldhill, Fargo, and Kindred stations measured 6.3, 5.49, and 3.5 inches of rain respectively. Kindred's gage was south of the storm track through the Maple Basin, whereas Baldhill and Fargo were in line. Baldhill's recording gage discontinued from 16 July at 0600 to 19 July 0900 and throughout the entire month of August. This gage was supplemented by a nonrecording station at the dam.

PLATE 13 shows mass rainfall curves for the three gages. Because Kindred's gage did not measure as much rainfall during the main period of the storm as the Baldhill and Fargo stations and because it's mass rainfall curve was dissimilar, it was not considered further for analysis. Baldhill and Fargo showed strong similarity through 16 July. Fargo was selected for temporal distribution for the ungaged subdrainage areas. The ungaged areas are; Rush River Basin below Amenias, Lower Rush River Basin and the Maple River Basin below Enderlin. The Fargo station was also used for unit hydrograph (UH) optimization for the gaged basin above Amenias on the Rush River. For the gaged basin above Enderlin on the Maple River, the Baldhill station was used.

Table 1 shows the basin average precipitation for each ungaged subbasin for the period from 13 July to 31 August.

TABLE 1.
BASIN AVERAGE PRECIPITATION
13 JULY - 31 AUGUST 1993

<u>Basin</u>	<u>Precipitation (inches)</u>
Rush R below Amenia, ND	8.16
Lower Rush R	9.05
Maple R below Enderlin, ND	8.09

D. Streamflow

During the summer event of 1993, the U.S. Geological Survey (USGS) measured flow at significant locations in the basin. Recording gages were in operation at two locations on the Sheyenne River. One was just above the Horace diversion structure and the second was downstream on the West Fargo Diversion channel at 12th Ave N. Recording gages were also operating on the Rush River at Amenias and the Maple River at Enderlin. Miscellaneous measurements were made on the upstream end of the diversion channel about one mile downstream of the Horace diversion structure, on Drain 21 north of West Fargo about one mile downstream of Drain 21 outlet structure, and at the I-29 bridge. PLATE 4 shows the project feature map for the Horace and West Fargo Levee and Diversion Projects and the location of the USGS flood gages in the vicinity of Horace and West Fargo. TABLE 2 shows the USGS measurement stations and miscellaneous measurements. Appendix A, B, and C present more detailed data as provided by the USGS for discharges and gage heights.

TABLE 2.
USGS FLOW DATA

<u>Station Number</u>	<u>Gage Location</u>	<u>Date</u>	<u>Gage Height (ft)</u>	<u>Discharge (cfs)</u>
05059480	Sheyenne R. above Diversion nr Horace, ND (index point A)	7/17/93	19.02	995
		7/20/93	20.64	1230
		7/22/93	22.77	2120
		7/23/93	23.20	2330
		7/24/93	23.60	2750
		7/26/93	23.15	2380
		8/03/93	23.50	2830
		8/09/93	24.17	3280
	Sheyenne R. Diversion at Horace (sidewalk and Bridge rail) (one mile west of Horace)	7/20/93	20.64	91
		7/22/93	22.77	656
		7/23/93	23.24	883
		7/24/93	23.63	1000
		7/26/93	23.15	932
		8/03/93	23.50	1210
		8/09/93	24.17	1580

TABLE 2. (continued)
USGS FLOW DATA

<u>Station Number</u>	<u>Gage Location</u>	<u>Date</u>	<u>Gage Height (ft)</u>	<u>Discharge (cfs)</u>
05059480	Sheyenne R. Diversion at W. Fargo, ND	7/16/93	15.17	1430
		7/18/93	15.95	1440
		7/20/93	18.70	1160
		7/20/93	20.17	2030
		7/23/93	20.70	2240
		7/24/93	20.84	2480
		7/26/93	21.06	2500
		7/28/93	20.57	2070
		7/30/93	20.37	2120
		8/03/93	20.01	2670
		8/10/93	19.84	3210
		8/11/93	19.68	3250
	Drain 21 at W. Fargo	7/18/93	15.95	462
		7/20/93	18.70	460
		7/22/93	20.12	813
		7/23/93	20.70	1020
		8/10/93	19.90	1170
05059600	Maple R. nr Enderlin, ND	7/17/93	10.12	1630
		7/17/93	12.52	3650
		7/19/93	11.43	2510
		7/20/93	11.20	
		7/27/93	9.10	1180
		8/02/93	9.15	1330
05060500	Rush R. at Amenia, ND	7/16/93	9.40	479
		7/17/93	10.00	1160
		7/17/93	10.25	pk GH
		7/18/93	8.70	310
		7/26/93	9.53	595
	Sheyenne R. at Harwood I-29 bridge	7/20/93		5450
		7/27/93		6540 +550
		9/10/93		4060 + 20

The USGS provided flows at 1 hour time interval. The USGS record at Enderlin is not complete from 21 July 0100 to 27 July 1600. Missing flow values were estimated by linear interpolation.

E. Unit Hydrograph and Loss Rate Optimization

Snyder's Unit Hydrograph method was selected to transform rainfall to runoff. The Initial and Uniform Loss Rate method was used to compute infiltration and rainfall excess. Snyder's parameters Ct and Cp as well as the loss rate parameters STRTL and CNSTL were optimized based on the hydrograph generated from the first rain period from 13-19 July.

Snyder's unit hydrograph is formulated with the parameters Cp and Ct. Cp (Snyder's coefficient) is equal to: $Q(lag)/(645A)$. Snyder's Ct was based on the following adopted regional equation:

$$Ct = tp / ((L Lca)^{.3})$$

Where: tp = Snyder's standard lag, hours.

Ct = a regional coefficient dependent upon basin slopes, stream patterns, shape, and other properties.

L = the main channel length from the outflow point to the upstream watershed boundary, in river miles.

Lca = the main channel length from the outflow point to a point opposite the center of gravity of the river basin, in river miles.

The unit hydrograph parameters were determined at the USGS streamflow gage on the Rush River at Amenia, ND and at the gage on the Maple River at Enderlin, ND. The downstream ungaged basins were considered hydrologically similar so that direct transfer was possible. The unit hydrograph and loss rate optimization capability in HEC-1 were used to estimate parameters for the summer event. TABLE 3 lists the optimized values as well as the computed values for each basin.

TABLE 3.
HEC-1 INPUT PARAMETERS

SUBBASINS					
Parameters	AMENIA	ENDERL	DSRUSH*	LWRUSH*	LMAPLE*
DRAINAGE AREA (sq.mi.)	116	746	56.5	66.2	722
L (mi.)	34	86.4	24.1	29.0	93.2
Lca (mi.)	17.1	36.5	11.0	12.5	58.7
Cp	0.77	0.40	0.77	0.77	0.40
Ct (hrs)	3.61*	5.00*	3.61	3.61	5.00
tp (hrs)	25.47	56.1	19.25*	21.14*	66.13*
STRTL (in)	2.23	2.56	2.23	2.23	2.56
CNSTL (in/hr)	0.24	0.27	0.24	0.24	0.27
STRTQ (cfs)	20	40	10	11	36
QRCSN (cfs)	500	550	243	285	499
RTIOR	1.019	1.00287	1.019	1.019	1.00287
BASIN AVE RAIN (in)			8.16	9.05	8.09
LOSS (in)			5.71	5.99	5.75
EXCESS (in)			2.45	3.07	2.34

* computed values

The second peak on the Rush River was separate and distinct from the first so a direct optimization on the observed hydrograph was possible. This was not the case for the hydrograph at Enderlin on the Maple River. The first hydrograph was separated from the second by transferring the recession of the second hydrograph peak to the first. Linear interpolation was then used to connect the two segments where flow needed to be estimated. PLATE 14 shows the observed hydrograph, the adjusted hydrograph, and results of the optimization hydrograph. The optimization was determined only for the first rainfall period 13-17 July. PLATE 14 shows good results were achieved in matching the computed with the observed values. PLATE 15 shows the unit hydrograph optimization results for the hydrograph at Amenia on the Rush River. The difference in the computed and measured peak discharge is approximately 600 cfs. This difference of 20 percent is not considered significant when compared to the small difference in flow volume. Additionally, hydrograph attenuation will occur as the hydrograph is routed downstream.

F. Rainfall-Runoff Model (HEC-1)

Once model parameters were obtained, model simulations were made for the summer event from 13 July to 31 August. The long simulation was made because of the long duration of runoff on the Lower Sheyenne River. A 1-hour computation interval was used since precipitation and runoff was available in 1-hour increments. Actual observed hydrographs were used where available. They include the Maple River at Enderlin, Rush River at Amenia, and the Sheyenne River Diversion channel at W.Fargo (12th Ave N). PLATE 16 shows the model schematic for the simulation. The HEC-1 subbasin names are also identified and associated with the subbasins as shown on PLATE 12. The Straddle-Stagger method was selected for the routing of hydrographs. Routing coefficients were estimated based on those presented in the "Timing Analysis Study for the Red River of the North" (reference 3).

G. Model Verification

PLATE 17 shows the results of the HEC-1 simulation at the I-29 bridge which is immediately downstream of Harwood. The USGS made three measurements at this location during the flood. These measurements are plotted on the plate for comparison with the computed hydrograph. Recorded elevations for the Sheyenne River at Harwood are also plotted on the graph for a more continuous comparison. The graph for the computed values shows close agreement with the measured values.

H. Model Results and Runoff Evaluation

PLATE 18, 19, and 20 show the total runoff hydrograph at I-29 separated into the contributing portions from each tributary source. These sources are the Rush River, Lower Rush River, Maple River, and the Sheyenne River. PLATE 18 shows only the Sheyenne River and the Maple River compared to the total hydrograph. The Rush River contributed flow early in the event and is reflected in the initial peak. Most of the flow after 18 July is from the Maple and the Sheyenne Rivers. The plot of the water surface elevation at Harwood and the computed flows is shown on PLATE 17. From these graphs it is clear that the Maple River contributed the most flow during the highest recorded stages at Harwood. The Sheyenne River did not contribute significant flow until after the Maple River flow and corresponding stages at Harwood had peaked. The second and lower peak flows at Harwood was caused primarily by flow from the Sheyenne River which resulted from the second rainstorm centered above Baldhill Dam. This second peak flow did not cause a second peak stage at Harwood as the water surface elevation after the first peak continued to fall.

PLATES 19 and 20 show monthly plots for each flooding source. At the time peak stages occurred at Harwood, the Maple, Sheyenne, Rush, and Lower Rush River contributed 56, 36, 7, and 1 percent of the flow respectively.

IV. 1993 STORM COMPARED TO 1975 STORM

PLATE 21 shows the isohyetal map for the renowned summer 1975 rain event that caused significant damage in the Maple and Sheyenne basins. The rainstorm of 26 June to 5 July had generated what had been called the "Flood of the Century". The "75" storm was more intense in rainfall, had more volume over a larger area, and caused more damage than the "93" event. An unofficial gage near Leonard, ND recorded an overwhelming 20 inches of rain in three days. Ten to twelve inches were common throughout the area. The storm track for the "75" event was very similar to the 15-17 July 93 event but shifted slightly south and centered near Enderlin, ND.

Up to 8 inches of rain were recorded for the 13-19 July 1993 event, however it was followed by another event that recorded a maximum of 11.7 inches from 21-29 July. This second event was centered north of the Rush and Maple Basins and did not generate a second discharge peak that was higher than the first.

In summary, the "75" event generated more rain in a shorter period of time than the "93" event. It was centered over the same area and resulted in higher flows, higher flood levels, and greater damages. (The comparison of flood stages for the 1975 and 1993 events is presented in section VI on pages 17, 18, and 19).

V. EFFECTS OF WEST FARGO AND HORACE LEVEE AND DIVERSION PROJECTS ON AREAS NORTH OF WEST FARGO

A. Available Data

During the summer event of 1993, the U.S. Geological Survey (USGS) measured flow at significant locations in the basin. Recording gages were in operation at two locations on the Sheyenne River. One was just above the Horace diversion structure and the second one was downstream on the West Fargo Diversion channel at 12th Ave N. Miscellaneous measurements were made on the upstream end of the diversion channel about one mile downstream of the Horace diversion structure, on Drain 21 north of West Fargo about one mile downstream of Drain 21 diversion structure, and at the I-29 bridge. PLATE 4 shows the project feature map and USGS gaging locations. PLATE 22 shows a plot that compares the USGS measured flows on the Sheyenne River near the Horace diversion structure and at West Fargo on 12th Ave N. Appendix A presents more detailed data as provided by the USGS for discharges and gage heights.

B. Analysis

Measured flood flows were synthetically routed through the Horace and West Fargo Levee and Diversion project from the U.S. Geological Survey (USGS) gage immediately above the Horace diversion structure (index point A - PLATE 4) to a point downstream of the project at the confluence with Drain 21 and the Sheyenne River (index point O - PLATE 4). These flows were then compared with the flows that would occur without the West Fargo Diversion project in place. For this condition, the measured flows at index point A were routed through the Sheyenne River to index point O, assuming the diversion not in place. The comparison would then show the direct effect of the project on the elevations and flows immediately downstream (including the community of Harwood) from the summer flood of 1993.

The U.S. Army Corps of Engineers's (USACE) water surface profile model (HEC-2) (reference 4) was used in conjunction with the USACE rainfall-runoff model (HEC-1) (reference 1). These models were used to determine the effect of any lost floodplain storage, and the alteration of the shape and timing of the flood-wave as it passes through the river and channel reach.

Modified Puls routing was used in the HEC-1 model. This method required storage-outflow relationships for each reach that was selected. The storage-outflow relationships were developed from the HEC-2 model for the Sheyenne River and Diversion segments. PLATE 4 shows the project features and selected routing reaches. Routing reaches were selected with reference to the storage characteristics of the river valley and diversion channel. TABLE 4 lists the routing reaches, travel times, and routing steps (NSTPS) for each reach.

TABLE 4.
ROUTING REACHES

WITHOUT-PROJECT CONDITION

<u>Reach</u>	<u>Travel Time (hrs.)</u>	<u>NSTPS</u>
B-C 10-yr	4.18	3
50-yr	4.02	
100-yr	3.94	
500-yr	3.88	
C-P 10-yr	3.10	2
50-yr	3.09	
100-yr	3.10	
500-yr	3.11	
P-K 10-yr	3.24	2
50-yr	3.29	
100-yr	3.29	
500-yr	3.35	
K-L 10-yr	2.41	2
50-yr	3.06	
100-yr	3.16	
500-yr	3.37	

WITH-PROJECT CONDITION

B-C 10-yr	4.18	3
50-yr	4.02	
100-yr	3.94	
500-yr	3.88	
C-D 10-yr	3.56	2
50-yr	3.63	
100-yr	3.64	
500-yr	3.67	
D-I 10-yr	2.66	2
50-yr	2.42	
100-yr	2.35	
500-yr	2.28	
I-J 10-yr	2.72	2
50-yr	2.48	
100-yr	2.40	
500-yr	2.33	
K-L 10-yr	2.77	2
50-yr	3.41	
100-yr	3.50	
500-yr	3.73	
M-N 10-yr	3.30	2
50-yr	3.55	
100-yr	3.92	
500-yr	5.03	
E-F 10-yr	2.47	2
50-yr	2.27	
100-yr	2.23	
500-yr	2.20	

TABLE 4. (continued)
ROUTING REACHES

WITHOUT-PROJECT CONDITION

<u>Reach</u>		<u>Travel Time (hrs.)</u>	<u>NSTPS</u>
F-G	10-yr	4.48	2
	50-yr	3.70	
	100-yr	3.52	
	500-yr	3.36	

Travel times were obtained from the HEC-2 model and are based on the average cross-section velocity. The flood-wave velocity was assumed to be 1.5 times faster than the average velocity. Reaches were subdivided (NSTPS) such that the flood-wave travel time for the subreach approximately equals the time interval for routing (Δt). This criterion is presented in "Routing of Floods through River Channels" EM 1110-2-1408 (USACE, 1960, pp 11) (reference 5) and HEC-1 input description for NSTPS (HEC, 1990). Additionally, HEC-1 has a computation stability criterion that will be met if the travel time approximately equals Δt . A one-hour time interval was selected for the model in order to give adequate representation of the flood hydrographs.

The inflow hydrograph for routing through both reach conditions (with- and without-project) was the measured inflow recorded by the USGS gage upstream of the Horace diversion structure. The ordinates were provided to the USACE by the USGS at a one-hour interval.

For verification purposes, a plot was made to compare the computed HEC-1 flow in the diversion channel at 12th AVE N with the measured flow by the USGS. This plot is shown on PLATE 23. Index point J (shown on PLATE 4) corresponds to the 12th AVE N location. The results as shown on this plate indicate that the model closely approximates the actual flow with a computed peak discharge that is less than 3 percent higher than the measured flow and is well within the expected accuracy of the model. The higher measured flows near 17 July reflect the intervening flow that occurred between the two USGS gages. These flows include the local runoff during the early portion of the storm from Drain 21 as well as the inlets to the channel which are not included in the HEC-1 model.

C. Diversion Channel Effect on Inflow

To show how the discharge hydrograph was changed as it passed through the project, the flow was routed downstream of the project to the confluence of Drain 21 and the Sheyenne River (index point O - PLATE 4). This included the flow in the channel and the Sheyenne River portion of the project. PLATE 24 compares the inflow with outflow. Very little attenuation occurred through the reach with a slight translation in time of approximately one day. No break-out flow occurred in the project reaches during this flood event except immediately above index point O and therefore was not included in the model for the with-project condition.

D. With- and Without-Project Effects Downstream

To show the effect the diversion project had on the observed summer flood event flows compared to what would have occurred if the project was not there, a simulation was made for the without-project condition. The adopted flood insurance study (FIS), HEC-2 model shows that break-out flows occur in the natural Sheyenne River channel at a discharge of approximately 3,050 cfs. Because the summer event of 1993 exceeded this amount, break-out flows were included in the HEC-1 model. These flows were modeled as diversions in HEC-1 nomenclature and are identified in PLATE 4. The flow was routed down Drain 21 and added back in at the confluence with the Sheyenne River. The break-out flow relationships are based on the adopted flood insurance study HEC-2 model for the Sheyenne River.

PLATE 1 shows the without-project flows compared to the with-project flows at the Burlington Northern Bridge downstream of the confluence with Drain 21 and the Sheyenne River. The results of this simulation clearly show that the Horace and West Fargo Levee and Diversion projects had virtually no effect on the downstream flows and thus corresponding elevations.

PLATE 25 shows the West Fargo pump station discharge in comparison to the computed flow at index point O (PLATE 4) which is located just upstream of the BNR Bridge about two miles north of West Fargo. As can be seen, the maximum total pump station discharge of 127 cfs is very small in comparison to the computed Sheyenne River flow. Also note that the pump station operates intermittently and that all three pumps do not always operate at the same time. For without-project conditions, the City of West Fargo has several small pump stations along the Sheyenne River that pump interior runoff into the river during high river levels. The combined capacity of these pump stations is about 85 cfs. Therefore, the difference between with- and without-project conditions due to pumped interior runoff is insignificant.

E. Project Channel Design Verification

The Horace diversion channel and the West Fargo diversion channel designs were verified using observed water surface elevations and discharges for the Summer 1993 event. The channel designs were checked by plotting the observed water surface elevations on discharge rating curves developed from design water surface profiles computed using the USACE water surface profile model, HEC-2, (reference 1). It should be noted that water surface profiles were developed using data from the flood insurance study model for the Sheyenne River and a USACE model for the Sheyenne River. The FIS model was developed from the USACE model. The starting water surface elevations for the FIS model are considerably lower than the starting water surface elevations used for the project design with the USACE model. The starting water surface elevations used with the FIS model were the same as those used in the FIS. The starting water surface elevations used with the USACE model were based on a rating curve at the BNR bridge, point O, located just downstream of West Fargo. This rating curve was developed from high water marks and discharges from prior flood events. Point O and all other HEC-1 model index locations referred to in the following paragraphs are shown on PLATE 4. Discharge rating curves are developed by plotting computed water surface elevations versus the corresponding discharge and drawing a curve through a series of these points. Observed water surface elevations were obtained from the USGS, USACE personnel, and Moore Engineering which obtained data for the project sponsor, the Southeast Cass Water Resource District. Discharges were obtained from the USGS and also from the HEC-1 model.

PLATE 26 is a discharge rating curve for the Sheyenne River just above the Horace diversion inlet structure, point A, with a continuous plot of the observed water surface elevations from July 15 through August 31 which were obtained from the USGS. As can be seen, the observed water surface elevations are generally between the computed FIS and CORPS curves with no point exceeding the computed CORPS curve. The Horace diversion inlet weir has a crest elevation of 910.0; therefore, the difference between the observed and computed water surface elevations below this elevation does not impact the project design. Above about elevation 911.0, the observed water surface elevations are generally very close to the computed water surface elevations and the structures will split the Sheyenne River flow as designed. This is supported by PLATE 35 which is a plot of the Horace diversion inlet structure diverted discharge versus the Sheyenne River inflow discharge. The observed discharges on this plot agree very well with the computed diverted discharge curves based on the FIS and USACE models. PLATE 35 is discussed in further detail later in this report.

PLATE 27 is a discharge rating curve for the Horace diversion channel at the box culvert bridge located just downstream of point E. The observed water surface elevations are generally about one foot lower than the computed CORPS and FIS rating curve. This is probably due to two factors. First, this bridge is

located toward the upstream end of the portion of the Horace diversion channel that has a steeper bottom slope and; thus, higher flow velocities. The higher flow velocities may have bent the channel vegetation over which would lower the channel flow resistance and water surface elevations. Second, these observed water surface elevations were taken during August after flow in the diversion had occurred for over two weeks. This increases the likelihood that flow in the channel bent the vegetation over and reduced the channel flow resistance.

PLATES 28 and 29 are discharge rating curves for the Horace diversion channel at the box culvert bridges at point F and just upstream of point G, respectively. The observed water surface elevations on these plates are generally very close to the computed CORPS and FIS rating curves except those for discharges less than about 1,000 cfs which were observed in late August and are about one foot lower than the computed CORPS curve. The box culvert bridge at point F (PLATE 28) is located at the upstream end of the portion of the Horace diversion channel that has a very mild bottom slope and lower flow velocities. The box culvert bridge just upstream of point G (PLATE 29) is located just upstream of the confluence with the West Fargo diversion which also has a very mild bottom slope and lower flow velocities. In addition, backwater from downstream reaches up to this point. The observed water surface elevations in late August are probably lower than the rating curve because downstream backwater had dissipated or channel vegetation had bent over and reduced flow resistance.

PLATES 30 and 31 are discharge rating curves for the West Fargo diversion channel at the County Road 17 bridge just upstream of point D and at the I-94 Eastbound bridge at point I, respectively. The observed water surface elevations are generally very close to the computed rating curves with no observed points exceeding the computed CORPS curve. The observed water surface elevations which are lower than the computed curves were observed in late August during the recession limb of the runoff hydrograph when backwater from downstream had dissipated.

PLATE 32 is a discharge rating curve at the 12th Avenue North bridge, point J. The observed water surface elevations which are above the computed rating curves occurred between 19 July and early August when downstream backwater affected flood elevations. The observed water surface elevations which are lower than the computed curves were observed in late August during the recession limb of the runoff hydrograph when backwater from downstream had dissipated. It should be noted that the observed water surface elevations are plotted 0.88 feet higher than the actual USGS gage heights observed during the flood. The gage heights were adjusted because of an apparent error in the gage datum of the new USGS gage at 12th Avenue North on the West Fargo diversion. This apparent error is described in additional detail later in this report.

PLATE 33 is a rating curve on Drain 21 at the 19th Avenue North bridge which is located just downstream of the Drain 21 outlet structure. The observed elevations obtained by Moore Engineering at this site are plotted on the rating curve as well as an observed point at the USGS gage at 12th Avenue North on August 10 which is the only day where both the USGS and Moore Engineering took measurements. The Moore Engineering measurement is about two feet less than the USGS measurement at 12th Avenue North. None of the Moore Engineering measurements at the 19th Avenue North bridge exceed the computed rating curve, but all of these measurements were taken in August which is after the peak high water at this location. Since the observed elevations at the 12th Avenue North Bridge shown on PLATE 32 and the peak observed elevation at the 19th Avenue North Bridge on the Sheyenne River shown on PLATE 34 exceed the rating curves, it is likely that the high water at this location also exceeded the computed rating curves due to downstream backwater.

PLATE 34 is a rating curve on the Sheyenne River at the 19th Avenue North bridge. The observed water surface elevations are very close to the computed rating curve. None of the Moore Engineering observed elevations exceed the computed curve, but as stated earlier, these measurements were taken in August which is after the peak high water at this location. The point which exceeds the curve

is the high water mark obtained by USACE personnel. The high water mark elevation is plotted versus an estimated discharge based on the 2,510 cfs discharge when the peak elevation occurred at 12th Avenue North. Using the diverted discharge curve based on observed 1993 data for the Drain 21 outlet structure on PLATE 36, it was estimated that 900 cfs would be diverted to Drain 21. This results in an estimated Sheyenne River discharge of 1,610 cfs.

F. Control Structure Design Verification

The control structure designs were checked using observed water surface elevations and discharges from the Summer 1993 event. The control structure designs, the Horace diversion inlet structure and the Drain 21 outlet structure, were checked by plotting the observed diverted discharge over the structure versus the observed inflow discharge in the Sheyenne River or West Fargo diversion channel on diverted discharge versus inflow discharge curves developed from design computations. PLATE 35 is a plot of the Horace diversion inlet structure diverted discharge versus the Sheyenne River inflow discharge. As can be seen, the observed diverted discharges agree very well with the computed curves based on the USACE and FIS models.

PLATE 36 is a plot of the Drain 21 outlet structure diverted discharge versus the West Fargo diversion inflow discharge. The observed diverted discharges are generally about 200 cfs more than the computed diverted discharge. There are two factors which could result in more flow over the structure than computed. First, the water surface elevation downstream of the structure could be lower than anticipated. This would decrease the weir flow submergence thereby increasing the weir flow over the structure. Second, the water surface elevation upstream of the structure could be higher than anticipated which would increase weir flow over the structure. It appears that both of these conditions may have occurred during the 1993 summer flood event.

The computed diverted discharges over the Drain 21 outlet structure are based on starting water surface elevations at the BNR bridge, point O, from either the FIS or are based on observed water surface elevations at the bridge from prior flood events for the USACE model. These starting water surface elevations result in specific computed diverted discharges based on the water surface elevations upstream and downstream of the Drain 21 outlet structure. For instance, on August 10 which is the only day where Moore Engineering measured the water surface elevation at the bridge about one mile north on Drain 21 and the USGS measured the flow in the drain, the West Fargo diversion discharge was 3210 cfs, the observed water surface elevation at 12th Avenue North was about 0.3 feet below the CORPS rating curve, the Drain 21 discharge was 1170 cfs and the difference in water surface elevation across the structure was about two feet. Based on the computations and the computed curve, the diverted discharge in Drain 21 should be about 1020 cfs and the difference in elevation should be about 0.65 feet. It appears that on August 10 the downstream backwater had dissipated, the actual downstream elevation was lower than used in the computations and; subsequently, the diverted discharge over the structure was greater than computed. All the other observed diverted discharges on this graph were obtained in July when there was backwater from downstream. The downstream backwater caused the observed water surface elevations which are higher than anticipated and exceed the rating curve at 12th Avenue North. This in turn resulted in diverted discharges which are greater than those computed. As stated earlier, the project design was based on starting water surface elevations which result in specific computed diverted discharges. However, it was realized during project design that different backwater conditions (i.e. different starting water surface elevations) would result in different diverted discharges. In fact, starting water surface elevations without downstream backwater were considered, but the higher starting water surface elevations with backwater were used because they result in higher water surface profiles along Drain 21 and the Sheyenne River between the BNR bridge and the downstream end of the project. Even though the flow split between Drain 21 and the Sheyenne River may have been slightly different than for without-project conditions, there was only a very small difference in water surface profiles in the reach due to backwater conditions.

G. Harwood and West Fargo Water Surface Elevation Adjustments

1. Harwood Adjustment

The water surface elevations at Harwood were adjusted based on surveys of the staff gage nailed to a tree on the right bank downstream of the County Highway 22 bridge. These surveys were performed when it was noticed that observed water surface elevations obtained by Moore Engineering were about 0.5 feet less than observed water surface elevations obtained from the staff gage by USACE personnel. These surveys found that the staff gage reads 0.31 feet too high. Based on these surveys, the USACE observed water surface elevations were decreased 0.31 feet and the Moore Engineering observed water surface elevations were increased about 0.2 feet. As shown in TABLE A-1 in Appendix A, the observed water surface elevations from the two sources agree very closely with these adjustments.

2. West Fargo Adjustment

As noted earlier, the observed water surface elevations at West Fargo were adjusted because of an apparent error when the new 12th Avenue North gage on the diversion channel was installed. This error became apparent during the flood when USACE personnel noticed that water surface elevations at the pump station staff gage were about 0.7 feet higher than those based on the USGS gage. The West Fargo gage height readings were increased 0.88 feet based on surveys performed by USGS personnel that are summarized below. The gage heights, adjusted gage heights based on a difference of 0.88 feet, adjusted water surface elevations and hourly discharges are shown in TABLE A-2 in Appendix A.

Surveys performed by USGS Personnel

USGS Gage, 12th Ave. No. Br., Check Bar Elevation Surveyed by USGS	907.75
Check Bar Stage used by USGS during 1993 Flood	29.68
Gage Datum used by USGS during 1993 Flood	<u>877.19</u>
Check Bar Elevation based on USGS Check Bar Stage and Gage Datum	906.87

$$\text{Difference} = 907.75 - 906.87 = 0.88 \text{ feet}$$

This adjustment appears about 0.2 to 0.3 feet too much based on surveys performed by USACE personnel during and after the flood. These surveys are summarized below and indicate that the adjustment should be about 0.67 or 0.61 feet.

Surveys performed by USACE Personnel during the Summer 1993 Flood

Water Surface Elevation on Pump Station Staff Gage	~897.8
Surveyed Water Surface Elevation at Pump Station	897.82
Surveyed Water Surface Elevation at 12th Ave. No. Br.	897.86
12th Ave. No. Gage Reading at time of Survey	20.00
Gage Datum used by USGS during 1993 Flood	<u>877.19</u>
Water Surface Elevation based on Gage Reading & Gage Datum	897.19

$$\text{Difference} = 897.86 - 897.19 = 0.67 \text{ feet}$$

Surveys performed by USACE Personnel after the Summer 1993 Flood

USGS Gage, 12th Ave. No. Br., Check Bar Elevation Surveyed by USACE	907.48
Check Bar Elevation based on USGS Check Bar Stage & Gage Datum	906.87

$$\text{Difference} = 907.48 - 906.87 = 0.61 \text{ feet}$$

The 0.88 foot adjustment was used mainly because the USGS used it to adjust their maximum gage height in the water supply papers which will be published, but also because it gave the highest water surface elevation at West Fargo. Even using

the 0.88 foot adjustment, the 1993 flood was lower than the 1975 flood at West Fargo. This is shown in TABLE 7 later in this report. The surveys by the USGS and USACE did not use common bench marks; therefore, additional surveys would have to be obtained to resolve the 0.27 foot difference (907.75 USGS versus 907.48 USACE) for the check bar elevation.

H. West Fargo/Harwood Water Surface Elevation and Discharge Comparison

The observed water surface elevations and discharges at West Fargo and Harwood are plotted on PLATE 37. The information contained in PLATE 37 is the same as in PLATE 2, but all the information is plotted on a single graph rather than on four separate graphs.

PLATE 37 shows that the peak observed water surface elevation at both West Fargo and Harwood occurred more than two weeks before the Sheyenne River reached its peak discharge at West Fargo. However, the peak observed water surface elevations at both locations occurred when the Sheyenne River at I-29 was at or very near its peak discharge. The peak discharge at I-29 is about 4500 cfs more than the corresponding discharge at West Fargo. This additional 4500 cfs discharge is runoff from the Maple, Rush and Lower Rush Rivers. PLATE 37 also shows that the water surface elevation at both West Fargo and Harwood had decreased by the time the Sheyenne River at West Fargo had reached its peak. At West Fargo, the water surface elevation decreased by about 1.3 feet and at Harwood the water surface elevation decreased by about 4.4 feet. These points indicate that the peak water surface elevation at West Fargo was due in part to backwater from downstream runoff. In addition, the peak water surface elevation at Harwood was due more to runoff from the Maple, Rush and Lower Rush Rivers than the Sheyenne River discharge just downstream of West Fargo.

I. Backwater Affects at West Fargo

PLATE 38 is a continuous plot of the adjusted observed water surface elevations (based on USGS adjustment of 0.88 feet) plotted versus discharge from July 15 through August 31 at the 12th Avenue North USGS gage. This plate graphically illustrates how much the water surface elevations at West Fargo are impacted by backwater from downstream runoff. The date, time, discharge, and elevation at several points are labeled on the graph. As can be seen, the water surface elevation at 12th Avenue North increases by about five feet from 892 to 897 while the discharge varies in a range from about 1100 cfs to 1800 cfs during the time from July 16 to July 21. This indicates that the elevation increase is due to backwater from downstream runoff. On PLATE 37, it can be seen that this is the same time period when the discharge at I-29 is increasing dramatically due to runoff from the Maple, Rush and Lower Rush Rivers.

J. Basin and Statewide Flood Levels for 1993 Flood Event

During the 1993 flood event, flood levels were generally higher for a given discharge than typically would have occurred for a spring flood event. This phenomenon was noted statewide and on the Sheyenne River at Valley City, Lisbon and Kindred. The flood levels at the three Sheyenne River sites were about 0.5 to 1.0 feet above the current USGS Sheyenne River rating curves. This phenomenon is due to dense summer vegetation which created higher flow resistance and; therefore, higher flood levels than would typically have occurred for a spring event.

VI. 1975 AND 1993 DISCHARGE AND HIGH WATER MARK COMPARISON

A. Discharge Comparison

A review of peak Sheyenne River discharges at Kindred and West Fargo for the two events shown below in TABLE 5 indicate that break-out flow occurred during the 1975 flood. For 1975, the peak discharge of 4,640 cfs at Kindred is 1790 cfs greater than the 2850 cfs peak discharge at West Fargo. This is much too large

a decrease to be caused by flow attenuation in the channel; therefore, the conclusion is that break-out flow occurred in 1975. Most of the break-out flow occurred between Kindred and Horace. This is discussed in further detail in the following high water mark comparison section. The in-channel discharge downstream of the break-outs is less for the 1975 Summer flood because the channel capacity is less after the agricultural dikes overtop and washout. Much of the break-out flow which occurred in 1975 flowed into Drain 21 and eventually back into the Sheyenne River north of West Fargo. TABLE 6 shows the Sheyenne River, Drain 21, and total discharges for 1975 at 12th Avenue North in West Fargo. The peak total discharge of 3657 cfs is about 400 cfs greater than the 3256 cfs peak discharge for the 1993 Summer flood. Aerial photographs and flood reconnaissance by USACE personnel when peak flows were occurring between Kindred and Horace indicate that very little, if any, break-out flow occurred during the Summer 1993 flood. The small decrease in discharge from Kindred to Horace to West Fargo is due primarily to flow attenuation in the channel.

TABLE 5
SHEYENNE, MAPLE AND RUSH RIVERS
PEAK DISCHARGES, JULY 1975 & JULY/AUGUST 1993

Location	USGS Station Number	1975	1993
Kindred	05059000	4640	3510
Horace	05059480	--	3409
West Fargo	05059480/05059500	2850 (3657) (1)	3256 (2)
Enderlin	05059700	7610	3742
Amenia	05060500	460	2975

(1) - Sheyenne River plus Drain 21.

(2) - Diversion channel which includes Sheyenne River and Drain 21.

TABLE 6
SHEYENNE RIVER, DRAIN 21, & TOTAL DISCHARGES FOR 1975
AT 12TH AVENUE NORTH IN WEST FARGO

Date	Sheyenne River	Drain 21	Total
7/01/75	2460		
7/02/75	2740	543 g	3283
7/03/75	2850	453 i	3303
7/04/75	2680	363 g	3043
7/05/75	2540	679 g	3219
7/06/75	2540	790 i	3330
7/07/75	2600	900 g	3500
7/08/75	2680	894 i	3574
7/09/75	2770	887 g	3657
7/10/75	2760		
7/11/75	2410		

g - gaged by USGS, i - interpolated from gaged data

B. High Water Mark Comparison

TABLE 7 is a comparison of high water marks along the Sheyenne River for the 1975 and 1993 Summer floods. The reference point locations in the first column of the table are shown on PLATE 39. A profile of the 1993 Summer flood is shown on PLATE 40 along with profiles for the 1969 and July 1975 floods. High water marks for numerous other floods are also listed on this profile. The County Highway 22 and 12th Avenue North high water marks were adjusted as discussed earlier. As can be seen in the table, the 1993 flood was generally about 0.5 feet lower than the 1975 flood downstream of West Fargo. Between reference points 36 and 40 which are located about midway between Horace and Kindred, the 1993 flood is

higher than the 1975 flood. The 1975 flood peak discharge of 4640 cfs at Kindred was higher than the 1993 flood peak discharge of 3510 cfs and the high water mark elevation for the 1975 flood at reference point 43 near Kindred is also higher than the 1993 flood. As stated in the discharge comparison section, this indicates that significant flow broke out of the Sheyenne River in the vicinity of reference points 36 through 40 during the 1975 flood. Thus inducing lower high water marks in this reach. The conclusion that break-out flow occurred in this reach is supported by numerous oblique aerial and ground photographs taken by or for USACE personnel during the 1975 flood which show substantial break-out flow occurring. The agricultural dikes along the Sheyenne River between reference points 36 and 40 may have been raised since 1975. This would keep more flow in the channel and raise the water surface profile in the reach. A debris/log jam was also noted at the reference point 38 bridge during flood reconnaissance by USACE personnel. This could also have raised water surface profiles in the reach.

TABLE 7
1975 AND 1993 HIGH WATER MARK COMPARISON

Reference Point	Location	July 1975	July/August 1993	
1	Cty. Hwy. 31	884.78	(1)	
3	Township Road	886.25	Bridge Removed	
5	U.S. Hwy. 81	889.37	889.37	
6A	I-29	889.46	889.15	
8	Cty. Hwy. 22	892.03	891.56	
9	Cty. Hwy. 17	~894.1	893.62	
10	Township Road	894.71	(2)	
11	Township Road	896.75	(1)	
12	BNRR Bridge	897.54	(3)	
14	19th Ave.No.	898.47	898.17	
15/15D	12th Ave.No.	15 899.44	15D	899.09
17/17D	BNRR Bridge	17 900.37	17D	899.30
24/24D	I-94 Eastbound	24 905.40	24D	899.17
25D	Township Road	N/A	25D	900.57
25.5D	Cty. Hwy. 17	N/A	25.5D	900.70
26/26D	Township Road	26 906.46	26 (3)	26D 900.96
27/27D	Cty. Hwy. 8	27 908.10	27 903.60	27D 900.98
28/28D	C.H. 6/Twnshp Rd	28 909.08	28 905.49	28D 902.08
29	Cty. Hwy. 17	29 911.08	29 (1)	N/A
30/30D	Township Road	30 912.06	30 (1)	30D 903.33
31/31D	Cty. Hwy. 6	31 --	31 (1)	31D 905.34
32/32D	Township Road	32 915.47	32 911.62	32D 909.02
34	Cty. Hwy. 14	918.68	916.82	
35	Township Road	919.48	918.32	
36	Cty. Hwy. 16	921.87	922.82	
37	Cty. Hwy. 36	922.54	(1)	
38	Township Road	923.75	925.24	
39	Township Road	927.57	929.03	
40	Cty. Hwy. 18	933.60	932.90	
41	Township Road	938.66	Bridge out of service	
42	Township Road	--	941.42	
43	State Hwy 46	947.38	946.11	

- (1) - Measurement taken, but reference point not surveyed.
(2) - No measurement taken due to log/debris jam.
(3) - No measurement taken.

VII. CONCLUSIONS

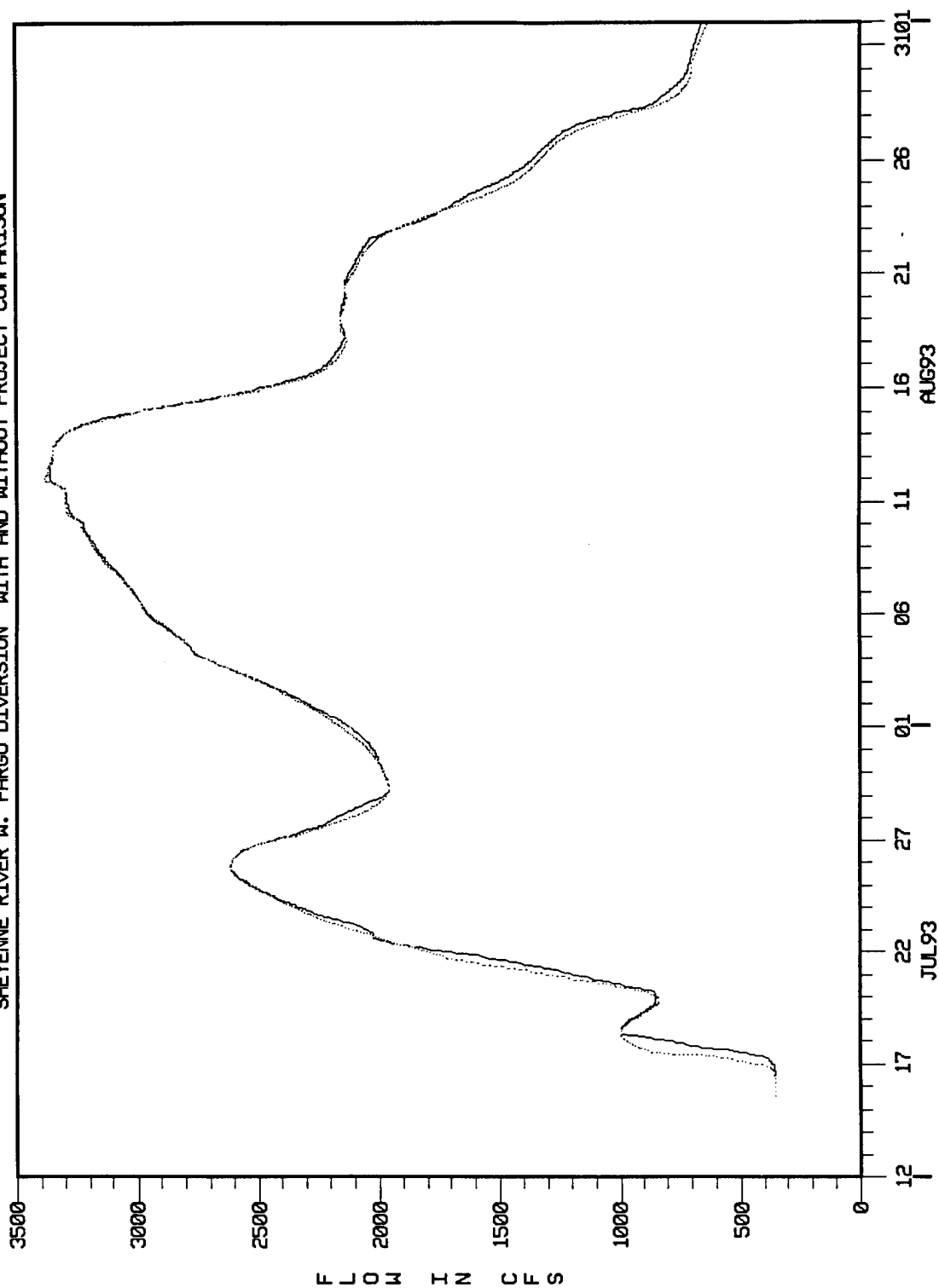
Based on this comprehensive analysis of the 1993 summer flood on the Maple, Rush, Lower Rush, and Lower Sheyenne River Basins, the following conclusions can be made:

- A. The Horace and West Fargo Levee and Diversion flood control projects had no measurable effect on flood levels downstream of the projects.
- B. The primary cause of the peak flood stages in the vicinity of Harwood was runoff from the Maple River.
- C. The effect on flood levels downstream of the West Fargo pump station from pumping that occurred from within the leveed area at West Fargo was not measurable. In addition, the difference between pumping for without- and with-project conditions was negligible.
- D. The 1975 summer flood event was more severe than the 1993 summer flood event and flood levels were about 1/2 foot higher in the Harwood area for the 1975 event.
- E. Flood data obtained during and after the event was not uniform and therefore had to be adjusted to a common datum. This nonuniformity of the data may have caused some misunderstanding of what was actually occurring during the flood event.
- F. Flood levels at the West Fargo gage are not truly representative of expected flooding conditions downstream because of the influence of the Maple and Rush Rivers and backwater effects from them and the Red River of the North.
- G. Agricultural dikes between Kindred and Horace have most likely been raised since the 1975 flood and; therefore, prevented break-out flows upstream of Sheyenne River control structures for the Horace Levee and Diversion Channel Project.
- H. The West Fargo and Horace Levee and Diversion projects performed as designed. The control structures at Horace split the flow as anticipated. However, the Drain 21 outlet structure allowed somewhat more flow into Drain 21 than expected. Even though the flow split between Drain 21 and the Sheyenne River may have been slightly different than for without-project conditions, there was only a very small difference in water surface profiles in the reach due to backwater conditions.
- I. The West Fargo Levee and Diversion Project prevented significant damage from occurring from Horace through West Fargo.

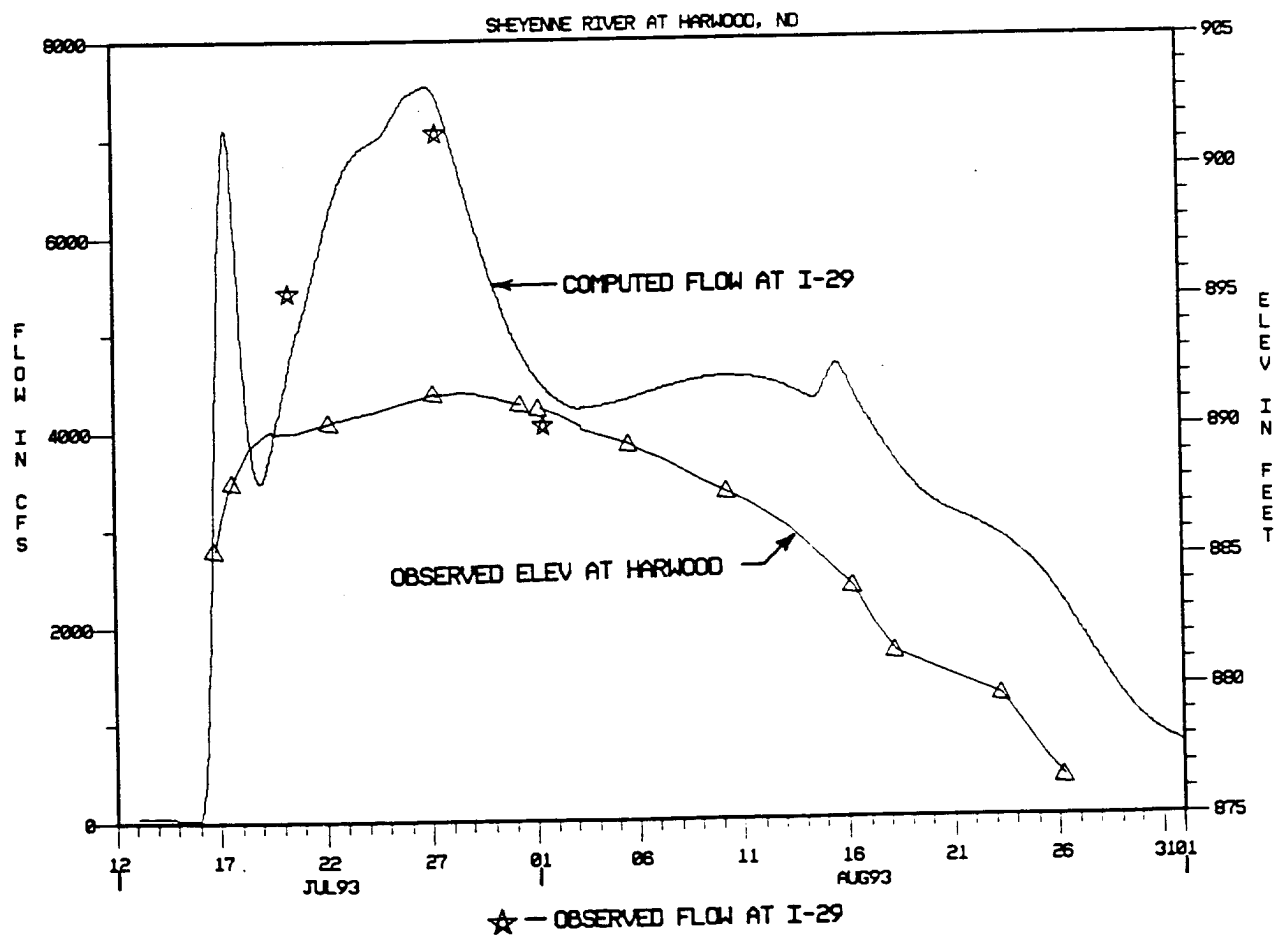
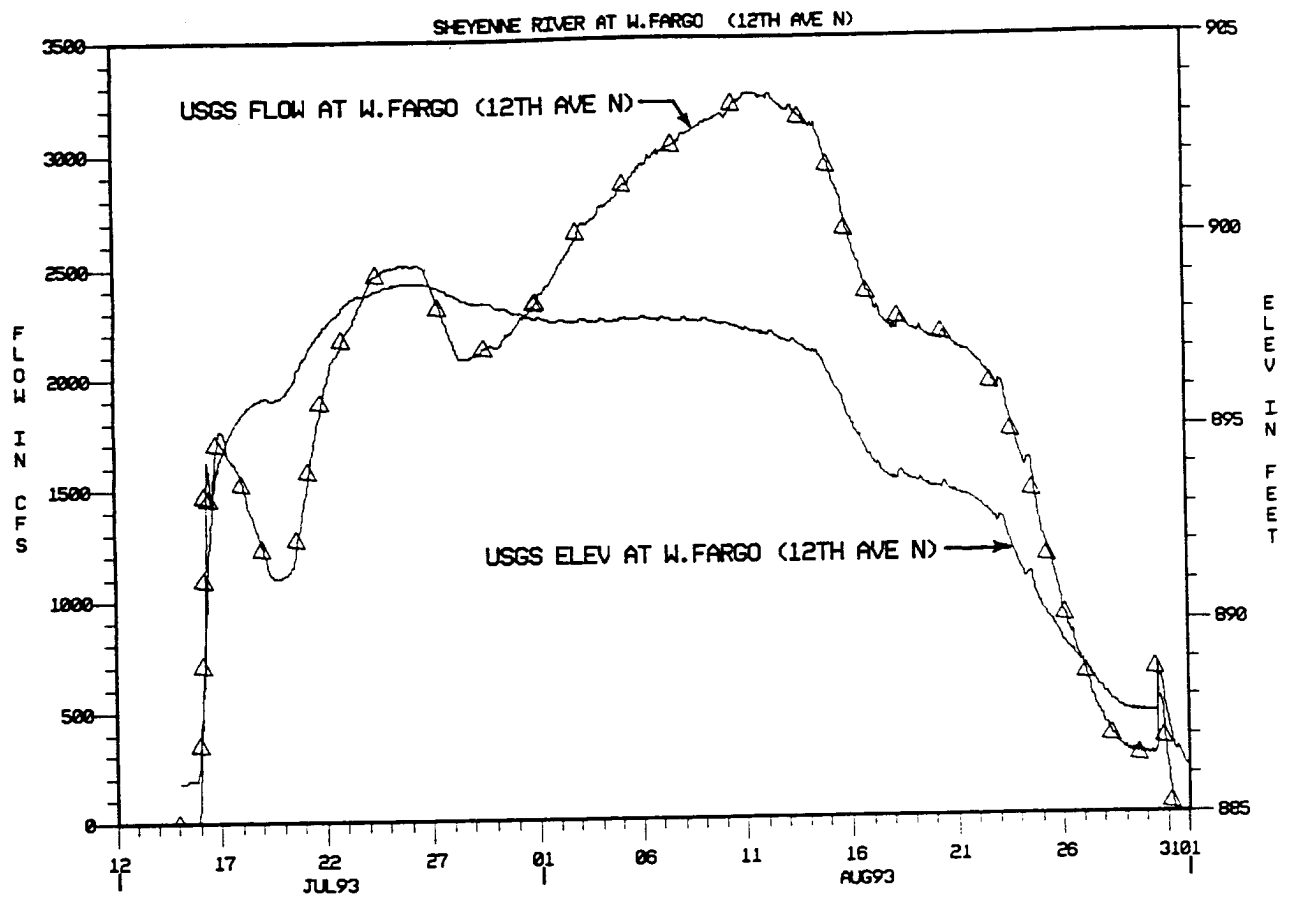
VIII. REFERENCES

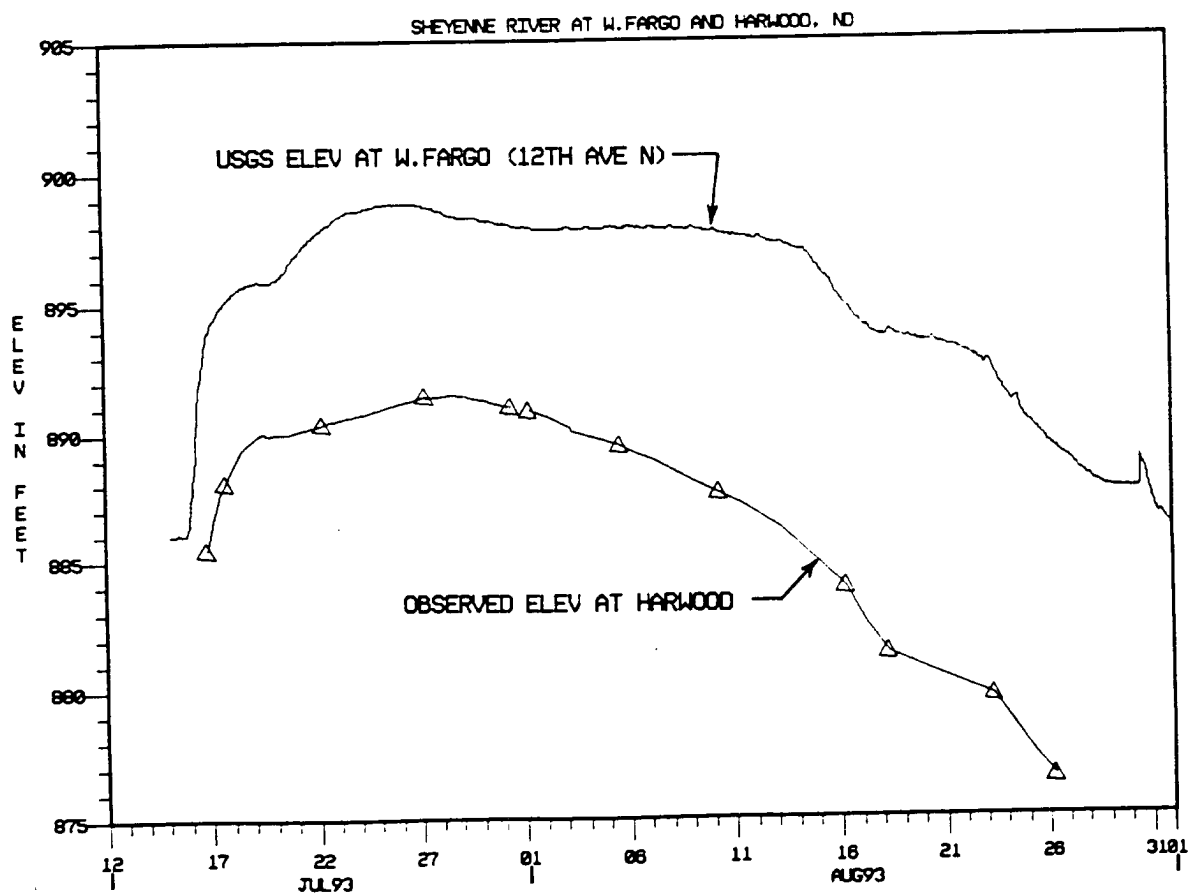
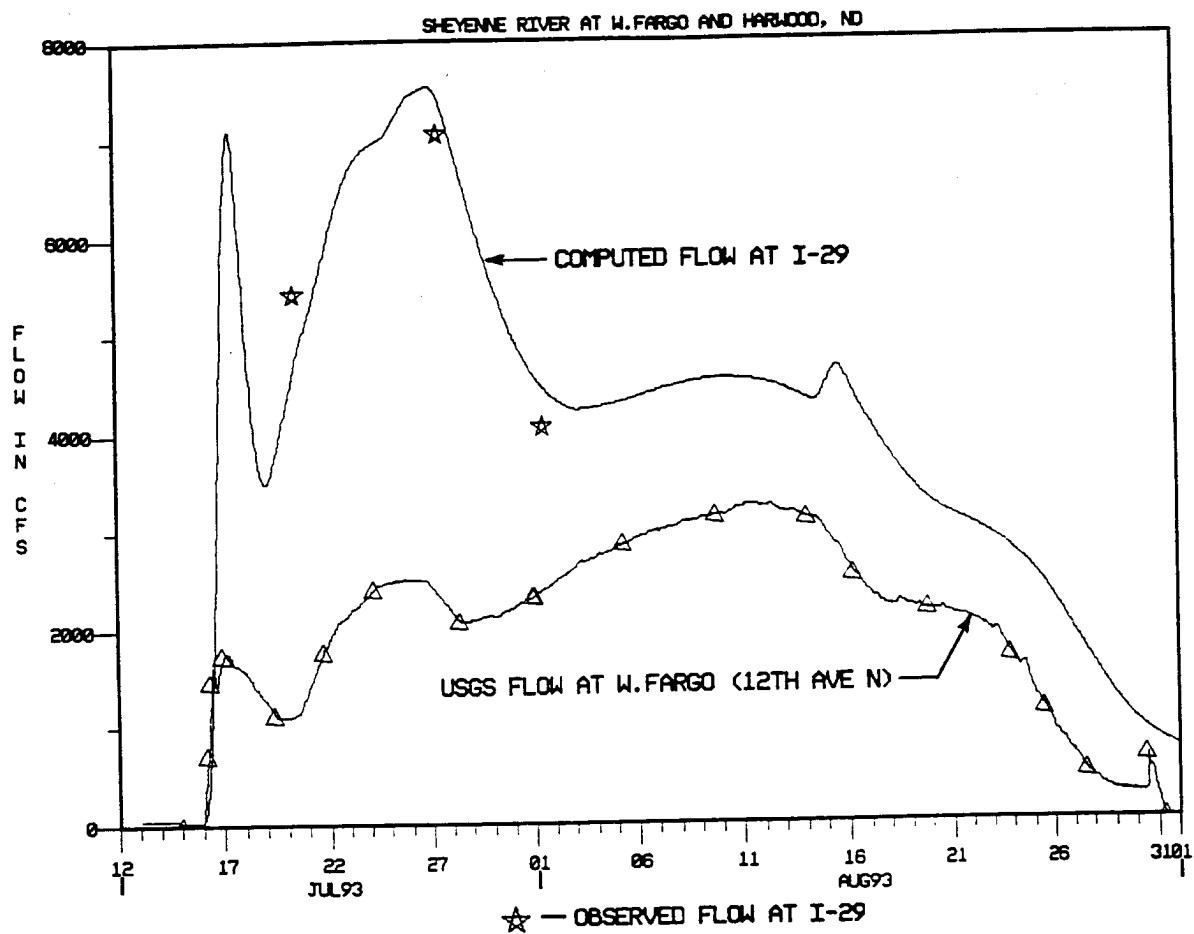
1. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, "HEC-1 Flood Hydrograph Package, User's Manual," HEC, July 1990.
2. Wahl, Kenneth L., Vining, Kevin C., and Wiche, Gregg J., U.S. Geological Survey Circular 1120-B, "Precipitation in the Upper Mississippi River Basin, January 1 Through July 31, 1993, Floods in the Upper Mississippi River Basin, 1993", Denver, 1993.
3. U.S. Department of the Army, Corps of Engineers, St. Paul District, Volume I, Timing Analysis, Technical Resource Service Red River of the North, St. Paul, March 1988.
4. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles, User's Manual," HEC, September 1982 (revised May 1985).
5. U.S. Department of the Army, Corps of Engineers, "Routing of Floods Through River Channels," USACE EM 1110-2-1408, March 1960.

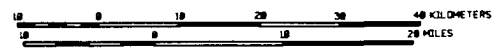
SHEYENNE RIVER W. FARGO DIVERSION WITH AND WITHOUT PROJECT COMPARISON

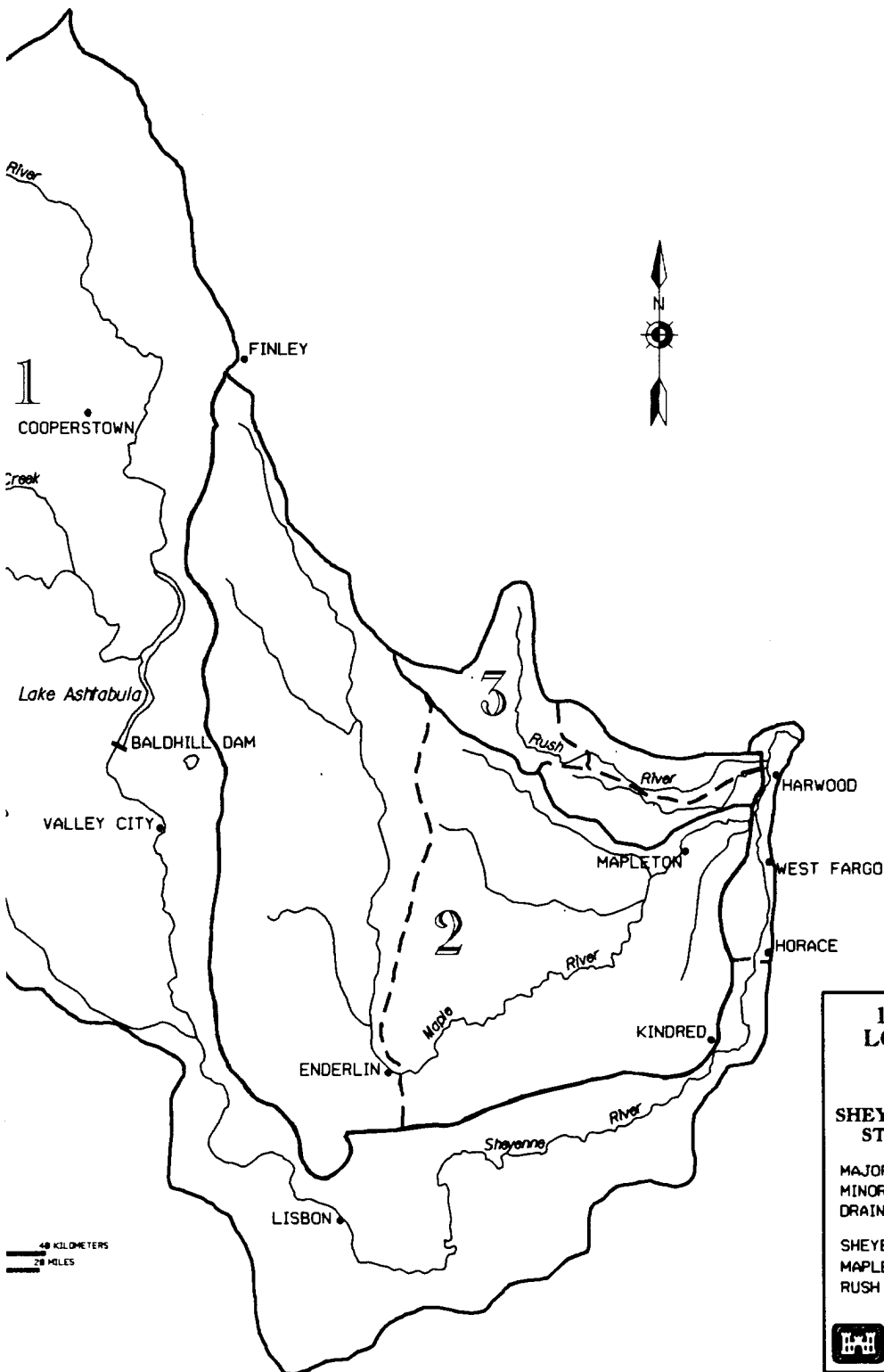


— DOWNSTREAM OF DIVERSION CHANNEL WITH PROJECT CONDITION AT BNRR BRIDGE
 DOWNSTREAM OF DIVERSION CHANNEL WITHOUT PROJECT CONDITION AT BNRR BRIDGE









1993 SUMMER FLOOD ANALYSIS LOWER SHEYENNE RIVER BASIN DRAINAGE AREAS

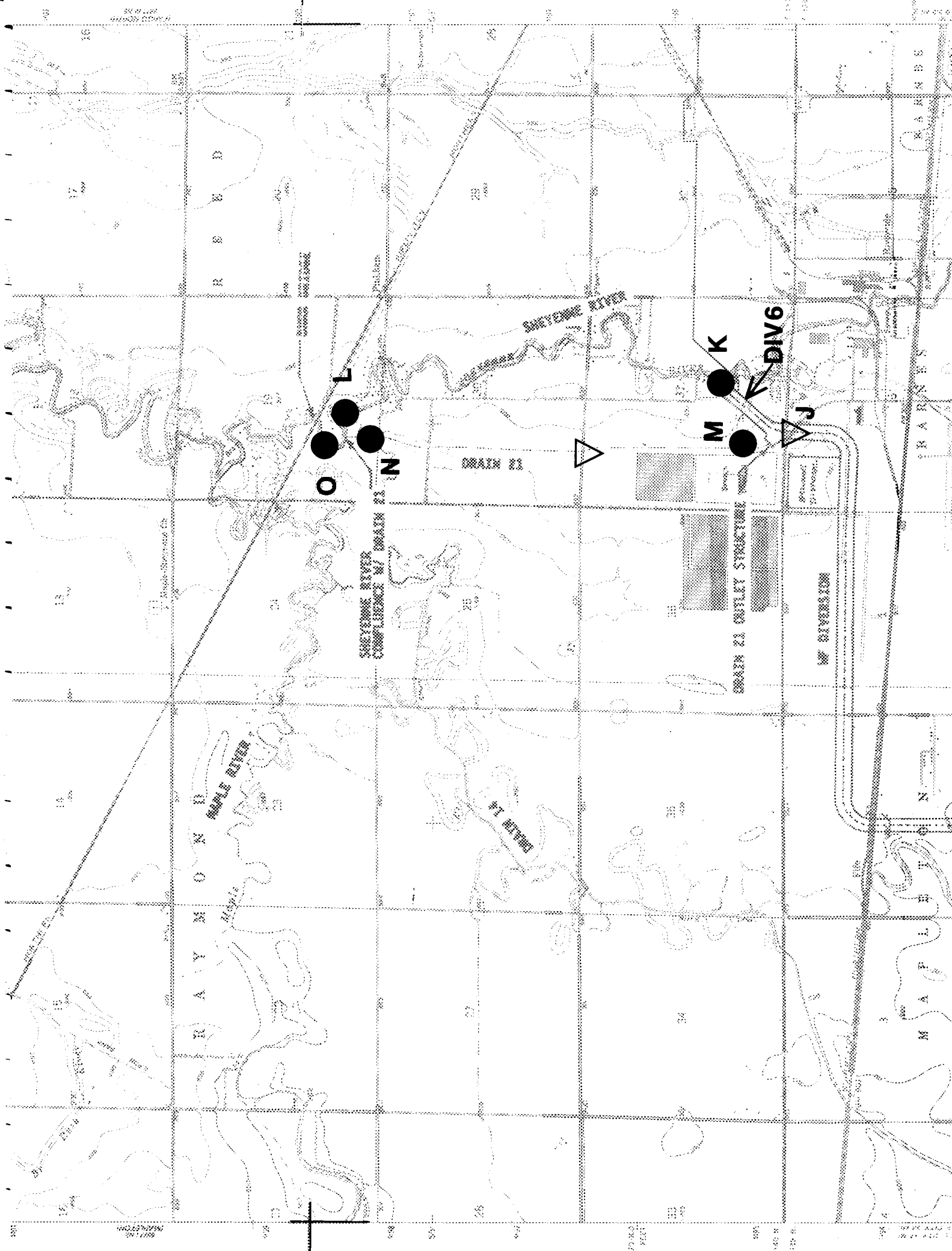
SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS

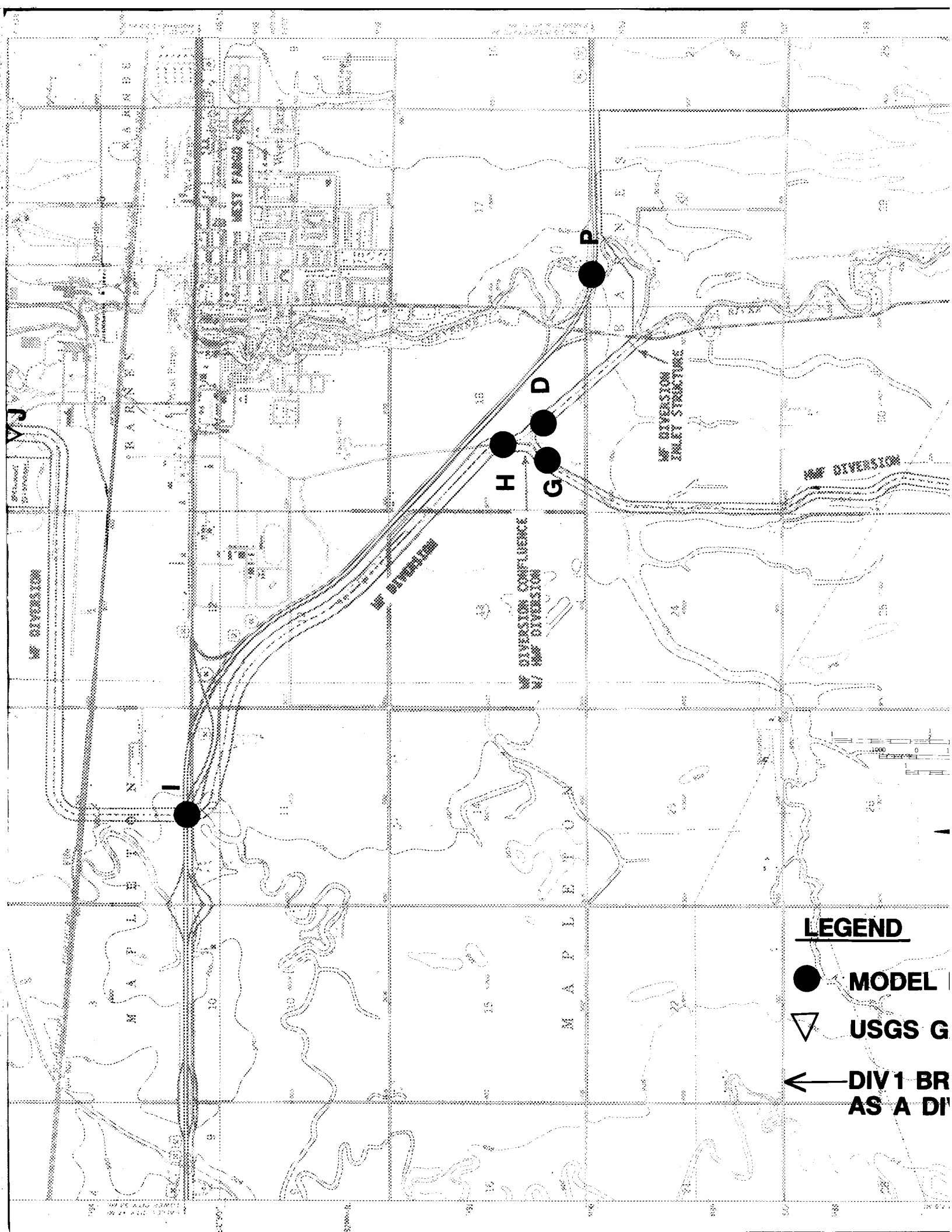
MAJOR WATERSHED BOUNDARY
MINOR WATERSHED BOUNDARY
DRAINAGE SYSTEMS.....

SHEYENNE RIVER WATERSHED 1
MAPLE RIVER WATERSHED 2
RUSH RIVER WATERSHED..... 3



Produced by St. Paul District, GIS Center, U.S. Army Corps of Engineers, February 1994.



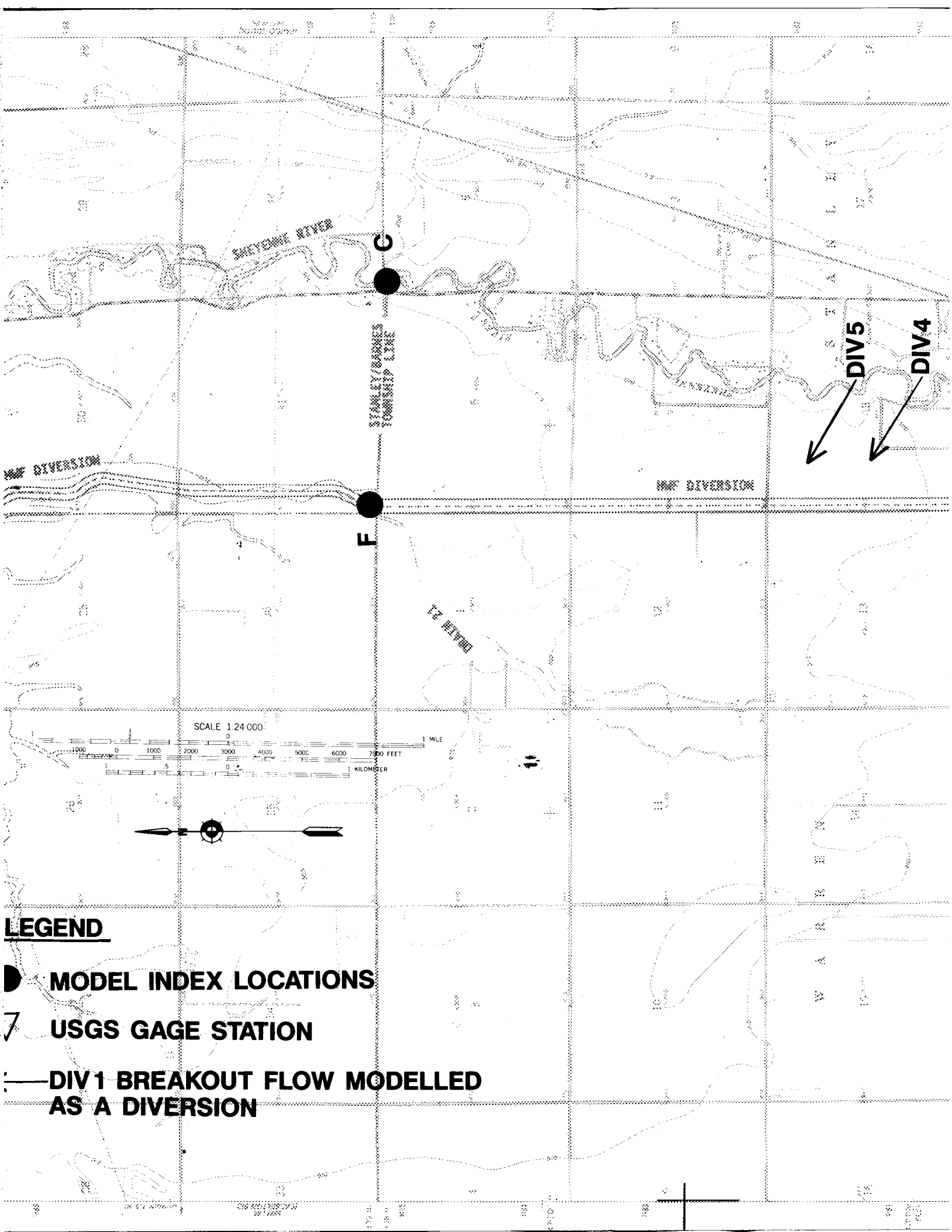


LEGEND

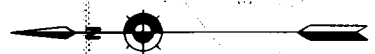
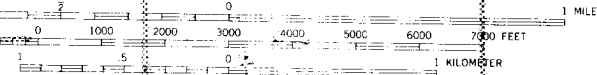
● MODEL

▽ USGS G

← DIV 1 BR
AS A DI

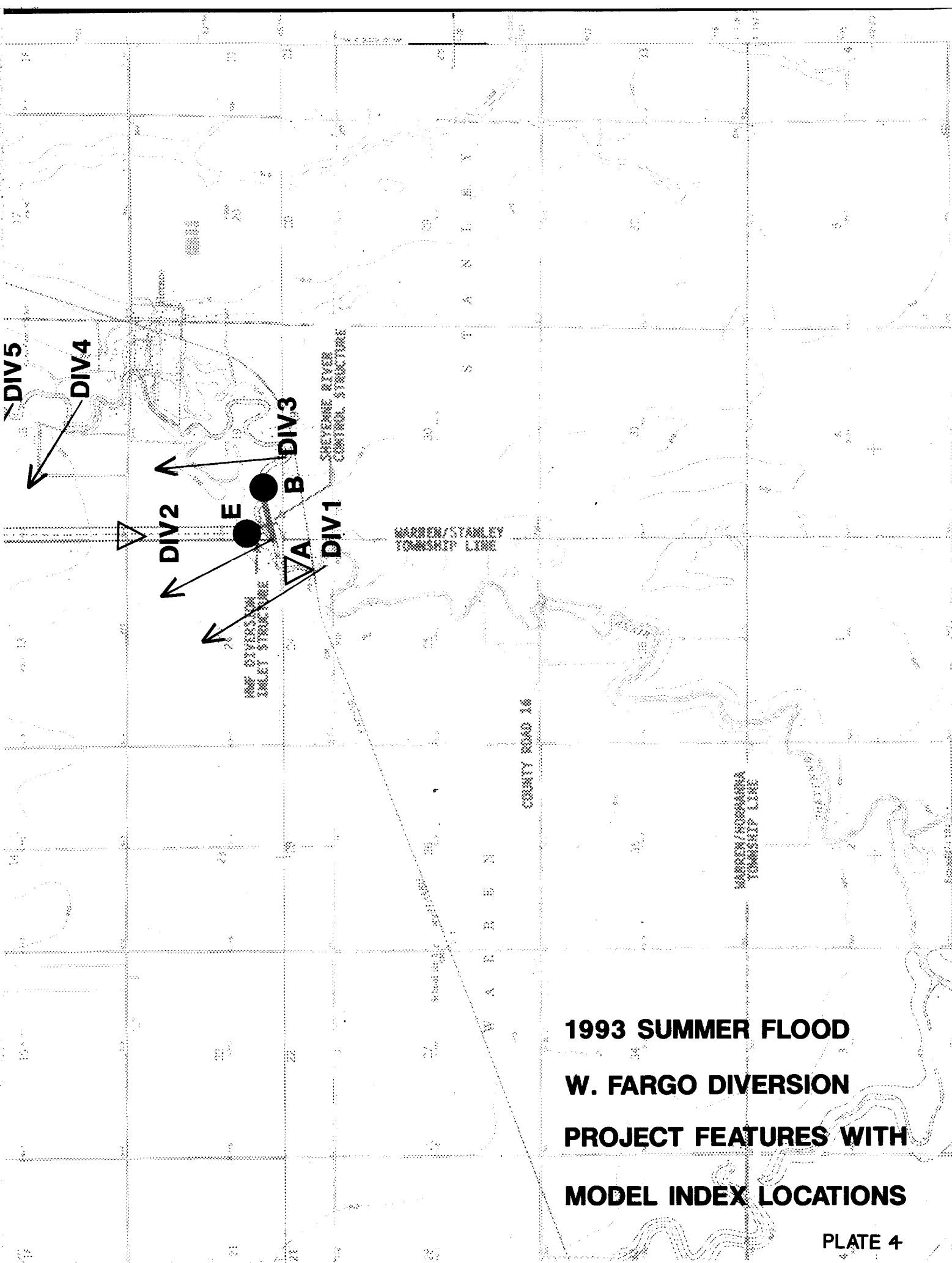


SCALE 1:24 000

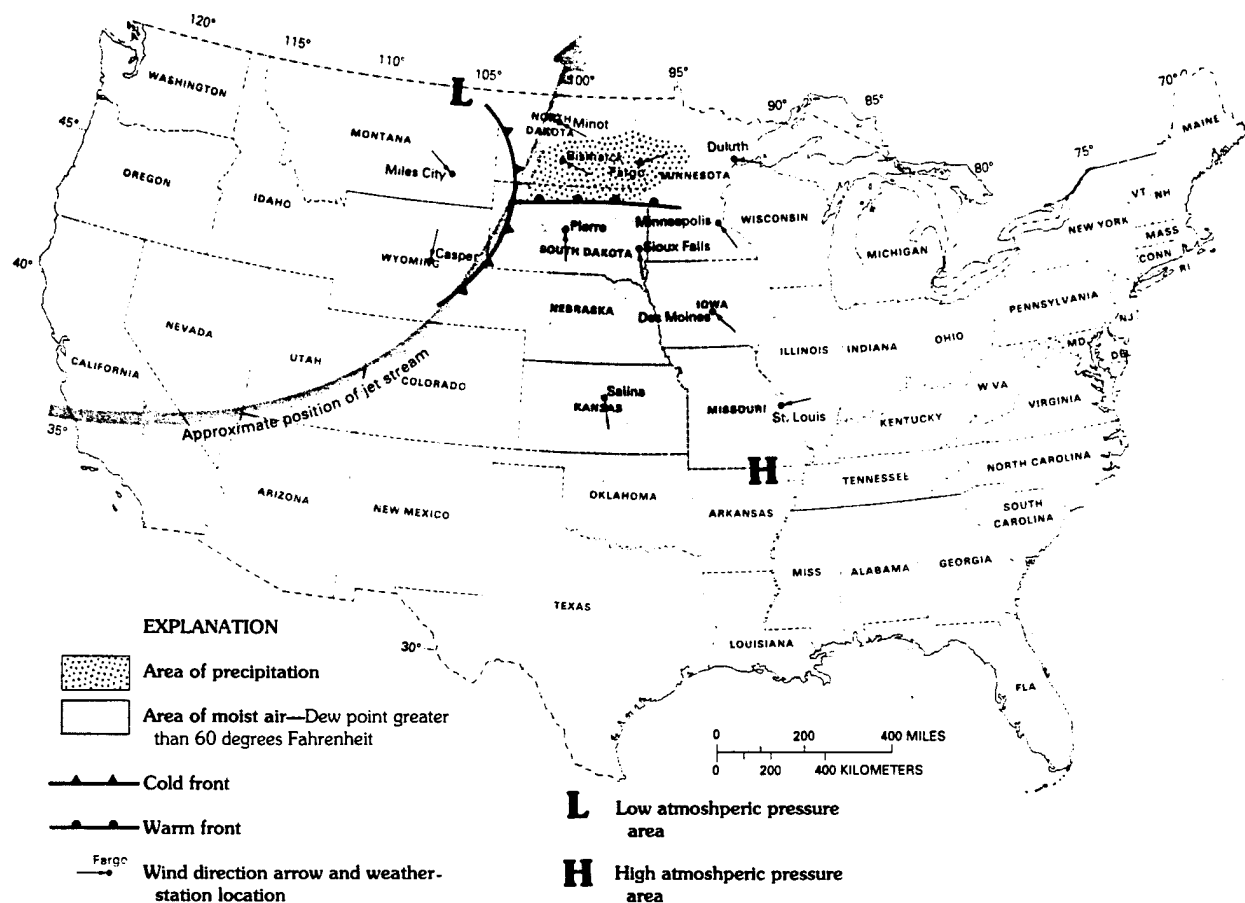


LEGEND

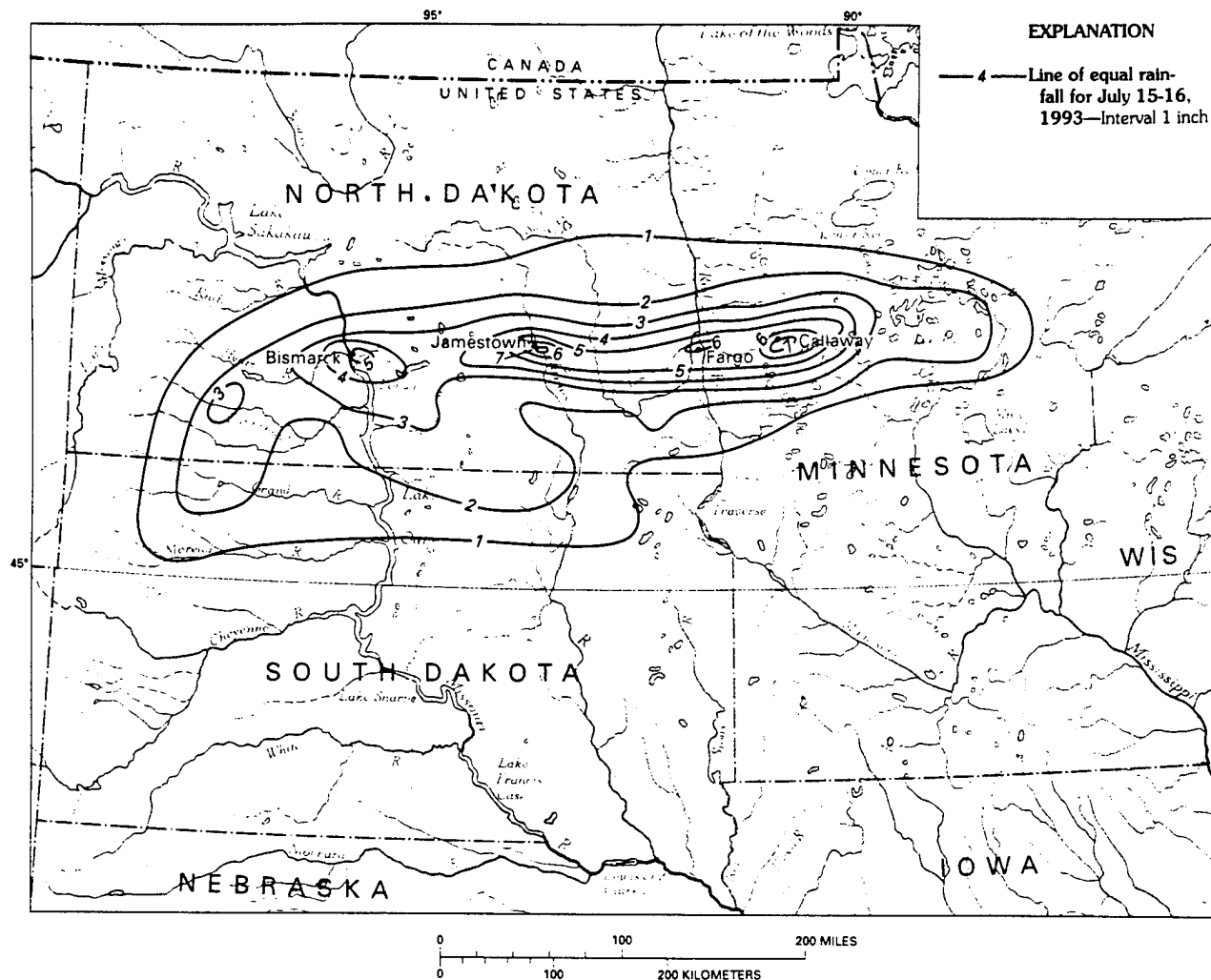
- MODEL INDEX LOCATIONS
- 7 USGS GAGE STATION
- DIV 1 BREAKOUT FLOW MODELLED AS A DIVERSION



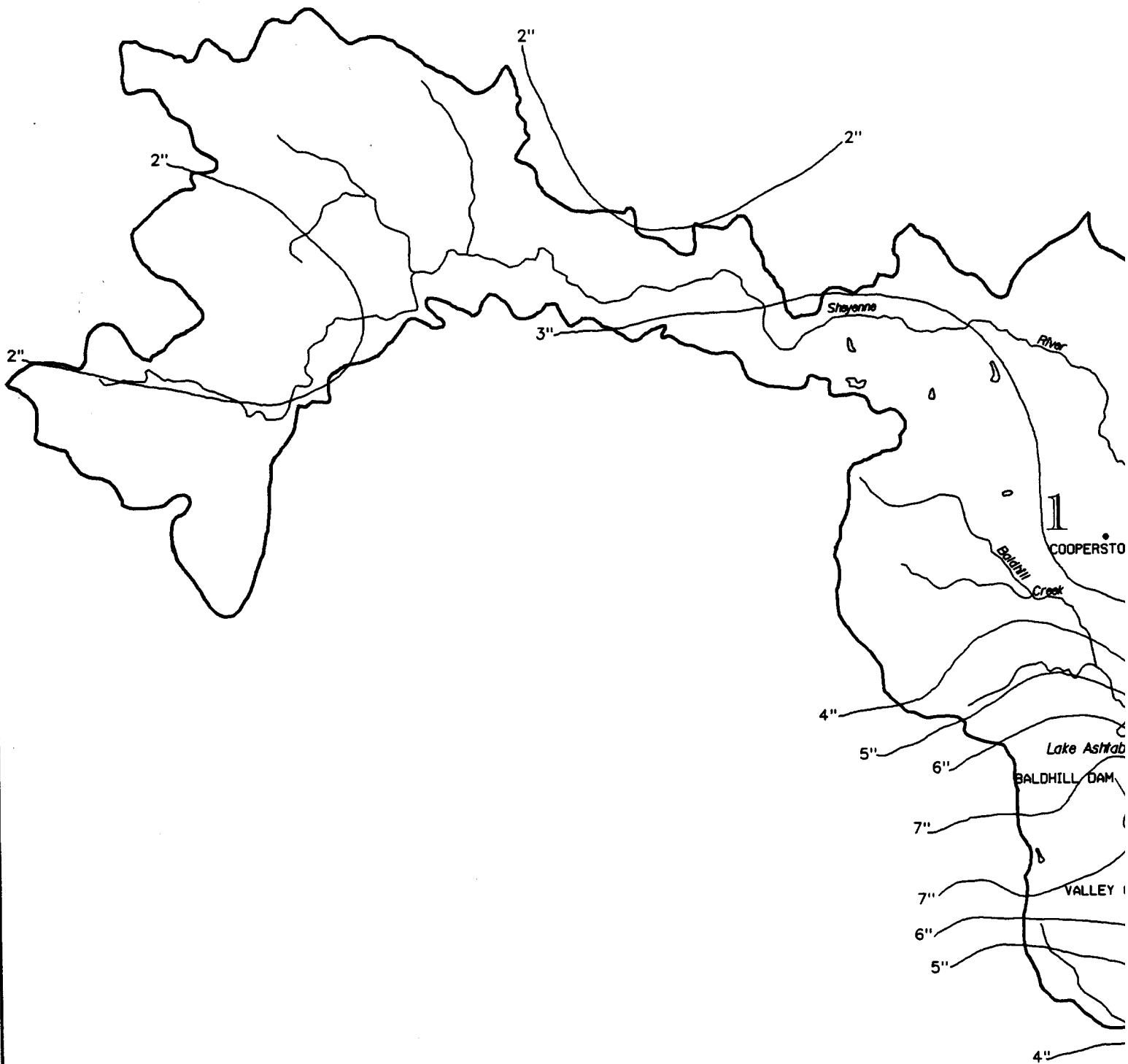
**1993 SUMMER FLOOD
W. FARGO DIVERSION
PROJECT FEATURES WITH
MODEL INDEX LOCATIONS**

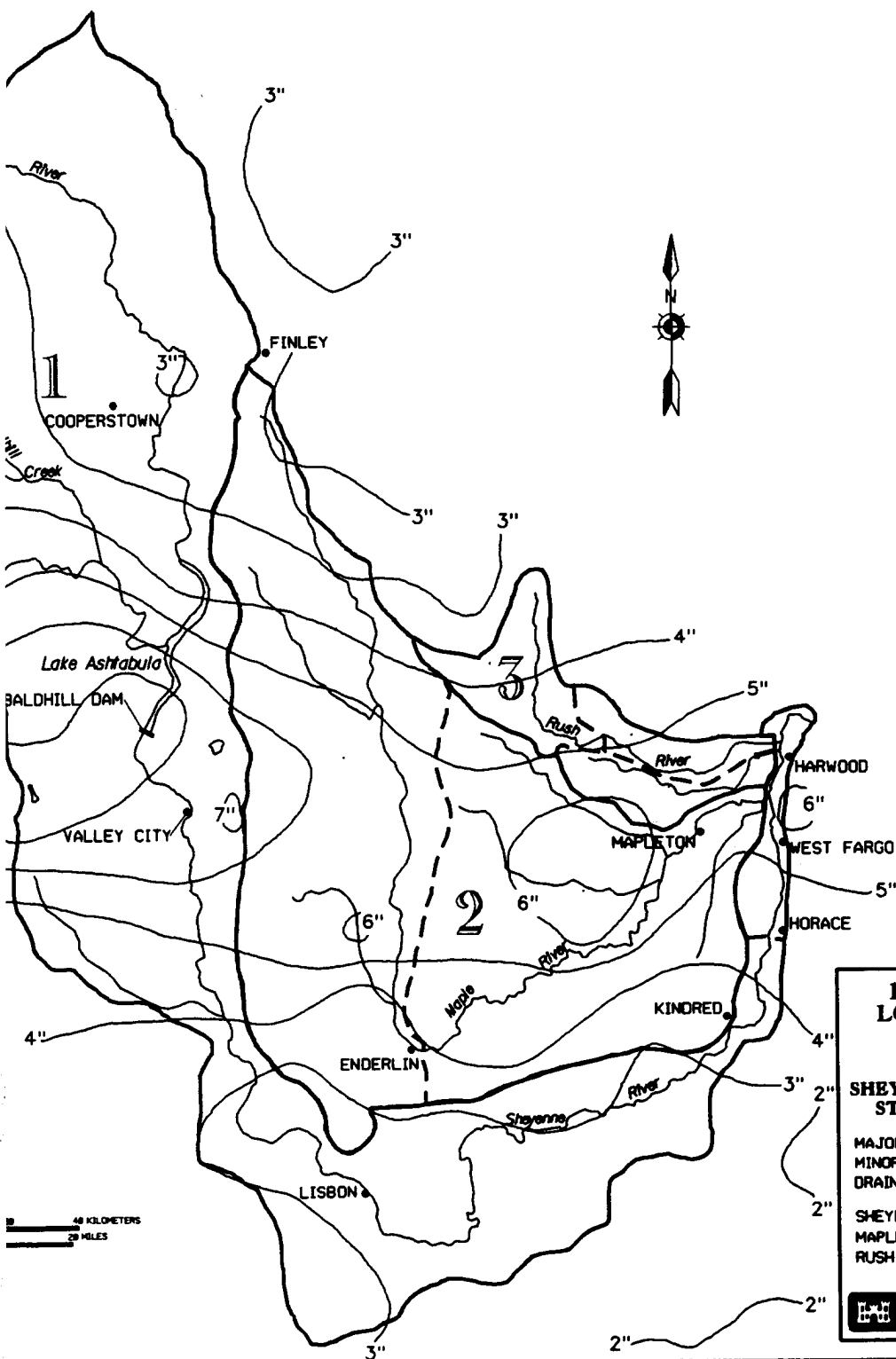


Average weather patterns over the United States for July 15–16, 1993. Data were supplied by the National Weather Service. (From Wahl, et al, 1993, Reference #1).



Areal distribution of rainfall for the July 15-16, 1993, storm in North Dakota, South Dakota, and Minnesota. Data were supplied by the National Weather Service. (From Wahl, et al, 1993, Reference #1).





**1993 SUMMER FLOOD ANALYSIS
LOWER SHEYENNE RIVER BASIN
ISOHYETAL MAP**
STORM 18-19 JULY 1993
SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS

MAJOR WATERSHED BOUNDARY
MINOR WATERSHED BOUNDARY
DRAINAGE SYSTEMS.....

SHEYENNE RIVER WATERSHED 1
MAPLE RIVER WATERSHED 2
RUSH RIVER WATERSHED..... 3

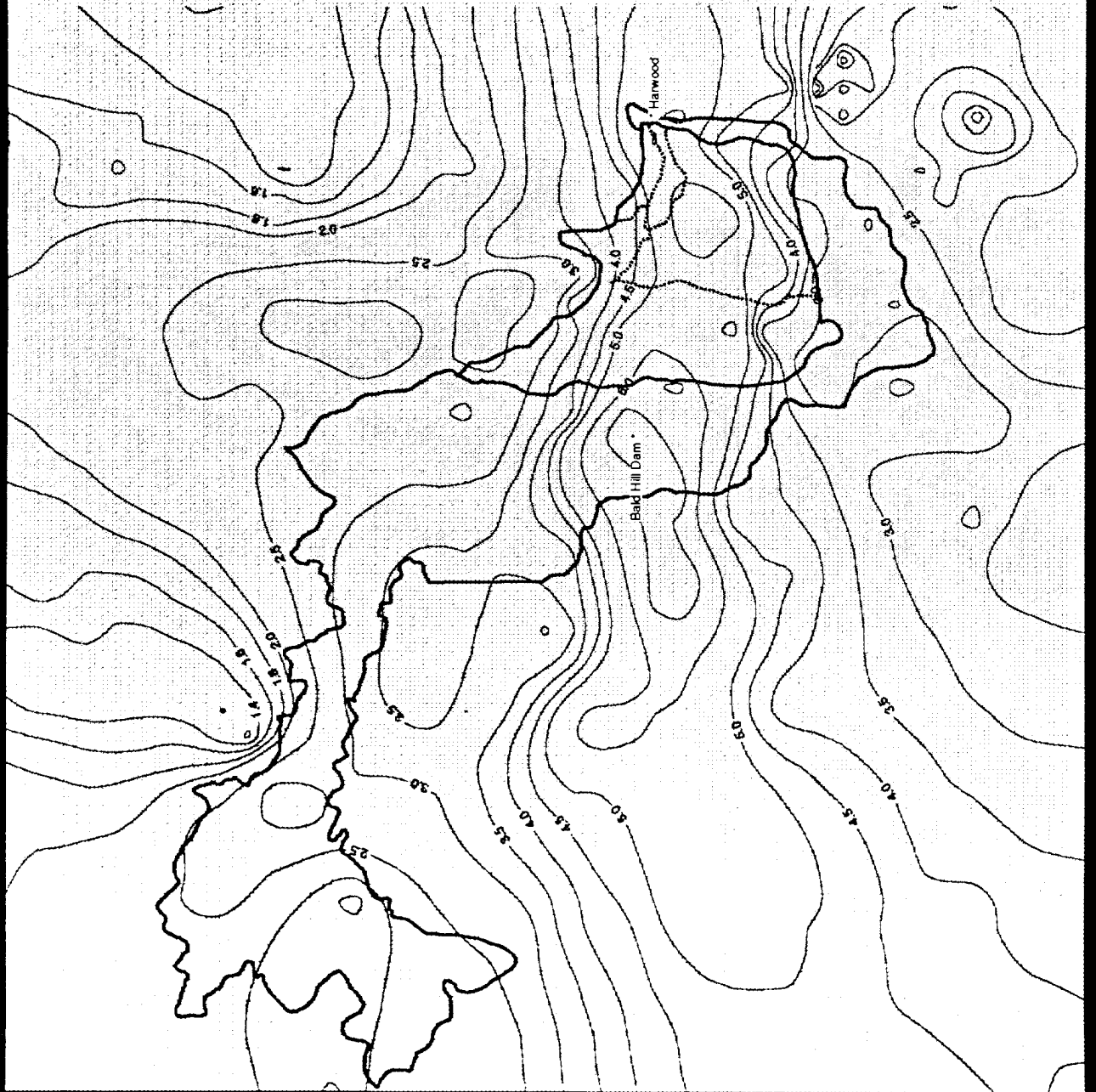
 Produced by St. Paul District, GIS Center, U.S. Army Corps of Engineers, February 1994.

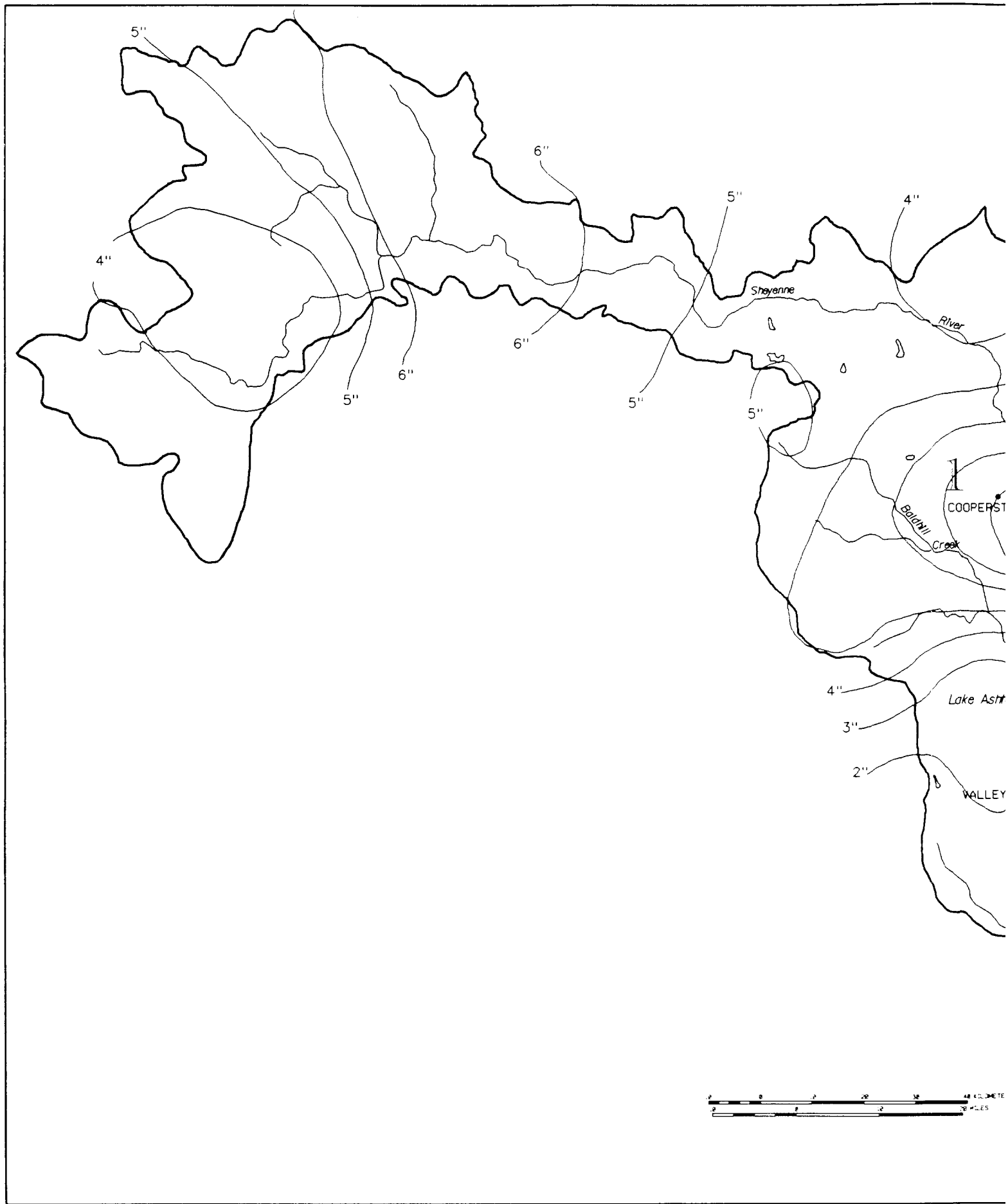
Isohyetal Map

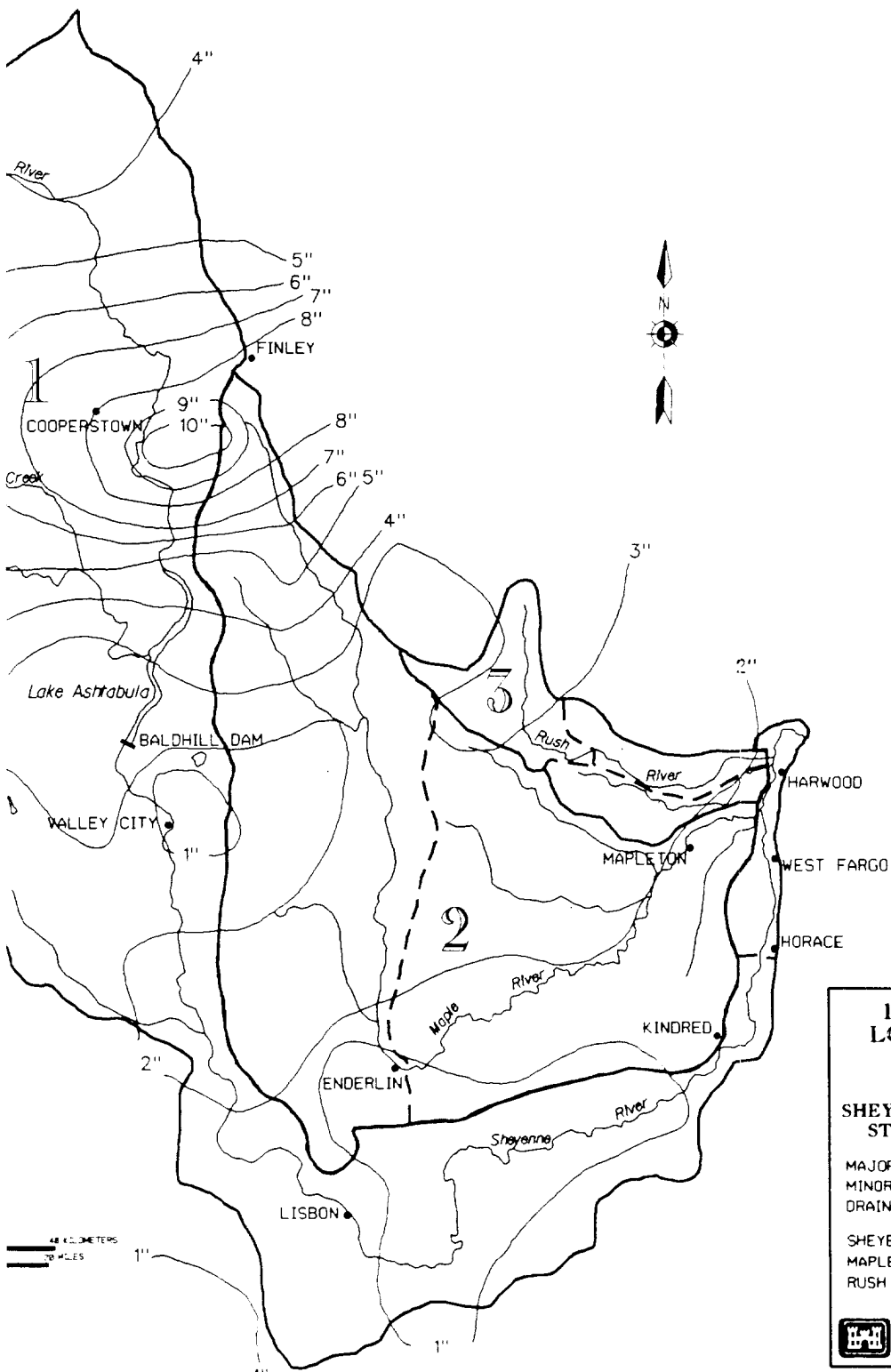
Storm 13—

19 July 1993

Max: 7.94
Min: 0.66
Ave: 3.59
Units: inches







**1993 SUMMER FLOOD ANALYSIS
LOWER SHEYENNE RIVER BASIN
ISOHYETAL MAP**
STORM 21-29 JULY 1993
SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS

MAJOR WATERSHED BOUNDARY	_____
MINOR WATERSHED BOUNDARY	-----
DRAINAGE SYSTEMS.....	_____

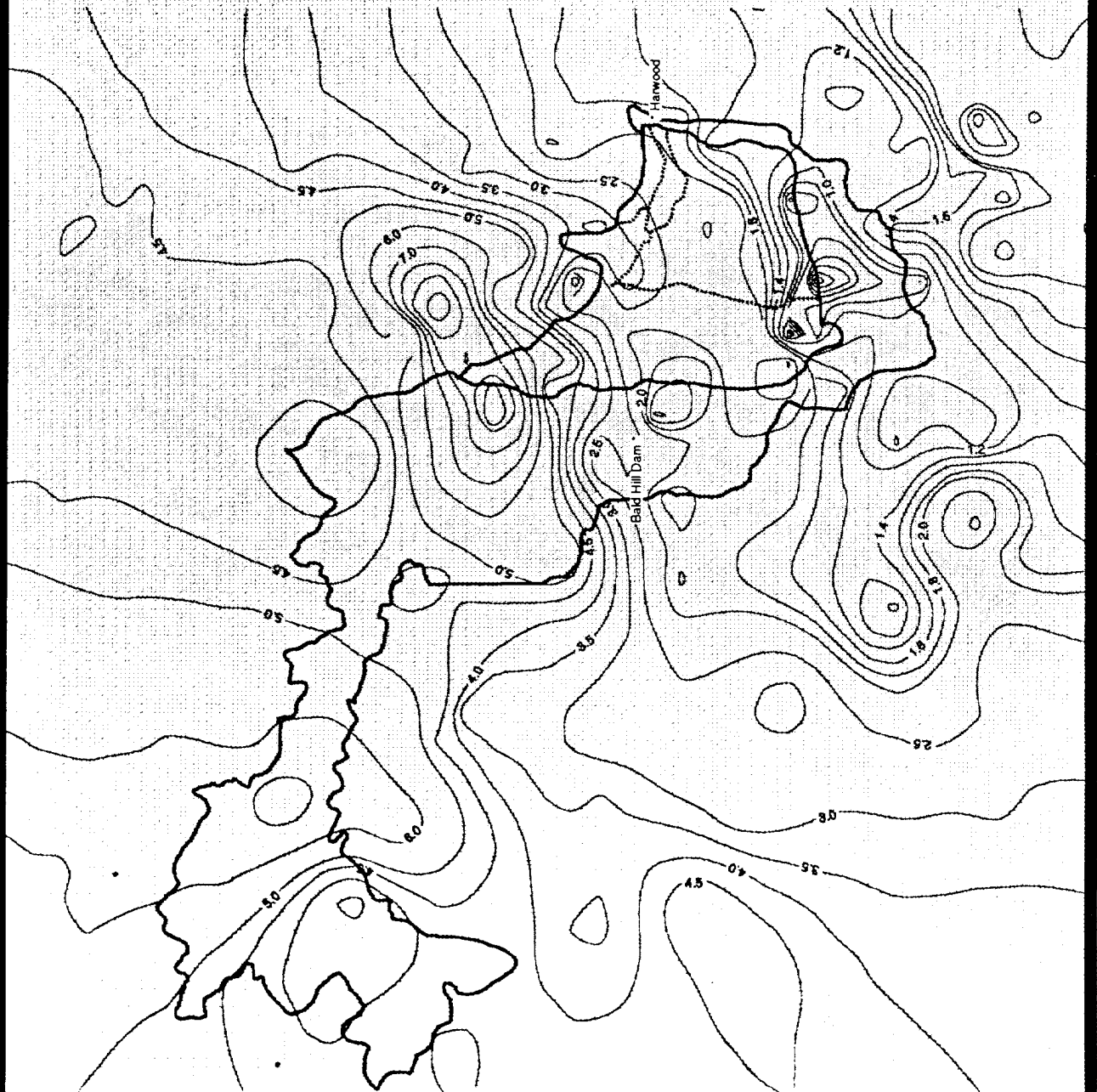
SHEYENNE RIVER WATERSHED	1
MAPLE RIVER WATERSHED	2
RUSH RIVER WATERSHED.....	3

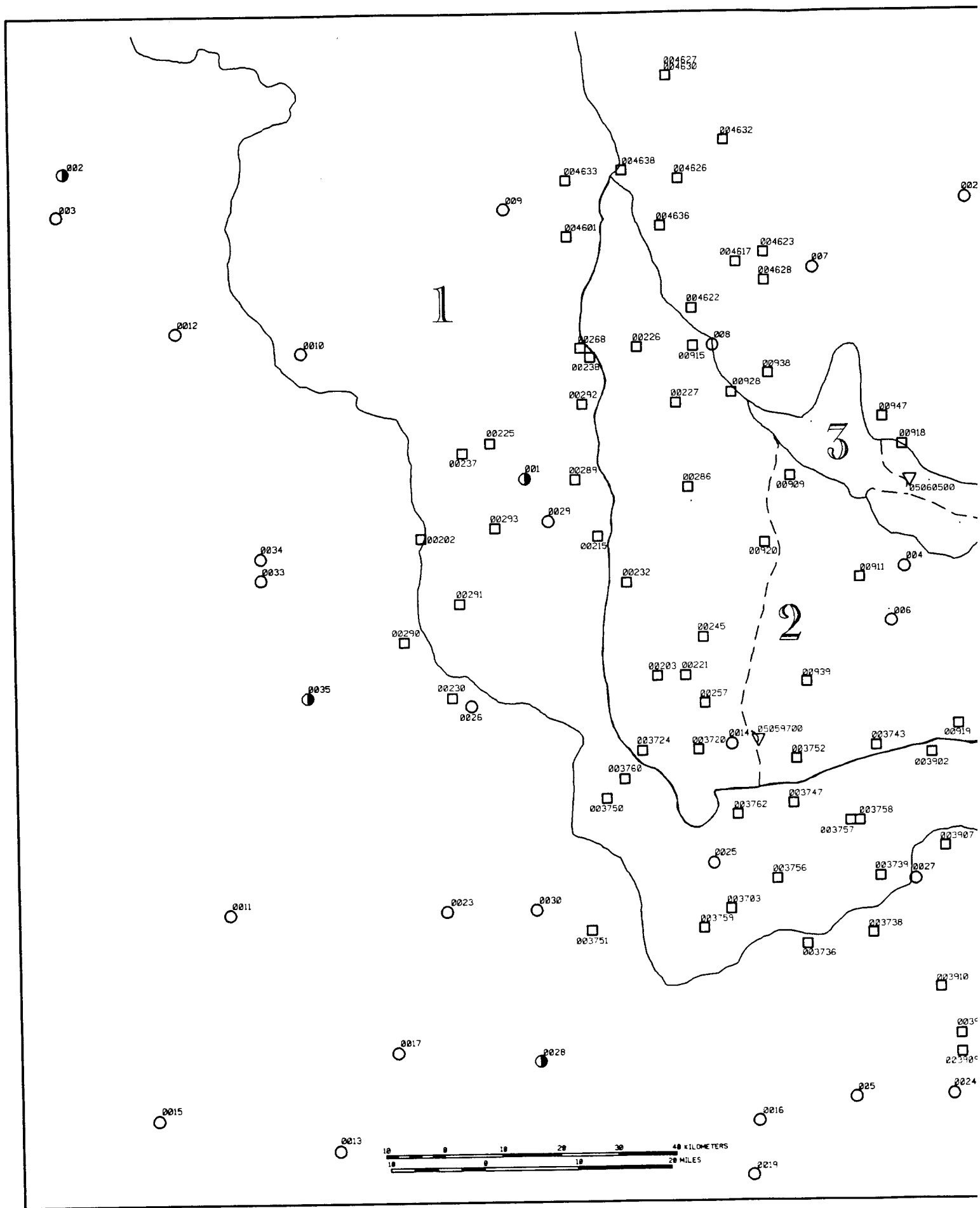
Produced by St. Paul District, SCS Center, U.S. Army Corps of Engineers, February 1994

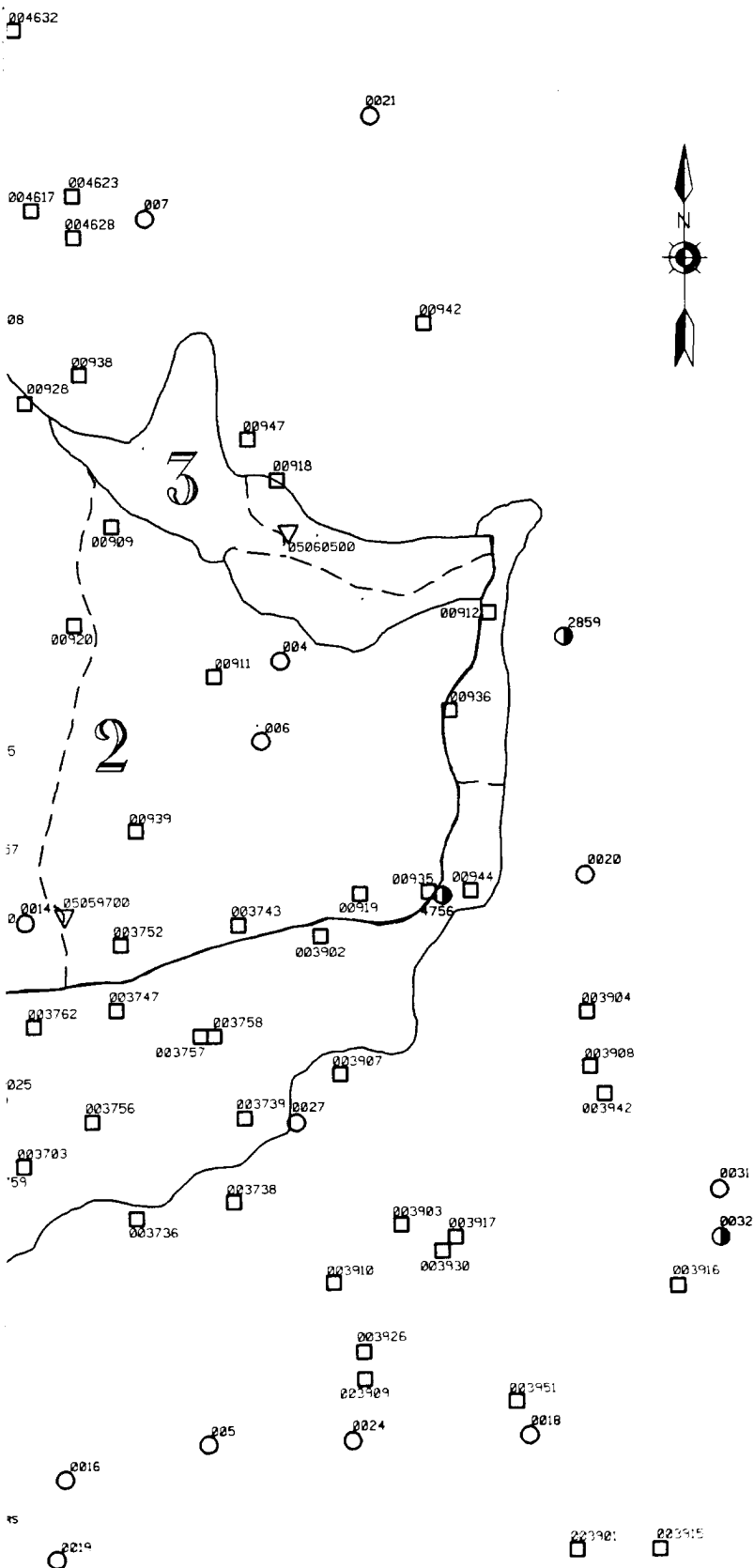
Isohyetal Map

Storm 21—
29 July 1993

Max: 11.67
Min: 0.00
Ave: 2.85
Units: inches







**1993 SUMMER FLOOD ANALYSIS
LOWER SHEYENNE RIVER BASIN
RAIN GAGE NETWORK**

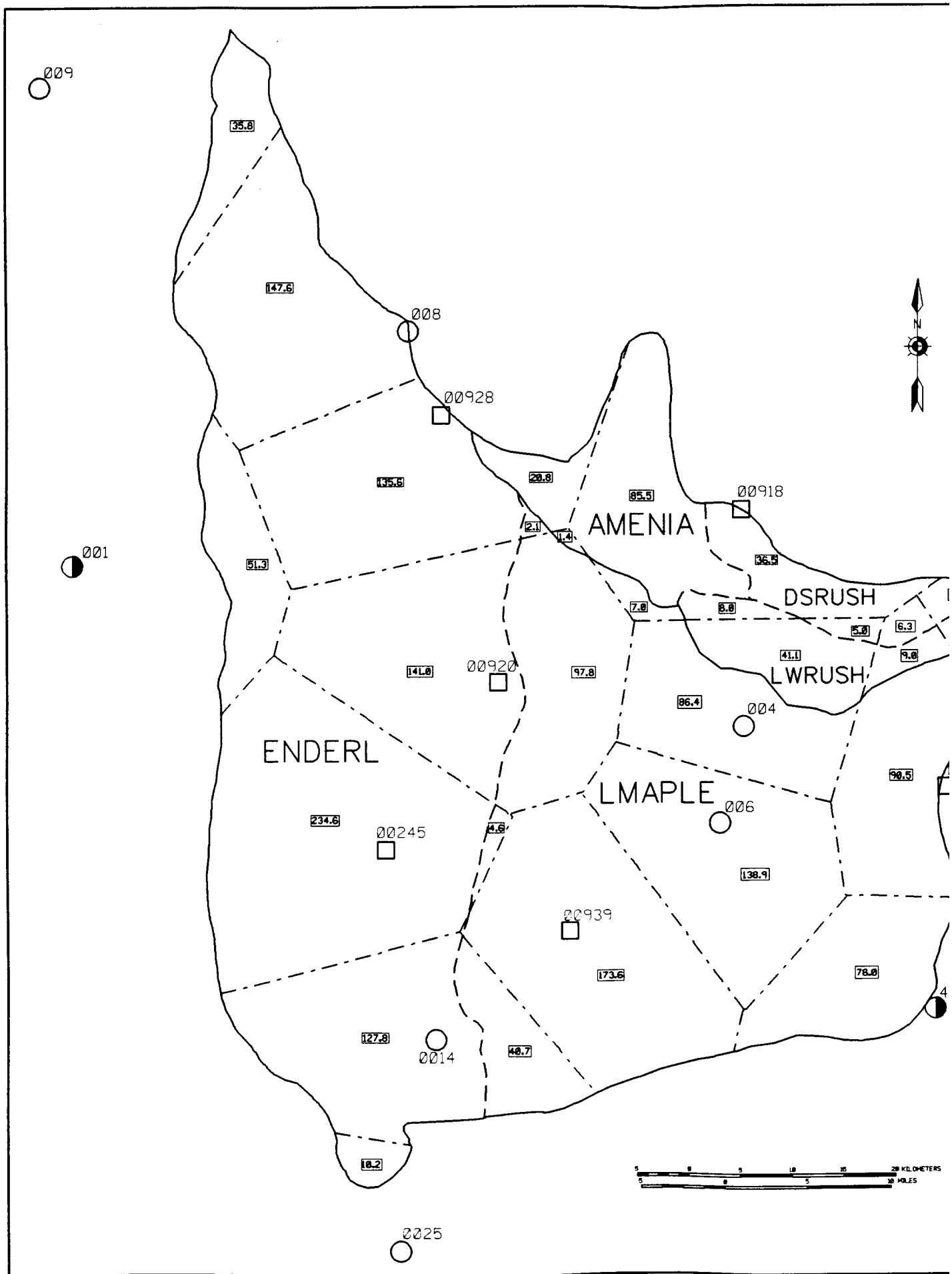
**SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS**

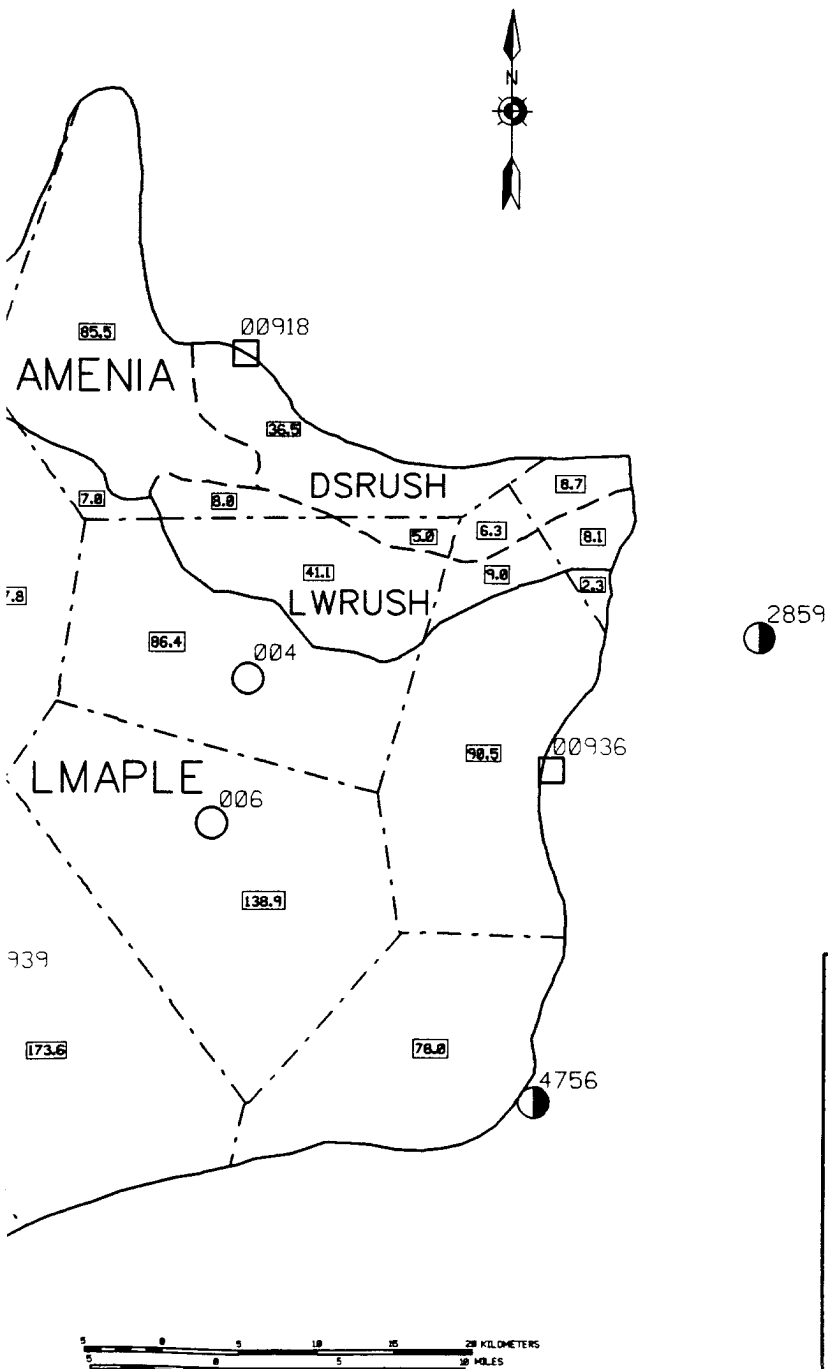
MAJOR WATERSHED BOUNDARY
MINOR WATERSHED BOUNDARY

U.S.G.S STATIONS ▽
N.W.S. CONTINUOUS RECORDING STATION ●
N.W.S. DAILY PRECIPITATION STATION ○
A.R.B. PRECIPITATION STATION □

SHEYENNE RIVER WATERSHED 1
MAPLE RIVER WATERSHED 2
RUSH RIVER WATERSHED 3

 Produced by St. Paul District, GIS Center, U.S. Army Corps of Engineers, February 1994.





**1993 SUMMER FLOOD ANALYSIS
LOWER SHEYENNE RIVER BASIN
THIESSEN POLYGON**

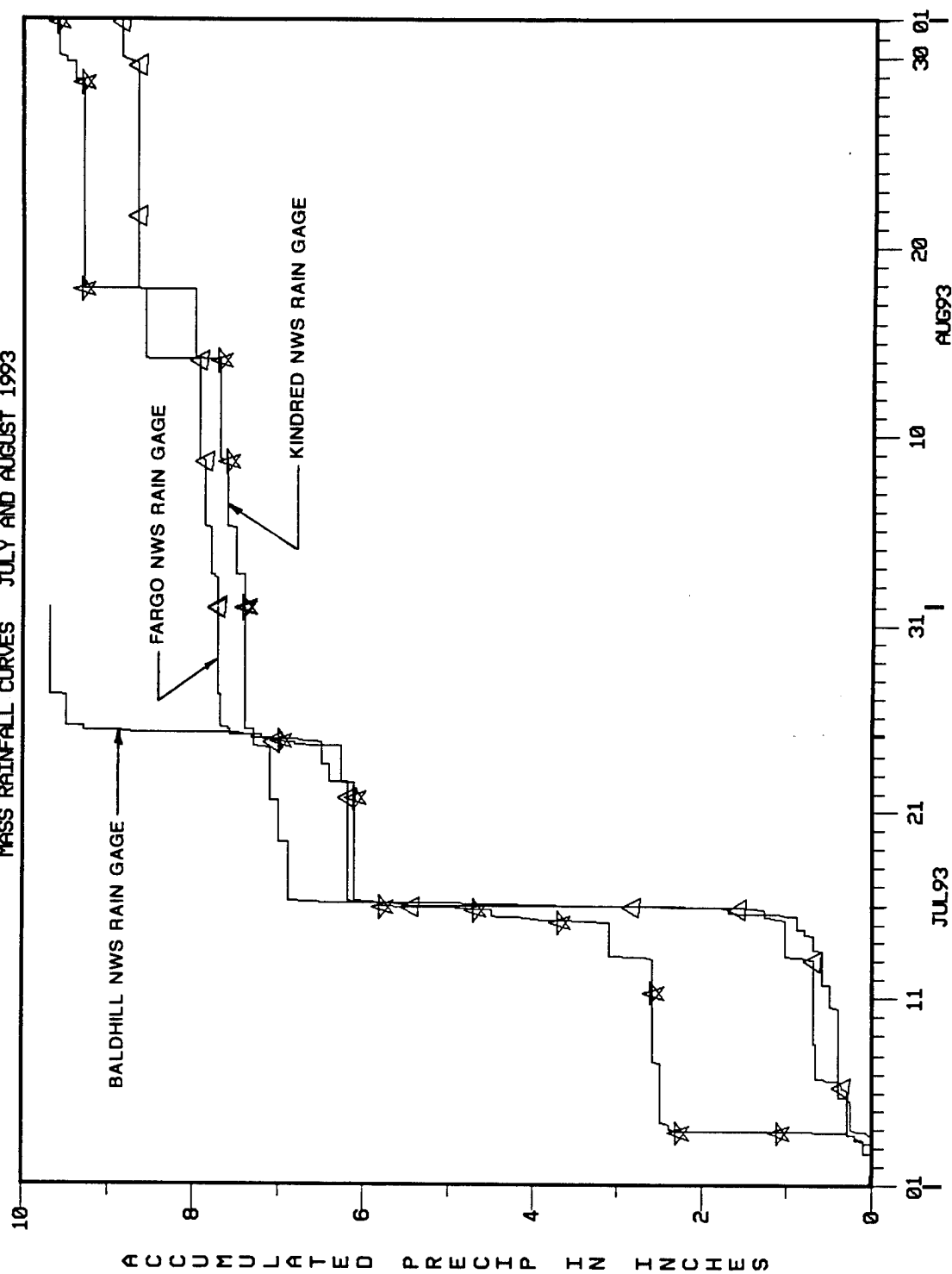
**SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS**

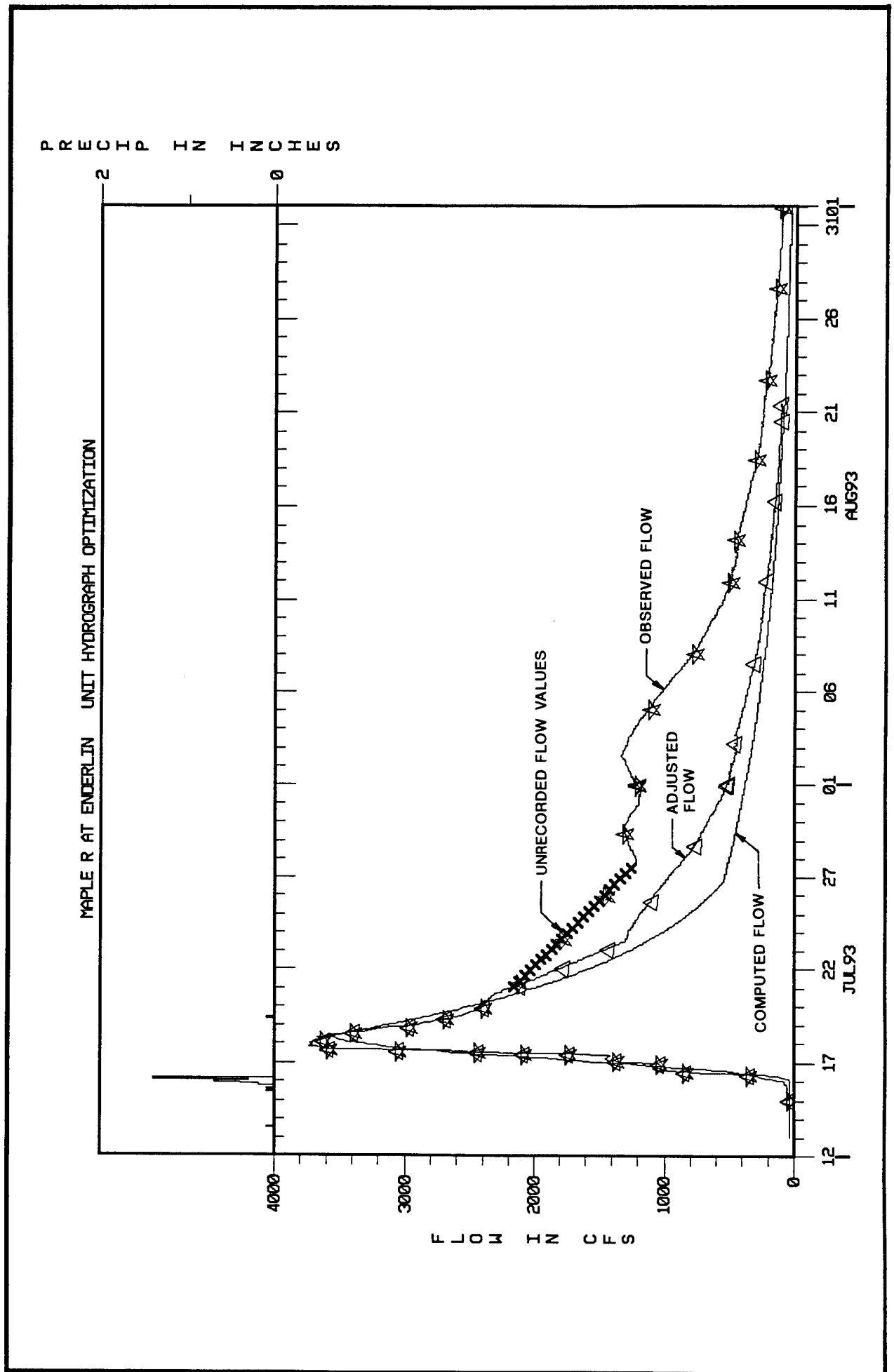
MAJOR WATERSHED BOUNDARY
 MINOR WATERSHED BOUNDARY
 THIESSEN POLYGON BOUNDARY
 POLYGON AREA MEASUREMENTS (SQUARE MILES)

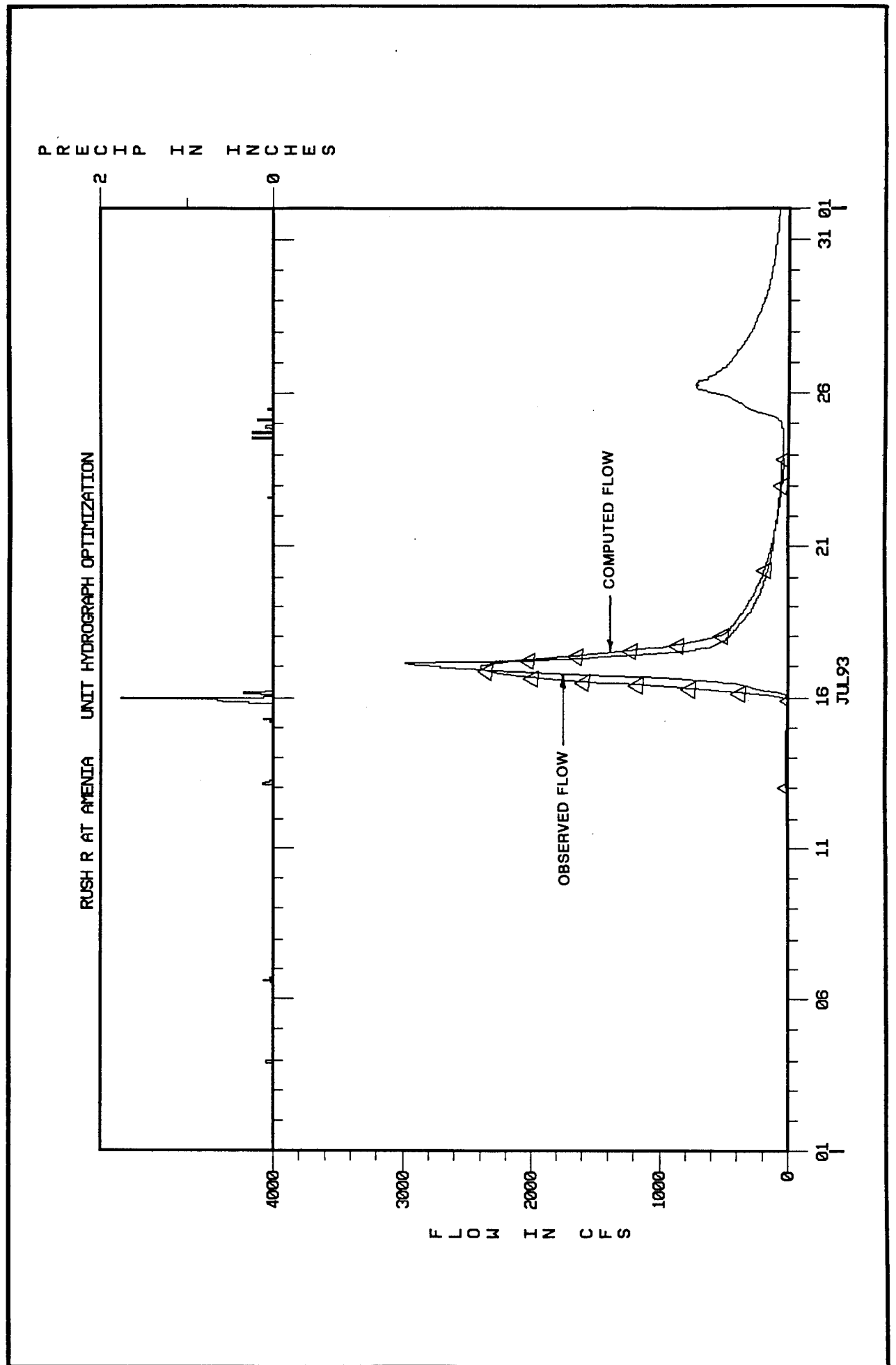
U.S.G.S STATIONS ▽
 N.W.S. CONTINUOUS RECORDING STATION ●
 N.W.S. DAILY PRECIPITATION STATION ○
 A.R.B. PRECIPITATION STATION □

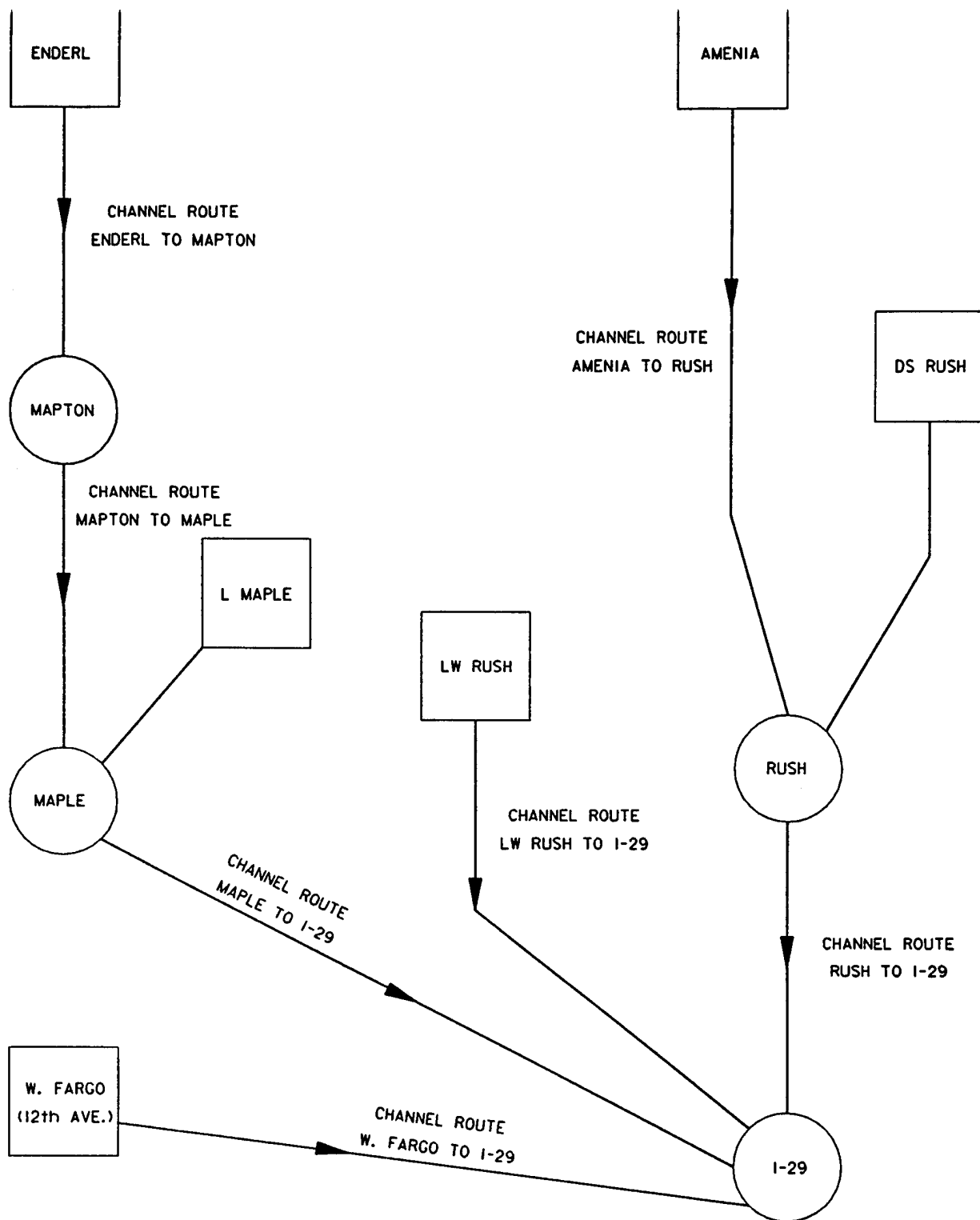
 Produced by St. Paul District GIS Center, U.S. Army Corps of Engineers, February 1994.

MASS RAINFALL CURVES JULY AND AUGUST 1993

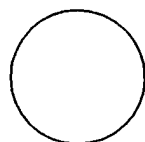








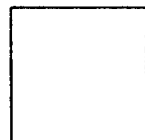
LEGEND



COMBINING
OPERATION

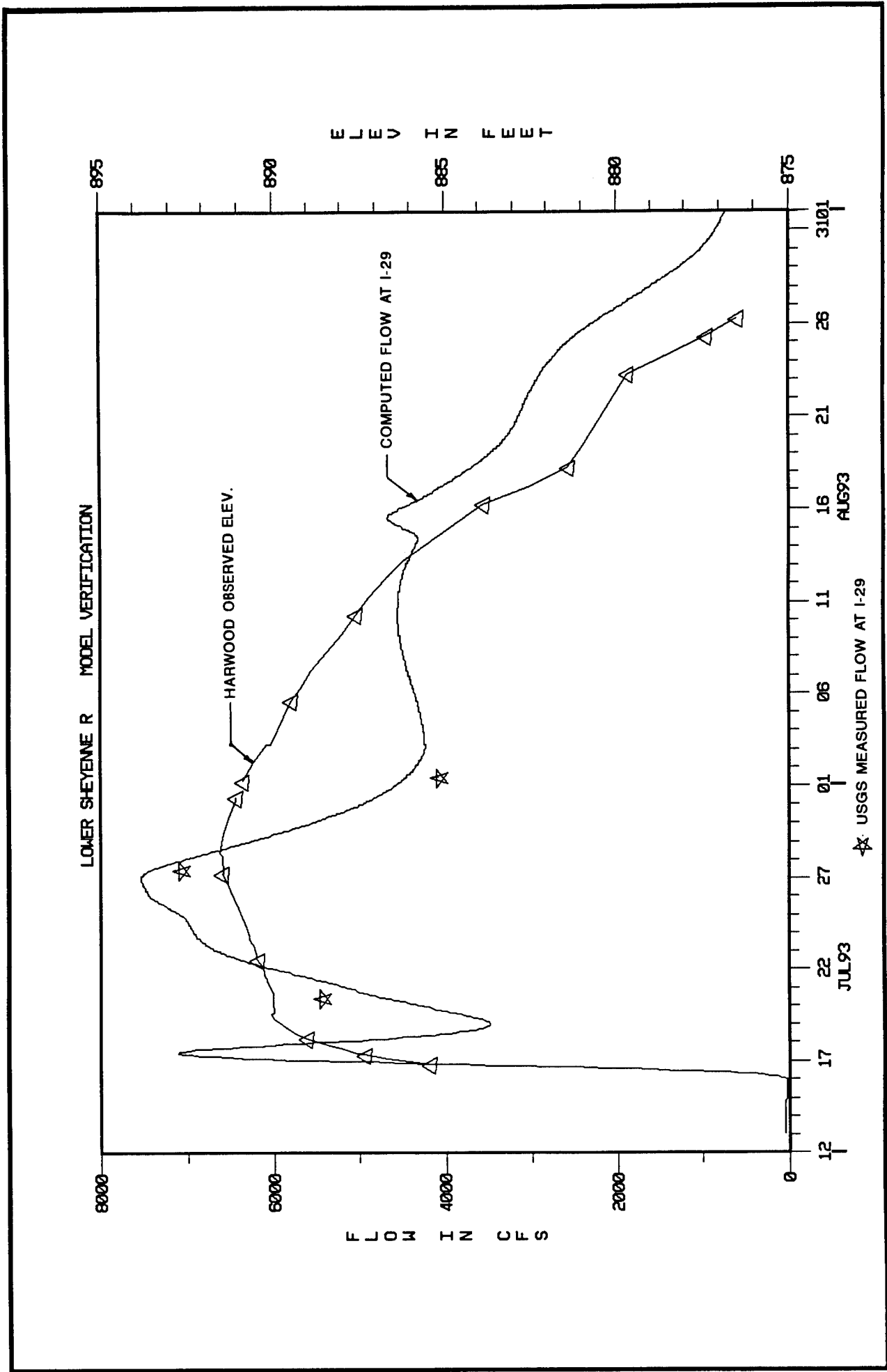


ROUTING
OPERATION

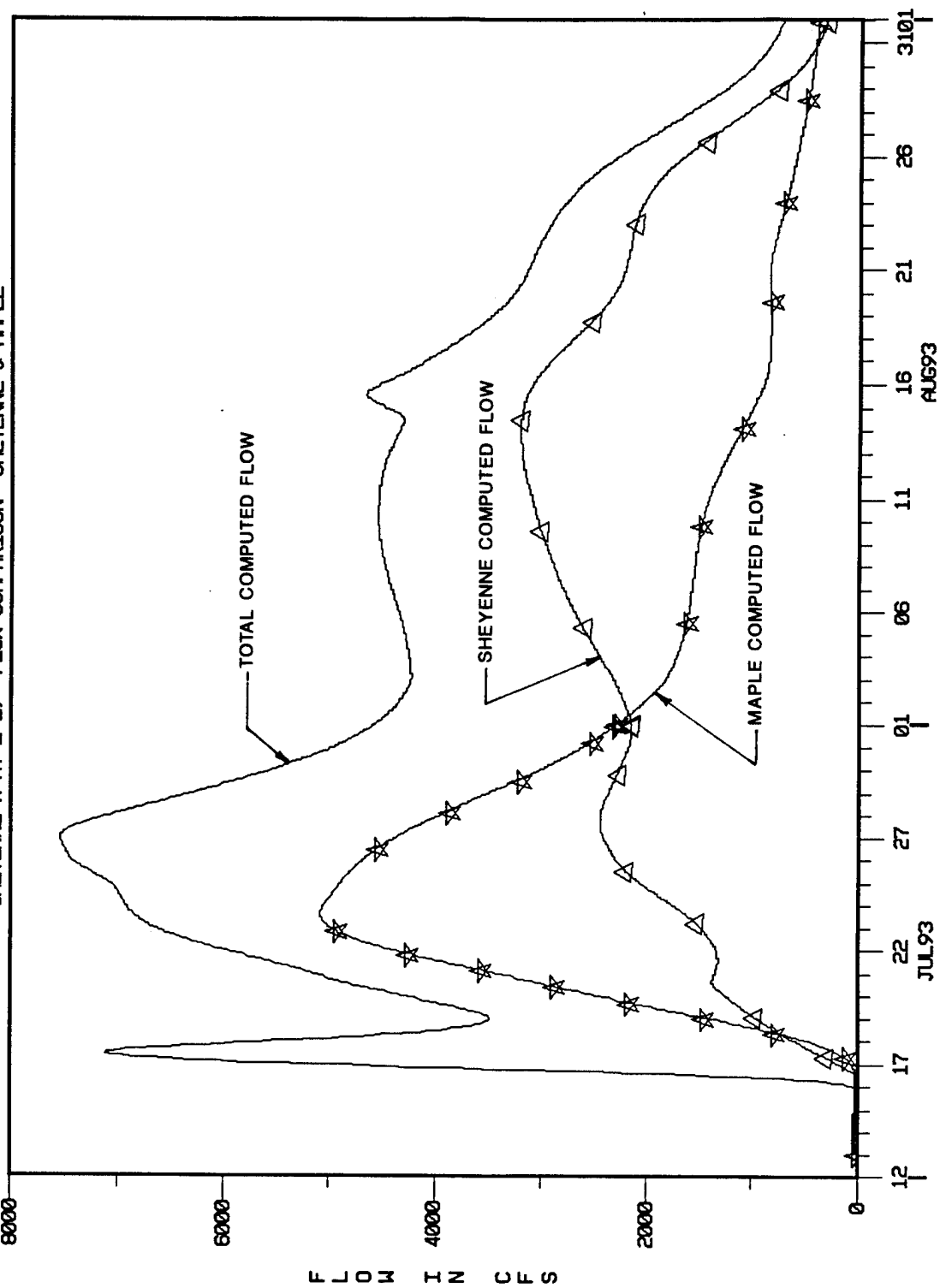


SUB-BASIN
RUNOFF

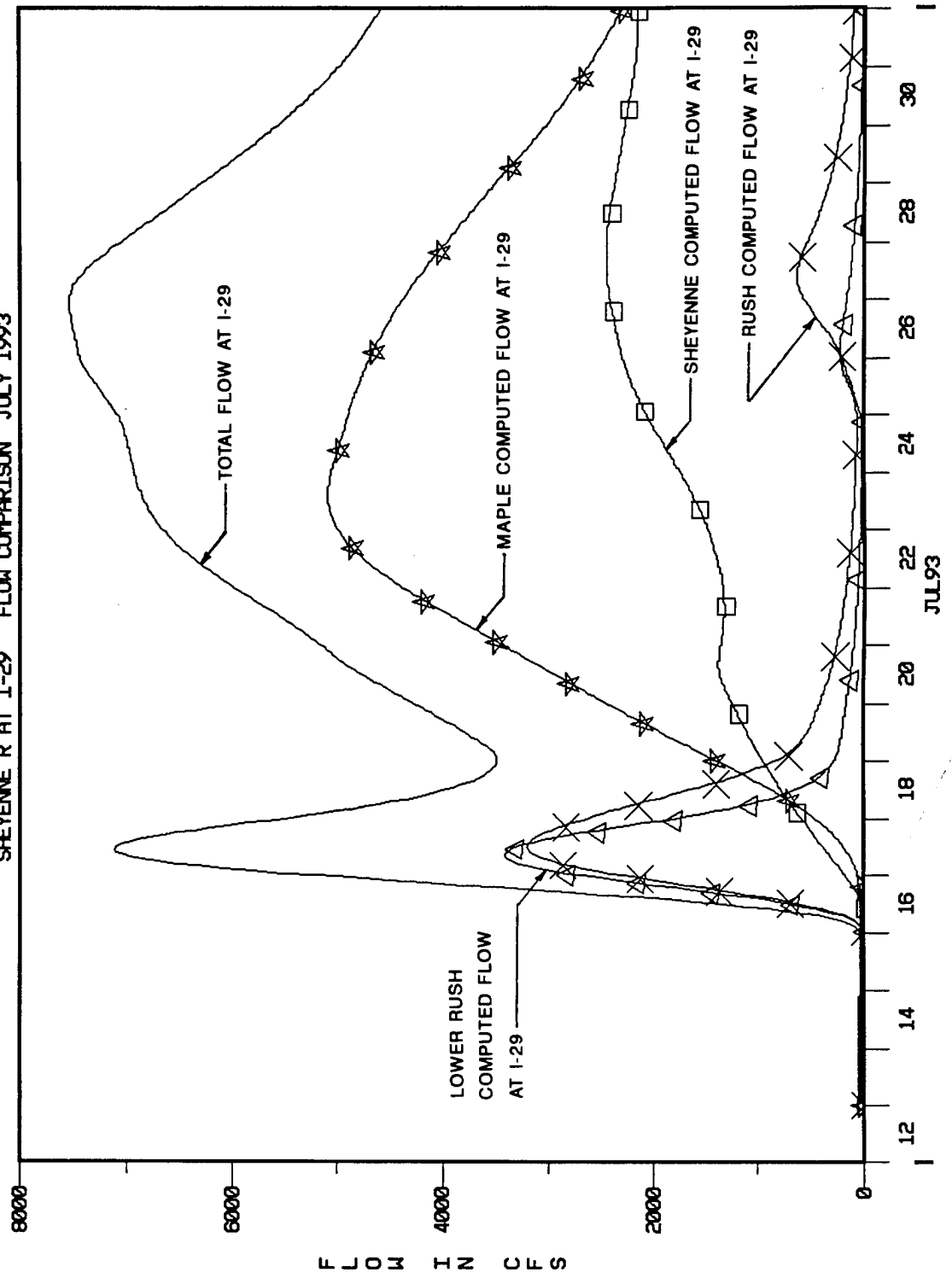
1993 SUMMER FLOOD ANALYSIS
LOWER SHEYENNE RIVER BASIN
STREAM NETWORK
MODEL SCHEMATIC
SHEYENNE RIVER FLOOD CONTROL PROJECT
ST. PAUL DISTRICT CORPS OF ENGINEERS
MARCH 1994



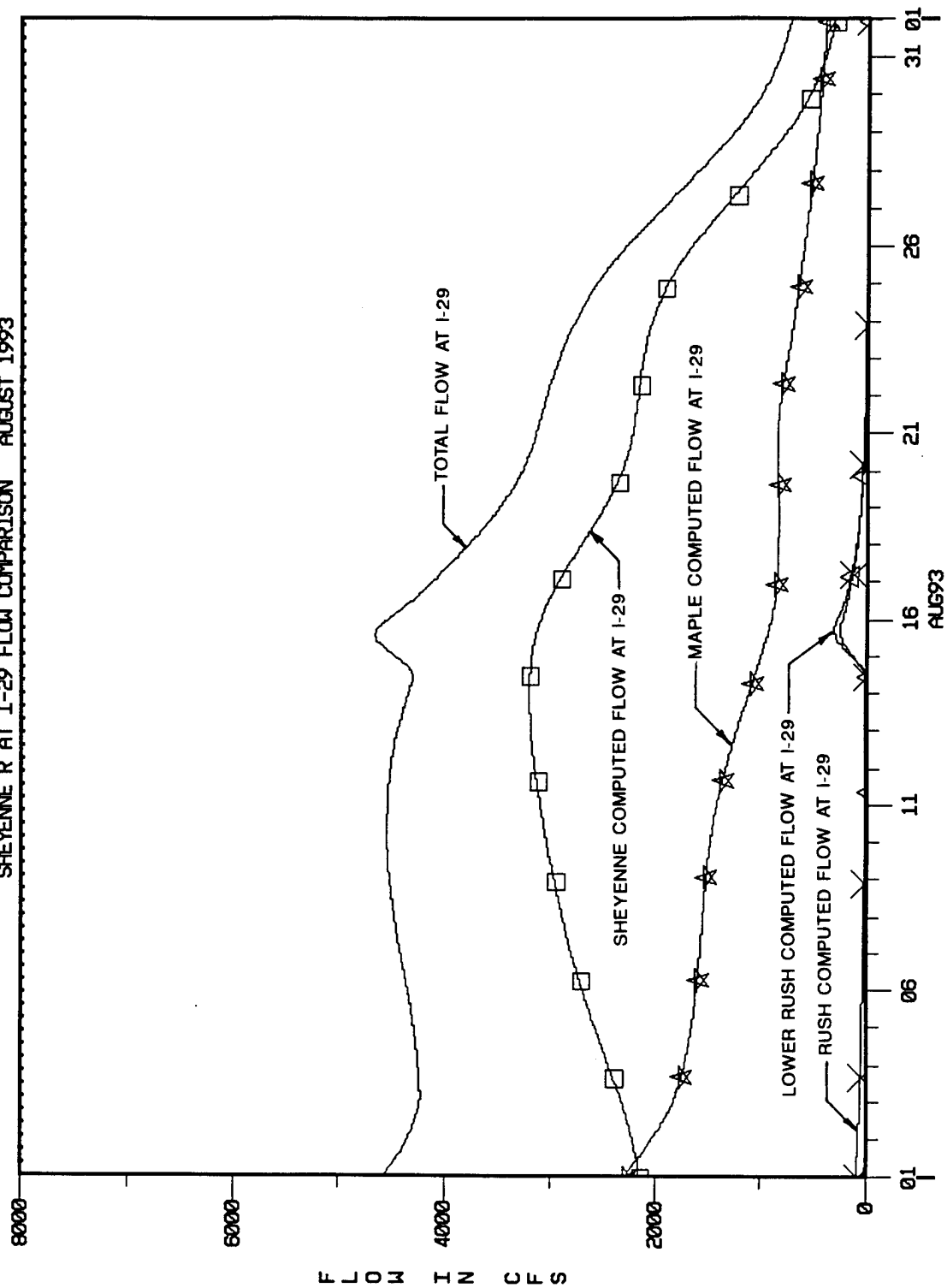
SHEYENNE R AT I-29 FLOW COMPARISON SHEYENNE & MAPLE

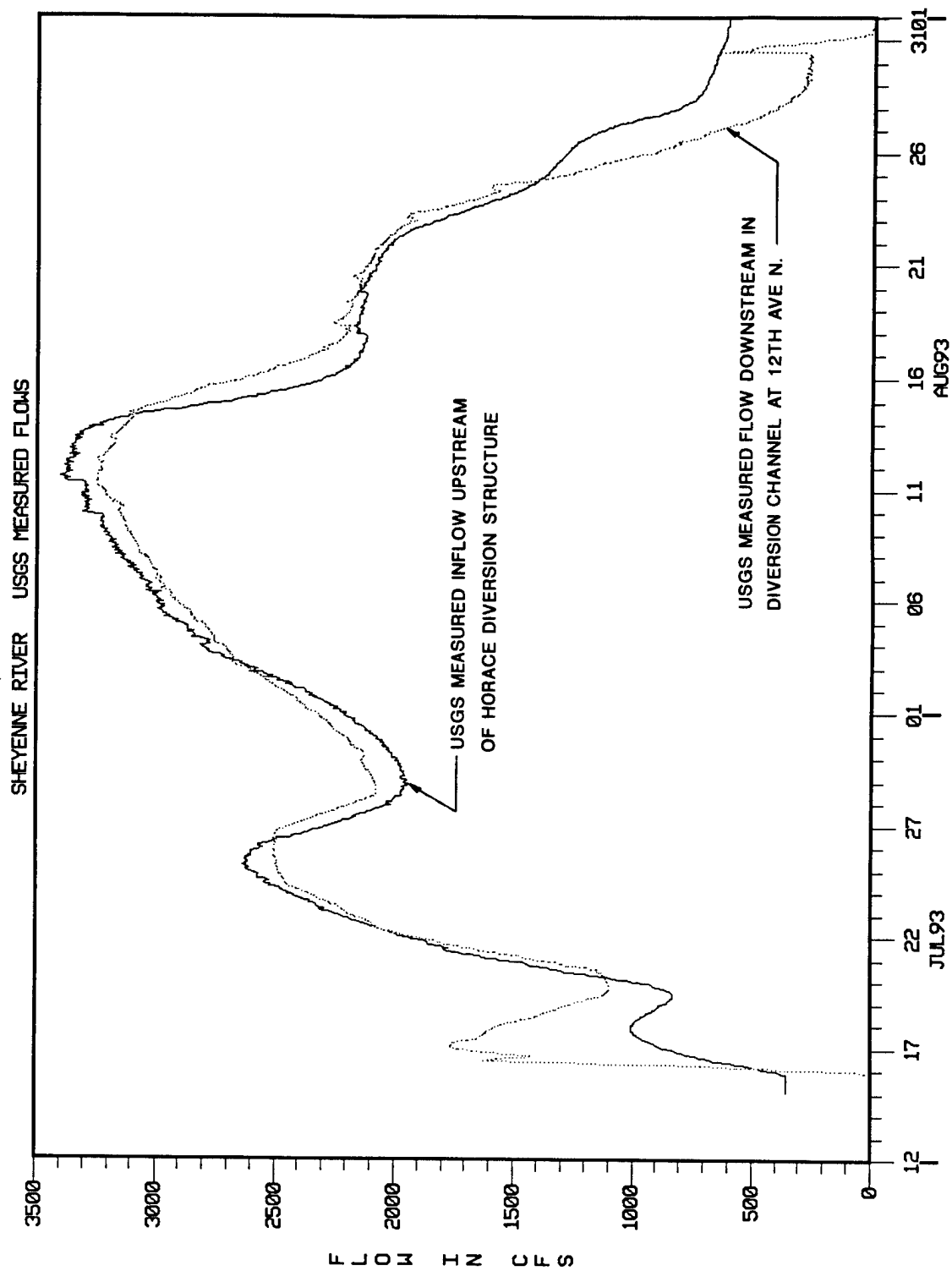


SHEYENNE R AT I-29 FLOW COMPARISON JULY 1993

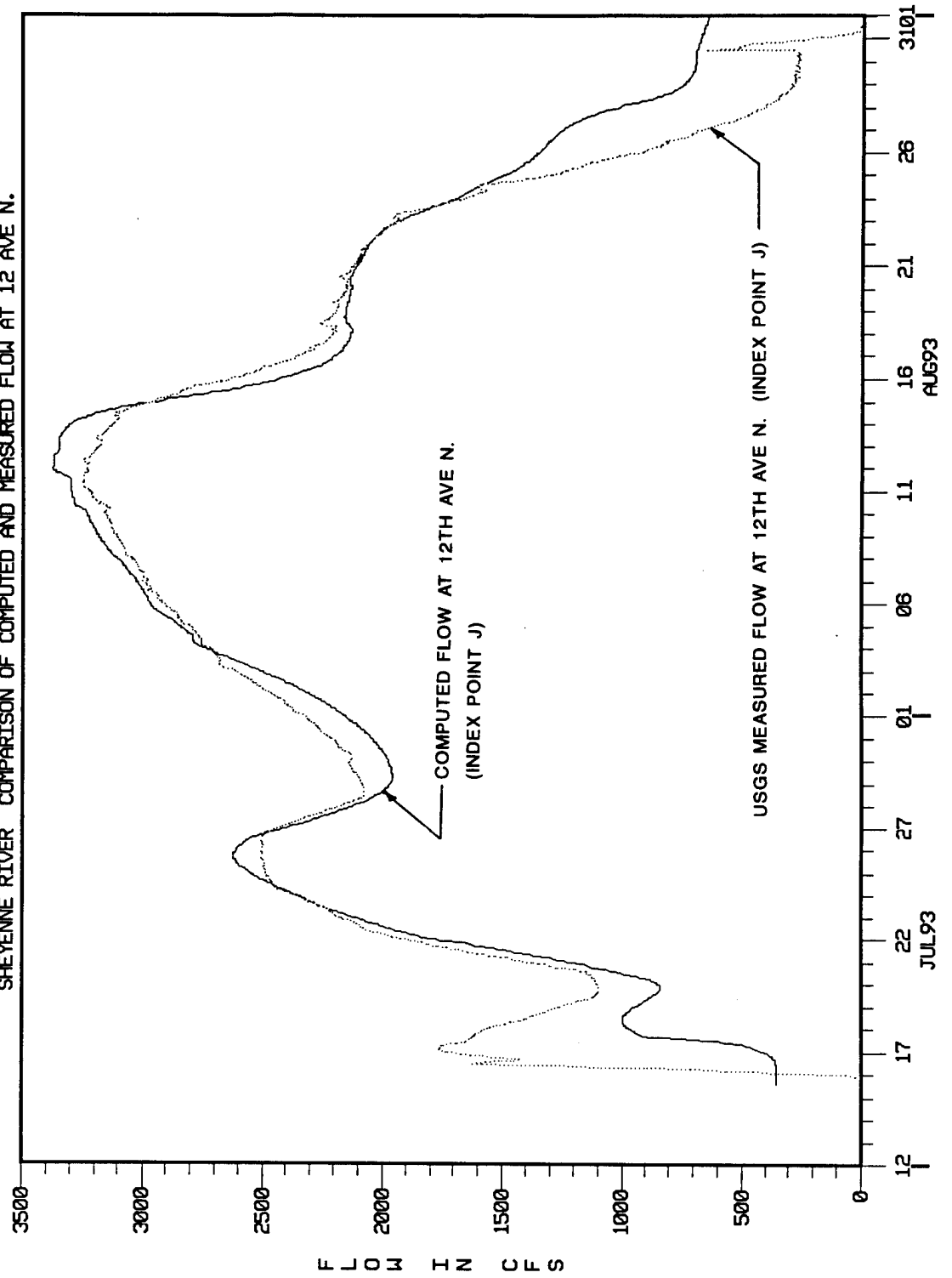


SHEYENNE R AT I-29 FLOW COMPARISON AUGUST 1993

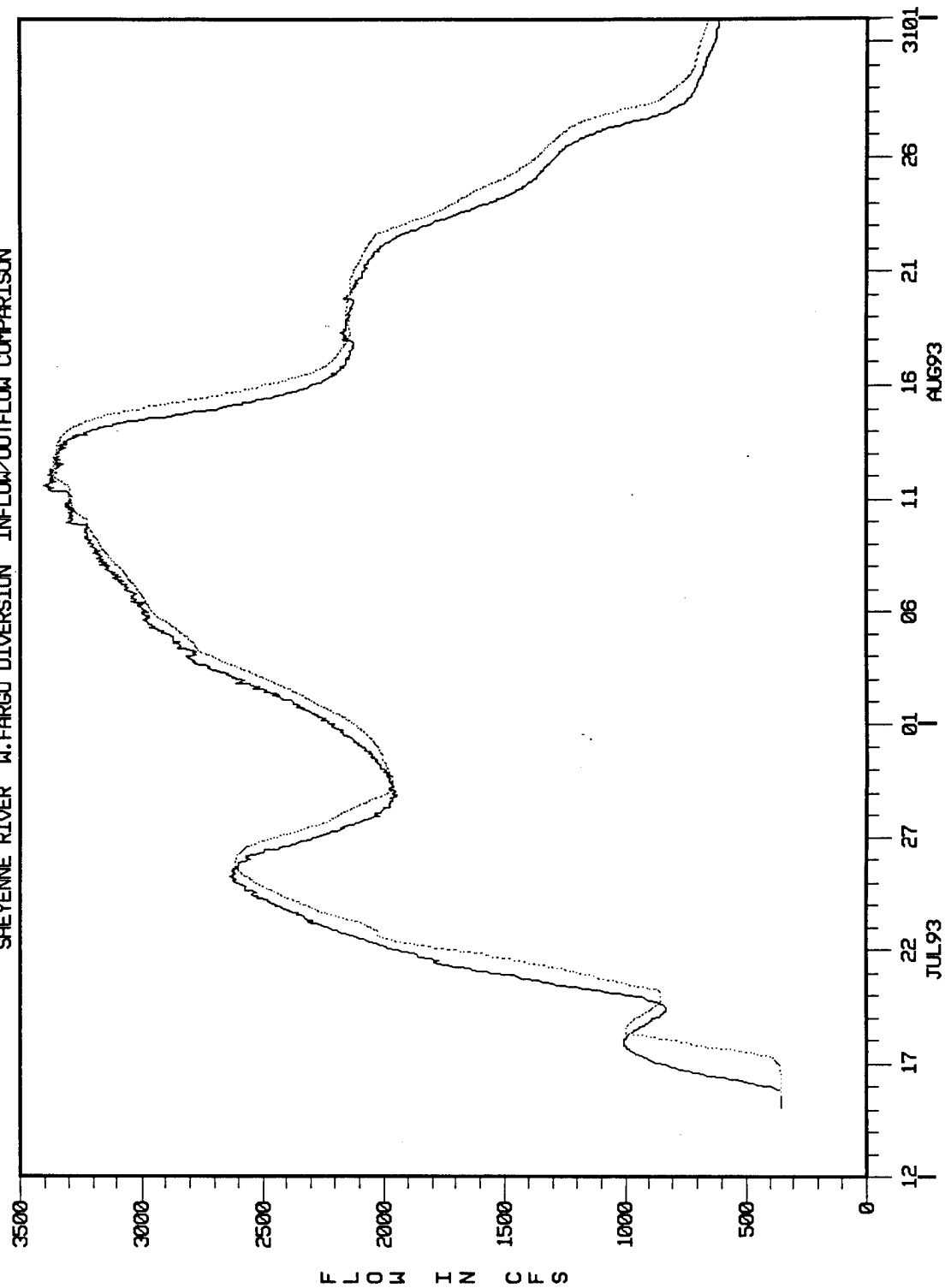




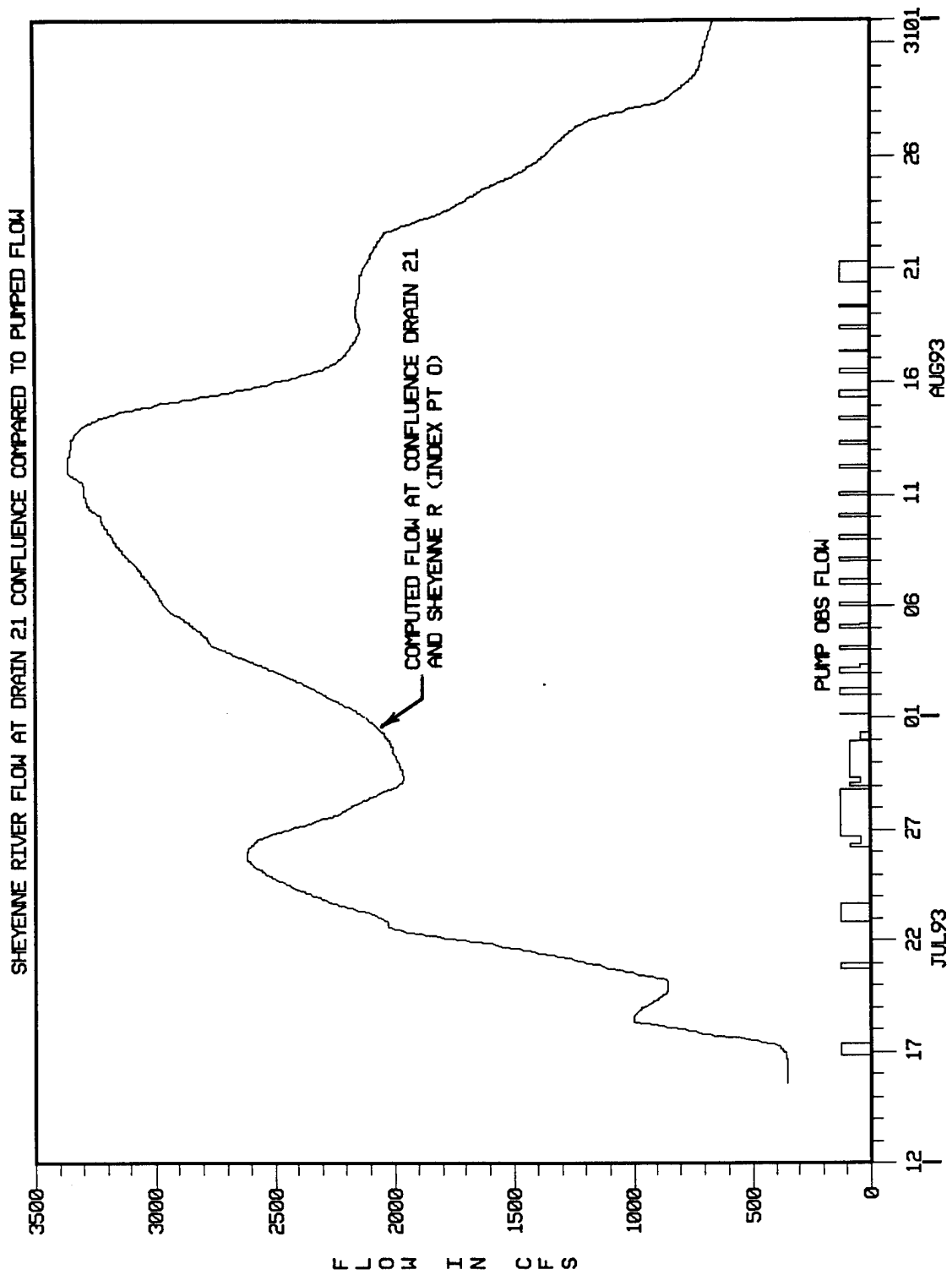
SHEYENNE RIVER COMPARISON OF COMPUTED AND MEASURED FLOW AT 12 AVE N.



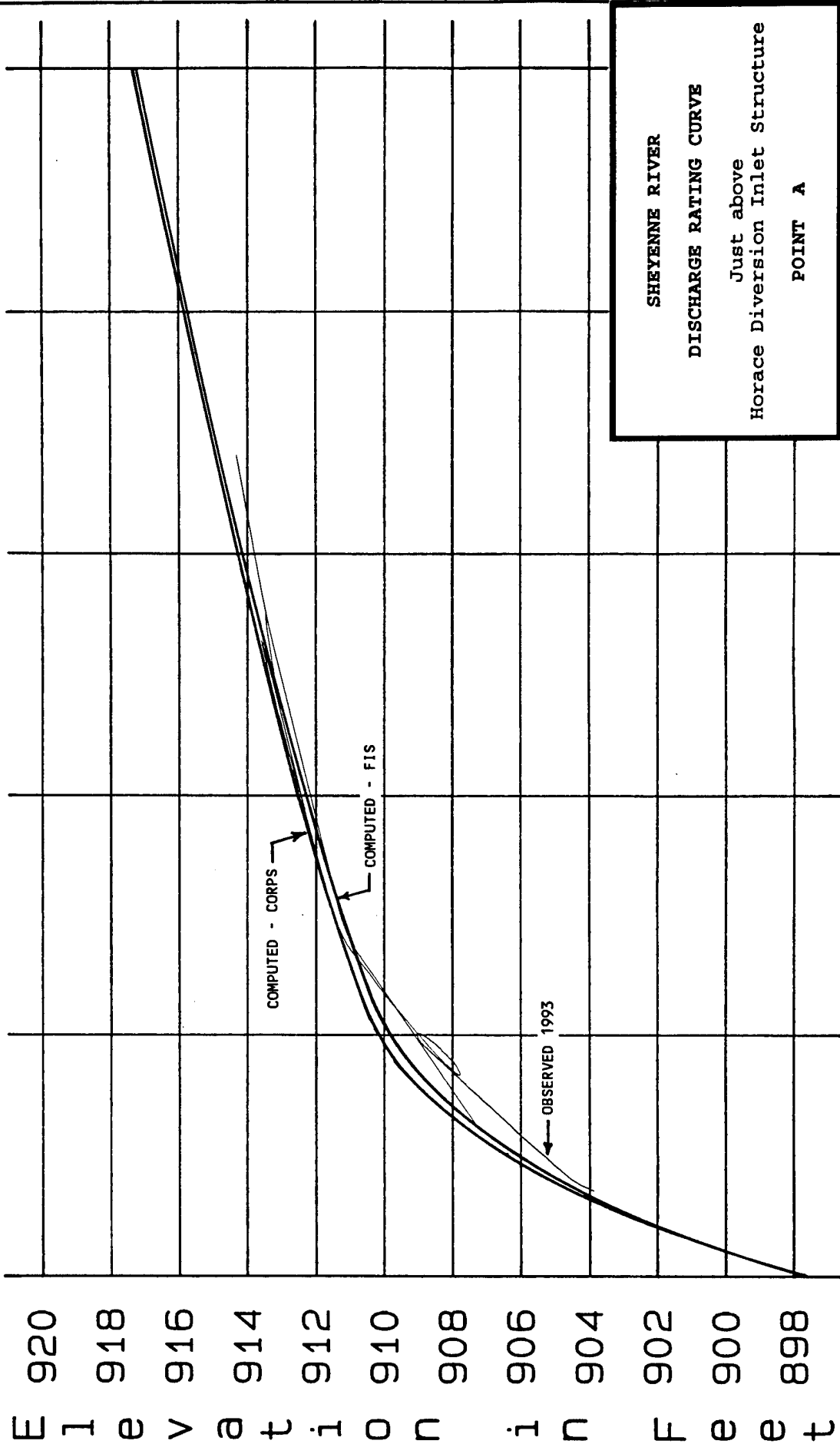
SHEYENNE RIVER W. FARGO DIVERSION INFLOW/OUTFLOW COMPARISON



_____ USGS MEASURED INFLOW UPSTREAM OF HORACE DIVERSION STRUCTURE
 OUTFLOW DOWNSTREAM OF DIVERSION CHANNEL (INDEX POINT 0)

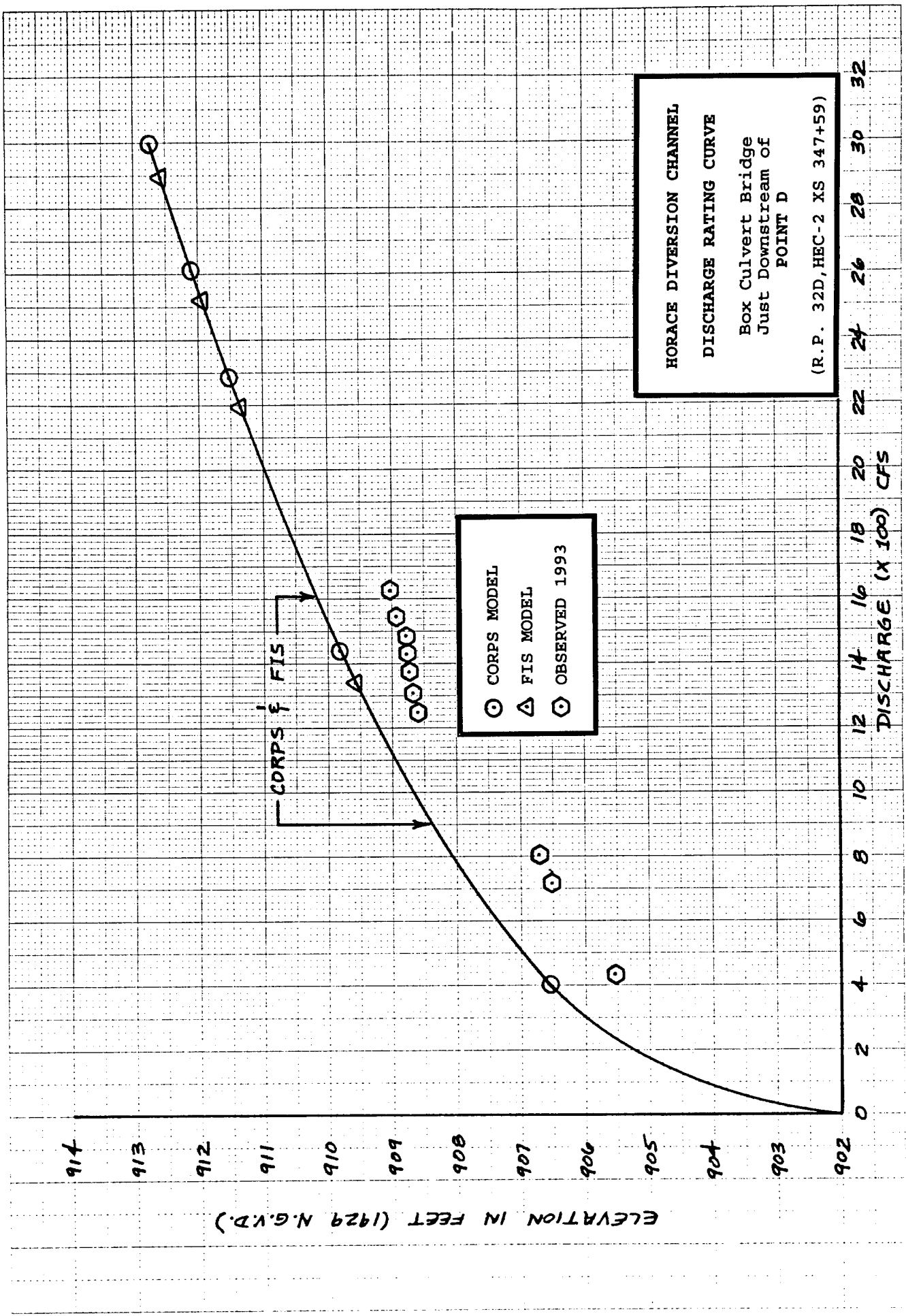


Sheyenne River above Horace



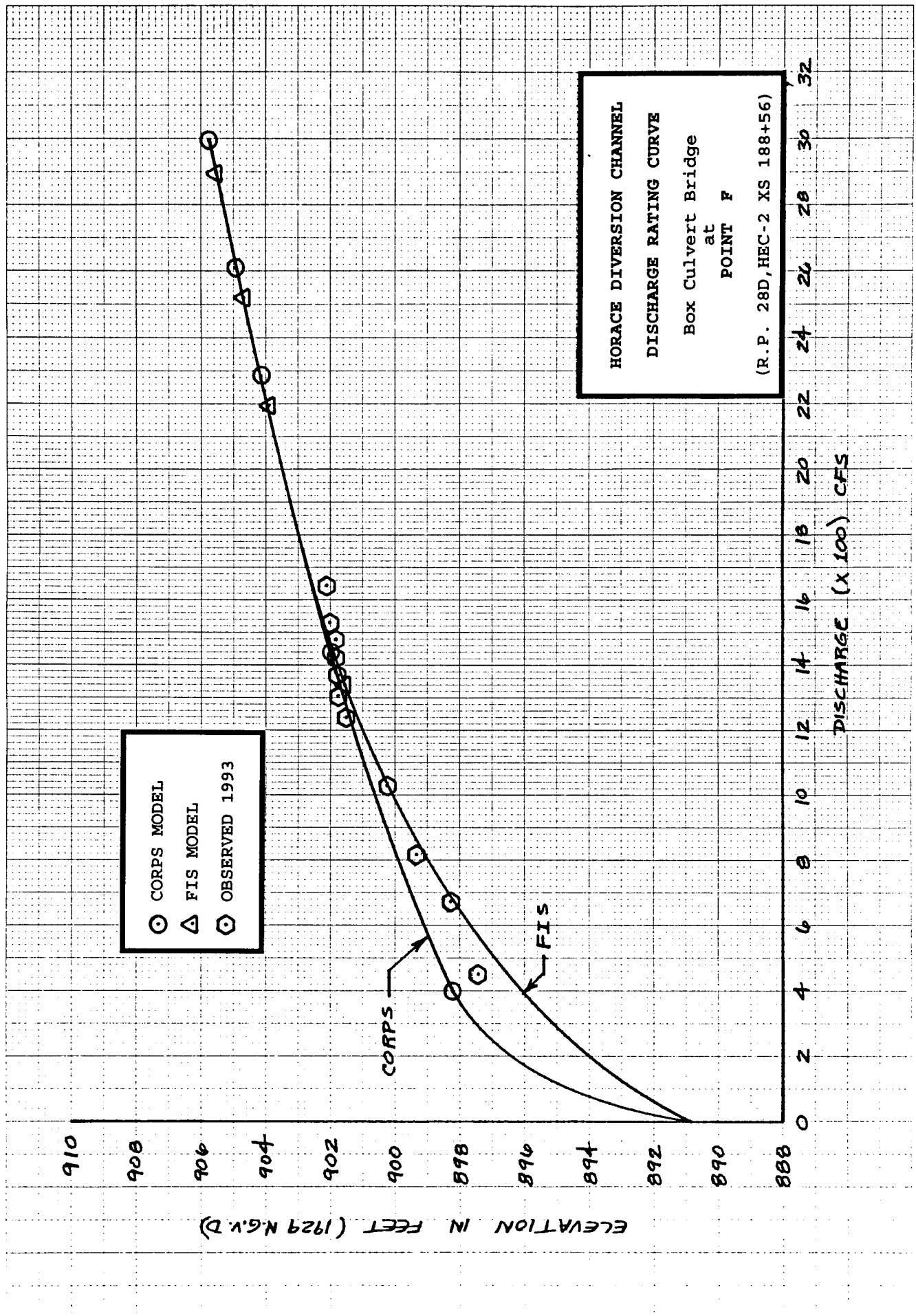
SHEYENNE RIVER
DISCHARGE RATING CURVE
Just above
Horace Diversion Inlet Structure
POINT A

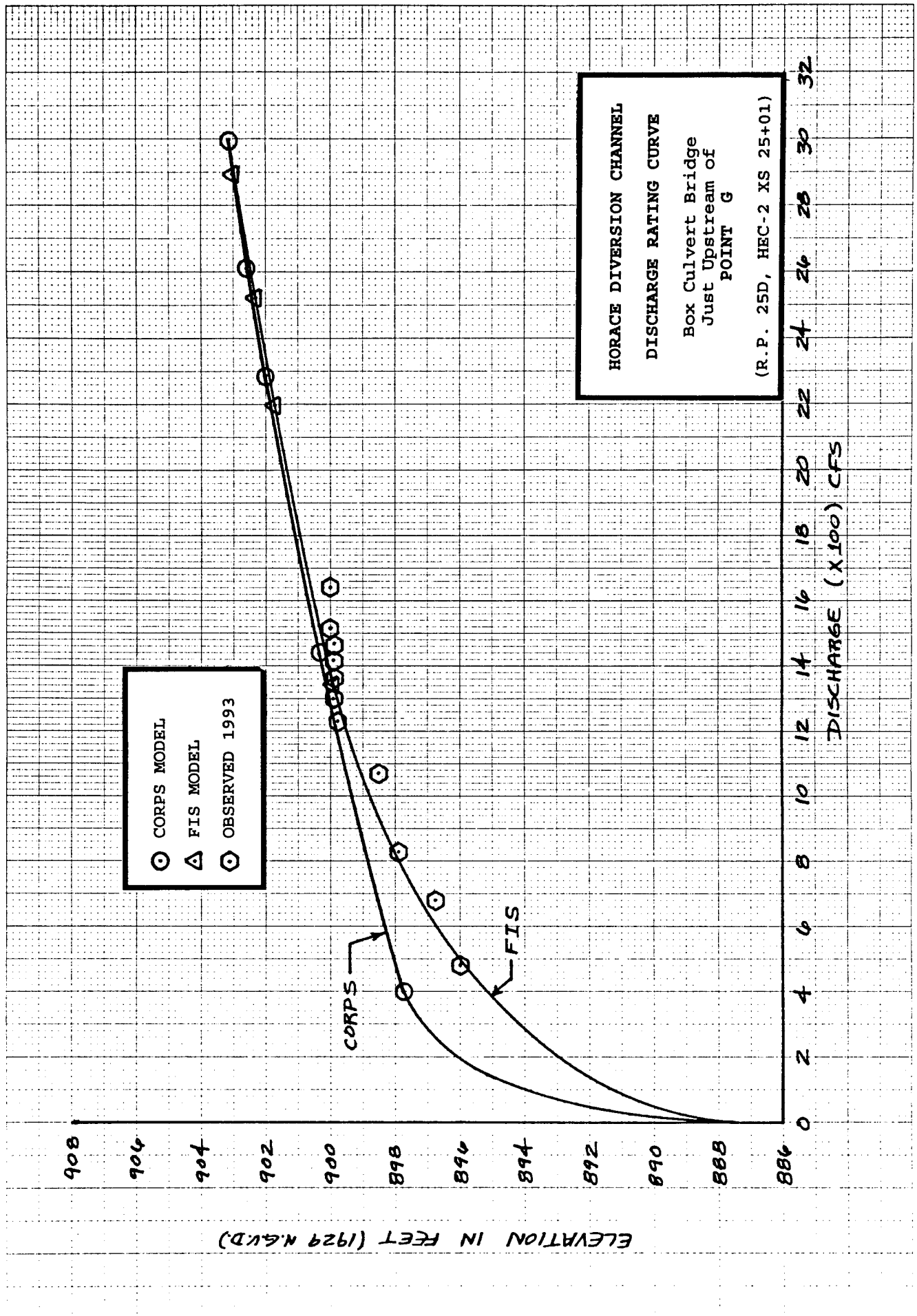
Discharge in CFS

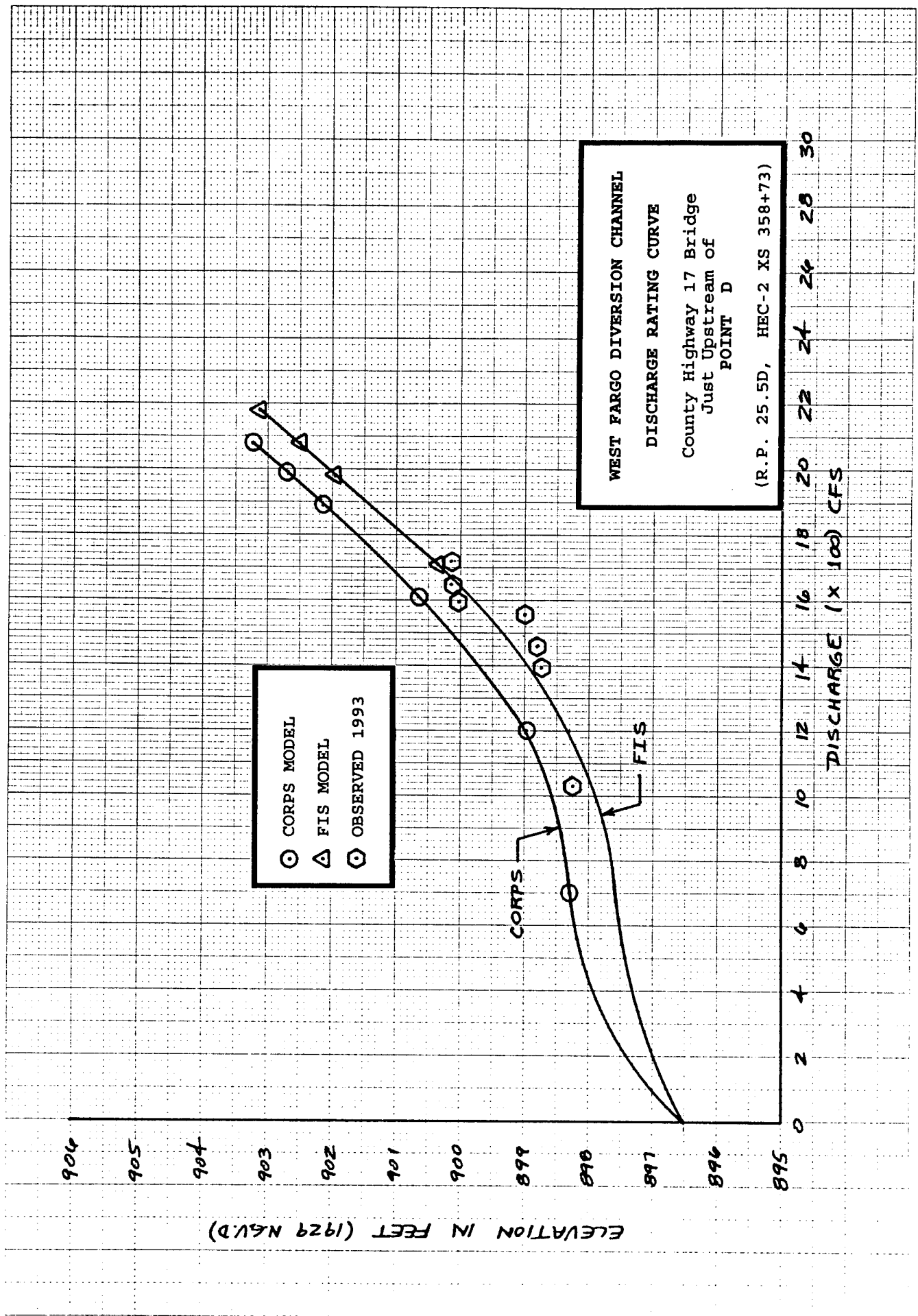


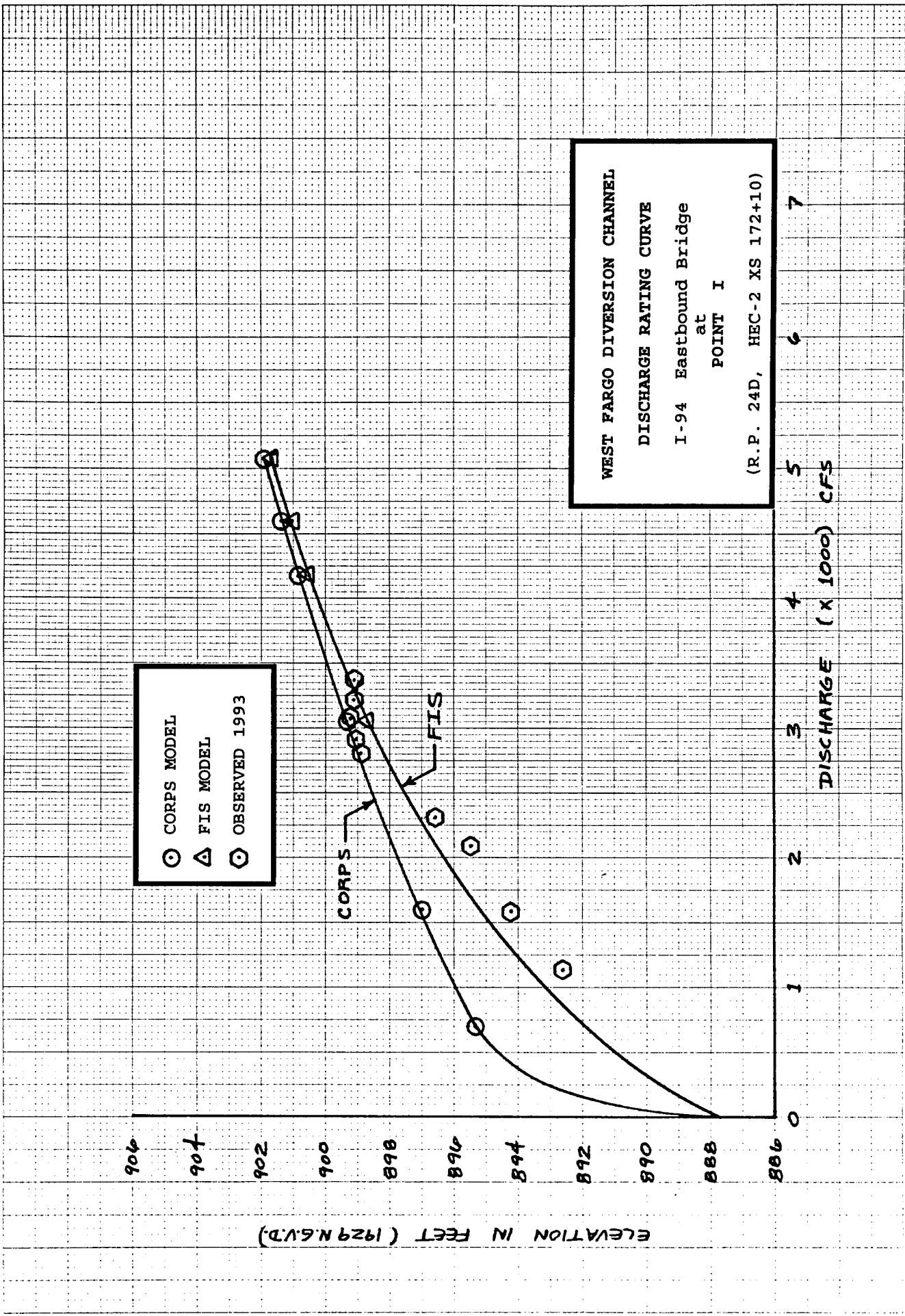
HORACE DIVERSION CHANNEL
DISCHARGE RATING CURVE
Box Culvert Bridge
Just Downstream of
POINT D
(R.P. 32D, HEC-2 XS 347+59)

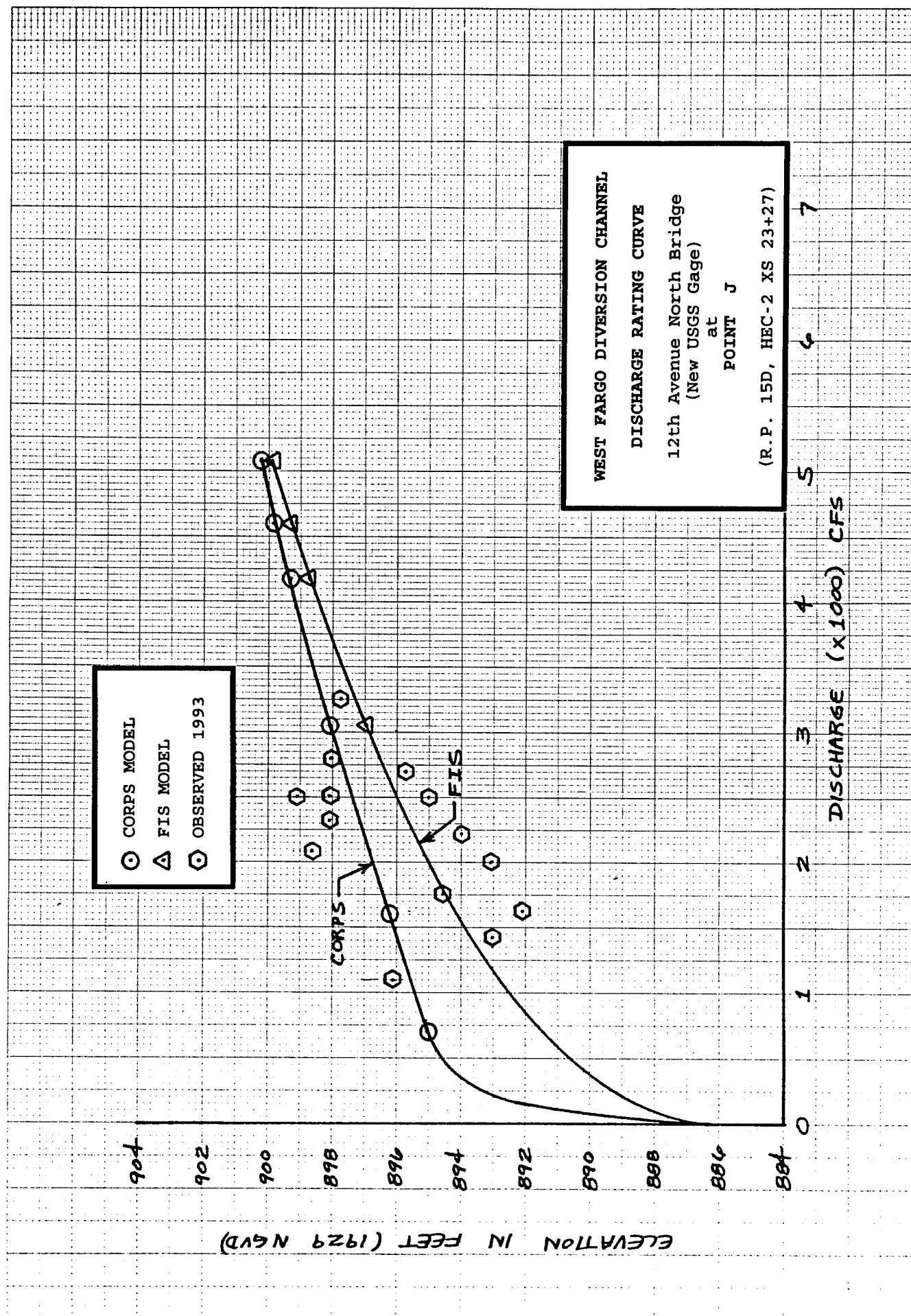
○ CORPS MODEL
△ FIS MODEL
⬡ OBSERVED 1993

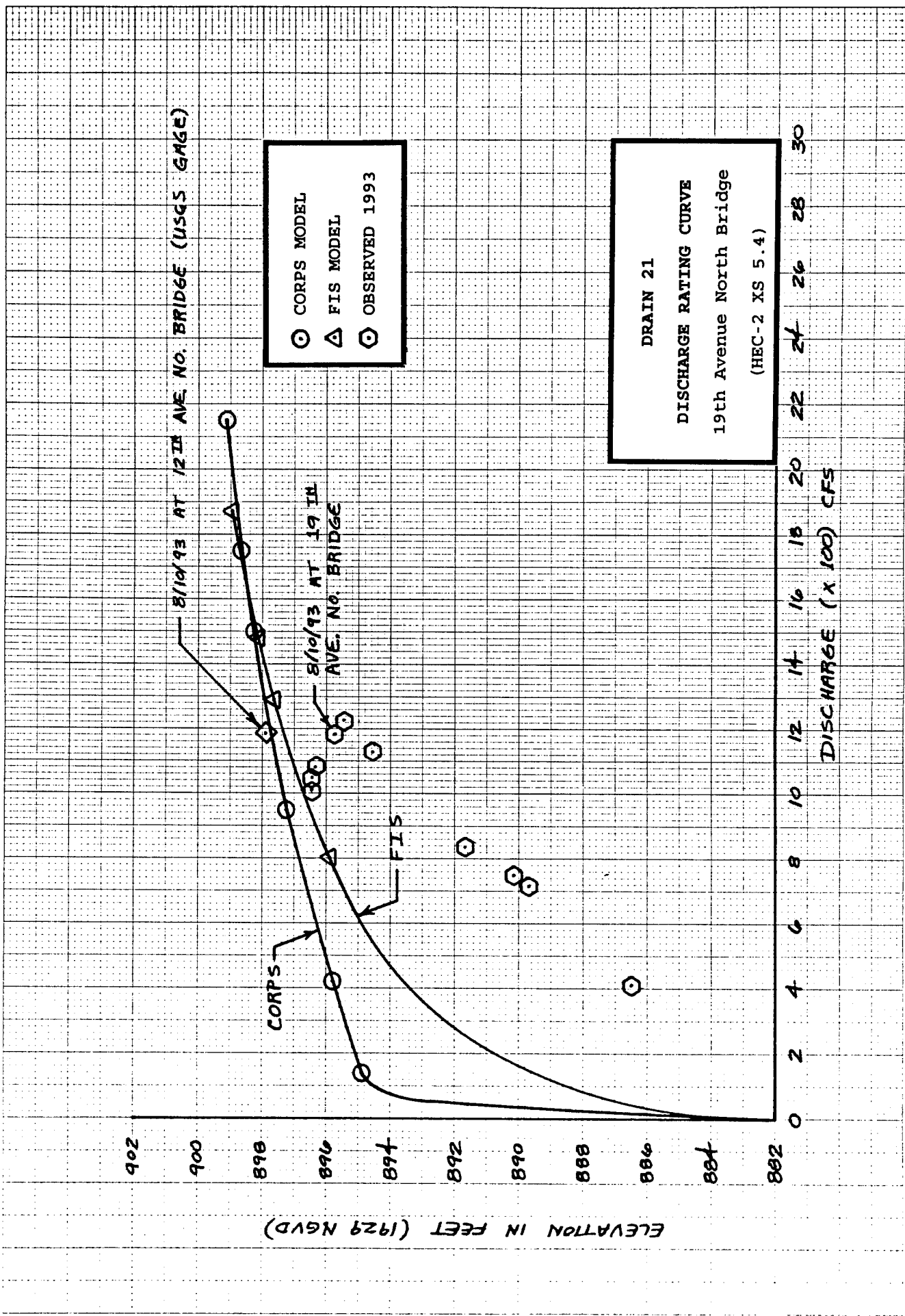


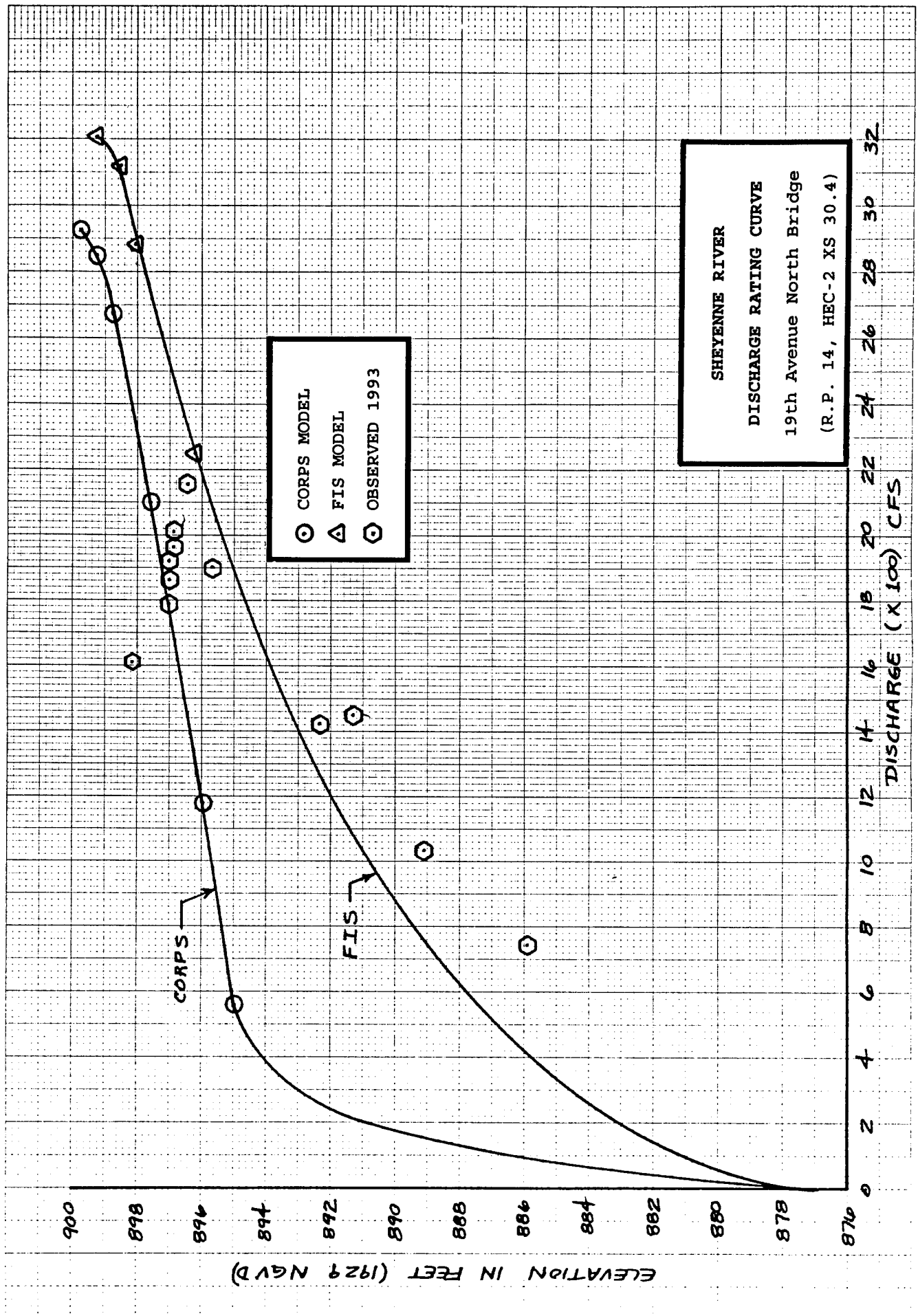


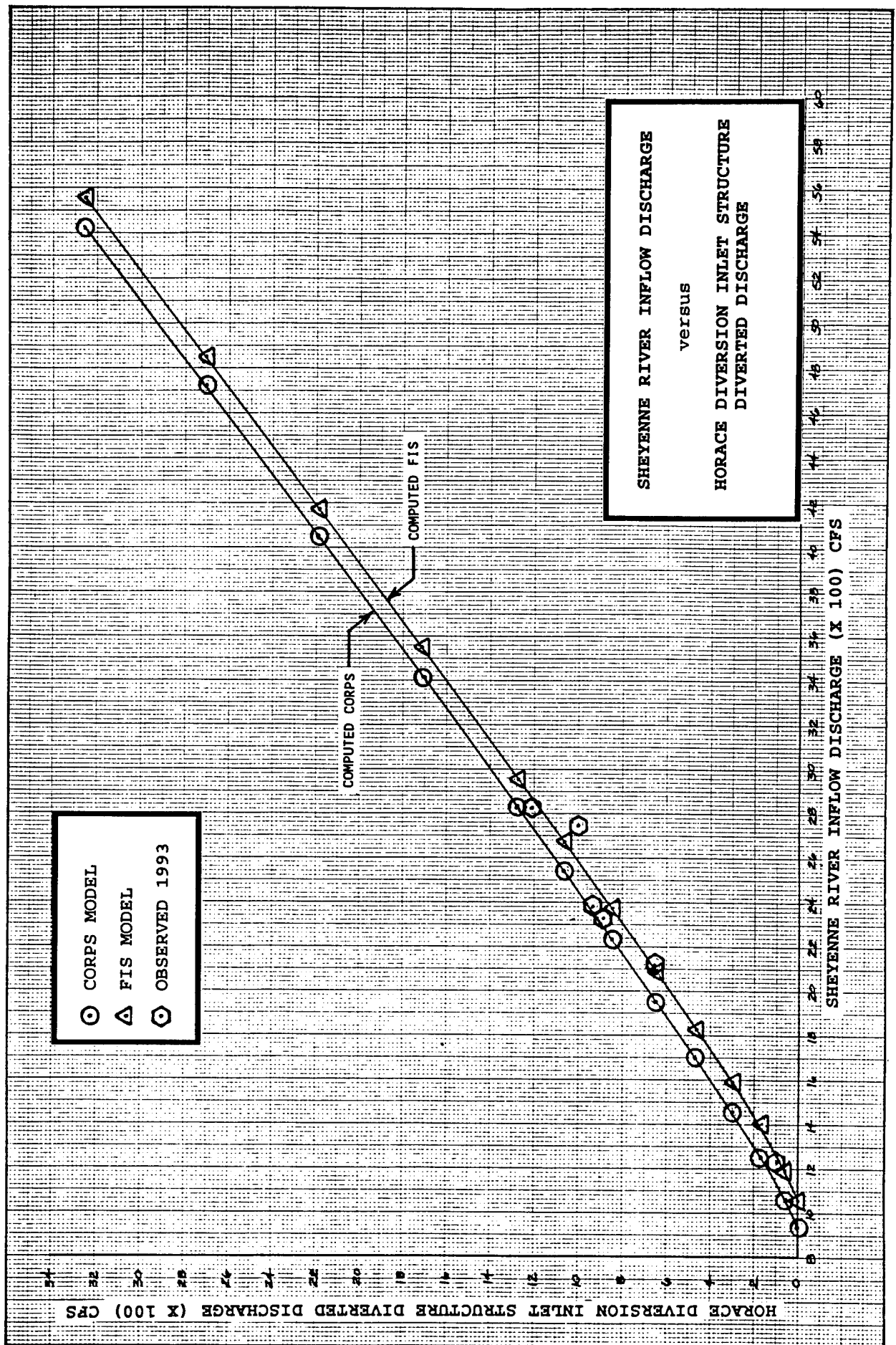


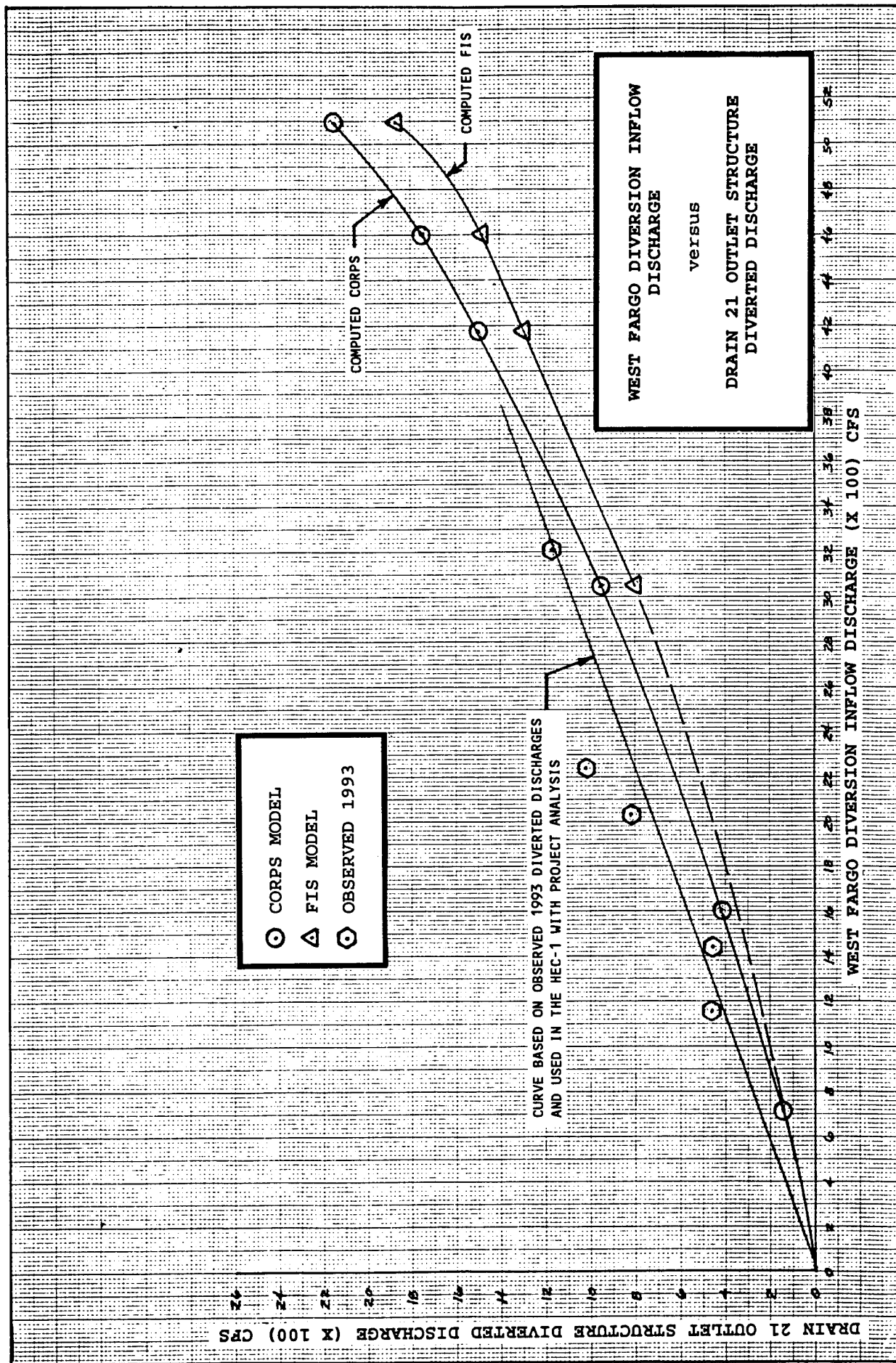


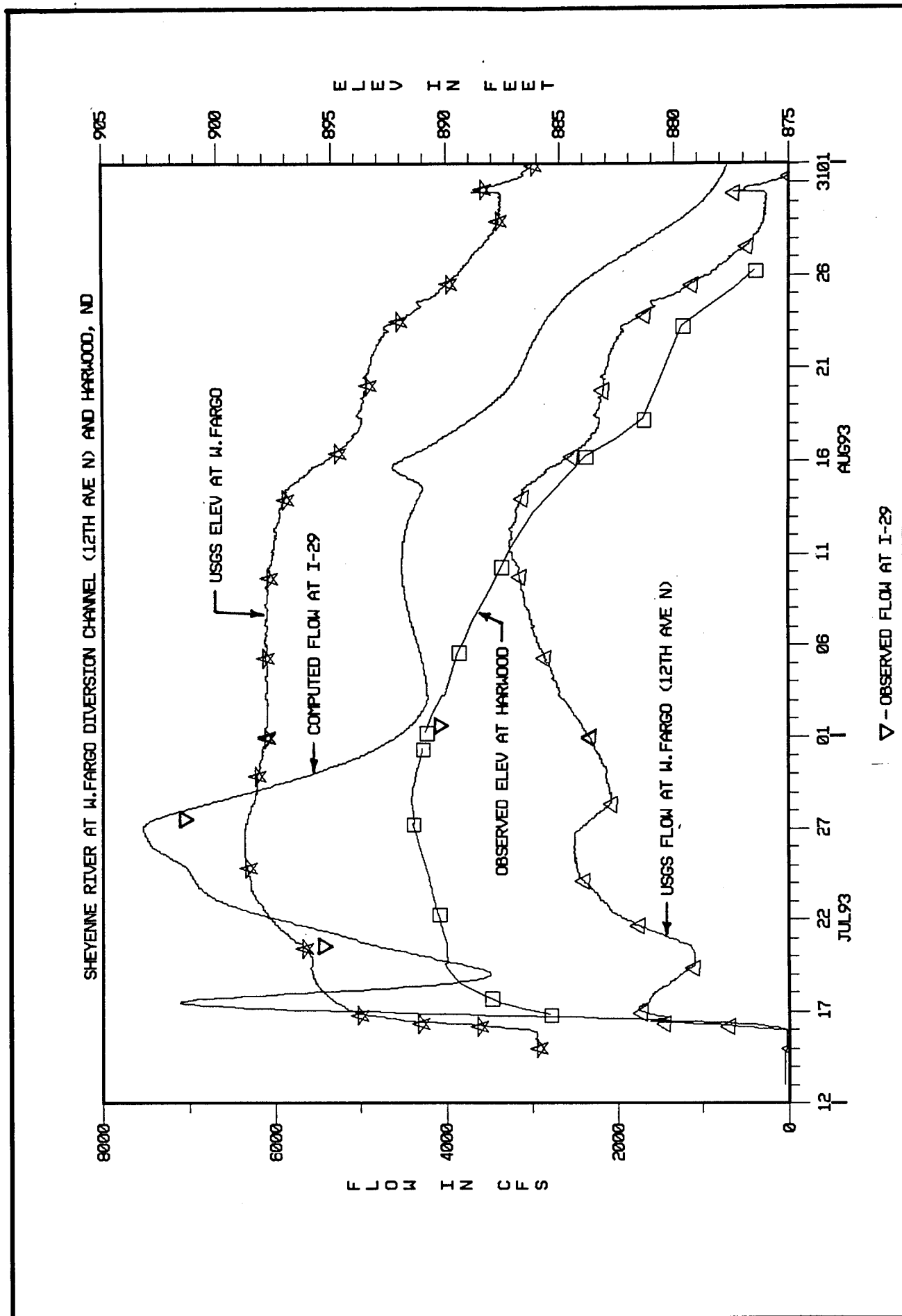






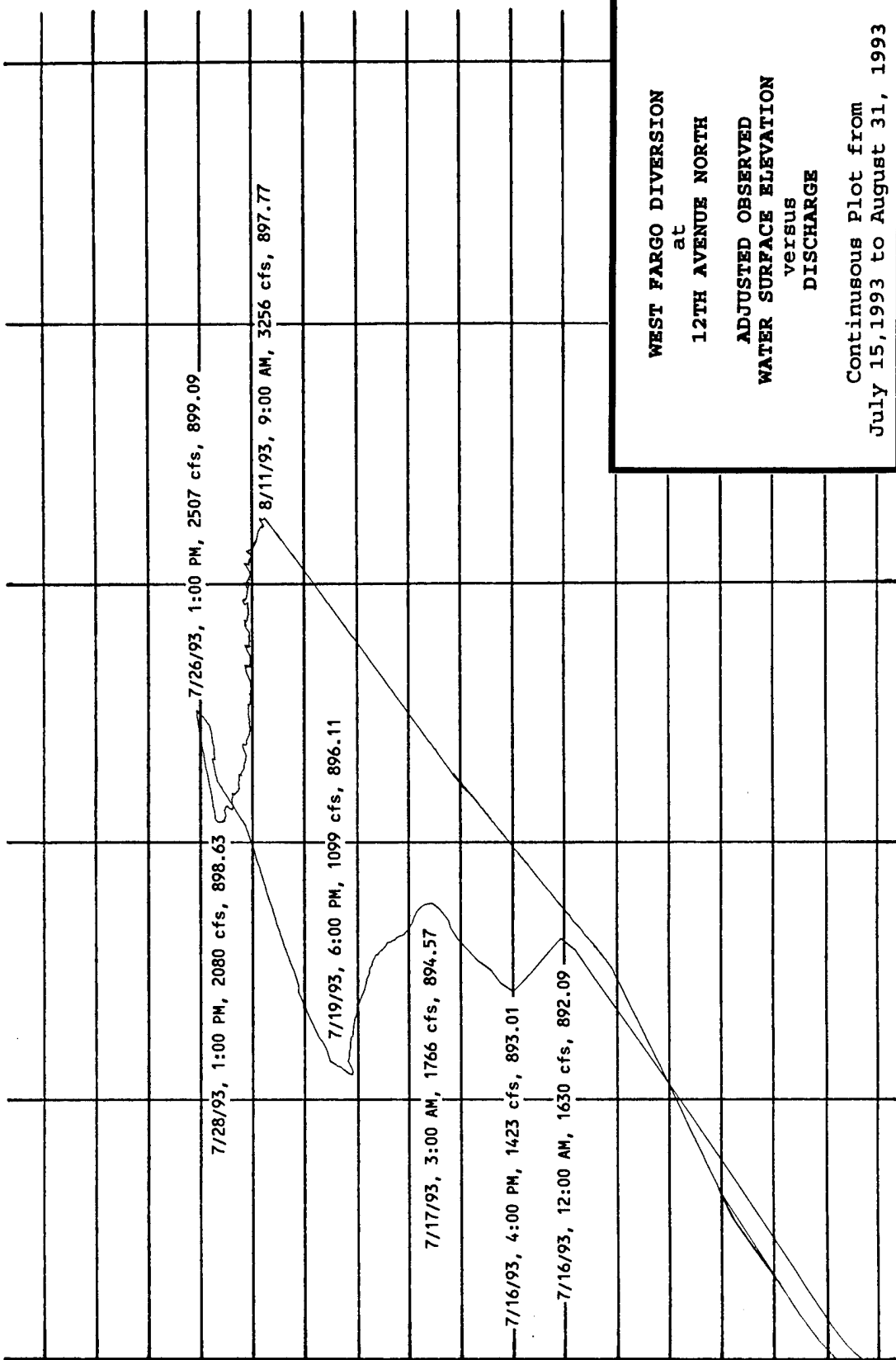






W. Fargo Div., 12th Ave. No

E 902
I 901
e 900
V 899
a 898
t 897
i 896
O 895
n 894
i 893
n 892
F 891
890
889
888
e 887
t 886

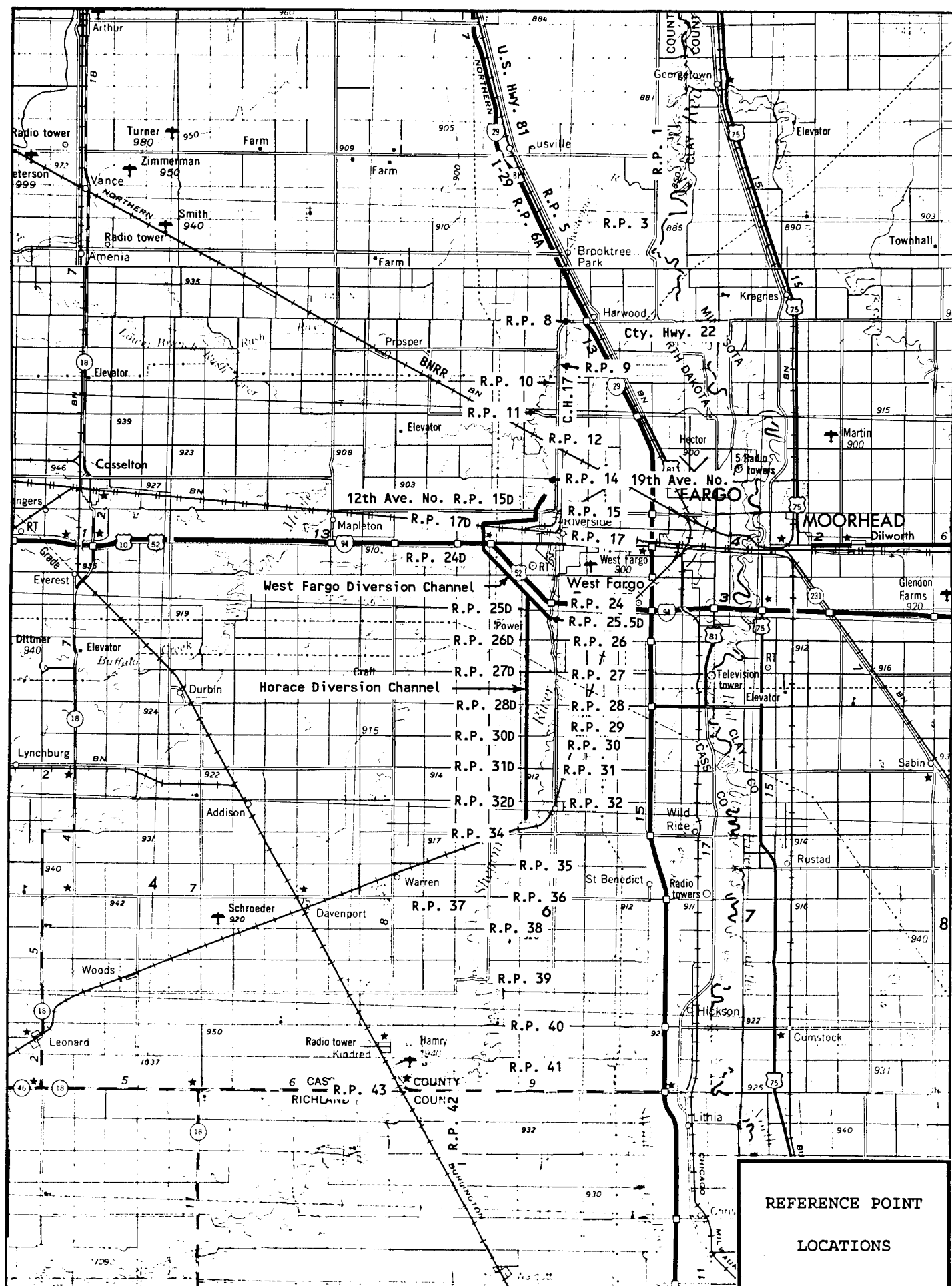


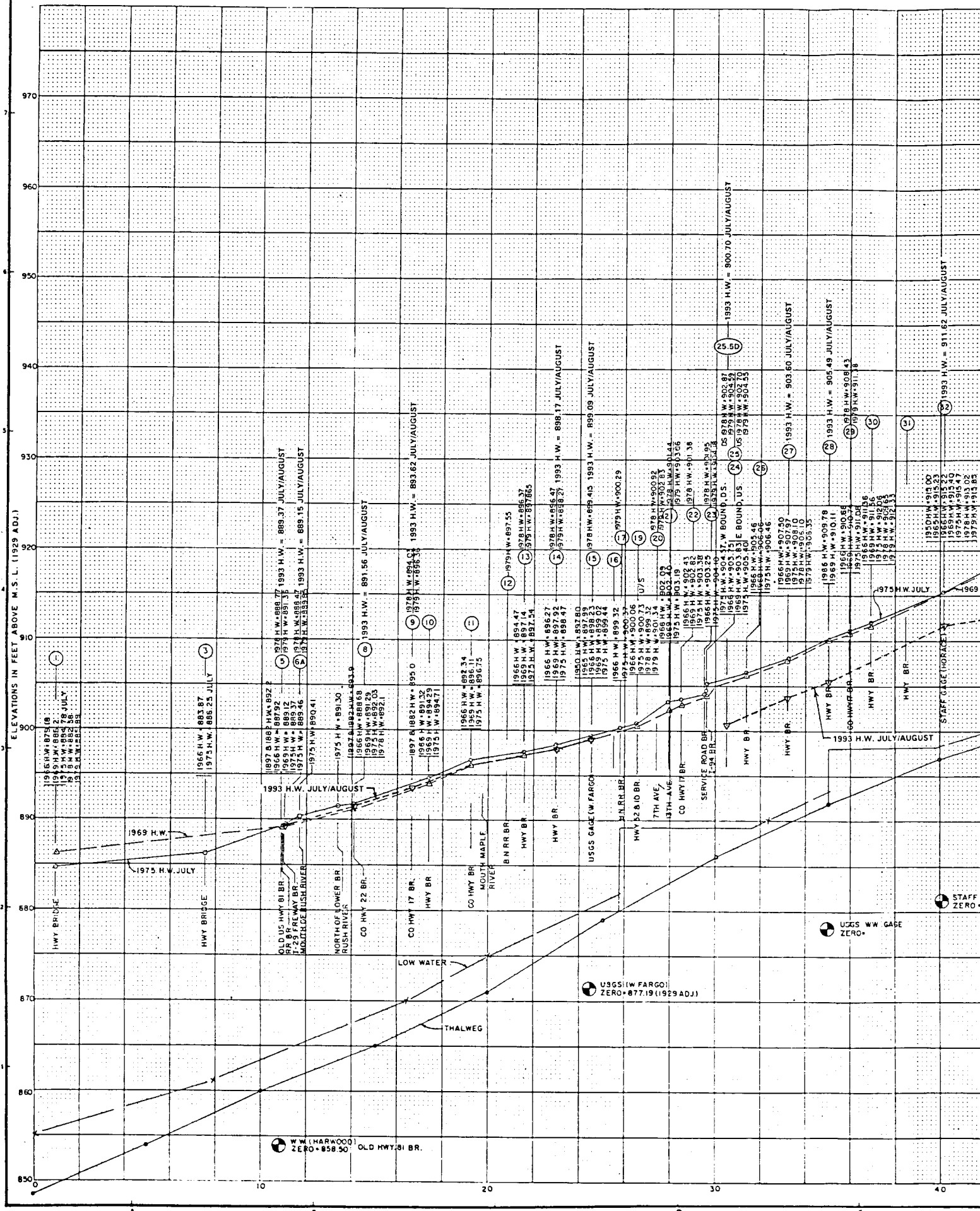
WEST FARGO DIVERSION
at
12TH AVENUE NORTH
ADJUSTED OBSERVED
WATER SURFACE ELEVATION
versus
DISCHARGE

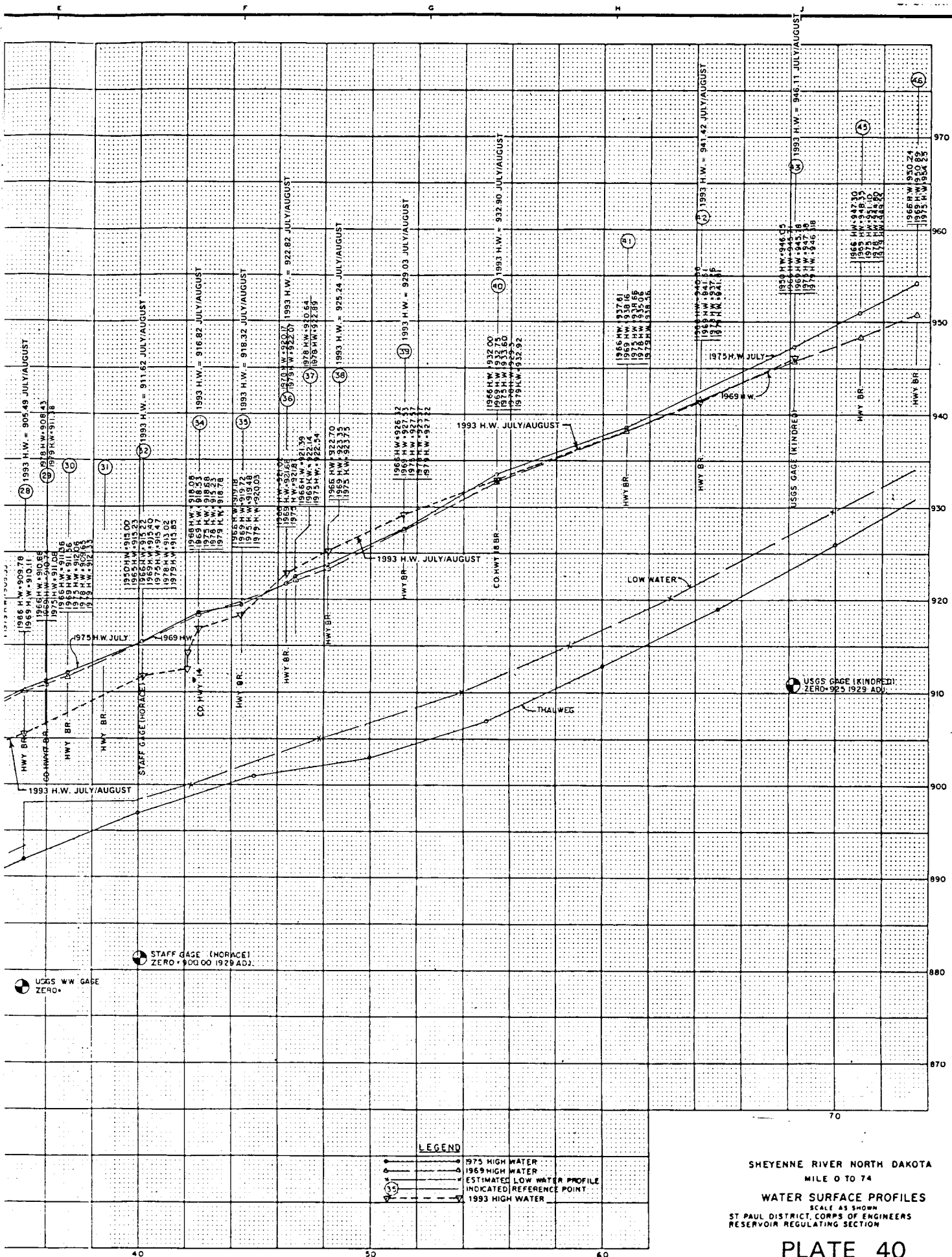
Continuous Plot from
July 15, 1993 to August 31, 1993

0 1000 2000 3000 4000 5000

Discharge in CFS







SHEYENNE RIVER NORTH DAKOTA
MILE 0 TO 74
WATER SURFACE PROFILES
SCALE AS SHOWN
ST PAUL DISTRICT, CORPS OF ENGINEERS
RESERVOIR REGULATING SECTION

THESE WATER SURFACE PROFILES ARE A COMPOSITE OF HYDROLOGIC DATA PRESENTLY AVAILABLE AND DO NOT NECESSARILY REPRESENT THE ACTUAL WATER SURFACE ELEVATION

APPENDIX A

SUMMER FLOOD 1993

OBSERVED WATER SURFACE ELEVATIONS BY USACE PERSONNEL

AND

OBSERVED WATER SURFACE ELEVATIONS BY MOORE ENGINEERING

AND

U.S. GEOLOGICAL SURVEY

MEASURED FLOWS, GAGE HEIGHTS, ADJUSTED GAGE HEIGHTS AND ELEVATION DATA

TABLE A-1
WATER SURFACE ELEVATION DATA - 1993 SUMMER FLOOD
HARWOOD, ND.

Date and Time of USACE reading	HARWOOD reading by USACE Personnel	ADJUSTED HARWOOD reading based on surveys (-0.31 ft)	Date and Time of Moore Eng. reading	HARWOOD reading by Moore Eng.	ADJUSTED HARWOOD reading by Moore Engineering	USACE Adj. minus Moore Eng. Adj.
16JUL 2100	885.80	885.49			(+0.2 ft for velocity draw down by abutment or based on USACE surveys)	
17JUL 2310	886.40	886.09				
17JUL 400	887.00	886.69				
17JUL 925	887.70	887.39				
17JUL 1100	887.90	887.59				
17JUL 1715	888.40	888.09				
17JUL 2105	888.70	888.39				
18JUL 620	889.35	889.04				
18JUL 1145	889.70	889.39				
18JUL 1810	889.90	889.59				
19JUL 730	890.30	889.99				
19JUL 1315	890.40	890.09				
19JUL 1600	890.30	889.99				
20JUL 755	890.35	890.04				
20JUL 1630	890.35	890.04				
21JUL 930	890.49	890.18				
21JUL 1200	890.51	890.20				
21JUL 1400	890.54	890.23				
21JUL 1640	890.58	890.27				
21JUL 2030	890.60	890.29				
22JUL 730	890.70	890.39				
22JUL 930	890.75	890.44				
22JUL 1200	890.78	890.47				
22JUL 1430	890.81	890.50				
22JUL 1630	890.82	890.51				
22JUL 2000	890.83	890.52				
23JUL 730	890.91	890.60				
23JUL 1230	890.99	890.68				
23JUL 1730	891.01	890.70				
23JUL 2130	891.02	890.71				
24JUL 730	891.09	890.78				
25JUL 730	891.32	891.01				
26JUL 730	891.57	891.26				
27JUL 630	891.78	891.47	26JUL 1230	891.10	891.30	
			27JUL 600	891.30	891.50	-0.03
			28JUL 600	891.30	891.50	0.06
28JUL 830	891.87	891.56	29JUL 630	891.30	891.50	-0.06
29JUL 900	891.75	891.44	30JUL 630	891.10	891.30	-0.01
30JUL	891.60	891.29	31JUL 900	890.90	891.10	-0.01
31JUL	891.40	891.09				
1AUG	891.20	890.89	2AUG	890.40	890.60	-0.01
2AUG	890.90	890.59	3AUG 600	890.00	890.20	-0.11
3AUG	890.40	890.09	5AUG 1600	889.30	889.50	
			6AUG 730	889.00	889.20	
7AUG	889.20	888.89	7AUG	888.60	888.80	0.09
9AUG	888.30	887.99	9AUG 700	887.80	888.00	-0.01
			10AUG 700	887.40	887.60	
			11AUG 700	887.00	887.20	
			12AUG 700	886.50	886.70	
			13AUG 700	886.00	886.20	
			16AUG 700	883.70	883.90	
			17AUG 700	882.30	882.50	
			18AUG 700	881.20	881.40	
			19AUG 700	880.80	881.00	
			20AUG 700	880.50	880.70	
			23AUG 700	879.50	879.70	
			24AUG 700	878.40	878.60	
			25AUG 700	877.20	877.40	
			26AUG 700	876.30	876.50	
MAXIMUMS	891.87	891.56		891.30	891.50	-0.11

TABLE A-2
WATER SURFACE ELEVATION DATA - 1993 FLOOD
USGS GAGE STATIONS

SHEYENNE RIVER ABOVE DIVERSION NEAR HORACE, ND

SHEYENNE RIVER DIVERSION CHANNEL
AT 12TH AVENUE NORTH BRIDGE, WEST FARGO, ND.

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	15	60	13.91	903.91	356	8.19	9.07	886.26	0
1993	7	15	120	13.90	903.90	356	8.19	9.07	886.26	0
1993	7	15	180	13.90	903.90	356	8.19	9.07	886.26	0
1993	7	15	240	13.89	903.89	355	8.18	9.06	886.25	0
1993	7	15	300	13.89	903.89	355	8.18	9.06	886.25	0
1993	7	15	360	13.89	903.89	355	8.18	9.06	886.25	0
1993	7	15	420	13.90	903.90	356	8.19	9.07	886.26	0
1993	7	15	480	13.89	903.89	355	8.19	9.07	886.26	0
1993	7	15	540	13.91	903.91	356	8.19	9.07	886.26	0
1993	7	15	600	13.90	903.90	356	8.23	9.11	886.30	0
1993	7	15	660	13.90	903.90	356	8.25	9.13	886.32	0
1993	7	15	720	13.91	903.91	356	8.26	9.14	886.33	1
1993	7	15	780	13.91	903.91	356	8.26	9.14	886.33	1
1993	7	15	840	13.90	903.90	356	8.25	9.13	886.32	0
1993	7	15	900	13.90	903.90	356	8.25	9.13	886.32	0
1993	7	15	960	13.89	903.89	355	8.25	9.13	886.32	0
1993	7	15	1020	13.89	903.89	355	8.25	9.13	886.32	0
1993	7	15	1080	13.88	903.88	354	8.25	9.13	886.32	0
1993	7	15	1140	13.88	903.88	354	8.25	9.13	886.32	0
1993	7	15	1200	13.88	903.88	354	8.23	9.11	886.30	0
1993	7	15	1260	13.90	903.90	356	8.23	9.11	886.30	0
1993	7	15	1320	14.14	904.14	368	8.26	9.14	886.33	1
1993	7	15	1380	14.31	904.31	380	8.41	9.29	886.48	25
1993	7	15	1440	14.55	904.55	402	8.58	9.46	886.65	63
1993	7	16	60	14.75	904.75	423	8.83	9.71	886.90	127
1993	7	16	120	14.89	904.89	442	9.30	10.18	887.37	268
1993	7	16	180	15.00	905.00	455	9.56	10.44	887.63	350
1993	7	16	240	15.10	905.10	467	9.89	10.77	887.96	451
1993	7	16	300	15.26	905.26	489	10.27	11.15	888.34	567
1993	7	16	360	15.50	905.50	517	10.74	11.62	888.81	709
1993	7	16	420	15.72	905.72	543	11.39	12.27	889.46	900
1993	7	16	480	15.92	905.92	569	12.06	12.94	890.13	1096
1993	7	16	540	16.11	906.11	594	12.75	13.63	890.82	1295
1993	7	16	600	16.28	906.28	616	13.35	14.23	891.42	1470
1993	7	16	660	16.46	906.46	639	13.73	14.61	891.80	1583
1993	7	16	720	16.61	906.61	659	14.02	14.90	892.09	1630
1993	7	16	780	16.77	906.77	680	14.27	15.15	892.34	1572
1993	7	16	840	16.91	906.91	700	14.55	15.43	892.62	1506
1993	7	16	900	17.05	907.05	717	14.76	15.64	892.83	1459
1993	7	16	960	17.19	907.19	735	14.94	15.82	893.01	1423
1993	7	16	1020	17.31	907.31	752	15.17	16.05	893.24	1456
1993	7	16	1080	17.43	907.43	766	15.36	16.24	893.43	1506
1993	7	16	1140	17.54	907.54	781	15.61	16.49	893.68	1542
1993	7	16	1200	17.65	907.65	795	15.82	16.70	893.89	1589
1993	7	16	1260	17.75	907.75	809	16.00	16.88	894.07	1628
1993	7	16	1320	17.85	907.85	822	16.14	17.02	894.21	1672
1993	7	16	1380	17.95	907.95	834	16.18	17.06	894.25	1702
1993	7	16	1440	18.06	908.06	849	16.29	17.17	894.36	1730
1993	7	17	60	18.15	908.15	861	16.36	17.24	894.43	1747
1993	7	17	120	18.24	908.24	873	16.45	17.33	894.52	1761
1993	7	17	180	18.33	908.33	885	16.50	17.38	894.57	1766
1993	7	17	240	18.42	908.42	896	16.57	17.45	894.64	1763
1993	7	17	300	18.50	908.50	906	16.65	17.53	894.72	1761
1993	7	17	360	18.57	908.57	916	16.71	17.59	894.78	1752
1993	7	17	420	18.64	908.64	925	16.78	17.66	894.85	1738
1993	7	17	480	18.72	908.72	935	16.83	17.71	894.90	1716
1993	7	17	540	18.77	908.77	943	16.88	17.76	894.95	1691
1993	7	17	600	18.83	908.83	949	16.95	17.83	895.02	1666
1993	7	17	660	18.90	908.90	959	16.99	17.87	895.06	1658
1993	7	17	720	18.94	908.94	966	17.04	17.92	895.11	1647
1993	7	17	780	18.97	908.97	974	17.08	17.96	895.15	1641
1993	7	17	840	19.00	909.00	980	17.14	18.02	895.21	1639

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	17	900	19.02	909.02	984	17.18	18.06	895.25	1633
1993	7	17	960	19.04	909.04	990	17.22	18.10	895.29	1625
1993	7	17	1020	19.05	909.05	994	17.26	18.14	895.33	1622
1993	7	17	1080	19.06	909.06	998	17.30	18.18	895.37	1616
1993	7	17	1140	19.06	909.06	1000	17.36	18.24	895.43	1614
1993	7	17	1200	19.05	909.05	1002	17.39	18.27	895.46	1603
1993	7	17	1260	19.05	909.05	1004	17.42	18.30	895.49	1594
1993	7	17	1320	19.04	909.04	1006	17.46	18.34	895.53	1586
1993	7	17	1380	19.02	909.02	1004	17.50	18.38	895.57	1580
1993	7	17	1440	19.01	909.01	1006	17.54	18.42	895.61	1569
1993	7	18	60	18.98	908.98	1004	17.58	18.46	895.65	1564
1993	7	18	120	18.95	908.95	1004	17.61	18.49	895.68	1553
1993	7	18	180	18.92	908.92	1000	17.64	18.52	895.71	1542
1993	7	18	240	18.88	908.88	997	17.66	18.54	895.73	1525
1993	7	18	300	18.83	908.83	992	17.70	18.58	895.77	1514
1993	7	18	360	18.80	908.80	989	17.71	18.59	895.78	1492
1993	7	18	420	18.75	908.75	985	17.75	18.63	895.82	1475
1993	7	18	480	18.70	908.70	981	17.77	18.65	895.84	1456
1993	7	18	540	18.65	908.65	973	17.80	18.68	895.87	1431
1993	7	18	600	18.60	908.60	968	17.82	18.70	895.89	1420
1993	7	18	660	18.54	908.54	962	17.84	18.72	895.91	1412
1993	7	18	720	18.49	908.49	954	17.86	18.74	895.93	1401
1993	7	18	780	18.44	908.44	948	17.88	18.76	895.95	1392
1993	7	18	840	18.39	908.39	942	17.90	18.78	895.97	1381
1993	7	18	900	18.34	908.34	935	17.92	18.80	895.99	1373
1993	7	18	960	18.29	908.29	927	17.93	18.81	896.00	1359
1993	7	18	1020	18.24	908.24	921	17.94	18.82	896.01	1348
1993	7	18	1080	18.19	908.19	915	17.95	18.83	896.02	1334
1993	7	18	1140	18.15	908.15	909	17.97	18.85	896.04	1326
1993	7	18	1200	18.11	908.11	903	17.99	18.87	896.06	1315
1993	7	18	1260	18.07	908.07	898	18.00	18.88	896.07	1301
1993	7	18	1320	18.02	908.02	890	18.01	18.89	896.08	1290
1993	7	18	1380	17.99	907.99	886	18.01	18.89	896.08	1273
1993	7	18	1440	17.95	907.95	877	18.03	18.91	896.10	1265
1993	7	19	60	17.91	907.91	869	18.03	18.91	896.10	1248
1993	7	19	120	17.89	907.89	863	18.06	18.94	896.13	1243
1993	7	19	180	17.86	907.86	857	18.07	18.95	896.14	1229
1993	7	19	240	17.84	907.84	851	18.08	18.96	896.15	1218
1993	7	19	300	17.83	907.83	849	18.07	18.95	896.14	1199
1993	7	19	360	17.81	907.81	842	18.09	18.97	896.16	1190
1993	7	19	420	17.80	907.80	837	18.10	18.98	896.17	1177
1993	7	19	480	17.81	907.81	837	18.10	18.98	896.17	1163
1993	7	19	540	17.81	907.81	835	18.12	19.00	896.19	1152
1993	7	19	600	17.82	907.82	833	18.06	18.94	896.13	1130
1993	7	19	660	17.84	907.84	833	18.04	18.92	896.11	1121
1993	7	19	720	17.86	907.86	835	18.03	18.91	896.10	1113
1993	7	19	780	17.90	907.90	839	18.03	18.91	896.10	1113
1993	7	19	840	17.95	907.95	842	18.03	18.91	896.10	1107
1993	7	19	900	18.01	908.01	848	18.03	18.91	896.10	1104
1993	7	19	960	18.06	908.06	856	18.04	18.92	896.11	1104
1993	7	19	1020	18.13	908.13	865	18.03	18.91	896.10	1099
1993	7	19	1080	18.21	908.21	875	18.04	18.92	896.11	1099
1993	7	19	1140	18.29	908.29	888	18.05	18.93	896.12	1099
1993	7	19	1200	18.39	908.39	902	18.06	18.94	896.13	1099
1993	7	19	1260	18.49	908.49	917	18.07	18.95	896.14	1102
1993	7	19	1320	18.60	908.60	934	18.08	18.96	896.15	1102
1993	7	19	1380	18.74	908.74	957	18.09	18.97	896.16	1102
1993	7	19	1440	18.88	908.88	978	18.11	18.99	896.18	1104
1993	7	20	60	19.03	909.03	1001	18.12	19.00	896.19	1107
1993	7	20	120	19.18	909.18	1028	18.14	19.02	896.21	1107
1993	7	20	180	19.35	909.35	1056	18.14	19.02	896.21	1110
1993	7	20	240	19.51	909.51	1083	18.17	19.05	896.24	1113
1993	7	20	300	19.65	909.65	1108	18.19	19.07	896.26	1118
1993	7	20	360	19.79	909.79	1130	18.21	19.09	896.28	1118
1993	7	20	420	19.93	909.93	1153	18.23	19.11	896.30	1121
1993	7	20	480	20.05	910.05	1178	18.26	19.14	896.33	1127
1993	7	20	540	20.18	910.18	1201	18.29	19.17	896.36	1130
1993	7	20	600	20.32	910.32	1230	18.32	19.20	896.39	1132
1993	7	20	660	20.47	910.47	1257	18.35	19.23	896.42	1138
1993	7	20	720	20.63	910.63	1287	18.38	19.26	896.45	1141
1993	7	20	780	20.74	910.74	1307	18.42	19.30	896.49	1146
1993	7	20	840	20.85	910.85	1326	18.46	19.34	896.53	1149
1993	7	20	900	20.95	910.95	1344	18.49	19.37	896.56	1171
1993	7	20	960	21.03	911.03	1362	18.53	19.41	896.60	1196
1993	7	20	1020	21.12	911.12	1380	18.58	19.46	896.65	1218

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	20	1080	21.21	911.21	1404	18.68	19.56	896.75	1246
1993	7	20	1140	21.29	911.29	1429	18.75	19.63	896.82	1276
1993	7	20	1200	21.35	911.35	1447	18.80	19.68	896.87	1298
1993	7	20	1260	21.41	911.41	1468	18.86	19.74	896.93	1323
1993	7	20	1320	21.49	911.49	1499	18.91	19.79	896.98	1348
1993	7	20	1380	21.56	911.56	1533	18.97	19.85	897.04	1376
1993	7	20	1440	21.60	911.60	1561	19.02	19.90	897.09	1398
1993	7	21	60	21.65	911.65	1578	19.07	19.95	897.14	1423
1993	7	21	120	21.70	911.70	1603	19.06	19.94	897.13	1442
1993	7	21	180	21.75	911.75	1635	19.09	19.97	897.16	1461
1993	7	21	240	21.78	911.78	1646	19.12	20.00	897.19	1484
1993	7	21	300	21.81	911.81	1659	19.16	20.04	897.23	1508
1993	7	21	360	21.86	911.86	1687	19.21	20.09	897.28	1531
1993	7	21	420	21.91	911.91	1711	19.25	20.13	897.32	1553
1993	7	21	480	21.96	911.96	1738	19.30	20.18	897.37	1580
1993	7	21	540	21.98	911.98	1750	19.34	20.22	897.41	1603
1993	7	21	600	22.02	912.02	1772	19.37	20.25	897.44	1622
1993	7	21	660	22.04	912.04	1778	19.41	20.29	897.48	1647
1993	7	21	720	22.07	912.07	1792	19.44	20.32	897.51	1666
1993	7	21	780	22.02	912.02	1773	19.49	20.37	897.56	1691
1993	7	21	840	22.06	912.06	1790	19.51	20.39	897.58	1711
1993	7	21	900	22.09	912.09	1808	19.54	20.42	897.61	1730
1993	7	21	960	22.13	912.13	1830	19.56	20.44	897.63	1747
1993	7	21	1020	22.16	912.16	1842	19.61	20.49	897.68	1772
1993	7	21	1080	22.19	912.19	1858	19.64	20.52	897.71	1791
1993	7	21	1140	22.20	912.20	1864	19.68	20.56	897.75	1813
1993	7	21	1200	22.22	912.22	1876	19.70	20.58	897.77	1833
1993	7	21	1260	22.25	912.25	1893	19.73	20.61	897.80	1849
1993	7	21	1320	22.29	912.29	1910	19.75	20.63	897.82	1866
1993	7	21	1380	22.31	912.31	1922	19.79	20.67	897.86	1888
1993	7	21	1440	22.35	912.35	1944	19.80	20.68	897.87	1902
1993	7	22	60	22.38	912.38	1957	19.85	20.73	897.92	1924
1993	7	22	120	22.42	912.42	1978	19.87	20.75	897.94	1938
1993	7	22	180	22.43	912.43	1984	19.89	20.77	897.96	1957
1993	7	22	240	22.45	912.45	1996	19.91	20.79	897.98	1971
1993	7	22	300	22.48	912.48	2012	19.94	20.82	898.01	1988
1993	7	22	360	22.49	912.49	2014	19.98	20.86	898.05	2007
1993	7	22	420	22.53	912.53	2035	19.99	20.87	898.06	2018
1993	7	22	480	22.53	912.53	2042	20.02	20.90	898.09	2035
1993	7	22	540	22.56	912.56	2053	20.05	20.93	898.12	2052
1993	7	22	600	22.58	912.58	2065	20.08	20.96	898.15	2068
1993	7	22	660	22.62	912.62	2081	20.10	20.98	898.17	2074
1993	7	22	720	22.63	912.63	2088	20.13	21.01	898.20	2085
1993	7	22	780	22.66	912.66	2105	20.14	21.02	898.21	2088
1993	7	22	840	22.69	912.69	2120	20.17	21.05	898.24	2096
1993	7	22	900	22.69	912.69	2119	20.18	21.06	898.25	2099
1993	7	22	960	22.75	912.75	2156	20.19	21.07	898.26	2105
1993	7	22	1020	22.77	912.77	2161	20.22	21.10	898.29	2113
1993	7	22	1080	22.77	912.77	2163	20.25	21.13	898.32	2124
1993	7	22	1140	22.81	912.81	2179	20.24	21.12	898.31	2118
1993	7	22	1200	22.83	912.83	2191	20.27	21.15	898.34	2129
1993	7	22	1260	22.85	912.85	2202	20.32	21.20	898.39	2146
1993	7	22	1320	22.87	912.87	2214	20.38	21.26	898.45	2163
1993	7	22	1380	22.90	912.90	2230	20.40	21.28	898.47	2171
1993	7	22	1440	22.90	912.90	2231	20.42	21.30	898.49	2177
1993	7	23	60	22.93	912.93	2242	20.47	21.35	898.54	2193
1993	7	23	120	22.94	912.94	2248	20.48	21.36	898.55	2196
1993	7	23	180	22.97	912.97	2266	20.51	21.39	898.58	2204
1993	7	23	240	23.01	913.01	2289	20.52	21.40	898.59	2210
1993	7	23	300	23.04	913.04	2305	20.54	21.42	898.61	2216
1993	7	23	360	23.07	913.07	2314	20.55	21.43	898.62	2218
1993	7	23	420	23.04	913.04	2299	20.56	21.44	898.63	2221
1993	7	23	480	23.05	913.05	2305	20.60	21.48	898.67	2235
1993	7	23	540	23.07	913.07	2317	20.60	21.48	898.67	2235
1993	7	23	600	23.09	913.09	2327	20.62	21.50	898.69	2241
1993	7	23	660	23.10	913.10	2327	20.62	21.50	898.69	2249
1993	7	23	720	23.10	913.10	2328	20.65	21.53	898.72	2266
1993	7	23	780	23.12	913.12	2341	20.66	21.54	898.73	2277
1993	7	23	840	23.16	913.16	2361	20.67	21.55	898.74	2288
1993	7	23	900	23.15	913.15	2357	20.68	21.56	898.75	2299
1993	7	23	960	23.17	913.17	2369	20.70	21.58	898.77	2313
1993	7	23	1020	23.20	913.20	2389	20.71	21.59	898.78	2324
1993	7	23	1080	23.20	913.20	2387	20.67	21.55	898.74	2321
1993	7	23	1140	23.24	913.24	2414	20.67	21.55	898.74	2327
1993	7	23	1200	23.26	913.26	2424	20.67	21.55	898.74	2335

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	23	1260	23.25	913.25	2420	20.68	21.56	898.75	2346
1993	7	23	1320	23.29	913.29	2438	20.68	21.56	898.75	2354
1993	7	23	1380	23.31	913.31	2453	20.68	21.56	898.75	2363
1993	7	23	1440	23.31	913.31	2452	20.68	21.56	898.75	2371
1993	7	24	60	23.30	913.30	2445	20.71	21.59	898.78	2388
1993	7	24	120	23.35	913.35	2476	20.71	21.59	898.78	2396
1993	7	24	180	23.35	913.35	2477	20.72	21.60	898.79	2407
1993	7	24	240	23.36	913.36	2481	20.72	21.60	898.79	2416
1993	7	24	300	23.35	913.35	2478	20.73	21.61	898.80	2427
1993	7	24	360	23.39	913.39	2499	20.75	21.63	898.82	2441
1993	7	24	420	23.39	913.39	2502	20.76	21.64	898.83	2452
1993	7	24	480	23.44	913.44	2532	20.77	21.65	898.84	2454
1993	7	24	540	23.42	913.42	2524	20.77	21.65	898.84	2454
1993	7	24	600	23.45	913.45	2540	20.79	21.67	898.86	2460
1993	7	24	660	23.47	913.47	2550	20.79	21.67	898.86	2460
1993	7	24	720	23.46	913.46	2543	20.79	21.67	898.86	2457
1993	7	24	780	23.43	913.43	2530	20.80	21.68	898.87	2460
1993	7	24	840	23.46	913.46	2553	20.82	21.70	898.89	2466
1993	7	24	900	23.50	913.50	2574	20.84	21.72	898.91	2471
1993	7	24	960	23.51	913.51	2579	20.84	21.72	898.91	2471
1993	7	24	1020	23.50	913.50	2574	20.85	21.73	898.92	2474
1993	7	24	1080	23.51	913.51	2579	20.85	21.73	898.92	2474
1993	7	24	1140	23.51	913.51	2578	20.87	21.75	898.94	2479
1993	7	24	1200	23.49	913.49	2571	20.89	21.77	898.96	2485
1993	7	24	1260	23.53	913.53	2596	20.89	21.77	898.96	2485
1993	7	24	1320	23.52	913.52	2592	20.90	21.78	898.97	2485
1993	7	24	1380	23.55	913.55	2608	20.91	21.79	898.98	2488
1993	7	24	1440	23.56	913.56	2615	20.93	21.81	899.00	2493
1993	7	25	60	23.58	913.58	2625	20.92	21.80	898.99	2491
1993	7	25	120	23.58	913.58	2624	20.93	21.81	899.00	2493
1993	7	25	180	23.56	913.56	2615	20.94	21.82	899.01	2496
1993	7	25	240	23.57	913.57	2626	20.93	21.81	899.00	2493
1993	7	25	300	23.58	913.58	2630	20.94	21.82	899.01	2496
1993	7	25	360	23.56	913.56	2622	20.94	21.82	899.01	2496
1993	7	25	420	23.60	913.60	2641	20.95	21.83	899.02	2499
1993	7	25	480	23.56	913.56	2620	20.95	21.83	899.02	2496
1993	7	25	540	23.57	913.57	2624	20.94	21.82	899.01	2493
1993	7	25	600	23.56	913.56	2620	20.95	21.83	899.02	2496
1993	7	25	660	23.57	913.57	2631	20.97	21.85	899.04	2502
1993	7	25	720	23.57	913.57	2629	20.97	21.85	899.04	2502
1993	7	25	780	23.53	913.53	2610	20.97	21.85	899.04	2502
1993	7	25	840	23.56	913.56	2623	20.99	21.87	899.06	2507
1993	7	25	900	23.52	913.52	2604	20.99	21.87	899.06	2507
1993	7	25	960	23.55	913.55	2618	21.00	21.88	899.07	2510
1993	7	25	1020	23.53	913.53	2608	21.01	21.89	899.08	2510
1993	7	25	1080	23.53	913.53	2608	21.00	21.88	899.07	2507
1993	7	25	1140	23.52	913.52	2607	21.00	21.88	899.07	2507
1993	7	25	1200	23.51	913.51	2602	20.99	21.87	899.06	2504
1993	7	25	1260	23.51	913.51	2600	21.01	21.89	899.08	2510
1993	7	25	1320	23.48	913.48	2584	21.00	21.88	899.07	2507
1993	7	25	1380	23.46	913.46	2573	21.00	21.88	899.07	2507
1993	7	25	1440	23.45	913.45	2567	21.01	21.89	899.08	2510
1993	7	26	60	23.43	913.43	2557	21.01	21.89	899.08	2510
1993	7	26	120	23.44	913.44	2568	21.00	21.88	899.07	2507
1993	7	26	180	23.44	913.44	2567	21.00	21.88	899.07	2504
1993	7	26	240	23.43	913.43	2561	20.99	21.87	899.06	2502
1993	7	26	300	23.41	913.41	2549	20.99	21.87	899.06	2502
1993	7	26	360	23.39	913.39	2536	20.99	21.87	899.06	2502
1993	7	26	420	23.34	913.34	2509	21.01	21.89	899.08	2507
1993	7	26	480	23.32	913.32	2498	21.00	21.88	899.07	2504
1993	7	26	540	23.30	913.30	2494	21.01	21.89	899.08	2507
1993	7	26	600	23.30	913.30	2493	21.01	21.89	899.08	2507
1993	7	26	660	23.21	913.21	2440	21.01	21.89	899.08	2507
1993	7	26	720	23.19	913.19	2430	21.01	21.89	899.08	2507
1993	7	26	780	23.18	913.18	2424	21.02	21.90	899.09	2507
1993	7	26	840	23.17	913.17	2416	21.01	21.89	899.08	2504
1993	7	26	900	23.13	913.13	2394	21.00	21.88	899.07	2502
1993	7	26	960	23.10	913.10	2378	21.00	21.88	899.07	2502
1993	7	26	1020	23.09	913.09	2371	20.99	21.87	899.06	2499
1993	7	26	1080	23.06	913.06	2355	21.01	21.89	899.08	2496
1993	7	26	1140	23.04	913.04	2342	21.00	21.88	899.07	2485
1993	7	26	1200	23.00	913.00	2321	20.99	21.87	899.06	2474
1993	7	26	1260	22.99	912.99	2314	20.98	21.86	899.05	2463
1993	7	26	1320	22.97	912.97	2304	20.98	21.86	899.05	2457
1993	7	26	1380	22.96	912.96	2297	20.97	21.85	899.04	2446

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	26	1440	22.93	912.93	2281	20.96	21.84	899.03	2435
1993	7	27	60	22.92	912.92	2273	20.96	21.84	899.03	2427
1993	7	27	120	22.87	912.87	2247	20.94	21.82	899.01	2413
1993	7	27	180	22.88	912.88	2251	20.93	21.81	899.00	2402
1993	7	27	240	22.85	912.85	2234	20.92	21.80	898.99	2391
1993	7	27	300	22.83	912.83	2224	20.92	21.80	898.99	2382
1993	7	27	360	22.83	912.83	2221	20.91	21.79	898.98	2371
1993	7	27	420	22.78	912.78	2194	20.90	21.78	898.97	2360
1993	7	27	480	22.76	912.76	2181	20.88	21.76	898.95	2349
1993	7	27	540	22.72	912.72	2163	20.87	21.75	898.94	2338
1993	7	27	600	22.75	912.75	2176	20.87	21.75	898.94	2329
1993	7	27	660	22.72	912.72	2160	20.86	21.74	898.93	2318
1993	7	27	720	22.70	912.70	2149	20.85	21.73	898.92	2307
1993	7	27	780	22.69	912.69	2142	20.84	21.72	898.91	2296
1993	7	27	840	22.66	912.66	2126	20.83	21.71	898.90	2285
1993	7	27	900	22.65	912.65	2119	20.81	21.69	898.88	2271
1993	7	27	960	22.62	912.62	2103	20.80	21.68	898.87	2260
1993	7	27	1020	22.61	912.61	2097	20.79	21.67	898.86	2249
1993	7	27	1080	22.59	912.59	2085	20.79	21.67	898.86	2243
1993	7	27	1140	22.57	912.57	2073	20.77	21.65	898.84	2229
1993	7	27	1200	22.54	912.54	2058	20.77	21.65	898.84	2221
1993	7	27	1260	22.54	912.54	2056	20.74	21.62	898.81	2204
1993	7	27	1320	22.52	912.52	2044	20.74	21.62	898.81	2196
1993	7	27	1380	22.48	912.48	2024	20.72	21.60	898.79	2182
1993	7	27	1440	22.50	912.50	2035	20.72	21.60	898.79	2174
1993	7	28	60	22.50	912.50	2033	20.71	21.59	898.78	2163
1993	7	28	120	22.47	912.47	2017	20.70	21.58	898.77	2152
1993	7	28	180	22.46	912.46	2012	20.70	21.58	898.77	2143
1993	7	28	240	22.47	912.47	2016	20.68	21.56	898.75	2132
1993	7	28	300	22.45	912.45	2006	20.67	21.55	898.74	2121
1993	7	28	360	22.45	912.45	2005	20.66	21.54	898.73	2110
1993	7	28	420	22.44	912.44	1999	20.66	21.54	898.73	2102
1993	7	28	480	22.41	912.41	1982	20.66	21.54	898.73	2093
1993	7	28	540	22.39	912.39	1973	20.61	21.49	898.68	2082
1993	7	28	600	22.41	912.41	1983	20.60	21.48	898.67	2082
1993	7	28	660	22.41	912.41	1983	20.58	21.46	898.65	2080
1993	7	28	720	22.40	912.40	1977	20.57	21.45	898.64	2080
1993	7	28	780	22.39	912.39	1972	20.56	21.44	898.63	2080
1993	7	28	840	22.40	912.40	1976	20.55	21.43	898.62	2080
1993	7	28	900	22.38	912.38	1966	20.54	21.42	898.61	2080
1993	7	28	960	22.38	912.38	1966	20.54	21.42	898.61	2082
1993	7	28	1020	22.38	912.38	1966	20.53	21.41	898.60	2082
1993	7	28	1080	22.39	912.39	1970	20.52	21.40	898.59	2082
1993	7	28	1140	22.36	912.36	1954	20.52	21.40	898.59	2085
1993	7	28	1200	22.36	912.36	1953	20.50	21.38	898.57	2082
1993	7	28	1260	22.34	912.34	1945	20.49	21.37	898.56	2082
1993	7	28	1320	22.37	912.37	1961	20.50	21.38	898.57	2088
1993	7	28	1380	22.38	912.38	1966	20.48	21.36	898.55	2085
1993	7	28	1440	22.38	912.38	1964	20.48	21.36	898.55	2088
1993	7	29	60	22.35	912.35	1950	20.47	21.35	898.54	2088
1993	7	29	120	22.37	912.37	1961	20.48	21.36	898.55	2093
1993	7	29	180	22.39	912.39	1972	20.47	21.35	898.54	2093
1993	7	29	240	22.40	912.40	1977	20.47	21.35	898.54	2096
1993	7	29	300	22.39	912.39	1971	20.47	21.35	898.54	2099
1993	7	29	360	22.38	912.38	1965	20.46	21.34	898.53	2099
1993	7	29	420	22.37	912.37	1961	20.46	21.34	898.53	2102
1993	7	29	480	22.38	912.38	1966	20.45	21.33	898.52	2105
1993	7	29	540	22.39	912.39	1971	20.45	21.33	898.52	2107
1993	7	29	600	22.38	912.38	1967	20.46	21.34	898.53	2113
1993	7	29	660	22.40	912.40	1978	20.47	21.35	898.54	2118
1993	7	29	720	22.41	912.41	1983	20.47	21.35	898.54	2121
1993	7	29	780	22.40	912.40	1978	20.48	21.36	898.55	2127
1993	7	29	840	22.41	912.41	1982	20.47	21.35	898.54	2127
1993	7	29	900	22.39	912.39	1973	20.47	21.35	898.54	2129
1993	7	29	960	22.42	912.42	1989	20.47	21.35	898.54	2132
1993	7	29	1020	22.42	912.42	1988	20.46	21.34	898.53	2132
1993	7	29	1080	22.40	912.40	1979	20.46	21.34	898.53	2135
1993	7	29	1140	22.42	912.42	1989	20.46	21.34	898.53	2138
1993	7	29	1200	22.42	912.42	1989	20.45	21.33	898.52	2138
1993	7	29	1260	22.42	912.42	1989	20.45	21.33	898.52	2141
1993	7	29	1320	22.42	912.42	1990	20.44	21.32	898.51	2141
1993	7	29	1380	22.44	912.44	2000	20.44	21.32	898.51	2143
1993	7	29	1440	22.43	912.43	1996	20.41	21.29	898.48	2138
1993	7	30	60	22.45	912.45	2007	20.38	21.26	898.45	2132
1993	7	30	120	22.47	912.47	2017	20.37	21.25	898.44	2132

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE	HORACE	HORACE	HORACE	AVE. NO.	AVE. NO.	AVE. NO.	AVE. NO.
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	7	30	180	22.46	912.46	2012	20.35	21.23	898.42	2129
1993	7	30	240	22.46	912.46	2012	20.35	21.23	898.42	2132
1993	7	30	300	22.46	912.46	2012	20.33	21.21	898.40	2129
1993	7	30	360	22.47	912.47	2019	20.32	21.20	898.39	2129
1993	7	30	420	22.49	912.49	2029	20.32	21.20	898.39	2135
1993	7	30	480	22.49	912.49	2030	20.31	21.19	898.38	2141
1993	7	30	540	22.50	912.50	2034	20.33	21.21	898.40	2152
1993	7	30	600	22.49	912.49	2028	20.33	21.21	898.40	2157
1993	7	30	660	22.48	912.48	2025	20.34	21.22	898.41	2168
1993	7	30	720	22.51	912.51	2041	20.33	21.21	898.40	2171
1993	7	30	780	22.52	912.52	2046	20.32	21.20	898.39	2174
1993	7	30	840	22.51	912.51	2042	20.32	21.20	898.39	2182
1993	7	30	900	22.54	912.54	2057	20.33	21.21	898.40	2191
1993	7	30	960	22.53	912.53	2051	20.29	21.17	898.36	2185
1993	7	30	1020	22.52	912.52	2048	20.28	21.16	898.35	2191
1993	7	30	1080	22.55	912.55	2063	20.26	21.14	898.33	2191
1993	7	30	1140	22.54	912.54	2058	20.25	21.13	898.32	2193
1993	7	30	1200	22.54	912.54	2060	20.24	21.12	898.31	2199
1993	7	30	1260	22.58	912.58	2080	20.22	21.10	898.29	2199
1993	7	30	1320	22.57	912.57	2075	20.21	21.09	898.28	2202
1993	7	30	1380	22.57	912.57	2076	20.21	21.09	898.28	2210
1993	7	30	1440	22.59	912.59	2086	20.19	21.07	898.26	2210
1993	7	31	60	22.59	912.59	2087	20.20	21.08	898.27	2218
1993	7	31	120	22.61	912.61	2099	20.20	21.08	898.27	2227
1993	7	31	180	22.63	912.63	2109	20.21	21.09	898.28	2235
1993	7	31	240	22.63	912.63	2108	20.20	21.08	898.27	2238
1993	7	31	300	22.62	912.62	2101	20.19	21.07	898.26	2243
1993	7	31	360	22.66	912.66	2125	20.20	21.08	898.27	2252
1993	7	31	420	22.64	912.64	2116	20.19	21.07	898.26	2254
1993	7	31	480	22.66	912.66	2127	20.20	21.08	898.27	2266
1993	7	31	540	22.67	912.67	2132	20.16	21.04	898.23	2260
1993	7	31	600	22.67	912.67	2133	20.16	21.04	898.23	2266
1993	7	31	660	22.69	912.69	2144	20.15	21.03	898.22	2271
1993	7	31	720	22.70	912.70	2149	20.14	21.02	898.21	2274
1993	7	31	780	22.70	912.70	2150	20.13	21.01	898.20	2277
1993	7	31	840	22.72	912.72	2162	20.12	21.00	898.19	2282
1993	7	31	900	22.74	912.74	2172	20.11	20.99	898.18	2285
1993	7	31	960	22.74	912.74	2173	20.10	20.98	898.17	2288
1993	7	31	1020	22.75	912.75	2177	20.10	20.98	898.17	2296
1993	7	31	1080	22.74	912.74	2173	20.10	20.98	898.17	2302
1993	7	31	1140	22.76	912.76	2184	20.10	20.98	898.17	2307
1993	7	31	1200	22.77	912.77	2191	20.08	20.96	898.15	2310
1993	7	31	1260	22.79	912.79	2202	20.08	20.96	898.15	2316
1993	7	31	1320	22.81	912.81	2212	20.07	20.95	898.14	2318
1993	7	31	1380	22.80	912.80	2208	20.07	20.95	898.14	2327
1993	7	31	1440	22.83	912.83	2222	20.06	20.94	898.13	2329
1993	8	1	60	22.80	912.80	2208	20.06	20.94	898.13	2335
1993	8	1	120	22.83	912.83	2225	20.09	20.97	898.16	2352
1993	8	1	180	22.85	912.85	2234	20.11	20.99	898.18	2363
1993	8	1	240	22.83	912.83	2225	20.13	21.01	898.20	2374
1993	8	1	300	22.86	912.86	2238	20.12	21.00	898.19	2379
1993	8	1	360	22.90	912.90	2261	20.09	20.97	898.16	2377
1993	8	1	420	22.86	912.86	2239	20.07	20.95	898.14	2377
1993	8	1	480	22.92	912.92	2275	20.05	20.93	898.12	2379
1993	8	1	540	22.91	912.91	2271	20.05	20.93	898.12	2385
1993	8	1	600	22.94	912.94	2286	20.06	20.94	898.13	2393
1993	8	1	660	22.92	912.92	2277	20.04	20.92	898.11	2396
1993	8	1	720	22.95	912.95	2293	20.04	20.92	898.11	2402
1993	8	1	780	22.95	912.95	2293	20.03	20.91	898.10	2404
1993	8	1	840	22.96	912.96	2301	20.02	20.90	898.09	2410
1993	8	1	900	23.00	913.00	2321	20.01	20.89	898.08	2413
1993	8	1	960	23.00	913.00	2318	20.00	20.88	898.07	2416
1993	8	1	1020	23.04	913.04	2342	20.00	20.88	898.07	2424
1993	8	1	1080	23.01	913.01	2329	19.99	20.87	898.06	2427
1993	8	1	1140	23.05	913.05	2351	19.99	20.87	898.06	2432
1993	8	1	1200	23.07	913.07	2361	19.98	20.86	898.05	2438
1993	8	1	1260	23.06	913.06	2355	19.99	20.87	898.06	2446
1993	8	1	1320	23.05	913.05	2353	19.99	20.87	898.06	2452
1993	8	1	1380	23.09	913.09	2379	20.00	20.88	898.07	2463
1993	8	1	1440	23.09	913.09	2379	19.99	20.87	898.06	2466
1993	8	2	60	23.09	913.09	2379	20.00	20.88	898.07	2474
1993	8	2	120	23.10	913.10	2383	20.01	20.89	898.08	2485
1993	8	2	180	23.14	913.14	2419	20.02	20.90	898.09	2493
1993	8	2	240	23.14	913.14	2419	20.02	20.90	898.09	2499
1993	8	2	300	23.15	913.15	2425	20.01	20.89	898.08	2504

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	2	360	23.15	913.15	2434	20.02	20.90	898.09	2513
1993	8	2	420	23.19	913.19	2461	20.02	20.90	898.09	2518
1993	8	2	480	23.15	913.15	2432	20.01	20.89	898.08	2524
1993	8	2	540	23.18	913.18	2453	20.02	20.90	898.09	2532
1993	8	2	600	23.18	913.18	2453	20.00	20.88	898.07	2532
1993	8	2	660	23.23	913.23	2497	19.98	20.86	898.05	2535
1993	8	2	720	23.21	913.21	2482	19.98	20.86	898.05	2541
1993	8	2	780	23.22	913.22	2490	19.98	20.86	898.05	2546
1993	8	2	840	23.24	913.24	2514	19.97	20.85	898.04	2552
1993	8	2	900	23.28	913.28	2541	19.98	20.86	898.05	2560
1993	8	2	960	23.24	913.24	2513	19.97	20.85	898.04	2563
1993	8	2	1020	23.27	913.27	2534	19.99	20.87	898.06	2577
1993	8	2	1080	23.28	913.28	2540	19.96	20.84	898.03	2574
1993	8	2	1140	23.29	913.29	2551	19.97	20.85	898.04	2582
1993	8	2	1200	23.30	913.30	2557	19.97	20.85	898.04	2591
1993	8	2	1260	23.36	913.36	2611	19.96	20.84	898.03	2593
1993	8	2	1320	23.33	913.33	2591	19.97	20.85	898.04	2602
1993	8	2	1380	23.34	913.34	2594	19.97	20.85	898.04	2610
1993	8	2	1440	23.32	913.32	2577	19.97	20.85	898.04	2616
1993	8	3	60	23.37	913.37	2624	19.98	20.86	898.05	2624
1993	8	3	120	23.36	913.36	2615	20.03	20.91	898.10	2646
1993	8	3	180	23.37	913.37	2625	20.06	20.94	898.13	2660
1993	8	3	240	23.37	913.37	2628	20.06	20.94	898.13	2666
1993	8	3	300	23.40	913.40	2655	20.07	20.95	898.14	2677
1993	8	3	360	23.40	913.40	2654	20.08	20.96	898.15	2685
1993	8	3	420	23.40	913.40	2648	20.04	20.92	898.11	2677
1993	8	3	480	23.44	913.44	2690	20.06	20.94	898.13	2685
1993	8	3	540	23.43	913.43	2682	20.04	20.92	898.11	2685
1993	8	3	600	23.45	913.45	2705	20.01	20.89	898.08	2680
1993	8	3	660	23.45	913.45	2707	20.01	20.89	898.08	2682
1993	8	3	720	23.47	913.47	2731	19.99	20.87	898.06	2680
1993	8	3	780	23.47	913.47	2729	19.98	20.86	898.05	2682
1993	8	3	840	23.46	913.46	2720	19.98	20.86	898.05	2685
1993	8	3	900	23.47	913.47	2745	19.99	20.87	898.06	2691
1993	8	3	960	23.47	913.47	2760	19.98	20.86	898.05	2691
1993	8	3	1020	23.51	913.51	2784	19.97	20.85	898.04	2694
1993	8	3	1080	23.49	913.49	2773	19.98	20.86	898.05	2699
1993	8	3	1140	23.52	913.52	2791	19.98	20.86	898.05	2702
1993	8	3	1200	23.51	913.51	2786	19.98	20.86	898.05	2705
1993	8	3	1260	23.52	913.52	2794	19.97	20.85	898.04	2707
1993	8	3	1320	23.55	913.55	2812	19.98	20.86	898.05	2713
1993	8	3	1380	23.53	913.53	2801	19.97	20.85	898.04	2713
1993	8	3	1440	23.56	913.56	2819	19.98	20.86	898.05	2719
1993	8	4	60	23.55	913.55	2810	19.98	20.86	898.05	2721
1993	8	4	120	23.50	913.50	2779	20.04	20.92	898.11	2744
1993	8	4	180	23.51	913.51	2785	20.05	20.93	898.12	2749
1993	8	4	240	23.51	913.51	2786	20.07	20.95	898.14	2757
1993	8	4	300	23.52	913.52	2790	20.08	20.96	898.15	2763
1993	8	4	360	23.50	913.50	2775	20.03	20.91	898.10	2755
1993	8	4	420	23.55	913.55	2814	20.04	20.92	898.11	2760
1993	8	4	480	23.56	913.56	2819	20.02	20.90	898.09	2757
1993	8	4	540	23.56	913.56	2817	20.02	20.90	898.09	2760
1993	8	4	600	23.60	913.60	2849	19.99	20.87	898.06	2757
1993	8	4	660	23.58	913.58	2835	20.00	20.88	898.07	2763
1993	8	4	720	23.58	913.58	2836	20.00	20.88	898.07	2766
1993	8	4	780	23.59	913.59	2843	20.00	20.88	898.07	2769
1993	8	4	840	23.60	913.60	2852	20.00	20.88	898.07	2774
1993	8	4	900	23.63	913.63	2870	20.00	20.88	898.07	2777
1993	8	4	960	23.59	913.59	2845	20.00	20.88	898.07	2780
1993	8	4	1020	23.62	913.62	2866	19.98	20.86	898.05	2780
1993	8	4	1080	23.63	913.63	2873	20.00	20.88	898.07	2785
1993	8	4	1140	23.63	913.63	2873	19.99	20.87	898.06	2791
1993	8	4	1200	23.63	913.63	2873	20.01	20.89	898.08	2796
1993	8	4	1260	23.64	913.64	2879	19.99	20.87	898.06	2796
1993	8	4	1320	23.63	913.63	2875	20.00	20.88	898.07	2799
1993	8	4	1380	23.66	913.66	2896	19.99	20.87	898.06	2805
1993	8	4	1440	23.67	913.67	2903	19.99	20.87	898.06	2808
1993	8	5	60	23.67	913.67	2904	20.00	20.88	898.07	2813
1993	8	5	120	23.69	913.69	2918	20.06	20.94	898.13	2830
1993	8	5	180	23.68	913.68	2913	20.08	20.96	898.15	2841
1993	8	5	240	23.71	913.71	2933	20.08	20.96	898.15	2844
1993	8	5	300	23.70	913.70	2929	20.05	20.93	898.12	2838
1993	8	5	360	23.73	913.73	2952	20.08	20.96	898.15	2849
1993	8	5	420	23.76	913.76	2971	20.07	20.95	898.14	2852
1993	8	5	480	23.73	913.73	2950	20.09	20.97	898.16	2860

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	5	540	23.74	913.74	2957	20.06	20.94	898.13	2855
1993	8	5	600	23.74	913.74	2959	20.05	20.93	898.12	2855
1993	8	5	660	23.76	913.76	2973	20.04	20.92	898.11	2858
1993	8	5	720	23.76	913.76	2974	20.04	20.92	898.11	2860
1993	8	5	780	23.77	913.77	2981	20.03	20.91	898.10	2860
1993	8	5	840	23.78	913.78	2988	20.04	20.92	898.11	2866
1993	8	5	900	23.77	913.77	2982	20.02	20.90	898.09	2872
1993	8	5	960	23.79	913.79	2993	20.03	20.91	898.10	2877
1993	8	5	1020	23.75	913.75	2967	20.01	20.89	898.08	2883
1993	8	5	1080	23.77	913.77	2979	20.02	20.90	898.09	2885
1993	8	5	1140	23.75	913.75	2967	20.01	20.89	898.08	2897
1993	8	5	1200	23.78	913.78	2989	20.01	20.89	898.08	2905
1993	8	5	1260	23.79	913.79	2997	20.01	20.89	898.08	2908
1993	8	5	1320	23.80	913.80	3001	20.03	20.91	898.10	2905
1993	8	5	1380	23.76	913.76	2975	20.02	20.90	898.09	2919
1993	8	5	1440	23.79	913.79	2995	20.02	20.90	898.09	2927
1993	8	6	60	23.77	913.77	2983	20.03	20.91	898.10	2927
1993	8	6	120	23.80	913.80	3004	20.08	20.96	898.15	2919
1993	8	6	180	23.80	913.80	3004	20.09	20.97	898.16	2924
1993	8	6	240	23.80	913.80	3006	20.12	21.00	898.19	2938
1993	8	6	300	23.82	913.82	3019	20.11	20.99	898.18	2938
1993	8	6	360	23.81	913.81	3011	20.06	20.94	898.13	2941
1993	8	6	420	23.80	913.80	3006	20.08	20.96	898.15	2936
1993	8	6	480	23.82	913.82	3016	20.09	20.97	898.16	2941
1993	8	6	540	23.78	913.78	2985	20.07	20.95	898.14	2941
1993	8	6	600	23.82	913.82	3022	20.06	20.94	898.13	2941
1993	8	6	660	23.85	913.85	3042	20.06	20.94	898.13	2944
1993	8	6	720	23.84	913.84	3034	20.05	20.93	898.12	2944
1993	8	6	780	23.82	913.82	3022	20.02	20.90	898.09	2980
1993	8	6	840	23.85	913.85	3043	20.03	20.91	898.10	2974
1993	8	6	900	23.85	913.85	3042	20.04	20.92	898.11	2966
1993	8	6	960	23.84	913.84	3036	20.03	20.91	898.10	2966
1993	8	6	1020	23.85	913.85	3041	20.03	20.91	898.10	2969
1993	8	6	1080	23.82	913.82	3020	20.02	20.90	898.09	2983
1993	8	6	1140	23.83	913.83	3027	20.02	20.90	898.09	2986
1993	8	6	1200	23.83	913.83	3031	20.01	20.89	898.08	2986
1993	8	6	1260	23.87	913.87	3059	20.00	20.88	898.07	3000
1993	8	6	1320	23.87	913.87	3060	20.00	20.88	898.07	3005
1993	8	6	1380	23.89	913.89	3074	20.00	20.88	898.07	3008
1993	8	6	1440	23.89	913.89	3073	20.01	20.89	898.08	2988
1993	8	7	60	23.87	913.87	3059	20.02	20.90	898.09	2980
1993	8	7	120	23.88	913.88	3067	20.06	20.94	898.13	2994
1993	8	7	180	23.89	913.89	3073	20.09	20.97	898.16	3005
1993	8	7	240	23.87	913.87	3061	20.07	20.95	898.14	3002
1993	8	7	300	23.90	913.90	3082	20.07	20.95	898.14	3005
1993	8	7	360	23.90	913.90	3082	20.06	20.94	898.13	3005
1993	8	7	420	23.90	913.90	3083	20.05	20.93	898.12	3005
1993	8	7	480	23.92	913.92	3095	20.02	20.90	898.09	3005
1993	8	7	540	23.89	913.89	3076	20.04	20.92	898.11	3011
1993	8	7	600	23.91	913.91	3090	20.02	20.90	898.09	3011
1993	8	7	660	23.91	913.91	3093	20.03	20.91	898.10	3013
1993	8	7	720	23.95	913.95	3118	20.01	20.89	898.08	3016
1993	8	7	780	23.91	913.91	3092	20.01	20.89	898.08	3019
1993	8	7	840	23.94	913.94	3111	19.99	20.87	898.06	3016
1993	8	7	900	23.92	913.92	3100	20.00	20.88	898.07	3022
1993	8	7	960	23.95	913.95	3122	20.00	20.88	898.07	3025
1993	8	7	1020	23.96	913.96	3127	19.99	20.87	898.06	3027
1993	8	7	1080	23.94	913.94	3115	19.98	20.86	898.05	3027
1993	8	7	1140	23.96	913.96	3131	19.98	20.86	898.05	3030
1993	8	7	1200	23.99	913.99	3151	19.98	20.86	898.05	3033
1993	8	7	1260	23.98	913.98	3143	19.97	20.85	898.04	3036
1993	8	7	1320	23.97	913.97	3136	19.98	20.86	898.05	3041
1993	8	7	1380	23.97	913.97	3139	19.96	20.84	898.03	3050
1993	8	7	1440	24.00	914.00	3157	19.97	20.85	898.04	3044
1993	8	8	60	23.96	913.96	3131	20.00	20.88	898.07	3052
1993	8	8	120	23.99	913.99	3154	20.03	20.91	898.10	3064
1993	8	8	180	24.02	914.02	3172	20.06	20.94	898.13	3072
1993	8	8	240	23.98	913.98	3147	20.07	20.95	898.14	3075
1993	8	8	300	24.01	914.01	3169	20.09	20.97	898.16	3080
1993	8	8	360	24.03	914.03	3181	20.04	20.92	898.11	3077
1993	8	8	420	24.00	914.00	3160	20.02	20.90	898.09	3075
1993	8	8	480	24.00	914.00	3162	20.00	20.88	898.07	3075
1993	8	8	540	24.03	914.03	3184	19.99	20.87	898.06	3075
1993	8	8	600	24.04	914.04	3189	20.00	20.88	898.07	3077
1993	8	8	660	24.01	914.01	3170	20.00	20.88	898.07	3083

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	8	720	24.04	914.04	3189	20.00	20.88	898.07	3086
1993	8	8	780	24.01	914.01	3171	19.97	20.85	898.04	3083
1993	8	8	840	24.05	914.05	3199	19.99	20.87	898.06	3089
1993	8	8	900	24.06	914.06	3203	19.99	20.87	898.06	3094
1993	8	8	960	24.01	914.01	3171	19.99	20.87	898.06	3097
1993	8	8	1020	24.05	914.05	3198	19.98	20.86	898.05	3097
1993	8	8	1080	24.04	914.04	3191	19.97	20.85	898.04	3097
1993	8	8	1140	24.04	914.04	3191	19.97	20.85	898.04	3100
1993	8	8	1200	24.04	914.04	3193	19.96	20.84	898.03	3102
1993	8	8	1260	24.07	914.07	3213	19.95	20.83	898.02	3102
1993	8	8	1320	24.06	914.06	3206	19.94	20.82	898.01	3105
1993	8	8	1380	24.05	914.05	3199	19.97	20.85	898.04	3111
1993	8	8	1440	24.05	914.05	3200	19.95	20.83	898.02	3114
1993	8	9	60	24.07	914.07	3215	19.95	20.83	898.02	3114
1993	8	9	120	24.08	914.08	3221	20.02	20.90	898.09	3122
1993	8	9	180	24.07	914.07	3213	20.03	20.91	898.10	3125
1993	8	9	240	24.06	914.06	3208	20.04	20.92	898.11	3125
1993	8	9	300	24.08	914.08	3224	20.04	20.92	898.11	3128
1993	8	9	360	24.10	914.10	3236	20.01	20.89	898.08	3128
1993	8	9	420	24.08	914.08	3224	20.00	20.88	898.07	3130
1993	8	9	480	24.10	914.10	3237	19.99	20.87	898.06	3130
1993	8	9	540	24.09	914.09	3230	19.97	20.85	898.04	3130
1993	8	9	600	24.09	914.09	3230	19.95	20.83	898.02	3136
1993	8	9	660	24.09	914.09	3231	19.94	20.82	898.01	3136
1993	8	9	720	24.10	914.10	3238	19.94	20.82	898.01	3136
1993	8	9	780	24.10	914.10	3238	19.94	20.82	898.01	3139
1993	8	9	840	24.10	914.10	3237	19.93	20.81	898.00	3141
1993	8	9	900	24.09	914.09	3231	19.92	20.80	897.99	3144
1993	8	9	960	24.10	914.10	3237	19.93	20.81	898.00	3141
1993	8	9	1020	24.09	914.09	3229	19.91	20.79	897.98	3147
1993	8	9	1080	24.08	914.08	3223	19.90	20.78	897.97	3150
1993	8	9	1140	24.09	914.09	3231	19.90	20.78	897.97	3153
1993	8	9	1200	24.10	914.10	3239	19.90	20.78	897.97	3155
1993	8	9	1260	24.13	914.13	3258	19.89	20.77	897.96	3155
1993	8	9	1320	24.18	914.18	3301	19.87	20.75	897.94	3161
1993	8	9	1380	24.20	914.20	3314	19.89	20.77	897.96	3161
1993	8	9	1440	24.18	914.18	3300	19.86	20.74	897.93	3167
1993	8	10	60	24.18	914.18	3298	19.88	20.76	897.95	3161
1993	8	10	120	24.16	914.16	3285	19.89	20.77	897.96	3158
1993	8	10	180	24.17	914.17	3294	19.92	20.80	897.99	3144
1993	8	10	240	24.19	914.19	3307	19.92	20.80	897.99	3144
1993	8	10	300	24.18	914.18	3298	19.91	20.79	897.98	3141
1993	8	10	360	24.16	914.16	3285	19.89	20.77	897.96	3150
1993	8	10	420	24.17	914.17	3293	19.87	20.75	897.94	3164
1993	8	10	480	24.18	914.18	3299	19.87	20.75	897.94	3155
1993	8	10	540	24.17	914.17	3294	19.85	20.73	897.92	3169
1993	8	10	600	24.19	914.19	3305	19.83	20.71	897.90	3189
1993	8	10	660	24.15	914.15	3279	19.84	20.72	897.91	3175
1993	8	10	720	24.18	914.18	3301	19.83	20.71	897.90	3192
1993	8	10	780	24.19	914.19	3305	19.82	20.70	897.89	3194
1993	8	10	840	24.16	914.16	3287	19.81	20.69	897.88	3208
1993	8	10	900	24.19	914.19	3309	19.80	20.68	897.87	3208
1993	8	10	960	24.21	914.21	3320	19.79	20.67	897.86	3208
1993	8	10	1020	24.17	914.17	3294	19.78	20.66	897.85	3217
1993	8	10	1080	24.20	914.20	3315	19.78	20.66	897.85	3217
1993	8	10	1140	24.20	914.20	3313	19.76	20.64	897.83	3219
1993	8	10	1200	24.17	914.17	3292	19.74	20.62	897.81	3217
1993	8	10	1260	24.17	914.17	3294	19.73	20.61	897.80	3217
1993	8	10	1320	24.19	914.19	3307	19.74	20.62	897.81	3225
1993	8	10	1380	24.18	914.18	3300	19.72	20.60	897.79	3222
1993	8	10	1440	24.18	914.18	3300	19.73	20.61	897.80	3228
1993	8	11	60	24.18	914.18	3301	19.71	20.59	897.78	3228
1993	8	11	120	24.19	914.19	3306	19.77	20.65	897.84	3242
1993	8	11	180	24.17	914.17	3294	19.79	20.67	897.86	3253
1993	8	11	240	24.19	914.19	3308	19.75	20.63	897.82	3247
1993	8	11	300	24.19	914.19	3308	19.74	20.62	897.81	3247
1993	8	11	360	24.19	914.19	3307	19.72	20.60	897.79	3250
1993	8	11	420	24.18	914.18	3301	19.71	20.59	897.78	3250
1993	8	11	480	24.20	914.20	3314	19.69	20.57	897.76	3250
1993	8	11	540	24.27	914.27	3372	19.70	20.58	897.77	3256
1993	8	11	600	24.29	914.29	3384	19.68	20.56	897.75	3250
1993	8	11	660	24.27	914.27	3369	19.67	20.55	897.74	3247
1993	8	11	720	24.27	914.27	3367	19.68	20.56	897.75	3250
1993	8	11	780	24.32	914.32	3409	19.68	20.56	897.75	3250
1993	8	11	840	24.32	914.32	3407	19.67	20.55	897.74	3247

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	11	900	24.29	914.29	3386	19.67	20.55	897.74	3247
1993	8	11	960	24.29	914.29	3386	19.67	20.55	897.74	3247
1993	8	11	1020	24.29	914.29	3382	19.67	20.55	897.74	3247
1993	8	11	1080	24.25	914.25	3357	19.66	20.54	897.73	3244
1993	8	11	1140	24.28	914.28	3379	19.64	20.52	897.71	3239
1993	8	11	1200	24.29	914.29	3383	19.61	20.49	897.68	3231
1993	8	11	1260	24.26	914.26	3363	19.65	20.53	897.72	3242
1993	8	11	1320	24.27	914.27	3371	19.63	20.51	897.70	3236
1993	8	11	1380	24.28	914.28	3377	19.62	20.50	897.69	3233
1993	8	11	1440	24.27	914.27	3369	19.62	20.50	897.69	3236
1993	8	12	60	24.26	914.26	3365	19.61	20.49	897.68	3233
1993	8	12	120	24.29	914.29	3384	19.61	20.49	897.68	3233
1993	8	12	180	24.27	914.27	3368	19.61	20.49	897.68	3233
1993	8	12	240	24.24	914.24	3350	19.61	20.49	897.68	3233
1993	8	12	300	24.28	914.28	3378	19.58	20.46	897.65	3225
1993	8	12	360	24.28	914.28	3378	19.65	20.53	897.72	3244
1993	8	12	420	24.28	914.28	3378	19.67	20.55	897.74	3250
1993	8	12	480	24.28	914.28	3375	19.66	20.54	897.73	3247
1993	8	12	540	24.24	914.24	3347	19.67	20.55	897.74	3250
1993	8	12	600	24.24	914.24	3347	19.60	20.48	897.67	3231
1993	8	12	660	24.25	914.25	3351	19.59	20.47	897.66	3228
1993	8	12	720	24.22	914.22	3328	19.56	20.44	897.63	3219
1993	8	12	780	24.27	914.27	3367	19.56	20.44	897.63	3219
1993	8	12	840	24.23	914.23	3341	19.54	20.42	897.61	3214
1993	8	12	900	24.26	914.26	3361	19.54	20.42	897.61	3214
1993	8	12	960	24.25	914.25	3355	19.51	20.39	897.58	3206
1993	8	12	1020	24.26	914.26	3360	19.51	20.39	897.58	3206
1993	8	12	1080	24.23	914.23	3342	19.49	20.37	897.56	3200
1993	8	12	1140	24.27	914.27	3368	19.49	20.37	897.56	3200
1993	8	12	1200	24.25	914.25	3354	19.46	20.34	897.53	3192
1993	8	12	1260	24.24	914.24	3347	19.46	20.34	897.53	3192
1993	8	12	1320	24.25	914.25	3355	19.45	20.33	897.52	3189
1993	8	12	1380	24.26	914.26	3362	19.45	20.33	897.52	3189
1993	8	12	1440	24.26	914.26	3361	19.43	20.31	897.50	3183
1993	8	13	60	24.24	914.24	3347	19.43	20.31	897.50	3183
1993	8	13	120	24.24	914.24	3347	19.41	20.29	897.48	3178
1993	8	13	180	24.24	914.24	3344	19.41	20.29	897.48	3178
1993	8	13	240	24.21	914.21	3326	19.41	20.29	897.48	3178
1993	8	13	300	24.24	914.24	3346	19.39	20.27	897.46	3172
1993	8	13	360	24.23	914.23	3336	19.43	20.31	897.50	3186
1993	8	13	420	24.20	914.20	3319	19.45	20.33	897.52	3192
1993	8	13	480	24.24	914.24	3344	19.46	20.34	897.53	3194
1993	8	13	540	24.21	914.21	3322	19.47	20.35	897.54	3197
1993	8	13	600	24.20	914.20	3315	19.42	20.30	897.49	3183
1993	8	13	660	24.19	914.19	3309	19.39	20.27	897.46	3175
1993	8	13	720	24.21	914.21	3322	19.37	20.25	897.44	3169
1993	8	13	780	24.20	914.20	3315	19.36	20.24	897.43	3167
1993	8	13	840	24.20	914.20	3315	19.36	20.24	897.43	3167
1993	8	13	900	24.19	914.19	3307	19.33	20.21	897.40	3158
1993	8	13	960	24.18	914.18	3298	19.31	20.19	897.38	3153
1993	8	13	1020	24.16	914.16	3282	19.32	20.20	897.39	3155
1993	8	13	1080	24.13	914.13	3263	19.29	20.17	897.36	3147
1993	8	13	1140	24.16	914.16	3283	19.29	20.17	897.36	3147
1993	8	13	1200	24.14	914.14	3265	19.26	20.14	897.33	3139
1993	8	13	1260	24.09	914.09	3231	19.23	20.11	897.30	3130
1993	8	13	1320	24.11	914.11	3245	19.23	20.11	897.30	3130
1993	8	13	1380	24.10	914.10	3236	19.21	20.09	897.28	3125
1993	8	13	1440	24.08	914.08	3220	19.21	20.09	897.28	3125
1993	8	14	60	24.06	914.06	3205	19.17	20.05	897.24	3114
1993	8	14	120	24.04	914.04	3189	19.17	20.05	897.24	3114
1993	8	14	180	24.02	914.02	3176	19.16	20.04	897.23	3111
1993	8	14	240	24.02	914.02	3178	19.15	20.03	897.22	3108
1993	8	14	300	23.97	913.97	3136	19.12	20.00	897.19	3100
1993	8	14	360	23.96	913.96	3128	19.12	20.00	897.19	3100
1993	8	14	420	23.95	913.95	3121	19.18	20.06	897.25	3116
1993	8	14	480	23.95	913.95	3118	19.16	20.04	897.23	3111
1993	8	14	540	23.91	913.91	3087	19.12	20.00	897.19	3100
1993	8	14	600	23.87	913.87	3056	19.15	20.03	897.22	3108
1993	8	14	660	23.84	913.84	3032	19.17	20.05	897.24	3116
1993	8	14	720	23.80	913.80	3003	19.13	20.01	897.20	3105
1993	8	14	780	23.79	913.79	2994	19.06	19.94	897.13	3086
1993	8	14	840	23.75	913.75	2967	19.03	19.91	897.10	3077
1993	8	14	900	23.69	913.69	2915	19.01	19.89	897.08	3072
1993	8	14	960	23.65	913.65	2885	18.97	19.85	897.04	3061
1993	8	14	1020	23.61	913.61	2855	18.93	19.81	897.00	3050

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	14	1080	23.58	913.58	2834	18.89	19.77	896.96	3038
1993	8	14	1140	23.57	913.57	2827	18.84	19.72	896.91	3025
1993	8	14	1200	23.56	913.56	2817	18.79	19.67	896.86	3011
1993	8	14	1260	23.51	913.51	2782	18.74	19.62	896.81	2997
1993	8	14	1320	23.46	913.46	2747	18.69	19.57	896.76	2983
1993	8	14	1380	23.42	913.42	2721	18.64	19.52	896.71	2969
1993	8	14	1440	23.37	913.37	2690	18.60	19.48	896.67	2958
1993	8	15	60	23.34	913.34	2675	18.56	19.44	896.63	2947
1993	8	15	120	23.28	913.28	2638	18.51	19.39	896.58	2933
1993	8	15	180	23.29	913.29	2641	18.46	19.34	896.53	2919
1993	8	15	240	23.24	913.24	2616	18.41	19.29	896.48	2905
1993	8	15	300	23.19	913.19	2585	18.36	19.24	896.43	2891
1993	8	15	360	23.19	913.19	2583	18.33	19.21	896.40	2883
1993	8	15	420	23.15	913.15	2560	18.27	19.15	896.34	2866
1993	8	15	480	23.11	913.11	2539	18.22	19.10	896.29	2852
1993	8	15	540	23.10	913.10	2531	18.16	19.04	896.23	2835
1993	8	15	600	23.06	913.06	2509	18.19	19.07	896.26	2844
1993	8	15	660	23.03	913.03	2491	18.17	19.05	896.24	2838
1993	8	15	720	22.99	912.99	2469	18.13	19.01	896.20	2827
1993	8	15	780	22.96	912.96	2453	18.12	19.00	896.19	2824
1993	8	15	840	22.95	912.95	2445	18.07	18.95	896.14	2810
1993	8	15	900	22.90	912.90	2416	18.02	18.90	896.09	2796
1993	8	15	960	22.86	912.86	2396	17.99	18.87	896.06	2791
1993	8	15	1020	22.86	912.86	2393	17.89	18.77	895.96	2763
1993	8	15	1080	22.82	912.82	2372	17.80	18.68	895.87	2738
1993	8	15	1140	22.81	912.81	2365	17.74	18.62	895.81	2721
1993	8	15	1200	22.78	912.78	2349	17.67	18.55	895.74	2702
1993	8	15	1260	22.77	912.77	2342	17.60	18.48	895.67	2682
1993	8	15	1320	22.74	912.74	2326	17.58	18.46	895.65	2677
1993	8	15	1380	22.72	912.72	2315	17.50	18.38	895.57	2655
1993	8	15	1440	22.71	912.71	2308	17.44	18.32	895.51	2638
1993	8	16	60	22.68	912.68	2293	17.39	18.27	895.46	2624
1993	8	16	120	22.68	912.68	2291	17.33	18.21	895.40	2607
1993	8	16	180	22.65	912.65	2274	17.28	18.16	895.35	2593
1993	8	16	240	22.63	912.63	2263	17.25	18.13	895.32	2585
1993	8	16	300	22.62	912.62	2258	17.22	18.10	895.29	2577
1993	8	16	360	22.61	912.61	2251	17.16	18.04	895.23	2560
1993	8	16	420	22.59	912.59	2240	17.09	17.97	895.16	2541
1993	8	16	480	22.57	912.57	2230	17.07	17.95	895.14	2535
1993	8	16	540	22.57	912.57	2229	17.03	17.91	895.10	2524
1993	8	16	600	22.56	912.56	2223	16.98	17.86	895.05	2510
1993	8	16	660	22.55	912.55	2216	16.99	17.87	895.06	2513
1993	8	16	720	22.52	912.52	2202	16.94	17.82	895.01	2499
1993	8	16	780	22.54	912.54	2212	16.95	17.83	895.02	2502
1993	8	16	840	22.54	912.54	2211	16.95	17.83	895.02	2502
1993	8	16	900	22.52	912.52	2200	16.85	17.73	894.92	2474
1993	8	16	960	22.51	912.51	2193	16.77	17.65	894.84	2452
1993	8	16	1020	22.48	912.48	2179	16.73	17.61	894.80	2441
1993	8	16	1080	22.49	912.49	2183	16.68	17.56	894.75	2427
1993	8	16	1140	22.48	912.48	2177	16.63	17.51	894.70	2413
1993	8	16	1200	22.46	912.46	2168	16.61	17.49	894.68	2407
1993	8	16	1260	22.48	912.48	2177	16.55	17.43	894.62	2391
1993	8	16	1320	22.47	912.47	2171	16.50	17.38	894.57	2379
1993	8	16	1380	22.45	912.45	2161	16.47	17.35	894.54	2371
1993	8	16	1440	22.45	912.45	2161	16.44	17.32	894.51	2363
1993	8	17	60	22.45	912.45	2161	16.42	17.30	894.49	2357
1993	8	17	120	22.45	912.45	2161	16.38	17.26	894.45	2346
1993	8	17	180	22.45	912.45	2161	16.33	17.21	894.40	2332
1993	8	17	240	22.45	912.45	2159	16.31	17.19	894.38	2327
1993	8	17	300	22.42	912.42	2144	16.27	17.15	894.34	2316
1993	8	17	360	22.43	912.43	2149	16.25	17.13	894.32	2310
1993	8	17	420	22.42	912.42	2144	16.21	17.09	894.28	2299
1993	8	17	480	22.42	912.42	2143	16.18	17.06	894.25	2291
1993	8	17	540	22.41	912.41	2138	16.24	17.12	894.31	2307
1993	8	17	600	22.41	912.41	2138	16.24	17.12	894.31	2307
1993	8	17	660	22.41	912.41	2138	16.18	17.06	894.25	2291
1993	8	17	720	22.41	912.41	2138	16.12	17.00	894.19	2274
1993	8	17	780	22.42	912.42	2143	16.13	17.01	894.20	2277
1993	8	17	840	22.41	912.41	2137	16.06	16.94	894.13	2257
1993	8	17	900	22.40	912.40	2132	16.02	16.90	894.09	2249
1993	8	17	960	22.39	912.39	2127	16.00	16.88	894.07	2243
1993	8	17	1020	22.40	912.40	2132	15.99	16.87	894.06	2241
1993	8	17	1080	22.40	912.40	2132	15.95	16.83	894.02	2229
1993	8	17	1140	22.39	912.39	2126	15.93	16.81	894.00	2224
1993	8	17	1200	22.39	912.39	2126	15.93	16.81	894.00	2227

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	17	1260	22.39	912.39	2126	15.93	16.81	894.00	2227
1993	8	17	1320	22.38	912.38	2122	15.88	16.76	893.95	2213
1993	8	17	1380	22.41	912.41	2140	15.88	16.76	893.95	2213
1993	8	17	1440	22.45	912.45	2162	15.85	16.73	893.92	2207
1993	8	18	60	22.47	912.47	2171	15.87	16.75	893.94	2213
1993	8	18	120	22.44	912.44	2156	15.82	16.70	893.89	2199
1993	8	18	180	22.45	912.45	2161	15.83	16.71	893.90	2202
1993	8	18	240	22.46	912.46	2166	15.86	16.74	893.93	2210
1993	8	18	300	22.45	912.45	2160	15.85	16.73	893.92	2210
1993	8	18	360	22.44	912.44	2157	15.84	16.72	893.91	2207
1993	8	18	420	22.47	912.47	2171	15.82	16.70	893.89	2202
1993	8	18	480	22.45	912.45	2163	15.82	16.70	893.89	2199
1993	8	18	540	22.48	912.48	2176	15.95	16.83	894.02	2235
1993	8	18	600	22.44	912.44	2155	16.01	16.89	894.08	2252
1993	8	18	660	22.44	912.44	2156	16.04	16.92	894.11	2260
1993	8	18	720	22.46	912.46	2165	16.07	16.95	894.14	2268
1993	8	18	780	22.44	912.44	2156	16.07	16.95	894.14	2268
1993	8	18	840	22.45	912.45	2160	15.97	16.85	894.04	2241
1993	8	18	900	22.44	912.44	2155	15.94	16.82	894.01	2235
1993	8	18	960	22.44	912.44	2155	15.92	16.80	893.99	2229
1993	8	18	1020	22.44	912.44	2156	15.92	16.80	893.99	2229
1993	8	18	1080	22.45	912.45	2161	15.89	16.77	893.96	2221
1993	8	18	1140	22.45	912.45	2160	15.86	16.74	893.93	2216
1993	8	18	1200	22.44	912.44	2155	15.84	16.72	893.91	2210
1993	8	18	1260	22.44	912.44	2154	15.83	16.71	893.90	2207
1993	8	18	1320	22.42	912.42	2145	15.82	16.70	893.89	2204
1993	8	18	1380	22.44	912.44	2154	15.81	16.69	893.88	2202
1993	8	18	1440	22.42	912.42	2144	15.80	16.68	893.87	2202
1993	8	19	60	22.42	912.42	2144	15.80	16.68	893.87	2199
1993	8	19	120	22.42	912.42	2143	15.79	16.67	893.86	2196
1993	8	19	180	22.41	912.41	2138	15.79	16.67	893.86	2196
1993	8	19	240	22.42	912.42	2144	15.77	16.65	893.84	2191
1993	8	19	300	22.43	912.43	2149	15.77	16.65	893.84	2193
1993	8	19	360	22.42	912.42	2143	15.75	16.63	893.82	2188
1993	8	19	420	22.41	912.41	2138	15.76	16.64	893.83	2191
1993	8	19	480	22.41	912.41	2138	15.75	16.63	893.82	2188
1993	8	19	540	22.41	912.41	2137	15.83	16.71	893.90	2207
1993	8	19	600	22.40	912.40	2133	15.85	16.73	893.92	2216
1993	8	19	660	22.41	912.41	2138	15.78	16.66	893.85	2196
1993	8	19	720	22.41	912.41	2137	15.77	16.65	893.84	2193
1993	8	19	780	22.40	912.40	2132	15.72	16.60	893.79	2179
1993	8	19	840	22.40	912.40	2132	15.71	16.59	893.78	2179
1993	8	19	900	22.40	912.40	2132	15.71	16.59	893.78	2179
1993	8	19	960	22.39	912.39	2126	15.68	16.56	893.75	2171
1993	8	19	1020	22.39	912.39	2126	15.67	16.55	893.74	2168
1993	8	19	1080	22.39	912.39	2126	15.69	16.57	893.76	2174
1993	8	19	1140	22.39	912.39	2127	15.64	16.52	893.71	2163
1993	8	19	1200	22.41	912.41	2136	15.66	16.54	893.73	2166
1993	8	19	1260	22.46	912.46	2165	15.64	16.52	893.71	2160
1993	8	19	1320	22.43	912.43	2149	15.63	16.51	893.70	2157
1993	8	19	1380	22.43	912.43	2149	15.63	16.51	893.70	2157
1993	8	19	1440	22.42	912.42	2143	15.61	16.49	893.68	2154
1993	8	20	60	22.41	912.41	2138	15.63	16.51	893.70	2160
1993	8	20	120	22.41	912.41	2138	15.60	16.48	893.67	2152
1993	8	20	180	22.41	912.41	2137	15.62	16.50	893.69	2157
1993	8	20	240	22.40	912.40	2133	15.60	16.48	893.67	2152
1993	8	20	300	22.41	912.41	2136	15.62	16.50	893.69	2157
1993	8	20	360	22.38	912.38	2122	15.61	16.49	893.68	2154
1993	8	20	420	22.40	912.40	2130	15.60	16.48	893.67	2152
1993	8	20	480	22.37	912.37	2116	15.61	16.49	893.68	2154
1993	8	20	540	22.38	912.38	2120	15.60	16.48	893.67	2152
1993	8	20	600	22.37	912.37	2116	15.57	16.45	893.64	2143
1993	8	20	660	22.38	912.38	2121	15.64	16.52	893.71	2163
1993	8	20	720	22.38	912.38	2120	15.70	16.58	893.77	2177
1993	8	20	780	22.36	912.36	2110	15.74	16.62	893.81	2188
1993	8	20	840	22.37	912.37	2115	15.72	16.60	893.79	2182
1993	8	20	900	22.37	912.37	2114	15.63	16.51	893.70	2160
1993	8	20	960	22.36	912.36	2109	15.58	16.46	893.65	2146
1993	8	20	1020	22.35	912.35	2102	15.57	16.45	893.64	2143
1993	8	20	1080	22.33	912.33	2092	15.55	16.43	893.62	2138
1993	8	20	1140	22.33	912.33	2092	15.55	16.43	893.62	2141
1993	8	20	1200	22.33	912.33	2091	15.53	16.41	893.60	2135
1993	8	20	1260	22.32	912.32	2087	15.53	16.41	893.60	2135
1993	8	20	1320	22.33	912.33	2092	15.51	16.39	893.58	2129
1993	8	20	1380	22.33	912.33	2092	15.48	16.36	893.55	2121

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	20	1440	22.33	912.33	2091	15.50	16.38	893.57	2127
1993	8	21	60	22.32	912.32	2086	15.50	16.38	893.57	2127
1993	8	21	120	22.31	912.31	2081	15.46	16.34	893.53	2116
1993	8	21	180	22.32	912.32	2086	15.45	16.33	893.52	2113
1993	8	21	240	22.31	912.31	2079	15.45	16.33	893.52	2116
1993	8	21	300	22.29	912.29	2070	15.44	16.32	893.51	2113
1993	8	21	360	22.31	912.31	2081	15.42	16.30	893.49	2107
1993	8	21	420	22.31	912.31	2080	15.41	16.29	893.48	2105
1993	8	21	480	22.30	912.30	2074	15.42	16.30	893.49	2107
1993	8	21	540	22.28	912.28	2064	15.40	16.28	893.47	2102
1993	8	21	600	22.29	912.29	2069	15.38	16.26	893.45	2096
1993	8	21	660	22.29	912.29	2069	15.40	16.28	893.47	2102
1993	8	21	720	22.28	912.28	2063	15.39	16.27	893.46	2099
1993	8	21	780	22.28	912.28	2063	15.39	16.27	893.46	2099
1993	8	21	840	22.27	912.27	2057	15.39	16.27	893.46	2099
1993	8	21	900	22.26	912.26	2051	15.38	16.26	893.45	2096
1993	8	21	960	22.24	912.24	2041	15.37	16.25	893.44	2093
1993	8	21	1020	22.25	912.25	2046	15.35	16.23	893.42	2088
1993	8	21	1080	22.24	912.24	2040	15.33	16.21	893.40	2082
1993	8	21	1140	22.24	912.24	2040	15.31	16.19	893.38	2080
1993	8	21	1200	22.24	912.24	2040	15.30	16.18	893.37	2077
1993	8	21	1260	22.23	912.23	2034	15.28	16.16	893.35	2071
1993	8	21	1320	22.21	912.21	2024	15.26	16.14	893.33	2066
1993	8	21	1380	22.22	912.22	2028	15.23	16.11	893.30	2060
1993	8	21	1440	22.21	912.21	2023	15.22	16.10	893.29	2057
1993	8	22	60	22.21	912.21	2022	15.22	16.10	893.29	2057
1993	8	22	120	22.19	912.19	2012	15.20	16.08	893.27	2052
1993	8	22	180	22.19	912.19	2011	15.19	16.07	893.26	2049
1993	8	22	240	22.18	912.18	2005	15.15	16.03	893.22	2041
1993	8	22	300	22.17	912.17	2000	15.17	16.05	893.24	2043
1993	8	22	360	22.16	912.16	1993	15.14	16.02	893.21	2035
1993	8	22	420	22.14	912.14	1983	15.12	16.00	893.19	2032
1993	8	22	480	22.13	912.13	1977	15.11	15.99	893.18	2030
1993	8	22	540	22.13	912.13	1976	15.09	15.97	893.16	2024
1993	8	22	600	22.11	912.11	1965	15.06	15.94	893.13	2016
1993	8	22	660	22.10	912.10	1960	15.06	15.94	893.13	2016
1993	8	22	720	22.09	912.09	1954	15.00	15.88	893.07	2002
1993	8	22	780	22.08	912.08	1948	15.03	15.91	893.10	2007
1993	8	22	840	22.06	912.06	1936	14.95	15.83	893.02	1991
1993	8	22	900	22.04	912.04	1925	14.98	15.86	893.05	1996
1993	8	22	960	22.03	912.03	1919	14.93	15.81	893.00	1985
1993	8	22	1020	22.02	912.02	1913	14.93	15.81	893.00	1982
1993	8	22	1080	21.99	911.99	1897	14.90	15.78	892.97	1977
1993	8	22	1140	21.98	911.98	1889	14.87	15.75	892.94	1969
1993	8	22	1200	21.94	911.94	1867	14.81	15.69	892.88	1955
1993	8	22	1260	21.92	911.92	1856	14.81	15.69	892.88	1955
1993	8	22	1320	21.91	911.91	1851	14.79	15.67	892.86	1949
1993	8	22	1380	21.91	911.91	1850	14.70	15.58	892.77	1927
1993	8	22	1440	21.88	911.88	1834	14.65	15.53	892.72	1916
1993	8	23	60	21.87	911.87	1826	14.66	15.54	892.73	1919
1993	8	23	120	21.83	911.83	1805	14.76	15.64	892.83	1941
1993	8	23	180	21.82	911.82	1799	14.83	15.71	892.90	1957
1993	8	23	240	21.81	911.81	1793	14.79	15.67	892.86	1949
1993	8	23	300	21.80	911.80	1786	14.80	15.68	892.87	1952
1993	8	23	360	21.76	911.76	1765	14.79	15.67	892.86	1949
1993	8	23	420	21.75	911.75	1758	14.77	15.65	892.84	1944
1993	8	23	480	21.73	911.73	1747	14.75	15.63	892.82	1938
1993	8	23	540	21.71	911.71	1736	14.63	15.51	892.70	1910
1993	8	23	600	21.70	911.70	1729	14.51	15.39	892.58	1880
1993	8	23	660	21.67	911.67	1713	14.42	15.30	892.49	1858
1993	8	23	720	21.66	911.66	1706	14.34	15.22	892.41	1838
1993	8	23	780	21.63	911.63	1690	14.27	15.15	892.34	1822
1993	8	23	840	21.61	911.61	1679	14.20	15.08	892.27	1805
1993	8	23	900	21.60	911.60	1672	14.16	15.04	892.23	1794
1993	8	23	960	21.57	911.57	1655	14.06	14.94	892.13	1769
1993	8	23	1020	21.55	911.55	1644	14.02	14.90	892.09	1761
1993	8	23	1080	21.54	911.54	1639	13.95	14.83	892.02	1744
1993	8	23	1140	21.53	911.53	1632	13.90	14.78	891.97	1730
1993	8	23	1200	21.50	911.50	1615	13.85	14.73	891.92	1719
1993	8	23	1260	21.48	911.48	1604	13.79	14.67	891.86	1702
1993	8	23	1320	21.46	911.46	1593	13.72	14.60	891.79	1686
1993	8	23	1380	21.45	911.45	1586	13.65	14.53	891.72	1672
1993	8	23	1440	21.42	911.42	1570	13.62	14.50	891.69	1664
1993	8	24	60	21.41	911.41	1564	13.58	14.46	891.65	1652
1993	8	24	120	21.39	911.39	1552	13.53	14.41	891.60	1639

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	24	180	21.36	911.36	1536	13.50	14.38	891.57	1633
1993	8	24	240	21.36	911.36	1535	13.38	14.26	891.45	1605
1993	8	24	300	21.33	911.33	1520	13.38	14.26	891.45	1603
1993	8	24	360	21.31	911.31	1510	13.34	14.22	891.41	1594
1993	8	24	420	21.29	911.29	1500	13.29	14.17	891.36	1580
1993	8	24	480	21.28	911.28	1494	13.22	14.10	891.29	1567
1993	8	24	540	21.26	911.26	1484	13.25	14.13	891.32	1572
1993	8	24	600	21.23	911.23	1473	13.36	14.24	891.43	1600
1993	8	24	660	21.22	911.22	1468	13.37	14.25	891.44	1600
1993	8	24	720	21.20	911.20	1460	13.37	14.25	891.44	1600
1993	8	24	780	21.18	911.18	1452	13.38	14.26	891.45	1605
1993	8	24	840	21.16	911.16	1444	13.38	14.26	891.45	1605
1993	8	24	900	21.14	911.14	1437	13.32	14.20	891.39	1589
1993	8	24	960	21.11	911.11	1427	13.15	14.03	891.22	1547
1993	8	24	1020	21.10	911.10	1424	13.03	13.91	891.10	1511
1993	8	24	1080	21.09	911.09	1419	12.92	13.80	890.99	1464
1993	8	24	1140	21.06	911.06	1410	12.83	13.71	890.90	1428
1993	8	24	1200	21.05	911.05	1406	12.77	13.65	890.84	1403
1993	8	24	1260	21.03	911.03	1400	12.71	13.59	890.78	1378
1993	8	24	1320	21.01	911.01	1395	12.66	13.54	890.73	1356
1993	8	24	1380	21.00	911.00	1391	12.61	13.49	890.68	1337
1993	8	24	1440	20.98	910.98	1386	12.60	13.48	890.67	1331
1993	8	25	60	20.97	910.97	1382	12.53	13.41	890.60	1304
1993	8	25	120	20.95	910.95	1377	12.50	13.38	890.57	1290
1993	8	25	180	20.93	910.93	1372	12.44	13.32	890.51	1265
1993	8	25	240	20.92	910.92	1370	12.43	13.31	890.50	1262
1993	8	25	300	20.90	910.90	1365	12.39	13.27	890.46	1246
1993	8	25	360	20.88	910.88	1360	12.38	13.26	890.45	1240
1993	8	25	420	20.86	910.86	1355	12.32	13.20	890.39	1215
1993	8	25	480	20.85	910.85	1353	12.27	13.15	890.34	1196
1993	8	25	540	20.83	910.83	1348	12.21	13.09	890.28	1171
1993	8	25	600	20.81	910.81	1345	12.23	13.11	890.30	1179
1993	8	25	660	20.80	910.80	1342	12.19	13.07	890.26	1163
1993	8	25	720	20.78	910.78	1338	12.14	13.02	890.21	1143
1993	8	25	780	20.76	910.76	1334	12.13	13.01	890.20	1138
1993	8	25	840	20.74	910.74	1330	12.12	13.00	890.19	1135
1993	8	25	900	20.72	910.72	1326	12.07	12.95	890.14	1113
1993	8	25	960	20.71	910.71	1323	12.01	12.89	890.08	1088
1993	8	25	1020	20.68	910.68	1317	11.97	12.85	890.04	1071
1993	8	25	1080	20.66	910.66	1314	11.96	12.84	890.03	1068
1993	8	25	1140	20.65	910.65	1311	11.96	12.84	890.03	1068
1993	8	25	1200	20.63	910.63	1307	11.87	12.75	889.94	1029
1993	8	25	1260	20.61	910.61	1303	11.84	12.72	889.91	1017
1993	8	25	1320	20.60	910.60	1301	11.79	12.67	889.86	995
1993	8	25	1380	20.58	910.58	1297	11.75	12.63	889.82	978
1993	8	25	1440	20.56	910.56	1293	11.67	12.55	889.74	945
1993	8	26	60	20.54	910.54	1289	11.63	12.51	889.70	925
1993	8	26	120	20.52	910.52	1284	11.61	12.49	889.68	917
1993	8	26	180	20.50	910.50	1280	11.59	12.47	889.66	908
1993	8	26	240	20.48	910.48	1276	11.56	12.44	889.63	894
1993	8	26	300	20.47	910.47	1274	11.57	12.45	889.64	900
1993	8	26	360	20.45	910.45	1270	11.49	12.37	889.56	866
1993	8	26	420	20.42	910.42	1264	11.44	12.32	889.51	847
1993	8	26	480	20.40	910.40	1259	11.44	12.32	889.51	847
1993	8	26	540	20.37	910.37	1253	11.43	12.31	889.50	841
1993	8	26	600	20.35	910.35	1249	11.38	12.26	889.45	821
1993	8	26	660	20.32	910.32	1243	11.37	12.25	889.44	816
1993	8	26	720	20.29	910.29	1237	11.40	12.28	889.47	830
1993	8	26	780	20.27	910.27	1233	11.36	12.24	889.43	813
1993	8	26	840	20.24	910.24	1226	11.28	12.16	889.35	779
1993	8	26	900	20.21	910.21	1220	11.24	12.12	889.31	762
1993	8	26	960	20.17	910.17	1212	11.22	12.10	889.29	754
1993	8	26	1020	20.14	910.14	1206	11.19	12.07	889.26	740
1993	8	26	1080	20.10	910.10	1197	11.18	12.06	889.25	737
1993	8	26	1140	20.06	910.06	1189	11.13	12.01	889.20	715
1993	8	26	1200	20.02	910.02	1181	11.13	12.01	889.20	715
1993	8	26	1260	19.98	909.98	1172	11.10	11.98	889.17	704
1993	8	26	1320	19.93	909.93	1162	11.07	11.95	889.14	690
1993	8	26	1380	19.89	909.89	1154	11.07	11.95	889.14	690
1993	8	26	1440	19.84	909.84	1143	11.08	11.96	889.15	695
1993	8	27	60	19.79	909.79	1133	11.02	11.90	889.09	670
1993	8	27	120	19.75	909.75	1125	10.99	11.87	889.06	656
1993	8	27	180	19.70	909.70	1115	10.96	11.84	889.03	645
1993	8	27	240	19.64	909.64	1104	10.92	11.80	888.99	628
1993	8	27	300	19.58	909.58	1092	10.89	11.77	888.96	614

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	27	360	19.52	909.52	1079	10.85	11.73	888.92	597
1993	8	27	420	19.46	909.46	1066	10.83	11.71	888.90	589
1993	8	27	480	19.38	909.38	1050	10.78	11.66	888.85	570
1993	8	27	540	19.31	909.31	1036	10.69	11.57	888.76	533
1993	8	27	600	19.24	909.24	1021	10.68	11.56	888.75	530
1993	8	27	660	19.17	909.17	1007	10.68	11.56	888.75	530
1993	8	27	720	19.10	909.10	992	10.65	11.53	888.72	521
1993	8	27	780	19.03	909.03	978	10.60	11.48	888.67	507
1993	8	27	840	18.95	908.95	961	10.53	11.41	888.60	487
1993	8	27	900	18.87	908.87	945	10.52	11.40	888.59	485
1993	8	27	960	18.79	908.79	928	10.52	11.40	888.59	485
1993	8	27	1020	18.71	908.71	912	10.47	11.35	888.54	470
1993	8	27	1080	18.64	908.64	898	10.46	11.34	888.53	468
1993	8	27	1140	18.58	908.58	885	10.40	11.28	888.47	451
1993	8	27	1200	18.51	908.51	871	10.40	11.28	888.47	451
1993	8	27	1260	18.45	908.45	858	10.40	11.28	888.47	451
1993	8	27	1320	18.40	908.40	846	10.35	11.23	888.42	437
1993	8	27	1380	18.35	908.35	836	10.30	11.18	888.37	423
1993	8	27	1440	18.30	908.30	826	10.27	11.15	888.34	414
1993	8	28	60	18.25	908.25	815	10.25	11.13	888.32	409
1993	8	28	120	18.20	908.20	805	10.26	11.14	888.33	411
1993	8	28	180	18.17	908.17	799	10.21	11.09	888.28	397
1993	8	28	240	18.13	908.13	791	10.14	11.02	888.21	378
1993	8	28	300	18.10	908.10	785	10.16	11.04	888.23	384
1993	8	28	360	18.07	908.07	779	10.12	11.00	888.19	372
1993	8	28	420	18.04	908.04	772	10.07	10.95	888.14	358
1993	8	28	480	18.01	908.01	766	10.06	10.94	888.13	356
1993	8	28	540	17.98	907.98	760	10.07	10.95	888.14	358
1993	8	28	600	17.95	907.95	754	10.05	10.93	888.12	353
1993	8	28	660	17.92	907.92	748	10.04	10.92	888.11	350
1993	8	28	720	17.91	907.91	746	10.01	10.89	888.08	342
1993	8	28	780	17.89	907.89	742	10.02	10.90	888.09	345
1993	8	28	840	17.87	907.87	737	9.97	10.85	888.04	331
1993	8	28	900	17.85	907.85	734	9.93	10.81	888.00	320
1993	8	28	960	17.84	907.84	731	9.95	10.83	888.02	325
1993	8	28	1020	17.82	907.82	727	9.91	10.79	887.98	314
1993	8	28	1080	17.81	907.81	725	9.91	10.79	887.98	314
1993	8	28	1140	17.79	907.79	721	9.90	10.78	887.97	311
1993	8	28	1200	17.78	907.78	719	9.89	10.77	887.96	309
1993	8	28	1260	17.77	907.77	717	9.86	10.74	887.93	300
1993	8	28	1320	17.75	907.75	713	9.84	10.72	887.91	295
1993	8	28	1380	17.75	907.75	713	9.82	10.70	887.89	289
1993	8	28	1440	17.75	907.75	713	9.87	10.75	887.94	303
1993	8	29	60	17.73	907.73	709	9.85	10.73	887.92	295
1993	8	29	120	17.72	907.72	707	9.82	10.70	887.89	287
1993	8	29	180	17.71	907.71	705	9.81	10.69	887.88	284
1993	8	29	240	17.70	907.70	703	9.84	10.72	887.91	292
1993	8	29	300	17.69	907.69	701	9.79	10.67	887.86	278
1993	8	29	360	17.69	907.69	700	9.81	10.69	887.88	284
1993	8	29	420	17.68	907.68	698	9.83	10.71	887.90	289
1993	8	29	480	17.67	907.67	696	9.78	10.66	887.85	274
1993	8	29	540	17.66	907.66	694	9.83	10.71	887.90	289
1993	8	29	600	17.65	907.65	692	9.80	10.68	887.87	281
1993	8	29	660	17.64	907.64	690	9.83	10.71	887.90	289
1993	8	29	720	17.64	907.64	690	9.76	10.64	887.83	268
1993	8	29	780	17.63	907.63	688	9.79	10.67	887.86	278
1993	8	29	840	17.62	907.62	686	9.80	10.68	887.87	281
1993	8	29	900	17.61	907.61	684	9.84	10.72	887.91	292
1993	8	29	960	17.60	907.60	682	9.78	10.66	887.85	274
1993	8	29	1020	17.60	907.60	682	9.78	10.66	887.85	274
1993	8	29	1080	17.59	907.59	680	9.76	10.64	887.83	268
1993	8	29	1140	17.58	907.58	678	9.80	10.68	887.87	281
1993	8	29	1200	17.57	907.57	676	9.82	10.70	887.89	287
1993	8	29	1260	17.57	907.57	676	9.76	10.64	887.83	268
1993	8	29	1320	17.56	907.56	674	9.76	10.64	887.83	268
1993	8	29	1380	17.56	907.56	674	9.79	10.67	887.86	278
1993	8	29	1440	17.55	907.55	672	9.79	10.67	887.86	278
1993	8	30	60	17.55	907.55	672	9.78	10.66	887.85	274
1993	8	30	120	17.55	907.55	672	9.75	10.63	887.82	265
1993	8	30	180	17.54	907.54	670	9.77	10.65	887.84	271
1993	8	30	240	17.53	907.53	667	9.77	10.65	887.84	271
1993	8	30	300	17.52	907.52	665	9.80	10.68	887.87	281
1993	8	30	360	17.51	907.51	664	9.80	10.68	887.87	281
1993	8	30	420	17.51	907.51	663	9.75	10.63	887.82	265
1993	8	30	480	17.50	907.50	661	9.74	10.62	887.81	262

GAGE HEIGHT & ELEVATION AT USGS GAGES ABOVE DIVERSION AT HORACE & WEST FARGO DIVERSION AT 12TH AVE. NO.				GAGE HEIGHT ABOVE DIVERSION AT HORACE	ELEVATION ABOVE DIVERSION AT HORACE	DISCHARGE ABOVE DIVERSION AT HORACE	GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ADJUSTED* GAGE HEIGHT WEST FARGO DIVERSION AT 12TH AVE. NO.	ELEVATION WEST FARGO DIVERSION AT 12TH AVE. NO.	DISCHARGE WEST FARGO DIVERSION AT 12TH AVE. NO.
YEAR	MONTH	DAY	MINUTE							
* WEST FARGO GAGE HEIGHTS INCREASED 0.88 FEET BASED ON SURVEYS PERFORMED BY USGS PERSONNEL.										
1993	8	30	540	17.49	907.49	659	9.80	10.68	887.87	281
1993	8	30	600	17.48	907.48	657	9.76	10.64	887.83	268
1993	8	30	660	17.48	907.48	657	9.83	10.71	887.90	289
1993	8	30	720	17.47	907.47	655	11.00	11.88	889.07	656
1993	8	30	780	17.47	907.47	655	10.74	11.62	888.81	547
1993	8	30	840	17.45	907.45	651	10.63	11.51	888.70	513
1993	8	30	900	17.44	907.44	649	10.68	11.56	888.75	527
1993	8	30	960	17.43	907.43	647	10.68	11.56	888.75	527
1993	8	30	1020	17.42	907.42	645	10.61	11.49	888.68	507
1993	8	30	1080	17.41	907.41	643	10.47	11.35	888.54	468
1993	8	30	1140	17.40	907.40	641	10.34	11.22	888.41	431
1993	8	30	1200	17.39	907.39	638	10.20	11.08	888.27	392
1993	8	30	1260	17.37	907.37	635	10.03	10.91	888.10	345
1993	8	30	1320	17.37	907.37	634	9.86	10.74	887.93	298
1993	8	30	1380	17.36	907.36	632	9.73	10.61	887.80	258
1993	8	30	1440	17.35	907.35	631	9.61	10.49	887.68	221
1993	8	31	60	17.35	907.35	630	9.45	10.33	887.52	173
1993	8	31	120	17.34	907.34	628	9.36	10.24	887.43	147
1993	8	31	180	17.34	907.34	628	9.25	10.13	887.32	116
1993	8	31	240	17.32	907.32	624	9.15	10.03	887.22	90
1993	8	31	300	17.32	907.32	624	9.09	9.97	887.16	75
1993	8	31	360	17.32	907.32	624	9.00	9.88	887.07	53
1993	8	31	420	17.32	907.32	624	8.93	9.81	887.00	38
1993	8	31	480	17.31	907.31	622	8.85	9.73	886.92	21
1993	8	31	540	17.31	907.31	622	8.78	9.66	886.85	5
1993	8	31	600	17.31	907.31	622	8.77	9.65	886.84	3
1993	8	31	660	17.30	907.30	620	8.83	9.71	886.90	18
1993	8	31	720	17.30	907.30	620	8.84	9.72	886.91	19
1993	8	31	780	17.30	907.30	620	8.81	9.69	886.88	14
1993	8	31	840	17.29	907.29	618	8.76	9.64	886.83	3
1993	8	31	900	17.29	907.29	618	8.71	9.59	886.78	0
1993	8	31	960	17.28	907.28	616	8.65	9.53	886.72	0
1993	8	31	1020	17.28	907.28	616	8.59	9.47	886.66	0
1993	8	31	1080	17.28	907.28	616	8.53	9.41	886.60	0
1993	8	31	1140	17.28	907.28	616	8.49	9.37	886.56	0
1993	8	31	1200	17.27	907.27	614	8.45	9.33	886.52	0
1993	8	31	1260	17.26	907.26	612	8.43	9.31	886.50	0
1993	8	31	1320	17.26	907.26	612	8.39	9.27	886.46	0
1993	8	31	1380	17.26	907.26	612	8.37	9.25	886.44	0
1993	8	31	1440	17.25	907.25	610	8.35	9.23	886.42	0
MAXIMUM VALUES				24.32	914.32	3409	21.02	21.90	899.09	3256

APPENDIX B
MAPLE RIVER AT ENDERLIN, ND
DISCHARGES AND GAGE HEIGHTS

APPENDIX B
MAPLE RIVER AT ENDERLIN, ND

DISCHARGES

/HARWOOD/ENDERLIN/FLOW/01JUL1993/1HOUR/OBS/

Start: 15JUL1993 at 0100 hours; End: 31JUL1993 at 2400 hours; Number: 408

Units: CFS	Type: INST-VAL						
15JUL93, 0100;	44.0	44.0	44.0	44.0	44.0	44.7	
15JUL93, 0700;	46.1	48.3	51.0	56.0	57.4	60.9	
15JUL93, 1300;	63.0	61.6	60.1	59.4	58.7	58.1	
15JUL93, 1900;	57.4	61.6	70.6	81.2	82.0	82.9	
16JUL93, 0100;	89.1	103.3	134.5	179.4	229.3	266.9	
16JUL93, 0700;	285.2	312.0	357.4	423.1	517.2	686.1	
16JUL93, 1300;	848.3	983.4	1062.0	1079.0	1096.2	1083.3	
16JUL93, 1900;	1032.6	1024.3	1020.1	1028.4	1053.5	1113.6	
17JUL93, 0100;	1226.0	1335.5	1389.9	1430.4	1456.0	1445.7	
17JUL93, 0700;	1445.7	1435.5	1420.2	1430.4	1508.1	1757.1	
17JUL93, 1300;	2094.4	2455.0	2705.4	3060.5	3295.4	3595.4	
17JUL93, 1900;	3586.3	3622.6	3741.6	3710.9	3710.9	3731.3	
18JUL93, 0100;	3731.3	3680.4	3710.9	3690.5	3640.8	3650.0	
18JUL93, 0700;	3680.4	3660.1	3595.4	3622.6	3586.3	3496.5	
18JUL93, 1300;	3478.8	3408.2	3329.9	3286.9	3295.4	3244.2	
18JUL93, 1900;	3235.7	3193.4	3118.3	2979.3	2963.2	2907.3	
19JUL93, 0100;	2883.5	2891.4	2844.2	2813.0	2782.0	2758.9	
19JUL93, 0700;	2675.2	2697.9	2637.7	2645.2	2615.3	2571.0	
19JUL93, 1300;	2541.7	2549.0	2519.8	2519.8	2498.1	2483.7	
19JUL93, 1900;	2455.0	2433.6	2433.6	2405.3	2405.3	2412.4	
20JUL93, 0100;	2412.4	2412.4	2398.3	2377.2	2391.3	2398.3	
20JUL93, 0700;	2370.2	2363.2	2363.2	2349.3	2349.3	2342.4	
20JUL93, 1300;	2342.4	2321.6	2321.6	2307.9	2294.1	2287.3	
20JUL93, 1900;	2260.1	2260.1	2239.8	2212.9	2199.5	2166.3	
21JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
21JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
21JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
21JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
22JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
22JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
22JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
22JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
23JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
23JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
23JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
23JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
24JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
24JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
24JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
24JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
25JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
25JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
25JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
25JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
26JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
26JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
26JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
26JUL93, 1900;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
27JUL93, 0100;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
27JUL93, 0700;	-901.0	-901.0	-901.0	-901.0	-901.0	-901.0	
27JUL93, 1300;	-901.0	-901.0	-901.0	-901.0	1226.0	1226.0	
27JUL93, 1900;	1216.8	1221.4	1221.4	1221.4	1221.4	1221.4	
28JUL93, 0100;	1230.7	1230.7	1235.3	1235.3	1240.0	1244.6	
28JUL93, 0700;	1244.6	1244.6	1254.0	1254.0	1258.7	1263.4	

-901.0 INDICATES THAT DATA IS MISSING.

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

DISCHARGES

28JUL93, 1300;	1268.2	1268.2	1272.9	1272.9	1277.6	1282.4
28JUL93, 1900;	1282.4	1282.4	1287.2	1282.4	1282.4	1282.4
29JUL93, 0100;	1292.0	1292.0	1292.0	1296.7	1296.7	1296.7
29JUL93, 0700;	1301.5	1301.5	1311.2	1316.0	1316.0	1316.0
29JUL93, 1300;	1316.0	1316.0	1316.0	1316.0	1316.0	1316.0
29JUL93, 1900;	1316.0	1311.2	1306.4	1301.5	1301.5	1292.0
30JUL93, 0100;	1296.7	1292.0	1287.2	1282.4	1282.4	1277.6
30JUL93, 0700;	1272.9	1268.2	1268.2	1268.2	1258.7	1254.0
30JUL93, 1300;	1249.3	1244.6	1240.0	1235.3	1230.7	1226.0
30JUL93, 1900;	1221.4	1216.8	1216.8	1212.2	1203.0	1203.0
31JUL93, 0100;	1198.4	1203.0	1203.0	1203.0	1203.0	1203.0
31JUL93, 0700;	1193.9	1193.9	1189.3	1193.9	1193.9	1189.3
31JUL93, 1300;	1189.3	1189.3	1189.3	1193.9	1198.4	1198.4
31JUL93, 1900;	1198.4	1203.0	1203.0	1203.0	1216.8	1216.8

/HARWOOD/ENDERLIN/FLOW/01AUG1993/1HOUR/OBS/

Start: 01AUG1993 at 0100 hours; End: 31AUG1993 at 2400 hours; Number: 744

Units: CFS Type: INST-VAL

01AUG93, 0100;	1216.8	1226.0	1226.0	1235.3	1235.3	1240.0
01AUG93, 0700;	1244.6	1244.6	1254.0	1254.0	1258.7	1258.7
01AUG93, 1300;	1263.4	1263.4	1263.4	1268.2	1272.9	1272.9
01AUG93, 1900;	1277.6	1277.6	1282.4	1287.2	1287.2	1292.0
02AUG93, 0100;	1292.0	1301.5	1301.5	1301.5	1301.5	1306.4
02AUG93, 0700;	1306.4	1311.2	1316.0	1320.9	1320.9	1325.7
02AUG93, 1300;	1330.6	1330.6	1330.6	1325.7	1325.7	1325.7
02AUG93, 1900;	1325.7	1325.7	1320.9	1316.0	1316.0	1311.2
03AUG93, 0100;	1301.5	1306.4	1306.4	1296.7	1296.7	1296.7
03AUG93, 0700;	1292.0	1292.0	1287.2	1287.2	1282.4	1282.4
03AUG93, 1300;	1277.6	1277.6	1272.9	1263.4	1263.4	1263.4
03AUG93, 1900;	1254.0	1254.0	1249.3	1244.6	1244.6	1240.0
04AUG93, 0100;	1235.3	1230.7	1230.7	1226.0	1221.4	1212.2
04AUG93, 0700;	1212.2	1207.6	1203.0	1203.0	1198.4	1193.9
04AUG93, 1300;	1184.8	1184.8	1180.2	1175.7	1171.2	1166.7
04AUG93, 1900;	1162.2	1153.3	1148.8	1144.4	1139.9	1131.1
05AUG93, 0100;	1131.1	1126.7	1117.9	1117.9	1109.2	1109.2
05AUG93, 0700;	1104.9	1100.5	1096.2	1091.9	1091.9	1087.6
05AUG93, 1300;	1083.3	1079.0	1074.7	1070.5	1066.2	1062.0
05AUG93, 1900;	1053.5	1049.3	1045.1	1036.8	1032.6	1028.4
06AUG93, 0100;	1024.3	1020.1	1016.0	1007.8	1003.7	999.6
06AUG93, 0700;	995.5	991.5	987.4	983.4	979.4	975.3
06AUG93, 1300;	967.3	967.3	963.3	955.4	951.4	947.5
06AUG93, 1900;	935.7	935.7	927.9	924.0	916.2	916.2
07AUG93, 0100;	904.7	900.9	893.2	881.9	881.9	881.9
07AUG93, 0700;	874.3	870.6	870.6	863.1	852.0	855.7
07AUG93, 1300;	852.0	841.0	833.7	833.7	830.0	819.2
07AUG93, 1900;	815.6	812.0	804.8	804.8	797.8	797.8
08AUG93, 0100;	794.2	790.7	783.7	783.7	776.7	773.2
08AUG93, 0700;	769.7	766.3	762.8	759.3	752.5	752.5
08AUG93, 1300;	745.7	745.7	738.9	735.5	732.2	728.8
08AUG93, 1900;	728.8	728.8	725.5	715.5	715.5	708.9
09AUG93, 0100;	705.6	702.3	699.1	692.5	692.5	686.1
09AUG93, 0700;	686.1	682.9	679.7	676.4	676.4	673.3
09AUG93, 1300;	666.9	663.7	663.7	660.6	657.4	654.3
09AUG93, 1900;	651.2	644.9	641.8	638.8	635.7	629.5
10AUG93, 0100;	626.5	623.4	620.4	617.4	614.4	611.4
10AUG93, 0700;	611.4	608.4	605.4	602.4	599.4	596.5

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

DISCHARGES

10AUG93, 1300;	596.5	590.6	587.6	570.2	573.1	564.5
10AUG93, 1900;	570.2	570.2	558.8	558.8	556.0	550.3
11AUG93, 0100;	547.5	547.5	547.5	547.5	544.7	541.9
11AUG93, 0700;	536.4	536.4	536.4	530.9	530.9	525.4
11AUG93, 1300;	519.9	511.8	517.2	509.1	506.5	511.8
11AUG93, 1900;	509.1	511.8	498.5	503.8	506.5	495.9
12AUG93, 0100;	501.2	503.8	503.8	501.2	503.8	498.5
12AUG93, 0700;	488.0	493.2	498.5	498.5	498.5	488.0
12AUG93, 1300;	498.5	493.2	475.1	493.2	488.0	477.6
12AUG93, 1900;	467.4	475.1	467.4	467.4	467.4	462.4
13AUG93, 0100;	467.4	462.4	467.4	459.8	457.3	467.4
13AUG93, 0700;	457.3	457.3	454.8	454.8	454.8	462.4
13AUG93, 1300;	462.4	475.1	457.3	442.5	440.0	462.4
13AUG93, 1900;	444.9	442.5	447.4	444.9	444.9	442.5
14AUG93, 0100;	444.9	442.5	442.5	442.5	454.8	462.4
14AUG93, 0700;	459.8	454.8	454.8	444.9	444.9	442.5
14AUG93, 1300;	442.5	440.0	437.6	435.1	432.7	432.7
14AUG93, 1900;	432.7	432.7	430.3	427.9	425.5	425.5
15AUG93, 0100;	423.1	423.1	420.7	418.3	418.3	416.0
15AUG93, 0700;	413.6	413.6	411.3	411.3	408.9	406.6
15AUG93, 1300;	406.6	406.6	399.6	399.6	397.4	395.1
15AUG93, 1900;	395.1	395.1	395.1	390.5	390.5	386.0
16AUG93, 0100;	386.0	383.7	381.5	381.5	381.5	377.0
16AUG93, 0700;	377.0	370.4	374.8	374.8	374.8	374.8
16AUG93, 1300;	372.6	370.4	370.4	368.2	366.0	363.9
16AUG93, 1900;	361.7	361.7	361.7	359.5	357.4	355.2
17AUG93, 0100;	355.2	351.0	353.1	351.0	353.1	346.7
17AUG93, 0700;	346.7	346.7	342.5	342.5	340.4	338.4
17AUG93, 1300;	338.4	336.3	332.2	332.2	330.1	328.1
17AUG93, 1900;	328.1	326.0	324.0	320.0	320.0	318.0
18AUG93, 0100;	318.0	316.0	314.0	314.0	310.1	312.0
18AUG93, 0700;	310.1	308.1	306.2	306.2	304.2	304.2
18AUG93, 1300;	302.3	300.3	298.4	298.4	296.5	296.5
18AUG93, 1900;	294.6	290.8	290.8	288.9	287.0	287.0
19AUG93, 0100;	287.0	285.2	285.2	283.3	281.5	281.5
19AUG93, 0700;	283.3	279.6	279.6	279.6	279.6	277.8
19AUG93, 1300;	277.8	275.9	275.9	275.9	274.1	270.5
19AUG93, 1900;	270.5	270.5	270.5	270.5	268.7	268.7
20AUG93, 0100;	268.7	266.9	266.9	266.9	266.9	265.1
20AUG93, 0700;	256.3	259.8	259.8	265.1	263.3	265.1
20AUG93, 1300;	259.8	261.5	259.8	258.0	256.3	254.5
20AUG93, 1900;	254.5	251.1	251.1	254.5	252.8	252.8
21AUG93, 0100;	252.8	251.1	251.1	252.8	252.8	245.9
21AUG93, 0700;	249.4	247.6	245.9	245.9	249.4	244.2
21AUG93, 1300;	242.6	247.6	245.9	240.9	240.9	239.2
21AUG93, 1900;	240.9	240.9	240.9	237.5	235.9	234.2
22AUG93, 0100;	234.2	234.2	232.6	230.9	230.9	230.9
22AUG93, 0700;	229.3	229.3	226.1	229.3	226.1	226.1
22AUG93, 1300;	226.1	219.6	224.4	224.4	221.2	226.1
22AUG93, 1900;	224.4	224.4	214.9	219.6	216.5	216.5
23AUG93, 0100;	218.1	213.4	208.7	210.3	211.8	211.8
23AUG93, 0700;	211.8	211.8	210.3	210.3	208.7	207.2
23AUG93, 1300;	207.2	207.2	198.1	201.1	199.6	198.1
23AUG93, 1900;	202.6	204.1	201.1	202.6	201.1	199.6
24AUG93, 0100;	199.6	196.7	198.1	198.1	198.1	196.7
24AUG93, 0700;	196.7	195.2	195.2	195.2	195.2	193.7
24AUG93, 1300;	193.7	193.7	193.7	192.3	187.9	187.9

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

DISCHARGES

24AUG93, 1900;	185.0	189.4	187.9	189.4	185.0	187.9
25AUG93, 0100;	180.8	186.5	186.5	185.0	180.8	180.8
25AUG93, 0700;	180.8	182.2	180.8	182.2	178.0	178.0
25AUG93, 1300;	180.8	176.6	173.9	175.2	175.2	172.5
25AUG93, 1900;	173.9	175.2	172.5	172.5	173.9	173.9
26AUG93, 0100;	173.9	173.9	171.1	168.4	167.1	168.4
26AUG93, 0700;	167.1	168.4	169.8	163.1	164.4	167.1
26AUG93, 1300;	160.5	160.5	160.5	159.2	159.2	157.9
26AUG93, 1900;	157.9	156.6	156.6	156.6	155.3	154.1
27AUG93, 0100;	154.1	154.1	152.8	151.5	151.5	151.5
27AUG93, 0700;	150.3	151.5	151.5	152.8	149.0	149.0
27AUG93, 1300;	149.0	149.0	149.0	149.0	147.8	146.5
27AUG93, 1900;	146.5	144.1	144.1	142.9	142.9	142.9
28AUG93, 0100;	142.9	142.9	142.9	141.7	141.7	141.7
28AUG93, 0700;	140.5	140.5	140.5	139.3	139.3	136.9
28AUG93, 1300;	136.9	136.9	135.7	134.5	134.5	134.5
28AUG93, 1900;	134.5	134.5	134.5	134.5	134.5	134.5
29AUG93, 0100;	134.5	134.5	134.5	133.4	133.4	132.2
29AUG93, 0700;	132.2	132.2	132.2	131.1	131.1	131.1
29AUG93, 1300;	129.9	129.9	127.7	127.7	127.7	127.7
29AUG93, 1900;	125.4	124.3	122.1	122.1	122.1	122.1
30AUG93, 0100;	123.2	122.1	124.3	124.3	122.1	121.0
30AUG93, 0700;	121.0	119.9	121.0	121.0	123.2	123.2
30AUG93, 1300;	122.1	121.0	119.9	121.0	119.9	118.8
30AUG93, 1900;	118.8	118.8	116.7	116.7	115.6	115.6
31AUG93, 0100;	115.6	114.5	116.7	115.6	114.5	114.5
31AUG93, 0700;	115.6	113.5	115.6	115.6	114.5	114.5
31AUG93, 1300;	114.5	114.5	113.5	112.4	113.5	113.5
31AUG93, 1900;	113.5	112.4	113.5	115.6	112.4	117.7

GAGE HEIGHTS (X 100)

/MAPLE/ENDERLIN/ELEV/01JUL1993/1HOUR/OBS/

Start: 15JUL1993 at 0100 hours; End: 31JUL1993 at 2400 hours; Number: 408

Units: FEET

Type: INST-VAL

15JUL93, 0100;	414.	414.	414.	414.	414.	415.
15JUL93, 0700;	417.	420.	424.	431.	433.	438.
15JUL93, 1300;	441.	439.	437.	436.	435.	434.
15JUL93, 1900;	434.	440.	452.	465.	466.	467.
16JUL93, 0100;	474.	489.	518.	553.	588.	610.
16JUL93, 0700;	621.	635.	658.	689.	727.	786.
16JUL93, 1300;	835.	872.	892.	896.	901.	897.
16JUL93, 1900;	885.	883.	882.	884.	890.	904.
17JUL93, 0100;	930.	954.	966.	975.	980.	978.
17JUL93, 0700;	978.	976.	972.	974.	990.	1034.
17JUL93, 1300;	1085.	1133.	1165.	1206.	1233.	1265.
17JUL93, 1900;	1266.	1271.	1283.	1280.	1279.	1281.
18JUL93, 0100;	1281.	1276.	1279.	1276.	1271.	1272.
18JUL93, 0700;	1275.	1273.	1265.	1268.	1264.	1254.
18JUL93, 1300;	1253.	1245.	1237.	1233.	1234.	1229.
18JUL93, 1900;	1227.	1222.	1215.	1200.	1199.	1192.
19JUL93, 0100;	1190.	1190.	1185.	1182.	1178.	1176.
19JUL93, 0700;	1167.	1170.	1163.	1163.	1160.	1156.
19JUL93, 1300;	1152.	1153.	1150.	1150.	1147.	1145.
19JUL93, 1900;	1141.	1137.	1137.	1133.	1133.	1134.
20JUL93, 0100;	1134.	1134.	1132.	1129.	1131.	1132.
20JUL93, 0700;	1128.	1127.	1127.	1125.	1125.	1123.

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

GAGE HEIGHTS (X 100)

20JUL93, 1300;	1123.	1120.	1120.	1118.	1116.	1115.
20JUL93, 1900;	1111.	1111.	1107.	1103.	1101.	1096.
21JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
21JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
21JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
21JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
22JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
22JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
22JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
22JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
23JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
23JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
23JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
23JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
24JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
24JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
24JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
24JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
25JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
25JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
25JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
25JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
26JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
26JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
26JUL93, 1300;	-901.	-901.	-901.	-901.	-901.	-901.
26JUL93, 1900;	-901.	-901.	-901.	-901.	-901.	-901.
27JUL93, 0100;	-901.	-901.	-901.	-901.	-901.	-901.
27JUL93, 0700;	-901.	-901.	-901.	-901.	-901.	-901.
27JUL93, 1300;	-901.	-901.	-901.	-901.	916.	916.
27JUL93, 1900;	914.	916.	916.	916.	916.	916.
28JUL93, 0100;	917.	917.	918.	918.	919.	920.
28JUL93, 0700;	921.	921.	922.	922.	923.	924.
28JUL93, 1300;	925.	925.	926.	926.	926.	927.
28JUL93, 1900;	928.	928.	928.	928.	928.	928.
29JUL93, 0100;	929.	929.	929.	930.	930.	930.
29JUL93, 0700;	931.	931.	932.	933.	933.	933.
29JUL93, 1300;	933.	933.	933.	933.	933.	933.
29JUL93, 1900;	932.	931.	930.	929.	929.	927.
30JUL93, 0100;	927.	926.	925.	924.	924.	923.
30JUL93, 0700;	922.	921.	920.	920.	918.	917.
30JUL93, 1300;	916.	915.	914.	913.	911.	910.
30JUL93, 1900;	909.	908.	907.	906.	904.	904.
31JUL93, 0100;	903.	903.	903.	903.	903.	903.
31JUL93, 0700;	901.	901.	900.	900.	900.	899.
31JUL93, 1300;	899.	899.	899.	900.	900.	900.
31JUL93, 1900;	900.	901.	901.	901.	903.	903.

-901. INDICATES THAT DATA IS MISSING.

/MAPLE/ENDERLIN/ELEV/01AUG1993/1HOUR/OBS/

Start: 01AUG1993 at 0100 hours; End: 31AUG1993 at 2400 hours; Number: 744

Units: FEET

Type: INST-VAL

01AUG93, 0100;	903.	905.	905.	906.	906.	907.
01AUG93, 0700;	908.	908.	909.	909.	910.	911.
01AUG93, 1300;	911.	911.	911.	912.	912.	912.
01AUG93, 1900;	913.	913.	913.	914.	914.	915.
02AUG93, 0100;	915.	916.	916.	916.	916.	916.
02AUG93, 0700;	916.	917.	918.	918.	918.	919.

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

		GAGE HEIGHTS (X 100)				
02AUG93, 1300;	920.	920.	920.	919.	919.	919.
02AUG93, 1900;	919.	919.	918.	917.	917.	916.
03AUG93, 0100;	914.	915.	915.	913.	913.	913.
03AUG93, 0700;	912.	912.	911.	911.	910.	910.
03AUG93, 1300;	909.	909.	908.	906.	906.	906.
03AUG93, 1900;	904.	904.	903.	902.	902.	901.
04AUG93, 0100;	900.	899.	899.	898.	897.	895.
04AUG93, 0700;	895.	894.	893.	893.	892.	891.
04AUG93, 1300;	889.	889.	888.	887.	886.	885.
04AUG93, 1900;	884.	882.	881.	880.	879.	877.
05AUG93, 0100;	877.	876.	874.	874.	872.	872.
05AUG93, 0700;	871.	870.	869.	868.	868.	867.
05AUG93, 1300;	866.	865.	864.	863.	862.	861.
05AUG93, 1900;	859.	858.	857.	855.	854.	853.
06AUG93, 0100;	852.	851.	850.	848.	847.	846.
06AUG93, 0700;	845.	844.	843.	842.	841.	840.
06AUG93, 1300;	838.	838.	837.	835.	834.	833.
06AUG93, 1900;	830.	830.	828.	827.	825.	825.
07AUG93, 0100;	823.	822.	820.	817.	817.	817.
07AUG93, 0700;	815.	814.	814.	812.	809.	810.
07AUG93, 1300;	809.	806.	804.	804.	803.	800.
07AUG93, 1900;	799.	798.	796.	796.	794.	794.
08AUG93, 0100;	793.	792.	790.	790.	788.	787.
08AUG93, 0700;	786.	785.	784.	783.	781.	781.
08AUG93, 1300;	779.	779.	777.	776.	775.	774.
08AUG93, 1900;	774.	774.	773.	770.	770.	768.
09AUG93, 0100;	767.	766.	765.	763.	763.	761.
09AUG93, 0700;	761.	760.	759.	758.	758.	757.
09AUG93, 1300;	755.	754.	754.	753.	752.	751.
09AUG93, 1900;	750.	748.	747.	746.	745.	743.
10AUG93, 0100;	742.	741.	740.	739.	738.	737.
10AUG93, 0700;	737.	736.	735.	734.	733.	732.
10AUG93, 1300;	732.	730.	729.	723.	724.	721.
10AUG93, 1900;	723.	723.	719.	719.	718.	716.
11AUG93, 0100;	715.	715.	715.	715.	714.	713.
11AUG93, 0700;	711.	711.	711.	709.	709.	707.
11AUG93, 1300;	705.	702.	704.	701.	700.	702.
11AUG93, 1900;	701.	702.	697.	699.	700.	696.
12AUG93, 0100;	698.	699.	699.	698.	699.	697.
12AUG93, 0700;	693.	695.	697.	697.	697.	693.
12AUG93, 1300;	697.	695.	688.	695.	693.	689.
12AUG93, 1900;	685.	688.	685.	685.	685.	683.
13AUG93, 0100;	685.	683.	685.	682.	681.	685.
13AUG93, 0700;	681.	681.	680.	680.	680.	683.
13AUG93, 1300;	683.	688.	681.	675.	674.	683.
13AUG93, 1900;	676.	675.	677.	676.	676.	675.
14AUG93, 0100;	675.	674.	674.	674.	679.	682.
14AUG93, 0700;	681.	679.	679.	675.	675.	674.
14AUG93, 1300;	674.	673.	672.	671.	670.	670.
14AUG93, 1900;	670.	670.	670.	669.	668.	668.
15AUG93, 0100;	667.	667.	666.	665.	665.	664.
15AUG93, 0700;	663.	663.	662.	662.	661.	660.
15AUG93, 1300;	660.	660.	657.	657.	656.	655.
15AUG93, 1900;	655.	655.	655.	653.	653.	651.
16AUG93, 0100;	651.	650.	649.	649.	649.	647.
16AUG93, 0700;	647.	644.	646.	646.	646.	646.
16AUG93, 1300;	645.	644.	644.	643.	642.	641.
16AUG93, 1900;	640.	640.	640.	639.	638.	637.

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

GAGE HEIGHTS (X 100)

17AUG93, 0100;	637.	635.	636.	635.	636.	633.
17AUG93, 0700;	633.	633.	631.	631.	630.	629.
17AUG93, 1300;	629.	628.	626.	626.	625.	624.
17AUG93, 1900;	624.	623.	622.	620.	620.	619.
18AUG93, 0100;	619.	618.	617.	617.	615.	616.
18AUG93, 0700;	615.	614.	613.	613.	612.	612.
18AUG93, 1300;	611.	610.	609.	609.	608.	608.
18AUG93, 1900;	607.	605.	605.	604.	603.	603.
19AUG93, 0100;	603.	602.	602.	601.	600.	600.
19AUG93, 0700;	601.	599.	599.	599.	599.	598.
19AUG93, 1300;	598.	597.	597.	597.	596.	594.
19AUG93, 1900;	594.	594.	594.	594.	593.	593.
20AUG93, 0100;	593.	592.	592.	592.	592.	591.
20AUG93, 0700;	586.	588.	588.	591.	590.	591.
20AUG93, 1300;	588.	589.	588.	587.	586.	585.
20AUG93, 1900;	585.	583.	583.	585.	584.	584.
21AUG93, 0100;	583.	582.	582.	583.	583.	579.
21AUG93, 0700;	581.	580.	579.	579.	581.	578.
21AUG93, 1300;	577.	580.	579.	576.	576.	575.
21AUG93, 1900;	576.	576.	576.	574.	573.	572.
22AUG93, 0100;	572.	572.	571.	570.	570.	570.
22AUG93, 0700;	569.	569.	567.	569.	567.	567.
22AUG93, 1300;	567.	563.	566.	566.	564.	567.
22AUG93, 1900;	566.	566.	560.	563.	561.	561.
23AUG93, 0100;	562.	559.	556.	557.	558.	558.
23AUG93, 0700;	558.	558.	557.	557.	556.	555.
23AUG93, 1300;	555.	555.	550.	552.	551.	550.
23AUG93, 1900;	553.	554.	552.	553.	552.	551.
24AUG93, 0100;	551.	549.	550.	550.	550.	549.
24AUG93, 0700;	549.	548.	548.	548.	548.	547.
24AUG93, 1300;	547.	547.	547.	546.	543.	543.
24AUG93, 1900;	541.	544.	543.	544.	541.	543.
25AUG93, 0100;	538.	542.	542.	541.	538.	538.
25AUG93, 0700;	538.	539.	538.	539.	536.	536.
25AUG93, 1300;	538.	535.	533.	534.	534.	532.
25AUG93, 1900;	533.	534.	532.	532.	533.	533.
26AUG93, 0100;	533.	533.	531.	529.	528.	529.
26AUG93, 0700;	528.	529.	530.	525.	526.	528.
26AUG93, 1300;	523.	523.	523.	522.	522.	521.
26AUG93, 1900;	521.	520.	520.	520.	519.	518.
27AUG93, 0100;	518.	518.	517.	516.	516.	516.
27AUG93, 0700;	515.	516.	516.	517.	514.	514.
27AUG93, 1300;	514.	514.	514.	514.	513.	512.
27AUG93, 1900;	512.	510.	510.	509.	509.	509.
28AUG93, 0100;	508.	508.	508.	507.	507.	507.
28AUG93, 0700;	506.	506.	506.	505.	505.	503.
28AUG93, 1300;	503.	503.	502.	501.	501.	501.
28AUG93, 1900;	501.	501.	501.	501.	501.	501.
29AUG93, 0100;	501.	501.	501.	500.	500.	499.
29AUG93, 0700;	499.	499.	499.	498.	498.	498.
29AUG93, 1300;	497.	497.	495.	495.	495.	495.
29AUG93, 1900;	493.	492.	490.	490.	490.	490.
30AUG93, 0100;	491.	490.	492.	492.	490.	489.
30AUG93, 0700;	489.	488.	489.	489.	491.	491.
30AUG93, 1300;	490.	489.	488.	489.	488.	487.
30AUG93, 1900;	487.	487.	485.	485.	484.	484.
31AUG93, 0100;	484.	483.	485.	484.	483.	483.

APPENDIX B (continued)
MAPLE RIVER AT ENDERLIN, ND

GAGE HEIGHTS (X 100)

31AUG93, 0700;	484.	482.	484.	484.	483.	483.
31AUG93, 1300;	483.	483.	482.	481.	482.	482.
31AUG93, 1900;	482.	481.	482.	484.	481.	486.

APPENDIX C
RUSH RIVER AT AMENIA, ND
DISCHARGES AND GAGE HEIGHTS

APPENDIX C
RUSH RIVER AT AMENIA, ND

DISCHARGES

/HARWOOD/AMENIA/FLOW/01JUL1993/1HOUR/OBS/

Start: 15JUL1993 at 0100 hours; End: 31JUL1993 at 2400 hours; Number: 408

Units: CFS

Type: INST-VAL

15JUL93, 0100;	5.9	5.3	5.3	5.1	5.1	5.1
15JUL93, 0700;	5.1	5.0	5.1	5.7	5.7	5.7
15JUL93, 1300;	5.7	5.7	5.9	5.9	6.1	6.1
15JUL93, 1900;	6.3	6.3	6.5	7.0	7.9	10.9
16JUL93, 0100;	14.2	18.5	49.2	102.6	182.8	233.1
16JUL93, 0700;	274.3	303.5	342.3	383.9	422.0	486.5
16JUL93, 1300;	571.4	703.8	860.7	1135.9	1398.2	1690.0
16JUL93, 1900;	1859.1	2109.8	2318.5	2468.3	2710.4	2710.4
17JUL93, 0100;	2884.1	2884.1	2974.8	2974.8	2044.3	1801.0
17JUL93, 0700;	1585.4	1440.0	1317.9	1070.0	971.8	807.8
17JUL93, 1300;	732.2	717.9	648.3	608.9	583.8	559.3
17JUL93, 1900;	535.8	521.8	497.8	483.0	476.2	459.3
18JUL93, 0100;	453.7	442.1	433.0	424.2	419.8	409.1
18JUL93, 0700;	400.6	394.3	388.0	377.8	369.7	361.7
18JUL93, 1300;	353.8	344.2	338.4	330.9	319.8	314.3
18JUL93, 1900;	307.1	300.0	293.0	287.8	282.7	274.3
19JUL93, 0100;	267.7	262.8	258.0	253.2	246.9	243.8
19JUL93, 0700;	240.7	236.1	233.1	225.6	224.2	218.3
19JUL93, 1300;	215.5	211.2	205.6	202.8	197.3	196.0
19JUL93, 1900;	191.9	189.3	185.4	181.5	178.9	175.1
20JUL93, 0100;	173.8	170.1	167.6	162.8	160.4	158.0
20JUL93, 0700;	155.7	153.3	151.0	148.8	146.5	143.1
20JUL93, 1300;	142.0	138.7	136.6	135.5	134.4	131.2
20JUL93, 1900;	129.1	126.1	124.0	122.0	120.0	118.0
21JUL93, 0100;	116.9	115.9	113.9	112.9	111.9	111.9
21JUL93, 0700;	111.0	110.0	110.0	109.0	107.4	106.6
21JUL93, 1300;	105.0	104.2	102.6	101.8	100.3	98.9
21JUL93, 1900;	97.5	96.1	94.7	93.4	92.2	91.0
22JUL93, 0100;	89.8	87.4	86.2	84.5	83.9	82.1
22JUL93, 0700;	81.0	79.8	78.7	77.0	76.5	75.4
22JUL93, 1300;	74.8	74.3	72.6	71.0	70.5	69.4
22JUL93, 1900;	68.9	68.3	66.7	66.2	65.2	64.7
23JUL93, 0100;	64.2	63.1	62.6	61.6	61.1	60.6
23JUL93, 0700;	59.1	58.6	57.6	57.2	56.7	56.2
23JUL93, 1300;	55.7	54.8	54.8	53.8	53.3	53.3
23JUL93, 1900;	52.9	51.9	51.5	51.9	51.0	50.6
24JUL93, 0100;	50.1	49.6	49.2	49.2	48.3	47.8
24JUL93, 0700;	47.4	47.4	46.9	46.9	46.5	46.9
24JUL93, 1300;	48.3	51.5	51.5	51.5	51.0	50.1
24JUL93, 1900;	49.6	51.9	55.7	55.7	56.2	58.6
25JUL93, 0100;	62.6	68.9	77.6	86.2	98.2	118.0
25JUL93, 0700;	149.9	191.9	236.1	271.0	298.2	319.8
25JUL93, 1300;	338.4	350.0	361.7	371.7	388.0	402.7
25JUL93, 1900;	419.8	439.8	456.0	483.0	521.8	577.6
26JUL93, 0100;	628.3	648.3	703.8	717.9	717.9	703.8
26JUL93, 0700;	732.2	717.9	703.8	703.8	638.3	628.3
26JUL93, 1300;	628.3	590.0	571.4	571.4	547.4	530.0
26JUL93, 1900;	517.8	505.7	490.0	486.5	476.2	469.4
27JUL93, 0100;	456.0	449.0	439.8	430.8	426.4	417.7
27JUL93, 0700;	411.2	404.8	400.6	390.1	383.9	373.7
27JUL93, 1300;	369.7	363.7	353.8	346.1	338.4	334.6
27JUL93, 1900;	325.3	321.6	314.3	308.9	303.5	298.2
28JUL93, 0100;	293.0	287.8	281.0	279.3	274.3	269.3
28JUL93, 0700;	264.4	261.2	256.4	253.2	248.4	245.3

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

DISCHARGES

28JUL93, 1300;	239.1	236.1	231.6	227.1	224.2	221.2
28JUL93, 1900;	218.3	212.6	209.8	204.2	200.1	196.0
29JUL93, 0100;	193.3	189.3	186.7	182.8	178.9	176.4
29JUL93, 0700;	172.6	170.1	166.4	164.0	160.4	159.2
29JUL93, 1300;	155.7	153.3	151.0	148.8	147.6	145.4
29JUL93, 1900;	142.0	139.8	137.6	136.6	134.4	132.3
30JUL93, 0100;	130.2	127.1	126.1	125.0	123.0	122.0
30JUL93, 0700;	120.0	118.0	115.9	114.9	114.9	112.9
30JUL93, 1300;	111.9	111.0	109.0	108.2	106.6	105.0
30JUL93, 1900;	105.0	103.4	102.6	101.0	101.0	100.3
31JUL93, 0100;	98.9	98.2	96.8	96.1	94.7	93.4
31JUL93, 0700;	92.8	91.6	90.4	89.8	89.2	88.6
31JUL93, 1300;	87.4	86.8	86.2	85.0	85.0	84.5
31JUL93, 1900;	83.3	82.7	82.1	81.0	80.4	79.8

/HARWOOD/AMENIA/FLOW/01AUG1993/1HOUR/OBS/

Start: 01AUG1993 at 0100 hours; End: 31AUG1993 at 2400 hours; Number: 744

Units: CFS

Type: INST-VAL

01AUG93, 0100;	79.3	78.7	77.6	77.6	77.0	75.9
01AUG93, 0700;	75.4	74.8	74.3	73.7	73.2	73.2
01AUG93, 1300;	72.1	72.1	71.0	70.5	70.5	69.9
01AUG93, 1900;	69.4	68.9	68.3	67.8	67.3	66.2
02AUG93, 0100;	66.2	65.2	65.2	64.7	64.7	63.6
02AUG93, 0700;	63.6	63.1	62.6	62.1	61.6	61.6
02AUG93, 1300;	61.6	61.1	60.6	60.6	60.1	59.6
02AUG93, 1900;	59.1	59.1	59.1	58.6	57.6	57.6
03AUG93, 0100;	57.6	57.6	57.2	56.7	56.2	55.7
03AUG93, 0700;	55.7	55.2	54.8	54.3	54.3	54.3
03AUG93, 1300;	53.8	52.9	52.9	52.9	52.4	51.9
03AUG93, 1900;	51.9	51.9	51.5	51.5	51.0	50.6
04AUG93, 0100;	50.6	50.1	49.6	49.6	49.2	48.7
04AUG93, 0700;	48.3	48.3	47.8	47.4	46.9	46.9
04AUG93, 1300;	46.1	46.1	46.1	45.6	45.6	45.2
04AUG93, 1900;	45.2	44.8	44.3	43.9	43.9	43.5
05AUG93, 0100;	43.5	43.5	43.0	42.6	42.6	42.2
05AUG93, 0700;	42.2	41.8	41.8	41.4	41.4	40.9
05AUG93, 1300;	40.9	40.5	40.5	40.5	40.5	40.1
05AUG93, 1900;	39.7	39.7	39.3	39.3	39.3	38.9
06AUG93, 0100;	38.5	38.5	38.5	38.5	38.1	38.1
06AUG93, 0700;	37.7	37.3	37.3	37.3	36.9	36.9
06AUG93, 1300;	36.9	36.5	36.5	36.1	36.1	35.3
06AUG93, 1900;	35.3	34.9	34.6	34.6	34.6	34.2
07AUG93, 0100;	34.2	34.2	33.8	33.8	33.4	33.4
07AUG93, 0700;	33.4	33.0	33.0	33.0	32.7	32.7
07AUG93, 1300;	32.3	32.3	31.9	31.9	31.9	31.6
07AUG93, 1900;	31.6	31.2	31.2	30.8	30.8	30.8
08AUG93, 0100;	30.8	30.8	30.5	30.5	30.5	29.7
08AUG93, 0700;	29.7	29.4	29.4	29.4	29.0	29.0
08AUG93, 1300;	29.0	29.0	29.0	28.7	28.7	28.7
08AUG93, 1900;	28.3	28.3	28.0	28.0	27.6	27.6
09AUG93, 0100;	27.6	27.6	27.6	27.3	27.3	27.3
09AUG93, 0700;	27.0	27.0	27.0	27.0	27.0	26.6
09AUG93, 1300;	26.6	26.6	26.6	26.3	26.3	25.6
09AUG93, 1900;	25.6	25.6	25.6	25.3	25.3	25.3
10AUG93, 0100;	25.3	25.3	25.0	25.0	25.0	24.6
10AUG93, 0700;	24.6	24.6	24.3	24.3	24.3	24.3

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

DISCHARGES

10AUG93, 1300;	24.0	24.0	24.0	24.0	24.0	23.7
10AUG93, 1900;	23.7	23.3	23.3	23.3	23.3	23.3
11AUG93, 0100;	23.3	23.3	23.3	23.0	23.0	22.7
11AUG93, 0700;	22.7	22.4	22.4	22.4	22.4	22.4
11AUG93, 1300;	22.1	22.1	22.1	22.1	22.1	22.1
11AUG93, 1900;	21.8	21.8	21.8	21.5	21.5	21.5
12AUG93, 0100;	21.2	21.2	21.2	21.2	21.2	21.2
12AUG93, 0700;	21.2	21.2	21.2	20.9	20.9	20.9
12AUG93, 1300;	20.9	20.9	20.9	20.9	20.9	20.6
12AUG93, 1900;	20.3	20.3	20.3	20.3	20.3	20.3
13AUG93, 0100;	20.3	20.3	20.3	20.3	20.3	20.3
13AUG93, 0700;	20.3	20.6	20.9	20.9	20.9	20.9
13AUG93, 1300;	20.9	20.9	20.9	20.9	20.9	20.9
13AUG93, 1900;	20.6	20.6	20.3	20.3	20.0	20.0
14AUG93, 0100;	20.0	20.0	19.7	19.4	19.4	19.4
14AUG93, 0700;	19.4	19.4	19.4	19.4	19.4	19.4
14AUG93, 1300;	19.4	19.4	19.4	19.4	19.4	19.4
14AUG93, 1900;	19.4	19.4	19.4	19.4	19.4	19.4
15AUG93, 0100;	19.4	19.4	19.4	19.4	19.4	19.4
15AUG93, 0700;	19.4	19.4	19.4	19.4	19.4	19.1
15AUG93, 1300;	19.1	19.1	19.1	19.1	19.1	19.1
15AUG93, 1900;	19.1	19.1	19.1	19.1	18.8	18.8
16AUG93, 0100;	18.8	18.8	18.8	18.5	18.5	18.2
16AUG93, 0700;	18.2	18.2	18.2	18.2	18.2	18.2
16AUG93, 1300;	18.2	18.2	18.2	18.2	18.2	18.2
16AUG93, 1900;	18.2	17.9	17.9	17.7	17.7	17.7
17AUG93, 0100;	17.4	17.4	17.4	17.4	17.4	17.4
17AUG93, 0700;	17.1	17.1	17.1	17.1	17.1	17.1
17AUG93, 1300;	17.1	17.1	17.1	17.1	16.8	16.8
17AUG93, 1900;	16.8	16.8	16.8	16.6	16.6	16.6
18AUG93, 0100;	16.6	16.3	16.3	16.0	16.0	16.0
18AUG93, 0700;	16.0	15.8	15.8	15.8	15.8	15.8
18AUG93, 1300;	15.8	15.8	15.8	15.8	15.8	15.8
18AUG93, 1900;	15.8	15.5	15.5	15.5	15.5	15.5
19AUG93, 0100;	15.5	15.5	15.5	15.2	15.2	15.0
19AUG93, 0700;	15.0	15.0	14.7	14.7	14.7	14.5
19AUG93, 1300;	14.5	14.5	14.5	14.5	14.5	14.2
19AUG93, 1900;	14.0	14.0	13.7	13.7	13.5	13.5
20AUG93, 0100;	13.5	13.5	13.2	13.2	13.0	12.7
20AUG93, 0700;	12.7	12.3	11.8	11.6	11.6	11.6
20AUG93, 1300;	11.6	12.0	12.0	12.3	12.3	12.3
20AUG93, 1900;	12.3	12.0	12.0	12.0	12.0	12.0
21AUG93, 0100;	12.0	12.0	12.0	12.0	12.0	12.0
21AUG93, 0700;	11.8	11.8	11.8	11.6	11.6	11.4
21AUG93, 1300;	11.4	11.4	11.4	11.2	11.2	11.2
21AUG93, 1900;	11.2	10.9	10.9	10.9	10.9	10.9
22AUG93, 0100;	10.9	10.7	10.7	10.5	10.5	10.5
22AUG93, 0700;	10.3	10.1	9.9	9.7	9.7	9.7
22AUG93, 1300;	9.7	9.7	9.7	9.7	9.7	9.7
22AUG93, 1900;	9.7	9.7	9.7	9.7	9.7	9.7
23AUG93, 0100;	9.7	9.7	9.7	9.7	9.7	9.7
23AUG93, 0700;	9.7	9.5	9.3	9.1	8.9	8.5
23AUG93, 1300;	8.3	8.1	8.1	8.1	8.1	8.1
23AUG93, 1900;	8.1	8.1	8.3	8.5	8.5	8.7
24AUG93, 0100;	8.7	8.9	8.9	8.9	8.3	7.9
24AUG93, 0700;	7.6	7.0	6.8	6.8	6.8	7.2
24AUG93, 1300;	7.6	7.7	7.9	8.1	8.1	8.1

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

DISCHARGES

24AUG93, 1900;	8.1	7.9	7.9	7.9	7.9	7.9
25AUG93, 0100;	7.9	7.9	7.9	8.1	8.1	8.1
25AUG93, 0700;	8.1	8.1	8.1	8.1	8.3	8.5
25AUG93, 1300;	8.5	8.5	8.5	8.5	8.5	8.1
25AUG93, 1900;	8.1	8.1	8.1	7.9	7.9	7.7
26AUG93, 0100;	7.6	7.4	7.4	7.0	7.0	7.0
26AUG93, 0700;	7.0	7.0	7.0	7.0	7.0	7.4
26AUG93, 1300;	7.4	7.4	7.4	7.4	7.4	7.4
26AUG93, 1900;	7.2	7.0	7.0	6.8	6.8	6.8
27AUG93, 0100;	6.8	6.8	6.8	6.8	6.7	6.7
27AUG93, 0700;	6.5	6.1	5.5	5.3	5.3	5.1
27AUG93, 1300;	5.1	5.1	5.3	5.3	5.5	5.5
27AUG93, 1900;	5.5	5.5	5.5	5.5	5.5	5.5
28AUG93, 0100;	5.5	5.7	5.7	5.7	5.7	5.3
28AUG93, 0700;	4.0	3.3	3.3	3.6	4.2	4.8
28AUG93, 1300;	5.0	5.1	5.1	5.3	5.3	5.3
28AUG93, 1900;	5.3	5.1	5.1	5.1	5.1	4.6
29AUG93, 0100;	4.4	4.4	4.4	4.4	4.8	4.8
29AUG93, 0700;	4.6	4.6	4.6	4.6	4.6	4.6
29AUG93, 1300;	4.6	4.6	4.6	4.6	4.6	4.6
29AUG93, 1900;	4.6	4.6	4.6	4.6	5.3	5.3
30AUG93, 0100;	5.3	5.3	5.3	5.1	5.7	6.3
30AUG93, 0700;	6.5	6.8	7.2	7.6	7.6	7.6
30AUG93, 1300;	7.6	7.6	7.6	7.6	7.6	7.4
30AUG93, 1900;	7.4	7.4	7.4	7.4	7.4	7.4
31AUG93, 0100;	7.4	7.2	7.2	7.2	7.2	7.2
31AUG93, 0700;	7.2	6.8	6.7	6.5	6.5	6.3
31AUG93, 1300;	6.3	6.3	6.3	6.3	6.3	6.3
31AUG93, 1900;	6.1	6.1	6.1	6.1	6.1	6.1

GAGE HEIGHTS (X 100)

/RUSH/AMENIA/ELEV/01JUL1993/1HOUR/OBS/

Start: 15JUL1993 at 0100 hours; End: 31JUL1993 at 2400 hours; Number: 408

Units: FEET

Type: INST-VAL

15JUL93, 0100;	495.	493.	493.	492.	492.	492.
15JUL93, 0700;	492.	492.	493.	495.	495.	495.
15JUL93, 1300;	495.	495.	496.	496.	497.	497.
15JUL93, 1900;	498.	498.	499.	502.	506.	520.
16JUL93, 0100;	533.	548.	624.	712.	779.	812.
16JUL93, 0700;	836.	852.	872.	890.	907.	929.
16JUL93, 1300;	951.	968.	980.	992.	999.	1005.
16JUL93, 1900;	1008.	1012.	1015.	1017.	1020.	1020.
17JUL93, 0100;	1022.	1022.	1023.	1023.	1011.	1007.
17JUL93, 0700;	1003.	1000.	997.	990.	985.	978.
17JUL93, 1300;	972.	970.	965.	960.	956.	953.
17JUL93, 1900;	948.	944.	938.	934.	931.	926.
18JUL93, 0100;	923.	918.	914.	909.	906.	902.
18JUL93, 0700;	897.	893.	890.	885.	880.	876.
18JUL93, 1300;	872.	866.	863.	858.	853.	850.
18JUL93, 1900;	846.	842.	838.	835.	832.	828.
19JUL93, 0100;	824.	821.	818.	815.	811.	808.
19JUL93, 0700;	806.	803.	801.	796.	795.	791.
19JUL93, 1300;	789.	786.	783.	781.	777.	776.
19JUL93, 1900;	773.	771.	768.	765.	763.	760.
20JUL93, 0100;	759.	756.	754.	750.	749.	747.
20JUL93, 0700;	745.	743.	741.	739.	737.	734.

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

GAGE HEIGHTS (X 100)

20JUL93, 1300;	733.	730.	727.	726.	725.	722.
20JUL93, 1900;	720.	718.	716.	714.	712.	710.
21JUL93, 0100;	709.	708.	706.	705.	704.	704.
21JUL93, 0700;	703.	702.	702.	701.	700.	699.
21JUL93, 1300;	697.	696.	694.	693.	691.	689.
21JUL93, 1900;	687.	685.	683.	681.	679.	677.
22JUL93, 0100;	675.	672.	670.	667.	666.	663.
22JUL93, 0700;	661.	659.	657.	654.	653.	651.
22JUL93, 1300;	650.	648.	645.	643.	642.	640.
22JUL93, 1900;	639.	638.	635.	634.	632.	631.
23JUL93, 0100;	630.	628.	627.	625.	624.	623.
23JUL93, 0700;	621.	620.	618.	617.	616.	615.
23JUL93, 1300;	614.	612.	612.	610.	609.	609.
23JUL93, 1900;	608.	606.	605.	605.	603.	602.
24JUL93, 0100;	601.	600.	599.	599.	597.	596.
24JUL93, 0700;	595.	595.	594.	594.	593.	593.
24JUL93, 1300;	596.	603.	603.	603.	602.	600.
24JUL93, 1900;	599.	604.	612.	612.	613.	618.
25JUL93, 0100;	627.	639.	654.	670.	689.	713.
25JUL93, 0700;	744.	779.	811.	834.	851.	863.
25JUL93, 1300;	873.	880.	886.	891.	898.	906.
25JUL93, 1900;	914.	924.	931.	938.	945.	952.
26JUL93, 0100;	957.	959.	962.	963.	963.	963.
26JUL93, 0700;	963.	963.	963.	963.	960.	960.
26JUL93, 1300;	960.	958.	956.	956.	954.	952.
26JUL93, 1900;	949.	946.	942.	941.	937.	935.
27JUL93, 0100;	931.	928.	924.	920.	918.	913.
27JUL93, 0700;	910.	907.	905.	900.	897.	892.
27JUL93, 1300;	889.	886.	881.	877.	873.	871.
27JUL93, 1900;	866.	863.	859.	856.	853.	850.
28JUL93, 0100;	847.	844.	840.	838.	835.	832.
28JUL93, 0700;	829.	827.	823.	821.	818.	816.
28JUL93, 1300;	812.	810.	807.	804.	802.	800.
28JUL93, 1900;	797.	793.	791.	787.	784.	781.
29JUL93, 0100;	779.	775.	773.	770.	767.	765.
29JUL93, 0700;	762.	759.	756.	754.	751.	750.
29JUL93, 1300;	747.	745.	743.	740.	739.	737.
29JUL93, 1900;	734.	732.	730.	729.	727.	725.
30JUL93, 0100;	723.	720.	719.	717.	715.	714.
30JUL93, 0700;	712.	710.	708.	707.	706.	704.
30JUL93, 1300;	703.	702.	700.	699.	697.	695.
30JUL93, 1900;	695.	693.	692.	690.	689.	688.
31JUL93, 0100;	686.	685.	683.	682.	680.	678.
31JUL93, 0700;	677.	675.	673.	672.	671.	670.
31JUL93, 1300;	668.	666.	665.	663.	662.	661.
31JUL93, 1900;	659.	658.	657.	655.	654.	653.

/RUSH/AMENIA/ELEV/01AUG1993/1HOUR/OBS/

Start: 01AUG1993 at 0100 hours; End: 31AUG1993 at 2400 hours; Number: 744

Units: FEET

Type: INST-VAL

01AUG93, 0100;	652.	651.	649.	649.	648.	646.
01AUG93, 0700;	645.	644.	643.	642.	641.	640.
01AUG93, 1300;	638.	638.	636.	635.	634.	633.
01AUG93, 1900;	632.	631.	630.	629.	628.	626.
02AUG93, 0100;	626.	624.	624.	623.	623.	621.
02AUG93, 0700;	621.	620.	619.	618.	617.	616.

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

GAGE HEIGHTS (X 100)

02AUG93, 1300;	616.	615.	614.	614.	613.	612.
02AUG93, 1900;	611.	610.	610.	609.	607.	607.
03AUG93, 0100;	607.	607.	606.	605.	604.	603.
03AUG93, 0700;	603.	602.	601.	600.	600.	600.
03AUG93, 1300;	599.	597.	597.	597.	596.	595.
03AUG93, 1900;	594.	594.	593.	593.	591.	590.
04AUG93, 0100;	590.	589.	588.	588.	587.	586.
04AUG93, 0700;	585.	585.	584.	583.	582.	582.
04AUG93, 1300;	580.	580.	580.	579.	579.	578.
04AUG93, 1900;	578.	577.	576.	575.	575.	574.
05AUG93, 0100;	574.	574.	573.	572.	572.	572.
05AUG93, 0700;	572.	571.	571.	570.	570.	569.
05AUG93, 1300;	569.	568.	568.	568.	568.	567.
05AUG93, 1900;	566.	566.	565.	565.	565.	564.
06AUG93, 0100;	563.	563.	563.	563.	562.	562.
06AUG93, 0700;	561.	560.	560.	560.	559.	559.
06AUG93, 1300;	559.	558.	558.	557.	557.	556.
06AUG93, 1900;	556.	555.	554.	554.	554.	553.
07AUG93, 0100;	553.	553.	552.	552.	551.	551.
07AUG93, 0700;	551.	550.	550.	550.	549.	549.
07AUG93, 1300;	548.	548.	547.	547.	547.	546.
07AUG93, 1900;	546.	545.	545.	544.	544.	544.
08AUG93, 0100;	544.	544.	543.	543.	543.	542.
08AUG93, 0700;	542.	541.	541.	541.	540.	540.
08AUG93, 1300;	540.	540.	540.	539.	539.	539.
08AUG93, 1900;	538.	538.	537.	537.	536.	536.
09AUG93, 0100;	536.	536.	536.	535.	535.	535.
09AUG93, 0700;	534.	534.	534.	534.	534.	533.
09AUG93, 1300;	533.	533.	533.	532.	532.	531.
09AUG93, 1900;	531.	531.	531.	530.	530.	530.
10AUG93, 0100;	530.	530.	529.	529.	529.	528.
10AUG93, 0700;	528.	528.	527.	527.	527.	527.
10AUG93, 1300;	526.	526.	526.	526.	526.	525.
10AUG93, 1900;	525.	524.	524.	524.	524.	524.
11AUG93, 0100;	524.	524.	524.	523.	523.	523.
11AUG93, 0700;	523.	522.	522.	522.	522.	522.
11AUG93, 1300;	521.	521.	521.	521.	521.	521.
11AUG93, 1900;	520.	520.	520.	519.	519.	519.
12AUG93, 0100;	518.	518.	518.	518.	518.	518.
12AUG93, 0700;	518.	518.	518.	517.	517.	517.
12AUG93, 1300;	517.	517.	517.	517.	517.	517.
12AUG93, 1900;	516.	516.	516.	516.	516.	516.
13AUG93, 0100;	516.	516.	516.	516.	516.	516.
13AUG93, 0700;	516.	517.	518.	518.	518.	518.
13AUG93, 1300;	518.	518.	518.	518.	518.	518.
13AUG93, 1900;	517.	517.	516.	516.	515.	515.
14AUG93, 0100;	515.	515.	514.	514.	514.	514.
14AUG93, 0700;	514.	514.	514.	514.	514.	514.
14AUG93, 1300;	514.	514.	514.	514.	514.	514.
14AUG93, 1900;	514.	514.	514.	514.	514.	514.
15AUG93, 0100;	514.	514.	514.	514.	514.	514.
15AUG93, 0700;	514.	514.	514.	514.	514.	514.
15AUG93, 1300;	514.	514.	514.	514.	514.	514.
15AUG93, 1900;	514.	514.	514.	514.	513.	513.
16AUG93, 0100;	513.	513.	513.	512.	512.	511.
16AUG93, 0700;	511.	511.	511.	511.	511.	511.
16AUG93, 1300;	511.	511.	511.	511.	511.	511.

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

GAGE HEIGHTS (X 100)

16AUG93, 1900;	511.	511.	511.	510.	510.	510.
17AUG93, 0100;	509.	509.	509.	509.	509.	509.
17AUG93, 0700;	508.	508.	508.	508.	508.	508.
17AUG93, 1300;	508.	508.	508.	508.	507.	507.
17AUG93, 1900;	507.	507.	507.	506.	506.	506.
18AUG93, 0100;	506.	505.	505.	505.	505.	505.
18AUG93, 0700;	505.	504.	504.	504.	504.	504.
18AUG93, 1300;	504.	504.	504.	504.	504.	504.
18AUG93, 1900;	504.	503.	503.	503.	503.	503.
19AUG93, 0100;	503.	503.	503.	502.	502.	501.
19AUG93, 0700;	501.	501.	500.	500.	500.	500.
19AUG93, 1300;	500.	500.	500.	500.	500.	499.
19AUG93, 1900;	498.	498.	497.	497.	496.	496.
20AUG93, 0100;	496.	496.	495.	495.	494.	493.
20AUG93, 0700;	493.	491.	490.	489.	489.	489.
20AUG93, 1300;	489.	491.	491.	492.	492.	492.
20AUG93, 1900;	492.	492.	492.	492.	492.	492.
21AUG93, 0100;	492.	492.	492.	492.	492.	492.
21AUG93, 0700;	491.	491.	491.	490.	490.	489.
21AUG93, 1300;	489.	489.	489.	488.	488.	488.
21AUG93, 1900;	488.	487.	487.	487.	487.	487.
22AUG93, 0100;	487.	486.	486.	486.	486.	486.
22AUG93, 0700;	485.	484.	483.	482.	482.	482.
22AUG93, 1300;	482.	482.	482.	482.	482.	482.
22AUG93, 1900;	482.	482.	482.	482.	482.	482.
23AUG93, 0100;	482.	482.	482.	482.	482.	482.
23AUG93, 0700;	482.	481.	480.	479.	478.	477.
23AUG93, 1300;	476.	475.	475.	475.	475.	475.
23AUG93, 1900;	475.	475.	476.	477.	477.	478.
24AUG93, 0100;	478.	479.	479.	479.	476.	474.
24AUG93, 0700;	472.	469.	468.	468.	468.	470.
24AUG93, 1300;	472.	473.	474.	475.	475.	475.
24AUG93, 1900;	475.	475.	475.	475.	475.	475.
25AUG93, 0100;	475.	475.	475.	476.	476.	476.
25AUG93, 0700;	476.	476.	476.	476.	477.	478.
25AUG93, 1300;	478.	478.	478.	478.	478.	476.
25AUG93, 1900;	476.	476.	476.	475.	475.	474.
26AUG93, 0100;	473.	472.	472.	471.	471.	471.
26AUG93, 0700;	471.	471.	471.	471.	471.	473.
26AUG93, 1300;	473.	473.	473.	473.	473.	473.
26AUG93, 1900;	472.	471.	471.	470.	470.	470.
27AUG93, 0100;	470.	470.	470.	470.	469.	469.
27AUG93, 0700;	468.	466.	463.	462.	462.	462.
27AUG93, 1300;	462.	462.	463.	463.	464.	464.
27AUG93, 1900;	464.	464.	464.	464.	464.	464.
28AUG93, 0100;	464.	465.	465.	465.	465.	463.
28AUG93, 0700;	456.	452.	452.	454.	457.	460.
28AUG93, 1300;	461.	462.	462.	463.	463.	463.
28AUG93, 1900;	463.	463.	463.	463.	463.	460.
29AUG93, 0100;	459.	459.	459.	459.	461.	461.
29AUG93, 0700;	460.	460.	460.	460.	460.	460.
29AUG93, 1300;	460.	460.	460.	460.	460.	460.
29AUG93, 1900;	460.	460.	460.	460.	464.	464.
30AUG93, 0100;	464.	464.	464.	464.	467.	470.
30AUG93, 0700;	471.	473.	475.	476.	476.	476.
30AUG93, 1300;	476.	476.	476.	476.	476.	475.
30AUG93, 1900;	475.	475.	475.	475.	475.	475.

APPENDIX C (continued)
RUSH RIVER AT AMENIA, ND

GAGE HEIGHTS (X 100)

31AUG93, 0100;	475.	474.	474.	474.	474.	474.
31AUG93, 0700;	474.	473.	472.	471.	471.	471.
31AUG93, 1300;	471.	471.	471.	471.	471.	471.
31AUG93, 1900;	470.	470.	470.	470.	470.	470.
