US Army Corps of Engineers
St. Paul District

WATER CONTROL MANUAL
FLOOD CONTROL
MINNESOTA RIVER, MINNESOTA

LAC QUI PARLE RESERVOIR

LAC QUI PARLE RESERVOIR AND MARCH LAKE RESERVOIR,
INCLUDING MARCH LAKE DAM, LAC QUI PARLE DAM
CHIPPEWA RIVER DIVERSION DAM, AND WATSON SAG WEIR

WATSON, MINNESOTA

REVISED AUGUST 1995

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Revised August 1995.

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FLOOD CONTROL MINNESOTA

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The purpose of this manual is to provide guidance and instruction for project personnel and as a reference source for others who may be involved with or affected by project regulation. The scope of this manual covers all water control management activities as they related to the hydraulic and hydrologic aspects of the project. Lac qui Parle Reservoir is located on the Minnesota River in western Minnesota near the South Dakota state line. The reservoir is immediately downstream of the headwaters on the Minnesota River at Big Stone Lake.

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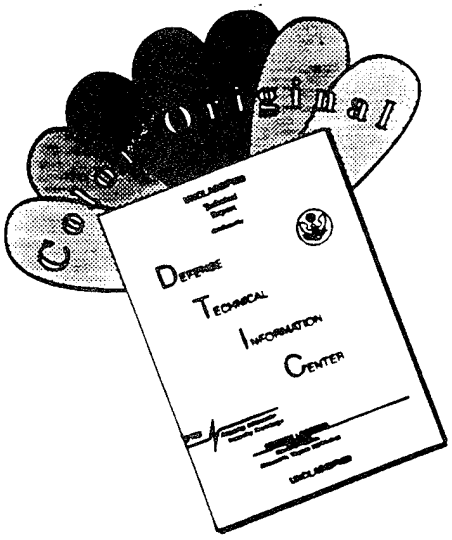

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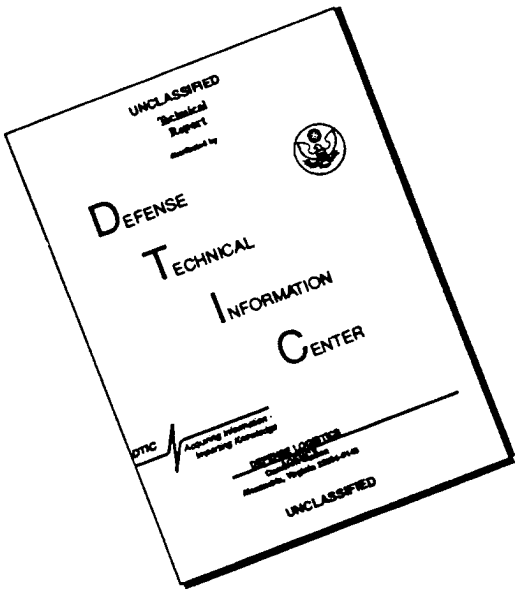

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AUGUST 1995
LAC QUI PARLE RESERVOIR
FLOOD CONTROL
MINNESOTA RIVER, MINNESOTA
WATER CONTROL MANUAL

REVISION RECORD SHEET

REVISION		PAGE NO.	SUBJECT
No.	Date		

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF
CENCS-PE-M

5 October 1995

MEMORANDUM FOR: Commander, North Central Division, ATTN: CENCD-PE-ED-WH, 111 North Canal Street, Chicago, Illinois 60606-7205

SUBJECT: Lac qui Parle Reservoir, Flood Control, Minnesota River, Minnesota, Water Control Manual

1. The Lac qui Parle Reservoir Water Control Manual is enclosed for your reference. This manual has been updated in accordance with ER 1110-2-240.

2. Please note that the "Standing Instructions to the Dam Tender" found in Appendix A of the manual dated July 1966 and in the draft of this report has been deleted. The information is incorporated into Chapters 5 and 7 of this report.

3. The process for developing this water control manual included a public meeting for problem appraisal prior to the formulation of alternatives. After the alternatives were evaluated and a proposed alternative was selected, a second public meeting was held to present the study findings and elicit public comments. The draft environmental assessment and finding of no significant impact (FONSI) were distributed for public and agency review and comment. The water control manual was revised in response to comments, and the FONSI was signed by the District Engineer. The manual was submitted by CENCS-PE-M letter dated 22 March 1995 (copy included with this water control manual) and was approved by North Central Division. The enclosed document is the final product from this process.

4. Point of contact for this water control manual is Ed Eaton, Chief of Water Control, CENCS-PE-H, (612) 290-5617.

FOR THE COMMANDER:

Robert F. Post

ROBERT F. POST, P.E.
Chief, Engineering and Planning Division

Encl
(2 cys)

Distribution of Lac qui Parle Water Control Manual

Organization	Number of Copies	Copy Numbers
Master, Water Control (CENCS-PE-H)	1	1
North Central Division (CENCD-PE-ED-WH)	2	2-3
Water Control (CENCS-PE-H)	12	4-15
Lac qui Parle Project Office (CENCS-CO-WF)	2	16-17
Western Flood Control Project Office (CENCS-CO-WF)	1	18
Environmental Resources (CENCS-PE-M)	1	19
Mr. Rodney W. Sando Commissioner Minnesota Department of Natural Resources 500 Lafayette Road St. Paul, Minnesota 55155-4037	1	20
Mr. Kerry Christopherson Minnesota Department of Natural Resources Lac qui Parle State Park Route 5, Box 74A Montevideo, Minnesota 56265	1	21
Honorable Wayne Gustafson Mayor of Watson City Hall P.O. Box 7 Watson, Minnesota 56295	1	22
Honorable Joyce Hagberg Mayor of Montevideo City Hall P.O. Box 676 Montevideo, Minnesota 56265-0676	1	23
Honorable Roy Lenzen Mayor of Granite Falls City Hall 885 Prentice Street Granite Falls, Minnesota 56241-1598	1	24
Honorable Bert Schapekahm Mayor of New Ulm City Hall 100 North Broadway New Ulm, Minnesota 56073-1785	1	25

CENCS-PE-M 5 October 1995

MEMORANDUM FOR See Distribution

SUBJECT: Lac qui Parle Reservoir, Flood Control, Minnesota River, Minnesota, Water Control Manual

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4. Point of contact for this water control manual is Ed Eaton, Chief of Water Control, CENCS-PE-H, (612) 290-5617.

Robert F. Post

Encl ROBERT F. POST, P.E.
Chief, Engineering and Planning Division

Distribution:

CENCS-PE-H/Water Control (12 cys)
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CENCS-PE-M/Environmental Resources (1 cy)

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

CENCS-PE-M

MEMORANDUM FOR Commander, North Central Division, ATTN: CENCD-PE-ED-WH/Joseph Raoul, River Center Building, 14th Floor, 111 North Canal Street, Chicago, Illinois 60606-7205

SUBJECT: Lac qui Parle Reservoir, Flood Control, Minnesota River, Minnesota, Water Control Manual

1. The subject draft manual is submitted for your review in accordance with ER 1110-2-240. Comments have been received from agency and public review of the Environmental Assessment for the Lac qui Parle Flood Control Project. The Finding of No Significant Impact has been signed by the District Commander. Two copies of the final water control manual will be provided after approval.

2. The POC for this matter is John Blackstone, (612) 290-5429.

FOR THE COMMANDER:

Robert F. Post

Encl

ROBERT F. POST, P.E.
Chief, Engineering and Planning Division

CENCD-PE-ED-WH (CENCS-PE-M/22 Mar 95) (1110) 1st End
Mr. Patel/pz/(312) 353-2579
SUBJECT: Lac qui Parle Reservoir, Flood Control, Minnesota River, Minnesota, Water Control Manual

Commander, North Central Division, U.S. Army Corps of Engineers,
111 North Canal Street, Chicago, IL 60606-7205 12 JUN 1995

FOR Commander, St. Paul District, ATTN: CENCS-PE-M, (Mr. Post)

1. The report is approved subject to the enclosed comments.

2. The HQ, NCD, POC is Mr. Ojas Patel, CENCD-PE-ED-WL, (312)353-2579.

FOR THE COMMANDER:

for DONALD J. LEONARD, P.E.
Director, Engineering and
Planning Directorate

Encl wd
Added 1 encl

The following comments need to be addressed for the Water Control Manual for the Lac qui Parle Reservoir:

a. Need NCS-RE review of the subject manual.

b. Paragraph 3-03. The accuracy of project events and respective dates of occurrence that are provided under the construction of Lac Qui Parle Reservoir section needs to be verified.

c. Paragraph 3-06. Needs to be reviewed. Shoreline erosion which is occurring should be within the federal flowage easement so as to not constitute a taking.

d. Pg. 2-14. 2nd Para. The sentence which states that the stage-discharge curve for gage #05292000 is shown on Plate 2-24 is incorrect. The Plate should be 2-25. Every plate referenced in section 2 from that point on until page 2-17 is incorrect and should be revised.

e. Pg. 5-9. Para 5-08. Last sentence. "...officials listed in Table 5-3..." should be Table 5-4.

f. Pg. 7-4. Chippewa Diversion Paragraph. Misspellings on second line.

August 1995

The CENCS-PE-M responses to the CENCD comments for the CENCD-PE-ED-WH 1st endorsement to the CENCS-PE-M/22 Mar 95 memo are provided below. These responses were not submitted to CENCD but are provided here for future reference.

a. CENCS-RE has reviewed the Water Control Manual. There are unresolved issues regarding ownership of land downstream of the Lac qui Parle Dam. Efforts are being taken to resolve these issues. The manual will be revised when this issue has been resolved.

b. The accuracy of the project events have been verified. The dates listed in the manual are correct.

c. This paragraph has been edited to delete references to rights-of-way and easements in the Lac qui Parle Reservoir.

d. The plate number references have been checked and corrected.

e. The reference to Table 5-4 has been corrected.

f. The misspellings have been corrected.

WATER CONTROL MANUAL

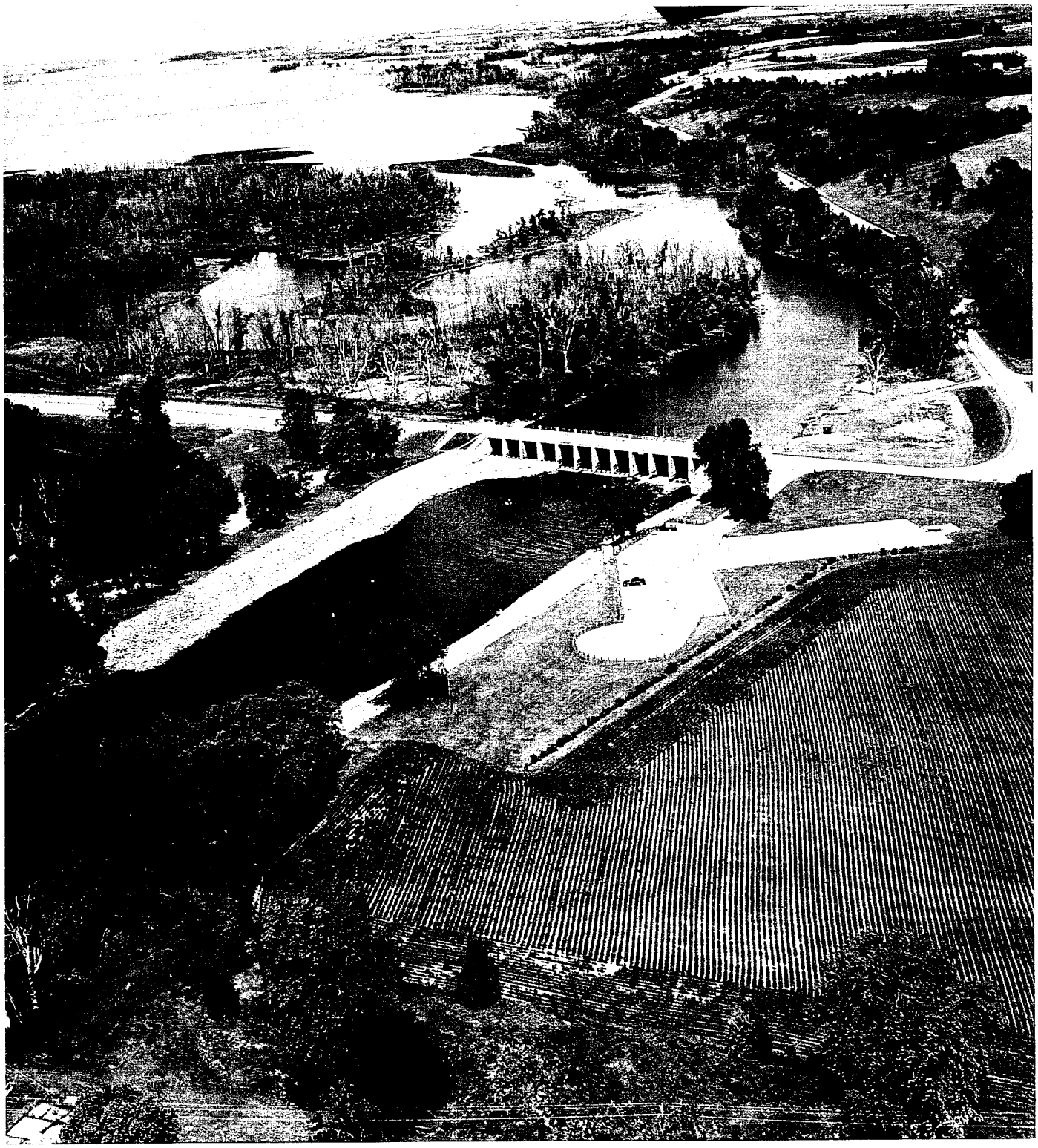
LAC QUI PARLE PROJECT

**Lac Qui Parle Reservoir and Marsh Lake Reservoir,
Including Marsh Lake Dam, Lac Qui Parle Dam
Chippewa River Diversion Dam, and Watson Sag Weir**

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

August 1995

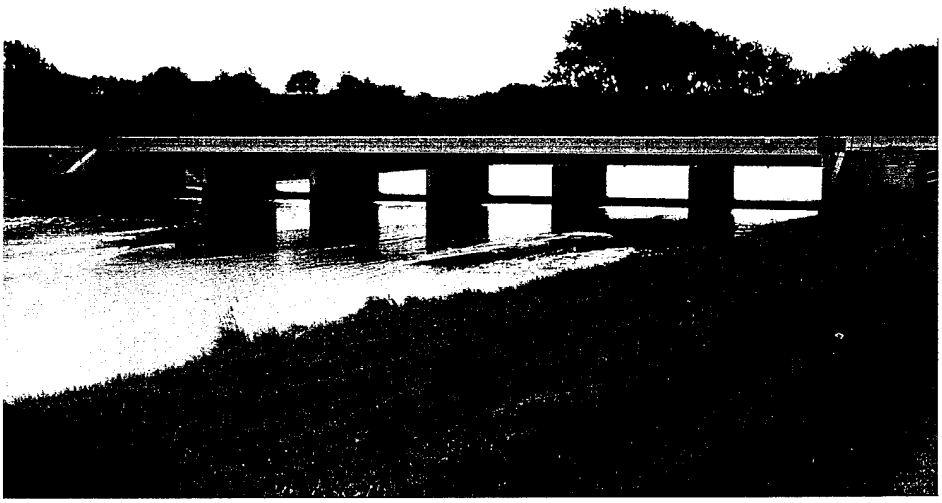
MARSH LAKE DAM
LOOKING UPSTREAM



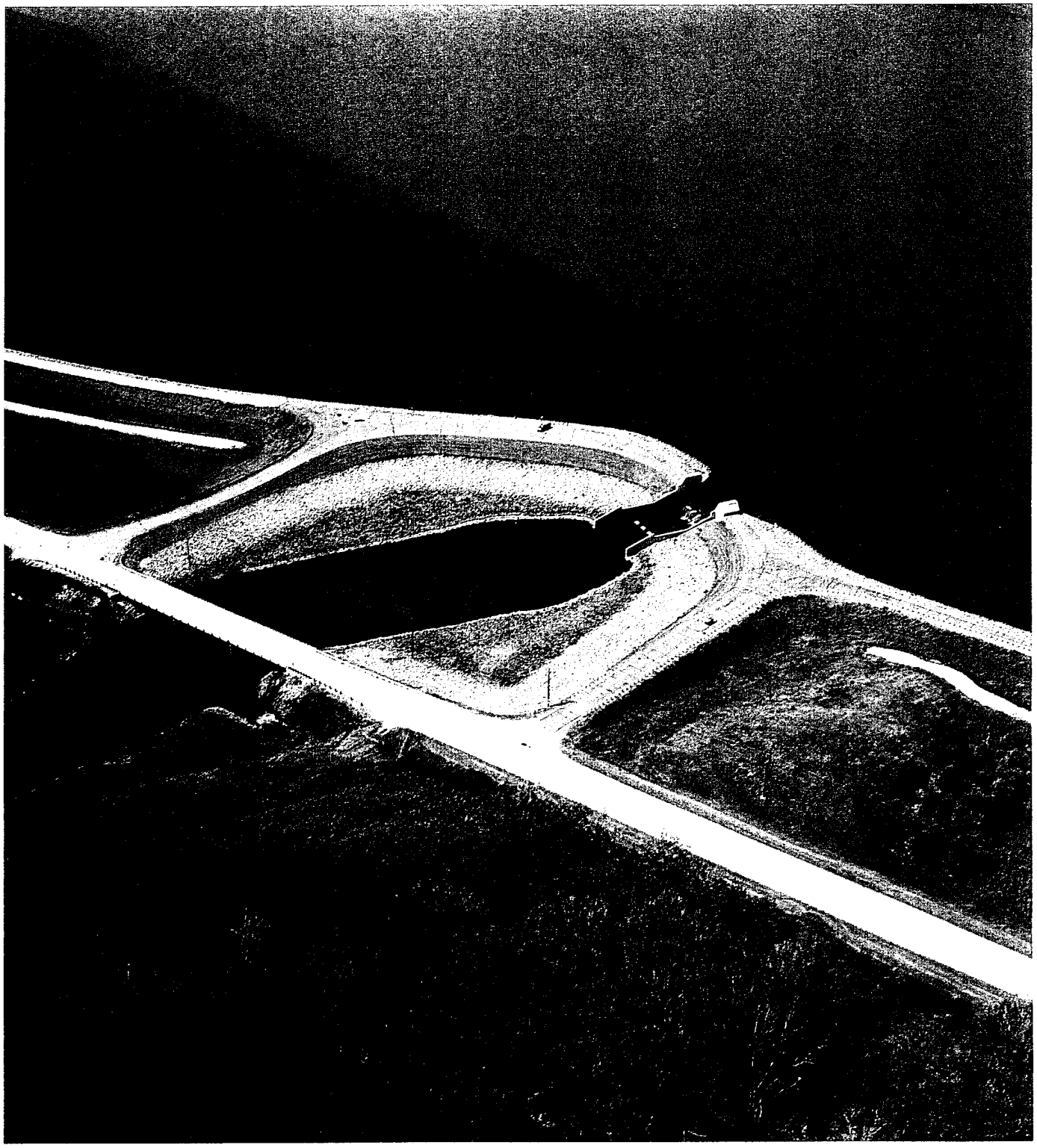
LAC QUI PARLE DAM
LOOKING UPSTREAM

LAC QUI PARLE DAM
LOOKING DOWNSTREAM

CHIPPEWA DIVERSION DAM
LOOKING UPSTREAM



CHIPPEWA DIVERSION CHANNEL
WATSON SAG WEIR
LOOKING UPSTREAM



HIGHWAY 75 DAM
LOOKING UPSTREAM

NOTICE TO USERS OF THIS MANUAL

Corps of Engineers regulations specify that this Water Control Manual be published in loose-leaf form to facilitate modifications. In the future, only those sections, or parts thereof, requiring changes will be revised and replaced.

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during normal business (duty) hours, contact can be made by telephone to Water Control (612.290.5620) or the District Communication Center's VHF-FM radio (call signal WUD6, Hastings, MN). Water Control's radio call signal is WUD613 (St. Paul, MN). During nonduty hours assistance can be achieved by contacting, in the order listed, one of the following persons. Their duty hour (work) phone numbers are also listed.

Name		Number
Gordon Heitzman,	Lac qui Parle Project Regulator	Work 612.290.5620 Home 612.772.3150
Fax Number,	Hydraulic and Hydrologic Branch	Fax 612.290.5841
Edward Eaton,	Chief, Water Control Section	Work 612.290.5617 Home 612.754.2640
Bonnie Montgomery,	Hydraulic Engineer	Work 612.290.5618 Home 612.450.0905
Kenton Spading,	Hydraulic Engineer	Work 612.290.5623 Home 612.488.8893
Helmer Johnson,	Chief, Hydraulic and Hydrologic Branch	Work 612.290.5602 Home 612.633.7791
Robert Post,	Chief, Planning and Engineering Division	Work 612.290.5303 Home 612.437.1316

Lac Qui Parle Project
Minnesota River

U. S. Army Corps of Engineers
St. Paul District
Revised August 1995

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E-6. MINNESOTA RIVER AT ORTONVILLE, MINNESOTA, U.S.G.S GAGE NO. 05292000, RATING NO. 25.0

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PLATES

PLATES (continued)

PLATES (continued)

Mean Sea Level Reference Datum

All elevations in this manual use the 1929 National Geodetic Vertical Datum (1929 NGVD) unless otherwise stated.

Metric Equivalents and Conversions

Length:

1 Centimeter = 0.394 inches
1 meter = 3.28 feet
1 kilometer = 0.621 miles

Area:

1 meter^2 = 10.764 feet^2
1 kilometer^2 = 0.386 miles^2
1 hectare = 2.471 acres

Volume:

1 meter^3 = 35.31 feet^3
1 meter^3 = 1.308 yards^3
1 meter^3 = 0.81 x 10^{-3} acre-feet

Flow:

1 meter^3/second = 35.31 feet^3/second

Temperature:

(Degrees Fahrenheit - 32)/1.8 = Degrees Celsius

PERTINENT DATA (Also see Exhibit A)
LAC QUI PARLE PROJECT
LAC QUI PARLE DAM/LAC QUI PARLE RESERVOIR
MARSH LAKE DAM/MARSH LAKE RESERVOIR

Project Location: Lac Qui Parle, Chippewa, Swift, and Big Stone Counties, Minnesota, 7 miles Northwest of Montevideo, Minnesota, 288.1 Miles Above the Mouth of the Minnesota River, Latitude 45° 01' 17", Longitude 95° 52' 05" (Lac Qui Parle Dam)

Drainage Area Above Lac Qui Parle Dam 4,050 square miles

Drainage Area Above the Chippewa River Diversion Dam Only 2,050 square miles

Dam[1]:	Lac Qui Parle Dam	Marsh Lake Dam
Type:	Rolled-Earth Fill	Rolled-Earth Fill
Length:	4,100 ± Feet	11,800 Feet
Height:	23-32 Feet	19.5 Feet
Top Width:	23 Feet (roadway)	10 Feet
Freeboard:	4.9 Feet (above full pool)	Not Applicable

Control Structure:

Type:	Reinforced Concrete	Reinforced Concrete
Length:	237 Feet	112 Feet

Reservoir/Capacities/Areas:

Lac Qui Parle Reservoir	Elevation Feet	Capacity Ac-Ft	Area Acres
Gate Sills	922.70	---	---
Conservation Pool	933.00	41,000	7,750
Top of Flood Control Pool	941.10	158,700	21,450
Flowage Easement Level	945.00	253,500	27,450
Top of Dam	946.00	281,500	28,850
Marsh Lake Reservoir			
Service Spillway Crest[2]	937.60	12,050	5,150
Emergency Spillway Crest	940.00	26,000	8,100

Note: The two pools become one pool at approximately elevation 937.6 feet. The control shifts to Lac Qui Parle Dam.

1. Chippewa River Diversion information is in Exhibit A.
2. Conservation pool elevation at Marsh Lake = 937.6 feet.

I - INTRODUCTION

1-01. Authorization. This manual was prepared in compliance with the following: 1) Engineering Regulation 1110-2-240 titled "*Water Control Management*" dated 30 April 1987; 2) Engineering Manual 1110-2-3600 titled "*Management of Water Control Systems*" dated 30 November 1987; 3) Engineering Circular 1110-2-278 titled "*Preparation of Water Control Manuals*" dated 31 August 1993. It supersedes the previous manual (dated July 1966) and incorporates changes to the water control plan. The previous water control manual was authorized by letter, 800.2 (Reservoirs), UMVGW, Upper Mississippi Valley Division, 30 August 1948, Subject: "Manual of Regulation for Flood Control and Multiple Purpose Reservoirs." An interim reservoir regulation manual was submitted in November 1956.

1-02. Purpose and Scope. The purpose of this manual is to provide guidance and instruction for project personnel and as a reference source for others who may be involved with or affected by project regulation. The manual is for daily use in Water Control Section activities for essentially all foreseeable conditions. The scope of this manual covers all water control management activities as they relate to the hydraulic and hydrologic aspects of the project.

1-03. Related Manuals and Reports. Prior reports on flood control and improved navigation for the region date from 1849. Some of the information is included in annual reports of the Chief of Engineers. A list of some of the reports follows. Additional reports are listed in **Exhibit B.**

a. *Diversion of Floodwaters of Little Minnesota River into Lake Traverse,* U.S. Engineer Office, St. Paul, Minnesota, 17 September 1945.

b. *Report on Survey of Minnesota River, Minnesota, For Flood Control and Allied Purposes,* Corps of Engineers, U.S. Army Office of the District Engineer, St. Paul, Minnesota, 3 January 1950.

c. *Interim Reservoir Regulation Manual,* Lac Qui Parle Dam and Reservoir, Corps of Engineers, U.S. Army, Office of the District Engineer, St. Paul, Minn., November 1956.

d. *Interim Report on Survey of Big Stone Lake-Whetstone River Project, Project Modifications,* Minnesota and North Dakota, U.S. Army Engineer District, St. Paul, Minnesota, Corps of Engineers, 2 Reports dated 30 January 1959 and 24 June 1960.

e. *General Design Memorandum, Minnesota River, Minnesota, In the Interest of Navigation and Related Purposes*, U.S. Army Engineer District, St. Paul, Corps of Engineers, St. Paul, Minnesota, February 1961.

f. *Phase 1 Report for Flood Control and Related Purposes, Minnesota River Basin*, Minnesota and South Dakota, Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota, 8 March 1966.

g. *Lac Qui Parle Reservoir and Minnesota River, Channel Improvement, Reservoir Regulation Manual*, U.S. Army Engineer District, St. Paul, Minnesota, Corps of Engineers, July 1966.

h. *Water Supply and Water Quality Control Study, Minnesota River Basin Reservoirs, Minnesota, South Dakota, Iowa*, United States Department of the Interior, Federal Water Pollution Control Administration, July 1969.

i. *Interim Survey Report, 9-Foot Navigation Channel Above Mile 14.7, Minnesota River, Minnesota*, Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota, 30 January 1970.

j. *Report on Probable Maximum Floods and Standard Project Floods, Minnesota River Basin, Minnesota,* Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota, June 1971.

k. *Flood Control, Big Stone Lake-Whetstone River, Minnesota-South Dakota, Design Memorandum No. 3,* Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota, June 1973.

l. *Forecasting Rainfall and Snowmelt Runoff on Floods on Upper Midwest Watersheds,* St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Lab Report No. 151, June 1974.

m. *Minnesota River Basin Report,* Southern Minnesota Rivers Basin Commission, February 1977.

n. *Highway 75 Dam and Reservoir, Reservoir Regulation Manual,* Big Stone Lake-Whetstone River Project, Appendix B, Department of the Army, St. Paul District, Corps of Engineers, St. Paul, Minnesota, October 1979.

o. *Upper Mississippi River Subbasins Study, Stage I, Report Alternatives,* Public Law 87-639, United States Department of Agriculture, Soil Conservation Service, and Department of the Army, St. Paul District, Corps of Engineers, January 1980.

p. *Computer Simulation of Low Flow Conditions, Minnesota River,* Barr Engineering for U.S. Army Corps of Engineers, St. Paul District, 1980.

q. *Operation and Maintenance Manual, Big Stone Lake-Whetstone River Flood Control,* U.S. Army Corps of Engineers, St. Paul District, December 1986, Draft.

r. *Sedimentation Rates and Changing Water Quality - Pomme de Terre River Watershed,* West Central Minnesota, Geology Department, University of Minnesota, Morris, Minnesota, Dr. James Van Alstine, March 1987.

s. *Problem Appraisal Report, Operation Plan Evaluation for Highway 75-Lac Qui Parle Reservoir,* U.S. Army Corps of Engineers, St. Paul District, September 1987.

t. *Reservoir Operation Plan Evaluation for Highway 75-Lac Qui Parle Reservoirs,* Minnesota River, Minnesota, U.S. Army Corps of Engineers, St. Paul District, September 1989 Draft Report.

u. *Dam Failure Planning Report, Marsh Lake Dam,* Minnesota River, Minnesota, U.S. Army Corps of Engineers, St. Paul District, August 1987.

v. *Dam Failure Planning Report, Chippewa Dam*, Chippewa River, Minnesota, U.S. Army Corps of Engineers, St. Paul District, September 1987.

w. *Emergency Action Plan, Lac Qui Parle Flood Control Project*, Corps of Engineers, St. Paul District, October 1988.

x. *Drought Contingency Plan, Big Stone Lake - Whetstone River, Highway 75 Dam, Lac Qui Parle Reservoir and Minnesota River - Channel Improvement, Reservoir Regulation Manual*, Appendix, U.S. Army Corps of Engineers, St. Paul District, September 1992, Draft.

y. *Minnesota River Assessment Project Report, Report to the Legislative Commission on Minnesota Resources*, Minnesota Pollution Control Agency, January 1994.

z. *The Great Flood of 1993*, Post-Flood Report, Upper Mississippi River and Lower Missouri River Basins, U.S. Army Corps of Engineers, North Central Division, Main Report, September 1994.

aa. *Economic Analysis, Agricultural Flood Damages, Lac Qui Parle Flood Control Project*, Gulf Engineers and Consultants, Incorporated, Project No. 22302401, Baton Rouge, Louisiana, Volume I: Main Report, Volume II: CACFDAS Output Data, Revised Draft Report, September 1994.

1-04. Project Owner. The U.S. Army Corps of Engineers, St. Paul District is responsible for the regulation of the Lac qui Parle Project. The United States government is the owner of the project.

1-05. Operating Agency. The U.S. Army Corps of Engineers, St. Paul District, Construction-Operations Division, Natural Resource Management Branch, is responsible for the operation and maintenance of the Lac qui Parle Project. Regulation instructions for the project are provided by the Water Control Section, Planning and Engineering Division. The project is attended continuously during normal business hours by the Project Resource Manager and his staff. The Area Resource Manager's office is in Fargo, North Dakota. The Project Resource Manager and his assistant and the Area Manager can be reached at the following numbers (see **Table 1-1**):

Table 1-1 Project Office, Points of Contact	
Name	**Number**
Curt Hanson, Project Resource Manager	Work 612.269.6303 Home 612.269.9632 VHF Radio WUD 630 FM Radio 6300
Wayne Gustafson (assistant)	Work 612.269.6303 Home 612.269.7915
Project Fax Number	612.269.5858
Timothy Bertschi, Area Resource Manager	Work 701.232.1894 Home 701.232.5967 Cellular 701.238.1680 VHF Radio WUD 642

1-06. Regulating Agency. The regulation of the Lac qui Parle Project is under the supervision of the Water Control Section, within the Hydraulics and Hydrologic Branch, Planning and Engineering Division, of the St. Paul District Corps of Engineers.

II - DESCRIPTION OF PROJECT

2-01. Location. Lac qui Parle Project is located on the Minnesota River in western Minnesota near the South Dakota state line. The project lies along the northeasterly boundary of Lac qui Parle County and the southwesterly boundaries of Chippewa, Swift, and Big Stone Counties **(Plate 2-1)**. The reservoir is immediately downstream of the headwaters of the Minnesota River at Big Stone Lake **(Plate 2-2)**.

Marsh Lake Dam is 303.5 river miles above the mouth of the Minnesota River and is located near Appleton, Minnesota just downstream of the Pomme de Terre River. The dam forms Marsh Lake Reservoir when the project pool is below elevation 937.6 feet. Lac qui Parle Dam is approximately 7 miles northwest of Montevideo, Minnesota, and is 288.1 miles above the mouth of the Minnesota River. The reservoirs extend upstream for a distance of about 27 miles.

2-02. Purpose. The Lac qui Parle Project was authorized by the Flood Control Act of 22 June 1936 (Public Law 74-738). The Act authorized flood control as a project purpose. The above, and other project purposes assigned by Congress following completion of the project, are listed in **Table 2-1**.

Table 2-1 Lac qui Parle Project Authorized Purposes Assigned by Congress		
Authorized Purpose	**Public Law No.**	**Description**
Flood Control	74-738	Flood Control Act of 1936
Recreation and Surplus Water	78-534	Flood Control Act of 1944
Fish and Wildlife	85-624	Fish and Wildlife Coordination Act of 1958
Water Supply	92-500	Water Supply Act of 1958
Recreation	89-72	Federal Water Project Recreation Act of 1965
Water Quality	92-500	Federal Water Pollution Control Act Amendments of 1972
Fish and Wildlife	93-205	Conservation, Protection, and Propagation of Endangered Species Law of 1973

2-03. Physical Components.

a. General. The Lac qui Parle Project consists of: Marsh Lake Dam, Lac qui Parle Dam, the Chippewa River Diversion structures, and the Minnesota River Channel down to Granite Falls, Minnesota (**Plate 2-2**).

Marsh Lake Dam divides the Lac qui Parle Reservoir into two sections when the Lac qui Parle pool is below approximately elevation 937.6 feet. The pool behind the dam is called Marsh Lake reservoir.

Lac qui Parle Dam is immediately downstream of Marsh Lake Dam. The pool behind the dam is called Lac qui Parle reservoir. When the Lac qui Parle pool reaches the same level as the Marsh Lake pool, Marsh Lake and Lac qui Parle become essentially one pool and the control shifts to Lac qui Parle Dam.

The Chippewa River Diversion Dam and the Watson Sag Weir divert high flows on the Chippewa River into Lac qui Parle Reservoir.

The Minnesota River channel project provides the necessary channel capacity for the drawdown of the Lac qui Parle Project.

b. Marsh Lake Dam. The Marsh Lake Dam is comprised of dredged earth fill totaling approximately 11,800 feet in length. The earth fill portion has a top width of 10 feet with a 1 on 3 side slope on the upstream and downstream sides. On the downstream side, the 1 on 3 side slope extends only to an elevation 5 feet below the top of the dam. Below this elevation, the slope changes to a 1 on 4 grade. The elevation of the top of the embankment

ranges between elevation 948.6 feet and 952.6 feet. The maximum height of the dam is about 19.5 feet with an average top elevation of approximately 950.0 feet. A general plan and cross section are shown on **Plate 2-3**.

c. Marsh Lake Dam Service Spillway. The Marsh Lake Dam service spillway is a concrete fixed crest overflow section 112 feet in width with a crest elevation of 937.6 feet. A general plan and cross section are shown on **Plate 2-3**. A family of elevation-discharge curves for Marsh Lake Dam at various tailwater elevations are shown on **Plate 2-4**.

d. Marsh Lake Dam Stilling Basin. The Marsh Lake Dam stilling basin is a bucket type with a bottom elevation of 924.6 feet. The discharge flows into the downstream channel at an elevation of 929.6 feet. A general plan and cross section are shown on **Plate 2-3**.

e. Marsh Lake Dam Emergency Spillway. The Marsh Lake Dam emergency spillway has a crest elevation of 940.0 feet. Both the upstream and downstream slopes are paved with 12 inches of grouted riprap. The spillway is 90 feet wide. A general plan and cross section are shown on **Plate 2-3**.

f. Marsh Lake Dam Low Flow Outlet. The Marsh Lake Dam low flow gate has a sill elevation of 932.6 feet and discharges through a 2-foot square conduit into the stilling basin. The discharge is regulated by a 2-foot square sluice gate in the main spillway.

g. Marsh Lake Dam Outflow Channel. The Marsh Lake Dam outflow channel extends for about 1,500 feet downstream from the spillways. The channel has a bottom width of 25 feet and 1 on 2 side slopes, bounded on both sides by dikes having a top elevation of 938.0 feet. A general plan and cross section are shown on **Plate 2-3**.

h. Lac qui Parle Dam. The Lac qui Parle Dam is comprised of earth fill. The left bank section extends about 200 feet from the control structure to high ground. The right bank section, descends from the control structure for about 250 feet to the emergency spillway section which is 2,500 feet in length. Beyond the spillway section, the top of the dam rises gradually over a distance of 1,000 feet to elevation 950.5 feet. The dam extends about another 700 feet before intercepting higher ground. The dam carries Chippewa County State Aid Highway (CSAH) No. 13 (Lac qui Parle CSAH No. 33) across the Minnesota River. The roadway is 23 feet wide. The total length of the dam, including the control structure and emergency spillway, is about 4,100 feet. A general plan and cross section are shown on **Plates 2-5 and 2-6**.

i. Lac qui Parle Dam Control Structure. The Lac qui Parle Dam control structure consists of a concrete curtain wall section and a fixed concrete spillway section (**Plate 2-5**). The curtain wall section is divided into four bays, numbered 1 through 4, beginning from the left bank. The spillway section is divided into eight bays, numbered 5 through 12. All bays have a span of 17 feet and all piers are 3 feet wide. The piers support a bridge over the control structure with a deck elevation of 946.2 feet.

Bays 1, 3, and 4 each have two 6.0- by 8.0-foot vertical lift gates with sill elevations at 922.7 feet. Bay No. 2 has three 4.0- by 4.0-foot vertical lift gates with sill elevations at 915.2 feet. These gates (Bay No. 2) are equipped with trash racks and are used for low flow regulation. The nine lift gates in the curtain wall section are numbered 1 through 9 beginning in bay No. 1.

In the spillway section, the crest elevation is 934.2 feet. Bays 5 through 7 are uncontrolled spillways with no gates. In bays 8 through 12, each bay has three sections of movable steel bulkheads. The bulkheads have a top elevation of 940.7 feet when they are in the sealed position and are 5.5 feet wide. The bulkheads are raised and lowered according to the operating plan.

A general plan and cross section are shown on **Plates 2-5 and 2-6**. A set of curves for determining discharge from Lac qui Parle Dam are shown on **Plate 2-7**. Individual elevation-discharge curves for

the slide gates, fixed crest spillway and emergency spillway are shown on **Plates 2-8, 2-9 and 2-10.** An elevation-discharge curve (tailwater curve) for the Minnesota River at U.S.G.S. gage No. 05301000, just below Lac qui Parle Dam (200 feet downstream), is shown on **Plate 2-11** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-12.**

The U.S.G.S. gage at Montevideo, Minnesota is a control point for Lac qui Parle Dam (see **Chapter VII**). A stage-discharge curve for U.S.G.S. gage No. 05311000, Minnesota River at Montevideo, Minnesota is shown on **Plate 2-12** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-13.**

j. Lac qui Parle Dam Stilling Basin. The stilling basin for Lac qui Parle Dam varies in length and floor elevation across the width of the structure. The stilling basin for bays 1 through 4 has a floor elevation of 914.2 feet with an end sill top elevation of 920.2 feet. The stilling basin for Bay No. 2 contains a baffle block with a top elevation of 921.7 feet. In bays 5 through 7, the basin has a floor elevation of 918.7 feet. In bays 8 through 12, the elevation of the floor is 923.2 feet. The length of the basin varies from 42 to 60 feet and the total width is 237 feet. A general plan and cross sections of the various bays are shown on **Plates 2-5 and 2-6.**

k. Lac qui Parle Dam Emergency Spillway. The emergency spillway section is capped with soil cement and a bituminous surfaced roadway and is 2500 feet long. A concrete core wall is keyed 3 feet into natural ground along the upstream edge of the spillway and has an average top elevation of 940.75 feet. The downstream slope of the spillway is paved with 1 foot of grouted riprap on a 1 on 2 slope with at least 6 feet of horizontal paving at the toe of the fill. The upstream slope is 1 on 3 and seeded. The spillway is not level. The low point has a crown elevation of about 941.2 feet. The original emergency spillway had a crown elevation of 941.1 feet. The road has been resurfaced which has raised the top elevation slightly. Elevation 941.1 is the top of the flood control pool. A general plan and cross section are shown on **Plate 2-5.** Elevation-discharge curves for the emergency spillway are shown on **Plates 2-7 and 2-10.**

l. Lac qui Parle Dam Outflow Channel. The Minnesota River channel was modified between Lac qui Parle Dam, (river mile 288.1) and Granite Falls, Minnesota, (river mile 245.0) **(Plate 2-13).** The project consisted of rock and snag removal and cutoffs at various locations to increase the bankfull capacity of the channel.

m. Reservoirs. The Lac qui Parle Project incorporates two reservoirs for the storage of water for flood control and water conservation; namely, Lac qui Parle and Marsh Lake reservoirs. Lac qui Parle Reservoir extends in a northwesterly direction about 15.4

miles above the dam. Marsh Lake Reservoir flows into Lac qui Parle and extends about 7 miles northwest above Lac qui Parle Reservoir. The combined storage capacity of both reservoirs at the maximum design elevation of 941.1 feet is 157,800 acre-feet. Marsh Lake Reservoir has 12,050 acre-feet of storage at the conservation pool elevation of 937.6 feet. Lac qui Parle Reservoir has 41,000 acre-feet of storage at the conservation pool elevation of 933.0 feet. The reservoir elevation-area and elevation-storage curves for Marsh Lake and Lac qui Parle Reservoirs are shown on **Plates 2-14 and 2-15.** Bathymetric maps of maps of Marsh Lake and Lac qui Parle are shown on **Plates 2-16, 2-17 and 2-18.**

The Pomme de Terre River is a tributary to Marsh Lake Reservoir. A stage-discharge curve for U.S.G.S. gage No. 05294000, Pomme de Terre River at Appleton, Minnesota is shown on **Plate 2-19** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-8.** The Lac qui Parle River is a tributary to Lac qui Parle Reservoir. A stage-discharge curve for U.S.G.S. gage No. 05300000, Lac qui Parle River near Lac qui Parle, Minnesota is shown on **Plate 2-20** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-9.**

n. Chippewa River Diversion Dam. The Chippewa Diversion dam diverts a portion of the floodwaters of the Chippewa River into the Lac qui Parle Reservoir. The dam is constructed of rolled earth fill and carries a 32-foot wide highway across the Chippewa River

at elevation 950.3 feet. Total length of the dam, which includes the main control structure and a low water control culvert, is about 1,900 feet. Side slopes are 1 on 3 on the upstream side and 1 on 4 on the downstream side. The approach channel has a 40-foot bottom width at elevation 932.8 feet and side slopes of 1 on 2. A 1,200-foot dike on the left bank of the approach channel has a minimum top width of 10 feet and side slopes of 1 on 3 with a top elevation of 950.3 feet. A general plan and cross section are shown on **Plates 2-21 and 2-22.**

o. Chippewa River Diversion Dam Control Structure. The main control structure is a 5-span combination highway bridge and dam. Bays 1, 2, 4, and 5 have a fixed crest spillway elevation of 942.3 feet. Discharge is onto a concrete apron at elevation 934.3 feet with a dentated end sill and baffles. Bay 3 provides the discharge control by means of a 27-foot Tainter gate. The top of the gate in the closed position is at elevation 942.3 feet. The sill elevation is 932.9 feet. Discharge through the gate is onto a concrete apron at elevation 932.0 feet with an end baffle at elevation 932.8 feet. The Tainter gate is powered by an electric gate lifter but can also be operated by hand. About 300 feet west of the right abutment of the control structure is a low water control culvert which was used prior to the installation of the Tainter gate in 1941. This culvert is a 4- by 4- by 90.4-foot concrete box type through the earth dike. The inlet is controlled by a 4- by 4-foot vertical lift gate protected by a trash rack. The entrance invert is at

elevation 933.3 feet and the exit invert is at 932.8 feet. A general plan and cross section are shown on **Plates 2-21 and 2-22.** A family of elevation-discharge curves for the Tainter gate at the Chippewa River Diversion Dam for various gate openings are shown on **Plate 2-23.** A tailwater rating curve for the Chippewa Dam is shown on **Plate 2-24.**

A stage-discharge curve for U.S.G.S. gage No. 05304500, Chippewa River near Milan, Minnesota is shown on **Plate 2-25** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-10.** This gage is upstream of the Chippewa River Diversion Dam.

p. Watson Sag Weir, Chippewa River Diversion Channel. The Chippewa River diversion channel passes some of the Chippewa River floodwaters into the Lac qui Parle Reservoir. It is an excavated channel about 3,500 feet in length with a bottom width of about 160 feet and side slopes of 1 on 3. The channel cuts through a part of a natural ridge which separates the Chippewa River from the abandoned glacial channel known as the Watson Sag. A six span combination highway bridge and spillway near the point of diversion controls the flow of water from the Chippewa River into the channel. A rolled earth dike on the left bank of the channel is an extension of the Chippewa River Diversion Dam and serves to protect the railroad tracks adjacent to the channel from being flooded.

The dike has a 10-foot top width and side slopes of 1 on 3 on the channel side and 1 on 4 on the landward side. The elevation of the top of the dike varies from 946.3 feet to 947.8 feet.

The spillway crest is at elevation 938.8 feet and discharge is onto a concrete apron at elevation 932.3 feet with a dentated end sill and baffles. The downstream channel bottom is at elevation 934.3 feet and the upstream approach bottom is 936.3 feet. The bridge deck is at elevation 950.0 feet. When the stage in Lac qui Parle reservoir is high enough and no flood flows are coming down the Chippewa River, the flow in the diversion channel will reverse and pass through the Chippewa River Dam and down the Chippewa River channel. A general plan and cross section are shown on **Plate 2-21**. A family of rating curves for the Watson Sag weir are shown on **Plate 2-26**.

2-04. Related Control Facilities.

a. General. There are two dams upstream of the Lac qui Parle Project called Big Stone Lake Dam and Highway 75 Dam. Both are incorporated into the Big Stone Lake-Whetstone River Project.

In 1935 Big Stone Lake was at an extremely low level after several years of extreme drought conditions. In that year, the Big Stone Lake - Whetstone River Project was initiated to maintain a better range of water levels on the lake and to utilize the immense

storage capacity of the lake for flood control and water conservation. The project was constructed by the State of Minnesota under the Federal Emergency Relief Act and the Works Progress Administration. Later, high lake levels, acceleration of silt deposit in the lower end of the lake, and flood damages, justified additional improvements downstream from the outlet of Big Stone Dam. In 1958, the State of Minnesota, with some cost sharing by the State of South Dakota, constructed a steel sheet-pile dam (which serves as a silt barrier) in the Minnesota River between the outlet of Big Stone Lake and the mouth of the Whetstone River diversion channel. In addition, the Highway 75 Dam was completed in 1974. It provides 45,300 acre-feet of storage for the reduction of flood damages to downstream areas. The pool sustains open-water areas for waterfowl use in the national wildlife refuge which was established as part of the project. Highway 75 Dam has a drainage area of approximately 1,700 square miles. The locations of these structures are shown on **Plate 2-1.** See **Paragraphs 3-04, 4-10 and 4-11.**

b. Big Stone Lake Dam Outlet Structures. The dam has 8 slide gates each measuring 7 feet high and 10 feet-10 inches wide. There are also 2 low flow gates. One is 4 feet by 4 feet and the other is 18 inches in diameter. All slide gates discharge at elevation 960.7 feet and the low flow orifices discharge at elevation 961.2 feet. The crest of the slide gates, when closed,

is elevation 964.7 feet. The dam is operated by the Minnesota Power and Light Company. Big Stone Lake Dam has a drainage area of approximately 1,160 square miles.

A stage-discharge curve (tailwater curve) for the Minnesota River at Ortonville, U.S.G.S. gage No. 05292000, below the Big Stone Lake Dam is shown on **Plate 2-27** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-11.**

c. Highway 75 Dam Outlet Structures. The service spillway is a reinforced-concrete gravity weir that is 65 feet long, with a crest elevation of 947.3 feet. Discharge is controlled by an electrically operated Bascule leaf gate that can be raised to a normal conservation pool elevation of 952.3 feet. The stilling basin is 68 feet long with a floor at elevation 934.0 feet. The stilling basin has five baffle blocks with top surfaces at elevation 938.58 feet and an end sill with a top elevation of 936.9 feet. A discharge channel 0.5 mile in length with a bottom width of 55 feet and 1 on 3 side slopes connects the service spillway with the Minnesota River.

Low flows are discharged through a 42-inch diameter reinforced concrete conduit. This conduit is capable of discharging 75 cfs at a pool elevation of 947.3 feet and 114 cfs at a pool elevation of 952.3 feet.

The emergency spillway for the Highway 75 dam is 715 feet long. The crest of the spillway is at elevation 956.6 feet and is 50 feet wide. A 1-foot deep v-shaped depression has been provided on the centerline of the emergency spillway crest and chute to concentrate any erosion in the center of the spillway and away from the training dikes constructed downstream from both ends of the spillway.

Reservoir elevation-area and elevation-storage curves for the Highway 75 Dam are shown on **Plates 2-28 and 2-29.** Elevation-discharge curves for the service and emergency spillways and the tailwater at the Highway 75 Dam are shown on **Plate 2-30.** A head-discharge curve for the service spillway alone is shown on **Plate 2-31.**

The Yellow Bank River is a tributary to the Highway 75 reservoir. A stage-discharge curve for the Yellow Bank River near Odessa, Minnesota is shown on **Plate 2-32** and in **Exhibit E.** A discharge-frequency curve for this gage is shown on **Plate 8-7.**

2-05. Real Estate Acquisition. Construction of the Lac qui Parle Reservoir was initiated early in 1936 as a Works Progress Administration project sponsored by the State of Minnesota. The operation of the project was transferred from the State to the Corps of Engineers on 7 September 1950. Land acquisition was completed by the Corps during March 1961.

The Corps has fee title to 516.31 acres for the dam, and easements on 19,826.67 acres for the reservoir. All of this area was conveyed to the United States by the State of Minnesota. Special easements on parcels of 32.80 and 1.31 acres of land in fee were also acquired by the Government. In 1957, 60.1 acres were withdrawn from public lands for use by the Department of the Army. All of the land acquisition for the project is complete. Project lands are shown on **Plates 2-33 and 2-34.** Flowage easements are to elevation 945.0 feet and are shown on **Plate 2-34.**

2-06. Public Facilities. Also see **Paragraphs 7-06 and 8-03.**

a. General. There are 3 public use facilities associated with the Lac qui Parle Project. The areas are referred to as Area A, B, and C. A brief description of each area can be found in the following paragraphs.

b. Area A, Marsh Lake Dam. The public use facilities at Marsh Lake Dam consist of a picnic area, shoreline fishing access, and privies. Area A is located adjacent to Marsh Lake Dam (**Plate 2-35**).

c. Area B, Lac qui Parle Dam. The facilities at Lac qui Parle Dam consist of a picnic area, drinking water, shoreline fishing access, fish cleaning facilities, handicap-accessible privies, and a playground. Area B is located adjacent to Lac qui Parle Dam (**Plate 2-36**).

d. Area C, Chippewa River Diversion Dam. The facilities at the Chippewa Diversion Dam consist of shoreline fishing sites, and access to hunting areas and hiking trails. Area C is located adjacent to the Chippewa Diversion Dam and the Watson Sag Weir (**Plate 2-37**).

e. Other. Lac qui Parle State Park is located on the right bank just upstream of Lac qui Parle Dam. The Minnesota River is part of the State's Wild and Scenic Rivers System and is also a state canoe route. There are 19 boat access sites surrounding the project.

III - HISTORY OF PROJECT

3-01. Authorization. The Lac qui Parle Project was a Works Progress Administration endeavor sponsored by the State of Minnesota from 1936 through 1939. During 1941 to 1951, the Lac qui Parle Project was reconstructed by the Corps of Engineers for flood control, as authorized under the June 22, 1936 Flood Control Act.

3-02. Planning and Design. A project for flood control at Lac qui Parle Lake was first described by the State of Minnesota in the first Biennial Report of the Commissioner of Drainage and Waters in 1921. The report followed the occurrence of several large floods in the Minnesota River Valley which culminated in the large flood of June 1919. Additional data are given in the Second Biennial Report of the Commissioner dated 1923.

During 1922 or 1923, the Minnesota Game and Fish Commission constructed a small low-head dam at the lower end of Lac qui Parle Lake about 1.3 miles above the present dam and about 1/4 mile above the mouth of the Lac qui Parle River. Apparently the structure was utilized for conservation purposes only as the crest elevation was 925.96 feet. The structure was removed prior to the completion of the existing dam. This interest in flood control and water conservation in the Minnesota River Valley culminated in the Lac qui Parle reservoir project. Lac qui Parle is a French phrase meaning "lake that speaks".

3-03. Construction. Construction of the Lac qui Parle reservoir was initiated early in 1936 as a Works Progress Administration project sponsored by the State of Minnesota. It was authorized as a Federal project by the Flood Control Act dated 22 June 1936. The State of Minnesota completed its portion of the construction in 1939. The Department of the Army, under the above Flood Control Act, completed its portion of the project during the period of September 1941 through December 1951, except for land acquisition which was completed in March 1961. The project completed by the Army included improvements to Lac qui Parle Dam and spillway, Marsh Lake Dam, access roads and dike, alterations to the Great Northern Railway bridge, construction of a Tainter gate at the Chippewa River Dam, and construction of 3 stage recorder houses. The project also included modifications to the Minnesota River between Lac qui Parle and Granite Falls, Minnesota, consisting of rock and snag removal and cutoffs at various locations to provide for increasing the bankfull capacity of the channel. The project was transferred from the State of Minnesota to the United States on 7 September 1950. Operation of the project was assumed by the U. S. Army Corps of Engineers on 8 September 1950. Previous to the transfer, operation of the project had been under the direction of the Commissioner of Drainage and Waters, State of Minnesota.

3-04. Related Projects. The Big Stone Lake - Whetstone River Project, located immediately upstream, is also used for flood control and water conservation. This project includes the Highway

75 Dam and reservoir. Refer to **Paragraph 2-04** and the Big Stone Lake - Whetstone River Project Reservoir Regulation Manuals for information about those projects. Also see **Paragraphs 4-10 and 4-11.**

There are two hydropower dams downstream in the vicinity of Granite Falls, Minnesota (see **Paragraph 4-11**).

3-05. Modification to Regulations. Following completion of the dam in 1939, the conservation pool elevation was set at 934.2 feet year-round. The State of Minnesota lowered the conservation pool elevation to 932.0 feet in 1946 in an effort to provide more flood control storage for agriculture and alleviate problems in the downstream channel. That same year, following meetings with the Sport and Gun Club and agricultural interests, the conservation pool elevation was set at 931.2 feet.

The project was transferred to the Corps of Engineers in 1950 and a spring drawdown to elevation 926 feet was adopted. Starting in 1968, the pool was raised every fall to 934.2 feet, from 15 October to 15 November, and held there through the winter to help prevent fish kill. A spring drawdown to elevation 931.2 feet, or lower, was to occur between 15 January and 15 March.

In 1968 and 1969 there was insufficient inflow to raise the pool in the fall to elevation 934.2 feet in one month. In 1970 the regulation plan was changed to start the fall pool rise on 1 August.

In 1979 the summer conservation pool elevation was officially changed to a band of 932.75 to 933 feet. The winter pool conservation pool elevation remained at 934.2 feet. In 1982 the spring drawdown period was changed to the period from 21 February to 10 March.

The current plan has a summer conservation pool elevation of 933 ± 0.2 feet. The winter conservation pool elevation is 934 ± 0.2 feet (to reduce fish kill). The fall pool rise is to occur during the month of September. The spring drawdown level is equal to the summer conservation pool elevation of 933 ± 0.2 feet. The spring drawdown occurs from 1 March to 15 March.

3-06. Principal Regulation Problems.

a. Reservoir Shoreline Erosion. Most of the shoreline erosion occurs along the clay banks which are located on the left bank approximately 3 miles upstream of Lac qui Parle Dam. The area is about 2,000 feet long with vertical drops of 15 feet in some locations. High reservoir levels greatly aggravate the erosion problems in this area.

b. Damage to Lac qui Parle State Park. The State Park is located on the right bank just upstream of Lac qui Parle Dam. When the reservoir reaches elevation 934 feet, shoreline erosion begins to be a problem. At elevation 935 feet, some of the park's trails are flooded. When the pool elevation gets to 936 feet and above, the park has substantial problems with: loss of shoreline trees, damage to the swimming beach and problems with the park's sewer system. As the pool exceeds elevation 936 feet, the park has to shut down its restroom facilities. Above elevation 937 feet, parking areas, picnic areas and the swimming beach are inundated. At 938 feet, the boat access area is flooded and above 939 feet the campground is under water. Damage to cultural resources (e.g. Indian mounds) within the park also occurs at high pool levels.

c. Agricultural Damages. Agricultural damages occur downstream of the dam when local inflows plus releases from the dam exceed channel capacity. These damages include both crop losses and the inability to use the land (e.g. pastureland).

d. Damage to Cultural Resources. The National Register-listed Fort Renville site (21CP24) and sites within Lac Qui Parle State park are subject to erosion when the reservoir exceeds approximately elevation 935.0 feet.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Minnesota River basin lies mostly in the southern part of Minnesota but also includes small portions of Iowa and South Dakota (**Plate 2-2**). Its total drainage area is 16,900 square miles, of which 14,900 square miles are in Minnesota.

From its source in Big Stone Lake, the river flows southeast for 224 miles to Mankato where it turns and flows northeast 106 miles to its junction with the Mississippi River in St. Paul, Minnesota. The average fall of the stream bed over its entire length is about 0.8 feet per mile. Throughout its length the river flows between the high bluffs of a valley and meanders widely across the alluvium deposits. Below Mankato, MN, the valley is from one to three miles wide. The land is generally relatively flat to gently rolling and is nearly all cultivated.

In the upper northwest corner of the watershed, Big Stone Lake reservoir is formed by a natural lake with a concrete dam at the outlet. Big Stone Lake has a drainage area of 668 square miles of which the Little Minnesota River is a major portion. The Little Minnesota River forms the headwaters of the Minnesota River. The Whetstone River with a drainage area of 395 square miles, which is

almost entirely within South Dakota, flows into Big Stone Lake just upstream of Big Stone Dam. The original confluence was downriver from the dam.

The Highway 75 Dam is approximately 9 miles downstream from Big Stone Lake Dam. The Yellow Bank River enters the Highway 75 reservoir just upstream of the Highway 75 Dam.

Marsh Lake Dam is below the Highway 75 Dam. The Pomme de Terre River enters the Marsh Lake reservoir immediately upstream of the Dam.

The Lac qui Parle Dam is downstream of Marsh Lake Dam. The Lac qui Parle River enters Lac qui Parle reservoir just above the dam from the south. The drainage area above the Lac qui Parle reservoir is 4,050 square miles. Water from a portion of the 2,050 square-mile Chippewa River watershed is diverted at times to Lac qui Parle reservoir for flood control through the Chippewa River diversion project.

Lac qui Parle Lake, Marsh Lake, and the Minnesota River are the most prominent surface water features in the region. The average stream discharges from the Pomme de Terre and Lac qui Parle Rivers combined, equal more than 30 percent of the average Minnesota River flow at the Lac qui Parle Dam. The Whetstone, Yellow Bank, and

Chippewa Rivers contribute less than 10 percent of the average flow. A large artificial drainage network and huge extent of row-cropped land are the predominate watershed features.

4-02. Topography. The Minnesota River Valley is in a gently undulating prairie region with general elevations ranging from 700 to 1900 feet above sea level. The general topography of the basin is typically glacial characterized by gently rolling hills separated by level outwash plains. Throughout the valley there are numerous depressions ranging from a few feet to about 30 feet below the surrounding prairie. These depressions contain lakes and wetlands some of which have been drained.

4-03. Geology and Soils. Most of the State of Minnesota is covered by glacial deposits (drift). Much of the land surface consists of features derived from the several different ice sheets that advanced and retreated from the state. During the Pleistocene Epoch, the entire state was overrun at various times by continental ice sheets except for a small area in the extreme southeastern corner. The debris left by these ice sheets covered the original landscape to depths ranging from 100 feet to over 400 feet. The glacial till in the area of the Lac qui Parle Project is made up principally of clays containing a noticeable amount of sand and gravel. The surface soils of the watershed are dark loess and glacial till soils developed under prairie vegetation.

With the retreat of the last ice sheet (Keewatin) about 10,000 year ago, a huge lake (Glacial Lake Agassiz) began to form at the base of the melting glacier. Since the drainage system in the area had been filled by glacial drift, there was no place for this water to drain naturally. The rising water had to reach a height which would allow it to drain to the south. Before drainage in this direction became possible, the lake reached a size, estimated from its ancient beach ridges, ranging from 100 to 200 miles in width and more than 600 miles in length.

When the outflow started, the general direction was southeast due to a flatiron shaped plateau known as the Coteau Des Prairies. The plateau is a morainal ridge extending from South Dakota in a southwesterly direction across Minnesota and into Iowa. The elevation of the crest of this ridge was nearly 2,000 feet above sea level. As the tremendous outflow from Lake Agassiz increased so did the erosion into the drift, creating the remarkable Valley of the Minnesota River. This ancient river channel ranged in width from 1 to 5 miles and 150 feet or more in depth and stretched over 330 miles from Big Stone Lake to the mouth. From the lower end of the outlet at Ortonville, Minnesota, to the vicinity of Lac qui Parle, the erosion carried down to the Archean bedrock of the original landscape. The outlet which was formed is now occupied by Big Stone Lake and Lake Traverse. The formation of these lakes was caused by the alluvial deposits of the Whetstone and Little Minnesota Rivers after the drainage of Lake Agassiz was completed.

When the draining of Lake Agassiz was completed, siltation of the main channel began. Tributary streams created alluvial fans where they entered the main stream. These tributary streams within or adjacent to the project were also created by the draining of the water from the melting ice sheet. However, erosion of these tributary valleys did not reach the Archean rock as it did in the main channel. Erosion stopped at depths of 40 - 50 feet below the present drift on a moraine of an earlier ice age which was composed of granite, syenite, and gneiss. Tributary streams entering from the south have their origin in the above mentioned Coteau Des Prairies, and these streams descend rather rapidly from the upland areas, some dropping as much as 500 feet in a few miles. The Lac qui Parle River drops 790 feet over 66-miles with the greatest fall of 250 feet occurring in an 8-mile reach near Canby, Minnesota. In the lowland plains adjacent to the main Minnesota River channel, the gradient is usually less than 2.0 feet per mile. In the lower 18 miles to the mouth the fall is about 14.0 feet per mile. Tributaries entering from the north, such as the Pomme de Terre and the Chippewa Rivers, are divided by north-south morainal hills which rise less than 75 feet above the water courses. Drainage in the upland regions of these streams is rather poorly defined with small lakes and marshy areas marking the water courses.

Between the Pomme De Terre and Chippewa River mouths are some ancient channels apart from, but in the main Minnesota River Valley which were produced by these streams and carry flows only during

periods of extreme floods. One of these abandoned channels is known as the Watson Sag and is now utilized in the Lac qui Parle Project for the Chippewa River Diversion Channel.

The prehistoric river which created the Minnesota River Valley was named the River Warren in honor of General G. K. Warren. General Warren explained the origin of the Valley in his report on the Examination and Survey of the Minnesota River published as Ex. Doc.#76, Forty-third Congress, Second Session, 1866-1867. General Warren's surveys, maps, descriptions, and discussions were considered a valuable contribution to science. The Minnesota River has had several names given it by the early explorers in the region. On one of the earliest maps of the region dated 1688, it was shown as the "Des Mascoutens Nadouscioux" or River of the Mascoutins after a tribe of Sioux Indians living in the Valley. Another map dated 1754 called it the River Saint Piene; however, the most complete map of the entire territory dated 1841 by the explorer J. N. Nicollet had it noted as the St. Peters River. By an act of Congress on 19 June 1852, the name was officially changed to "Minnesota River."

4-04. Sediment. There has been a large amount of sediment deposition in Marsh Lake reservoir over the past 48 years. A study conducted by the University of Minnesota (see **Paragraph 1-03.**)

indicated that approximately 105 centimeters of silt has been deposited at the mouth of the Pomme de Terre River (near the dam). Only one core sample was taken for the University study.

The Corps of Engineers, Waterways Experimental Station Laboratory at Eau Galle Dam (WI) is investigating the resuspension of sediments in Marsh Lake.

An estimate of the amount of storage volume lost to sedimentation is shown in **Table 4-1**. Also see **Paragraph 5-03**.

Table 4-1

Sediment Deposition
Marsh Lake And Lac qui Parle Reservoirs

Reservoir	Sediment Load Ac-Ft/Year[1]	Number of Years[2]	Estimated Deposition Ac-Ft	Percent of Conservation Storage Lost[3]
Marsh Lake	60.5	56	3388	28
Lac qui Parle	69.0	56	3864	9

1. U.S. Army Corps of Engineers, General Design Memorandum No. 1, Supplement No. 2, Flood Control, Big Stone-Whetstone River, Page 3, 30 November 1979. Based on an observed Sediment rate of 0.05 ac-ft/sq. mi. for the Big Stone River. Also see the Reservoir Operation Plan Evaluation dated September 1989, Pages 75 and 103.
2. 1939 through 1994
3. Marsh Lake Conservation Storage = 12,050 ac-ft = Storage Below Elevation 937.6 Feet
   Lac qui Parle Conservation Storage = 41,000 ac-ft = Storage Below Elevation 933.0 Feet

4-05. Climate. The climate in the region is characterized by moderate precipitation and wide variations in temperature. The area is subject to cold winters and warm summers, typical of continental conditions in the temperate zone. The average length of the growing season, the interval between killing frosts, is about 150 days.

The climate is favorable for wheat, corn, soy beans, and other small grains. Historical temperature, precipitation, and evaporation values at typical National Weather Services stations in and adjacent to the Minnesota River basin are shown in **Tables 4-2, 4-3, and 4-4** respectively.

a. Temperature. The average annual temperature is about 44 degrees Fahrenheit with average monthly temperatures varying between 12 degrees Fahrenheit in January and 74 degrees Fahrenheit in July. Extremes in temperatures which have been observed in the general area range from a low of -42 degrees Fahrenheit to 114 degrees Fahrenheit. Normal monthly temperatures (30-year average) for the National Weather Service gages at Milan and Redwood Falls, Minnesota are listed in **Table 4-2**. On the average, the first killing frost occurs on 22 September.

b. Precipitation. The mean annual precipitation over the basin is about 23.0 inches, with more than 75 percent of the precipitation falling during the months of April through September.

Precipitation in the winter generally occurs as snow. Average monthly precipitation values for the National Weather Service gages at Milan and Redwood Falls, Minnesota are listed in **Table 4-3**.

c. Evaporation. Evaporation represents a major portion of the water lost from the reservoir during the period April through October. Evaporation from Lac qui Parle reservoir has been estimated to average about 30 inches per open water season. Average monthly pan evaporation for the National Weather Service gage at Fargo, North Dakota is listed in **Table 4-4**. Evaporation from lakes is less than pan evaporation due to cooler water temperatures.

d. Wind. The average wind speed in this area is about 10 miles per hour. The prevailing winds are from the northwest, but southeast winds are very common during the summer months. Wind speeds are usually highest during the afternoon and lowest at night.

TABLE 4-2

Normal Temperatures at the National Weather Service Gages at Milan, and Redwood Falls Minnesota In Degrees Fahrenheit

Month	Milan, MN	Redwood Falls, MN
January	8.7	12.9
February	15.3	27.9
March	27.4	32.6
April	44.3	52.1
May	57.4	59.7
June	67.2	72.7
July	71.8	78.0
August	69.6	75.4
September	59.5	63.5
October	48.3	45.7
November	31.0	29.1
December	16.7	15.2
Annual	43.1	47.1
Period of Record	1951-80	1951-80

TABLE 4-3

Average Precipitation at the National Weather Service Gages at Milan and Redwood Falls, Minnesota In Inches

Month	Milan, MN	Redwood Falls, MN
January	0.63	0.59
February	0.73	0.72
March	1.39	1.42
April	2.32	2.33
May	2.93	3.16
June	4.04	3.87
July	3.34	3.51
August	3.30	3.23
September	2.37	2.39
October	1.93	1.69
November	1.06	1.20
December	0.68	0.69
Annual	24.72	24.80
Period of Record	1949-90	1932-41 1943-63 1965-89

TABLE 4-4

Average Pan Evaporation for the National Weather Service Gage at Fargo, North Dakota In Inches

Month	Fargo, ND Airport
January	NA
February	NA
March	NA
April	3.64
May	7.15
June	7.41
July	8.43
August	7.31
September	4.95
October	3.29
November	NA
December	NA
Period of Record	1963-80 (Gage Discontinued)

4-06. Storms and Floods. Floods of damaging proportions occur quite frequently in the Minnesota River Basin. Floods which occur as a result of melting snow during the spring breakup are more prevalent, although floods may also result from heavy summer rains extending over the watershed. The most destructive floods are those that affect the agricultural economy of the region.

A brief description of some floods that have occurred in the upper reaches of the Minnesota River from Big Stone Lake to Montevideo, Minnesota follows.

a. **April 1881.** This flood was the result of excessive snowfall during the winter of 1880 - 1881. Below normal temperatures prevailed up to the end of April, followed by a high and sudden rise in temperature, a condition which produced rapid runoff. There is very little information on this flood except for old newspaper accounts and high water marks. A description of the 1881 flood at Saint Paul is contained on Pages 1754 - 1756 of the Annual Report of the Chief of Engineers wherein the major portion of the flood waters was attributed to the Minnesota River. The U.S. Geological Survey estimates the discharge at Mankato was about 110,000 cfs.

b. **April 1897.** The only evidence that there was a flood of high magnitude in the upper reaches of the river was a high water mark at Big Stone Lake. This high water mark indicates a flood stage only 0.26 foot lower than the maximum stage of record, established in April of 1952. There is no other information available.

c. **April 1916.** Rainfall during the fall of 1915 was above normal. The ground froze while saturated, a condition favorable for high runoff during the spring breakup. Snowfall during the winter averaged 4.8 inches in water content which is about normal. Flooding apparently originated on the Chippewa River where the discharge of 4,750 cfs occurred on 29 March. At Montevideo on 2 - 5 April, the flow was 7,540 cf with a stage of 15.45 feet. Flows

on the Chippewa did not recede very rapidly, and the discharge at Montevideo did not drop much below 3,000 cfs until the middle of June. Three flood crests occurred at Mankato, during March, April and July.

d. April 1917. Rain during the fall of 1916 averaged about 4.0 inches, followed by snow during the winter, averaging about 6.5 inches in water content. Again, as in 1916, this flood was apparently caused entirely by the Chippewa River. The crest at Montevideo occurred on 4 - 5 April with a flow of 10,000 cfs and a stage of 16.2 feet.

e. June 1919. Prior to the winter of 1918, rainfall had saturated the ground throughout the watershed. This was followed by abnormally heavy snowfall over the entire basin. Before any appreciable amount of runoff started in the basin above Montevideo, flooding was already occurring in the downstream reaches. Much of this flooding was attributed to ice and debris choking the main channel at many points. The runoff above Montevideo did not contribute much to this early flooding in the lower reaches, but all of the lower tributaries were flooding at this time. With the main river at stages above normal and the watershed already saturated, heavy rains fell in the upper reaches between 1 - 26 June, averaging approximately 7.0 inches with a maximum of 10.10 inches at Canby, Minnesota. The crest occurred at Montevideo on 25 June with a flow of 22,000 cfs and a stage of 19.4 feet, 5.4 feet

above flood stage. This flood inundated about 106,000 acres of bottom lands from Big Stone Lake to the mouth of the river, resulting in a tremendous crop loss. This flood was the deciding factor in the planning of the Lac qui Parle flood control project.

f. May - June 1942. This flood marked the end of a period of about 20 years wherein no high flows had occurred on the Minnesota River after 1 May in the vicinity of Montevideo. A series of frequent storms of high intensity began in the last week of April and continued for several months. These storms covered widespread areas of the Minnesota River watershed producing recurrent high discharges on a number of the tributaries in the upper reaches of the basin. Rainfall during the period 25 - 30 April averaged 3.5 inches. May and June received an average of 8.0 inches and 3.5 inches. The Little Minnesota and the Whetstone River basins during this period received approximately 15.0 inches of rainfall. Flood flows from these streams filled Big Stone Lake to 0.1 foot above the upper limit of the flood control storage. Lac qui Parle reservoir was filled to elevation 940.0 or 1.1 feet below the top of the 2,500 foot emergency spillway. Operation of the Lac qui Parle Dam held the mean daily discharge of the Minnesota River at Montevideo to 4,540 cfs on 6 - 8 June, approximately 0. 5 foot below the flood stage of 14.0 feet.

g. April 1943. During the fall and winter months of 1942 - 1943, precipitation was somewhat above normal and temperatures were below normal. During the period 12 - 19 March, heavy snow and near-blizzard conditions occurred. This new snow had a high water content. Warmer weather followed with temperatures averaging about 80 degrees Fahrenheit in the latter part of March, causing rapid melting of the snow cover and a high runoff rate. Operation of Lac qui Parle Dam held the flood crest at Montevideo to 9,200 cfs on 4 - 5 April (stage 16.0 feet) . However, the reach downstream from Montevideo to New Ulm was inundated from bluff to bluff. Several highway crossings on the main stem were overtopped, and buildings in the lowlands were partially submerged. In a low-lying residential area of Montevideo, three persons were drowned when their boat capsized in an attempt to retrieve some of their belongings. Many of the tributary streams attained new record flood stages During this period. Heavy precipitation, concentrated in the lower reaches, produced another flood in June which was the largest flood in the lower area since 1920. Relatively uniform flows from the operation of Big Stone and Lac qui Parle Dams of 1,200 to 2,000 cfs did not have any appreciable effect on the flood crests of the lower river.

h. March 1946. This flood was of minor importance and was produced mainly by the Lac qui Parle and Pomme De Terre Rivers. Operation of Lac qui Parle Dam held the peak flow at Montevideo to 5,380 cfs on 28 - 30 March with a crest stage of 14.25 feet.

However, this was the 5th consecutive year that floods had occurred in the lower reach of the river, produced entirely by the tributary streams below Montevideo.

i. April, July 1947. Precipitation during the winter of 1946 - 1947 was below normal with March being the driest for the State of Minnesota since 1939. However, above normal rainfall during April 1947 averaged 3.5 inches over the watershed, and this was augmented by the snowmelt. This condition resulted in a flood similar in magnitude and characteristics to the spring flood of 1943. Floods of considerable magnitude occurred on the Little Minnesota, Whetstone, Yellow Bank, Pomme de Terre, and Lac qui Parle Rivers. Floodwaters on the Yellow Bank River overtopped U.S. Highway 75 near the head of Marsh Lake and eroded the shoulder of the roadway. Lac qui Parle reservoir was filled to its capacity and water overflowed the 2,500 foot emergency spillway at a depth of 0.1 foot. However, this outflow was not as great as the 1943 flood when the reservoir level was lower. During the early stages of the 1947 flood, a number of local farmers, in an attempt to prevent the flooding of their land downstream from the dam, placed some stop logs in the spillway of the Lac qui Parle Dam without proper authority. The gates in the dam were closed at the time. The discharge capacity of the dam was reduced, causing a higher level in the reservoir. The Minnesota River at Montevideo reached a peak flow of 8,500 cfs on 17 April and a stage of 15.95 feet, 0.3 foot lower than the 1943 peak. A residential area with about 50

homes was flooded. Heavy rains over the watershed between 3 and 5 July, averaging about 7.0 inches, again caused some flooding with crests generally below the April flood. Flooding on tributary streams below Montevideo produced the highest flood of record at that time on the Redwood River at Marshall, Minnesota.

j. April 1951. Above normal precipitation occurred during the fall and winter months. Flooding started on most tributaries the first week in April. The Yellow Bank River overtopped U. S. Highway 75 near the head of Marsh Lake. Flood flows from the Pomme De Terre, Lac qui Parle, and Chippewa Rivers filled Lac qui Parle reservoir to within 1.2 feet (elevation 939.90 feet) of the crest of the emergency spillway section. Due to the anticipated high water, the pool at Lac qui Parle Dam had been lowered to elevation 929.5 feet. The highest flows were attributed to the Chippewa River Basin. The peak flow on the Minnesota River at Montevideo occurred on 11 April with a discharge of 12,200 cfs and a stage of 16.80 feet (**Table 4-5**). The operation of Lac qui Parle Dam caused a reduction of 0.17 feet in the stage at Montevideo. Tributary streams below Montevideo combined to produce a maximum discharge at Mankato of 66,600 cfs.

k. April 1952. Above normal rainfall occurred during the fall of 1951. Heavy snowfall fell during the winter months of 1951 - 1952 resulting in an accumulation of snow about twice the normal amount. The snow survey made in mid-March indicated a

water content of about 4.0 inches. Drawdown of the pool at Lac qui Parle Dam was started in mid-February, and the pool was lowered to elevation 927.85 before the spring breakup. Temperatures rose sharply in early April, exceeding 50 degrees Fahrenheit on 7 April. The resultant runoff caused tributary streams to crest on 8 April. The crest on the Minnesota River at Lac qui Parle Dam and at Montevideo occurred on 10 April. Maximum outflow at Lac qui Parle Dam was 19,700 cfs and the peak stage was 0.85 feet above the crest of the 2,500 foot emergency spillway. The peak flow at Montevideo was 24,500 cfs with a stage of 20.02 feet, 6.0 feet above flood stage (**Table 4-5**). Fifty homes in a low lying area were evacuated. There was some damage to the dike on the diversion channel and to the emergency spillway. It was estimated that operation of the Lac qui Parle Dam resulted in less than 0.10 foot decrease in the stage at Montevideo. A secondary rise was caused by heavy local rains on 25 and 28 June, causing the Lac qui Parle pool to crest at an elevation of 936.0 by 30 June.

1. **June 1953.** Heavy rainfall during the latter part of April 1953 and continuing through May gradually filled the Lac qui Parle reservoir. In addition, excessive rainfall occurred on 16 and 25 June, causing a pool elevation in Lac qui Parle reservoir of 940.35 feet and a peak discharge at Montevideo of 9,770 cfs, (stage 16.1).

m. June 1957. Heavy rains during the period 14 May through 17 June filled Lac qui Parle reservoir to elevation 940.35 feet. Operation of the reservoir kept Montevideo below the flood stage of 14.0 feet during the period except for one day when a local rain of 7.5 inches fell in a 24 hour period. The maximum discharge at Montevideo occurred on 17 June with a flow of 5,500 cfs (stage 14.4).

n. April 1965. By 3 April 1965, the winter drawdown at Lac qui Parle had lowered the pool to elevation 929.22 feet. Snow surveys had shown a snow water content varying from 2 to 5 inches with an average over the basin of about 4 inches. On 6 April 1965, rainfall averaging 1.63 inches over the basin was added to this available runoff. Temperatures near 50 degrees Fahrenheit started the melting within a week after the rainfall. The frost was still in the ground and the runoff was very high. On 14 April 1965, the Lac qui Parle pool crested at an elevation of 939.90 feet and remained above the conservation pool elevation of 931.2 feet until 4 May 1965. The 14 foot flood stage at Montevideo was exceeded on 10 April 1965, reaching a peak of 16.64 feet on 14 April 1965 (**Table 4-5**). Stages above flood stage were recorded at Montevideo until 27 April 1965. Flood damage at Montevideo and other downstream localities was minor.

The peak stage at Mankato was reached on 10 April 1965. Since the travel time from Lac qui Parle Dam to Mankato is about seven days, the peak discharge from Lac qui Parle reservoir affected only the receding flows at Mankato.

o. Spring 1969. The water content of the snow in the headwaters of the Minnesota River Basin at the end of March 1969 was about 6 inches. The upper part of the basin received 1 to 1.5 inches of rain during April 7-10 just as the snowmelt runoff was reaching its peak. Conditions were such that severe flooding was inevitable. The highest discharge and pool elevation ever recorded were measured at the Lac qui Parle Dam (29,400 cfs and 942.47 feet). Montevideo also experienced a flood of record (35,100 cfs) (**Table 4-5**).

p. 1979. A heavy snowpack resulted in a peak discharge and pool elevation at Lac qui Parle Dam of 10,600 cfs and 939.78 feet on 18 to 19 April (**Table 4-5**). Heavy rains in June resulted in the pool rising to near an elevation of 940 feet after falling to 934 feet after the spring runoff.

q. 1985. A heavy snowpack resulted in a peak discharge and pool elevation at Lac qui Parle Dam of 9,360 cfs and 939.40 feet on 25 March 1985 (**Table 4-5**).

r. 1986. A heavy snowpack resulted in a peak discharge and pool elevation at Lac qui Parle Dam of 13,200 cfs and 941.06 feet on 8 April 1986 (**Table 4-5**). Heavy rains through the summer kept the pool above an elevation 938 feet well into October. The pool reached a second peak elevation of 941.23 feet on 12 October.

s. 1993. By the end of April 1993, streamflow in the Minnesota River basin had been in the excessive range for 9 of the past 10 months. Wet antecedent conditions existed in the basin dating back to 1991. As a result, heavy rains in May brought flooding to the Minnesota River Valley. Most of the severe flooding occurred downstream of Mankato. Agricultural flooding occurred all along the river for the entire summer. The peak discharge and pool elevation at the Lac qui Parle Dam was 10,200 cfs and 941.72 feet on 3 August (**Table 4-5**).

Table 4-5

Summary of Peak Discharges and Elevations/Stages at Lac qui Parle Dam, and Montevideo, Minnesota For Selected Floods

Lac qui Parle Dam[1]		Lac qui Parle Dam		Montevideo, MN Gage[2]		
Date	Peak Discharge cfs	Date	Peak Elevation Feet[3]	Date	Peak Discharge cfs	Peak Stage Feet[4]
4/12/69	29,400	4/13/69	942.47	4/12/69	35,100	21.68
4/10/52	19,700	4/10/52	941.95	4/10/52	24,500	20.02
4/08/86	13,200	4/08/86 10/12/86	941.06 941.23	4/08/86	13,990	17.26
4/14/65	10,700	4/03/65	939.90	4/14/65	12,900	16.64
4/18/79	10,600	4/19/79	939.78	4/19/79	12,200	16.21
8/03/93	10,200	8/03/93	941.72	8/04/93	11,500	16.46
4/10/51	9,760	4/11/51	939.90	4/11/51	12,200	16.80
3/25/85	9,360	3/25/85	939.40	3/26/85	11,510	16.09

1. U.S.G.S. Gage No. 05301000, 200 ft. downstream of the dam
2. U.S.G.S. Gage No. 05311000, Gage Datum = 909.12 ft., 1929 NGVD adj.
   The construction of the dam was completed in 1939
3. Corps Gage, 1929 NGVD Adjustment
4. Project Control Point, Target Stage = 17 feet = approximately 13,000 cfs
   National Weather Service Flood Stage = 14 feet

4-07. Runoff Characteristics. Floods on the Minnesota River and its tributaries are caused by both snowmelt runoff and summer storms. Floods occurring as a result of melting snow can encompass the entire basin. During the spring breakup, floods are often aggravated by ice jams forming in the river. Floods can also occur from heavy rains extending over the entire basin (e.g. 1919, 1944, 1993) or from intense rainfall events that are local in nature.

The percent of time a given annual inflow or outflow, to or from the Lac qui Parle Project, is equaled or exceeded (annual flow duration), is shown on **Plates 4-1 and 4-2.** The mean monthly and annual inflow and outflow distributions for the project are presented on **Plates 4-3 and 4-4.** **Plate 4-5** illustrates the variation in monthly streamflow at the Montevideo, Minnesota control point. Monthly inflow and outflow duration is shown in **Tables 4-6 and 4-7.** Average monthly and annual reservoir inflows and outflows are listed in **Tables 4-8 and 4-9.** Daily inflows were computed using mean daily outflows and the change in pool elevation from 1940 through 1993.

Maximum monthly inflows and outflows occur in April, May, and June from snowmelt and spring rain runoff, but most of the spring inflow is retained in the reservoir for flood protection purposes. As a result of this retention, monthly inflows generally exceed outflows during the spring as the reservoir is filling. In the summer, the highest evaporation losses occur, and outflows are reduced.

Outflows are decreased in late fall as necessary to raise the reservoir level to provide an additional volume of water for fish over the winter (see **Chapter VII**).

TABLE 4-6
LAC QUI PARLE PROJECT
RESERVOIR NET INFLOW - DURATION TABLE
YEARS 1940 THROUGH 1993

FLOW CFS	PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL SEASON
25000				0.40									
24000				0.40									
23000				0.40									
22000				0.40									
21000				0.54									
20000				0.67									
19000				0.81									
18000				0.88									
17000				1.01									0.10
16000				1.15		0.14							0.12
15000				1.42		0.14							0.15
14000				1.89		0.14							0.20
13000			0.29	2.23		0.21							0.26
12000			0.58	2.83		0.43							0.36
11000			0.79	3.91		0.43							0.48
10000			1.23	4.39		0.71		0.17					0.60
9000			1.44	5.26	0.13	1.07	0.29	0.33					0.78
8000			1.88	6.68	0.74	1.78	1.03	0.50					1.15
7000			2.53	7.89	1.34	2.56	1.47	0.66		0.27			1.52
6000			3.75	11.00	2.14	3.69	2.21	0.74	0.18	0.54			2.20
5000			5.84	14.57	3.41	4.83	3.54	1.07	0.55	0.72	0.32		3.14
4000			8.01	20.04	5.69	7.60	4.64	2.06	1.57	1.62	0.48		4.63
3000			11.04	29.15	11.98	11.08	7.96	3.96	2.30	2.25	0.89		7.21
2000		0.26	17.17	42.98	24.90	21.24	13.78	7.51	5.07	4.41	2.66		12.46
1000		1.04	30.45	68.76	50.74	44.39	31.25	17.00	15.21	15.29	13.39	3.11	25.44
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

TABLE 4-7
LAC QUI PARLE PROJECT
RESERVOIR TAILWATER OUTFLOW - DURATION TABLE
YEARS 1940 THROUGH 1993

FLOW CFS	PERCENT OF TIME AT OR ABOVE INDICATED ELEVATION												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL SEASON
25000				0.19									
24000				0.19									
23000				0.19									
22000				0.25									
21000				0.31									
20000				0.31									
19000				0.49									
18000				0.56									
17000				0.68									
16000				0.80									
15000				0.93									
14000				1.05									
13000				1.30									0.11
12000				1.85									0.15
11000				2.72									0.22
10000			0.18	3.95				0.12					0.35
9000			0.54	4.94				0.30					0.48
8000			0.84	5.62		0.62	0.12	0.48					0.64
7000			0.90	7.53	0.24	1.54	1.14	0.60					0.99
6000			1.27	9.94	1.49	2.28	2.21	0.78					1.50
5000			2.23	13.27	2.45	2.96	2.45	1.02					2.03
4000			3.98	18.02	4.18	4.38	4.12	1.61	0.25				3.06
3000			5.42	26.36	10.39	7.53	7.05	3.23	0.49	1.79	0.43		5.25
2000			7.23	35.80	19.18	13.83	11.65	6.45	1.42	2.63	1.73		8.37
1000	0.12		21.75	66.30	46.48	43.02	33.21	16.43	8.33	8.96	8.58	4.64	21.62
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

TABLE 4-8
SUMMARY OF AVERAGE MONTHLY / ANNUAL RESERVOIR NET INFLOW
YEARS 1940 THROUGH 1993

YEAR	MEAN MONTHLY / ANNUAL NET INFLOW IN CFS												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL NET INFLOW
1940	0	0	413	1712	364	368	51	159	157	262	145	14	303
1941	43	43	331	1276	476	366	281	153	337	352	293	199	346
1942	105	28	272	479	1939	3095	804	602	980	809	568	222	827
1943	204	282	1665	4767	1357	1907	1036	634	432	280	194	144	1073
1944	187	210	659	1755	3113	1643	672	477	377	281	365	161	828
1945	129	153	1451	1033	636	1171	663	476	265	330	243	90	555
1946	76	18	3844	2384	1141	840	1304	471	509	657	684	229	1020
1947	163	255	730	6127	2497	2487	934	324	413	294	591	262	1252
1948	138	103	4714	3266	1403	630	542	645	480	333	251	176	1063
1949	97	127	1041	1810	420	401	488	283	299	423	314	71	482
1950	52	69	872	2926	2861	852	422	338	243	392	208	63	778
1951	43	130	208	5894	1618	721	506	503	796	473	365	318	961
1952	135	179	377	12452	2942	1751	2828	497	270	424	539	103	1868
1953	82	472	1636	1571	1544	3504	2448	2394	368	224	240	161	1224
1954	78	194	1518	1271	1531	1074	509	250	447	382	355	101	645
1955	76	79	731	748	652	449	677	247	357	419	124	37	385
1956	42	78	222	1121	647	688	651	796	199	397	324	93	440
1957	63	79	1995	786	1321	2992	1501	882	1356	933	1027	404	1115
1958	237	264	868	2164	746	504	328	140	247	295	332	71	515
1959	55	30	203	355	727	289	195	241	287	526	122	82	261
1960	84	54	738	3113	653	463	282	247	228	389	233	87	547
1961	50	45	253	733	635	255	76	141	267	188	174	107	244
1962	31	70	582	3643	1847	2022	3649	1177	617	474	315	237	1227
1963	114	125	510	800	893	1073	328	469	304	307	433	136	458
1964	63	67	328	1248	839	270	246	439	547	321	226	33	386
1965	29	52	86	5571	2522	2808	916	333	509	518	353	222	1156
1966	154	328	3477	1872	1216	554	269	318	220	501	121	71	763
1967	88	103	1008	2148	877	1166	496	261	226	456	321	48	600
1968	47	33	115	807	372	395	338	289	199	535	197	139	290
1969	81	49	306	10921	4127	1346	587	195	262	394	289	132	1552
1970	67	73	299	1160	961	1286	502	363	313	376	876	241	543
1971	78	98	1434	1286	547	647	1528	223	203	466	1029	604	682
1972	199	113	2270	3287	4136	3140	1185	1144	330	364	565	289	1425
1973	144	254	2813	1114	1036	752	204	203	171	200	277	135	612
1974	77	99	382	750	745	531	195	367	212	118	178	81	312
1975	82	73	132	1647	1759	514	507	271	345	276	365	74	505
1976	70	157	978	711	360	175	133	153	654	2052	1358	1	568
1977	7	538	1214	506	184	321	245	230	303	411	536	246	394
1978	130	62	2329	5734	1871	881	1038	319	290	331	192	119	1109
1979	75	53	392	6814	2607	2271	956	705	275	363	516	244	1269
1980	160	107	524	1204	400	1038	390	381	427	441	407	96	464
1981	45	146	322	804	454	1093	539	248	357	576	370	100	421
1982	63	28	548	2616	1100	607	406	289	396	473	481	323	611
1983	204	249	1025	1657	1019	486	508	241	395	400	699	388	607
1984	176	327	1909	4932	1863	5434	1726	456	491	2695	1831	1026	1905
1985	485	350	5464	3082	1870	994	624	384	1974	559	508	368	1394
1986	255	295	3463	10823	5345	2083	2847	2236	3250	2729	1251	832	2957
1987	519	593	1346	1378	716	540	408	467	232	442	371	116	594
1988	85	131	525	508	610	184	124	225	459	382	351	50	303
1989	67	61	994	1965	888	324	274	204	663	348	421	60	523
1990	39	72	222	616	489	1144	304	348	332	394	351	93	367
1991	51	100	279	798	879	3538	2196	2231	967	554	563	314	1042
1992	267	246	1308	1132	770	3729	2003	569	588	465	401	272	980
1993	141	104	958	4598	3072	4009	7356	4815	1582	1188	1193	971	2515
PERIOD MEAN (1940-1993)	115	149	1153	2664	1400	1330	930	582	508	540	464	208	838

	PERIOD (1940-1993) MONTHLY NET MAXIMUMS AND MINIMUMS											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MINIMUM	1	1	1	2	3	1	1	2	1	4	1	1
YEAR	1961	1941	1941	1969	1977	1987	1960	1974	1972	1970	1951	1976
MAXIMUM	790	2710	14366	47197	9664	19179	9418	13041	7482	7773	6285	4191
YEAR	1987	1953	1985	1969	1972	1953	1993	1993	1986	1984	1947	1971

TABLE 4-9
SUMMARY OF AVERAGE MONTHLY / ANNUAL RESERVOIR OUTFLOW
YEARS 1940 THROUGH 1993

MEAN MONTHLY / ANNUAL OUTFLOW IN CFS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL OUTFLOW
1940	0	0	95	1505	437	100	9	9	9	9	9	9	182
1941	16	77	297	771	656	114	169	17	20	22	59	65	191
1942	43	21	33	285	1052	3492	1247	704	752	841	386	153	752
1943	169	318	813	5199	1284	1558	1420	569	304	56	88	125	989
1944	156	216	412	1764	2917	1850	532	218	138	144	142	135	720
1945	143	238	1004	1134	461	941	603	389	220	155	80	80	454
1946	76	23	1891	2907	666	946	1117	495	244	505	545	287	811
1947	189	92	263	4235	2994	2479	1502	413	112	113	183	192	1064
1948	56	94	1424	4048	1531	404	332	336	219	34	33	89	717
1949	74	195	835	1454	548	173	265	133	89	57	57	53	328
1950	52	51	152	2439	2443	1193	423	72	118	25	28	45	587
1951	30	155	243	5098	2039	628	456	267	531	122	72	270	823
1952	245	170	363	10595	3722	1076	2884	556	41	58	33	33	1646
1953	46	250	531	1331	1325	1799	3309	2046	639	40	40	50	956
1954	83	299	921	1315	1369	1071	487	86	117	52	49	79	494
1955	90	109	571	463	267	121	565	29	74	39	34	33	201
1956	35	55	47	969	325	606	526	756	128	34	146	77	309
1957	61	51	278	704	736	2093	2435	1076	1044	1123	1012	538	933
1958	257	234	695	1915	992	281	126	59	25	25	26	57	390
1959	60	57	123	164	122	217	20	18	22	23	53	50	77
1960	53	54	158	3312	609	367	234	53	114	53	37	53	422
1961	64	75	172	151	455	156	19	20	21	21	24	29	101
1962	27	34	147	3495	1556	1889	3091	2150	722	249	124	126	1139
1963	121	96	317	666	875	1056	206	449	245	78	112	192	368
1964	56	59	215	900	581	176	111	39	42	36	33	30	190
1965	32	31	76	4769	2184	2808	1584	200	211	491	310	172	1070
1966	195	283	2620	2327	1288	285	95	43	38	196	31	98	627
1967	97	64	637	1939	627	953	479	115	5	25	19	18	414
1968	18	16	80	285	170	160	81	48	24	22	21	19	79
1969	169	220	82	10315	3917	1895	589	106	25	22	90	158	1458
1970	195	169	291	1179	825	1174	284	29	26	77	730	360	444
1971	203	181	1448	1120	364	477	1326	56	84	356	957	580	599
1972	231	148	1973	3310	3144	4058	1119	1226	309	75	552	366	1379
1973	222	352	2392	1518	863	788	53	27	34	149	103	131	554
1974	153	203	393	648	645	431	37	12	11	10	34	88	222
1975	96	192	93	803	1596	1048	541	104	69	103	75	158	407
1976	151	168	590	1048	228	54	38	26	22	4	1	1	194
1977	1	1	669	616	200	151	46	25	25	26	180	355	192
1978	253	93	1504	5983	2022	946	913	317	206	158	77	94	1047
1979	145	196	351	6019	2728	1386	1714	955	266	103	509	262	1219
1980	227	247	296	1180	296	821	361	66	79	164	124	127	331
1981	106	74	217	216	144	876	526	130	23	78	147	143	224
1982	83	161	319	2578	1037	642	355	85	59	424	260	306	525
1983	218	323	1046	1378	867	347	427	107	360	270	417	435	517
1984	136	370	1300	5035	2131	4526	2578	368	252	1718	2437	1259	1841
1985	602	434	4407	3228	1638	1369	695	324	1234	953	391	411	1312
1986	385	298	2207	11009	5777	1990	2310	2674	2560	3083	1716	1106	2933
1987	537	615	1351	1411	397	608	240	68	25	34	62	162	457
1988	85	196	419	445	149	30	16	15	19	17	16	18	118
1989	15	15	579	2057	864	158	101	48	18	19	20	53	329
1990	44	33	181	281	310	659	378	258	111	151	99	90	217
1991	65	24	389	633	853	2624	2573	2480	664	298	427	305	951
1992	268	367	1278	1064	677	2756	2390	696	336	117	372	278	885
1993	139	272	481	4454	3030	3116	7021	6060	1556	1362	1030	1019	2479
PERIOD MEA (1940-1993)	135	162	735	2475	1277	1147	944	512	271	267	271	212	701

PERIOD (1940-1993) MONTHLY MAXIMUMS AND MINIMUMS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MINIMUM	1	1	1	43	41	9	9	2	1	1	1	1
YEAR	1977	1977	1977	1956	1980	1940	1940	1974	1979	1976	1976	1976
MAXIMUM	1050	1220	10396	28700	8955	8780	8115	10060	4370	4020	3760	1824
YEAR	1985	1987	1986	1969	1986	1984	1993	1993	1986	1984	1984	1984

4-08. Water Quality. Lac qui Parle reservoir is a shallow wind swept lake located in the Minnesota River watershed. Water quality in the lake is relatively poor, characterized by hard, nutrient rich water, nuisance blue-green algae, and frequently resuspended sediment. Lac qui Parle is classified as a hypereutrophic lake, typical for a lake in the northern glaciated plains ecoregion. Lakes in this ecoregion are generally shallow, well mixed, hypereutrophic lakes whose watersheds are predominately agricultural. Ninety-five percent of land use in Lac qui Parle's watershed is agricultural. Lack of proper conservation practices, wetland drainage, fragile and highly erodible soils, waste discharges, nutrient loading by birds, and internal nutrient recycling, all contribute to high nutrient loading in Lac qui Parle reservoir. The lake's shallow depth and large surface area allow frequent wind mixing of the water column. During calm periods intermittent stratification can develop allowing phosphorous release from the sediments into the water column. Properly treated water from the Minnesota River is suitable for domestic use. See **Paragraphs 5-02, 7-07 and 8-04.**

4-09. Channel and Floodway Characteristics.

a. Main Stem and Tributaries. The Minnesota River channel was modified between Lac qui Parle Dam, (river mile 288.1) and Granite Falls, Minnesota, (river mile 245.0) **(Plate 2-13)**. The project consisted of rock and snag removal and cutoffs at various

locations to increase the bankfull capacity of the channel. The channel was designed to handle a 15-year recurrence interval event. A general plan and a typical cross section of the channel are shown on **Plate 2-13.**

The width of the flood plain varies from about 1/2 mile to 2 miles from Big Stone Lake to the Lac qui Parle Dam . Below the dam to the vicinity of New Ulm (river mile 146.3), the width is quite uniform, varying between 3,000 and 4,000 feet. In regions containing granite outcrops, the valley suddenly widens to about 10,000 feet. The depth of the valley varies from 100 to 200 feet. Once flow leaves the banks of the river, it can spread quite rapidly to the valley walls due to the relatively flat topography of the flood plain between the bluffs.

An elevation-discharge curve for the Minnesota River at U.S.G.S. gage No. 05301000, just below Lac qui Parle Dam (200 feet downstream), is shown on **Plate 2-11** and in **Exhibit E.** The Lac qui Parle River is a tributary to the Lac qui Parle reservoir. A stage-discharge curve for U.S.G.S. gage No. 05300000, Lac Qui Parle River near Lac qui Parle, Minnesota is shown on **Plate 2-20** and in **Exhibit E.** The Lac qui Parle River has a slope of 12.7 feet per mile.

The Pomme de Terre River is a tributary to Marsh Lake reservoir. A Stage-discharge curve for U.S.G.S. gage No. 05294000, Pomme de Terre River at Appleton, Minnesota is shown on **Plate 2-19** and in **Exhibit E.** The Pomme de Terre River has a slope of 2.5 feet per mile.

A tailwater rating curve for the Chippewa River Diversion Dam is shown on **Plate 2-24.** A stage-discharge curve for U.S.G.S. gage No. 05304500, Chippewa River near Milan, Minnesota is shown on **Plate 2-25** and in **Exhibit E.**

A stage-discharge curve for U.S.G.S. gage No. 05311000, Minnesota River at Montevideo, Minnesota is shown on **Plate 2-12** and in **Exhibit E.**

b. Environmental Conditions. Lac qui Parle and Marsh Lake are impounded natural lakes on the Minnesota River. The lakes were created by fluvatile dams formed at the confluences of the Lac qui Parle and the Yellow Bank Rivers with the Minnesota River. The lakes formerly varied in stage in concert with river discharge, and nearly dried out in drought years. Prior to impoundment, the lakes supported extensive stands of emergent and submersed aquatic plants. The lakes historically provided and continue to provide a major staging area for thousands of migrating waterfowl and a highly productive fishery.

The State of Minnesota initiated the project for conservation of the abundant fish and wildlife resources. Since impoundment, the lakes have been continuously inundated (except for winter drawdowns) to at least an elevation range of 931.2 to 933.0 feet in Lac qui Parle (see **Paragraph 3-05**), and 937.6 feet in Marsh Lake. There has been a gradual deterioration in the quality of aquatic and wetland habitat resulting from sedimentation, littoral processes, nutrient loading, continuous inundation, and extended periods of high water. Long-duration high water events in recent years have killed much of the floodplain terrestrial vegetation in the reservoir area, even very old trees.

Despite the deteriorating aquatic habitat and water quality conditions, Lac qui Parle still supports a popular, economically significant, and productive sport fishery. Walleye and northern pike are the most commonly creeled fish. A commercial fishery continues to harvest carp and buffalo from Lac qui Parle. Harvest has averaged 196,630 pounds per year over the last 10 years. The reservoir fishery is threatened by winter oxygen depletion and winterkill.

The Minnesota River downstream from Lac qui Parle Dam supports a diverse fish assemblage, with 70 species reported during recent (1982 and 1992) surveys by the MNDNR. During the 1992 survey, carp, channel catfish, yellow bullhead, freshwater drum, shorthead

redhorse, and northern pike and walleye were the most abundant large fishes found in the Minnesota River from Lac qui Parle Dam to Granite Falls.

A study to determine the instream flow needs for the Minnesota River is being conducted with the Minnesota Department of Natural Resources and the Minnesota Pollution Control Agency. The interim low flow release schedule may be modified to provide instream flow needed for aquatic life, recreational activities, water appropriations, and waste assimilation.

There is a need for more intensive management measures to rehabilitate wetland and aquatic habitat conditions in Marsh Lake. A drawdown of the reservoir during the growing season would consolidate sediments and trigger the germination of emergent aquatic plants. An interagency collaborative effort was begun in 1993 to plan for management of the Minnesota River. A plan for rehabilitation of Marsh Lake is being pursued that may include reservoir drawdown and other management measures.

4-10. Upstream Structures. There are two dams upstream of the Lac qui Parle Project called Big Stone Lake Dam and Highway 75 Dam. Both are incorporated into the Big Stone Lake-Whetstone River Project. Refer to **Paragraph 2-04** for details on these structures.

Big Stone Lake Dam has a drainage area of approximately 1,160 square miles. The dam is operated by the Minnesota Power and Light Company.

Highway 75 Dam has a drainage area of approximately 1,700 square miles. The dam is operated by the U.S. Army of Corps of Engineers.

4-11. Downstream Structures. There are two dams downstream of the Lac qui Parle Project. One is located at Granite Falls, Minnesota and the other is located 3.7 miles downstream near Minnesota Falls, Minnesota (see **Paragraphs 7-09, 7-10, 8-06 and 8-07**).

a. Granite Falls Dam. The Granite Falls Dam is a concrete gravity structure with 2.8 feet of flashboards on the crest of the overflow section. The overflow section has a nominal height of 21 feet and is 300 feet long.

The dam was built in 1911 and is owned and operated by the City of Granite Falls. It is operated for hydroelectric power production and to provide an impoundment for the withdrawal of surface water for municipal use. The drainage area above Granite Falls is 6,370 square miles.

b. Minnesota Falls Dam. The Minnesota Falls Dam is primarily a concrete and granite masonry structure with earth embankments at each end. The dam has a maximum height of 18 feet and is 600 feet long.

The dam was built by the Northern States Power (NSP) Company in 1905 for the production of hydroelectric power. It is still owned by NSP and is no longer operated for hydropower. The impounded water is used to cool a 47 kilowatt steam electric generating plant owned by NSP.

4-12. Economic Data.

a. Population. The Lac qui Parle reservoir and the downstream floodplain to New Ulm includes portions of seven counties: Chippewa, Lac qui Parle, Yellow Medicine, Redwood, Renville, Nicollet, and Brown. **Table 4-10** displays the trends in population from 1980 to 1990 for the seven-county area. Figures for the state of Minnesota and for the U.S. as a whole are displayed as well for comparative purposes. Only Nicollet County grew in population over this period. The other counties realized population declines ranging from 6 to 16 percent.

b. Income. **Table 4-10** also displays median family income for the seven-county area. Nicollet County experienced the largest growth in median income from 1979 to 1989. Income growth exceeded that of the state over this period and equaled that of the nation as a whole. Median income changes for the other counties ranged from minor growth to moderate declines.

Table 4-10

Population and Median Income Counties Along The Minnesota River Compared to Minnesota and the United States

Sample County or Area	Population			Median Income 1989	Percent Change in Median Income From 1979
	1980	1990	Percent Change		
Brown	28,645	26,984	-5.8	25,032	-3.0
Chippewa	14,941	13,228	-11.4	22,227	-0.8
Lac qui Parle	10,592	8,924	-15.8	21,646	1.9
Nicollet	26,920	28,076	4.3	30,491	6.6
Redwood	19,341	17,254	-10.8	22,827	0.4
Renville	20,401	17,673	-13.4	23,278	-6.1
Yellow Medicine	13,653	11,684	-14.4	21,537	-0.1
Minnesota	4,075,970	4,375,099	7.3	30,909	3.8
United States	226,542,204	248,709,873	9.8	30,056	6.5

c. Employment. **Table 4-11** presents employment of the labor force by industry within the seven-county area. Over 85 percent of the labor force is employed in either manufacturing, trade, or services. **Table 4-12** shows how the counties compared with the

state and with the U.S. in terms of unemployment in 1992. Each of the counties, with the exception of Chippewa, were equal to or lower than state levels and all counties were lower than national levels.

Table 4-11

Employment by Industry for
Counties Along The Minnesota River

Type of Industry	Number Employed	% of Total
Construction	1,528	4.1
Manufacturing	11,073	29.6
Wholesale/Retail Trade	9,902	26.4
Finance, Insurance, Real Estate	1,582	4.2
Services	11,099	29.6
Other	2,267	6.1
Total	37,451	100.0

Table 4-12

Unemployment Rates for
Counties Along The Minnesota River
Compared to State and National Figures

Sample County or Area	1992 Rate in Percent
Brown	5.1
Chippewa	6.0
Lac qui Parle	4.5
Nicollet	3.3
Redwood	4.5
Renville	5.1
Yellow Medicine	4.9
Minnesota	5.1
United States	7.4

d. Flood Damages. A primary authorized purpose for the Lac qui Parle project is reduction of downstream flood damages. Beneficiaries of the reservoir's flood control operation include the cities of Montevideo and Granite Falls and the agricultural properties within the floodplain between the dam and New Ulm, a distance of approximately 150 miles. For purposes of evaluating crop damages, this area has been divided into four reaches. Discharge-area flooded relationships are depicted on **Plates 4-6 to 4-9.**

Montevideo and Granite Falls have experienced flooding in the past. The flood of record occurred in 1969, an event equated to the 100-year flood. Damage categories include residential, commercial, and public properties. Emergency levees that were constructed in response to past floods still exist. These levees do provide some low level protection from flooding. However, they are still considered high risk structures that do not provide reasonable protection from the 100-year flood event. Potential flood damages at Montevideo and Granite Falls from a 100-year event amount to approximately $2,000,000. A plot of residential and urban damage versus discharge for Granite Falls and Montevideo is shown on **Plate 4-10**.

The magnitude of crop damage due to flooding depends on when the flood occurs during the growing season. Floods occurring before mid-April may cause little or no damage. Floods after this will cause damage to the extent that production operations may have to be repeated and delayed planting reduces ultimate crop yields. Mid-season floods are the most devastating since total yield loss may occur with no chance to replant a crop to salvage an income from the affected acreage. **Table 4-13** summarizes crop damages from the reservoir down to the City of New Ulm for the period 1965 through 1993. The damage reaches are shown on **Plate 4-11**.

Table 4-13

Summary of Crop Damages From the Reservoir Down to the City of New Ulm for the Period 1965 through 1993

Reach Description See Plate 4-11	Average Annual Acres Flooded 1965-1993	Crop Damage per Acre	Total Average Annual Damages 1965-1993
Reach #1, Lac qui Parle Dam to Upstream of Chippewa River	944	$36.14	$34,116
Reach #2, From Reach #1 to upstream of the Yellow Medicine River	873	$18.16	$15,854
Reach #3, From Reach #2 to the Yellow Medicine and Redwood Co. Line	526	$18.70	$9,836
Reach #4, From Reach #3 to the U.S. Highway 14 Bridge in New Ulm	5,135	$37.12	$190,611
Total	7,478	$33.49	$250,417

Source: Economic Analysis Agricultural Flood Damages Lac qui Parle Flood Control Project, Prepared for St. Paul District Corps of Engineers by Gulf Engineers and Consultants Inc., Revised Draft Report September 1994

V - DATA COLLECTION AND COMMUNICATION NETWORK

5-01. Hydrometeorological Stations.

a. Facilities. The regulation and proper operation of the project requires the collection and evaluation of several meteorological, hydraulic and hydrologic parameters. Pool and tailwater elevations, outflow, precipitation, wind, and air temperature are recorded at the project site. Data Collection Platforms (DCPs) are used for recording the pool and tailwater elevations at Lac qui Parle Dam, Marsh Lake Dam and Watson Sag Weir and the pool elevaion at Highway 40. Wire weight gages are used to record stages at the Chippewa Diversion Dam and are also available at Watson Sag Weir and Highway 40. Equipment is also available for measuring the water content of snow, frost depth, and the lake ice thickness. Additional information is available at various Corps, U.S. Geological Survey (U.S.G.S.), and National Weather Service gages in the project area. **Table 5-1** lists the data collection facilities at the Lac qui Parle Project. **Table 5-2** lists various streamflow gage sites that are in the area including the control point at Montevideo, Minnesota. **Table 5-3** is a tabulation of the snow survey stations that are in the basin. **Plate 5-1** shows the locations of hydrometeorological stations in the Upper Minnesota River Basin. **Plate 5-2** shows the locations of stations for the Lac qui Parle Project. **Plate 5-3** shows the snow survey sites in the project area.

Table 5-1

Lac qui Parle Project Hydrometeorological Stations (See Plate 5-2)

Location	Data Type	Equipment	Notes
Lac qui Parle Dam	Pool Elevation	Data Collection Plat.[1]	Corps Gage
Lac qui Parle Dam	Tailwater Elevation	Data Collection Plat.[1]	U.S.G.S. Gage
Lac qui Parle Dam	Ice Depth	Manual	Corps Gage
Lac qui Parle Dam	Precipitation	Tipping Bucket Gage[1]	Corps Gage
Highway 75 Dam, Low Flow	Precipitation	Data Collection Plat. Tipping Bucket Gate	Corps Gage
Chippewa Diversion	Pool Elevation Tailwater Elev.	Wire Weight Gage on Both	Corps Gage
Chippewa Diversion	Precipitation	Recording Gage	NWS Gage
Chippewa Diversion	Air Temperature	Thermometer	Corps Gage
Chippewa Diversion	Windspeed/Dir.	Anemometer	Corps Gage
Chippewa Diversion	Snow Depth/Water Content	Snow Tube	Corps Gage
Chippewa Diversion	Frost Depth	Frost Tube	Corps Gage
Watson Sag Weir	Pool Elevation Tailwater Elev.	Data Collection Plat.[1] Wire Weight Gage on Both	Corps Gage
Marsh Lake Dam	Pool Elevation Tailwater Elev.	Data Collection Plat.[1] and a Talk-a-Mark	U.S.G.S Gage
Highway 40 Bridge Over Lac qui Parle Pool near Milan	Pool Elevation	Data Collection Plat.[1] and a Wire Weight Gage	Corps Gage

1. There is one Data Collection Platform (DCP) servicing both the pool and tailwater gages.

Table 5-2

Streamflow Stations in the Vicinity of the Lac qui Parle Project (see Plate 5-1)

Gage No./Owner	Drainage Area Sq. Mi.	River and Location	Notes
U.S.G.S. 05291000	389	Whetstone R Near Big Stone City SD	Flows Into Big Stone Lake
U.S.G.S. 05292000	1,160	Minnesota R at Ortonville MN	1300 ft downstream of the Big Stone Lake Dam
U.S.G.S. 05293000	398	Yellow Bank River Near Odessa MN	4.5 miles upstream From the Mouth
U.S.G.S. 05294000	905	Pomme de Terre R at Appleton MN	8.0 miles upstream From the Mouth
U.S.G.S. 05300000	983	Lac qui Parle R Near Lac qui Parle MN	0.5 Miles SW of Lac qui Parle MN
U.S.G.S. 05301000	4,050	Minnesota R Near Lac qui Parle MN	200 ft downstream of the Lac qui Parle Dam
U.S.G.S. 05304500	1,870	Chippewa River Near Milan MN	5.5 Miles East of Milan MN
U.S.G.S. 05311000	6,180	Minnesota River at Montevideo MN	400 ft downstream of the Chippewa River Control Point for the Project

Table 5-3 Snow Survey Sites Within the Lac qui Parle Project Area (See Plate 5-3)	
Number	**Location**
1.	Clara City, Minnesota
2.	Granite Falls, Minnesota
3.	Vesta, Minnesota
4.	Tracy, Minnesota
5.	Marshall, Minnesota
6.	Taunton, Minnesota
7.	Marietta, Minnesota
8.	Lac qui Parle State Park, Minnesota
9.	Benson, Minnesota
10.	Sunburg, Minnesota
11.	Glenwood, Minnesota
12.	Cyrus, Minnesota
13.	Morris, Minnesota
14.	Sisseton, South Dakota
15.	Wilmot, South Dakota
16.	Millbank, South Dakota
17.	Ortonville, Minnesota
18.	Appleton, Minnesota

b. Maintenance. The tailwater gage at Lac qui Parle Dam and the pool elevation gage at Marsh Lake Dam are maintained by the U.S. Geological Survey. The National Weather Service maintains the precipitation gage. The rest of the gages listed in **Table 5-1** are maintained by the Water Control gage crew.

5-02. Water Quality Stations. See **Paragraphs 4-08, 7-07 and 8-04.**

a. Facilities. The Corps has thirteen (13) water quality data-collection stations within the Lac qui Parle Project. Station locations are shown on **Plate 5-4.** Only 2 of the stations have a long term record (L1 and L4). Periodic measurements are taken at

the other locations. Insitu depth profiles of water temperature, dissolved oxygen, pH, and specific conductance are monitored electronically. In addition, water samples are collected and analyzed for nutrients such as total phosphorous and nitrogen species as well as suspended solids and chlorophyll a. Several of the stations in both Lac qui Parle and Marsh Lake are sampled for special studies and short term intensive monitoring. Water quality data is collected by project personnel, water quality unit staff, and volunteers from the Lac qui Parle Lake Association. The stations are seasonal and are operated only as funding and resources allow.

b. Maintenance. The water quality equipment used at the Lac qui Parle Project is not permanently deployed in the field. A Hydrolab Surveyor II is kept at the Lac qui Parle Project Office. The Surveyor II is used by Corps personnel and the local volunteers to monitor insitu water quality parameters. Maintenance is performed by both project personnel and Water Quality Unit staff.

5-03. Sediment Stations. The Corps of Engineers does not monitor sediment at the Lac qui Parle Project. Estimates of the sediment load for Lac qui Parle and Marsh Lake reservoirs are given in **Paragraph 4-04.**

5-04. Recording Hydrologic Data. Currently the hydrometeorologic records collected are read into data base files on the computer system in the Water Control Section. The data from U.S.G.S. gages in the area are archived in the U.S.G.S. WATSTORE data base in Reston, Virginia. The daily precipitation data collected at the Chippewa Diversion Dam are archived by the National Climatic Data Center in Asheville, North Carolina.

a. Reservoir Elevation/Discharge and Streamflow Data. The Project Resource Manager obtains river and reservoir stage data from gages in the vicinity of the dams and other pertinent locations either in or adjacent to the Lac qui Parle reservoir project. The data is collected by recording and non-recording gages at frequencies varying with the conditions as determined by Water Control. Pool and tailwater readings are recorded at 8:00 a.m. daily unless otherwise directed by Water Control. The U. S. Geological Survey makes streamflow measurements as requested by the District Office. During flood conditions, the resource manager collects data from selected stations as requested by Water Control. Streamflow and stage data reports are transmitted according to **Paragraph 5-06.**

b. Precipitation. The official precipitation gage is a Friez 24-hour, dual-traverse rain and snow gage, with 12-inch recording capacity. Records are published by the U. S. Weather Bureau as Watson 1 NE. The gage is at the office near the Chippewa River

Diversion Dam. The 24-hour precipitation is recorded at 8:00 a.m. daily by the Project Resource Manager. Whenever there is a rainfall of more than one inch, Water Control is notified immediately by telephone. Following weekends and holidays, the amount and the times of the weekend/holiday rainfall is taken from the Friez recording chart. See **Paragraph 5-06.** There are tipping bucket rain gages at Lac qui Parle and Highway 75 Dam. The data is transmitted by a DCP to the Project Office and the Water Control Section.

c. Snow Depth And Moisture Content. During the winter, regular measurements of snowfall are made at 8:00 a.m. daily, (except weekends and holidays) by the Project Resource Manager. Snowfall for weekends and holidays is recorded on the first workday following. In addition, measurements of the water content of the snow on the ground are made at least as often as indicated below:

(1) Each day when any new snowfall has occurred, except Saturdays, Sundays, and holidays.

(2) At weekly intervals, whether or not any new snow has fallen during the previous period. To determine the water content of the snow, follow the instructions contained in Circular B, "Instructions for Climatological Observers."

The Resource manager reports "winter conditions" along with the normal reports on Monday mornings from the end of November until the end of March. The reports consist of the amount of snow on the ground, the water content of the snow, the thickness of the ice on the lake, and the ground frost depth.

d. Wind and Temperature. Daily readings of wind direction and velocity and maximum and minimum air temperature, are recorded at 8:00 a.m. on workdays.

e. Water Quality Measurements. Site personnel are asked, on occasion, to assist district office personnel or contractors to collect water samples and/or water quality measurements in the project area.

f. Annual Snow Surveys. Prior to the spring breakup, the resource manager conducts a snow survey in the Minnesota River Basin. The survey is taken during the last week of February and the first week of March when conditions warrant. Instructions as to the exact date to start the survey are issued by the Water Control Section of the District Office. If an appreciable amount of snow should fall after the survey has been completed, another survey may be required.

Prior to making the actual snow survey, the resource manager might conduct a snow reconnaissance in the basin to determine if a detailed snow survey is necessary. This windshield survey covers the general area of the snow survey sites. The resource manager drives through the area, making a visual inspection and stopping at appropriate locations to make a snow depth measurement. A report of this survey is forwarded to Water Control as soon as possible after completion.

During the annual snow survey, at least four samples are taken at each station. The average snow depth and water content of the snow in inches is recorded and transmitted to the District Office to analyze the probable runoff to be expected. In addition to the snow samples, notes are made on the general conditions of snow cover in fields, timbered areas, river channels, dry runs, and ditches both at the stations where measurements are made and between the stations. Frost depths are obtained from power company crews, construction crews, or from anyone who may have occasion to penetrate the ground surface. Snow survey stations are shown on **Plate 5-3.** **Table 5-3** lists the permanent snow survey stations which are be used each time a snow survey is requested.

g. Supplemental Readings. Extra readings of the precipitation gage or other gages are made whenever required by the District Office. When extra readings of the rain gage are made, the total which has fallen since the last regular observation time

is to be reported. The regular 8:00 a.m. reading should always include all the precipitation since the previous day's 8:00 a.m. reading. Instructions pertaining to the transmission of special readings are contained in **Paragraph 5-06.**

5-05. Communication Network. The staff can transmit hydrologic data and information by, telephone, radio, modem and via the United States mail. Streamflow, water level, rainfall and other pertinent data are received regularly from the project during normal regulation periods and daily during periods of flooding (see **Paragraph 5-07**).

5-06. Communication with Project. The information needed to operate the dam and regulate the reservoir is provided by the Project Resource Manager to Water Control. Daily (8:00 a.m.) readings for the pool, tailwater, and outflow are given, as well as precipitation and wind readings. The pool and tailwater elevations are also recorded by DCPs and transmitted via satellite directly to Water Control's digital ground readout station (DGRS). At each DCP gage, the correspondence between the gage and DCP readings is checked visually by project personnel at regular intervals. Daily inflow to the reservoir is calculated by Water Control from the change in reservoir elevation and the outflow. In the winter and spring, snow depth, water content, frost depth, and lake ice thickness are reported weekly to Water Control. The snow survey is used to estimate the amount of water available for spring

runoff. Frost depth readings provide information on the amount of infiltration expected. The snow and frost information is also provided to the National Weather Service and the State of Minnesota Climatology Office.

Daily data are reported to Water Control via telephone and modem. Copies of the official site log sheets are mailed monthly to Water Control. Also, the daily meteorological record is compiled on National Weather Service Form E-15 and mailed monthly to the National Weather Service Forecast Office in Chanhassen, Minnesota.

a. Regulating Office With Project Office. Water Control communicates with the project via the telephone. Present radio facilities do not allow for a reliable audible signal between St. Paul and the Lac qui Parle Project.

1. Weekly Log Sheet. NAP Form 405, "Weekly Log Sheet," is used to record all pertinent data at the Lac qui Parle project, including gage readings noted or requested and local weather conditions. The original is mailed to Water Control in the District Office after the last entry has been made at the end of the week.

2. Gage Recorder Charts. The charts from the weekly stage recorder (pool gage) at Lac qui Parle Dam are submitted to Water Control each week. Whenever the charts are removed, the

recorder pen is reset. After removal, the following information is noted on the charts: the name of the site in large letters (LQP Pool, etc.), time of removal or pen resetting, time and date the new chart is started, and gage height from either the inside staff or tape gage, and initials of the observer. These notations enable Water Control to make whatever corrections are necessary to the record. **Exhibit C** contains an example of a properly annotated chart.

The pool and tailwater gages at Marsh Lake Dam are continuous recording (A-71 type) gages. The gages are checked and the charts are annotated, as noted above, at least weekly. The charts from these gages are removed semi-annually and mailed to Water Control.

3. Water Quality Data. Water quality data is recorded on data sheets and mailed to the Water Quality Unit in the District office. Raw water samples analyzed for nutrients and chlorophyll are processed at the field site and shipped to a Corps-approved laboratory for analysis. All chemical analysis follow recommended EPA or equivalent procedures. Lab results are then forwarded to the Water Quality Unit. The data is reviewed and entered into DBASE and the USEPA's STORET data storage system. Project Water Quality Reports are generated on a yearly basis for the project

site. The information is used to asses current trophic conditions in the reservoir and to evaluate the effects of operational changes and watershed management options on reservoir water quality and quality of releases from the project.

4. Emergency Reports. During floods or other emergencies, the Resource Manager reports by telephone daily to Water Control as soon after 8:00 a.m. as possible. Requests for any necessary additional readings on the same day are made by Water Control at the time of the morning call. Special reports are transmitted by telephone (612-290-5620) or by mail as directed by the District Office. If a telephone call must be made after the regular office hours on regular work days and/or Saturdays, Sundays, or holidays, first call Water Control. If Water Control cannot be contacted, one of the regulators in order of preference as shown in the front of the manual, is called.

b. Between Project Office and Others. Local residents are well-attuned to fluctuations in the lake level, and they have access to lake level information from the Resource Manager, either by telephone, in person, or through the local news media. Notifications of severe weather or impending unusual conditions would be handled through local law enforcement and civil defense authorities (see **Paragraph 5-08**).

1. **Daily Report to National Weather Service.** Reports of daily Lac qui Parle project air temperatures, precipitation and Montevideo gage height are provided to the National Weather Service. The data is transmitted daily (except weekends and holidays) to the Weather Service Forecast Office in Chanhassen, Minnesota. The data is provided either by voice or direct computer entry (COMPU ROSA program).

2. **Recording Rain Gage Monthly Charts.** Charts from the recording rain gage are removed and sent in on the first workday of each month. The charts are sent to the National Weather Service Forecast Office, 1733 Lake Drive West, Chanhassen, Minnsota .

5-07. Project Reporting Instructions. The Project Resource Manager reports hydrologic and climatic conditions to Water Control. Normally, these reports are made each Monday, Wednesday and Friday. Water Control may request more frequent reports, if warranted by flooding situations, or less frequent reports under relatively quiescent conditions. Also, when the local 24-hour rainfall total exceeds 1.5 inches, the Resource Manager notifies Water Control as soon as possible.

5-08. Warnings. In the event of impending emergency conditions, or advisories requiring interim gate changes, Water Control will call the Resource Manager at the Lac qui Parle Project. **Paragraph 1-05** contains phone numbers for project personnel. **Page viii**

contains phone numbers for Water Control and various District personnel. In the event of other emergencies affecting project regulation and concerns downstream, the officials listed in **Table 5-4** will be contacted.

Table 5-4

Points of Contact for Emergency Notification

Point of Contact	Telephone Numbers	
	Work	**Home**
Lac qui Parle County, MN		
Civil Defense Director, 24 Hr	612.598.3720	612.598.7751
County Sheriff, 24 Hr	612.598.3720	612.598.7751
Chippewa County, MN		
Civil Defense Director, 24 Hr	612.269.8808	612.269.5070
County Sheriff, 24 Hr	612.269.2121	612.269.5247
Yellow Medicine County, MN		
Civil Defense Director,	612.564.3134	612.843.4604
County Sheriff, 24 Hr	612.564.2130	612.564.3583
Montevideo, MN		
Police and Fire Dept., 24 Hr	612.269.8808	612.269.5070
Emer. Services Coord., 24 Hr	612.269.2121	612.269.5247
Granite Falls, MN		
Police and Fire Dept., 24 Hr	612.564.2129	-------
Emer. Services Coord., 24 Hr	612.564.2129	612.564.3920
Granite Falls, MN		
Hydropower Plant	612.564.2530	-------
Minnesota Div. Emergency Man.	612.649.5451	24 Hours
Minnesota Statewide Emergency	1.800.422.0798	24 Hours

Note: Phone Nos. for Water Control, District, and project personnel are listed on **Page viii** and in **Paragraph 1-05.**

VI - HYDROLOGIC FORECASTS

6-01. General. All stream-stage forecasting in the public interest is performed by the National Weather Service (NWS) Forecast Office, in Chanhassen, Minnesota. The St. Paul District, Corps of Engineers, provides advisory forecasts of reservoir inflow/outflow and pool elevation as needed for its projects. Corps' forecasts may arise from either wet or dry conditions, and are used to assist the NWS, Water Control regulators and the Project Resource Manager in their work.

The water quality divisions of the various state agencies within the St. Paul District forecasts water quality conditions when warranted. The St. Paul District may provide data through its Water Quality Unit in the Environmental Resources Section.

6-02. Flood Condition Forecasts. The National Weather Service Forecast Office, in Chanhassen, Minnesota is the official source for all stream-stage forecast information. The Water Control Center prepares flood forecasts of reservoir inflow/outflow and pool elevation for internal use during critical flood periods (See **Chapter 7.**) During non-critical periods of reservoir regulation, forecasts are not required for regulation.

6-03. Conservation Purpose Forecasts. Forecasts for water conservation purposes are not required for the Lac qui Parle Project.

6-04. Long Range Forecasts. Long-range forecasts of reservoir inflows and levels are not normally required for flood periods or conservation purposes as discussed in **Paragraphs 6-02 and 6-03.** Long range forecasts for drought conditions may be required depending upon the severity of the drought as discussed in **Paragraph 6-05.**

6-05. Drought Forecast. The Minnesota Department of Natural Resources and the National Weather Service routinely monitor and report drought indicators. Drought forecasting of project inflow/outflow and pool elevations is not normally required since there are no significant municipal water supply or hydropower concerns and the low flow plan adequately meets fish and wildlife concerns. During drought conditions, the regulation of the project will be in accordance with the approved drought contingency plan for the project (see **Paragraphs 7-12 and 8-09**). For additional information (see **Paragraph 1-03**).

VII - WATER CONTROL PLAN

7-01. General Objectives. The water control plan incorporates procedures that affect flood control performance, water conservation, recreation, and environmental conditions. It includes a provision for an autumn rise in Lac qui Parle reservoir to create enhanced conditions for fish survival during the winter. Conservation pool levels are maintained on both Lac qui Parle and Marsh Lake in the summer to facilitate recreation, and for fish and wildlife habitat requirements.

The water control plan presented in this document differs from the previous plan in the following respects:

1. The method of flood control has changed, both for spring snowmelt floods and for summer floods.
2. The maximum release rate from Lac qui Parle Dam for non-flood events has been increased from 1,500 to 2,500 cfs.
3. The minimum flow release from Lac qui Parle Dam has been increased from 14 cfs to 20 cfs for normal pool levels (see **Table 7-3**).
4. The new plan requires the opening of the bulkheads during certain flood control situations.
5. Computer simulations of previous flood events show no major benefit in making a pre-flood drawdown to elevation 931.2, so the new plan has no such drawdown for flood control.

Dimensions Pertinent to Project Regulation

Lac qui Parle	
Emergency Spillway	2500 feet at 941.5 feet (effective)
Top of Flood Control Pool	941.1 feet
Marsh Lake Spillway Crest	112 feet at 937.6 feet
Lac qui Parle Spillway Bays	8 bays x 17 feet at 934.2 feet

7-02. Constraints. Some of the notable physical problem areas which currently reduce or impede the effectiveness of water control operations at the Lac qui Parle project are:

a. Lac qui Parle Dam Bulkheads. The spillway bulkheads are not equipped with mechanisms to raise or lower them. They are normally moved by a backhoe, with a chain attached to the bucket. The bulkheads are difficult to move when there is water pressure against them. The new water control plan may require opening or closing of the bulkheads during periods when the reservoir is at or near full flood control pool (elevation 941.1), or in freezing conditions.

b. Gates Jammed by Trees at Lac qui Parle Dam. Sometimes uprooted trees become lodged in the gates at Lac qui Parle Dam. The trees reduce the flow capacity of the gates, and may also prevent them from being closed.

c. Aggradation above Lac qui Parle Dam. There is an area of deposition (sandbar) in the pool just upstream of Lac qui Parle Dam. Ice jams can form on this bar, causing large fluctuations in the pool level below the ice jam. The formation of this sand bar over the years has effectively raised the top-of-dead-storage level of Lac qui Parle from the low-flow gate sill (elevation 915.2) to approximately elevation 928 feet.

d. Siltation at Chippewa River Diversion Dam. The pool/channel behind the Chippewa River Diversion Dam is subject to siltation, which sometimes blocks the low flow outlet. Under severe conditions the flow into the diversion dam inlet channel can be restricted forcing more water over the Sag Weir.

e. Chippewa River Diversion - Tainter Gate. The Tainter gate at the diversion structure has no heater or de-icing equipment. The gate is closed in the winter, and is frozen in place until it thaws in the spring. This can cause a delay in operation of the Tainter gate during a snowmelt flood situation.

7-03. Overall Plan for Water Control. Following the spring breakup or the passing of a summer flood, the reservoir is maintained at conservation elevation, 933.0 $\pm$.2 feet. The outflow from Lac qui Parle Dam is regulated to maintain this elevation while not exceeding a release rate of 2,500 cfs. A minimum flow of 20 cfs is maintained for downstream water supply and pollution

abatement (see **Table 7-3**). During the month of September, the pool is raised gradually to an elevation of 934.0 feet to help prevent fish kill (see **Paragraph 7-07**). Before freeze-up starts, the spillway bulkheads (bays 8-12) are put in the raised (open) position. (The bulkheads have only two positions: open and shut.) During years when the pool is above elevation 934.2 late in the fall, the bulkheads will be raised as soon as possible after the pool is down to the winter level, 934.0 ±.2. The pool is then held at elevation 934.0 ±.2 until the end of February. On 1 March each year, the lowering of the Lac qui Parle pool will begin, in order to bring the pool to conservation elevation 933.0 by 15 March. From then on until 15 May, the spring regulation schedule is in effect. After 15 May, the summer/fall regulation schedule is in effect. The bulkheadds in bays 8-12 are installed on May 16. See **Paragraph 7-05.b.** for details on the Chippewa River Diversion Dam.

7-04. Standing Instructions to the Project Resource Manager. For information on data collection and transmission of reports, refer to **Chapter 5**. For procedures to be followed in the event of lost communications, refer to **Paragraph 7-16**. In the event of communication failure, the procedures outlined in this chapter should be followed as far as practicable until communications are re-established.

7-05. Flood Control.

a. General. Floods in the area are of two types: spring floods caused by snowmelt, often with rainfall, and summer floods caused by periods of heavy or prolonged rainfall. For purposes of project regulation, the spring snowmelt flood period extends from 1 March through 15 May, and flooding after 15 May is considered to be in the summer flood period.

Definitions:

1. **Lac qui Parle Reservoir Inflow:** The sum of: Minnesota River flow from Highway 75 Dam, **Diverted Flow** (see below), and tributary and local inflows to the reservoir. In actual practice, this is calculated by adding the average outflow to the change in storage over the period (storage equation).

2. **Lac qui Parle Dam Discharge:** The flow released from Lac qui Parle Dam, including flow from gates, spillway bays, and the emergency spillway.

3. **Chippewa Diversion Inflow:** The total flow in the Chippewa River immediately upstream of the diversion channel leading to the Watson Sag Weir.

4. **Chippewa Diversion Dam Discharge:** The flow released from the diversion dam downstream into the Chippewa River channel.

5. **Diverted Flow:** the flow diverted by the Chippewa Diversion Dam through the Watson Sag Weir into Lac qui Parle reservoir.

6. **Total Project Inflow:** The sum of the **Lac qui Parle Reservoir Inflow** and the **Chippewa Diversion Inflow.**

7. **Total Project Outflow:** The sum of the **Lac qui Parle Dam Discharge** and the **Chippewa Diversion Dam Discharge.**

b. Chippewa River Diversion Dam. The Chippewa Diversion Dam diverts water from the Chippewa River over the Watson Sag Weir and down the Watson Sag channel into Lac qui Parle reservoir (**Plate 2-19**). Operation of the Chippewa River Diversion provides additional flood protection to downstream areas, including Montevideo, by diverting part of the Chippewa River flow into flood control storage in Lac qui Parle reservoir.

The Chippewa Diversion Dam has 5 bays. Bays 1, 2, 4 and 5 are fixed-crest spillways with a crest elevation of 942.3 feet. Bay 3 contains a Tainter gate having a top elevation of 942.3 feet when closed. The Sag Weir has six spillway bays with a fixed crest elevation of 938.8 feet. See **Chapter 2 and Appendix A.** For constraints, see **Paragraphs 7-02.d and 7-02.e.**

The flood-control operation of the Diversion Dam is the same for all seasons. An intermediate flow situation would have the Tainter gate partially open, dividing the flow between the Chippewa River channel and Watson Sag. As inflows increase, the gate is opened (to divide the flow equally) until the outflow is 1,000 cfs (downstream channel capacity). As inflows continue to rise,

causing the outflow from the Diversion Dam to exceed 1,000 cfs, the Tainter gate is closed enough to maintain the discharge at 1,000 cfs. As the gate is lowered and inflow continues to increase, the water level behind the dam and the flow over the Sag Weir also continue to increase. When the Diversion Dam pool reaches elevation 942.3 feet, flow begins to pass through the Diversion Dam spillway (bays no. 1, 2, 4 and 5). This mode of regulation continues until the gate is fully closed, and all the flow through the Diversion Dam is then passing through the spillway sections and over the Tainter gate. (The remainder of the inflow is diverted through Watson Sag.)

On recession, when the outflow at the Diversion Dam falls below 1,000 cfs, the Tainter gate is opened as necessary to maintain the discharge at 1,000 cfs. When the discharge can no longer be maintained at 1,000 cfs, the gate is kept at the maximum opening until the flow through the Diversion Dam falls to about 600 cfs. Below this flow, the diversion through Watson Sag will fall off without some help from the Tainter gate. The Tainter gate is closed enough to divert about 50 percent of the inflow over the Sag Weir, resuming normal operation.

Under normal operation, moderate flows are divided evenly between Watson Sag and the Chippewa River channel. "Moderate flows" means flows less than about 1,000 cfs Chippewa inflow (as measured at the Milan gage).

Approaching winter, the Diversion Dam Tainter gate is to be closed before freeze-up occurs (flows allowing), because there is not de-icing capability on the structure. The low-flow outlet is then used to control the outflows.

During the winter, a minimum flow (approximately 10 percent of Chippewa River inflow) is maintained down the Watson Sag channel, to provide oxygenated water and suitable habitat for fish overwintering in the Watson Sag portion of Lac qui Parle Reservoir.

c. Lac qui Parle Spring Regulation, 1 March through 15 May. The spillway bulkheads (bays 8-12) are in the raised (open) position. Between 1 March and 15 March, the pool at Lac qui Parle Dam will be drawn down from elevation 934.0 feet to elevation 933.0 (see **Table 7-1 and Plate 7-1**). The discharge during runoff will be set equal to inflow to hold elevation 933.0 feet, until inflow exceeds the dam's outflow capacity. At the Chippewa Diversion Dam, the discharge should follow the flow schedule, not exceeding channel capacity of 1,000 cfs insofar as possible.

As the spring breakup begins and Lac qui Parle reservoir inflows exceed the discharge of 2,500 cfs, the pool is held at the conservation pool elevation of 933.0 feet by maintaining discharges equal to inflow (see **Table 7-2 and Plate 7-1**). As the inflows increase, opening of the gates continues as required to hold the pool level constant, until all gates are wide open. At the

Chippewa Diversion Dam, flow begins over the spillway in bays numbered 1, 2, 4, and 5 when the stage reaches elevation 942.3. As the flow reaches 1,000 cfs, the Tainter gate is opened or closed as necessary to hold the discharge at 1,000 cfs. This mode of regulation continues until the gate is sealed and further control of the flow at the Chippewa Diversion Dam is automatic (see **Paragraph 7-05.b.**).

Table 7-1
Lac qui Parle Dam Spring Regulation Schedule
1 March - 15 May

For Lac qui Parle Condition:		Set Lac qui Parle Discharge:
Lac qui Parle Inflow* is less than outflow capacity	1 - 15 March	Discharge as necessary to achieve a uniform drawdown to elevation 933.0 by 15 March.
	16 March to 15 May	Discharge inflow and hold pool at elevation 933.0 ±.2, or discharge minimum flow, whichever is greater.
Lac qui Parle *Inflow greater than outflow capacity		Discharge full capacity: (all gates are open, all bulkheads are up)
* See definition in section 7-05a, definition 1		

After all the gates at the Lac qui Parle Dam are fully opened, the pool will rise in an unrestricted manner until the stage at Montevideo approaches the urban target no-damage limit stage of 17 feet. At this point, and so long as flood control storage is available below elevation 941.1, the gates and bulkheads are closed

as necessary to maintain the stage at Montevideo at 17.0 feet. However, if the pool is expected to exceed elevation 941.1 the dam will be fully open (all gates and bulkheads open) by the time the pool reaches that point to ensure the safety of the structure. As flows recede, gates and bulkheads are opened if necessary, to hold the stage at Montevideo near, but not over, the target stage. Opening of the gates continues until the dam is again fully open. On May 16, the bulkheads are placed in the closed position, and summer/fall regulation begins. (See **Paragraph 7-05.d.**, and **Table 7-2.**)

At the Chippewa Diversion, as soon as the outflow drops below channel capacity, the Tainter gate should be opened as necessary to maintain the discharge at 1,000 cfs. Opening of the Tainter gate should continue while holding 1,000 cfs discharge, until the gate is fully opened (See **Paragraph 7-05.b.**)

d. Summer /Fall Regulation. Reservior regulation for summer and fall floods is formulated to reduce downstream agricultural and urban flood damages. The spillway bulkheads (bays 8-12) are installed (closed) on May 16. Generally, during the period from 16 May until the end of the following February, the outflow is limited to 2,500 cfs for all pool levels between conservation pool and elevation 938.0 feet. For floods which raise the pool above elevation 938.0, the regulation objective is to fully utilize the remaining flood control storage to store the flood peak, if at all

possible, and if not, then to have the dam fully open (all gates and bulkheads open) by the time the pool reaches top of flood control (941.1 feet) to ensure the safety of the structure. These goals are reviewed and adjustments are made (at least) daily until the peak is reached (see the discussion following **Table 7-2**). After the peak has passed, the regulation schedule in **Table 7-2** is followed.

Table 7-2

Lac qui Parle Dam Summer/Fall/Winter Regulation Schedule: from 16 May through the end of February

Pool Elevation	LQP Inflow* cfs	16 May - 31 August	September (see para. 7-05e)	1 October to end February
Conservation Pool	<2500	Discharge inflow to hold pool elevation 933.0±.2	Raise pool uniformly to elevation 934.0	Discharge inflow to hold pool elevation 934.0±.2
below 938 ft.	>2500	Discharge 2500 cfs from LQP Dam		
above 938 ft.	>2500	Use Discharge Computation Procedure		
* See **Paragraph 7-05.a.** Definition No. 1				

Discharge Computation Procedure for Summer/Fall Floods

(for LQP pool above 938 feet, using 14-day inflow forecast)

Discussion of Maximum Flood Control Storage: for Lac qui Parle reservoir, top of flood control is set at elevation 941.1 feet (the emergency spillway road has been re-surfaced once or twice, and the

effective crest elevation is now approximately 941.5 feet.) For a given flood event, the peak pool elevation on Marsh Lake usually is higher than the peak on Lac qui Parle reservoir, from about 0.1 foot to more than 2 feet higher, depending on the type of flood. Floods which originate mostly above Marsh Lake Dam seem to have the higher differences, and floods in which all the tributaries are flooding have the lower differences. For estimating the available storage, the following representative values have been chosen:

Lac qui Parle @ 941.1 feet = 122,800 acre-feet

Marsh Lake @ 941.5 feet = 39,500 acre feet

Total Max. Flood Control Storage = 162,300 acre-feet

1. Find the flood storage available: subtract storage used at current pool elevations, for both Marsh Lake and Lac qui Parle (from storage tables, or **Plates 2-14 and 2-15**) from Maximum Flood Control Storage (162,300 acre-feet); convert result to cfs-days (divided by 1.9835).

2. Obtain or synthesize a 14-day forecast inflow hydrograph for Lac qui Parle reservoir. Project current outflow 14 days.

3. Plot outflow and inflow hydrographs together. If the recession of the inflow hydrograph does not recede below the current outflow within 14 days, see if the volume between the curves is less than the available flood storage. If so, hold

discharge constant. If not, see if increasing the discharge by as much as 2,000 cfs will allow the remainder of the 14 days' inflow to be stored. Increase the discharge to the required amount, but not to exceed 2,000 cfs increase in the discharge per day. If the required increase is more than 400 cfs, it should be made in two or three equal steps throughout the day.

4. If the hydrographs intersect on the recession (indicating inflow = outflow, or the flood peak), see if the volume between today and the projected intersection date can be stored with the current outflow projected either:

i) as a straight line, or

ii) with an increase of up to 2,000 today, or

iii) with daily increases of up to 2,000 per day through the intersection date.

5. Set the discharge as indicated by the above projections, but not to exceed 2,000 cfs increase per day. As Lac qui Parle pool rises toward elevation 941.1, attempt to discharge inflow by increasing up to 2,000 cfs per day until either discharging inflow or the dam is wide open. Generally, the goal is a smooth transition to a wide-open condition at a pool elevation of 941.1 (gates fully open, bulkheads up.)

6. On recession and when pool is below elevation 941.1 but above elevation 938, reduce outflow to inflow at a rate not to exceed 1,000 cfs decrease per day. Then discharge inflow or 2,500 cfs, whichever is greater, until pool is down to conservation level.

e. Winter Conservation Level. Starting in early to mid-September, depending on the available inflow, the Lac qui Parle discharge will be reduced so as to uniformly raise the pool to elevation 934.0 by 30 September. After this, the pool will be held at elevation 934.0 ± 0.2 feet throughout the winter until the end of February. On 1 March, the spring regulation schedule begins. (see **Paragraph 7-05.c).** The actual dates may vary depending on inflow and conditions in the reservoir.

f. Freeze-up Period Flow Limitation. To the extent that these procedures and runoff conditions allow, avoid discharging substantially more than 1,000 cfs during the initial winter freeze-up period. Also, notify the City of Granite Falls as soon as possible when discharges over 1,000 cfs are anticipated during this period.

7-06. Recreation. Recreation in the project area consists primarily of hunting, fishing, camping, canoeing, hiking and auto tour routes. A Minnesota State Park with picnic and camping facilities is located on the right bank, just upstream of Lac qui Parle Dam. See **Paragraphs 2-06 and 8-03.**

7-07. Water Quality. Each year during September, the Lac qui Parle pool will be raised to elevation 934.0 feet for the winter. The reservoir will be held at this elevation until 1 March, when the transition to elevation 933.0 begins. Fish and other aquatic life require adequate amounts of dissolved oxygen to survive. Stressed fish populations and winter fish kills can often be attributed to low levels of dissolved oxygen (DO). Conditions contributing to low dissolved oxygen levels include:

1. Since DO is proportional to the water volume, low lake level means low water volume, which means low total DO.
2. Poor quality inflows fail to bring in adequate DO levels during the winter months.
3. Snow and ice cover reduce light penetration, and therefore photosynthetic DO production is reduced.

Of these parameters, the only one which can be easily affected is the lake water volume. Holding the lake higher during the winter months creates a larger supply of dissolved oxygen for the critical winter months, reducing the chance of winter fishkill. See **Paragraphs 4-08, 5-02 and 8-04.**

7-08. Fish and Wildlife. Most of Lac qui Parle and Marsh Lake lie within the Lac qui Parle Wildlife Management Area, which is administered by the Minnesota Department of Natural Resources. Immediately upstream is the Big Stone National Wildlife Refuge, which is administered by the U. S. Department of the Interior, Fish

and Wildlife Service. These wildlife areas, plus the Minnesota River valley, form a natural corridor which traverses the region from northwest to southeast. This corridor offers an excellent opportunity for viewing and photographing the wildlife found there. Conservation groups have expressed concern that the water levels in Lac qui Parle reservoir not be operated exclusively for flood control, to the detriment of fish and wildlife resources. See **Paragraphs 7-07 and 8-05.**

7-09. Water Supply. Granite Falls is the only community that is clearly dependent on Lac qui Parle outflows for its water supply. The Granite Falls water treatment plant has a capacity of 620 gallons per minute, (0.893 MGD) or 1.38 cfs. The city has two 300,000 gallon supply tanks, and a 275,000 gallon post-clarification tank for a total storage of 875,000 gallons. Average daily use is 275,000 gallons per day, with a high usage of 700,000 gallons per day. See **Paragraph 8-06.**

7-10. Hydroelectric Power. There are two hydropower dams at Granite Falls. Granite Falls Dam is in the town proper, while Minnesota Falls Dam is 3 miles downstream. Granite Falls Dam is still producing hydropower today, but Minnesota Falls was taken out of service in 1958, and its powerhouse was demolished. The pool at Minnesota Falls is still used to provide cooling water for a Northern States Power Company thermal power plant 1.5 miles upstream.

Granite Falls Dam was built by the city in 1911 to produce electric power. The gravity overflow section has a nominal height of 21 feet, and is 300 feet long. In addition to hydropower production, the city also uses the impoundment to provide for its municipal water supply. The dam has three turbines: two older units produce 470 kW together, and the new turbine (1986) produces 710 kW. The total maximum flow capacity of the turbines is 900 cfs.

7-11. Navigation. Navigation is not an authorized purpose of the project.

7-12. Drought Contingency Plans. The drought contingency plan is in draft form (dated September 1992) and is a stand-alone document (see **Paragraph 1-03 and 8-09**). Copies of the plan are located at the Lac qui Parle Project Office at Watson, Minnesota, and in the District Water Control Section in St. Paul.

7-13. Flood Emergency Action Plans. The flood emergency action plan is a stand-alone document (dated October 1988) (see **Paragraph 1-03 and 8-10**). The plan is located at the Lac qui Parle Project Office at Watson, Minnesota, and in the District Water Control Section in St. Paul.

7-14. Deviation from Normal Regulation. Unusual circumstances that require minor deviations from the normal regulation plan must be approved by the District Engineer and Division Commander. For

deviations that become necessary with little advance notice, Water Control will obtain verbal approval from the District Engineer and the Division Commander, with supporting documentation provided as soon as possible after the fact. Water Control personnel may authorize necessary short-term changes, under extreme emergency conditions, until approval from higher authority is obtained.

7-15. Discharge - Minimum Instream Flows. The reservoir will be operated during low water periods so as to provide required minimum flows downstream. The routine minimum discharge from Lac qui Parle Dam (interim schedule) is shown in **Table 7-3**, below:

Table 7-3
Minimum Outflow from Lac qui Parle Dam
Interim Schedule[1]

Pool Elevation	Minimum Release, cfs
above 932.0	20
932.0 to 930.0	15
below 930.0	10

1. Pending the outcome of an instream flow study.

Minimum outflow from the Chippewa River Diversion Dam will be approximately one-half the Chippewa Diversion Inflow. The remainder of the Chippewa flow is diverted through Watson Sag to provide for the needs of fish and wildlife (See **Paragraph 7-05.b.**).

All requests by affected parties for increases or decreases in flow, or requests for deviations from current procedures, should be transmitted to the District Office for evaluation and approval.

7-16. Loss of Communication. In the event of failure of normal (telephone) communications, the Resource Manager will maintain contact with the District Office by any other means available, including radio, alternate telephone services, or sending a messenger to the nearest point where communications are available.

If flooding conditions are also present, the primary objective will be to ensure the safety of the structures and to provide the most effective operation of the project by following the guidance in this chapter. During such emergency operation, the appropriate schedule in either **Table 7-1 or Table 7-2** will be followed until contact with the District Office is reestablished. It will also be necessary for the Resource Manager to keep informed concerning effects of any reservoir releases on downstream damage centers.

If Water Control cannot be contacted at the District Office, call one of the regulators in order of preference as shown on the list on **Page viii**, near the front of this manual.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The primary benefits from the project are derived from flood control. Agricultural and urban flood control benefits are realized along the Minnesota River and at Montevideo and Granite Falls, Minnesota. Secondary benefits include fish and wildlife and recreation.

8-02. Flood Control.

a. Spillway Design Flood.

1. Marsh Lake Dam. The spillway design flood for Marsh Lake Dam was estimated for the Dam Failure Planning Report (see **Paragraph 1-03**). The design flood was produced by reducing the Probable Maximum Precipitation hyetograph until the resulting event produced a peak reservoir stage with 3 feet of freeboard. The spillway design flood for Marsh Lake Dam results in a maximum outflow of 15,000 cfs and a maximum pool elevation of 947.1 feet.

2. Lac qui Parle Dam. Information on the spillway design flood for Lac qui Parle Dam is not available.

3. Chippewa River Diversion Dam. The spillway design flood for the Chippewa Diversion Dam was estimated for the Dam Failure Planning Report (see **Paragraph 1-03**). The design flood was

produced by reducing the Probable Maximum Precipitation hyetograph until the resulting event produced a peak reservoir stage for which the dam could be expected to sustain no damage. Since this dam has no emergency spillway, the spillway design elevation was chosen to be 944.0 feet.

The spillway design flood results in a maximum outflow of 7,000 cfs and a maximum pool elevation of 944.0 feet (6 feet of freeboard). This is the combined outflow from the outlet and the diversion channel.

b. Probable Maximum Flood (PMF). The Lac qui Parle Project was constructed prior to the development of the current spillway design flood standards. The original design was not based upon PMF criteria. A PMF inflow hydrograph was developed for Lac qui Parle reservoir, Marsh Lake reservoir, and the Chippewa Diversion Dam for the *Emergency Plan* study (see **Paragraph 1-03**) and has been incorporated into this manual for comparative purposes.

Additional details on the PMF for Marsh Lake reservoir and the Chippewa Diversion can be found in the Dam Failure Planning Reports (see **Paragraph 1-03**). The PMF for each location was developed using a 15 June All-Season event.

1. **Marsh Lake Dam.** The computed peak inflow into Marsh Lake reservoir from the PMF is 109,000 cfs. Routing of the PMF through the reservoir resulted in a computed peak pool elevation of 952.0 feet (zero freeboard) and a maximum outflow through the spillway and over the dam (without dam failure) of 108,000 cfs. The PMF inflow hydrograph is presented on **Plate 8-1.**

2. **Lac qui Parle Dam.** The computed peak inflow into Lac qui Parle reservoir from the PMF is 124,000 cfs. Routing of the PMF through the reservoir resulted in a computed peak pool elevation of 946.5 feet and a maximum outflow through the spillway and over the dam (without dam failure) of 106,500 cfs. The PMF overtops the dam by 0.5 feet. The PMF inflow hydrograph is presented on **Plate 8-2.**

3. **Chippewa River Diversion Dam.** The computed peak inflow into Chippewa Diversion Dam pool from the PMF is 98,000 cfs. Routing of the PMF through the reservoir resulted in a computed peak pool elevation of 954.2 feet and a maximum outflow through the spillway and over the dam (without dam failure) of 98,000 cfs (inflow=outflow). This is the combined outflow from the outlet and the diversion channel. The PMF overtops the dam by 4.2 feet. The PMF inflow hydrograph is presented on **Plate 8-3.**

c. Standard Project Flood. The Standard Project Flood has not been developed for the drainage area above the Lac qui Parle Project.

d. Intermediate Flood (IF). The intermediate flood (IF) is an event that is half way between the probable maximum flood (PMF) and the spillway design flood.

1. Marsh Lake Dam. At Marsh Lake, the IF was assumed to be an event which produced a peak reservoir stage that is midway between the stage resulting from the PMF and spillway design flood. Routing of the IF through the reservoir resulted in a computed peak pool elevation of 949.6 feet. The computed peak inflow into Marsh Lake reservoir from the IF is 22,000 cfs.

2. Lac qui Parle Dam. Information on the intermediate flood for Lac qui Parle Dam is not available.

3. Chippewa River Diversion Dam. At the Chippewa Diversion Dam, the IF was assumed to be an event which produced a peak inflow that is midway between the PMF and spillway design flood inflow. The computed peak inflow into Marsh Lake reservoir from the IF is 53,000 cfs. Routing of the IF through the reservoir resulted in a computed peak pool elevation of 951.8 feet.

8-03. Recreation. The current water control plan for the Lac qui Parle Project provides dependable and stable summer lake levels. This benefits resort owners, lakeshore residents, the state park, and area commerce. Stable summer levels reduce shoreline erosion, and improve wildlife habitat. See **Paragraphs 2-06 and 7-06.**

8-04. Water Quality. Releases from the Lac qui Parle Project can affect both the quantity and quality of water available for water supply in the Minnesota River. Presently, no known problems exist with using Minnesota River water for municipal use after treatment. The pool is raised to elevation 934 feet in the fall to conserve dissolved oxygen. This provides additional oxygen for fish and other aquatic life between freeze-up and the spring thaw. See **Paragraphs 4-08, 5-02 and 7-07.**

8-05. Fish and Wildlife. The water control plan for Lac qui Parle reservoir includes achieving a target lake level of 933.0 feet, if possible, following spring runoff. This target level provides sufficient lake volume to provide for aquatic habitat conditions during the growing season. The pool level is raised to elevation 934 feet in the fall to limit the potential for winterkill of fish.

Marsh Lake does not support a consistent fishery because it is shallow and prone to winterkill. Marsh Lake is in need of more intensive management to improve deteriorated aquatic and wetland habitat conditions. See **Paragraph 7-08.**

8-06. Water Supply. The project does not have sufficient storage available to be a dependable long-term source of surface water for downstream water utilities.

The City of Granite Falls is the only community in the immediate area that is dependent on Minnesota River water for water supply. The city has a water treatment plant that treats 620 gallons per minute (gpm) or 1.38 cfs daily. The utility has two 300,000 gallon supply tanks and a 275,000 gallon post-clarification tank for water storage. See **Paragraph 7-09.**

8-07. Hydroelectric Power. The City of Granite Falls operates a hydroelectric plant on the Minnesota River (see **paragraph 4-11**). The dam has three turbines that produce a total of 1,180 kilowatts of power. The facility supplies about 35 percent of the electric demand for the city. The current maximum usable flow for hydropower at the plant is 900 cfs.

8-08. Navigation. Navigation is not an authorized purpose of the project.

8-09. Drought Contingency Plans. The Drought Contingency Plan (DCP) provides a basic reference for water management decisions and responses to a water shortage in the Lac qui Parle basin induced by climatological droughts. The DCP includes a plan formulation process for the release of low flows and an interagency coordination matrix. The drought contingency plan is in draft form (dated September 1992) and is a stand-alone document (see **Paragraph 1-03 and 7-12**).

8-10. Flood Emergency Action Plans. The *Emergency Plan* outlines procedures to be followed under various emergency conditions. The report includes: an emergency identification plan, an emergency operations and repair plan, an emergency notification list, and an inundation map. The plan is dated October 1988 and is a stand-alone document (see **Paragraph 1-03 and 7-13**).

8-11. Frequencies. Inflow and outflow duration data can be found in **Chapter 4**.

a. Peak Annual Inflow Frequency. Plate 8-4 shows the probability of a given maximum annual daily inflow into the Lac qui Parle Project. Daily inflows were computed using mean daily outflows and the change in pool elevation from 1940 through 1993.

b. Pool Stage/Elevation Frequency. The annual probability of a given project pool stage/elevation occurring at Lac qui Parle Dam is presented on **Plate 8-5.** This curve was developed for the period 1940 through 1993. The data used to develop the curve reflects the maximum project pool elevation recorded at Lac qui Parle Dam. The control shifts from Marsh Lake Dam to Lac qui Parle Dam, depending on the project pool elevations.

The annual probability of a given project pool stage/elevation occurring at Marsh Lake Dam is presented on **Plate 8-6.** This curve was developed for the period 1964 through 1993.

c. Discharge-Frequency Curves. **Table 8-1** lists discharge-frequency curves for various gages and the plates on which they can be found.

Table 8-1 Peak Annual Discharge-Frequency Curves in the Vicinity or the Lac qui Parle Project	
Plate Number	**Description**
8-7	U.S.G.S. Gage No. 05293000, Yellow Bank River near Odessa, Minnesota
8-8	U.S.G.S. Gage No. 05294000, Pomme de Terre River at Appleton, Minnesota
8-9	U.S.G.S. Gage No. 05300000, Lac qui Parle River near Lac qui Parle, Minnesota
8-10	U.S.G.S. Gage No. 05304500, Chippewa River near Milan, Minnesota
8-11	U.S.G.S. Gage No. 05292000, Minnesota River at Ortonville, Minnesota [1]
8-12	U.S.G.S. Gage No. 05301000, Minnesota River near Lac qui Parle [2]
8-13	U.S.G.S. Gage No. 05311000, Minnesota River at Montevideo, Minnesota [3]
1. The gage is 1300 feet downstream of the Big Stone Lake Dam. 2. The gage is 200 feet downstream of the Lac qui Parle Dam. 3. This is a control point for the Lac qui Parle Project.	

d. Key Control Points. The only control point below the project is at Montevideo, Minnesota. The project is regulated during flood periods for a target stage of 17 feet at U.S.G.S. gage No. 05311000 in Montevideo (see **Paragraph 7-05**).

8-12. Other Studies. See **Paragraph 1-03.**

a. Flood Forecasting. *Forecasting Rainfall and Snowmelt Runoff on Floods on Upper Midwest Watersheds,* University of Minnesota, St. Anthony Falls Hydraulic Lab, Report No. 151, June 1974. This report used SSARR (Streamflow Synthesis and Reservoir Regulation), HEC-1 (Flood Hydrograph Package), and the National Weather Service's River Forecast model to compare various flood forecasting techniques. The entire Minnesota River basin was modelled.

b. Low Flow Simulation. *Computer Simulation of Low Flow Conditions, Minnesota River,* Barr Engineering for U.S. Army Corps of Engineers, St. Paul District, 1980. This report discusses an HEC-3 model (Reservoir System Analysis for Conservation) that was developed to examine the effects of low flows in the Minnesota River valley.

c. Flood Flow Simulation and Damages. An HEC-5 model (Simulation of Flood Control and Conservation Systems) was developed as part of the effort to revise the current reservoir regulation manual (in 1994). Over 50 different operating plans for the Lac qui Parle Project were simulated. A detailed economic analysis was also done. (see **Paragraph 1-03 and 4-12**).

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization.

a. Corps of Engineers. The Corps of Engineers is the owner, operator, and regulator of the Lac qui Parle Project. The St. Paul District Water Control Section has direct day-to-day responsibility for the regulation of flows from Lac qui Parle Dam, Marsh Lake Dam, Chippewa Diversion Dam and the Highway 75 Dam. The Construction Operations Division, Western Flood Control Project Office has responsibility for the operation and maintenance of the project (see **Chapter V**).

b. Other Federal Agencies. The National Weather Service has the responsibility for all hydrologic forecasts within the Minnesota River Basin. The U.S. Geological Survey collects data on the discharges at various stations within this basin (see **Table 5-2**). The U.S. Fish and Wildlife Service, Soil Conservation Service, U.S. Geological Survey, and the U.S. Environmental Protection Agency all have an ongoing interest in the regulation of the Lac qui Parle Project.

c. State and County Agencies. The State and county agencies that have an interest in the regulation of the Lac qui Parle Project are listed in **Table 9-1**.

Table 9-1

Organizations With an Interest in Water Control Activities

NATIVE AMERICAN
Upper and Lower Sioux

FEDERAL
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Federal Emergency Management Agency

MINNESOTA
Department of Natural Resources
Pollution Control Agency
Board of Water and Soil Resources

COUNTY
Big Stone County
Lac qui Parle County
Swift County
Chippewa County
Yellow Medicine County
Watershed Districts

OTHER
Minnesota Valley Partnership

9-02. Interagency Coordination.

a. Local Press and Corps Bulletins. Information concerning the regulation of the Lac qui Parle Project is provided by the St. Paul District's Public Affairs Office (PAO) to the local news media in response to their requests. Additionally, the PAO provides news releases of an advisory nature to the local media regarding important aspects of project regulation. These releases do not provide the public with forecasts of river stages or flows. River forecasting is a Congressionally mandated responsibility of the National Weather Service.

b. National Weather Service. Current readings from the reservoirs are supplied to the National Weather Service on a weekly basis or as requested. These readings include snow depth/water content, frost depths, precipitation, discharges and reservoir levels. The National Weather Service uses this information in developing their spring runoff outlook and flood forecasts.

c. U. S. Geological Survey. This agency receives data from its own and co-operative observer gages as well as from Water Control on a daily schedule and at other times as requested.

d. Other Federal, State or Local Agencies. Local interests include various recreation resources. Lac qui Parle State Park is located on the right bank just upstream of Lac qui Parle Dam.

9-03. Interagency Agreements. The St. Paul District is a participant in the Upper Minnesota River Partnership Group. The group consists of representatives from the St. Paul District, the U. S. Fish and Wildlife Service, the Soil Conservation Service, the Minnesota Department of Natural Resources, the Minnesota Pollution Control Agency, and the Minnesota Board of Water and Soil Resources. Its two main objectives are to provide a mechanism for participating state and federal agencies to facilitate the coordination of their programs and activities, and to provide an opportunity for other interested parties to express their concerns and receive guidance. Each participating agency, including the

St. Paul District, functions within the partnership according to its own authorities, programs, funding, and management or regulatory responsibilities. The responsibilities of the St. Paul District in the upper Minnesota River valley include, among others, the regulation of Minnesota River flows through the Lac qui Parle Project.

9-04. Commissions, River Authorities, Compacts & Committees. Organizations and governments that have an interest in water control activities in the basin are listed in **Table 9-1.**

9-05. Reports. **Table 9-2** presents a listing of reports compiled by or for the Water Control Section regarding the regulation of the Lac qui Parle Project. These reports are prepared in accordance with Engineering Manual No. 1110-2-3600. Blank copies of the necessary forms are kept in the Water Control Section.

Table 9-2

Reports, Lac qui Parle Project

Report Name	Date Required	Form Number
Compiled by Water Control		
Annual Reservoir Summary	30 September	NCS-18
Reservoir Status Bulletin	End of Month	Computer Generated
Gage Records	As Needed	Computer Archived
Compiled by Field Office for the Water Control Center		
Monthly Log Sheet	End of Month	NCS-64
Weekly Gage Charts	Monday, a.m.	Recorder Chart
Snow Reports and Frost Reports	December 7 to March 30	NCS-430 NCS-58
Emergency Reports when Required or Requested	Daily, 0800	By Phone
Other		
Monthly Climat-ological Report	End of Month	WS-E15

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

LAC QUI PARLE PROJECT

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA
LAC QUI PARLE PROJECT

General

Drainage Area (Excluding Chippewa River)	4,050 Square Miles
Drainage Area (Including Chippewa River)	6,100 Square Miles
Elevation of Pool Gage Zero (1929 NGVD) (Lac qui Parle, Marsh Lake, and Chippewa Div.)	900.00 Feet
Year of First Operation (State of Minnesota)	1939
Operation by Corps of Engineers began	8 September 1950

Lac qui Parle Reservoir

Maximum Pool Elevation and Date (Since Construction)	942.47 Feet, April 1969
Conservation Pool Elevation	933.0 Feet
Full Pool Elevation	941.1 Feet
Capacity at Conservation Pool	41,000 Acre-Feet
Capacity at Full Pool (See Paragraph 7-05.d.)	162,300 Acre-Feet

Lac qui Parle Dam

Maximum discharge of record and year	29,400 cfs, 1969
Location in Miles above Mouth of MN River	288.1
Type	Rolled Earth Fill
Tof of Dam Elevation	946.0 Feet
Length (Includes Emergency Spillway Section)	4,100± Feet
Freeboard Above Full Pool	4.9 Feet
Upstream Slope	1 on 3
Downstream Slope	1 on 4

Lac qui Parle Dam Control Structure

Type	Concrete
Length Between Abutments	237.0 Feet
Elevation of top of Abutments	946.7 Feet
Elevation of top of Piers	944.28 Feet
No. of Bays	12
No. of Gates (In Bays 1-4)	9

SUPPLEMENTARY PERTINENT DATA (continued)

LAC QUI PARLE PROJECT

Lac qui Parle Dam Gates

Bays Nos. 1-4 inclusive	Slide Gates
Total Number of Gates	9
Sill Elevation, Bays 1, 3, and 4	922.7 Feet
Bays 1, 3, and 4	2-6'x8' Lift gates in each bay operated with a power unit or by hand
Sill Elevation, Bay 2	915.2 Feet
Bay 2 (Low Water Control)	3-4'x4' Lift gates operated with a power unit or by hand

Lac qui Parle Dam Fixed Crest Spillway

Bays Nos. 5-12	Concrete Fixed Crest
Crest Elevation	934.2 Feet
Length of Each Bay	17 Feet
Bays 5-7 inclusive	Uncontrolled
Bays 8-12 inclusive	3 Steel Bulkhead Sections in each Bay
Elevation Top of Bulkhead (Closed)	940.7 Feet
Bulkhead Size	5.5 L x 6.5 H Feet

Lac qui Parle Dam Stilling Basin

Type	Concrete
Length (Varies)	42 to 60 Feet
Width	237 Feet
Floor Elevation:	
Bays 8-12 incl.	923.2 Feet
Bays 5-7 incl.	918.7 Feet
Bays 1-4 incl.	914.2 Feet

SUPPLEMENTARY PERTINENT DATA (continued)

LAC QUI PARLE PROJECT

Lac qui Parle Dam Emergency Spillway

Type	Earth fill with concrete core wall and bituminous surfaced roadway
Length	2,500 Feet
Crest Elevation	Varies, 940.75 to 941.3 Feet
Roadway Width	23.0 Feet
Upstream Embankment Slope	1 on 3
Downstream (Grouted Riprap)	1 on 2

Bridge Over Lac qui Parle Dam

Elevation of Roadway (Crown)	946.2 feet
Elevation of Walkway	946.7 Feet
Roadway Width	23 Feet

Marsh Lake Reservoir

Maximum Pool Elevation and Date (Since Construction)	945.55, April 1969
Conservation Pool Elevation	937.6 Feet
Full Pool Elevation (See Paragraph 7-05.d.)	941.5 feet
Capacity at Conservation Pool	12,050 Acre-Feet
Capacity at Full Pool	35,000 Acre-Feet

Marsh Lake Dam

Location in Miles Above Mouth of MN River	303.5
Drainage Area	2,800 Square Miles
Type	Rolled earth fill Upstream slope ripraped to Elevation 942.0 Feet
Length	11,800 Feet
Top Elevation (Varies)	948.6 to 952.6 Feet
Maximum Height	19.5 Feet
Top Width	10.0 Feet

SUPPLEMENTARY PERTINENT DATA (continued)

LAC QUI PARLE PROJECT

Marsh Lake Dam Control Structure

Type	Concrete Gravity Overflow
Length	112 Feet
Crest Elevation	937.6 Feet

Marsh Lake Dam Low Water Control

Type	Concrete Conduit
Size	2'x2' Square
Length	17 Feet
Control	2'x2' Vertical Lift Gate
Sill Elevation	932.6 Feet

Marsh Lake Dam Emergency Spillway

Type	Earth Fill-grouted riprap
Length	90 Feet
Crest Elevation	940.0 Feet

Marsh Lake Dam Stilling Basin

Type	Bucket Type
Bottom Elevation	924.6 Feet

Chippewa River Diversion Dam

Location	On the Chippewa River near Watson, Minnesota
Location in Miles Above Mouth	11.3
Drainage Area	2,050 Square Miles
Type	Rolled Earth Fill
Total Length (includes dam and all dikes)	17,975 Feet
Top Elevation	950.3 Feet
Maximum Height	23.3 Feet
Top Width	32.0 Feet

SUPPLEMENTARY PERTINENT DATA (continued)

LAC QUI PARLE PROJECT

Chippewa River Diversion Dam Control Structure

Type	Concrete, Modified Ogee
Length Between Abutments	147 Feet
Number of Bays	5
Length of Each Bay	27 Feet
Fixed Crest Elevation (Bays 1, 2, 4, and 5)	942.3 Feet
Tainter Gate (Bay No. 3)	27.0 Feet - Operation with portable electric unit (electric nut runner or by hand).
Gate Sill Elevation (Bay No. 3)	933.6 Feet
Elevation Top of Gate (Closed)	942.3 Feet
Stilling Basin Elevation (Bays 1, 2, 4, and 5)	934.3 Feet
Stilling Basin Elevation (Bay 3)	932.0 Feet

Bridge Over Chippewa River Diversion Dam

Roadway Elevation	950.55 Feet
Roadway Width	23.0 Feet
Elevation Top of Abutments	950.3 Feet
Elevation Top of Curb	950.8 Feet
Elevation Low Concrete	947.8 Feet

Chippewa River Diversion Dam Low Water Control Structure

Type	Concrete Conduit
Size	4 x 4 Feet
Length	90.4 Feet
Entrance Invert	933.3 Feet
Exit Invert	932.8 Feet
Gate (Vertical Slide)	4 x 4 Feet

SUPPLEMENTARY PERTINENT DATA (continued)

LAC QUI PARLE PROJECT

Chippewa River (Watson Sag) Diversion Channel

Length	3,500 Feet
Bottom Width	160 Feet
Bottom Elevation	934.3 Feet
Side Slopes	1 on 3

Dike, Chippewa River (Watson Sag) Diversion Channel

Location	Left or South Bank of Diversion Channel
Type	Rolled Earth Fill
Top Elevation (Varies)	946.3 - 947.8 Feet
Top Width	10.0 Feet
Side Slope (Channel Side)	1 on 3
Side Slope (Land Side)	1 on 4

Chippewa River Diversion (Watson Sag) Weir

Type	Concrete, Modified Ogee
Length Between Abutments	177.0 Feet
Number of Bays	6
Length of Bays	27.0 Feet
Fixed Crest Elevation	938.8 Feet
Stilling Basin Elevation	932.3 Feet
Elevation of Gage Zero (1929 NGVD)	900.00 Feet

Bridge Over Weir Diversion (Watson Sag) Weir

Roadway Elevation	950.00 Feet
Roadway Width	23.0 Feet
Elevation Top of Abutments	949.8 Feet
Elevation Top of Curb	950.25 feet
Elevation Low Concrete	947.25 Feet

EXHIBIT B

RELATED MANUALS AND REPORTS

LAC QUI PARLE PROJECT

EXHIBIT B

RELATED MANUALS AND REPORTS

LAC QUI PARLE PROJECT

1. General. Prior reports for flood control and navigation aids date from about 1874 and include a number of printed documents and annual reports of the Chief of Engineers. These reports deal with investigations into the advisability of dredging, removal of obstructions, and construction of locks and dams on the Minnesota River, Lake Traverse, and the Red River of the North and tributary streams. In general, these early reports were favorable to dredging and the removal of obstructions but were unfavorable to the construction of locks and dams as aids to navigation.

2. *Report of an exploration of the Territory of Minnesota in 1849,* Ex. Document No. 42, 31st Congress, Corps of Topographical Engineers, Captain John Pope, 1850.

3. *Examination and Survey of the Minnesota River,* Ex. Document No. 76, 43rd Congress, 2nd Session, Corps of Engineers, Major G. K. Warren, 1866 - 1867.

4. *Survey of Minnesota River, Big Stone Lake, and Lake Traverse,* House Document No. 75, 44th Congress, 1st Session, Corps of Engineers, Colonel T. N. Macomb, 1872.

5. *Report on Reservoir at Foot of Big Stone Lake,* Senate Document No. 30, 48th Congress, 1st Session, Unfavorable recommendations as commerce did not justify cost of reservoir for navigation.

6. *Preliminary Examination of Big Stone Lake and Lake Traverse.* House Document No. 71, 48th Congress, 2nd Session, (Unfavorable). This report examined the possibility of connecting the two lakes.

7. *Red River of the North and Big Stone Lake,* House Document No. 127, 52nd Congress, 1st Session, Concluded that a reservoir at Big Stone Lake could aid navigation on the Mississippi River by increasing low flows.

8. *Preliminary Examination of Big Stone Lake,* House Ex. Document No. 256, 53rd Congress, 3rd Session, Recommended a survey of Big Stone Lake and Lake Traverse for Reservoirs.

9. *Survey of Big Stone Lake and Lake Traverse for Reservoirs,* House Document No. 134, 55th Congress, 2nd Session, 1897, Report includes plans for reservoir and estimate of cost, (Unfavorable, Recommended further study).

10. *Preliminary Report on Survey of Big Stone Lake and Lake Traverse for Reservoirs,* House Document No. 675, 56th Congress, 1st Session, Progress Report, Final Report to be Made in 3 Years.

11. *Survey Report on Reservoirs at Big Stone and Lake Traverse,* House Document No. 539, 58th Congress, 2nd Session, 1904 (Unfavorable Recommendation).

12. *Examination of the Bois de Sioux River, Lakes Traverse and Big Stone Lake,* House Document No. 493, 60th Congress, 1st Session, 1908. This report examined the possibility of diverting floodwaters from the Red River of the North basin into the Minnesota River (Report Unfavorable).

13. *Survey of Minnesota River for Upper Valley Navigation Reservoirs,* House Document No. 700, 62nd Congress 2nd Session, Recommended the construction of a 45-foot dam at Lac qui Parle with water power development to be operated as a navigation reservoir.

14. *Examination of Lake Traverse and Big Stone Lake.* House Document No. 199, 65th Congress, 1st Session, 1917. This report looked at flood control, water power, and the possibility of connecting and extending navigation on and between the lakes.

15. *First Biennial Report of the Commissioner of Drainage and Waters to the Governor of the State of Minnesota and the Legislature,* 1921, Presents plans of improvement for control of floods on the Minnesota River by means of 3 main stem reservoirs.

16. *Second Biennial Report of the Commissioner of Drainage and Waters to the Governor of the State of Minnesota and the Legislature,* 1923, Results of continuation of studies on plan in 1st Biennial Report.

17. *Minnesota River, Minnesota (Navigation, water power, flood control, and irrigation),* House Document No. 230, 74th Congress, 1st Session. The prospective flood control benefits from three reservoirs (Big Stone Lake, Lac qui Parle, New Ulm) was not sufficiently general in character to warrant Federal participation, Proposed the Mendota Reservoir.

18. *Big Stone Lake Reservoir Project and Lac qui Parle Reservoir Project,* House Document No. 669, 76th Congress, 3rd Session, Reservoirs proposed to reduce the frequency of flooding in the upper portions of the Minnesota River Valley. A future reservoir is proposed near New Ulm, Minnesota in a tabulation of a comprehensive flood control plan.

19. *Report on Diversion of Flood Waters of Little Minnesota River into Lake Traverse,* Review of House Document No. 230, 74th Congress, 1st Session, Includes a study of flood problems on the Minnesota River from Browns Valley to Lac qui Parle Dam.

EXHIBIT C

PROPER MARKING OF RECORDER CHARTS

LAC QUI PARLE PROJECT

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
CENCS-ED-GH (1110-2-1400b)	Proper Marking of Recorder Charts

TO THRU CENCS-~~ED~~ CO FROM CENCS-ED-GH DATE 13 Dec 88 CMT 1
KWillis/mc/619

TO All Lockmasters, Park Managers,
and Damtenders

1. Although a number of sites are marking their recorder charts properly, many are not. Water Control now has an 8-year backlog of charts that cannot be microfilmed because they are not properly marked. To mark them properly on site takes only an additional second or two, but it costs us hundreds of man-hours to redo incorrectly marked charts.

2. Please direct your personnel to do them properly the first time. Your cooperation is greatly appreciated.

3. Enclosed is a sample of the proper notation. If anyone has any questions please contact Water Control for clarification.

Edward G. Eaton

EDWARD G. EATON
Chief, Water Control

Encl

Proper Markings for Recorder Charts

Should Include

1. Elevation for at least three consecutive feet should be noted in order to set vertical scale.
2. M-N-M (Midnight-Noon-Midnight) should be noted in order to set the horizontal scale.
3. The date on which the observation was made should be noted.
4. The gage reading at the time the recorder was checked should be noted.

4a. Note: The recorder pen should be gently moved up and down to show when the reading was made.

5. The person recording the observation should initial and log the time of the observation, along with any other (tape, staff, etc.) observations.
6. The site name and number should be printed in large bold letters at both the beginning and ending of the recorder chart, along with the charts date.

Additional Comments:

Use a felt tip marker for your notation (regular pen and pencil are usually unreadable on microfilm). USE THIS SIZE LETTERING

Notations should be made at least once a week in order to insure proper documentation when copies made from microfilm rolls.

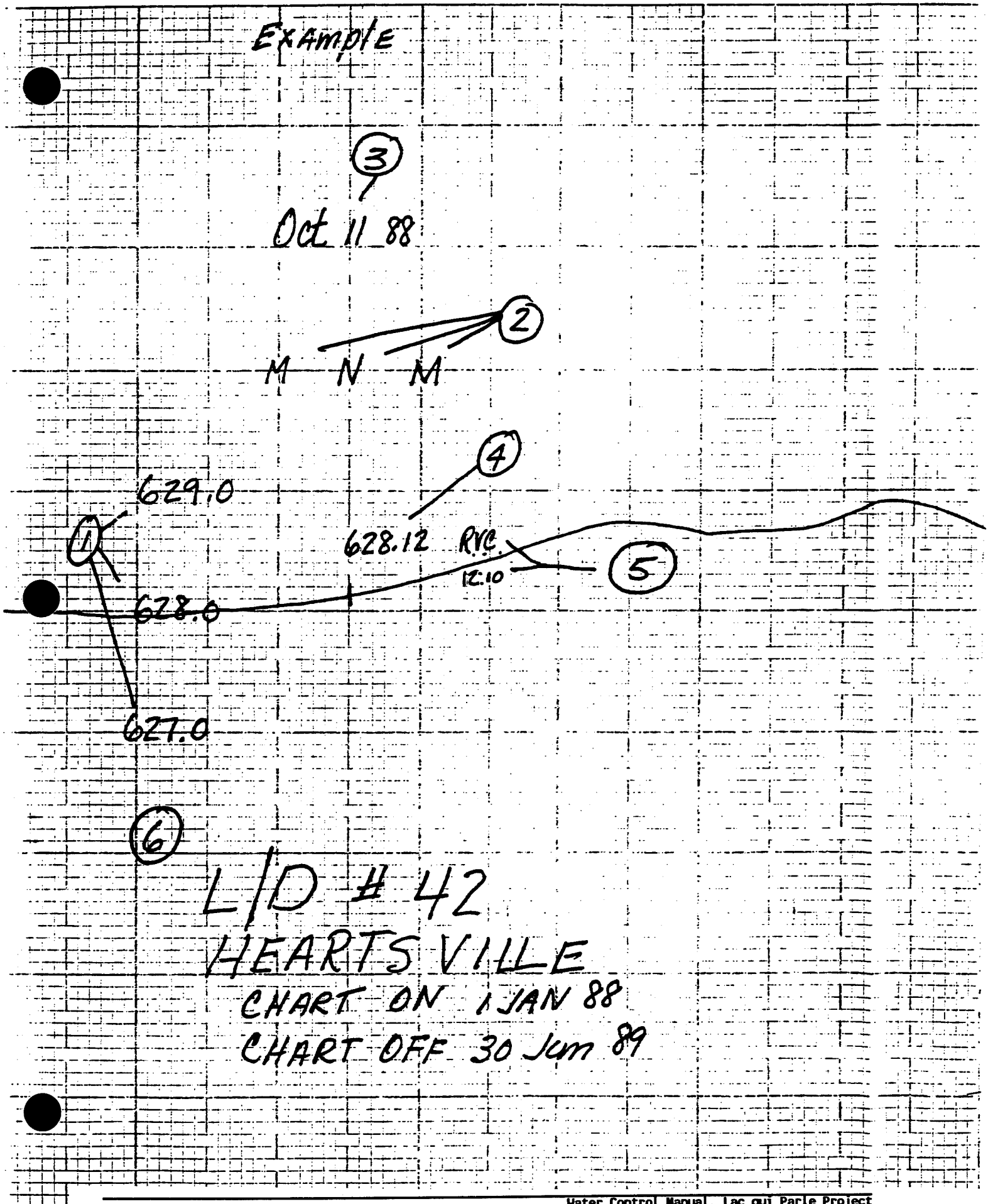
Example
3
Oct 11 88
2
M N M
4
629.0
1
628.12 R.V.C.
12.10
5
628.0
627.0
6
L/D # 42
HEARTSVILLE
CHART ON 1 JAN 88
CHART OFF 30 Jun 89

EXHIBIT D

PROJECT LETTERS, AGREEMENTS AND RESOLUTIONS

PARTNERING AGREEMENT

FOR MANAGEMENT OF THE UPPER MINNESOTA RIVER MAINSTEM FROM GRANITE FALLS TO BIGSTONE LAKE

We, as partners, agree to cooperatively participate in the development and implementation of integrated natural resource management strategies for the Upper Minnesota River mainstem from Granite Falls to Bigstone Lake.

GOALS

I. Cooperatively identify conditions, needs, constraints, and opportunities in resource management on the Upper Minnesota River.

II. Encourage public participation in program development and implementation.

III. Develop strategies for the integrated management of Upper Minnesota River resources.

IV. Implement developed strategies within agency authorities and budgets.

We acknowledge the dynamic nature of the Upper Minnesota River and agree to meet again within three years to review our common goals and modify them, if necessary, to better serve the resource.

James C. Gritman, Regional Director, Region 3
U.S. Fish and Wildlife Service

Col. Roger L. Baldwin, District Engineer
St. Paul District Corps of Engineers

Rod W. Sando, Commissioner
Minnesota Department of Natural Resources

Charles W. Williams, Commissioner
Minnesota Pollution Control Agency

May 2, 1991

UPPER MINNESOTA RIVER PARTNERSHIP GROUP CHARTER

Operating Procedures

OBJECTIVES

The objectives of the Upper Minnesota River Partnership Group (UMRPG) are to:

(1) provide a mechanism for participating State and Federal agencies to facilitate the coordination of their programs and activities;

and to

(2) provide an opportunity for other interested parties to express their concerns and receive guidance on agencys' programs.

PARTICIPANTS

Representatives of the following State and Federal agencies are participants in the partnership group. Other agencies will be invited to participate as interest and opportunities grow.

State
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency

Federal
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

AUTHORITY

The authority for each agency's participation in the activities of the Partnership lies within that individual agency's programs, authorities, and management or regulatory responsibilities. Participation in the Partnership does not affect an individual agency's responsibility to issue permits, to manage programs, or to operate projects.

SCOPE

The scope of the UMRPG includes the mainstem of the Upper Minnesota River from Granite Falls to Big Stone Lake, specifically, all fee lands managed by the participating agencies and lands upon which the agencies have direct management authorities.

Recognizing the importance of contributing watersheds to the mainstem area, Partners will address watershed problems to the extent possible by their individual agency authorities and budgets.

FUNDING

Each agency or interest would be responsible for the funding of its representatives. The UMRPG could recommend priority funding of identified research and/or implementation effort through an appropriate lead governmental unit.

OPERATION

The UMRPG will generally meet as per consensus of the group; however, there will be no fewer than three meetings annually. Meeting places and times will be determined by the UMRPG. Meetings will be open to the public when appropriate, as determined by the UMRPG.

Discussion topics and management strategy proposals are welcomed from all participants of the UMRPG. Formal recommendations from the UMRPG will be reached through mutual agreement of the participants.

FUNCTIONS

The functions of the UMRPG include, but are not limited to, the following:

- establish common goals and objectives for resource management between participating agencies.

- providing the opportunity for agencies to discuss and assist each other in resource information collection and exchange.

- recommending strategies for improving resource management.

- providing a referral service to the public by assisting them in understanding each agency's authorities and identifying programs that meet their needs.

- providing each agency with up-to-date information on current activities in the Upper Minnesota River area.

- providing resource information to other agencies or groups.

EXHIBIT E

STAGE-DISCHARGE TABLES

EXHIBIT E

STAGE-DISCHARGE TABLES

E-1. MINNESOTA RIVER AT MONTEVIDEO, MINNESOTA, U.S.G.S GAGE NO. 05311000, RATING NO. 45.0

E-2. MINNESOTA RIVER NEAR LAC QUI PARLE, MINNESOTA, U.S.G.S GAGE NO. 05301000, RATING NO. 24.0

E-3. POMME DE TERRE RIVER AT APPLETON, MINNESOTA, U.S.G.S GAGE NO. 05294000, RATING NO. 33.0

E-4. LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MINNESOTA, U.S.G.S GAGE NO. 05300000, RATING NO. 39.0

E-5. CHIPPEWA RIVER NEAR MILAN, MINNESOTA, U.S.G.S GAGE NO. 05304500, RATING NO. 27.0

E-6. MINNESOTA RIVER AT ORTONVILLE, MINNESOTA, U.S.G.S GAGE NO. 05292000, RATING NO. 25.0

E-7. YELLOW BANK RIVER NEAR ODESSA, MINNESOTA, U.S.G.S GAGE NO. 05293000, RATING NO. 26.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 1
EXPANDED RATING TABLE TYPE: LOG
05311000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH
MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0
NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS
COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
.00				.000*	.013	.026	.039	.051	.064	.077	.129
.10	.090*	.107	.125	.144	.164	.186	.208	.232	.257	.283	.220
.20	.310*	.345	.382	.420	.461	.504	.549	.596	.645	.697	.440
.30	.750*	.829	.913	1.002	1.098	1.199	1.306	1.420	1.540	1.667	1.050
.40	1.800*	1.918	2.041	2.169	2.301	2.439	2.581	2.728	2.880	3.038	1.400
.50	3.200*	3.373	3.552	3.737	3.928	4.124	4.327	4.536	4.750	4.972	1.999
.60	5.199	5.433	5.673	5.920	6.174	6.434	6.701	6.974	7.255	7.542	2.638
.70	7.837	8.138	8.447	8.763	9.086	9.417	9.755	10.10*	10.52	10.95	3.553
.80	11.39	11.85	12.31	12.79	13.28	13.79	14.30	14.84	15.38	15.94	5.120
.90	16.51	17.09	17.69	18.30	18.93	19.57	20.23	20.90	21.58	22.28	6.490
1.00	23.00*	23.58	24.16	24.75	25.35	25.96	26.58	27.21	27.85	28.49	6.150
1.10	29.15	29.81	30.48	31.16	31.85	32.55	33.26	33.98	34.70	35.44	7.030
1.20	36.18	36.94	37.70	38.47	39.25	40.05	40.85	41.66	42.48	43.31	7.970
1.30	44.15	44.99	45.85	46.72	47.60	48.49	49.38	50.29	51.21	52.14	8.920
1.40	53.07	54.02	54.98	55.94	56.92	57.91	58.91	59.92	60.93	61.96	9.930
1.50	63.00*	63.92	64.85	65.78	66.72	67.67	68.63	69.59	70.56	71.54	9.520
1.60	72.52	73.52	74.52	75.52	76.54	77.56	78.59	79.62	80.67	81.72	10.26
1.70	82.78	83.84	84.92	86.00	87.09	88.18	89.28	90.39	91.51	92.64	10.99
1.80	93.77	94.91	96.06	97.21	98.38	99.55	100.7	101.9	103.1	104.3	11.73
1.90	105.5	106.7	107.9	109.2	110.4	111.7	112.9	114.2	115.4	116.7	12.50
2.00	118.0*	119.3	120.6	121.9	123.2	124.6	125.9	127.2	128.6	130.0	13.30
2.10	131.3	132.7	134.1	135.5	136.9	138.3	139.7	141.1	142.5	144.0	14.10
2.20	145.4	146.9	148.3	149.8	151.3	152.8	154.3	155.8	157.3	158.8	14.90
2.30	160.3	161.8	163.4	164.9	166.5	168.0	169.6	171.2	172.8	174.4	15.70
2.40	176.0	177.6	179.2	180.8	182.5	184.1	185.8	187.4	189.1	190.8	16.40
2.50	192.4	194.1	195.8	197.5	199.3	201.0	202.7	204.5	206.2	208.0	17.30
2.60	209.7	211.5	213.3	215.1	216.9	218.7	220.5	222.3	224.1	226.0	18.10
2.70	227.8	229.7	231.5	233.4	235.3	237.2	239.1	241.0	242.9	244.8	18.90
2.80	246.7	248.7	250.6	252.5	254.5	256.5	258.5	260.4	262.4	264.4	19.70
2.90	266.4	268.5	270.5	272.5	274.6	276.6	278.7	280.7	282.8	284.9	20.60
3.00	287.0*	289.0	291.0	293.0	295.0	297.0	299.0	301.0	303.0	305.1	20.10
3.10	307.1	309.2	311.2	313.3	315.4	317.4	319.5	321.6	323.7	325.8	20.80
3.20	327.9	330.1	332.2	334.3	336.5	338.6	340.8	342.9	345.1	347.3	21.60
3.30	349.5	351.7	353.9	356.1	358.3	360.5	362.7	364.9	367.2	369.4	22.20
3.40	371.7	374.0	376.2	378.5	380.8	383.1	385.4	387.7	390.0	392.3	22.90
3.50	394.6	397.0	399.3	401.7	404.0	406.4	408.7	411.1	413.5	415.9	23.70
3.60	418.3	420.7	423.1	425.5	427.9	430.4	432.8	435.3	437.7	440.2	24.30
3.70	442.6	445.1	447.6	450.1	452.6	455.1	457.6	460.1	462.6	465.2	25.10

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EXPANDED RATING TABLE TYPE: LOG

05311000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0

NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
3.80	467.7	470.3	472.8	475.4	477.9	480.5	483.1	485.7	488.3	490.9	25.80
3.90	493.5	496.1	498.7	501.4	504.0	506.7	509.3	512.0	514.6	517.3	26.50
4.00	520.0*	522.3	524.7	527.0	529.4	531.7	534.1	536.4	538.8	541.2	23.50
4.10	543.5	545.9	548.3	550.7	553.1	555.5	557.9	560.3	562.7	565.1	24.00
4.20	567.5	569.9	572.4	574.8	577.2	579.7	582.1	584.6	587.0	589.5	24.40
4.30	591.9	594.4	596.9	599.4	601.8	604.3	606.8	609.3	611.8	614.3	24.90
4.40	616.8	619.4	621.9	624.4	626.9	629.5	632.0	634.5	637.1	639.6	25.40
4.50	642.2	644.7	647.3	649.9	652.5	655.0	657.6	660.2	662.8	665.4	25.80
4.60	668.0	670.6	673.2	675.8	678.4	681.0	683.7	686.3	688.9	691.6	26.20
4.70	694.2	696.9	699.5	702.2	704.8	707.5	710.2	712.9	715.5	718.2	26.70
4.80	720.9	723.6	726.3	729.0	731.7	734.4	737.1	739.9	742.6	745.3	27.10
4.90	748.0	750.8	753.5	756.3	759.0	761.8	764.5	767.3	770.1	772.8	27.60
5.00	775.6	778.4	781.2	784.0	786.8	789.6	792.4	795.2	798.0	800.8	28.00
5.10	803.6	806.5	809.3	812.1	815.0	817.8	820.7	823.5	826.4	829.2	28.50
5.20	832.1	835.0	837.8	840.7	843.6	846.5	849.4	852.3	855.2	858.1	28.90
5.30	861.0	863.9	866.8	869.7	872.7	875.6	878.5	881.5	884.4	887.4	29.30
5.40	890.3	893.3	896.2	899.2	902.2	905.1	908.1	911.1	914.1	917.1	29.80
5.50	920.1	923.1	926.1	929.1	932.1	935.1	938.1	941.2	944.2	947.2	30.20
5.60	950.3	953.3	956.4	959.4	962.5	965.5	968.6	971.7	974.7	977.8	30.60
5.70	980.9	984.0	987.1	990.2	993.3	996.4	999.5	1003	1006	1009	31.10
5.80	1012	1015	1018	1021	1024	1028	1031	1034	1037	1040	31.00
5.90	1043	1047	1050	1053	1056	1059	1062	1066	1069	1072	32.00
6.00	1075	1079	1082	1085	1088	1091	1095	1098	1101	1104	33.00
6.10	1108	1111	1114	1117	1121	1124	1127	1131	1134	1137	32.00
6.20	1140	1144	1147	1150	1154	1157	1160	1164	1167	1170	34.00
6.30	1174	1177	1180	1184	1187	1190	1194	1197	1200	1204	33.00
6.40	1207	1211	1214	1217	1221	1224	1227	1231	1234	1238	34.00
6.50	1241	1245	1248	1251	1255	1258	1262	1265	1269	1272	35.00
6.60	1276	1279	1283	1286	1289	1293	1296	1300	1303	1307	34.00
6.70	1310	1314	1317	1321	1324	1328	1332	1335	1339	1342	36.00
6.80	1346	1349	1353	1356	1360	1363	1367	1371	1374	1378	35.00
6.90	1381	1385	1389	1392	1396	1399	1403	1407	1410	1414	36.00
7.00	1417	1421	1425	1428	1432	1436	1439	1443	1447	1450	37.00
7.10	1454	1458	1461	1465	1469	1472	1476	1480	1483	1487	37.00
7.20	1491	1495	1498	1502	1506	1509	1513	1517	1521	1524	37.00
7.30	1528	1532	1536	1539	1543	1547	1551	1554	1558	1562	38.00
7.40	1566	1570	1573	1577	1581	1585	1589	1592	1596	1600	38.00

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EXPANDED RATING TABLE TYPE: LOG

05311000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0

NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
7.50	1604	1608	1612	1615	1619	1623	1627	1631	1635	1639	38.00
7.60	1642	1646	1650	1654	1658	1662	1666	1670	1674	1677	39.00
7.70	1681	1685	1689	1693	1697	1701	1705	1709	1713	1717	40.00
7.80	1721	1725	1729	1733	1737	1741	1744	1748	1752	1756	39.00
7.90	1760	1764	1768	1772	1776	1780	1784	1788	1792	1797	41.00
8.00	1801	1805	1809	1813	1817	1821	1825	1829	1833	1837	40.00
8.10	1841	1845	1849	1853	1857	1861	1866	1870	1874	1878	41.00
8.20	1882	1886	1890	1894	1898	1903	1907	1911	1915	1919	41.00
8.30	1923	1927	1932	1936	1940	1944	1948	1952	1957	1961	42.00
8.40	1965	1969	1973	1978	1982	1986	1990	1994	1999	2003	42.00
8.50	2007	2011	2016	2020	2024	2028	2033	2037	2041	2045	43.00
8.60	2050	2054	2058	2063	2067	2071	2075	2080	2084	2088	43.00
8.70	2093	2097	2101	2106	2110	2114	2119	2123	2127	2132	43.00
8.80	2136	2140	2145	2149	2153	2158	2162	2166	2171	2175	44.00
8.90	2180	2184	2188	2193	2197	2202	2206	2210	2215	2219	44.00
9.00	2224	2228	2233	2237	2241	2246	2250	2255	2259	2264	44.00
9.10	2268	2273	2277	2282	2286	2290	2295	2299	2304	2308	45.00
9.20	2313	2317	2322	2326	2331	2336	2340	2345	2349	2354	45.00
9.30	2358	2363	2367	2372	2376	2381	2386	2390	2395	2399	46.00
9.40	2404	2408	2413	2418	2422	2427	2431	2436	2441	2445	46.00
9.50	2450	2454	2459	2464	2468	2473	2478	2482	2487	2492	46.00
9.60	2496	2501	2506	2510	2515	2520	2524	2529	2534	2538	47.00
9.70	2543	2548	2552	2557	2562	2567	2571	2576	2581	2585	47.00
9.80	2590	2595	2600	2604	2609	2614	2619	2623	2628	2633	48.00
9.90	2638	2643	2647	2652	2657	2662	2666	2671	2676	2681	48.00
10.00	2686	2691	2695	2700	2705	2710	2715	2719	2724	2729	48.00
10.10	2734	2739	2744	2749	2753	2758	2763	2768	2773	2778	49.00
10.20	2783	2788	2792	2797	2802	2807	2812	2817	2822	2827	49.00
10.30	2832	2837	2842	2847	2852	2856	2861	2866	2871	2876	49.00
10.40	2881	2886	2891	2896	2901	2906	2911	2916	2921	2926	50.00
10.50	2931	2936	2941	2946	2951	2956	2961	2966	2971	2976	50.00
10.60	2981	2986	2991	2996	3001	3007	3012	3017	3022	3027	51.00
10.70	3032	3037	3042	3047	3052	3057	3062	3067	3073	3078	51.00
10.80	3083	3088	3093	3098	3103	3108	3114	3119	3124	3129	51.00
10.90	3134	3139	3144	3150	3155	3160	3165	3170	3175	3181	52.00
11.00	3186	3191	3196	3201	3207	3212	3217	3222	3227	3233	52.00
11.10	3238	3243	3248	3254	3259	3264	3269	3275	3280	3285	52.00
11.20	3290	3296	3301	3306	3311	3317	3322	3327	3333	3338	53.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 4

EXPANDED RATING TABLE TYPE: LOG

05311000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0

NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
11.30	3343	3349	3354	3359	3364	3370	3375	3380	3386	3391	53.00
11.40	3396	3402	3407	3412	3418	3423	3429	3434	3439	3445	54.00
11.50	3450*	3457	3464	3471	3478	3485	3493	3500	3507	3514	71.00
11.60	3521	3528	3536	3543	3550	3557	3564	3572	3579	3586	72.00
11.70	3593	3600	3608	3615	3622	3630	3637	3644	3651	3659	73.00
11.80	3666	3673	3681	3688	3695	3703	3710	3718	3725	3732	74.00
11.90	3740	3747	3755	3762	3770	3777	3784	3792	3799	3807	74.00
12.00	3814	3822	3829	3837	3844	3852	3860	3867	3875	3882	76.00
12.10	3890	3897	3905	3913	3920	3928	3935	3943	3951	3958	76.00
12.20	3966	3974	3981	3989	3997	4005	4012	4020	4028	4035	77.00
12.30	4043	4051	4059	4066	4074	4082	4090	4098	4105	4113	78.00
12.40	4121	4129	4137	4145	4153	4160	4168	4176	4184	4192	79.00
12.50	4200*	4209	4218	4226	4235	4244	4253	4262	4271	4280	89.00
12.60	4289	4298	4307	4316	4325	4334	4343	4352	4361	4370	90.00
12.70	4379	4388	4397	4406	4415	4424	4433	4442	4451	4461	91.00
12.80	4470	4479	4488	4497	4506	4516	4525	4534	4543	4553	92.00
12.90	4562	4571	4581	4590	4599	4608	4618	4627	4637	4646	93.00
13.00	4655	4665	4674	4684	4693	4702	4712	4721	4731	4740	95.00
13.10	4750	4759	4769	4778	4788	4798	4807	4817	4826	4836	96.00
13.20	4846	4855	4865	4875	4884	4894	4904	4913	4923	4933	97.00
13.30	4943	4952	4962	4972	4982	4991	5001	5011	5021	5031	98.00
13.40	5041	5051	5060	5070	5080	5090	5100	5110	5120	5130	99.00
13.50	5140*	5155	5171	5186	5202	5218	5233	5249	5265	5280	156.0
13.60	5296	5312	5328	5344	5360	5376	5392	5408	5424	5440	160.0
13.70	5456	5472	5488	5504	5521	5537	5553	5570	5586	5603	163.0
13.80	5619	5636	5652	5669	5685	5702	5719	5736	5752	5769	167.0
13.90	5786	5803	5820	5837	5854	5871	5888	5905	5922	5939	171.0
14.00	5957	5974	5991	6009	6026	6043	6061	6078	6096	6114	174.0
14.10	6131	6149	6166	6184	6202	6220	6238	6256	6273	6291	178.0
14.20	6309	6327	6345	6364	6382	6400	6418	6436	6455	6473	183.0
14.30	6492	6510	6528	6547	6565	6584	6603	6621	6640	6659	186.0
14.40	6678	6696	6715	6734	6753	6772	6791	6810	6829	6848	190.0
14.50	6868	6887	6906	6925	6945	6964	6984	7003	7023	7042	194.0
14.60	7062	7081	7101	7121	7140	7160	7180	7200	7220	7240	198.0
14.70	7260	7280	7300	7320	7340	7361	7381	7401	7421	7442	202.0
14.80	7462	7483	7503	7524	7544	7565	7586	7606	7627	7648	207.0
14.90	7669	7690	7711	7732	7753	7774	7795	7816	7837	7858	211.0

EXPANDED RATING TABLE TYPE: LOG

05311000
DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0

NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
15.00	7880	7901	7922	7944	7965	7987	8008	8030	8051	8073	215.0
15.10	8095	8117	8138	8160	8182	8204	8226	8248	8270	8292	219.0
15.20	8314	8337	8359	8381	8403	8426	8448	8471	8493	8516	224.0
15.30	8538	8561	8584	8607	8629	8652	8675	8698	8721	8744	229.0
15.40	8767	8790	8813	8836	8860	8883	8906	8930	8953	8977	233.0
15.50	9000	9024	9047	9071	9095	9118	9142	9166	9190	9214	238.0
15.60	9238	9262	9286	9310	9334	9359	9383	9407	9432	9456	242.0
15.70	9480	9505	9529	9554	9579	9603	9628	9653	9678	9703	248.0
15.80	9728	9753	9778	9803	9828	9853	9878	9904	9929	9954	252.0
15.90	9980	10010	10030	10060	10080	10110	10130	10160	10180	10210	260.0
16.00	10240	10260	10290	10310	10340	10370	10390	10420	10450	10470	260.0
16.10	10500	10530	10550	10580	10600	10630	10660	10680	10710	10740	270.0
16.20	10770	10790	10820	10850	10870	10900	10930	10960	10980	11010	270.0
16.30	11040	11070	11090	11120	11150	11180	11200	11230	11260	11290	270.0
16.40	11310	11340	11370	11400	11430	11460	11480	11510	11540	11570	290.0
16.50	11600	11630	11650	11680	11710	11740	11770	11800	11830	11860	280.0
16.60	11880	11910	11940	11970	12000	12030	12060	12090	12120	12150	300.0
16.70	12180	12210	12240	12270	12300	12330	12360	12390	12420	12450	300.0
16.80	12480	12510	12540	12570	12600	12630	12660	12690	12720	12750	300.0
16.90	12780	12810	12840	12870	12900	12930	12970	13000	13030	13060	310.0
17.00	13090	13120	13150	13180	13210	13250	13280	13310	13340	13370	310.0
17.10	13400	13440	13470	13500	13530	13560	13600	13630	13660	13690	330.0
17.20	13730	13760	13790	13820	13860	13890	13920	13950	13990	14020	320.0
17.30	14050	14080	14120	14150	14180	14220	14250	14280	14320	14350	330.0
17.40	14380	14420	14450	14480	14520	14550	14590	14620	14650	14690	340.0
17.50	14720	14760	14790	14820	14860	14890	14930	14960	15000	15030	350.0
17.60	15070	15100	15140	15170	15210	15240	15280	15310	15350	15380	350.0
17.70	15420	15450	15490	15520	15560	15590	15630	15670	15700	15740	350.0
17.80	15770	15810	15840	15880	15920	15950	15990	16030	16060	16100	370.0
17.90	16140	16170	16210	16240	16280	16320	16360	16390	16430	16470	360.0
18.00	16500	16540	16580	16620	16650	16690	16730	16770	16800	16840	380.0
18.10	16880	16920	16950	16990	17030	17070	17110	17140	17180	17220	380.0
18.20	17260	17300	17340	17380	17410	17450	17490	17530	17570	17610	390.0
18.30	17650	17690	17730	17770	17800	17840	17880	17920	17960	18000	390.0
18.40	18040	18080	18120	18160	18200	18240	18280	18320	18360	18400	400.0
18.50	18440	18480	18520	18560	18610	18650	18690	18730	18770	18810	410.0
18.60	18850	18890	18930	18970	19020	19060	19100	19140	19180	19220	410.0
18.70	19260	19310	19350	19390	19430	19470	19520	19560	19600	19640	430.0

EXPANDED RATING TABLE TYPE: LOG

05311000
DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER AT MONTEVIDEO, MINN DD: 4 TYPE: 001 RATING NO: 45.0

NO OFFSETS USED START DATE/TIME: 10-01-85 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
18.80	19690	19730	19770	19810	19860	19900	19940	19980	20030	20070	420.0
18.90	20110	20160	20200	20240	20290	20330	20370	20420	20460	20510	440.0
19.00	20550	20590	20640	20680	20730	20770	20810	20860	20900	20950	440.0
19.10	20990	21040	21080	21130	21170	21210	21260	21300	21350	21400	450.0
19.20	21440	21490	21530	21580	21620	21670	21710	21760	21810	21850	460.0
19.30	21900	21940	21990	22040	22080	22130	22170	22220	22270	22310	460.0
19.40	22360	22410	22450	22500	22550	22600	22640	22690	22740	22780	470.0
19.50	22830	22880	22930	22970	23020	23070	23120	23170	23210	23260	480.0
19.60	23310	23360	23410	23460	23500	23550	23600	23650	23700	23750	490.0
19.70	23800	23850	23890	23940	23990	24040	24090	24140	24190	24240	490.0
19.80	24290	24340	24390	24440	24490	24540	24590	24640	24690	24740	500.0
19.90	24790	24840	24890	24940	24990	25040	25100	25150	25200	25250	510.0
20.00	25300	25350	25400	25450	25510	25560	25610	25660	25710	25770	520.0
20.10	25820	25870	25920	25970	26030	26080	26130	26180	26240	26290	520.0
20.20	26340	26390	26450	26500	26550	26610	26660	26710	26770	26820	530.0
20.30	26870	26930	26980	27040	27090	27140	27200	27250	27310	27360	550.0
20.40	27420	27470	27520	27580	27630	27690	27740	27800	27850	27910	540.0
20.50	27960	28020	28080	28130	28190	28240	28300	28350	28410	28470	560.0
20.60	28520	28580	28630	28690	28750	28800	28860	28920	28970	29030	570.0
20.70	29090	29140	29200	29260	29320	29370	29430	29490	29550	29600	570.0
20.80	29660	29720	29780	29840	29890	29950	30010	30070	30130	30190	580.0
20.90	30240	30300	30360	30420	30480	30540	30600	30660	30720	30780	600.0
21.00	30840	30890	30950	31010	31070	31130	31190	31250	31310	31370	590.0
21.10	31430	31500	31560	31620	31680	31740	31800	31860	31920	31980	610.0
21.20	32040	32100	32170	32230	32290	32350	32410	32470	32540	32600	620.0
21.30	32660	32720	32790	32850	32910	32970	33040	33100	33160	33220	630.0
21.40	33290	33350	33410	33480	33540	33600	33670	33730	33790	33860	630.0
21.50	33920	33990	34050	34110	34180	34240	34310	34370	34440	34500	650.0
21.60	34570	34630	34700	34760	34830	34890	34960	35020	35090	35150	650.0*
21.70	35220*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 1

EXPANDED RATING TABLE TYPE: LOG

05301000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER NEAR LAC QUI PARLE, MN DD: 4 TYPE: 001 RATING NO: 24.0

OFFSET: 19.90 START DATE/TIME: 10-01-90 (0001)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS

COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
20.20	9.500*	10.02	10.56	11.10	11.66	12.22	12.80	13.38	13.98	14.58	5.700
20.30	15.20*	15.94	16.70	17.48	18.28	19.09	19.92	20.76	21.62	22.50	8.200
20.40	23.40*	24.45	25.53	26.63	27.76	28.91	30.09	31.30	32.53	33.79	11.67
20.50	35.07	36.38	37.72	39.08	40.47	41.89	43.33	44.80	46.30	47.82	14.31
20.60	49.38	50.96	52.56	54.20	55.86	57.55	59.26	61.01	62.78	64.58	17.03
20.70	66.41	68.27	70.15	72.06	74.00	75.97	77.97	80.00	82.05	84.14	19.84
20.80	86.25	88.39	90.56	92.76	94.99	97.25	99.53	101.8	104.2	106.6	22.75
20.90	109.0	111.4	113.9	116.4	118.9	121.4	124.0	126.6	129.3	131.9	25.60
21.00	134.6	137.4	140.1	142.9	145.7	148.6	151.5	154.4	157.3	160.3	28.70
21.10	163.3	166.4	169.4	172.5	175.7	178.8	182.0	185.2	188.5	191.8	31.80
21.20	195.1	198.4	201.8	205.2	208.6	212.1	215.6	219.2	222.7	226.3	34.80
21.30	229.9	233.6	237.3	241.0	244.8	248.6	252.4	256.2	260.1	264.0	38.10
21.40	268.0*	271.1	274.3	277.4	280.6	283.8	287.0	290.2	293.5	296.7	32.00
21.50	300.0*	303.0	305.9	308.9	311.9	314.9	317.9	320.9	323.9	327.0	30.00
21.60	330.0*	332.2	334.5	336.7	338.9	341.2	343.4	345.7	347.9	350.2	22.40
21.70	352.4	354.7	356.9	359.2	361.4	363.7	365.9	368.2	370.5	372.7	22.60
21.80	375.0	377.3	379.5	381.8	384.1	386.4	388.7	390.9	393.2	395.5	22.80
21.90	397.8	400.1	402.4	404.6	406.9	409.2	411.5	413.8	416.1	418.4	22.90
22.00	420.7	423.0	425.3	427.6	430.0	432.3	434.6	436.9	439.2	441.5	23.10
22.10	443.8	446.2	448.5	450.8	453.1	455.5	457.8	460.1	462.4	464.8	23.30
22.20	467.1	469.4	471.8	474.1	476.5	478.8	481.1	483.5	485.8	488.2	23.40
22.30	490.5	492.9	495.2	497.6	499.9	502.3	504.7	507.0	509.4	511.7	23.60
22.40	514.1	516.5	518.8	521.2	523.6	525.9	528.3	530.7	533.1	535.4	23.70
22.50	537.8	540.2	542.6	544.9	547.3	549.7	552.1	554.5	556.9	559.3	23.90
22.60	561.7	564.0	566.4	568.8	571.2	573.6	576.0	578.4	580.8	583.2	23.90
22.70	585.6	588.0	590.4	592.8	595.3	597.7	600.1	602.5	604.9	607.3	24.10
22.80	609.7	612.2	614.6	617.0	619.4	621.8	624.3	626.7	629.1	631.5	24.30
22.90	634.0	636.4	638.8	641.3	643.7	646.1	648.6	651.0	653.4	655.9	24.30
23.00	658.3	660.8	663.2	665.6	668.1	670.5	673.0	675.4	677.9	680.3	24.50
23.10	682.8	685.2	687.7	690.1	692.6	695.1	697.5	700.0	702.4	704.9	24.60
23.20	707.4	709.8	712.3	714.8	717.2	719.7	722.2	724.6	727.1	729.6	24.70
23.30	732.1	734.5	737.0	739.5	742.0	744.5	746.9	749.4	751.9	754.4	24.80
23.40	756.9	759.4	761.8	764.3	766.8	769.3	771.8	774.3	776.8	779.3	24.90
23.50	781.8	784.3	786.8	789.3	791.8	794.3	796.8	799.3	801.8	804.3	25.00
23.60	806.8	809.3	811.8	814.3	816.8	819.3	821.9	824.4	826.9	829.4	25.10
23.70	831.9	834.4	836.9	839.5	842.0	844.5	847.0	849.6	852.1	854.6	25.20
23.80	857.1	859.7	862.2	864.7	867.2	869.8	872.3	874.8	877.4	879.9	25.30
23.90	882.4	885.0	887.5	890.0	892.6	895.1	897.7	900.2	902.8	905.3	25.40

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
24.00	907.8	910.4	912.9	915.5	918.0	920.6	923.1	925.7	928.2	930.8	25.50
24.10	933.3	935.9	938.5	941.0	943.6	946.1	948.7	951.2	953.8	956.4	25.60
24.20	958.9	961.5	964.1	966.6	969.2	971.8	974.3	976.9	979.5	982.0	25.70
24.30	984.6	987.2	989.8	992.3	994.9	997.5	1000	1003	1005	1008	25.40
24.40	1010	1013	1016	1018	1021	1023	1026	1028	1031	1034	26.00
24.50	1036	1039	1041	1044	1047	1049	1052	1054	1057	1060	26.00
24.60	1062	1065	1067	1070	1073	1075	1078	1080	1083	1086	26.00
24.70	1088	1091	1093	1096	1099	1101	1104	1106	1109	1112	26.00
24.80	1114	1117	1120	1122	1125	1127	1130	1133	1135	1138	26.00
24.90	1140	1143	1146	1148	1151	1154	1156	1159	1161	1164	27.00
25.00	1167	1169	1172	1175	1177	1180	1183	1185	1188	1190	26.00
25.10	1193	1196	1198	1201	1204	1206	1209	1212	1214	1217	26.00
25.20	1219	1222	1225	1227	1230	1233	1235	1238	1241	1243	27.00
25.30	1246	1249	1251	1254	1257	1259	1262	1265	1267	1270	27.00
25.40	1273	1275	1278	1280	1283	1286	1288	1291	1294	1296	26.00
25.50	1299	1302	1304	1307	1310	1312	1315	1318	1321	1323	27.00
25.60	1326	1329	1331	1334	1337	1339	1342	1345	1347	1350	27.00
25.70	1353	1355	1358	1361	1363	1366	1369	1371	1374	1377	26.00
25.80	1379	1382	1385	1388	1390	1393	1396	1398	1401	1404	27.00
25.90	1406	1409	1412	1414	1417	1420	1423	1425	1428	1431	27.00
26.00	1433	1436	1439	1441	1444	1447	1450	1452	1455	1458	27.00
26.10	1460	1463	1466	1469	1471	1474	1477	1479	1482	1485	28.00
26.20	1488	1490	1493	1496	1498	1501	1504	1507	1509	1512	27.00
26.30	1515	1517	1520	1523	1526	1528	1531	1534	1536	1539	27.00
26.40	1542	1545	1547	1550	1553	1556	1558	1561	1564	1566	27.00
26.50	1569	1572	1575	1577	1580	1583	1586	1588	1591	1594	28.00
26.60	1597	1599	1602	1605	1608	1610	1613	1616	1619	1621	27.00
26.70	1624	1627	1629	1632	1635	1638	1640	1643	1646	1649	27.00
26.80	1651	1654	1657	1660	1662	1665	1668	1671	1674	1676	28.00
26.90	1679	1682	1685	1687	1690	1693	1696	1698	1701	1704	28.00
27.00	1707	1709	1712	1715	1718	1720	1723	1726	1729	1732	27.00
27.10	1734	1737	1740	1743	1745	1748	1751	1754	1756	1759	28.00
27.20	1762	1765	1768	1770	1773	1776	1779	1781	1784	1787	28.00
27.30	1790	1793	1795	1798	1801	1804	1806	1809	1812	1815	28.00
27.40	1818	1820	1823	1826	1829	1832	1834	1837	1840	1843	27.00
27.50	1845	1848	1851	1854	1857	1859	1862	1865	1868	1871	28.00
27.60	1873	1876	1879	1882	1885	1887	1890	1893	1896	1899	28.00
27.70	1901	1904	1907	1910	1913	1915	1918	1921	1924	1927	28.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 3

EXPANDED RATING TABLE TYPE: LOG

05301000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER NEAR LAC QUI PARLE, MN DD: 4 TYPE: 001 RATING NO: 24.0

OFFSET: 19.90 START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
27.80	1929	1932	1935	1938	1941	1944	1946	1949	1952	1955	29.00
27.90	1958	1960	1963	1966	1969	1972	1974	1977	1980	1983	28.00
28.00	1986	1989	1991	1994	1997	2000	2003	2005	2008	2011	28.00
28.10	2014	2017	2020	2022	2025	2028	2031	2034	2037	2039	28.00
28.20	2042	2045	2048	2051	2054	2056	2059	2062	2065	2068	29.00
28.30	2071	2073	2076	2079	2082	2085	2088	2090	2093	2096	28.00
28.40	2099	2102	2105	2107	2110	2113	2116	2119	2122	2124	28.00
28.50	2127	2130	2133	2136	2139	2142	2144	2147	2150	2153	29.00
28.60	2156	2159	2161	2164	2167	2170	2173	2176	2179	2181	28.00
28.70	2184	2187	2190	2193	2196	2199	2201	2204	2207	2210	29.00
28.80	2213	2216	2219	2221	2224	2227	2230	2233	2236	2239	28.00
28.90	2241	2244	2247	2250	2253	2256	2259	2261	2264	2267	29.00
29.00	2270	2273	2276	2279	2282	2284	2287	2290	2293	2296	29.00
29.10	2299	2302	2305	2307	2310	2313	2316	2319	2322	2325	29.00
29.20	2328	2330	2333	2336	2339	2342	2345	2348	2351	2353	28.00
29.30	2356	2359	2362	2365	2368	2371	2374	2376	2379	2382	29.00
29.40	2385	2388	2391	2394	2397	2400	2402	2405	2408	2411	29.00
29.50	2414	2417	2420	2423	2426	2428	2431	2434	2437	2440	29.00
29.60	2443	2446	2449	2452	2455	2457	2460	2463	2466	2469	29.00
29.70	2472	2475	2478	2481	2484	2486	2489	2492	2495	2498	29.00
29.80	2501	2504	2507	2510	2513	2515	2518	2521	2524	2527	29.00
29.90	2530*	2535	2539	2544	2549	2554	2558	2563	2568	2572	47.00
30.00	2577	2582	2587	2591	2596	2601	2606	2610	2615	2620	48.00
30.10	2625	2630	2634	2639	2644	2649	2654	2658	2663	2668	48.00
30.20	2673	2678	2682	2687	2692	2697	2702	2707	2711	2716	48.00
30.30	2721	2726	2731	2736	2741	2746	2750	2755	2760	2765	49.00
30.40	2770	2775	2780	2785	2790	2795	2799	2804	2809	2814	49.00
30.50	2819	2824	2829	2834	2839	2844	2849	2854	2859	2864	50.00
30.60	2869	2874	2879	2884	2889	2894	2899	2904	2909	2914	50.00
30.70	2919	2924	2929	2934	2939	2944	2949	2954	2959	2964	50.00
30.80	2969	2974	2979	2984	2989	2995	3000	3005	3010	3015	51.00
30.90	3020*	3026	3032	3038	3044	3050	3056	3062	3068	3074	60.00
31.00	3080	3086	3092	3098	3104	3110	3116	3123	3129	3135	61.00
31.10	3141	3147	3153	3159	3165	3171	3178	3184	3190	3196	61.00
31.20	3202	3208	3215	3221	3227	3233	3239	3246	3252	3258	62.00
31.30	3264	3270	3277	3283	3289	3296	3302	3308	3314	3321	63.00
31.40	3327	3333	3340	3346	3352	3359	3365	3371	3378	3384	63.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 4

EXPANDED RATING TABLE TYPE: LOG

05301000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER NEAR LAC QUI PARLE, MN DD: 4 TYPE: 001 RATING NO: 24.0

OFFSET: 19.90 START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
31.50	3390	3397	3403	3409	3416	3422	3429	3435	3441	3448	64.00
31.60	3454	3461	3467	3474	3480	3486	3493	3499	3506	3512	65.00
31.70	3519	3525	3532	3538	3545	3551	3558	3564	3571	3578	65.00
31.80	3584	3591	3597	3604	3610	3617	3624	3630	3637	3643	66.00
31.90	3650*	3658	3666	3674	3682	3690	3698	3706	3714	3722	80.00
32.00	3730	3738	3746	3754	3762	3771	3779	3787	3795	3803	81.00
32.10	3811	3819	3828	3836	3844	3852	3860	3869	3877	3885	82.00
32.20	3893	3902	3910	3918	3927	3935	3943	3952	3960	3968	84.00
32.30	3977	3985	3994	4002	4010	4019	4027	4036	4044	4053	84.00
32.40	4061	4070	4078	4087	4095	4104	4112	4121	4130	4138	86.00
32.50	4147	4155	4164	4173	4181	4190	4199	4207	4216	4225	86.00
32.60	4233	4242	4251	4260	4268	4277	4286	4295	4304	4312	88.00
32.70	4321	4330	4339	4348	4357	4365	4374	4383	4392	4401	89.00
32.80	4410	4419	4428	4437	4446	4455	4464	4473	4482	4491	90.00
32.90	4500*	4511	4521	4532	4543	4553	4564	4575	4586	4596	107.0
33.00	4607	4618	4629	4640	4650	4661	4672	4683	4694	4705	109.0
33.10	4716	4727	4738	4749	4760	4771	4782	4793	4804	4815	111.0
33.20	4827	4838	4849	4860	4871	4883	4894	4905	4916	4928	112.0
33.30	4939	4950	4962	4973	4984	4996	5007	5019	5030	5041	114.0
33.40	5053	5064	5076	5088	5099	5111	5122	5134	5145	5157	116.0
33.50	5169	5180	5192	5204	5216	5227	5239	5251	5263	5275	117.0
33.60	5286	5298	5310	5322	5334	5346	5358	5370	5382	5394	120.0
33.70	5406	5418	5430	5442	5454	5466	5478	5490	5503	5515	121.0
33.80	5527	5539	5551	5564	5576	5588	5601	5613	5625	5638	123.0
33.90	5650*	5664	5679	5693	5708	5722	5736	5751	5765	5780	145.0
34.00	5795	5809	5824	5839	5853	5868	5883	5897	5912	5927	147.0
34.10	5942	5957	5972	5987	6002	6017	6032	6047	6062	6077	150.0
34.20	6092	6107	6122	6137	6153	6168	6183	6199	6214	6229	153.0
34.30	6245	6260	6275	6291	6306	6322	6337	6353	6369	6384	155.0
34.40	6400*	6415	6431	6446	6462	6477	6492	6508	6523	6539	155.0
34.50	6555	6570	6586	6602	6617	6633	6649	6664	6680	6696	157.0
34.60	6712	6728	6744	6760	6776	6792	6808	6824	6840	6856	160.0
34.70	6872	6888	6904	6920	6937	6953	6969	6985	7002	7018	163.0
34.80	7035	7051	7067	7084	7100	7117	7133	7150	7167	7183	165.0
34.90	7200*	7225	7250	7275	7300	7325	7351	7376	7401	7427	252.0
35.00	7452	7478	7504	7529	7555	7581	7607	7633	7659	7686	260.0
35.10	7712	7738	7765	7791	7818	7844	7871	7898	7925	7952	267.0
35.20	7979	8006	8033	8060	8087	8115	8142	8170	8197	8225	274.0

EXPANDED RATING TABLE TYPE: LOG

05301000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER NEAR LAC QUI PARLE, MN DD: 4 TYPE: 001 RATING NO: 24.0

OFFSET: 19.90 START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
35.30	8253	8280	8308	8336	8364	8393	8421	8449	8477	8506	281.0
35.40	8534	8563	8592	8620	8649	8678	8707	8736	8765	8794	290.0
35.50	8824	8853	8882	8912	8942	8971	9001	9031	9061	9091	297.0
35.60	9121	9151	9181	9212	9242	9273	9303	9334	9364	9395	305.0
35.70	9426	9457	9488	9519	9551	9582	9613	9645	9676	9708	314.0
35.80	9740	9771	9803	9835	9867	9900	9932	9964	9996	10030	320.0
35.90	10060	10090	10130	10160	10190	10230	10260	10290	10330	10360	330.0
36.00	10390	10430	10460	10490	10530	10560	10590	10630	10660	10700	340.0
36.10	10730	10770	10800	10830	10870	10900	10940	10970	11010	11040	350.0
36.20	11080	11110	11150	11180	11220	11260	11290	11330	11360	11400	360.0
36.30	11440	11470	11510	11540	11580	11620	11650	11690	11730	11760	360.0
36.40	11800	11840	11880	11910	11950	11990	12030	12060	12100	12140	380.0
36.50	12180	12220	12250	12290	12330	12370	12410	12450	12480	12520	380.0
36.60	12560	12600	12640	12680	12720	12760	12800	12840	12880	12920	400.0
36.70	12960	13000	13040	13080	13120	13160	13200	13240	13280	13320	400.0
36.80	13360	13400	13440	13490	13530	13570	13610	13650	13690	13740	420.0
36.90	13780	13820	13860	13900	13950	13990	14030	14070	14120	14160	420.0
37.00	14200	14250	14290	14330	14380	14420	14460	14510	14550	14600	440.0
37.10	14640	14680	14730	14770	14820	14860	14910	14950	15000	15040	450.0
37.20	15090	15130	15180	15220	15270	15310	15360	15410	15450	15500	450.0
37.30	15540	15590	15640	15680	15730	15780	15820	15870	15920	15960	470.0
37.40	16010	16060	16110	16160	16200	16250	16300	16350	16400	16440	480.0
37.50	16490	16540	16590	16640	16690	16740	16790	16840	16880	16930	490.0
37.60	16980	17030	17080	17130	17180	17230	17280	17340	17390	17440	510.0
37.70	17490	17540	17590	17640	17690	17740	17800	17850	17900	17950	510.0
37.80	18000	18060	18110	18160	18210	18270	18320	18370	18420	18480	530.0
37.90	18530	18580	18640	18690	18750	18800	18850	18910	18960	19020	540.0
38.00	19070	19130	19180	19240	19290	19350	19400	19460	19510	19570	550.0
38.10	19620	19680	19740	19790	19850	19900	19960	20020	20070	20130	570.0
38.20	20190	20250	20300	20360	20420	20480	20530	20590	20650	20710	580.0
38.30	20770	20830	20880	20940	21000	21060	21120	21180	21240	21300	590.0
38.40	21360	21420	21480	21540	21600	21660	21720	21780	21840	21900	600.0
38.50	21960	22030	22090	22150	22210	22270	22330	22400	22460	22520	620.0
38.60	22580	22650	22710	22770	22840	22900	22960	23030	23090	23150	640.0
38.70	23220	23280	23350	23410	23470	23540	23600	23670	23730	23800	640.0
38.80	23860	23930	24000	24060	24130	24190	24260	24330	24390	24460	670.0
38.90	24530	24590	24660	24730	24800	24860	24930	25000	25070	25140	670.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 6

EXPANDED RATING TABLE TYPE: LOG

05301000 DATE PROCESSED: 07-18-1994 @ 12:25 BY GAROACH

MINNESOTA RIVER NEAR LAC QUI PARLE, MN DD: 4 TYPE: 001 RATING NO: 24.0

OFFSET: 19.90 START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
39.00	25200	25270	25340	25410	25480	25550	25620	25690	25760	25830	700.0
39.10	25900	25970	26040	26110	26180	26250	26320	26390	26460	26530	700.0
39.20	26600	26670	26750	26820	26890	26960	27030	27110	27180	27250	720.0
39.30	27320	27400	27470	27540	27620	27690	27770	27840	27910	27990	740.0
39.40	28060	28140	28210	28290	28360	28440	28510	28590	28670	28740	760.0
39.50	28820	28890	28970	29050	29120	29200	29280	29360	29430	29510	770.0
39.60	29590	29670	29740	29820	29900	29980	30060	30140	30220	30300	780.0
39.70	30380	30450	30530	30610	30690	30770	30860	30940	31020	31100	800.0
39.80	31180	31260	31340	31420	31510	31590	31670	31750	31830	31920	820.0*
39.90	32000*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 1

EXPANDED RATING TABLE TYPE: LOG

05294000 DATE PROCESSED: 08-12-1994 @ 13:41 BY HAVE

POMME DE TERRE RIVER AT APPLETON, MN DD: 3 TYPE: 001 RATING NO: 33.0

OFFSET: 3.11 BREAK,OFFSET: (4.10,3.90) (8.00,3.00) START DATE/TIME: 10-01-90 (0015)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS

COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
3.10	.000*	.003	.011*	.026	.045	.069	.096	.127	.162	.199	.240
3.20	.240	.284	.330	.380	.432	.487	.544	.604	.666	.731	.558
3.30	.798	.868	.940	1.014	1.090	1.169	1.250	1.333	1.418	1.505	.796
3.40	1.594	1.685	1.779	1.874	1.971	2.070	2.172	2.275	2.380	2.487	1.002
3.50	2.596	2.706	2.819	2.933	3.050	3.168	3.287	3.409	3.532	3.657	1.188
3.60	3.784	3.913	4.043	4.175	4.309	4.444	4.581	4.720	4.860	5.002	1.362
3.70	5.146	5.291	5.438	5.587	5.737	5.888	6.042	6.197	6.353	6.511	1.525
3.80	6.671	6.832	6.994	7.158	7.324	7.491	7.660	7.830	8.002	8.175	1.679
3.90	8.350*	8.580	8.813	9.049	9.289	9.533	9.779	10.03	10.28	10.54	2.450
4.00	10.80*	11.03	11.26	11.50	11.73	11.97	12.21	12.46	12.70	12.95	2.400
4.10	13.20*	13.59	13.97	14.34	14.71	15.07	15.43	15.78	16.12	16.46	3.600
4.20	16.80*	17.23	17.66	18.09	18.51	18.93	19.35	19.77	20.18	20.59	4.200
4.30	21.00*	21.50	22.00	22.51	23.01	23.51	24.01	24.50	25.00	25.50	5.000
4.40	26.00*	26.68	27.37	28.06	28.75	29.45	30.15	30.86	31.57	32.28	7.000
4.50	33.00*	33.99	35.00	36.02	37.05	38.09	39.15	40.22	41.30	42.39	10.50
4.60	43.50*	44.81	46.14	47.48	48.85	50.24	51.65	53.08	54.53	56.00	13.99
4.70	57.49	59.00	60.53	62.08	63.66	65.25	66.86	68.50	70.15	71.83	16.03
4.80	73.52	75.24	76.98	78.73	80.51	82.31	84.13	85.97	87.83	89.71	18.10
4.90	91.62	93.54	95.48	97.45	99.44	101.4	103.5	105.5	107.6	109.7	20.18
5.00	111.8	113.9	116.1	118.3	120.5	122.7	124.9	127.2	129.4	131.7	22.30
5.10	134.1	136.4	138.8	141.2	143.6	146.0	148.5	150.9	153.4	155.9	24.40
5.20	158.5	161.0	163.6	166.2	168.8	171.5	174.1	176.8	179.5	182.2	26.50
5.30	185.0	187.8	190.5	193.4	196.2	199.1	201.9	204.8	207.7	210.7	28.70
5.40	213.7	216.6	219.6	222.7	225.7	228.8	231.9	235.0	238.1	241.3	30.80
5.50	244.5	247.7	250.9	254.2	257.4	260.7	264.0	267.4	270.7	274.1	33.00
5.60	277.5	280.9	284.3	287.8	291.3	294.8	298.3	301.9	305.4	309.0	35.20
5.70	312.7	316.3	320.0	323.6	327.3	331.1	334.8	338.6	342.4	346.2	37.30
5.80	350.0	353.9	357.8	361.7	365.6	369.5	373.5	377.5	381.5	385.5	39.60
5.90	389.6	393.7	397.8	401.9	406.1	410.2	414.4	418.6	422.9	427.1	41.80
6.00	431.4	435.7	440.0	444.4	448.7	453.1	457.5	462.0	466.4	470.9	44.00
6.10	475.4	479.9	484.5	489.0	493.6	498.3	502.9	507.5	512.2	516.9	46.30
6.20	521.7	526.4	531.2	536.0	540.8	545.6	550.5	555.4	560.3	565.2	48.40
6.30	570.1	575.1	580.1	585.1	590.2	595.2	600.3	605.4	610.6	615.7	50.80
6.40	620.9	626.1	631.3	636.5	641.8	647.1	652.4	657.7	663.1	668.5	53.00
6.50	673.9	679.3	684.7	690.2	695.7	701.2	706.8	712.3	717.9	723.5	55.20
6.60	729.1	734.8	740.5	746.2	751.9	757.6	763.4	769.2	775.0	780.8	57.60
6.70	786.7	792.5	798.4	804.4	810.3	816.3	822.3	828.3	834.3	840.4	59.80
6.80	846.5	852.6	858.7	864.9	871.0	877.2	883.5	889.7	896.0	902.3	62.10

EXPANDED RATING TABLE TYPE: LOG

05294000 DATE PROCESSED: 08-12-1994 @ 13:41 BY HAVE

POMME DE TERRE RIVER AT APPLETON, MN DD: 3 TYPE: 001 RATING NO: 33.0

OFFSET: 3.11 BREAK,OFFSET: (4.10,3.90) (8.00,3.00) START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
6.90	908.6	914.9	921.3	927.7	934.1	940.5	946.9	953.4	959.9	966.4	64.40
7.00	973.0	979.5	986.1	992.7	999.4	1006	1013	1019	1026	1033	67.00
7.10	1040	1046	1053	1060	1067	1074	1081	1088	1095	1102	69.00
7.20	1109	1116	1123	1130	1137	1144	1151	1158	1166	1173	71.00
7.30	1180*	1187	1194	1201	1208	1215	1222	1229	1236	1243	70.00
7.40	1250*	1257	1264	1271	1278	1285	1292	1299	1306	1313	70.00
7.50	1320*	1327	1334	1341	1348	1355	1362	1369	1376	1383	70.00
7.60	1390*	1397	1404	1411	1418	1425	1432	1439	1446	1453	70.00
7.70	1460*	1466	1472	1478	1484	1490	1496	1502	1508	1514	60.00
7.80	1520*	1526	1532	1538	1544	1550	1556	1562	1568	1574	60.00
7.90	1580*	1586	1592	1598	1604	1610	1616	1622	1628	1634	60.00
8.00	1640*	1645	1650	1655	1661	1666	1671	1676	1681	1686	52.00
8.10	1692	1697	1702	1707	1712	1718	1723	1728	1733	1739	52.00
8.20	1744	1749	1754	1760	1765	1770	1775	1781	1786	1791	53.00
8.30	1797	1802	1807	1812	1818	1823	1828	1834	1839	1844	53.00
8.40	1850	1855	1861	1866	1871	1877	1882	1887	1893	1898	54.00
8.50	1904	1909	1915	1920	1925	1931	1936	1942	1947	1953	54.00
8.60	1958	1964	1969	1975	1980	1986	1991	1997	2002	2008	55.00
8.70	2013	2019	2024	2030	2035	2041	2046	2052	2057	2063	56.00
8.80	2069	2074	2080	2085	2091	2097	2102	2108	2113	2119	56.00
8.90	2125	2130	2136	2142	2147	2153	2159	2164	2170	2176	56.00
9.00	2181	2187	2193	2198	2204	2210	2215	2221	2227	2233	57.00
9.10	2238	2244	2250	2256	2261	2267	2273	2279	2284	2290	58.00
9.20	2296	2302	2308	2313	2319	2325	2331	2337	2343	2348	58.00
9.30	2354	2360	2366	2372	2378	2384	2389	2395	2401	2407	59.00
9.40	2413	2419	2425	2431	2437	2442	2448	2454	2460	2466	59.00
9.50	2472	2478	2484	2490	2496	2502	2508	2514	2520	2526	60.00
9.60	2532	2538	2544	2550	2556	2562	2568	2574	2580	2586	60.00
9.70	2592	2598	2604	2610	2616	2623	2629	2635	2641	2647	61.00
9.80	2653	2659	2665	2671	2677	2684	2690	2696	2702	2708	61.00
9.90	2714	2720	2727	2733	2739	2745	2751	2757	2764	2770	62.00
10.00	2776	2782	2788	2795	2801	2807	2813	2820	2826	2832	62.00
10.10	2838	2845	2851	2857	2863	2870	2876	2882	2889	2895	63.00
10.20	2901	2907	2914	2920	2926	2933	2939	2945	2952	2958	63.00
10.30	2964	2971	2977	2983	2990	2996	3003	3009	3015	3022	64.00
10.40	3028	3035	3041	3047	3054	3060	3067	3073	3080	3086	64.00
10.50	3092	3099	3105	3112	3118	3125	3131	3138	3144	3151	65.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

TYPE: LOG

05294000

DATE PROCESSED: 08-12-1994 @ 13:41 BY HAVE

POMME DE TERRE RIVER AT APPLETON, MN

DD: 3 TYPE: 001 RATING NO: 33.0

OFFSET: 3.11 BREAK,OFFSET: (4.10,3.90) (8.00,3.00)

START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
10.60	3157	3164	3170	3177	3183	3190	3196	3203	3209	3216	65.00
10.70	3222	3229	3235	3242	3249	3255	3262	3268	3275	3281	66.00
10.80	3288	3295	3301	3308	3314	3321	3328	3334	3341	3348	66.00
10.90	3354	3361	3368	3374	3381	3388	3394	3401	3408	3414	67.00
11.00	3421	3428	3434	3441	3448	3454	3461	3468	3475	3481	67.00
11.10	3488	3495	3501	3508	3515	3522	3529	3535	3542	3549	68.00
11.20	3556	3562	3569	3576	3583	3590	3596	3603	3610	3617	68.00
11.30	3624	3630	3637	3644	3651	3658	3665	3672	3678	3685	68.00
11.40	3692	3699	3706	3713	3720	3727	3734	3740	3747	3754	69.00
11.50	3761	3768	3775	3782	3789	3796	3803	3810	3817	3824	70.00
11.60	3831	3838	3845	3852	3859	3866	3873	3880	3887	3894	70.00
11.70	3901	3908	3915	3922	3929	3936	3943	3950	3957	3964	70.00
11.80	3971	3978	3985	3992	3999	4006	4013	4020	4028	4035	71.00
11.90	4042	4049	4056	4063	4070	4077	4084	4092	4099	4106	71.00
12.00	4113	4120	4127	4134	4142	4149	4156	4163	4170	4177	72.00
12.10	4185	4192	4199	4206	4213	4221	4228	4235	4242	4250	72.00
12.20	4257	4264	4271	4279	4286	4293	4300	4308	4315	4322	72.00
12.30	4329	4337	4344	4351	4359	4366	4373	4381	4388	4395	73.00
12.40	4402	4410	4417	4424	4432	4439	4446	4454	4461	4469	74.00
12.50	4476	4483	4491	4498	4505	4513	4520	4528	4535	4542	74.00
12.60	4550	4557	4565	4572	4580	4587	4594	4602	4609	4617	74.00
12.70	4624	4632	4639	4647	4654	4662	4669	4677	4684	4692	75.00
12.80	4699	4707	4714	4722	4729	4737	4744	4752	4759	4767	75.00
12.90	4774	4782	4789	4797	4804	4812	4820	4827	4835	4842	76.00
13.00	4850	4857	4865	4873	4880	4888	4895	4903	4911	4918	76.00
13.10	4926	4934	4941	4949	4956	4964	4972	4979	4987	4995	76.00
13.20	5002	5010	5018	5025	5033	5041	5049	5056	5064	5072	77.00
13.30	5079	5087	5095	5103	5110	5118	5126	5133	5141	5149	78.00
13.40	5157	5164	5172	5180	5188	5196	5203	5211	5219	5227	78.00
13.50	5235	5242	5250	5258	5266	5274	5281	5289	5297	5305	78.00
13.60	5313	5321	5328	5336	5344	5352	5360	5368	5376	5383	78.00
13.70	5391	5399	5407	5415	5423	5431	5439	5447	5455	5462	79.00
13.80	5470	5478	5486	5494	5502	5510	5518	5526	5534	5542	80.00
13.90	5550	5558	5566	5574	5582	5590	5598	5606	5614	5622	80.00
14.00	5630	5638	5646	5654	5662	5670	5678	5686	5694	5702	80.00
14.10	5710	5718	5726	5734	5742	5750	5758	5766	5774	5782	81.00
14.20	5791	5799	5807	5815	5823	5831	5839	5847	5855	5864	81.00
14.30	5872	5880	5888	5896	5904	5912	5920	5929	5937	5945	81.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 4

EXPANDED RATING TABLE TYPE: LOG

05294000 DATE PROCESSED: 08-12-1994 @ 13:41 BY HAVE

POMME DE TERRE RIVER AT APPLETON, MN DD: 3 TYPE: 001 RATING NO: 33.0

OFFSET: 3.11 BREAK,OFFSET: (4.10,3.90) (8.00,3.00) START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
14.40	5953	5961	5969	5978	5986	5994	6002	6010	6019	6027	82.00
14.50	6035	6043	6051	6060	6068	6076	6084	6093	6101	6109	82.00
14.60	6117	6126	6134	6142	6150	6159	6167	6175	6183	6192	83.00*
14.70	6200*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 1
EXPANDED RATING TABLE TYPE: LOG
05300000 DATE PROCESSED: 08-12-1994 @ 13:42 BY HAVE
LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN DD: 3 TYPE: 001 RATING NO: 39.0
OFFSET: .00 START DATE/TIME: 10-01-91 (0001)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS
COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
.20										6.000*	4.680
.30	6.468	6.955	7.461	7.987	8.532	9.098	9.683	10.29	10.91	11.56	5.762
.40	12.23	12.91	13.62	14.35	15.10	15.87	16.66	17.47	18.31	19.16	7.810
.50	20.04	20.94	21.85	22.80	23.76	24.74	25.75	26.78	27.83	28.90	9.960
.60	30.00*	31.10	32.23	33.37	34.54	35.73	36.94	38.17	39.42	40.70	12.00
.70	42.00*	43.46	44.96	46.48	48.04	49.62	51.24	52.88	54.56	56.26	16.00
.80	58.00*	59.68	61.38	63.11	64.87	66.66	68.47	70.31	72.18	74.08	18.00
.90	76.00*	77.63	79.27	80.93	82.60	84.29	86.00	87.73	89.47	91.23	17.00
1.00	93.00*	94.52	96.05	97.59	99.13	100.7	102.3	103.8	105.4	107.0	15.60
1.10	108.6	110.2	111.9	113.5	115.1	116.8	118.4	120.1	121.8	123.5	16.60
1.20	125.2	126.9	128.6	130.3	132.0	133.8	135.5	137.3	139.0	140.8	17.40
1.30	142.6	144.4	146.2	148.0	149.8	151.6	153.5	155.3	157.1	159.0	18.30
1.40	160.9	162.7	164.6	166.5	168.4	170.3	172.2	174.2	176.1	178.0	19.10
1.50	180.0*	181.8	183.6	185.4	187.2	189.1	190.9	192.7	194.6	196.4	18.30
1.60	198.3	200.1	202.0	203.9	205.7	207.6	209.5	211.4	213.3	215.2	18.80
1.70	217.1	219.0	221.0	222.9	224.8	226.8	228.7	230.7	232.6	234.6	19.40
1.80	236.5	238.5	240.5	242.5	244.5	246.5	248.5	250.5	252.5	254.5	20.00
1.90	256.5	258.5	260.6	262.6	264.6	266.7	268.7	270.8	272.9	274.9	20.50
2.00	277.0*	278.8	280.7	282.6	284.4	286.3	288.1	290.0	291.9	293.7	18.60
2.10	295.6	297.5	299.4	301.3	303.2	305.0	306.9	308.8	310.7	312.6	18.90
2.20	314.5	316.4	318.4	320.3	322.2	324.1	326.0	328.0	329.9	331.8	19.20
2.30	333.7	335.7	337.6	339.6	341.5	343.5	345.4	347.4	349.3	351.3	19.50
2.40	353.2	355.2	357.2	359.1	361.1	363.1	365.1	367.0	369.0	371.0	19.80
2.50	373.0*	375.0	377.0	378.9	380.9	382.9	384.9	386.9	388.9	390.9	19.90
2.60	392.9	394.9	396.9	398.9	400.9	403.0	405.0	407.0	409.0	411.0	20.20
2.70	413.1	415.1	417.1	419.2	421.2	423.2	425.3	427.3	429.4	431.4	20.40
2.80	433.5	435.5	437.6	439.6	441.7	443.8	445.8	447.9	450.0	452.0	20.60
2.90	454.1	456.2	458.3	460.4	462.4	464.5	466.6	468.7	470.8	472.9	20.90
3.00	475.0*	477.5	480.0	482.6	485.1	487.6	490.2	492.7	495.3	497.8	25.40
3.10	500.4	502.9	505.5	508.1	510.7	513.3	515.8	518.4	521.0	523.6	25.90
3.20	526.3	528.9	531.5	534.1	536.7	539.4	542.0	544.6	547.3	549.9	26.30
3.30	552.6	555.3	557.9	560.6	563.3	566.0	568.6	571.3	574.0	576.7	26.80
3.40	579.4	582.1	584.8	587.6	590.3	593.0	595.7	598.5	601.2	604.0	27.30
3.50	606.7	609.5	612.2	615.0	617.8	620.5	623.3	626.1	628.9	631.7	27.80
3.60	634.5	637.3	640.1	642.9	645.7	648.5	651.3	654.2	657.0	659.8	28.20
3.70	662.7	665.5	668.4	671.2	674.1	677.0	679.8	682.7	685.6	688.5	28.60
3.80	691.3	694.2	697.1	700.0	702.9	705.8	708.8	711.7	714.6	717.5	29.10
3.90	720.4	723.4	726.3	729.3	732.2	735.2	738.1	741.1	744.1	747.0	29.60

EXPANDED RATING TABLE TYPE: LOG

05300000 DATE PROCESSED: 08-12-1994 @ 13:42 BY HAVE

LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN DD: 3 TYPE: 001 RATING NO: 39.0

OFFSET: .00 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
4.00	750.0*	752.8	755.7	758.5	761.3	764.2	767.0	769.9	772.7	775.6	28.40
4.10	778.4	781.3	784.2	787.1	789.9	792.8	795.7	798.6	801.5	804.4	28.90
4.20	807.3	810.2	813.1	816.0	818.9	821.8	824.7	827.6	830.6	833.5	29.10
4.30	836.4	839.3	842.3	845.2	848.2	851.1	854.1	857.0	860.0	862.9	29.50
4.40	865.9	868.9	871.9	874.8	877.8	880.8	883.8	886.8	889.8	892.8	29.90
4.50	895.8	898.8	901.8	904.8	907.8	910.8	913.8	916.9	919.9	922.9	30.10
4.60	925.9	929.0	932.0	935.1	938.1	941.2	944.2	947.3	950.3	953.4	30.60
4.70	956.5	959.5	962.6	965.7	968.8	971.8	974.9	978.0	981.1	984.2	30.80
4.80	987.3	990.4	993.5	996.6	999.7	1003	1006	1009	1012	1015	30.70
4.90	1018	1022	1025	1028	1031	1034	1037	1041	1044	1047	32.00
5.00	1050*	1053	1057	1060	1063	1067	1070	1073	1077	1080	33.00
5.10	1083	1087	1090	1093	1097	1100	1104	1107	1110	1114	34.00
5.20	1117	1120	1124	1127	1131	1134	1137	1141	1144	1148	34.00
5.30	1151	1155	1158	1161	1165	1168	1172	1175	1179	1182	35.00
5.40	1186	1189	1193	1196	1199	1203	1206	1210	1213	1217	34.00
5.50	1220	1224	1227	1231	1234	1238	1241	1245	1249	1252	36.00
5.60	1256	1259	1263	1266	1270	1273	1277	1280	1284	1288	35.00
5.70	1291	1295	1298	1302	1305	1309	1313	1316	1320	1323	36.00
5.80	1327	1331	1334	1338	1342	1345	1349	1352	1356	1360	36.00
5.90	1363	1367	1371	1374	1378	1382	1385	1389	1393	1396	37.00
6.00	1400*	1404	1407	1411	1415	1418	1422	1426	1429	1433	37.00
6.10	1437	1440	1444	1448	1451	1455	1459	1462	1466	1470	36.00
6.20	1473	1477	1481	1484	1488	1492	1496	1499	1503	1507	38.00
6.30	1511	1514	1518	1522	1526	1529	1533	1537	1541	1544	37.00
6.40	1548	1552	1556	1559	1563	1567	1571	1575	1578	1582	38.00
6.50	1586	1590	1594	1597	1601	1605	1609	1613	1616	1620	38.00
6.60	1624	1628	1632	1636	1639	1643	1647	1651	1655	1659	39.00
6.70	1663	1666	1670	1674	1678	1682	1686	1690	1694	1698	38.00
6.80	1701	1705	1709	1713	1717	1721	1725	1729	1733	1737	40.00
6.90	1741	1744	1748	1752	1756	1760	1764	1768	1772	1776	39.00
7.00	1780*	1784	1788	1792	1796	1800	1804	1808	1812	1816	41.00
7.10	1821	1825	1829	1833	1837	1841	1845	1849	1853	1857	40.00
7.20	1861	1865	1870	1874	1878	1882	1886	1890	1894	1898	42.00
7.30	1903	1907	1911	1915	1919	1923	1927	1932	1936	1940	41.00
7.40	1944	1948	1952	1957	1961	1965	1969	1973	1977	1982	42.00
7.50	1986	1990	1994	1999	2003	2007	2011	2015	2020	2024	42.00
7.60	2028	2032	2037	2041	2045	2049	2054	2058	2062	2066	43.00
7.70	2071	2075	2079	2083	2088	2092	2096	2101	2105	2109	42.00

EXPANDED RATING TABLE TYPE: LOG

05300000 DATE PROCESSED: 08-12-1994 @ 13:42 BY HAVE

LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN DD: 3 TYPE: 001 RATING NO: 39.0

OFFSET: .00 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
7.80	2113	2118	2122	2126	2131	2135	2139	2144	2148	2152	44.00
7.90	2157	2161	2165	2170	2174	2178	2183	2187	2191	2196	43.00
8.00	2200*	2205	2209	2214	2218	2223	2228	2232	2237	2242	46.00
8.10	2246	2251	2256	2260	2265	2270	2274	2279	2284	2288	47.00
8.20	2293	2298	2302	2307	2312	2316	2321	2326	2331	2335	47.00
8.30	2340	2345	2349	2354	2359	2364	2368	2373	2378	2383	47.00
8.40	2387	2392	2397	2402	2406	2411	2416	2421	2426	2430	48.00
8.50	2435	2440	2445	2450	2454	2459	2464	2469	2474	2479	48.00
8.60	2483	2488	2493	2498	2503	2508	2513	2517	2522	2527	49.00
8.70	2532	2537	2542	2547	2552	2556	2561	2566	2571	2576	49.00
8.80	2581	2586	2591	2596	2601	2606	2611	2615	2620	2625	49.00
8.90	2630	2635	2640	2645	2650	2655	2660	2665	2670	2675	50.00
9.00	2680*	2685	2690	2695	2700	2705	2710	2715	2720	2725	50.00
9.10	2730	2735	2740	2745	2751	2756	2761	2766	2771	2776	51.00
9.20	2781	2786	2791	2796	2801	2806	2812	2817	2822	2827	51.00
9.30	2832	2837	2842	2847	2853	2858	2863	2868	2873	2878	52.00
9.40	2884	2889	2894	2899	2904	2909	2915	2920	2925	2930	51.00
9.50	2935	2941	2946	2951	2956	2961	2967	2972	2977	2982	53.00
9.60	2988	2993	2998	3003	3008	3014	3019	3024	3030	3035	52.00
9.70	3040	3045	3051	3056	3061	3066	3072	3077	3082	3088	53.00
9.80	3093	3098	3104	3109	3114	3120	3125	3130	3136	3141	53.00
9.90	3146	3152	3157	3162	3168	3173	3178	3184	3189	3195	54.00
10.00	3200*	3205	3210	3215	3221	3226	3231	3236	3241	3246	52.00
10.10	3252	3257	3262	3267	3272	3278	3283	3288	3293	3298	52.00
10.20	3304	3309	3314	3319	3324	3330	3335	3340	3345	3351	52.00
10.30	3356	3361	3366	3371	3377	3382	3387	3393	3398	3403	52.00
10.40	3408	3414	3419	3424	3429	3435	3440	3445	3451	3456	53.00
10.50	3461	3466	3472	3477	3482	3488	3493	3498	3504	3509	53.00
10.60	3514	3520	3525	3530	3536	3541	3546	3552	3557	3562	54.00
10.70	3568	3573	3579	3584	3589	3595	3600	3605	3611	3616	54.00
10.80	3622	3627	3632	3638	3643	3649	3654	3659	3665	3670	54.00
10.90	3676	3681	3686	3692	3697	3703	3708	3714	3719	3725	54.00
11.00	3730*	3736	3742	3748	3754	3760	3767	3773	3779	3785	61.00
11.10	3791	3797	3803	3809	3816	3822	3828	3834	3840	3846	62.00
11.20	3853	3859	3865	3871	3877	3883	3890	3896	3902	3908	61.00
11.30	3914	3921	3927	3933	3939	3946	3952	3958	3964	3971	63.00
11.40	3977	3983	3989	3996	4002	4008	4014	4021	4027	4033	63.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 4

EXPANDED RATING TABLE TYPE: LOG

05300000 DATE PROCESSED: 08-12-1994 @ 13:42 BY HAVE

LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN DD: 3 TYPE: 001 RATING NO: 39.0

OFFSET: .00 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
11.50	4040	4046	4052	4058	4065	4071	4077	4084	4090	4096	63.00
11.60	4103	4109	4115	4122	4128	4135	4141	4147	4154	4160	63.00
11.70	4166	4173	4179	4186	4192	4198	4205	4211	4218	4224	65.00
11.80	4231	4237	4243	4250	4256	4263	4269	4276	4282	4289	64.00
11.90	4295	4302	4308	4314	4321	4327	4334	4340	4347	4353	65.00
12.00	4360*	4366	4372	4379	4385	4391	4397	4404	4410	4416	62.00
12.10	4422	4429	4435	4441	4447	4454	4460	4466	4472	4479	63.00
12.20	4485	4491	4498	4504	4510	4517	4523	4529	4536	4542	63.00
12.30	4548	4554	4561	4567	4573	4580	4586	4593	4599	4605	64.00
12.40	4612	4618	4624	4631	4637	4643	4650	4656	4663	4669	63.00
12.50	4675	4682	4688	4695	4701	4707	4714	4720	4727	4733	65.00
12.60	4740	4746	4753	4759	4765	4772	4778	4785	4791	4798	64.00
12.70	4804	4811	4817	4824	4830	4837	4843	4850	4856	4863	65.00
12.80	4869	4876	4882	4889	4895	4902	4908	4915	4921	4928	65.00
12.90	4934	4941	4947	4954	4961	4967	4974	4980	4987	4993	66.00
13.00	5000*	5008	5015	5023	5031	5039	5046	5054	5062	5070	77.00
13.10	5077	5085	5093	5101	5108	5116	5124	5132	5140	5147	78.00
13.20	5155	5163	5171	5179	5187	5194	5202	5210	5218	5226	79.00
13.30	5234	5242	5250	5257	5265	5273	5281	5289	5297	5305	79.00
13.40	5313	5321	5329	5337	5345	5353	5361	5369	5377	5385	80.00
13.50	5393	5401	5409	5417	5425	5433	5441	5449	5457	5465	80.00
13.60	5473	5481	5489	5497	5505	5513	5521	5529	5538	5546	81.00
13.70	5554	5562	5570	5578	5586	5594	5603	5611	5619	5627	81.00
13.80	5635	5643	5652	5660	5668	5676	5684	5693	5701	5709	82.00
13.90	5717	5726	5734	5742	5750	5759	5767	5775	5783	5792	83.00
14.00	5800*	5809	5817	5826	5835	5843	5852	5861	5869	5878	87.00
14.10	5887	5896	5904	5913	5922	5931	5939	5948	5957	5966	88.00
14.20	5975	5983	5992	6001	6010	6019	6027	6036	6045	6054	88.00
14.30	6063	6072	6081	6089	6098	6107	6116	6125	6134	6143	89.00
14.40	6152	6161	6170	6179	6188	6197	6206	6215	6224	6233	90.00
14.50	6242	6251	6260	6269	6278	6287	6296	6305	6314	6323	90.00
14.60	6332	6341	6350	6359	6368	6377	6386	6395	6405	6414	91.00
14.70	6423	6432	6441	6450	6459	6469	6478	6487	6496	6505	92.00
14.80	6515	6524	6533	6542	6551	6561	6570	6579	6588	6598	92.00
14.90	6607	6616	6625	6635	6644	6653	6663	6672	6681	6691	93.00
15.00	6700*	6712	6725	6737	6749	6762	6774	6786	6799	6811	123.0
15.10	6823	6836	6848	6861	6873	6886	6898	6911	6923	6936	125.0
15.20	6948	6961	6973	6986	6999	7011	7024	7037	7049	7062	127.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 5
EXPANDED RATING TABLE TYPE: LOG
05300000
DATE PROCESSED: 08-12-1994 @ 13:42 BY HAVE
LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN DD: 3 TYPE: 001 RATING NO: 39.0
OFFSET: .00 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
15.30	7075	7087	7100	7113	7126	7138	7151	7164	7177	7190	127.0
15.40	7202	7215	7228	7241	7254	7267	7280	7293	7306	7319	130.0
15.50	7332	7345	7358	7371	7384	7397	7410	7423	7436	7449	130.0
15.60	7462	7476	7489	7502	7515	7528	7542	7555	7568	7581	133.0
15.70	7595	7608	7621	7634	7648	7661	7675	7688	7701	7715	133.0
15.80	7728	7742	7755	7769	7782	7796	7809	7823	7836	7850	135.0
15.90	7863	7877	7891	7904	7918	7931	7945	7959	7973	7986	137.0*
16.00	8000*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE TYPE: LOG

05304500
DATE PROCESSED: 08-12-1994 @ 13:43 BY HAVE
CHIPPEWA RIVER NEAR MILAN, MN DD: 7 TYPE: 001 RATING NO: 27.0
OFFSET: .50 START DATE/TIME: 10-01-90 (0015)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS
COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
1.10	27.50*	28.18	28.86	29.55	30.24	30.94	31.64	32.35	33.06	33.78	7.000
1.20	34.50*	35.27	36.05	36.84	37.63	38.43	39.23	40.04	40.85	41.67	8.000
1.30	42.50*	43.46	44.42	45.40	46.39	47.38	48.39	49.40	50.43	51.46	10.00
1.40	52.50*	53.69	54.89	56.11	57.34	58.58	59.84	61.11	62.39	63.69	12.50
1.50	65.00*	66.48	67.98	69.50	71.03	72.59	74.16	75.76	77.37	79.00	15.65
1.60	80.65	82.32	84.01	85.72	87.44	89.19	90.95	92.74	94.54	96.37	17.56
1.70	98.21	100.1	102.0	103.9	105.8	107.7	109.7	111.7	113.7	115.7	19.49
1.80	117.7	119.8	121.9	124.0	126.1	128.2	130.4	132.6	134.8	137.0	21.50
1.90	139.2	141.5	143.8	146.1	148.4	150.7	153.1	155.5	157.9	160.3	23.60
2.00	162.8	165.2	167.7	170.2	172.7	175.3	177.9	180.5	183.1	185.7	25.60
2.10	188.4	191.0	193.7	196.4	199.2	201.9	204.7	207.5	210.3	213.2	27.70
2.20	216.1	218.9	221.9	224.8	227.7	230.7	233.7	236.7	239.8	242.8	29.80
2.30	245.9	249.0	252.1	255.3	258.4	261.6	264.8	268.1	271.3	274.6	32.00
2.40	277.9	281.2	284.6	287.9	291.3	294.7	298.2	301.6	305.1	308.6	34.20
2.50	312.1	315.7	319.2	322.8	326.4	330.1	333.7	337.4	341.1	344.8	36.50
2.60	348.6	352.3	356.1	360.0	363.8	367.7	371.5	375.4	379.4	383.3	38.70
2.70	387.3	391.3	395.3	399.3	403.4	407.5	411.6	415.7	419.9	424.1	41.00
2.80	428.3	432.5	436.8	441.0	445.3	449.7	454.0	458.4	462.8	467.2	43.30
2.90	471.6	476.1	480.5	485.1	489.6	494.1	498.7	503.3	507.9	512.6	45.70
3.00	517.3	522.0	526.7	531.4	536.2	541.0	545.8	550.6	555.5	560.4	48.00
3.10	565.3	570.2	575.2	580.2	585.2	590.2	595.2	600.3	605.4	610.5	50.40
3.20	615.7*	620.9	626.1	631.3	636.6	641.8	647.1	652.5	657.8	663.2	52.90
3.30	668.6*	673.8	679.1	684.3	689.6	694.9	700.3	705.6	711.0	716.4	53.20
3.40	721.8*	727.0	732.3	737.6	742.8	748.2	753.5	758.8	764.2	769.6	53.20
3.50	775.0*	780.2	785.5	790.8	796.1	801.4	806.7	812.1	817.4	822.8	53.20
3.60	828.2*	833.4	838.7	844.0	849.3	854.6	859.9	865.3	870.6	876.0	53.20
3.70	881.4*	886.7	891.9	897.2	902.5	907.8	913.1	918.5	923.8	929.2	53.20
3.80	934.6*	939.9	945.2	950.5	955.9	961.2	966.6	972.0	977.4	982.8	53.60
3.90	988.2*	993.5	998.9	1004	1010	1015	1020	1026	1031	1037	53.80
4.00	1042*	1047	1053	1058	1063	1069	1074	1080	1085	1091	54.00
4.10	1096*	1101	1107	1112	1117	1123	1128	1134	1139	1145	54.00
4.20	1150*	1155	1161	1166	1171	1177	1182	1188	1193	1199	54.00
4.30	1204*	1209	1215	1220	1225	1231	1236	1242	1247	1253	54.00
4.40	1258*	1263	1269	1274	1279	1285	1290	1296	1301	1307	54.00
4.50	1312*	1317	1323	1328	1333	1339	1344	1350	1355	1361	54.00
4.60	1366*	1371	1377	1382	1388	1393	1398	1404	1409	1415	54.00
4.70	1420*	1425	1431	1436	1442	1447	1452	1458	1463	1469	54.00
4.80	1474*	1479	1485	1490	1496	1501	1506	1512	1517	1523	54.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 2

EXPANDED RATING TABLE TYPE: LOG

05304500 DATE PROCESSED: 08-12-1994 @ 13:43 BY HAVE

CHIPPEWA RIVER NEAR MILAN, MN DD: 7 TYPE: 001 RATING NO: 27.0

OFFSET: .50 START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
4.90	1528*	1533	1539	1544	1550	1555	1560	1566	1571	1577	54.00
5.00	1582*	1588	1593	1599	1604	1610	1616	1621	1627	1632	56.00
5.10	1638	1644	1649	1655	1661	1666	1672	1678	1683	1689	57.00
5.20	1695	1700	1706	1712	1718	1723	1729	1735	1741	1746	57.00
5.30	1752	1758	1764	1770	1775	1781	1787	1793	1799	1804	58.00
5.40	1810	1816	1822	1828	1834	1840	1846	1851	1857	1863	59.00
5.50	1869	1875	1881	1887	1893	1899	1905	1911	1917	1923	60.00
5.60	1929	1935	1941	1947	1953	1959	1965	1971	1977	1983	60.00
5.70	1989	1995	2001	2007	2013	2019	2025	2031	2038	2044	61.00
5.80	2050	2056	2062	2068	2074	2080	2087	2093	2099	2105	61.00
5.90	2111	2118	2124	2130	2136	2142	2149	2155	2161	2167	63.00
6.00	2174	2180	2186	2192	2199	2205	2211	2217	2224	2230	62.00
6.10	2236	2243	2249	2255	2262	2268	2274	2281	2287	2294	64.00
6.20	2300	2306	2313	2319	2326	2332	2338	2345	2351	2358	64.00
6.30	2364	2371	2377	2384	2390	2397	2403	2410	2416	2423	65.00
6.40	2429	2436	2442	2449	2455	2462	2468	2475	2481	2488	66.00
6.50	2495	2501	2508	2514	2521	2528	2534	2541	2547	2554	66.00
6.60	2561	2567	2574	2581	2587	2594	2601	2607	2614	2621	66.00
6.70	2627	2634	2641	2648	2654	2661	2668	2675	2681	2688	68.00
6.80	2695	2702	2708	2715	2722	2729	2736	2742	2749	2756	68.00
6.90	2763	2770	2777	2783	2790	2797	2804	2811	2818	2825	69.00
7.00	2832	2838	2845	2852	2859	2866	2873	2880	2887	2894	69.00
7.10	2901	2908	2915	2922	2929	2936	2943	2950	2957	2964	70.00
7.20	2971	2978	2985	2992	2999	3006	3013	3020	3027	3034	70.00
7.30	3041	3048	3055	3062	3070	3077	3084	3091	3098	3105	71.00
7.40	3112	3119	3127	3134	3141	3148	3155	3162	3170	3177	72.00
7.50	3184	3191	3198	3206	3213	3220	3227	3235	3242	3249	72.00
7.60	3256	3264	3271	3278	3285	3293	3300	3307	3315	3322	73.00
7.70	3329	3337	3344	3351	3359	3366	3373	3381	3388	3395	74.00
7.80	3403	3410	3417	3425	3432	3440	3447	3454	3462	3469	74.00
7.90	3477	3484	3492	3499	3507	3514	3521	3529	3536	3544	74.00
8.00	3551	3559	3566	3574	3581	3589	3597	3604	3612	3619	76.00
8.10	3627	3634	3642	3649	3657	3665	3672	3680	3687	3695	76.00
8.20	3703	3710	3718	3725	3733	3741	3748	3756	3764	3771	76.00
8.30	3779	3787	3794	3802	3810	3817	3825	3833	3840	3848	77.00
8.40	3856	3864	3871	3879	3887	3895	3902	3910	3918	3926	77.00
8.50	3933	3941	3949	3957	3965	3972	3980	3988	3996	4004	79.00

EXPANDED RATING TABLE TYPE: LOG

05304500 DATE PROCESSED: 08-12-1994 @ 13:43 BY HAVE

CHIPPEWA RIVER NEAR MILAN, MN DD: 7 TYPE: 001 RATING NO: 27.0

OFFSET: .50 START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
8.60	4012	4019	4027	4035	4043	4051	4059	4067	4074	4082	78.00
8.70	4090	4098	4106	4114	4122	4130	4138	4146	4154	4162	79.00
8.80	4169	4177	4185	4193	4201	4209	4217	4225	4233	4241	80.00
8.90	4249	4257	4265	4273	4281	4289	4297	4305	4314	4322	81.00
9.00	4330	4338	4346	4354	4362	4370	4378	4386	4394	4402	81.00
9.10	4411	4419	4427	4435	4443	4451	4459	4468	4476	4484	81.00
9.20	4492	4500	4508	4517	4525	4533	4541	4549	4558	4566	82.00
9.30	4574	4582	4591	4599	4607	4615	4624	4632	4640	4648	83.00
9.40	4657	4665	4673	4681	4690	4698	4706	4715	4723	4731	83.00
9.50	4740	4748	4756	4765	4773	4781	4790	4798	4807	4815	83.00
9.60	4823	4832	4840	4849	4857	4865	4874	4882	4891	4899	85.00
9.70	4908	4916	4924	4933	4941	4950	4958	4967	4975	4984	84.00
9.80	4992	5001	5009	5018	5026	5035	5043	5052	5060	5069	85.00
9.90	5077	5086	5095	5103	5112	5120	5129	5137	5146	5155	86.00
10.00	5163	5172	5180	5189	5198	5206	5215	5224	5232	5241	87.00
10.10	5250	5258	5267	5276	5284	5293	5302	5310	5319	5328	86.00
10.20	5336	5345	5354	5363	5371	5380	5389	5397	5406	5415	88.00
10.30	5424	5432	5441	5450	5459	5468	5476	5485	5494	5503	88.00
10.40	5512	5520	5529	5538	5547	5556	5565	5573	5582	5591	88.00
10.50	5600*	5609	5618	5628	5637	5646	5655	5664	5674	5683	92.00
10.60	5692	5701	5711	5720	5729	5738	5748	5757	5766	5775	93.00
10.70	5785	5794	5803	5813	5822	5831	5841	5850	5859	5869	93.00
10.80	5878	5887	5897	5906	5915	5925	5934	5944	5953	5962	94.00
10.90	5972	5981	5991	6000	6009	6019	6028	6038	6047	6057	94.00
11.00	6066	6076	6085	6095	6104	6114	6123	6133	6142	6152	95.00
11.10	6161	6171	6180	6190	6199	6209	6218	6228	6237	6247	96.00
11.20	6257	6266	6276	6285	6295	6305	6314	6324	6333	6343	96.00
11.30	6353	6362	6372	6382	6391	6401	6411	6420	6430	6440	96.00
11.40	6449	6459	6469	6479	6488	6498	6508	6517	6527	6537	98.00
11.50	6547	6556	6566	6576	6586	6595	6605	6615	6625	6635	97.00
11.60	6644	6654	6664	6674	6684	6694	6703	6713	6723	6733	99.00
11.70	6743	6753	6763	6772	6782	6792	6802	6812	6822	6832	99.00
11.80	6842	6852	6862	6872	6882	6891	6901	6911	6921	6931	99.00
11.90	6941	6951	6961	6971	6981	6991	7001	7011	7021	7031	100.0
12.00	7041	7051	7061	7071	7082	7092	7102	7112	7122	7132	101.0
12.10	7142	7152	7162	7172	7182	7192	7203	7213	7223	7233	101.0
12.20	7243	7253	7263	7274	7284	7294	7304	7314	7324	7335	102.0
12.30	7345	7355	7365	7375	7386	7396	7406	7416	7427	7437	102.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 4
EXPANDED RATING TABLE TYPE: LOG
05304500 DATE PROCESSED: 08-12-1994 @ 13:43 BY HAVE
CHIPPEWA RIVER NEAR MILAN, MN DD: 7 TYPE: 001 RATING NO: 27.0
OFFSET: .50 START DATE/TIME: 10-01-90 (0015)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
12.40	7447	7457	7468	7478	7488	7498	7509	7519	7529	7540	103.0
12.50	7550*	7562	7573	7585	7597	7609	7621	7632	7644	7656	118.0
12.60	7668	7680	7691	7703	7715	7727	7739	7751	7763	7775	119.0
12.70	7787	7798	7810	7822	7834	7846	7858	7870	7882	7894	119.0
12.80	7906	7918	7930	7942	7954	7966	7978	7990	8002	8014	120.0
12.90	8026	8039	8051	8063	8075	8087	8099	8111	8123	8135	122.0
13.00	8148	8160	8172	8184	8196	8209	8221	8233	8245	8257	122.0
13.10	8270	8282	8294	8306	8319	8331	8343	8356	8368	8380	123.0
13.20	8393	8405	8417	8430	8442	8454	8467	8479	8492	8504	123.0
13.30	8516	8529	8541	8554	8566	8579	8591	8603	8616	8628	125.0
13.40	8641	8653	8666	8678	8691	8704	8716	8729	8741	8754	125.0
13.50	8766	8779	8792	8804	8817	8829	8842	8855	8867	8880	127.0
13.60	8893	8905	8918	8931	8943	8956	8969	8982	8994	9007	127.0
13.70	9020	9033	9045	9058	9071	9084	9096	9109	9122	9135	128.0
13.80	9148	9161	9173	9186	9199	9212	9225	9238	9251	9264	128.0
13.90	9276	9289	9302	9315	9328	9341	9354	9367	9380	9393	130.0
14.00	9406	9419	9432	9445	9458	9471	9484	9497	9510	9523	131.0
14.10	9537	9550	9563	9576	9589	9602	9615	9628	9641	9655	131.0
14.20	9668	9681	9694	9707	9721	9734	9747	9760	9773	9787	132.0
14.30	9800	9813	9826	9840	9853	9866	9880	9893	9906	9920	133.0
14.40	9933	9946	9960	9973	9986	10000	10010	10030	10040	10050	137.0
14.50	10070	10080	10090	10110	10120	10130	10150	10160	10170	10190	130.0
14.60	10200	10210	10230	10240	10260	10270	10280	10300	10310	10320	140.0
14.70	10340	10350	10360	10380	10390	10400	10420	10430	10450	10460	130.0
14.80	10470	10490	10500	10510	10530	10540	10560	10570	10580	10600	140.0
14.90	10610	10620	10640	10650	10670	10680	10690	10710	10720	10730	140.0
15.00	10750	10760	10780	10790	10800	10820	10830	10850	10860	10870	140.0
15.10	10890	10900	10910	10930	10940	10960	10970	10980	11000	11010	140.0
15.20	11030	11040	11050	11070	11080	11100	11110	11120	11140	11150	140.0
15.30	11170	11180	11190	11210	11220	11240	11250	11270	11280	11290	140.0
15.40	11310	11320	11340	11350	11360	11380	11390	11410	11420	11440	140.0*
15.50	11450*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE TYPE: LOG

05292000 DATE PROCESSED: 08-12-1994 @ 14:36 BY HAVE

MINNESOTA RIVER AT ORTONVILLE, MN DD: 3 TYPE: 001 RATING NO: 25.0

OFFSET: 1.00 BREAK,OFFSET: (2.45,.30) START DATE/TIME: 10-01-90 (0001)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS

COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION)										DIFF IN Q PER TENTH FT
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	
.70					.000*	.006	.012	.019	.025	.031	.062
.80	.037	.044	.050	.056	.062	.069	.075	.081	.087	.094	.063
.90	.100*	.125	.150	.175	.200	.225	.250	.275	.300	.325	.250
1.00	.350*	.410	.470	.530	.590	.650	.710	.770	.830	.890	.600
1.10	.950*	1.088	1.230	1.378	1.531	1.689	1.851	2.017	2.187	2.362	1.590
1.20	2.540*	2.799	3.069	3.353	3.649	3.957	4.278	4.611	4.956	5.314	3.144
1.30	5.684	6.067	6.462	6.869	7.289	7.721	8.165	8.622	9.091	9.573	4.386
1.40	10.07	10.57	11.09	11.62	12.17	12.72	13.29	13.87	14.46	15.07	5.610
1.50	15.68	16.31	16.95	17.61	18.27	18.95	19.64	20.35	21.06	21.79	6.850
1.60	22.53	23.28	24.04	24.82	25.61	26.41	27.22	28.05	28.89	29.74	8.070
1.70	30.60	31.47	32.36	33.26	34.17	35.10	36.03	36.98	37.94	38.91	9.300
1.80	39.90	40.89	41.90	42.92	43.96	45.00	46.06	47.13	48.21	49.31	10.51
1.90	50.41	51.53	52.66	53.81	54.96	56.13	57.31	58.50	59.71	60.92	11.74
2.00	62.15	63.39	64.65	65.91	67.19	68.48	69.78	71.09	72.42	73.76	12.96
2.10	75.11*	76.48	77.87	79.27	80.68	82.10	83.53	84.98	86.44	87.91	14.29
2.20	89.40*	90.79	92.20	93.61	95.04	96.48	97.92	99.38	100.8	102.3	14.40
2.30	103.8*	105.2	106.7	108.1	109.5	111.0	112.5	113.9	115.4	116.9	14.60
2.40	118.4*	119.8	121.3	122.8	124.2	125.7*	127.2	128.6	130.1	131.6	14.70
2.50	133.1*	134.5	136.0	137.4	138.9	140.3	141.8	143.3	144.8	146.3	14.70
2.60	147.8*	149.3	150.7	152.2	153.7	155.2	156.6	158.1	159.7	161.2	14.90
2.70	162.7*	164.2	165.6	167.1	168.6	170.1	171.6	173.1	174.6	176.2	15.00
2.80	177.7*	179.2	180.7	182.1	183.6	185.1	186.7	188.2	189.7	191.2	15.00
2.90	192.7	194.3	195.8	197.4	198.9	200.5	202.1	203.7	205.2	206.8	15.70
3.00	208.4	210.0	211.6	213.2	214.9	216.5	218.1	219.8	221.4	223.1	16.30
3.10	224.7	226.4	228.1	229.8	231.4	233.1	234.8	236.5	238.2	240.0	17.00
3.20	241.7	243.4	245.2	246.9	248.6	250.4	252.2	253.9	255.7	257.5	17.60
3.30	259.3	261.1	262.9	264.7	266.5	268.3	270.1	272.0	273.8	275.7	18.20
3.40	277.5	279.4	281.2	283.1	285.0	286.9	288.7	290.6	292.5	294.5	18.90
3.50	296.4	298.3	300.2	302.2	304.1	306.0	308.0	310.0	311.9	313.9	19.50
3.60	315.9	317.9	319.9	321.9	323.9	325.9	327.9	329.9	332.0	334.0	20.10
3.70	336.0	338.1	340.2	342.2	344.3	346.4	348.4	350.5	352.6	354.7	20.80
3.80	356.8	359.0	361.1	363.2	365.4	367.5	369.6	371.8	374.0	376.1	21.50
3.90	378.3	380.5	382.7	384.9	387.1	389.3	391.5	393.7	395.9	398.2	22.10
4.00	400.4	402.6	404.9	407.2	409.4	411.7	414.0	416.3	418.5	420.8	22.70
4.10	423.1	425.5	427.8	430.1	432.4	434.8	437.1	439.5	441.8	444.2	23.40
4.20	446.5	448.9	451.3	453.7	456.1	458.5	460.9	463.3	465.7	468.2	24.10
4.30	470.6	473.0	475.5	477.9	480.4	482.9	485.3	487.8	490.3	492.8	24.70
4.40	495.3	497.8	500.3	502.8	505.4	507.9	510.4	513.0	515.5	518.1	25.40

EXPANDED RATING TABLE TYPE: LOG

05292000 DATE PROCESSED: 08-12-1994 @ 14:36 BY HAVE

MINNESOTA RIVER AT ORTONVILLE, MN DD: 3 TYPE: 001 RATING NO: 25.0

OFFSET: 1.00 BREAK,OFFSET: (2.45,.30) START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
4.50	520.7	523.2	525.8	528.4	531.0	533.6	536.2	538.8	541.4	544.0	26.00
4.60	546.7	549.3	552.0	554.6	557.3	559.9	562.6	565.3	568.0	570.7	26.70
4.70	573.4	576.1	578.8	581.5	584.2	586.9	589.7	592.4	595.2	597.9	27.30
4.80	600.7	603.5	606.2	609.0	611.8	614.6	617.4	620.2	623.0	625.8	28.00
4.90	628.7	631.5	634.3	637.2	640.1	642.9	645.8	648.7	651.5	654.4	28.60
5.00	657.3	660.2	663.1	666.0	669.0	671.9	674.8	677.8	680.7	683.7	29.30
5.10	686.6	689.6	692.6	695.6	698.5	701.5	704.5	707.5	710.6	713.6	30.00
5.20	716.6	719.6	722.7	725.7	728.8	731.8	734.9	738.0	741.1	744.1	30.60
5.30	747.2	750.3	753.4	756.6	759.7	762.8	765.9	769.1	772.2	775.4	31.30
5.40	778.5	781.7	784.9	788.1	791.2	794.4	797.6	800.8	804.1	807.3	32.00
5.50	810.5	813.7	817.0	820.2	823.5	826.7	830.0	833.3	836.6	839.8	32.60
5.60	843.1	846.4	849.7	853.1	856.4	859.7	863.0	866.4	869.7	873.1	33.30
5.70	876.4	879.8	883.2	886.6	889.9	893.3	896.7	900.1	903.6	907.0	34.00
5.80	910.4	913.8	917.3	920.7	924.2	927.6	931.1	934.6	938.1	941.5	34.60
5.90	945.0	948.5	952.0	955.6	959.1	962.6	966.1	969.7	973.2	976.8	35.30
6.00	980.3	983.9	987.5	991.1	994.6	998.2	1002	1005	1009	1013	35.70
6.10	1016	1020	1024	1027	1031	1035	1038	1042	1046	1049	37.00
6.20	1053	1057	1060	1064	1068	1072	1075	1079	1083	1087	37.00
6.30	1090	1094	1098	1102	1105	1109	1113	1117	1121	1124	38.00
6.40	1128	1132	1136	1140	1144	1148	1151	1155	1159	1163	39.00
6.50	1167	1171	1175	1179	1183	1187	1190	1194	1198	1202	39.00
6.60	1206	1210	1214	1218	1222	1226	1230	1234	1238	1242	40.00
6.70	1246	1250	1254	1258	1262	1267	1271	1275	1279	1283	41.00
6.80	1287	1291	1295	1299	1303	1308	1312	1316	1320	1324	41.00
6.90	1328	1332	1337	1341	1345	1349	1353	1358	1362	1366	42.00
7.00	1370	1375	1379	1383	1387	1392	1396	1400	1404	1409	43.00
7.10	1413	1417	1422	1426	1430	1435	1439	1443	1448	1452	43.00
7.20	1456	1461	1465	1470	1474	1478	1483	1487	1492	1496	45.00
7.30	1501	1505	1509	1514	1518	1523	1527	1532	1536	1541	44.00
7.40	1545	1550	1554	1559	1563	1568	1573	1577	1582	1586	46.00
7.50	1591	1595	1600	1605	1609	1614	1618	1623	1628	1632	46.00
7.60	1637	1642	1646	1651	1656	1660	1665	1670	1674	1679	47.00
7.70	1684	1688	1693	1698	1703	1707	1712	1717	1722	1726	47.00
7.80	1731	1736	1741	1746	1750	1755	1760	1765	1770	1775	48.00
7.90	1779	1784	1789	1794	1799	1804	1809	1813	1818	1823	49.00
8.00	1828	1833	1838	1843	1848	1853	1858	1863	1868	1873	50.00
8.10	1878	1883	1888	1893	1898	1903	1908	1913	1918	1923	50.00
8.20	1928	1933	1938	1943	1948	1953	1958	1964	1969	1974	51.00

EXPANDED RATING TABLE TYPE: LOG

05292000
DATE PROCESSED: 08-12-1994 @ 14:36 BY HAVE

MINNESOTA RIVER AT ORTONVILLE, MN DD: 3 TYPE: 001 RATING NO: 25.0

OFFSET: 1.00 BREAK,OFFSET: (2.45,.30) START DATE/TIME: 10-01-90 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
8.30	1979	1984	1989	1994	1999	2005	2010	2015	2020	2025	51.00
8.40	2030	2036	2041	2046	2051	2057	2062	2067	2072	2078	53.00
8.50	2083	2088	2093	2099	2104	2109	2114	2120	2125	2130	53.00
8.60	2136	2141	2146	2152	2157	2163	2168	2173	2179	2184	53.00
8.70	2189	2195	2200	2206	2211	2217	2222	2227	2233	2238	55.00
8.80	2244	2249	2255	2260	2266	2271	2277	2282	2288	2293	55.00
8.90	2299	2304	2310	2315	2321	2327	2332	2338	2343	2349	56.00
9.00	2355	2360	2366	2371	2377	2383	2388	2394	2400	2405	56.00
9.10	2411	2417	2422	2428	2434	2439	2445	2451	2457	2462	57.00
9.20	2468	2474	2480	2485	2491	2497	2503	2508	2514	2520	58.00
9.30	2526	2532	2538	2543	2549	2555	2561	2567	2573	2579	58.00
9.40	2584	2590	2596	2602	2608	2614	2620	2626	2632	2638	60.00
9.50	2644	2650	2656	2661	2667	2673	2679	2685	2691	2697	59.00
9.60	2703	2710	2716	2722	2728	2734	2740	2746	2752	2758	61.00
9.70	2764	2770	2776	2782	2789	2795	2801	2807	2813	2819	61.00
9.80	2825	2832	2838	2844	2850	2856	2862	2869	2875	2881	62.00
9.90	2887	2894	2900	2906	2912	2919	2925	2931	2937	2944	63.00*
10.00	2950*										

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION PAGE 1

EXPANDED RATING TABLE TYPE: LOG

05293000 DATE PROCESSED: 08-12-1994 @ 13:40 BY HAVE

YELLOW BANK RIVER NEAR ODESSA, MN DD: 7 TYPE: 001 RATING NO: 26.0

OFFSET: 1.40 START DATE/TIME: 10-01-91 (0001)

BASED ON _____ DISCHARGE MEASUREMENTS, NOS _____, AND _____, AND IS _____ WELL DEFINED BETWEEN _____ AND _____ CFS

COMP BY _____ DATE _____ CHK. BY _____ DATE _____

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
1.60					.000*	.071	.143	.214	.286	.357	.715
1.70	.429	.500	.571	.643	.714	.786	.857	.929	1.000*	1.092	.760
1.80	1.189	1.292	1.402	1.518	1.640	1.769	1.906	2.049	2.200*	2.330	1.276
1.90	2.465	2.605	2.750	2.901	3.056	3.216	3.382	3.553	3.730	3.912	1.635
2.00	4.100*	4.348	4.607	4.877	5.158	5.451	5.755	6.071	6.400*	6.932	3.400
2.10	7.500*	7.983	8.490	9.022	9.578	10.16	10.77	11.41	12.08	12.77	6.000
2.20	13.50*	14.03	14.58	15.14	15.72	16.31	16.92	17.54	18.18	18.83	6.000
2.30	19.50*	20.22	20.95	21.70	22.47	23.26	24.07	24.90	25.75	26.61	8.000
2.40	27.50*	28.23	28.96	29.71	30.48	31.25	32.04	32.83	33.64	34.47	7.800
2.50	35.30*	36.08	36.86	37.66	38.46	39.28	40.10	40.93	41.78	42.63	8.200
2.60	43.50*	44.27	45.04	45.83	46.61	47.41	48.21	49.03	49.84	50.67	8.000
2.70	51.50*	52.32	53.15	53.98	54.82	55.67	56.52	57.38	58.25	59.12	8.500
2.80	60.00*	60.87	61.75	62.63	63.52	64.42	65.32	66.23	67.15	68.07	9.000
2.90	69.00*	69.88	70.76	71.64	72.54	73.43	74.34	75.24	76.16	77.08	9.000
3.00	78.00*	78.91	79.82	80.73	81.66	82.58	83.51	84.45	85.39	86.33	9.280
3.10	87.28	88.24	89.20	90.16	91.13	92.11	93.09	94.07	95.06	96.05	9.770
3.20	97.05	98.05	99.06	100.1	101.1	102.1	103.1	104.2	105.2	106.2	10.25
3.30	107.3	108.3	109.4	110.5	111.5	112.6	113.7	114.7	115.8	116.9	10.70
3.40	118.0*	119.1	120.2	121.3	122.4	123.5	124.6	125.8	126.9	128.0	11.20
3.50	129.2	130.3	131.4	132.6	133.7	134.9	136.1	137.2	138.4	139.6	11.60
3.60	140.8	142.0	143.2	144.4	145.6	146.8	148.0	149.2	150.4	151.6	12.10
3.70	152.9	154.1	155.3	156.6	157.8	159.1	160.3	161.6	162.8	164.1	12.50
3.80	165.4	166.7	167.9	169.2	170.5	171.8	173.1	174.4	175.7	177.1	13.00
3.90	178.4	179.7	181.0	182.4	183.7	185.0	186.4	187.7	189.1	190.4	13.40
4.00	191.8	193.2	194.5	195.9	197.3	198.7	200.1	201.5	202.9	204.3	13.90
4.10	205.7	207.1	208.5	209.9	211.4	212.8	214.2	215.7	217.1	218.6	14.30
4.20	220.0	221.5	222.9	224.4	225.9	227.3	228.8	230.3	231.8	233.3	14.80
4.30	234.8	236.3	237.8	239.3	240.8	242.3	243.9	245.4	246.9	248.5	15.20
4.40	250.0*	251.5	253.1	254.6	256.2	257.7	259.3	260.9	262.4	264.0	15.60
4.50	265.6	267.2	268.8	270.3	271.9	273.5	275.1	276.8	278.4	280.0	16.00
4.60	281.6	283.2	284.9	286.5	288.1	289.8	291.4	293.1	294.7	296.4	16.40
4.70	298.0	299.7	301.4	303.1	304.7	306.4	308.1	309.8	311.5	313.2	16.90
4.80	314.9	316.6	318.3	320.1	321.8	323.5	325.2	327.0	328.7	330.5	17.30
4.90	332.2	334.0	335.7	337.5	339.3	341.0	342.8	344.6	346.4	348.1	17.70
5.00	349.9	351.7	353.5	355.3	357.1	359.0	360.8	362.6	364.4	366.2	18.20
5.10	368.1	369.9	371.8	373.6	375.4	377.3	379.2	381.0	382.9	384.8	18.50
5.20	386.6	388.5	390.4	392.3	394.2	396.1	398.0	399.9	401.8	403.7	19.00
5.30	405.6	407.5	409.5	411.4	413.3	415.3	417.2	419.1	421.1	423.0	19.40

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

EXPANDED RATING TABLE TYPE: LOG

05293000

DATE PROCESSED: 08-12-1994 @ 13:40 BY HAVE

YELLOW BANK RIVER NEAR ODESSA, MN DD: 7 TYPE: 001 RATING NO: 26.0

OFFSET: 1.40 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
5.40	425.0*	427.0	429.0	431.0	433.0	435.0	437.0	439.0	441.0	443.0	20.00
5.50	445.0	447.1	449.1	451.1	453.2	455.2	457.3	459.3	461.4	463.4	20.50
5.60	465.5	467.6	469.7	471.7	473.8	475.9	478.0	480.1	482.2	484.3	20.90
5.70	486.4	488.5	490.6	492.8	494.9	497.0	499.2	501.3	503.4	505.6	21.30
5.80	507.7	509.9	512.1	514.2	516.4	518.6	520.7	522.9	525.1	527.3	21.80
5.90	529.5	531.7	533.9	536.1	538.3	540.5	542.7	545.0	547.2	549.4	22.20
6.00	551.7	553.9	556.1	558.4	560.6	562.9	565.2	567.4	569.7	572.0	22.50
6.10	574.2	576.5	578.8	581.1	583.4	585.7	588.0	590.3	592.6	594.9	23.10
6.20	597.3	599.6	601.9	604.2	606.6	608.9	611.3	613.6	616.0	618.3	23.40
6.30	620.7	623.1	625.4	627.8	630.2	632.6	635.0	637.3	639.7	642.1	23.80
6.40	644.5	647.0	649.4	651.8	654.2	656.6	659.1	661.5	663.9	666.4	24.30
6.50	668.8	671.3	673.7	676.2	678.6	681.1	683.6	686.0	688.5	691.0	24.70
6.60	693.5	696.0	698.5	701.0	703.5	706.0	708.5	711.0	713.5	716.1	25.10
6.70	718.6	721.1	723.7	726.2	728.7	731.3	733.8	736.4	739.0	741.5	25.50
6.80	744.1	746.7	749.3	751.8	754.4	757.0	759.6	762.2	764.8	767.4	25.90
6.90	770.0	772.6	775.3	777.9	780.5	783.1	785.8	788.4	791.1	793.7	26.40
7.00	796.4	799.0	801.7	804.3	807.0	809.7	812.4	815.0	817.7	820.4	26.70
7.10	823.1	825.8	828.5	831.2	833.9	836.6	839.3	842.1	844.8	847.5	27.20
7.20	850.3	853.0	855.7	858.5	861.2	864.0	866.7	869.5	872.3	875.0	27.50
7.30	877.8	880.6	883.4	886.2	889.0	891.8	894.6	897.4	900.2	903.0	28.00
7.40	905.8	908.6	911.4	914.3	917.1	919.9	922.8	925.6	928.5	931.3	28.40
7.50	934.2	937.0	939.9	942.8	945.6	948.5	951.4	954.3	957.2	960.1	28.80
7.60	963.0	965.9	968.8	971.7	974.6	977.5	980.4	983.3	986.3	989.2	29.10
7.70	992.1	995.1	998.0	1001	1004	1007	1010	1013	1016	1019	29.90
7.80	1022	1025	1028	1031	1034	1037	1040	1043	1046	1049	30.00
7.90	1052	1055	1058	1061	1064	1067	1070	1073	1076	1079	30.00
8.00	1082	1085	1088	1091	1094	1097	1101	1104	1107	1110	31.00
8.10	1113	1116	1119	1122	1125	1128	1132	1135	1138	1141	31.00
8.20	1144	1147	1150	1154	1157	1160	1163	1166	1169	1173	32.00
8.30	1176	1179	1182	1185	1188	1192	1195	1198	1201	1205	32.00
8.40	1208	1211	1214	1217	1221	1224	1227	1230	1234	1237	32.00
8.50	1240	1243	1247	1250	1253	1256	1260	1263	1266	1270	33.00
8.60	1273	1276	1280	1283	1286	1289	1293	1296	1299	1303	33.00
8.70	1306	1309	1313	1316	1320	1323	1326	1330	1333	1336	34.00
8.80	1340	1343	1346	1350	1353	1357	1360	1363	1367	1370	34.00
8.90	1374	1377	1381	1384	1387	1391	1394	1398	1401	1405	34.00
9.00	1408	1412	1415	1418	1422	1425	1429	1432	1436	1439	35.00

EXPANDED RATING TABLE TYPE: LOG

05293000
DATE PROCESSED: 08-12-1994 @ 13:40 BY HAVE
YELLOW BANK RIVER NEAR ODESSA, MN DD: 7 TYPE: 001 RATING NO: 26.0
OFFSET: 1.40 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
9.10	1443	1446	1450	1453	1457	1460	1464	1467	1471	1474	35.00
9.20	1478	1482	1485	1489	1492	1496	1499	1503	1506	1510	36.00
9.30	1514	1517	1521	1524	1528	1532	1535	1539	1542	1546	36.00
9.40	1550	1553	1557	1560	1564	1568	1571	1575	1579	1582	36.00
9.50	1586	1590	1593	1597	1601	1604	1608	1612	1615	1619	37.00
9.60	1623	1626	1630	1634	1637	1641	1645	1649	1652	1656	37.00
9.70	1660	1663	1667	1671	1675	1678	1682	1686	1690	1693	37.00
9.80	1697	1701	1705	1709	1712	1716	1720	1724	1728	1731	38.00
9.90	1735	1739	1743	1747	1750	1754	1758	1762	1766	1770	38.00
10.00	1773	1777	1781	1785	1789	1793	1797	1800	1804	1808	39.00
10.10	1812	1816	1820	1824	1828	1832	1836	1839	1843	1847	39.00
10.20	1851	1855	1859	1863	1867	1871	1875	1879	1883	1887	40.00
10.30	1891	1895	1899	1903	1907	1911	1915	1919	1922	1926	39.00
10.40	1930	1935	1939	1943	1947	1951	1955	1959	1963	1967	41.00
10.50	1971	1975	1979	1983	1987	1991	1995	1999	2003	2007	40.00
10.60	2011	2015	2019	2024	2028	2032	2036	2040	2044	2048	41.00
10.70	2052	2056	2061	2065	2069	2073	2077	2081	2085	2090	42.00
10.80	2094	2098	2102	2106	2110	2115	2119	2123	2127	2131	41.00
10.90	2135	2140	2144	2148	2152	2156	2161	2165	2169	2173	43.00
11.00	2178	2182	2186	2190	2195	2199	2203	2207	2212	2216	42.00
11.10	2220	2224	2229	2233	2237	2242	2246	2250	2254	2259	43.00
11.20	2263	2267	2272	2276	2280	2285	2289	2293	2298	2302	43.00
11.30	2306	2311	2315	2319	2324	2328	2332	2337	2341	2346	44.00
11.40	2350*	2354	2359	2363	2367	2372	2376	2381	2385	2389	44.00
11.50	2394	2398	2403	2407	2411	2416	2420	2425	2429	2434	44.00
11.60	2438	2442	2447	2451	2456	2460	2465	2469	2474	2478	45.00
11.70	2483	2487	2492	2496	2501	2505	2510	2514	2519	2523	45.00
11.80	2528	2532	2537	2541	2546	2550	2555	2559	2564	2568	45.00
11.90	2573	2577	2582	2587	2591	2596	2600	2605	2609	2614	46.00
12.00	2619	2623	2628	2632	2637	2642	2646	2651	2655	2660	46.00
12.10	2665	2669	2674	2678	2683	2688	2692	2697	2702	2706	46.00
12.20	2711	2716	2720	2725	2730	2734	2739	2744	2748	2753	47.00
12.30	2758	2763	2767	2772	2777	2781	2786	2791	2796	2800	47.00
12.40	2805	2810	2814	2819	2824	2829	2833	2838	2843	2848	48.00
12.50	2853	2857	2862	2867	2872	2876	2881	2886	2891	2896	47.00
12.60	2900	2905	2910	2915	2920	2925	2929	2934	2939	2944	49.00
12.70	2949	2954	2958	2963	2968	2973	2978	2983	2988	2992	48.00
12.80	2997	3002	3007	3012	3017	3022	3027	3032	3037	3041	49.00

EXPANDED RATING TABLE TYPE: LOG

05293000 DATE PROCESSED: 08-12-1994 @ 13:40 BY HAVE

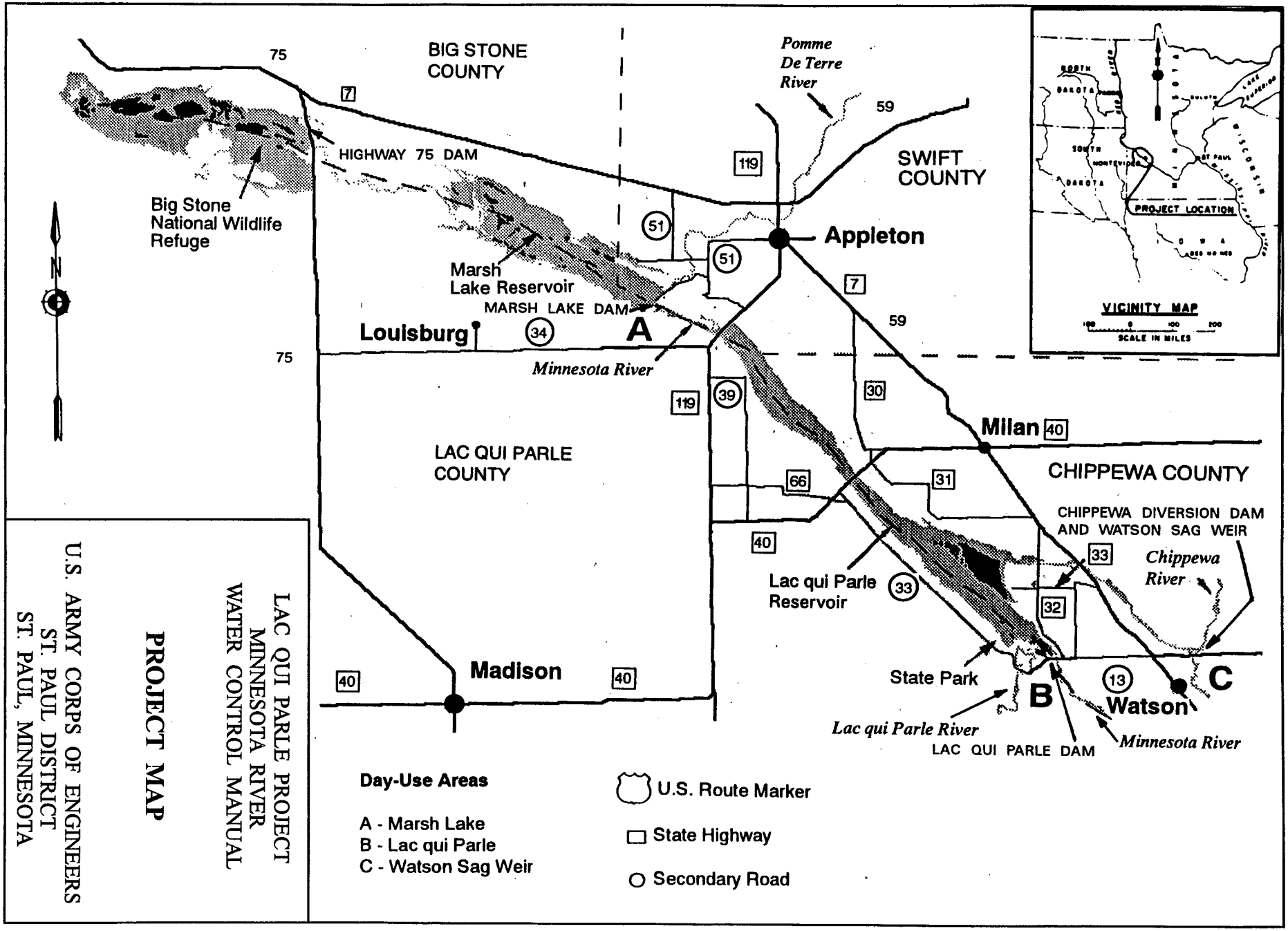
YELLOW BANK RIVER NEAR ODESSA, MN DD: 7 TYPE: 001 RATING NO: 26.0

OFFSET: 1.40 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
12.90	3046	3051	3056	3061	3066	3071	3076	3081	3086	3091	50.00
13.00	3096	3101	3106	3111	3116	3121	3126	3131	3135	3140	49.00
13.10	3145	3150	3155	3160	3165	3170	3175	3181	3186	3191	51.00
13.20	3196	3201	3206	3211	3216	3221	3226	3231	3236	3241	50.00
13.30	3246	3251	3256	3261	3266	3271	3277	3282	3287	3292	51.00
13.40	3297	3302	3307	3312	3317	3322	3328	3333	3338	3343	51.00
13.50	3348	3353	3358	3364	3369	3374	3379	3384	3389	3394	52.00
13.60	3400	3405	3410	3415	3420	3426	3431	3436	3441	3446	52.00
13.70	3452	3457	3462	3467	3472	3478	3483	3488	3493	3499	52.00
13.80	3504	3509	3514	3520	3525	3530	3535	3541	3546	3551	53.00
13.90	3557	3562	3567	3572	3578	3583	3588	3594	3599	3604	53.00
14.00	3610	3615	3620	3626	3631	3636	3642	3647	3652	3658	53.00
14.10	3663	3668	3674	3679	3684	3690	3695	3700	3706	3711	54.00
14.20	3717	3722	3727	3733	3738	3744	3749	3754	3760	3765	54.00
14.30	3771	3776	3782	3787	3792	3798	3803	3809	3814	3820	54.00
14.40	3825	3831	3836	3842	3847	3853	3858	3864	3869	3875	55.00
14.50	3880	3886	3891	3897	3902	3908	3913	3919	3924	3930	55.00
14.60	3935	3941	3946	3952	3957	3963	3968	3974	3980	3985	56.00
14.70	3991	3996	4002	4007	4013	4019	4024	4030	4035	4041	56.00
14.80	4047	4052	4058	4063	4069	4075	4080	4086	4092	4097	56.00
14.90	4103	4109	4114	4120	4126	4131	4137	4142	4148	4154	57.00
15.00	4160	4165	4171	4177	4182	4188	4194	4199	4205	4211	56.00
15.10	4216	4222	4228	4234	4239	4245	4251	4257	4262	4268	58.00
15.20	4274	4280	4285	4291	4297	4303	4308	4314	4320	4326	58.00
15.30	4332	4337	4343	4349	4355	4360	4366	4372	4378	4384	58.00
15.40	4390	4395	4401	4407	4413	4419	4425	4430	4436	4442	58.00
15.50	4448	4454	4460	4466	4471	4477	4483	4489	4495	4501	59.00
15.60	4507	4513	4519	4524	4530	4536	4542	4548	4554	4560	59.00
15.70	4566	4572	4578	4584	4590	4596	4601	4607	4613	4619	59.00
15.80	4625	4631	4637	4643	4649	4655	4661	4667	4673	4679	60.00
15.90	4685	4691	4697	4703	4709	4715	4721	4727	4733	4739	60.00
16.00	4745	4751	4757	4763	4769	4776	4782	4788	4794	4800	61.00
16.10	4806	4812	4818	4824	4830	4836	4842	4848	4855	4861	61.00
16.20	4867	4873	4879	4885	4891	4897	4903	4910	4916	4922	61.00
16.30	4928	4934	4940	4946	4953	4959	4965	4971	4977	4983	62.00
16.40	4990	4996	5002	5008	5014	5020	5027	5033	5039	5045	61.00
16.50	5051	5058	5064	5070	5076	5083	5089	5095	5101	5108	63.00

05293000
DATE PROCESSED: 08-12-1994 @ 13:40 BY HAVE
YELLOW BANK RIVER NEAR ODESSA, MN DD: 7 TYPE: 001 RATING NO: 26.0
OFFSET: 1.40 START DATE/TIME: 10-01-91 (0001)

GAGE HEIGHT (FEET)	DISCHARGE IN CUBIC FEET PER SECOND (EXPANDED PRECISION) .00	.01	.02	.03	.04	.05	.06	.07	.08	.09	DIFF IN Q PER TENTH FT
16.60	5114	5120	5126	5133	5139	5145	5151	5158	5164	5170	62.00
16.70	5176	5183	5189	5195	5202	5208	5214	5221	5227	5233	63.00
16.80	5239	5246	5252	5258	5265	5271	5277	5284	5290	5296	64.00
16.90	5303	5309	5316	5322	5328	5335	5341	5347	5354	5360	64.00
17.00	5367	5373	5379	5386	5392	5398	5405	5411	5418	5424	64.00
17.10	5431	5437	5443	5450	5456	5463	5469	5476	5482	5489	64.00
17.20	5495	5501	5508	5514	5521	5527	5534	5540	5547	5553	65.00
17.30	5560	5566	5573	5579	5586	5592	5599	5605	5612	5618	65.00
17.40	5625	5631	5638	5644	5651	5658	5664	5671	5677	5684	65.00
17.50	5690	5697	5703	5710	5717	5723	5730	5736	5743	5749	66.00
17.60	5756	5763	5769	5776	5783	5789	5796	5802	5809	5816	66.00
17.70	5822	5829	5836	5842	5849	5855	5862	5869	5875	5882	67.00
17.80	5889	5895	5902	5909	5915	5922	5929	5936	5942	5949	67.00
17.90	5956	5962	5969	5976	5982	5989	5996	6003	6009	6016	67.00
18.00	6023	6030	6036	6043	6050	6057	6063	6070	6077	6084	67.00
18.10	6090	6097	6104	6111	6117	6124	6131	6138	6145	6151	68.00
18.20	6158	6165	6172	6179	6186	6192	6199	6206	6213	6220	68.00
18.30	6226	6233	6240	6247	6254	6261	6268	6274	6281	6288	69.00
18.40	6295	6302	6309	6316	6323	6330	6336	6343	6350	6357	69.00
18.50	6364	6371	6378	6385	6392	6399	6406	6412	6419	6426	69.00
18.60	6433	6440	6447	6454	6461	6468	6475	6482	6489	6496	70.00
18.70	6503	6510	6517	6524	6531	6538	6545	6552	6559	6566	70.00
18.80	6573	6580	6587	6594	6601	6608	6615	6622	6629	6636	70.00
18.90	6643	6650	6657	6664	6671	6679	6686	6693	6700	6707	71.00
19.00	6714	6721	6728	6735	6742	6749	6756	6764	6771	6778	71.00
19.10	6785	6792	6799	6806	6813	6821	6828	6835	6842	6849	71.00
19.20	6856	6863	6871	6878	6885	6892	6899	6906	6914	6921	72.00
19.30	6928	6935	6942	6950	6957	6964	6971	6978	6986	6993	72.00*
19.40	7000*										

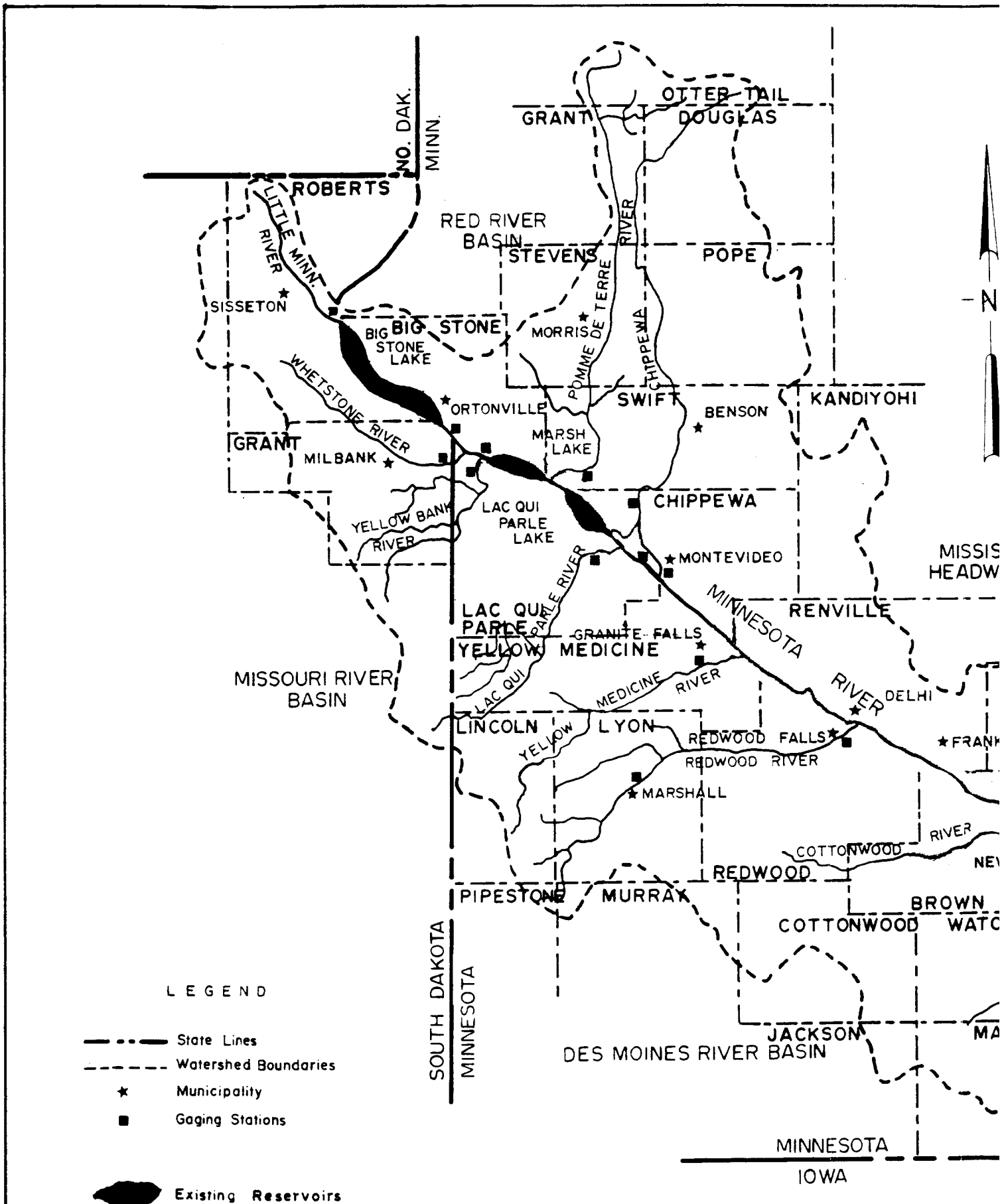


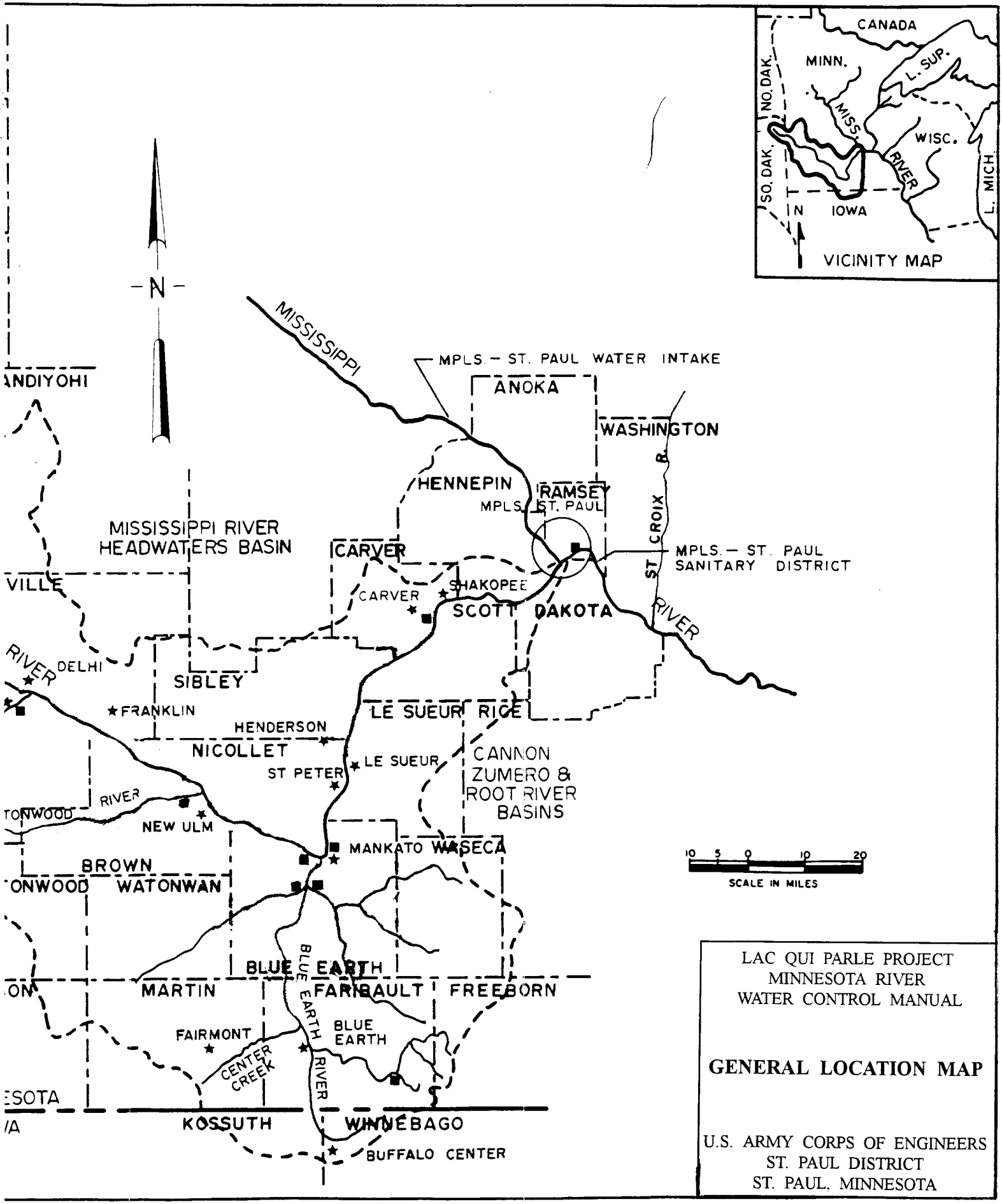
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PROJECT MAP

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/86 **PLATE 2-1**


NO. DAK.
MINN.
OTTER TAIL
GRANT
DOUGLAS
ROBERTS
LITTLE MINN. RIVER
RED RIVER BASIN
STEVENS
POMME DE TERRE RIVER
CHIPPEWA RIVER
POPE
SISSETON
BIG STONE
BIG STONE LAKE
MORRIS
WHETSTONE RIVER
ORTONVILLE
SWIFT
BENSON
KANDIYOHI
GRANT
MILBANK
MARSH LAKE
CHIPPEWA
YELLOW BANK RIVER
LAC QUI PARLE LAKE
MONTEVIDEO
LAC QUI PARLE RIVER
MINNESOTA RIVER
RENVILLE
LAC QUI PARLE
GRANITE FALLS
YELLOW MEDICINE
MISSOURI RIVER BASIN
LAC QUI
MEDICINE RIVER
DELHI
LINCOLN
LYON
YELLOW
REDWOOD FALLS
REDWOOD RIVER
MARSHALL
COTTONWOOD RIVER
REDWOOD
PIPESTONE
MURRAY
BROWN
COTTONWOOD
SOUTH DAKOTA
MINNESOTA
JACKSON
DES MOINES RIVER BASIN
MINNESOTA
IOWA
LEGEND
State Lines
Watershed Boundaries
Municipality
Gaging Stations
Existing Reservoirs

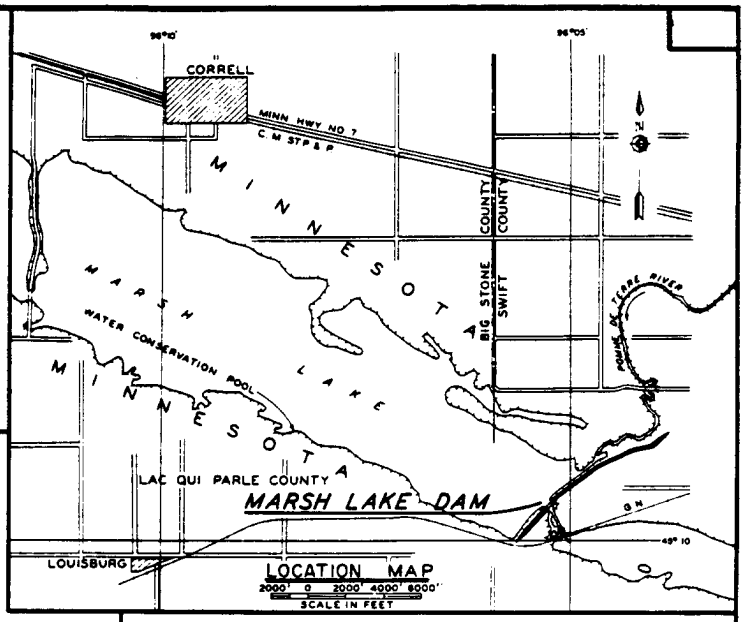


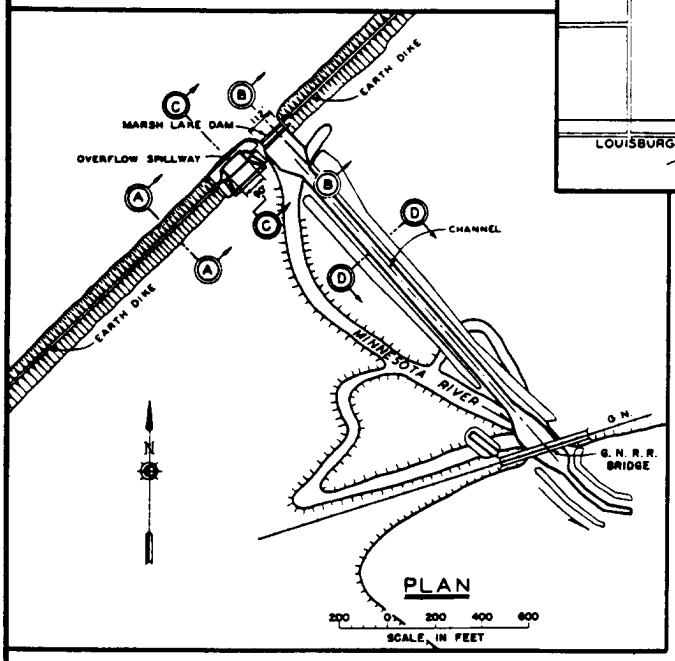
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

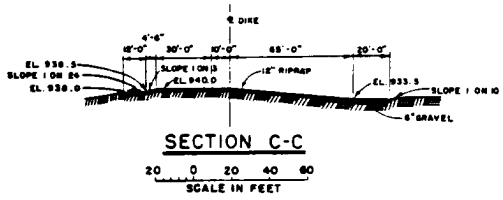
GENERAL LOCATION MAP

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/87 **PLATE 2-2**



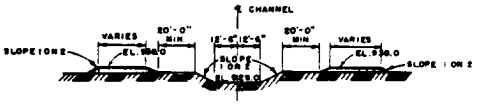




SECTION C-C

20 0 20 40 60

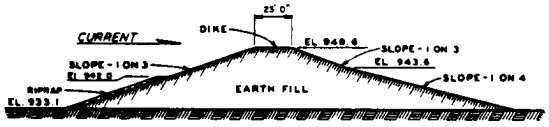
SCALE IN FEET



SECTION D-D

20 0 20 40 60

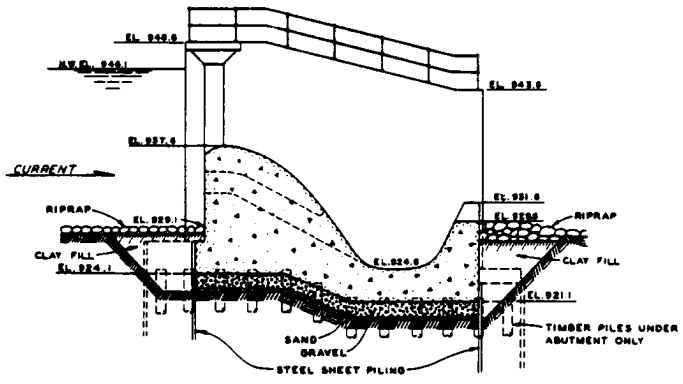
SCALE IN FEET



SECTION A-A

10 0 10 20 30

SCALE IN FEET



SECTION B-B

5 0 5 10 15

SCALE IN FEET

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

MARSH LAKE DAM
PLANS AND SECTIONS

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

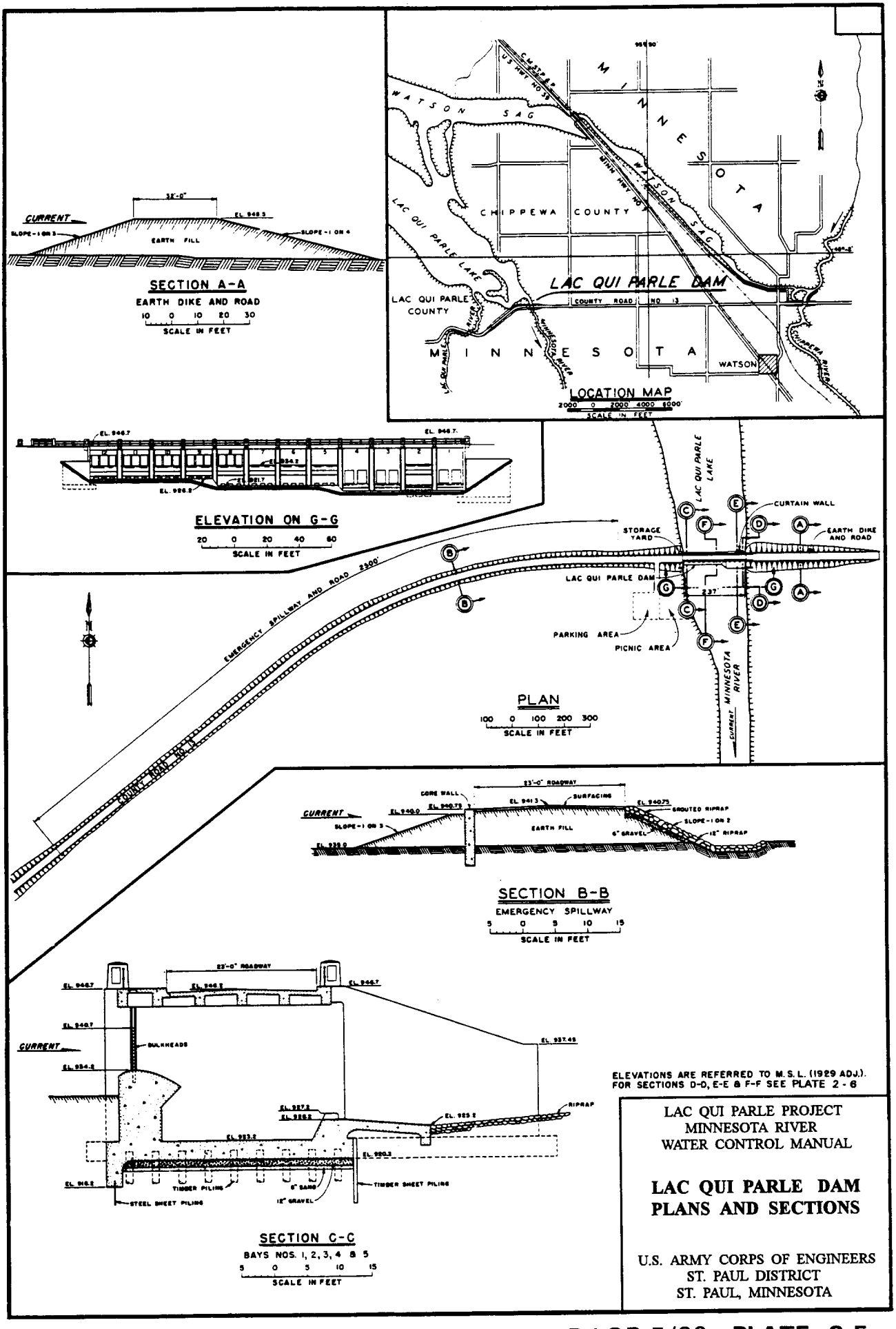
FILE NO. M34-R-LQP-5/88 **PLATE 2-3**

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

**RATING CURVES
FOR VARIOUS
TAILWATER ELEVATIONS
MARSH LAKE DAM**

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/89 **PLATE 2-4**



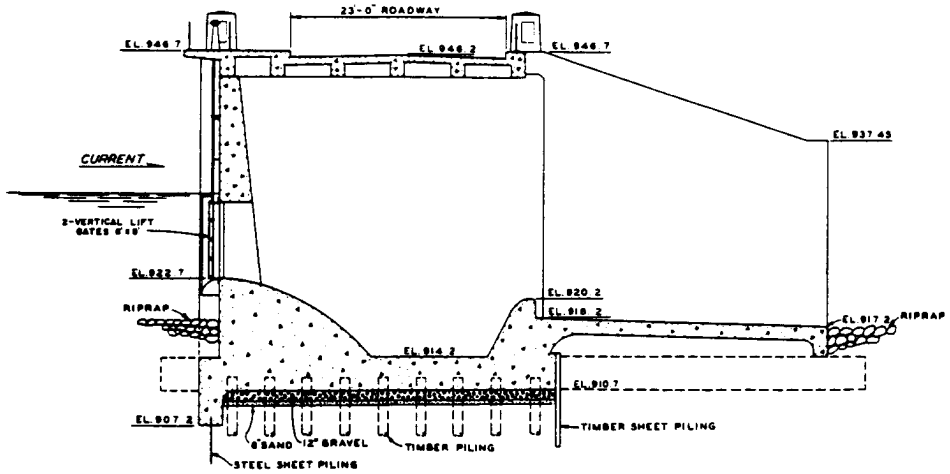
ELEVATIONS ARE REFERRED TO M.S.L. (1929 ADJ.).
FOR SECTIONS D-D, E-E & F-F SEE PLATE 2 - 6

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

LAC QUI PARLE DAM
PLANS AND SECTIONS

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/90 **PLATE 2-5**

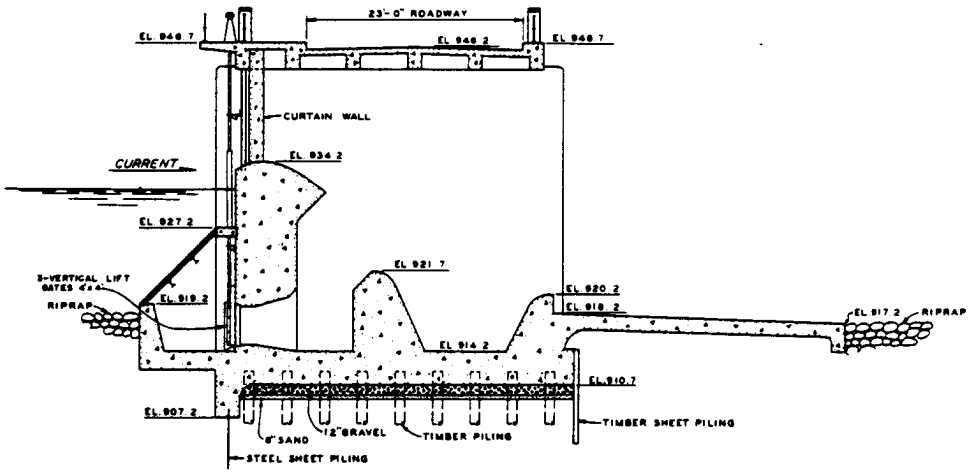


SECTION D-D

BAYS NOS. 1, 3 & 4

5 0 5 10 15

SCALE IN FEET

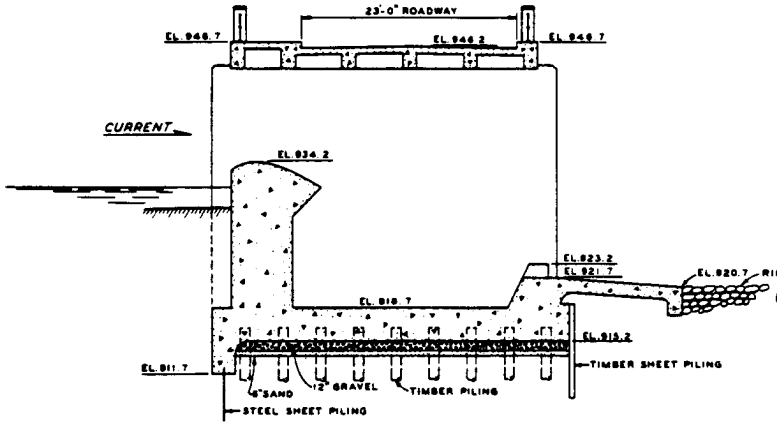


SECTION E-E

BAY NO. 2

5 0 5 10 15

SCALE IN FEET



SECTION F-F

BAYS NOS. 5, 6 & 7

5 0 5 10 15

SCALE IN FEET

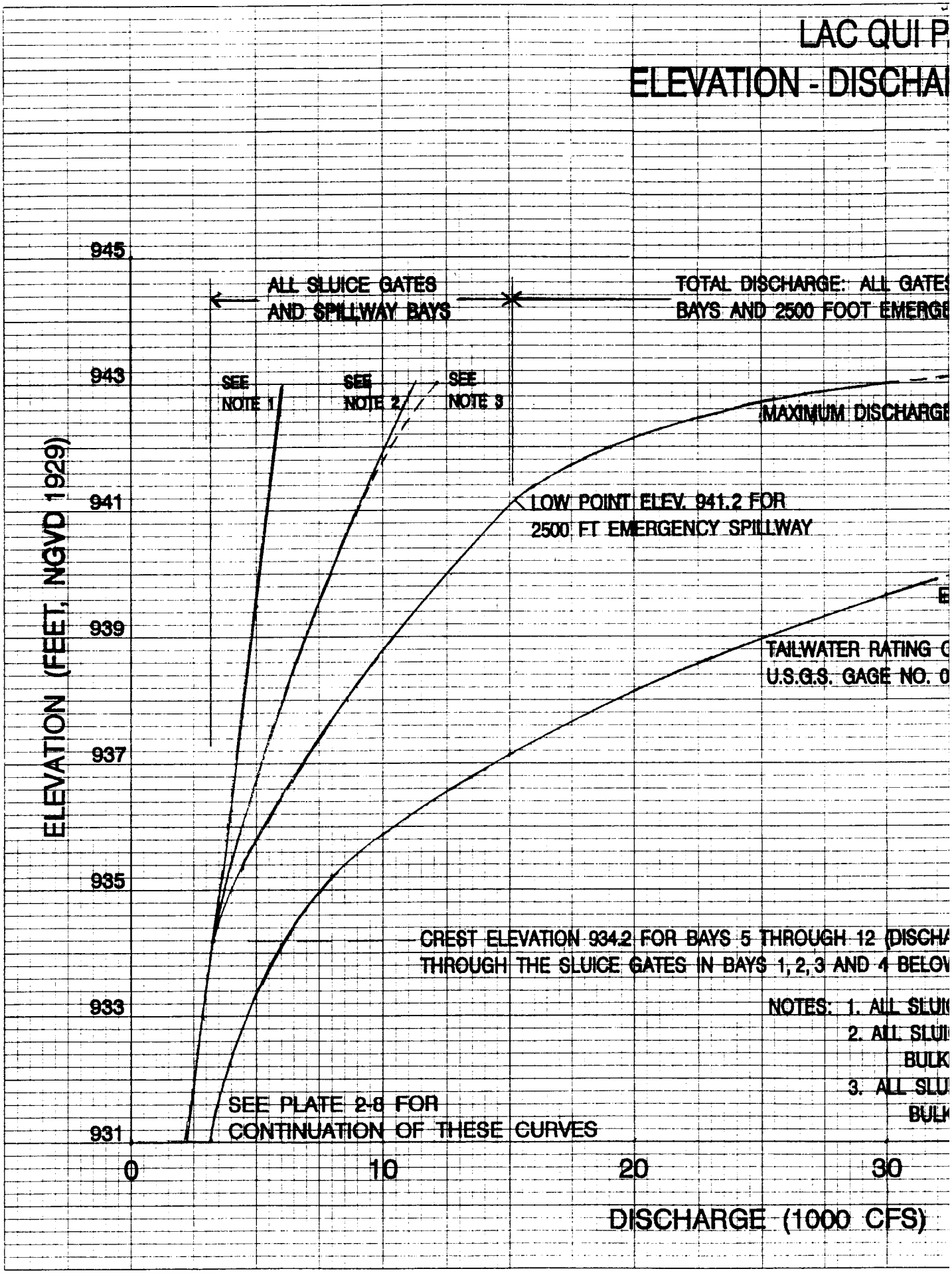
FOR LOCATION OF SECTIONS SEE PLATE 2 - 5

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

LAC QUI PARLE DAM SECTIONS

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

(1)



QUI PARLE DAM
CHARGE RATING CURVES

FOR MAXIMUM DISCHARGE CURVE:

BELOW EMERGENCY SPILLWAY LOW POINT -
DEVELOPED FROM CURVES DATED APRIL 1957, WHICH WERE COMPUTED FROM OBSERVED 1952 FLOOD FLOWS

ABOVE EMERGENCY SPILLWAY LOW POINT -
DEVELOPED FROM COMPUTATIONS BASED ON 1995 FLOOD AND SPILLWAY CREST SURVEY

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVES
MAXIMUM DISCHARGE
LAC QUI PARLE DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

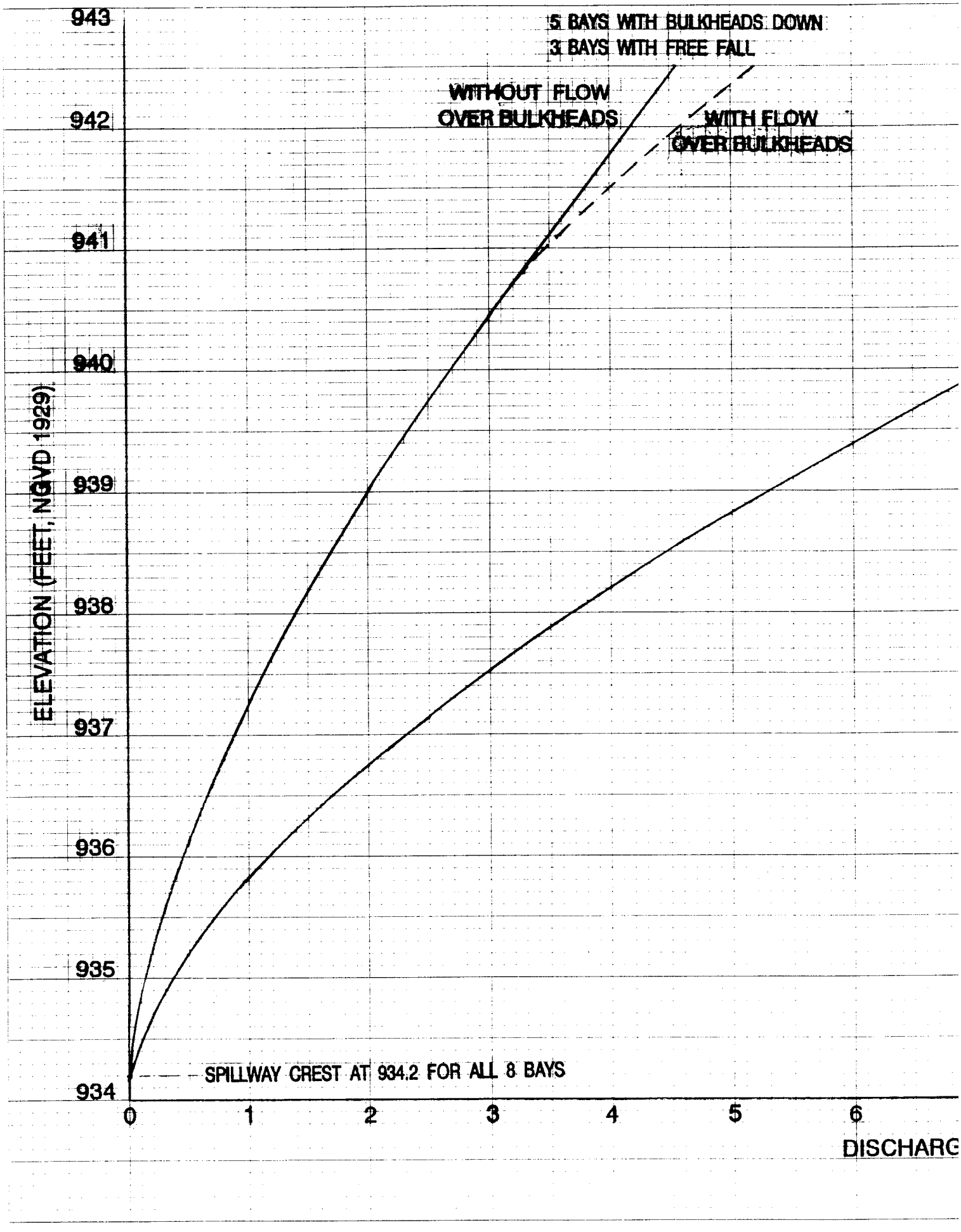
FILE NO. M34-R-LQP-5/92 **PLATE 2-7**

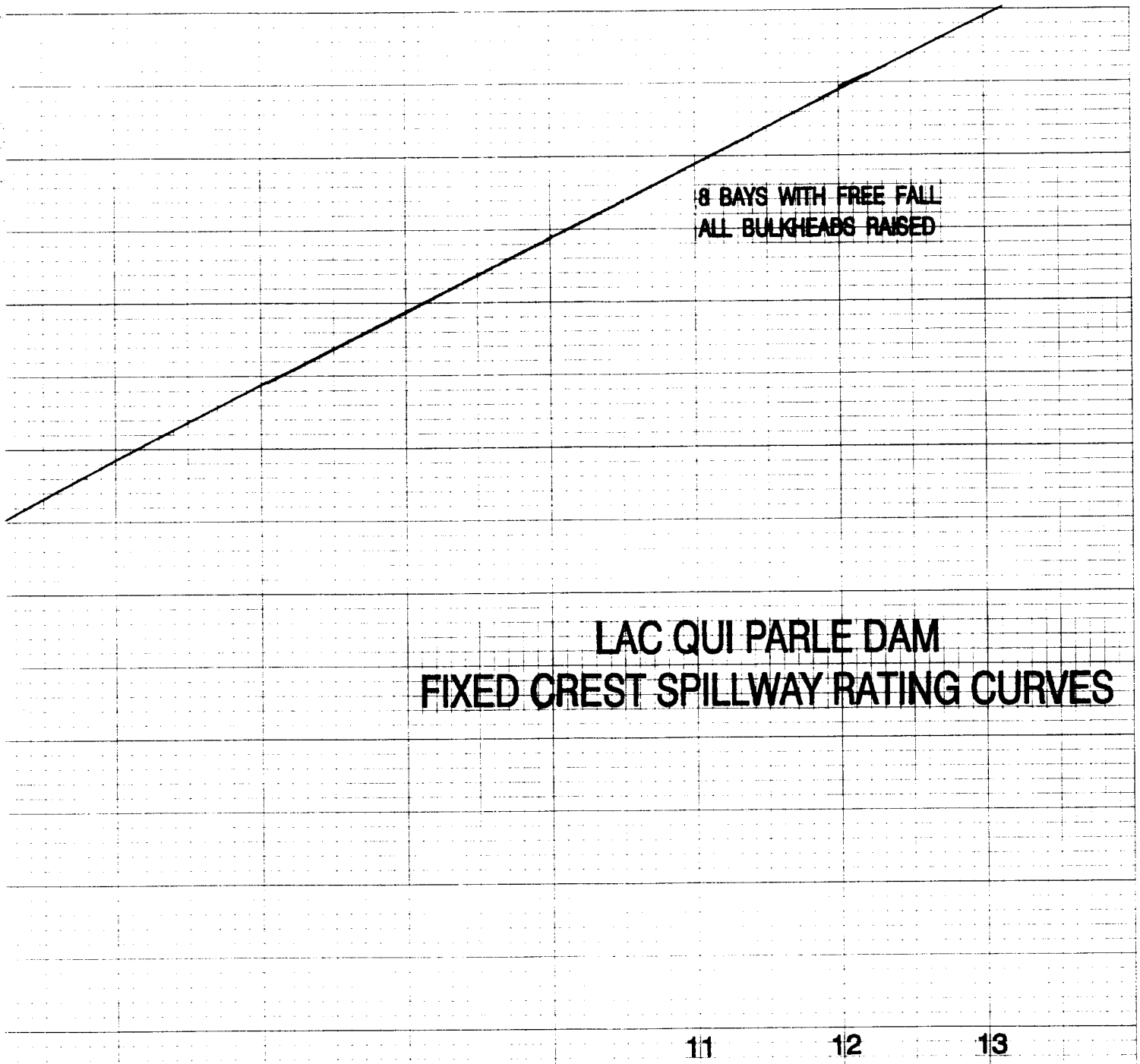
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVES
ELEVATIONS BELOW 934.2 FEET
LAC QUI PARLE DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/93 PLATE 2-8


5 BAYS WITH BULKHEADS DOWN
3 BAYS WITH FREE FALL
WITHOUT FLOW OVER BULKHEADS
WITH FLOW OVER BULKHEADS
ELEVATION (FEET, NGVD 1929)
943
942
941
940
939
938
937
936
935
934
SPILLWAY CREST AT 934.2 FOR ALL 8 BAYS
0
1
2
3
4
5
6
DISCHARG



LAC QUI PARLE DAM
FIXED CREST SPILLWAY RATING CURVES

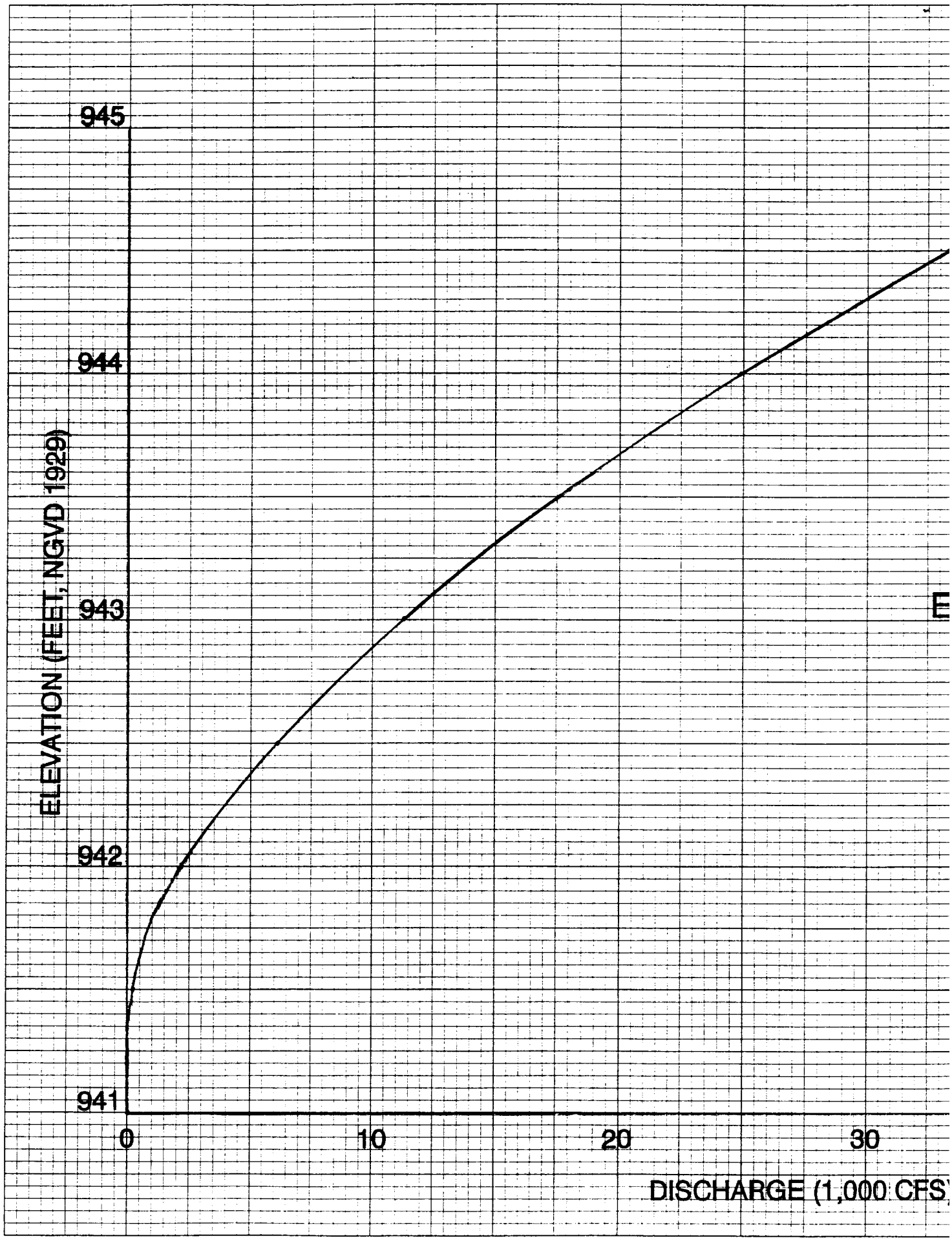
THESE CURVES WERE DEVELOPED
FROM ORIGINAL CURVES DATED MARCH 1948

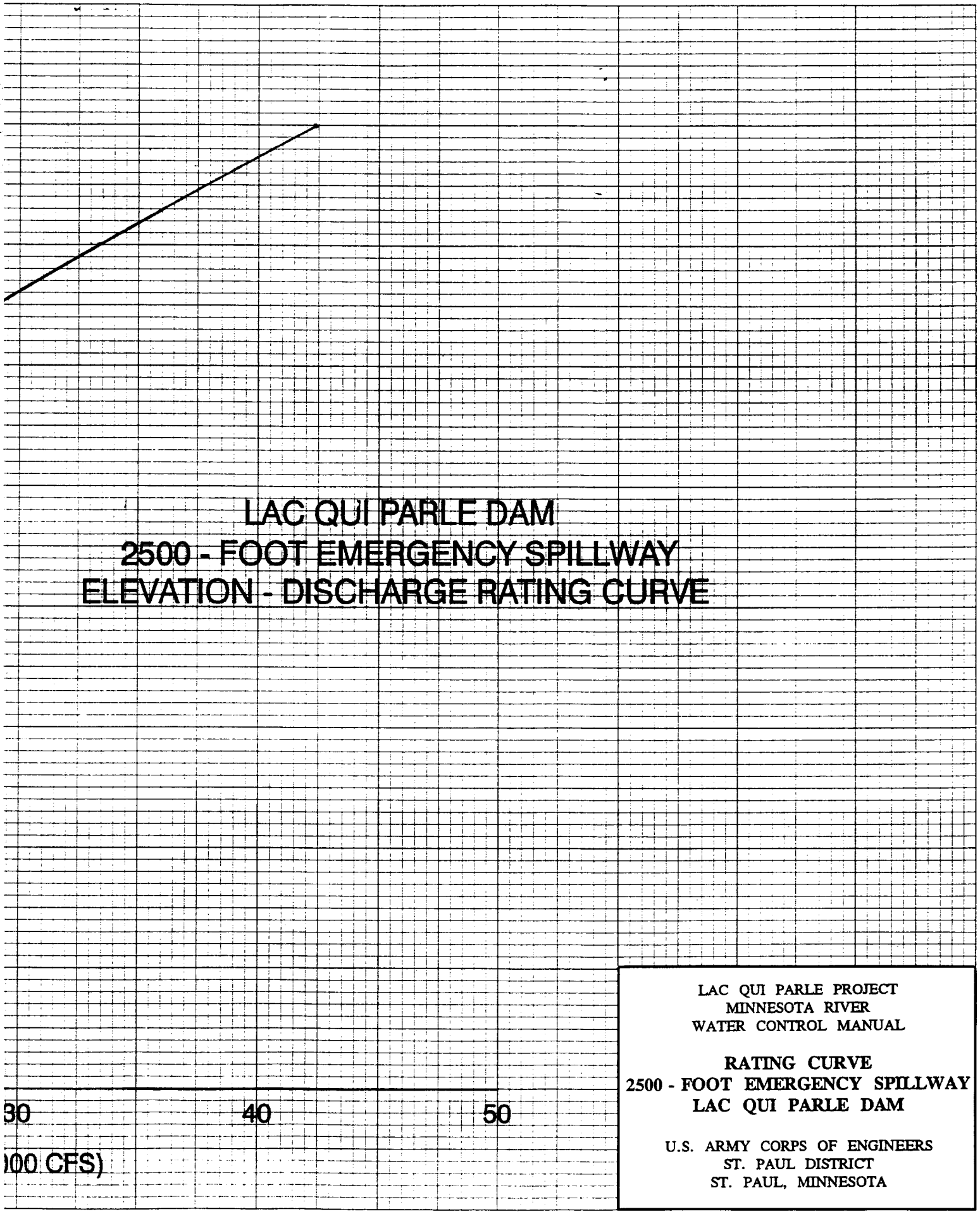
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVES
FIXED - CREST SPILLWAY
LAC QUI PARLE DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/94 PLATE 2-9





LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
2500 - FOOT EMERGENCY SPILLWAY
LAC QUI PARLE DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/95 **PLATE 2-10**

MINNESOTA RIVER NEAR LAC QUI PARLE, MN
U.S.G.S. GAGE NUMBER 05301000
TAILWATER STAGE - DISCHARGE RATING CURVE

RATING CURVE NUMBER 24, STARTING 1 OCTOBER 1990
GAGE DATUM IS 900.00 FEET ABOVE MSL

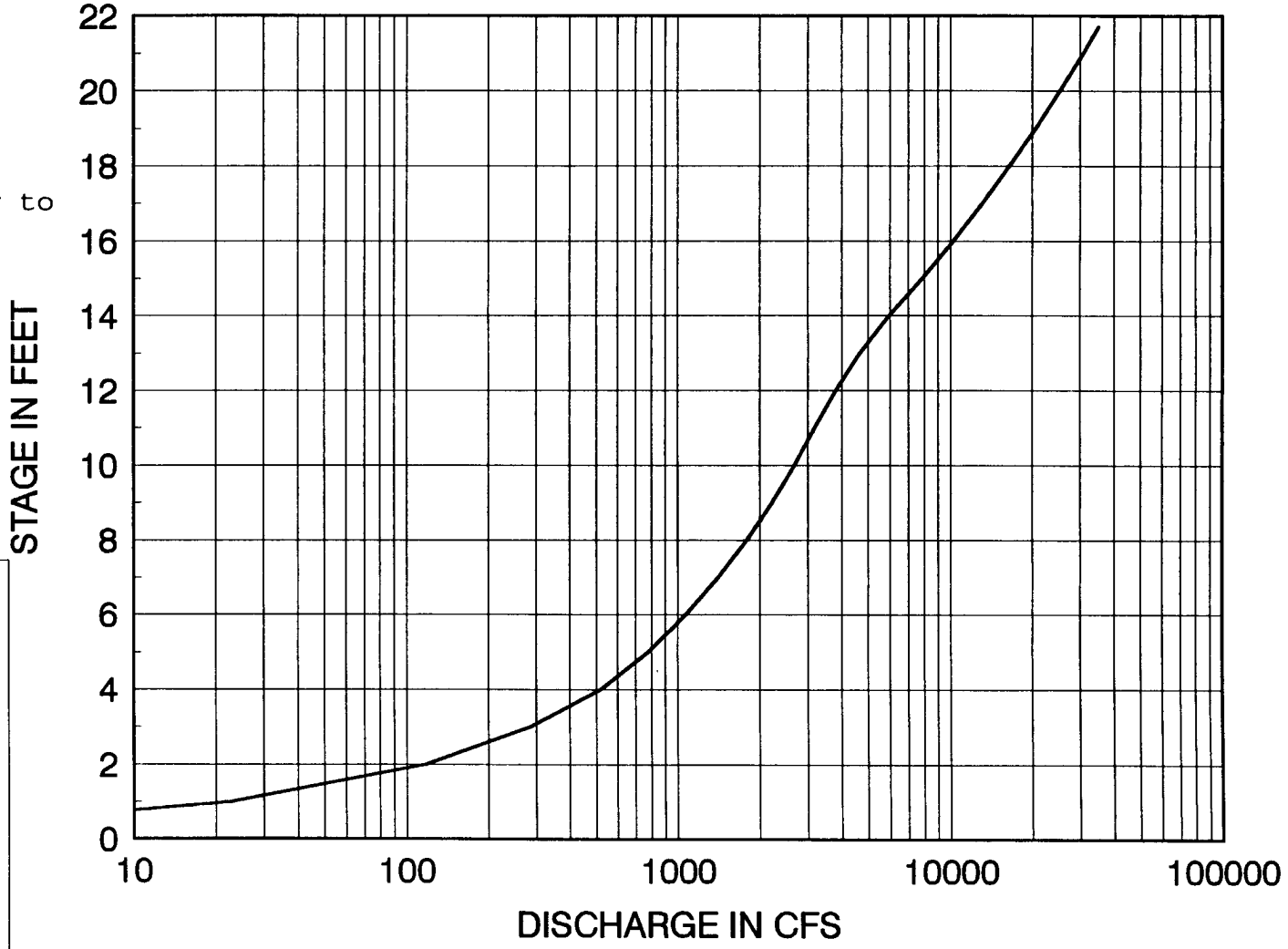
See Exhibit E for tables corresponding to this plate.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05301000
MINNESOTA RIVER
NEAR LAC QUI PARLE, MN

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

MINNESOTA RIVER AT MONTEVIDEO, MN
U.S.G.S. GAGE NUMBER 05311000
STAGE - DISCHARGE RATING CURVE



RATING CURVE NUMBER 45, STARTING 1 OCTOBER 1985
GAGE DATUM IS 909.12 FEET ABOVE MSL

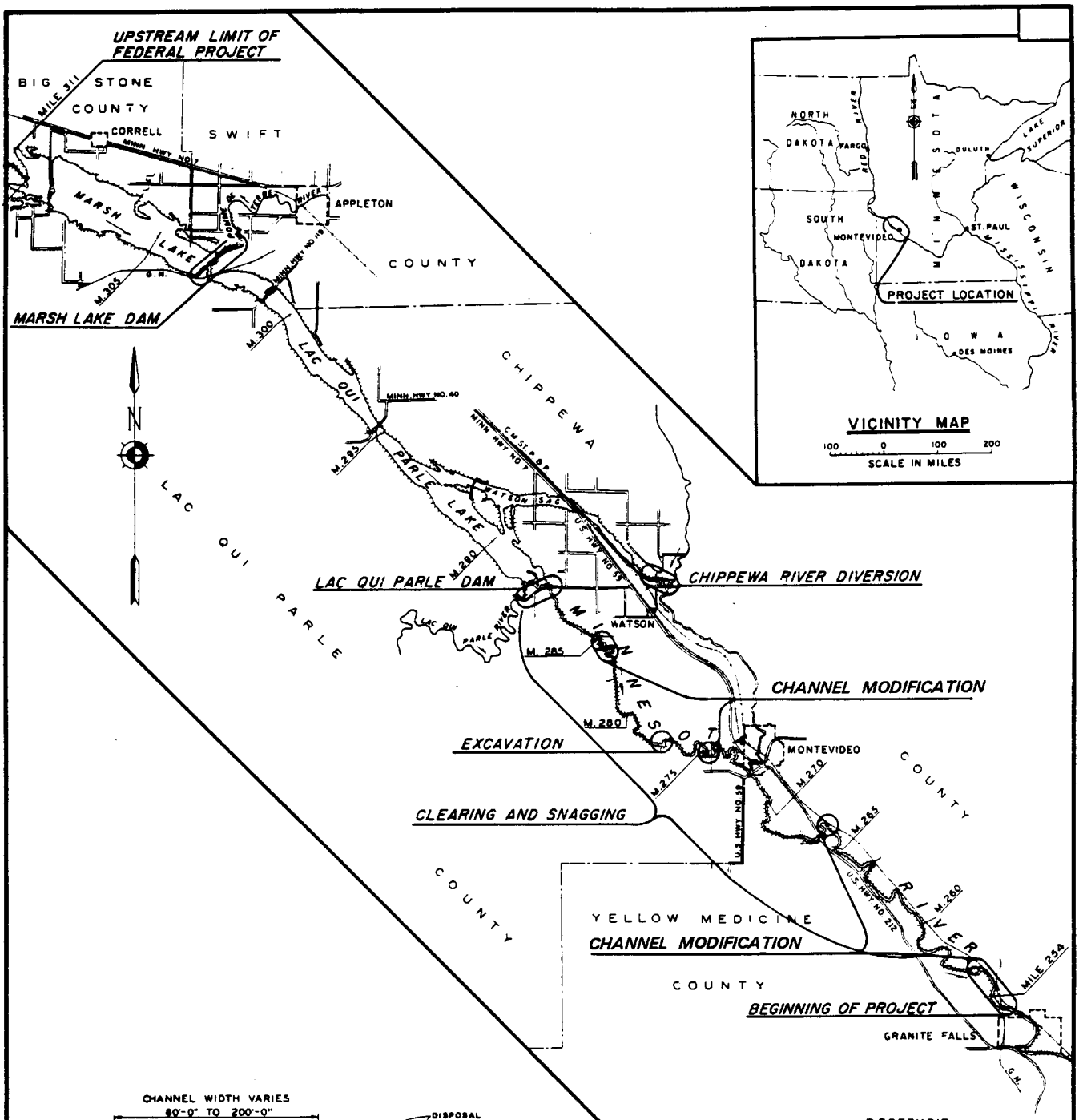
See Exhibit E for tables corresponding to this plate.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05311000
MINNESOTA RIVER
AT MONTEVIDEO, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/97 PLATE 2-12



RESERVOIR

CONSERVATION STORAGE	41,750 AC FT
FLOOD CONTROL STORAGE	116,050 AC FT
GROSS CAPACITY	157,800 AC FT
FREEBOARD ABOVE FULL POOL	4.9 FT.

LENGTH
FROM A POINT ON THE MINNESOTA RIVER, MILE 254 TO THE UPSTREAM END OF MARSH LAKE, MILE 311, A DISTANCE OF 57 MILES.

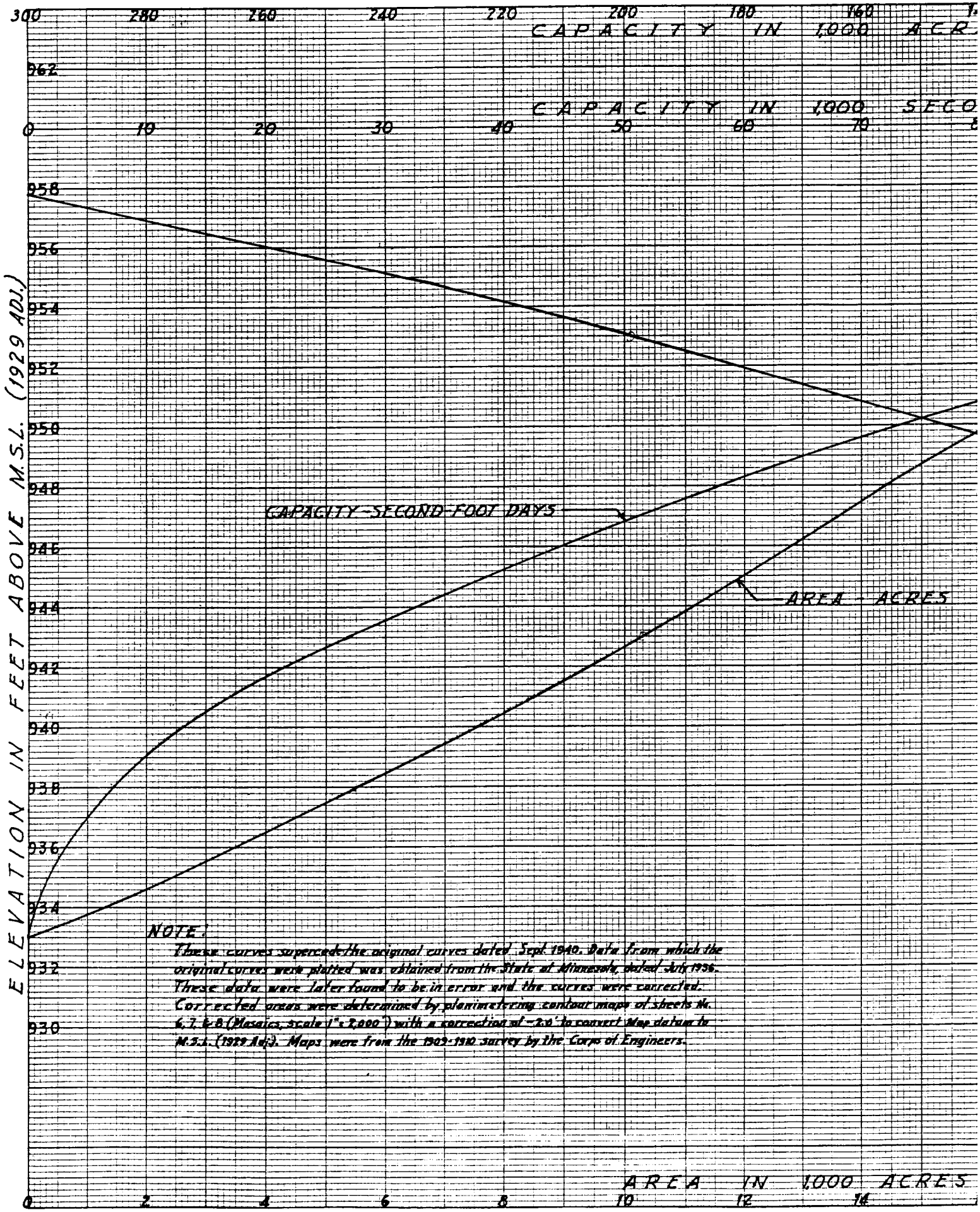
CHANNEL WIDTH
VARIES FROM 80 FEET TO 200 FEET

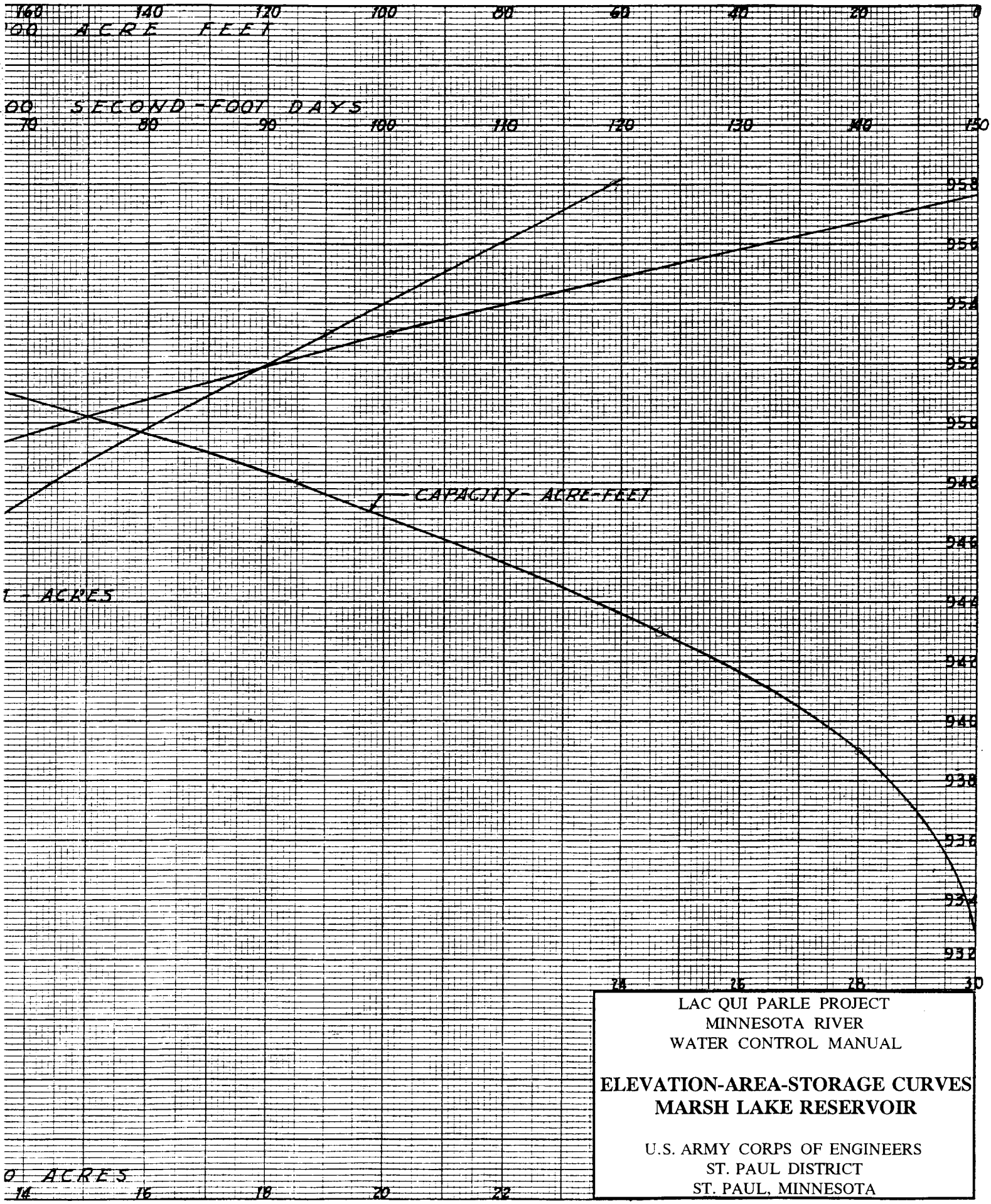
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

MINNESOTA RIVER CHANNEL MODIFICATIONS RIVER MILE 254 TO 288.1

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/98 **PLATE 2-13**


300
280
260
240
220
200
180
160
CAPACITY IN 1,000 ACR
962
CAPACITY IN 1,000 SECO
0
10
20
30
40
50
60
70
958
956
954
952
950
948
946
944
942
940
938
936
934
932
930
ELEVATION IN FEET ABOVE M.S.L. (1929 ADJ.)
CAPACITY-SECOND-FOOT DAYS
AREA ACRES
NOTE:
These curves supercede the original curves dated Sept. 1940. Data from which the original curves were plotted was obtained from the State of Minnesota, dated July 1936. These data were later found to be in error and the curves were corrected. Corrected areas were determined by planimetering contour maps of sheets No. 6, 7, & 8 (Mosaics, Scale 1" = 2,000') with a correction of -2.0' to convert Map datum to M.S.L. (1929 Adj). Maps were from the 1909-1910 survey by the Corps of Engineers.
AREA IN 1,000 ACRES
0
2
4
6
8
10
12
14



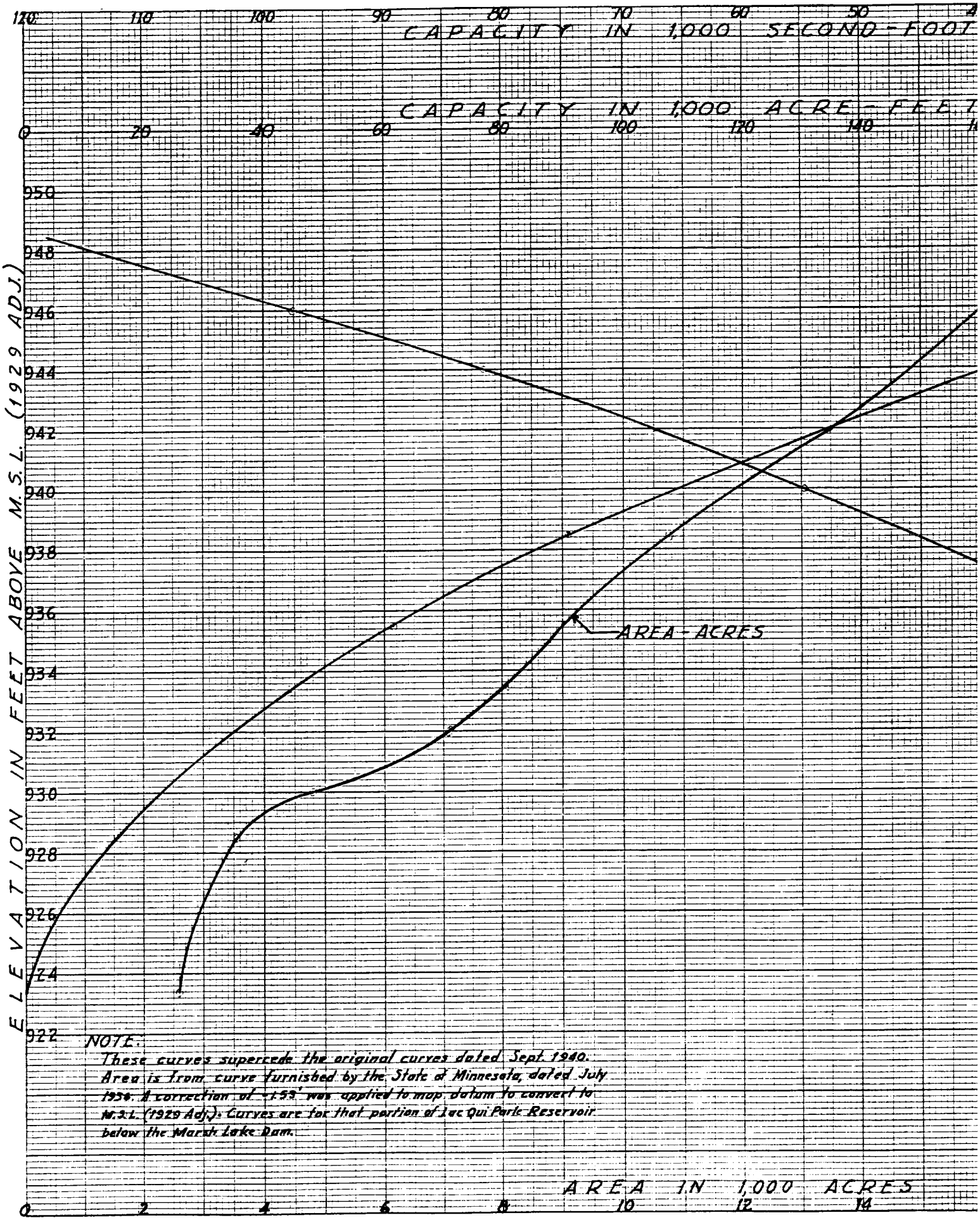
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

ELEVATION-AREA-STORAGE CURVES
MARSH LAKE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

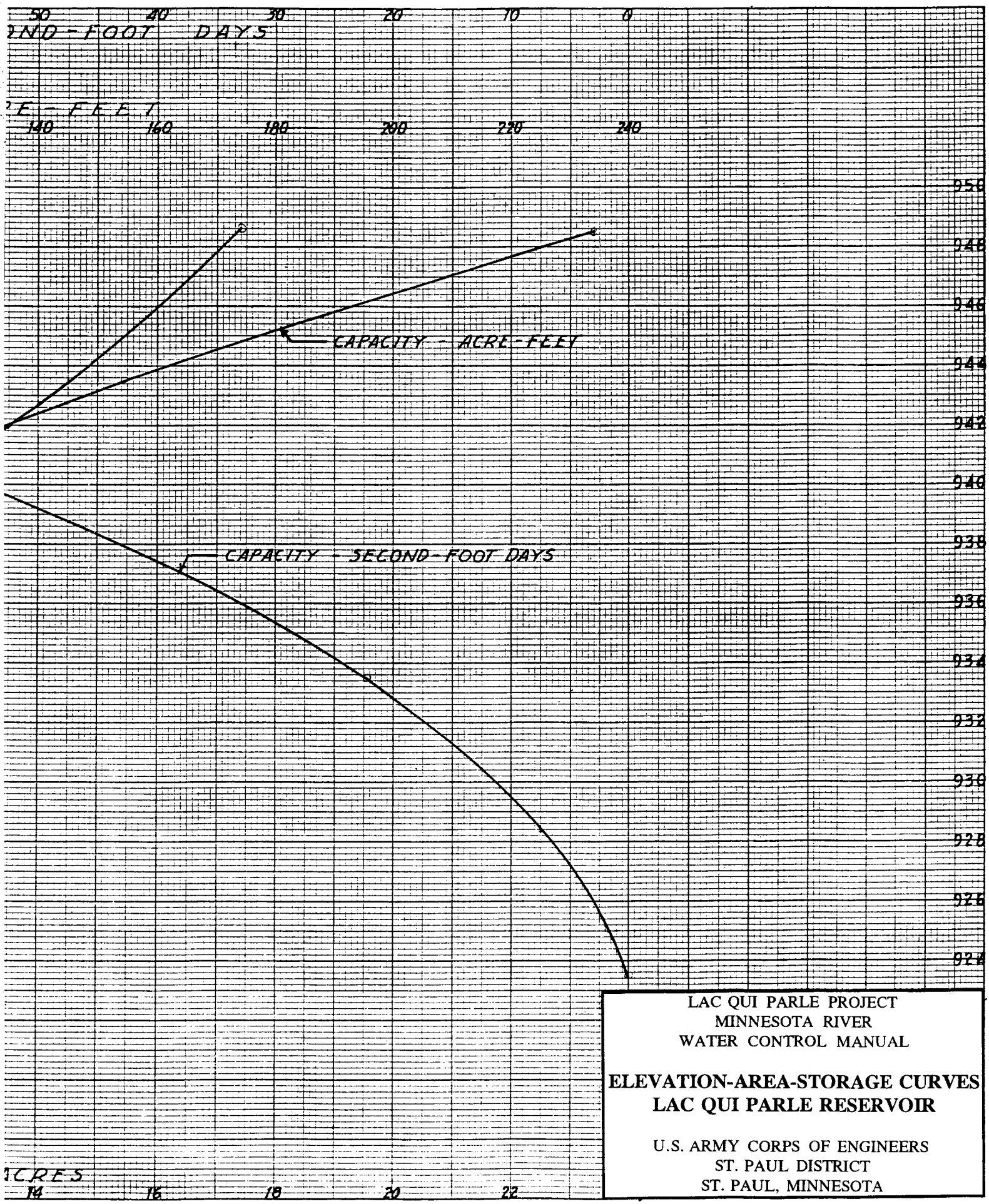
FILE NO. M34-R-LQP-5/99 **PLATE 2-14**

(1)



NOTE:
These curves supercede the original curves dated Sept. 1940. Area is from curve furnished by the State of Minnesota, dated July 1938. A correction of -1.53' was applied to map datum to convert to M.S.L. (1929 Adj.). Curves are for that portion of Lac Qui Parle Reservoir below the Marsh Lake Dam.

(7)

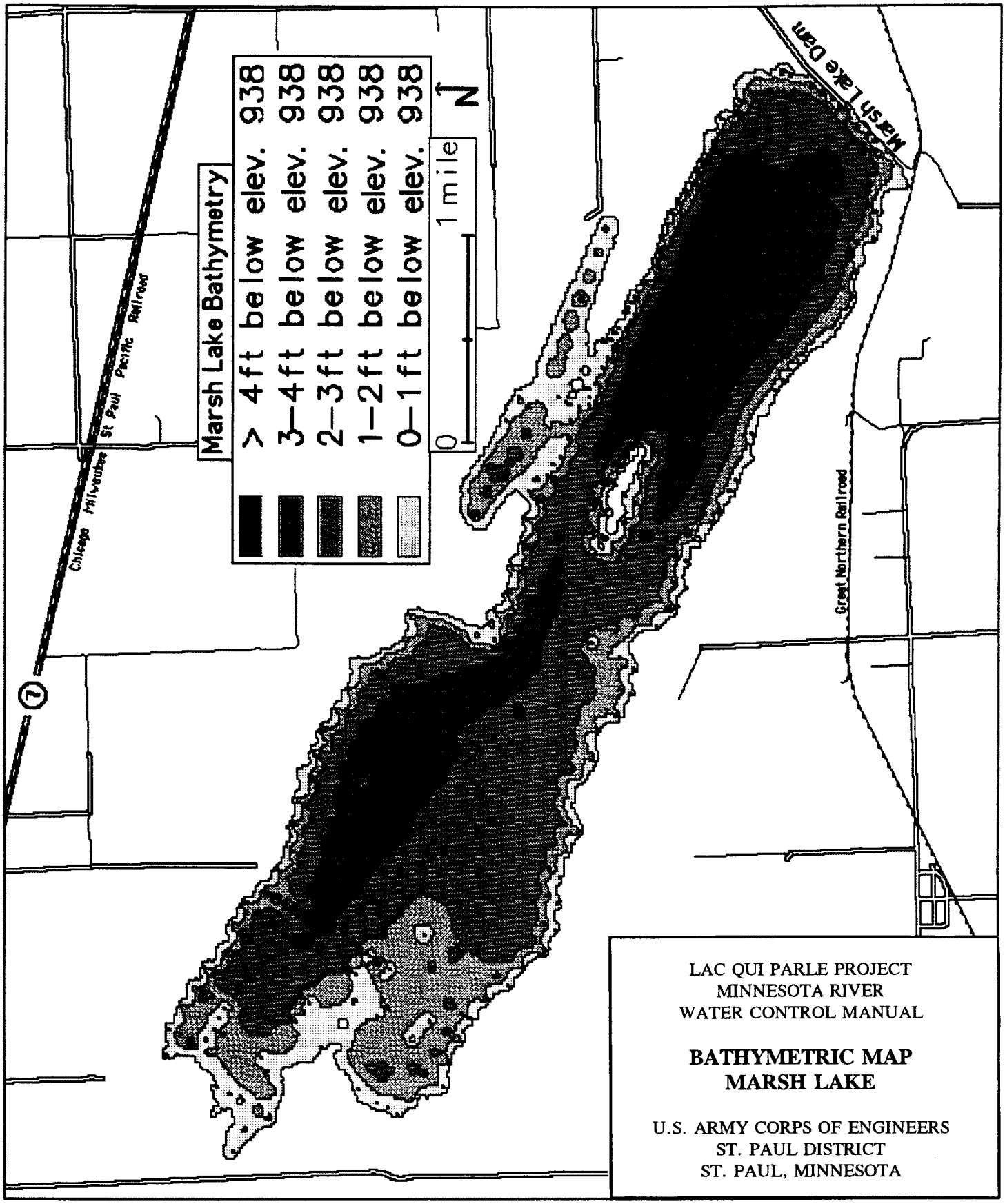


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

ELEVATION-AREA-STORAGE CURVES
LAC QUI PARLE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/100 PLATE 2-15



FILE NO. M34-R-LQP-5/101 **PLATE 2-16**


TWP 120 N
TWP 119 N
MANAGEMENT
WILDLIFE
S.H. 119
PUBLIC ACCESS AREA
WILDLIFE
MANAGEMENT
PUBLIC ACCESS
AREA
PUBLIC ACCESS
S.A.R.S
C.A.R.D

REVISED 2-7-68 DBC

B.M. = CENTER OF BOTTOM CONCRETE STEP ON STAIRWAY FROM RIP-RAP TO BOAT LANDING AT MILAN BEACH BRIDGE, ON S.H. 40

W.S. = B.M. - 3.2'

PLANIMETERED AREA = 5,588.9 ACRES

State of Minnesota 1964

State of Minnesota 1964

B - 1

OUTLINE TRACED FROM 1955 AERIAL PHOTO

STATE OF MINNESOTA
DEPARTMENT OF CONSERVATION

DIVISION OF GAME AND FISH
BUREAU OF RESEARCH AND PLANNING

LAC QUI PARLE LAKE 37-4
LAC QUI PARLE, SWIFT, CHIPPEWA CO.
SHEET 1 OF 2
TWP 118, 119, 120 N. R 42, 43 W. SEC. VAR.

FIELDWORK S.E.A	DRAWN BY S.E.A	PROJECT NO
DATE 9-12-57	DATE 12-27-57	10-6-2

Department of Administration

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Contour Lake Map
612/297-3000 or o
Nationwide toll-fre
1-800-657-3757

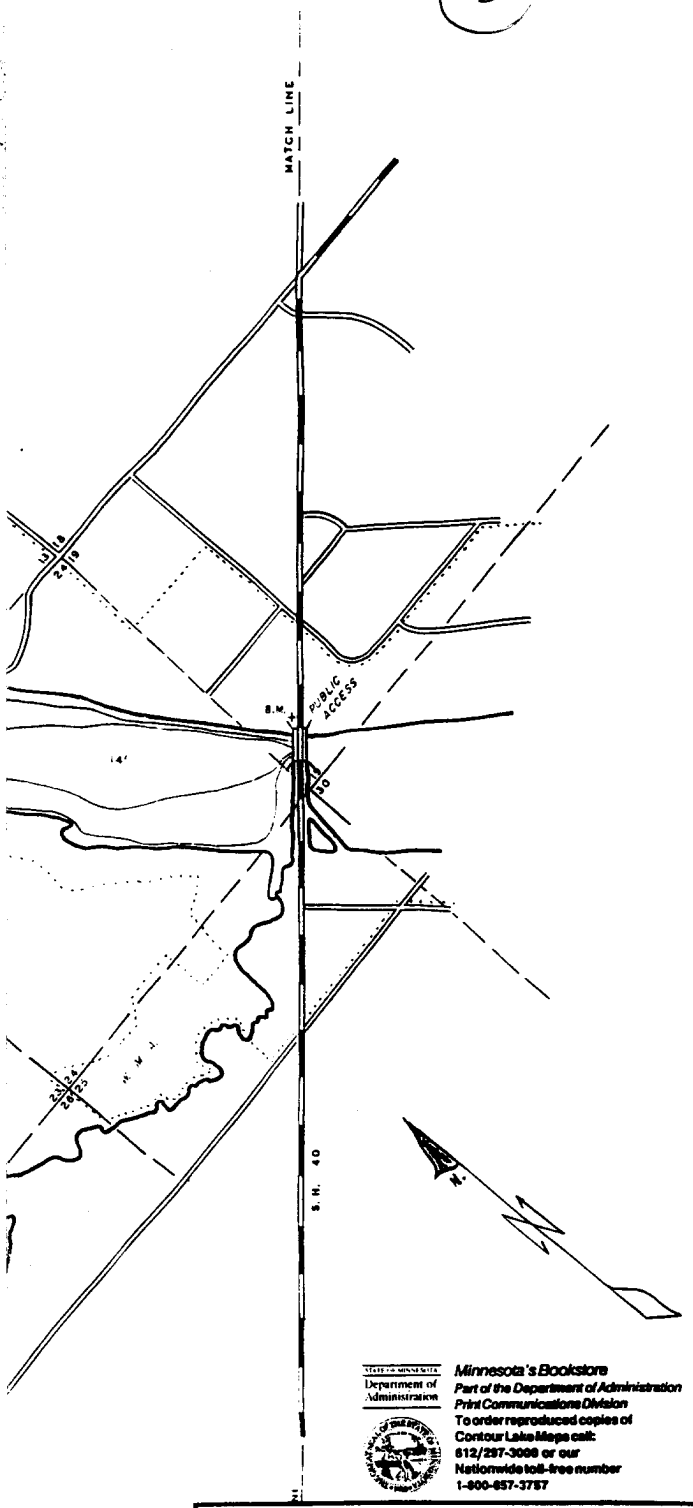
LAC QUI PARLE PR
MINNESOTA RI
WATER CONTROL M

BATHYMETRIC
LAC QUI PARLE RI
UPSTREAM I

U.S. ARMY CORPS OF
ST. PAUL DISTI
ST. PAUL, MINN

FILE NO. M34-R-LQP-5/102

(3)



2640

ERVATION

AND FISH
PLANNING

LE LAKE 37-4
CHIPPEWA CO.

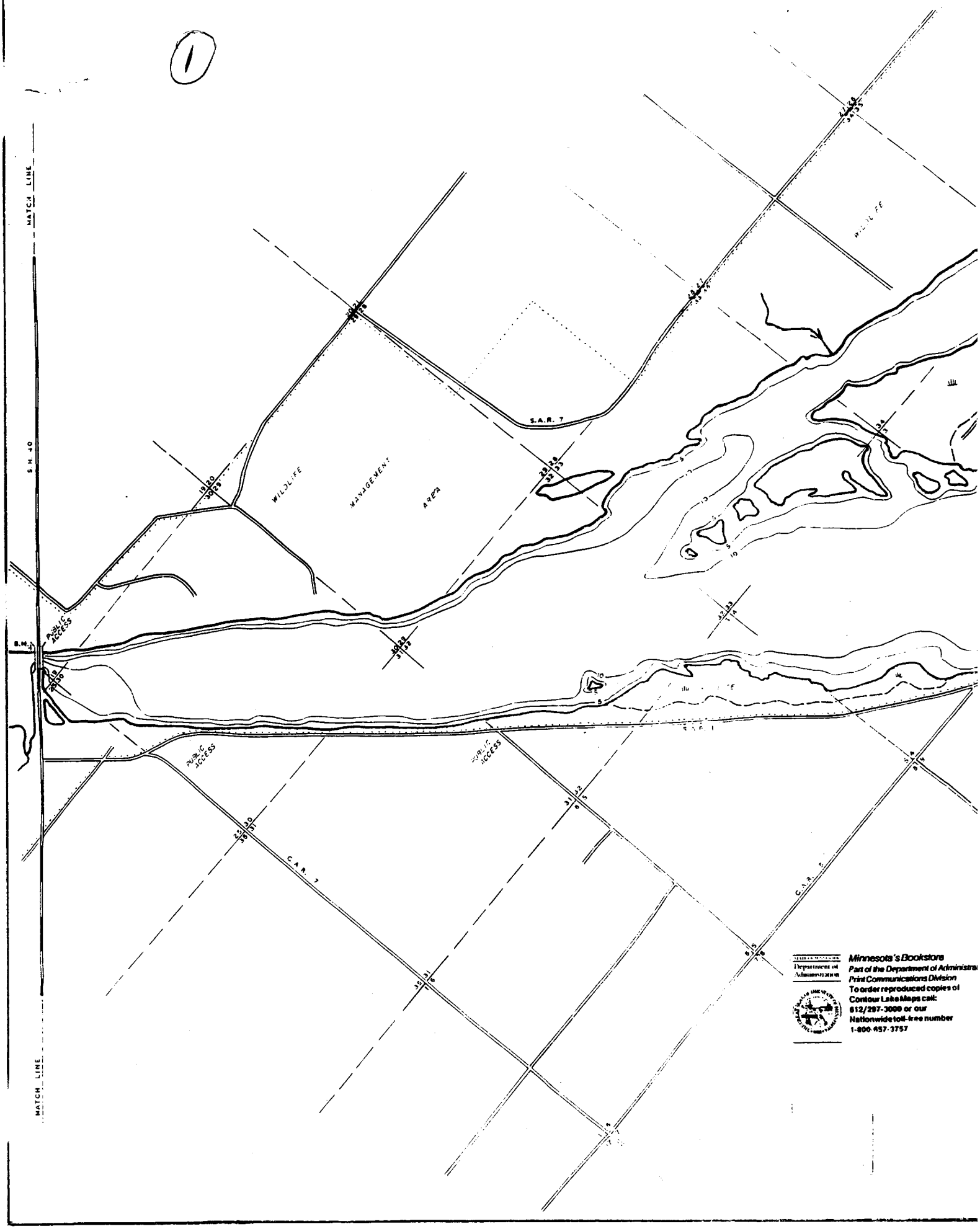
SEC. VAR.

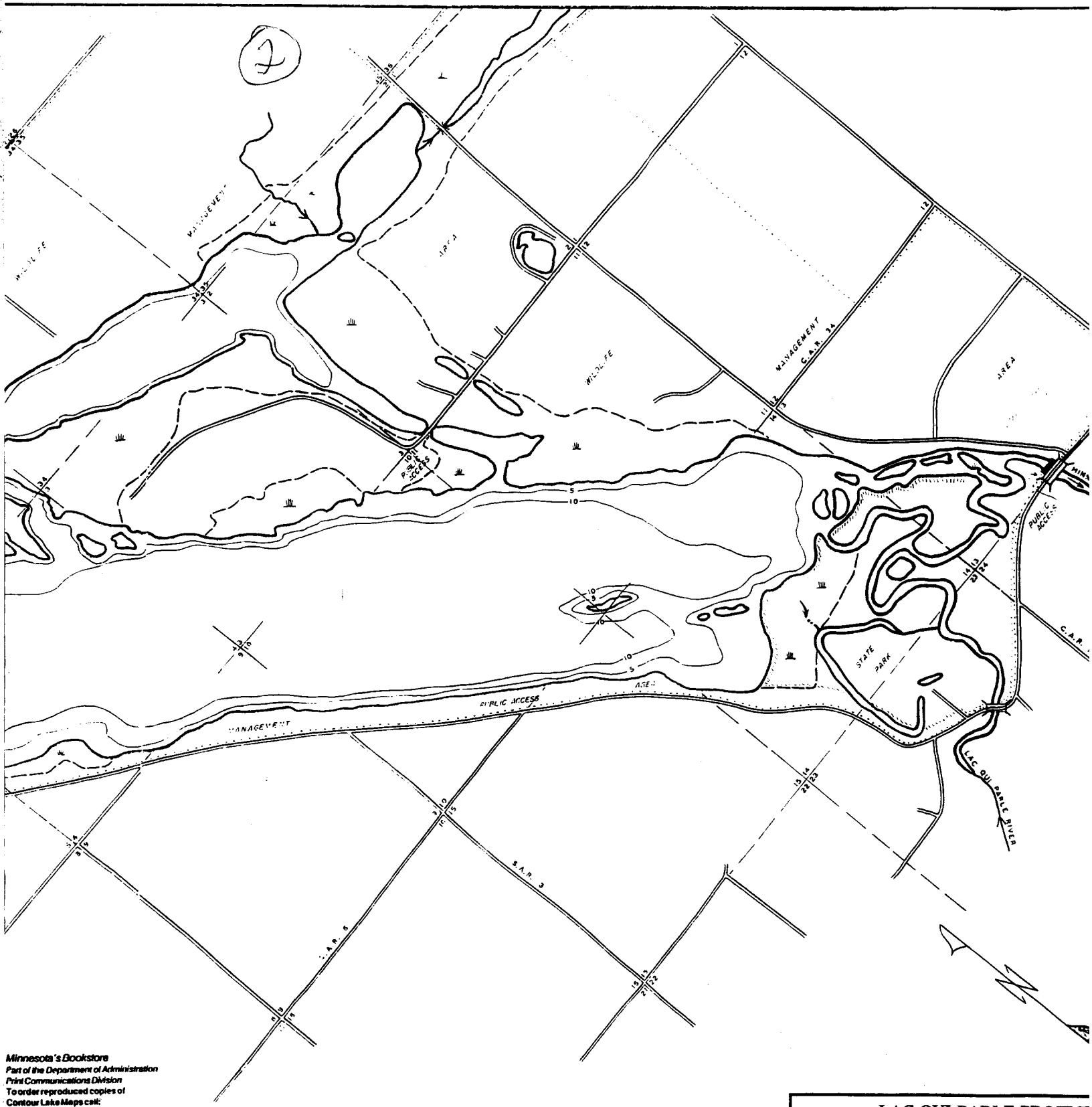
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

BATHYMETRIC MAP
LAC QUI PARLE RESERVOIR
UPSTREAM END

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/102 PLATE 2-17





REVISED 2-7-68 DBD

B.M = CENTER OF BOTTOM CONCRETE STEP ON STAIRWAY FROM RIP-RAP TO BOAT LANDING AT MILAN BEACH BRIDGE, ON S.H. 40.

M.S = B.M - 3.2'

PLANIMETERED AREA = 5,588.9 ACRES

OUTLINE TRACED FROM 1955 AERIAL PHOTO

1320 660 330 0 1320 2640

SCALE IN FEET

STATE OF MINNESOTA
DEPARTMENT OF CONSERVATION

DIVISION OF GAME AND FISH
BUREAU OF RESEARCH AND PLANNING

LAC QUI PARLE LAKE 37-46
LAC QUI PARLE, SWIFT, CHIPPEWA CO.
SHEET 2 OF 2

TWP. 118, 119, 120 N. R. 42, 43 W. SEC. VAR.

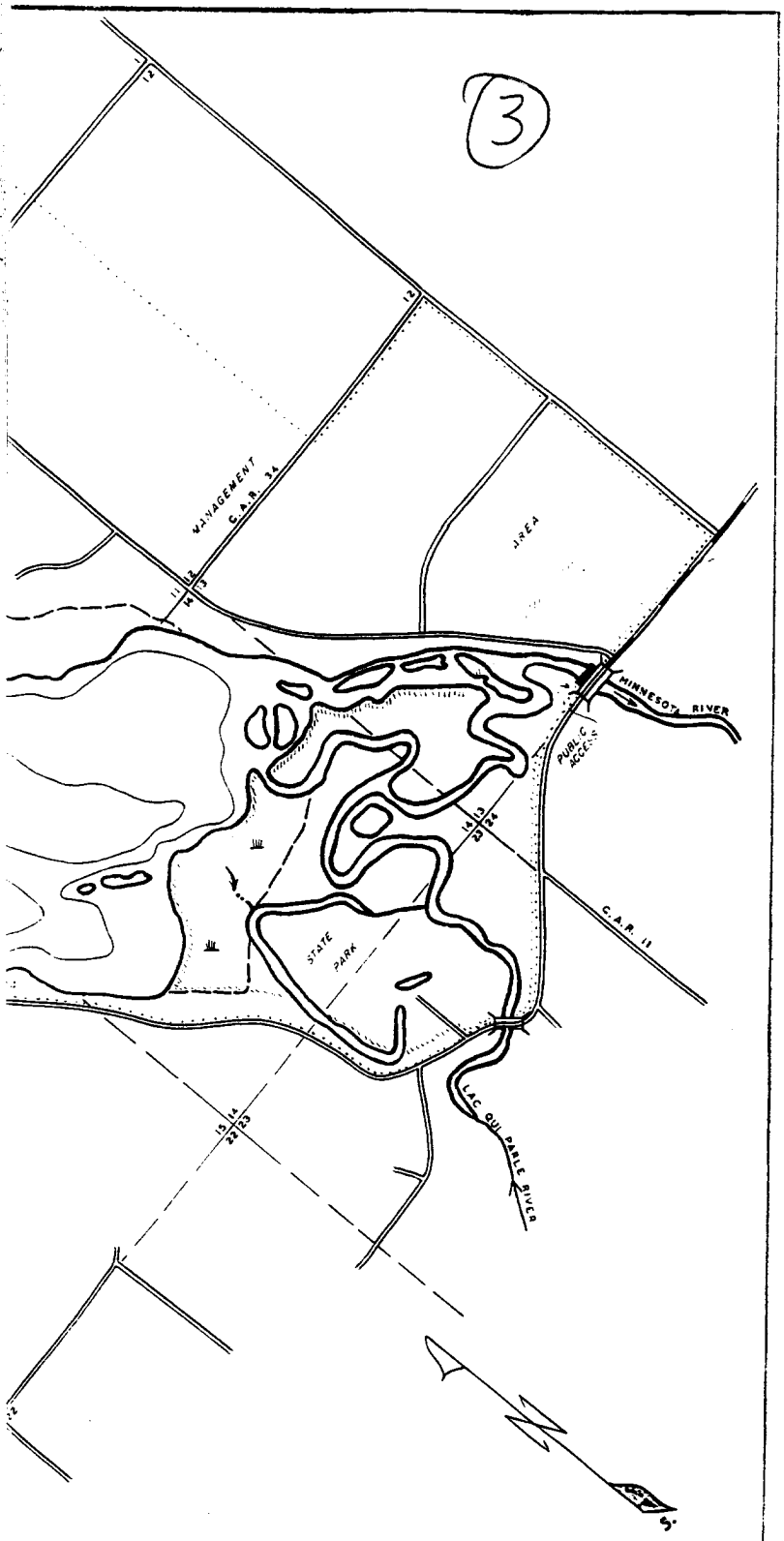
DELINEATED S.E.A.	DRAWN BY S.E.A.	CROSS REF. NO.
DATE 9-12-57	DATE 12-31-57	37-46-2

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUA

BATHYMETRIC MAP
LAC QUI PARLE RESERV
DOWNSTREAM END

U.S. ARMY CORPS OF ENGINE
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/103 PLAT



LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

BATHYMETRIC MAP
LAC QUI PARLE RESERVOIR
DOWNSTREAM END

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

120 2640

SOTA
NSERVATION
AND FISH
ID PLANNING
LAKE 37-46
T. CHIPPEWA CO.
SEC VAR.

FILE NO. M34-R-LQP-5/103 PLATE 2-18

POMME DE TERRE RIVER AT APPLETON, MN
U.S.G.S. GAGE NUMBER 05294000
STAGE - DISCHARGE RATING CURVE

RATING CURVE NUMBER 33, STARTING 1 OCTOBER 1990
GAGE DATUM IS 959.69 FEET ABOVE MSL

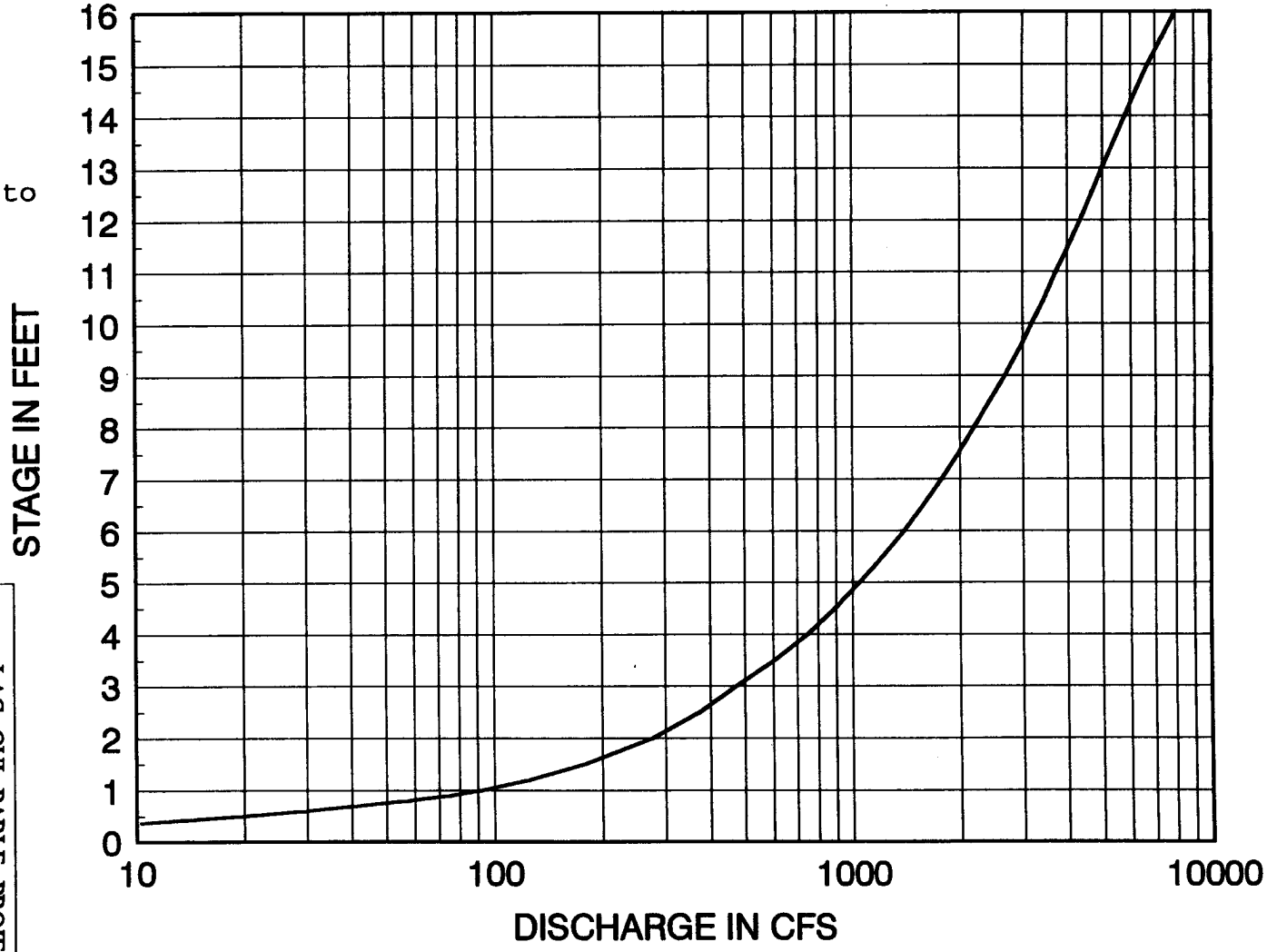
See Exhibit E for tables corresponding to this plate.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05294000
POMME DE TERRE RIVER
AT APPLETON, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MN
U.S.G.S. GAGE NUMBER 05300000
STAGE - DISCHARGE RATING CURVE



RATING CURVE NUMBER 39, STARTING 1 OCTOBER 1991
GAGE DATUM IS 951.98 FEET ABOVE MSL

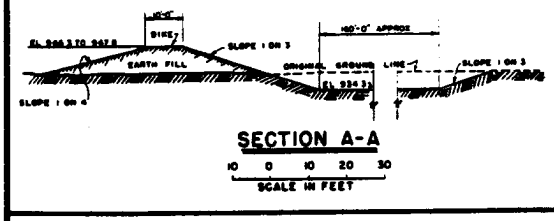
See Exhibit E for tables corresponding to this plate.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05300000
LAC QUI PARLE RIVER
NEAR LAC QUI PARLE, MN

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

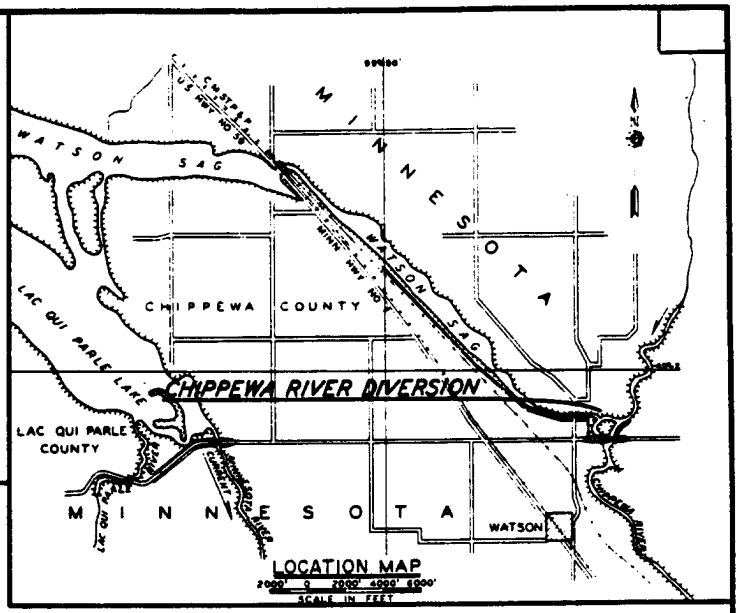
FILE NO. M34-R-LOP-5/105 PLATE 2-20



SECTION A-A

10 0 10 20 30

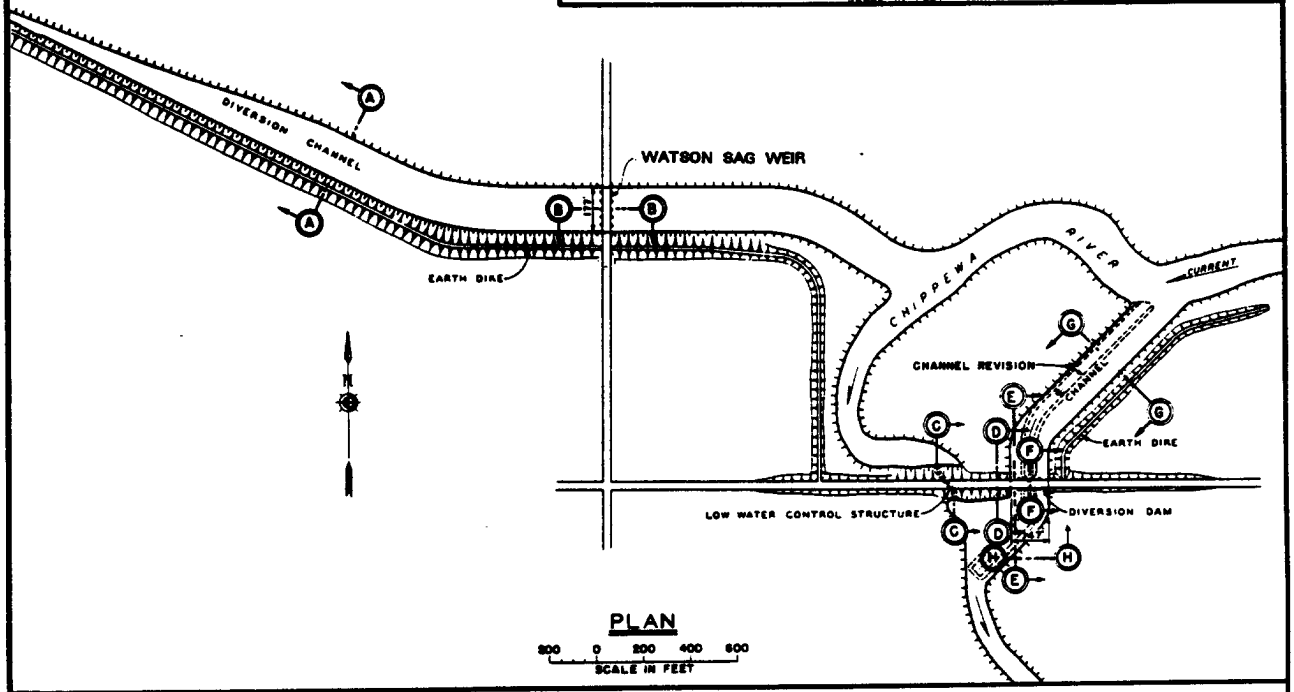
SCALE IN FEET



LOCATION MAP

2000' 0 2000' 4000' 6000'

SCALE IN FEET



PLAN

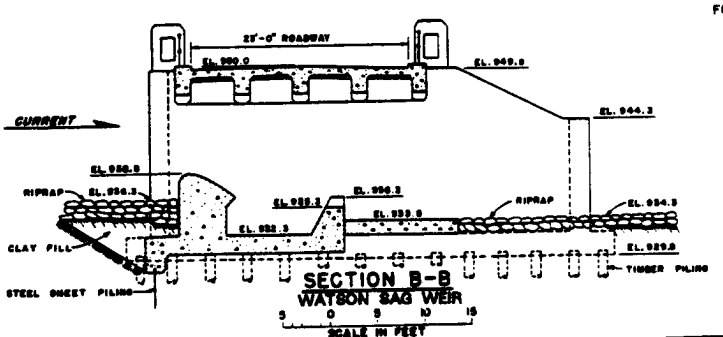
200 0 200 400 600

SCALE IN FEET

ELEVATION ON H-H

10 0 10 20 30

SCALE IN FEET



SECTION B-B

WATSON SAG WEIR

5 0 5 10 15

SCALE IN FEET

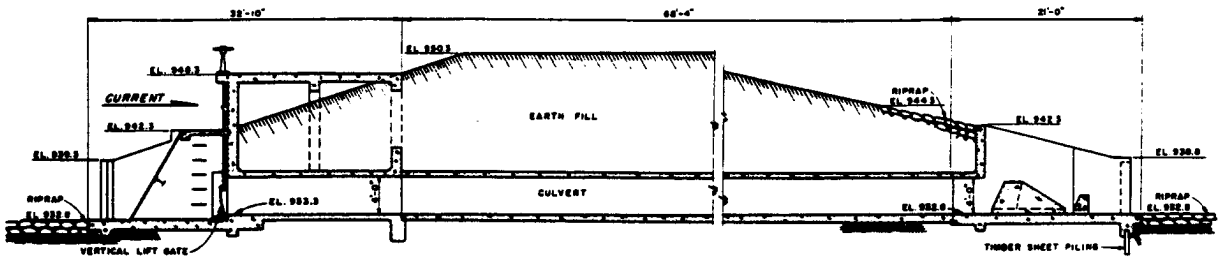
FOR SECTIONS C-C, D-D, E-E, F-F & G-G, SEE PLATE 2 - 20

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

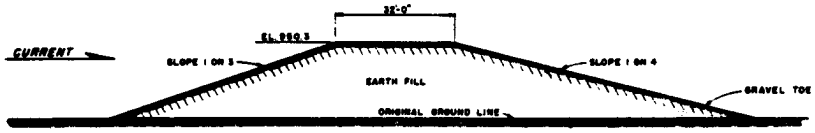
CHIPPEWA RIVER DIVERSION PLANS AND SECTIONS

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

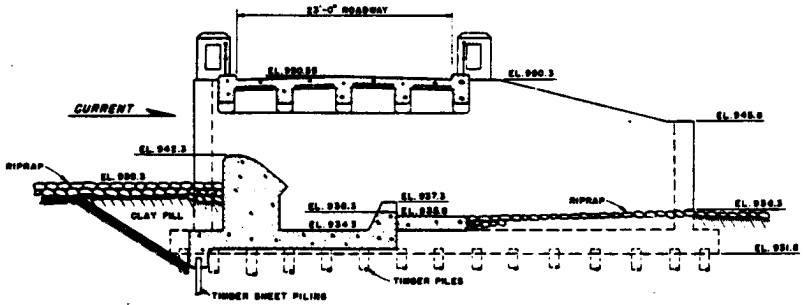
FILE NO. M34-R-LQP-5/106 **PLATE 2-21**



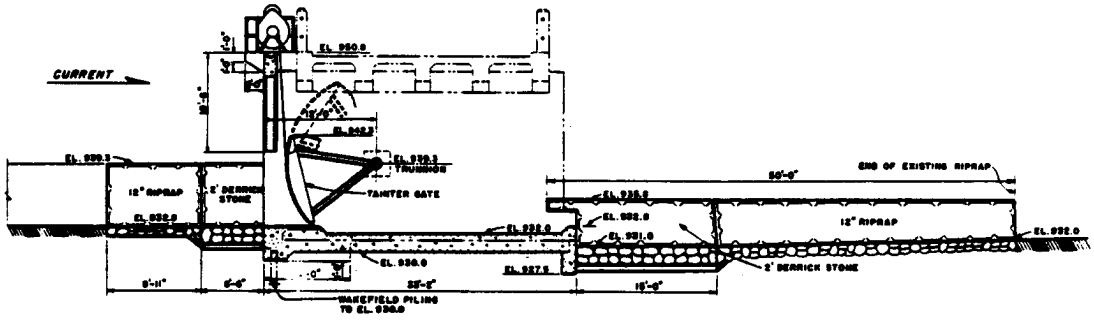
SECTION C-C
LOW WATER CONTROL STRUCTURE
5 0 5 10 15
SCALE IN FEET



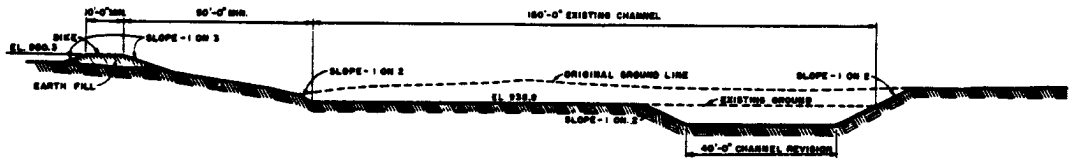
SECTION D-D
10 0 10 20 30
SCALE IN FEET



SECTION E-E
DIVERSION DAM
5 0 5 10 15
SCALE IN FEET



SECTION F-F
5 0 5 10 15
SCALE IN FEET



SECTION G-G
CHANNEL AND DIKE
10 0 10 20 30
SCALE IN FEET

NOTE:
FOR LOCATION OF SECTIONS SEE PLATE 2 - 19
ELEVATIONS ARE REFERRED TO M.S.L.(1929 ADJ.)

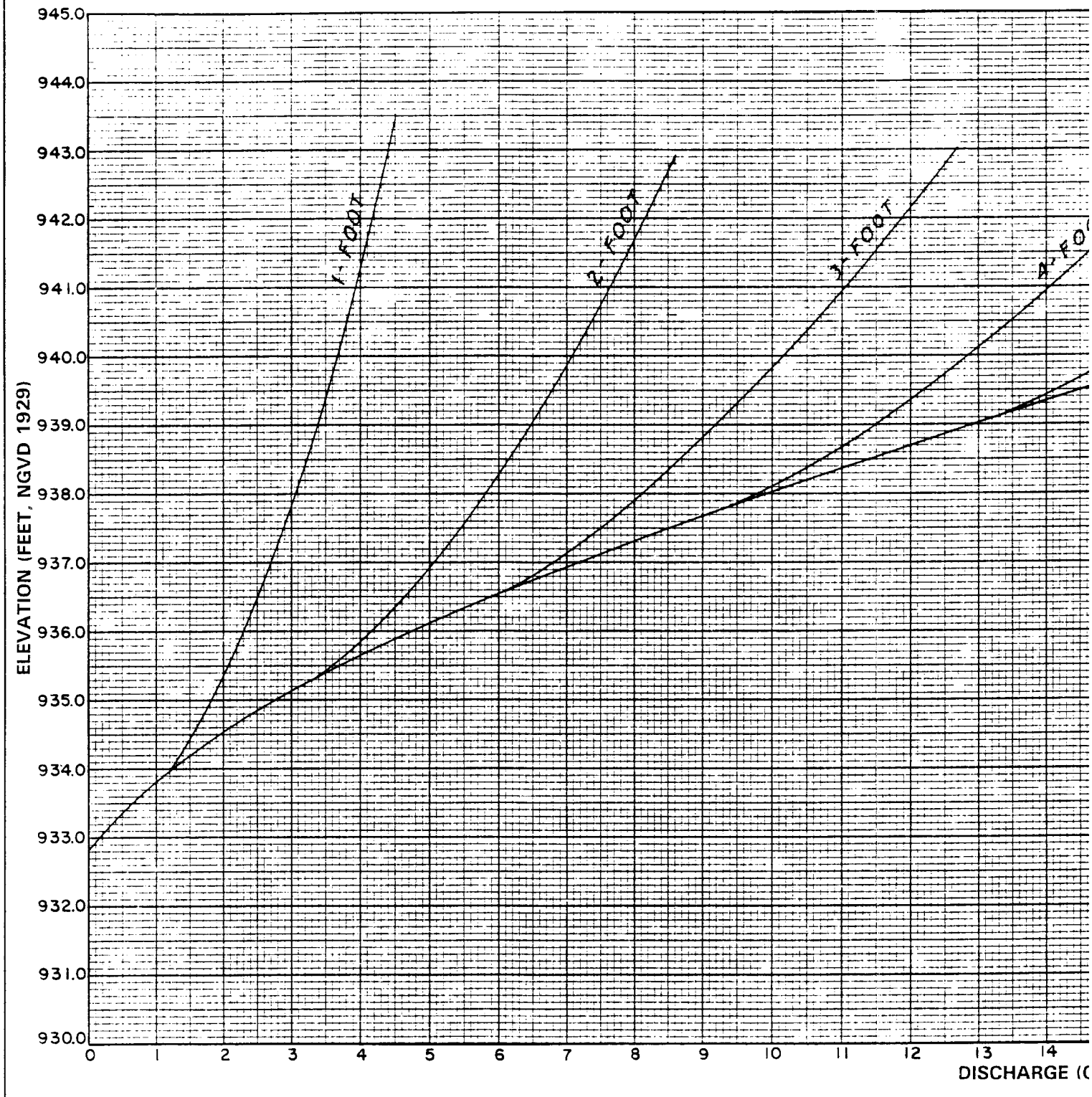
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

CHIPPEWA RIVER DIVERSION SECTIONS

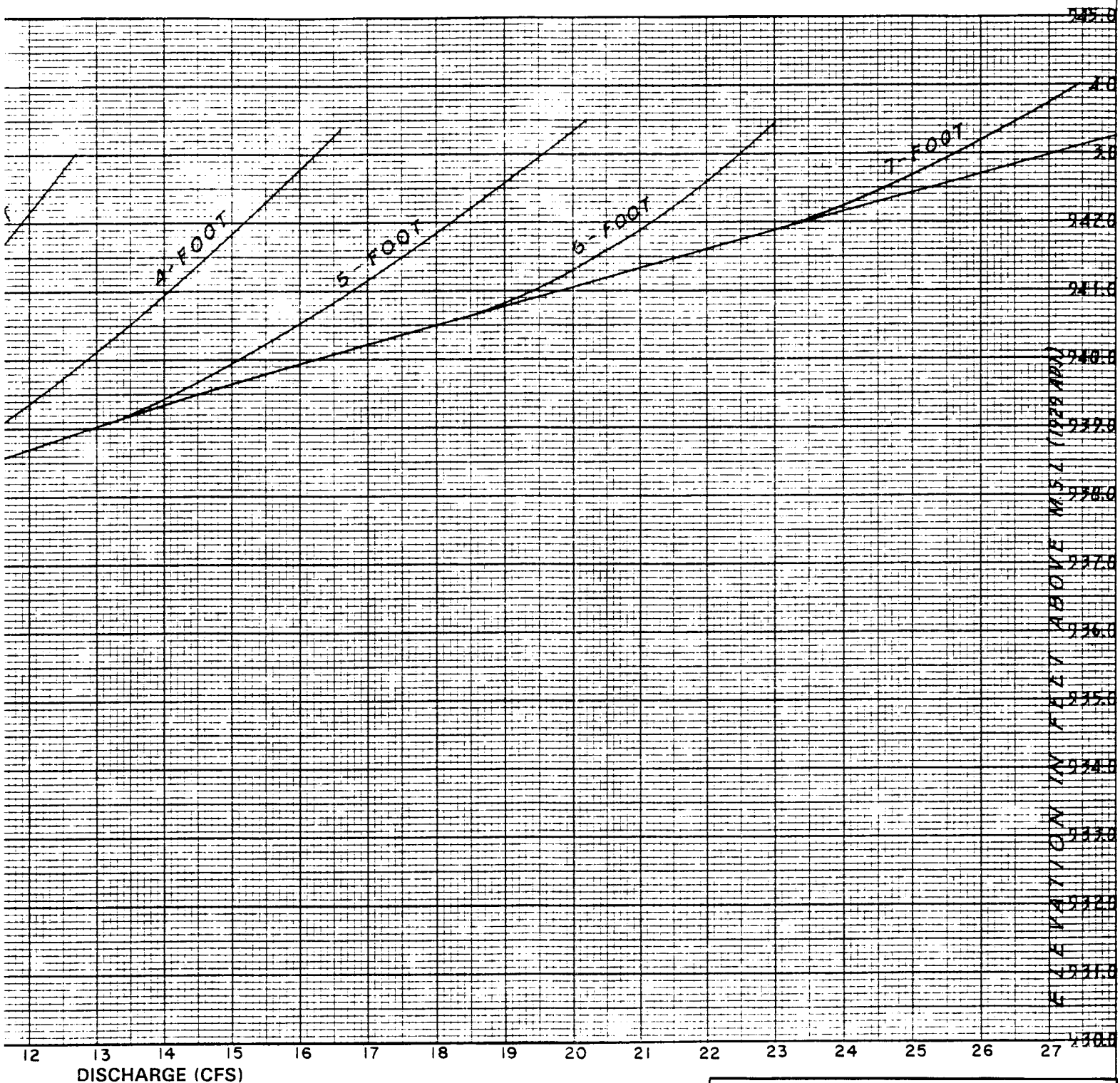
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/107 PLATE 2-22

CORPS OF ENGINEERS



(1)



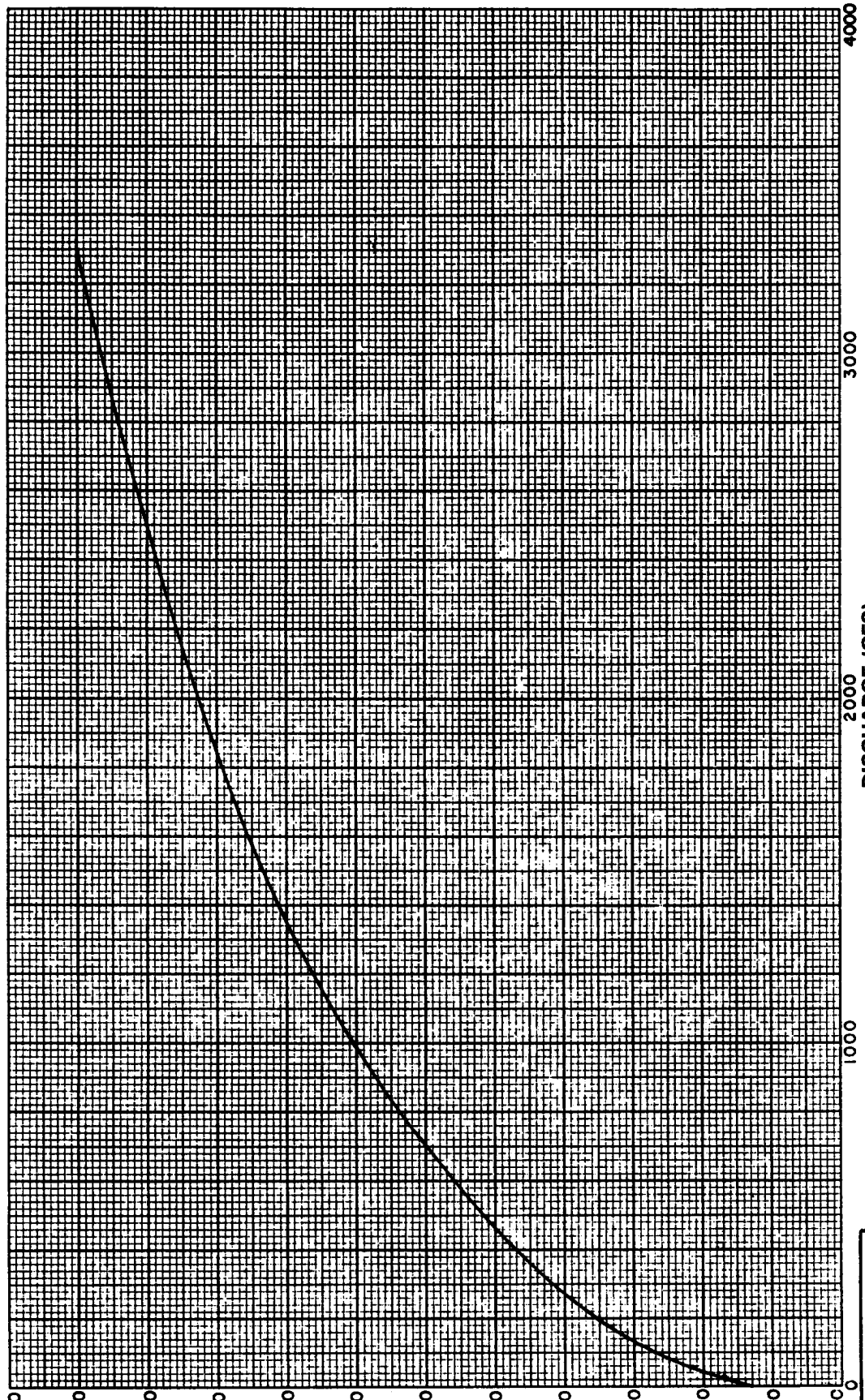
(2)

NOTE:
THESE CURVES WERE DEVELOPED FROM ORIGINAL CURVES DATED 9 JULY 1954.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVES
FOR SELECTED GATE OPENINGS
27 - FOOT TAINTER GATE
CHIPPEWA RIVER DIVERSION DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA



GAGE ZERO = 900.0 FEET (NGVD 1929)

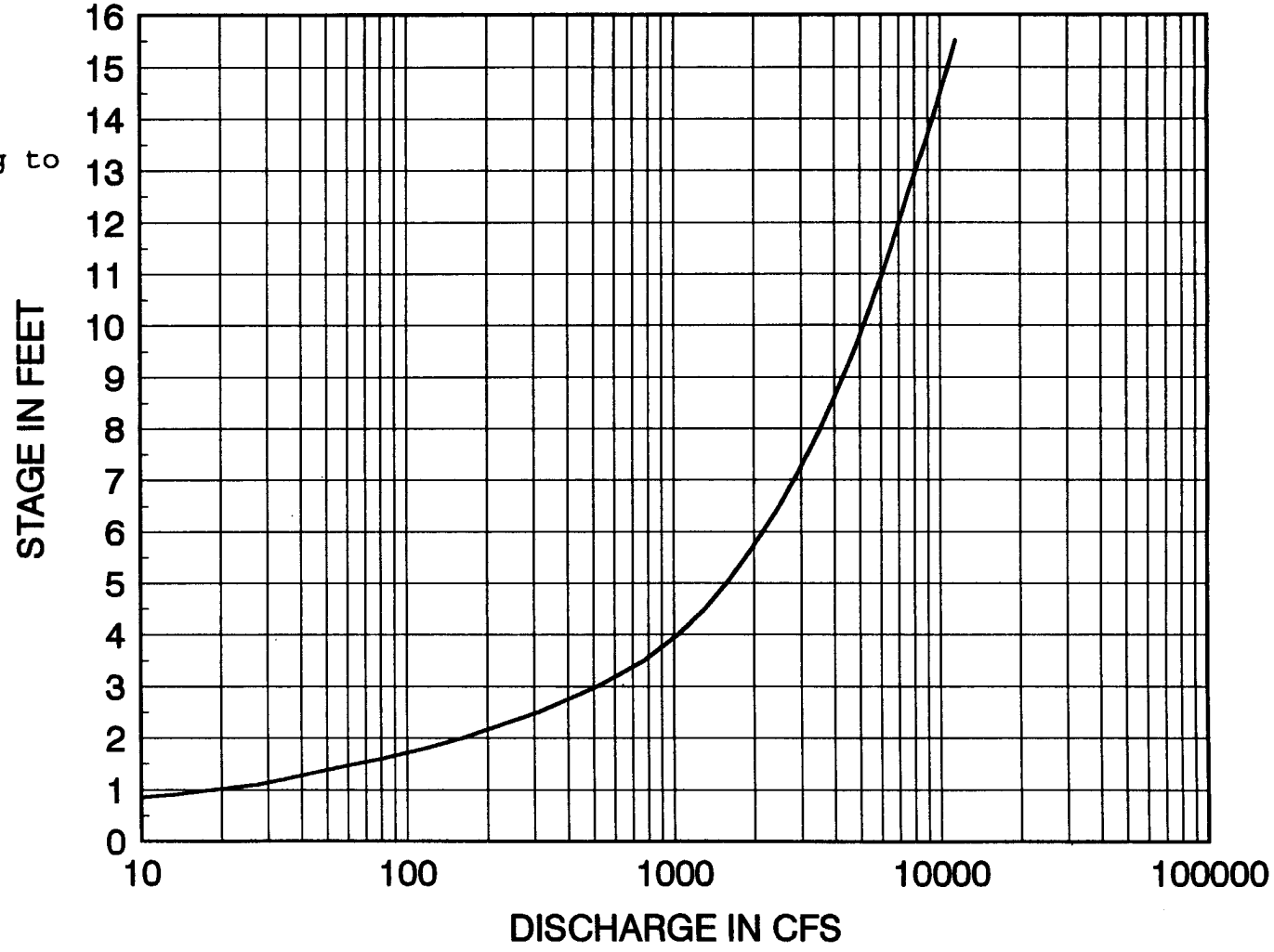
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
CHIPPEWA RIVER
BELOW DIVERSION DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/109 PLATE 2-24

CHIPPEWA RIVER NEAR MILAN, MN
U.S.G.S. GAGE NUMBER 05304500
STAGE - DISCHARGE RATING CURVE



RATING CURVE NUMBER 27, STARTING 1 OCTOBER 1990
GAGE DATUM IS 959.69 FEET ABOVE MSL

See Exhibit E for tables corresponding to this plate.

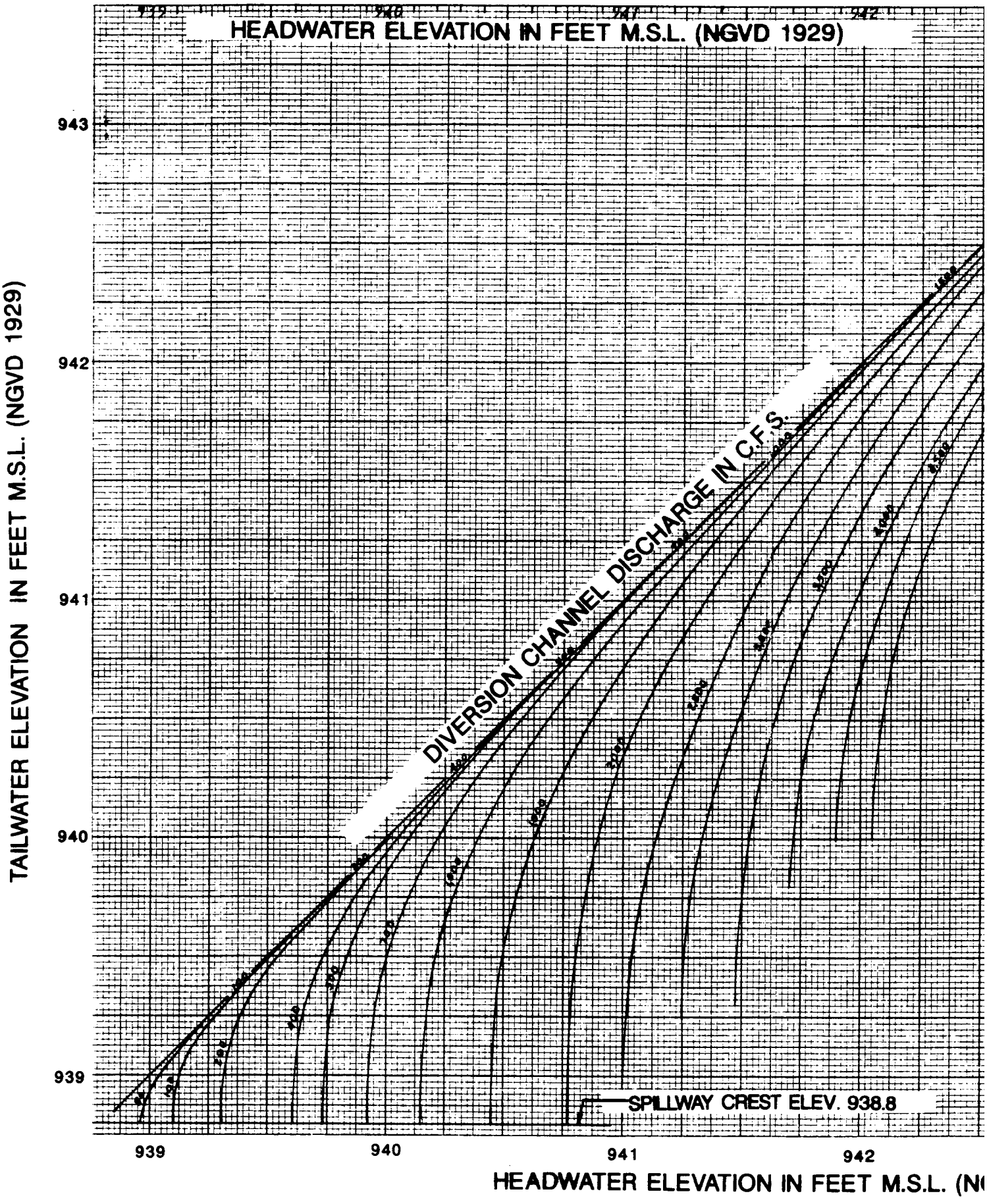
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05304500
CHIPPEWA RIVER
NEAR MILAN, MINNESOTA

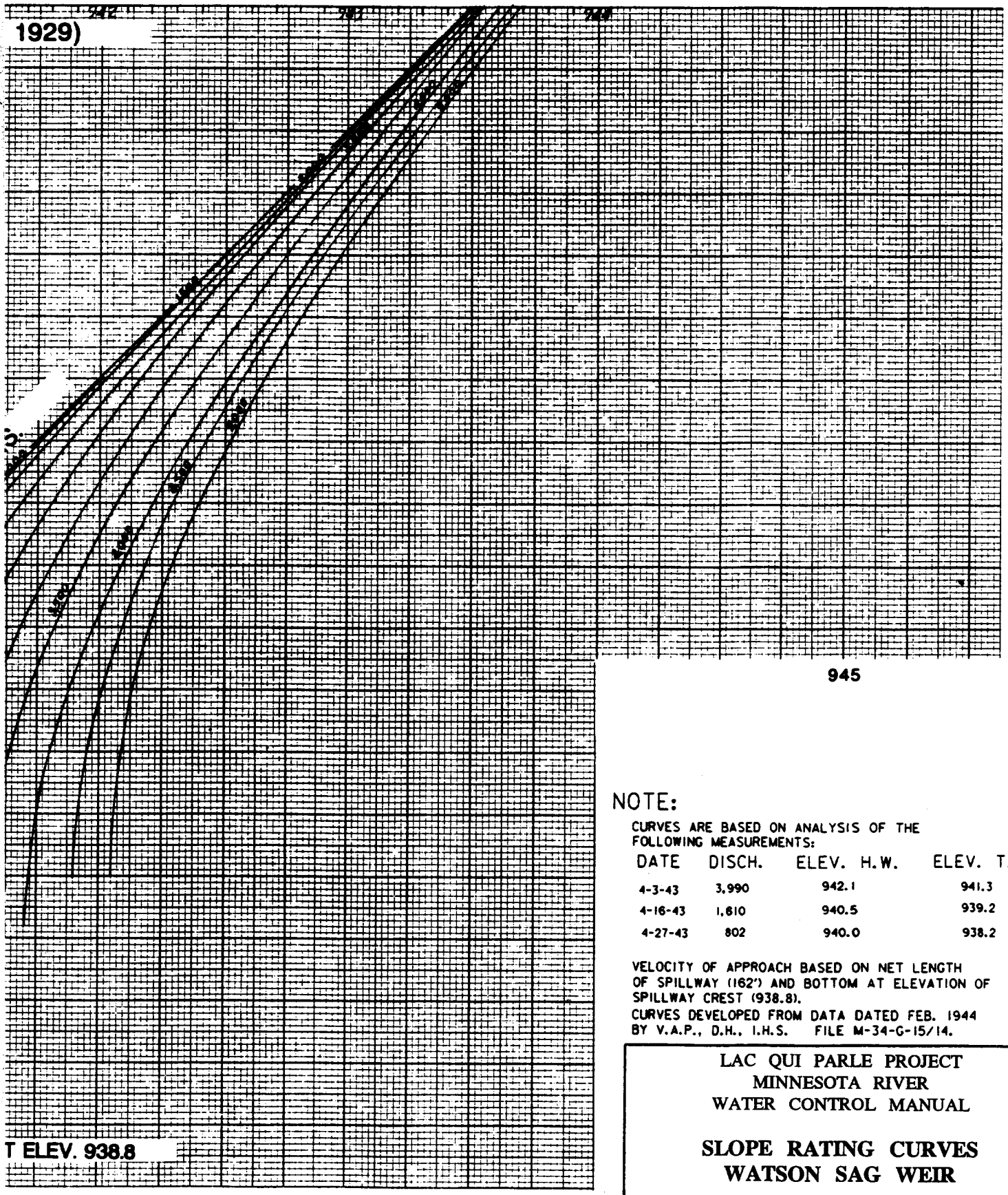
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/110 PLATE 2-25

(1


HEADWATER ELEVATION IN FEET M.S.L. (NGVD 1929)
TAILWATER ELEVATION IN FEET M.S.L. (NGVD 1929)
DIVERSION CHANNEL DISCHARGE IN C.F.S.
SPILLWAY CREST ELEV. 938.8
939
940
941
942
943
HEADWATER ELEVATION IN FEET M.S.L. (N

(7)



NOTE:

CURVES ARE BASED ON ANALYSIS OF THE FOLLOWING MEASUREMENTS:

DATE	DISCH.	ELEV. H.W.	ELEV. T.W
4-3-43	3,990	942.1	941.3
4-16-43	1,610	940.5	939.2
4-27-43	802	940.0	938.2

VELOCITY OF APPROACH BASED ON NET LENGTH OF SPILLWAY (162') AND BOTTOM AT ELEVATION OF SPILLWAY CREST (938.8).

CURVES DEVELOPED FROM DATA DATED FEB. 1944 BY V.A.P., D.H., I.H.S. FILE M-34-G-15/14.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

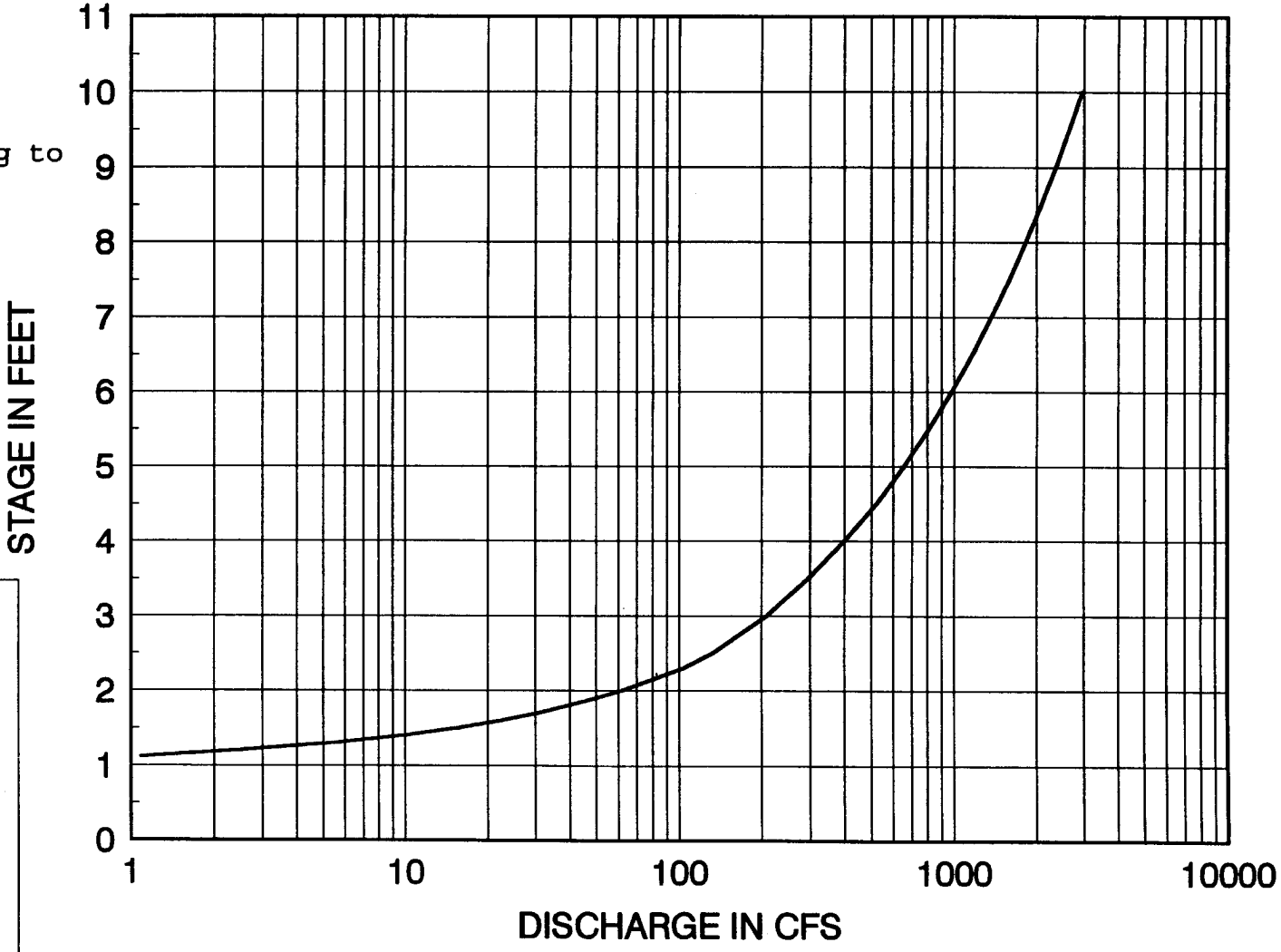
SLOPE RATING CURVES
WATSON SAG WEIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/111 PLATE 2-26

MINNESOTA RIVER AT ORTONVILLE, MN
U.S.G.S. GAGE NUMBER 05292000
STAGE - DISCHARGE RATING CURVE

See Exhibit E for tables corresponding to this plate.



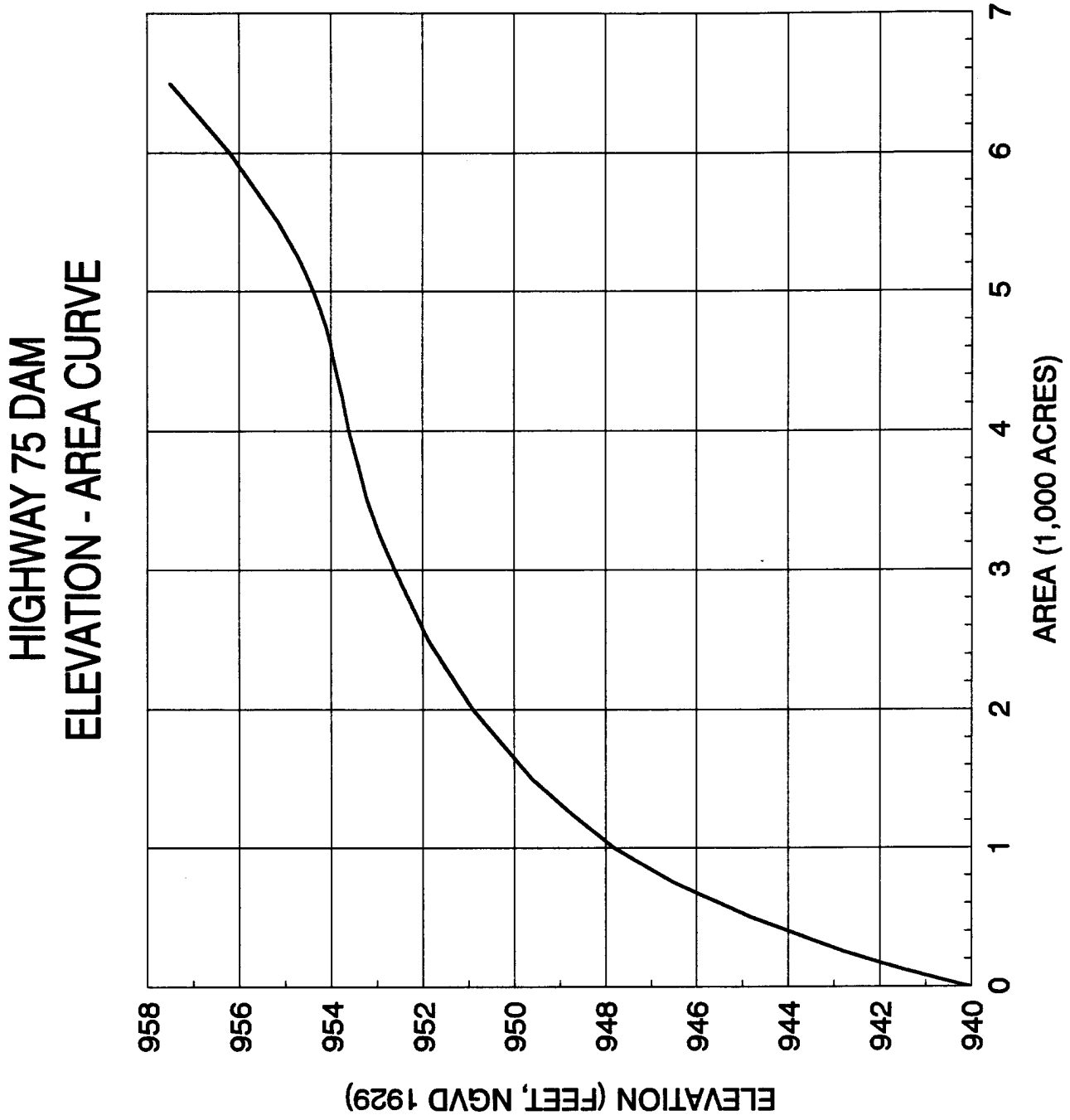
RATING CURVE NUMBER 25, STARTING 1 OCTOBER 1990
GAGE DATUM IS 956.38 FEET ABOVE MSL

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

RATING CURVE
U.S.G.S. GAGE NO. 05292000
MINNESOTA RIVER
AT ORTONVILLE, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/112 PLATE 2-27

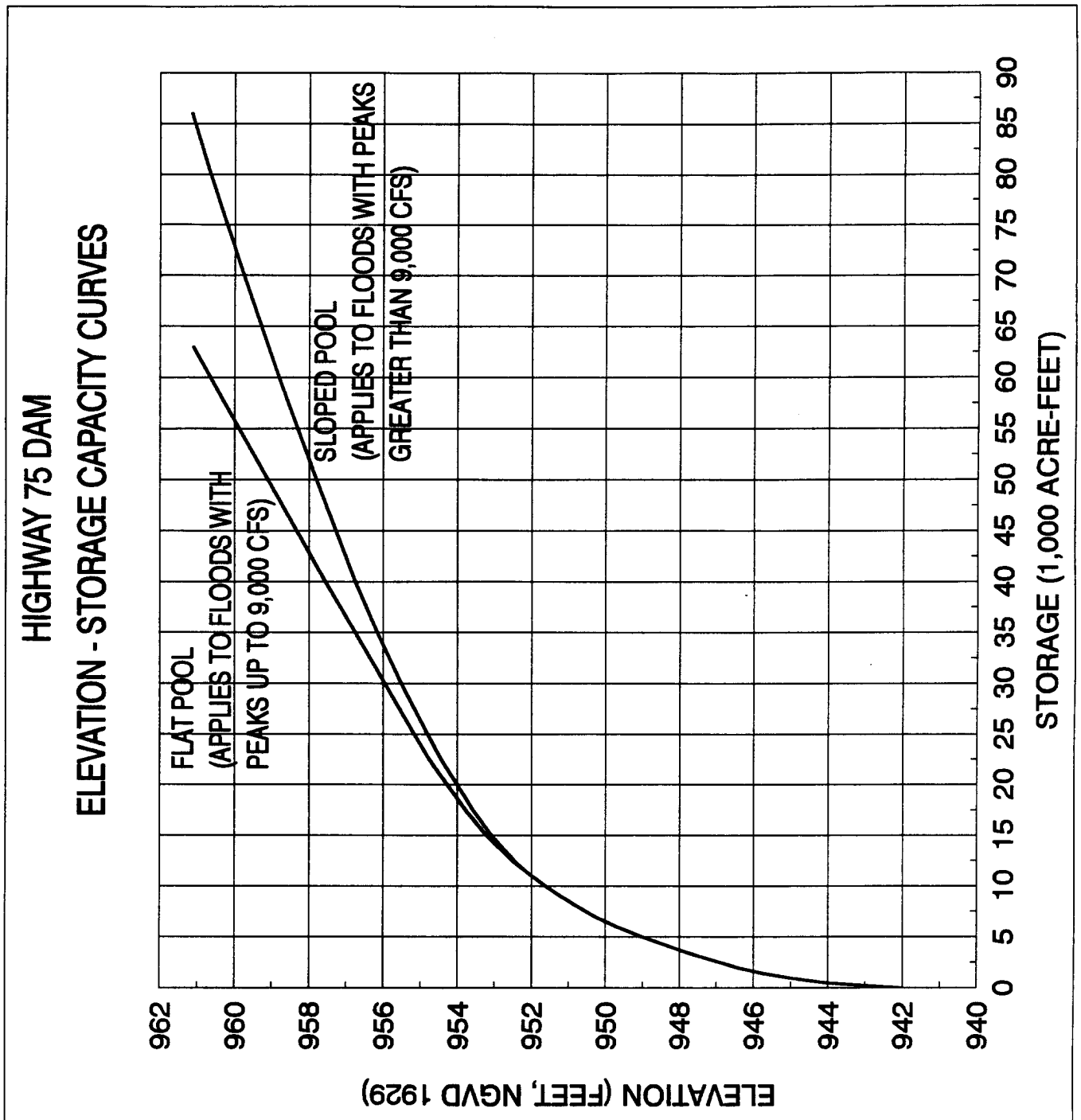


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

ELEVATION - AREA CURVE
HIGHWAY 75 DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/113 **PLATE 2-28**

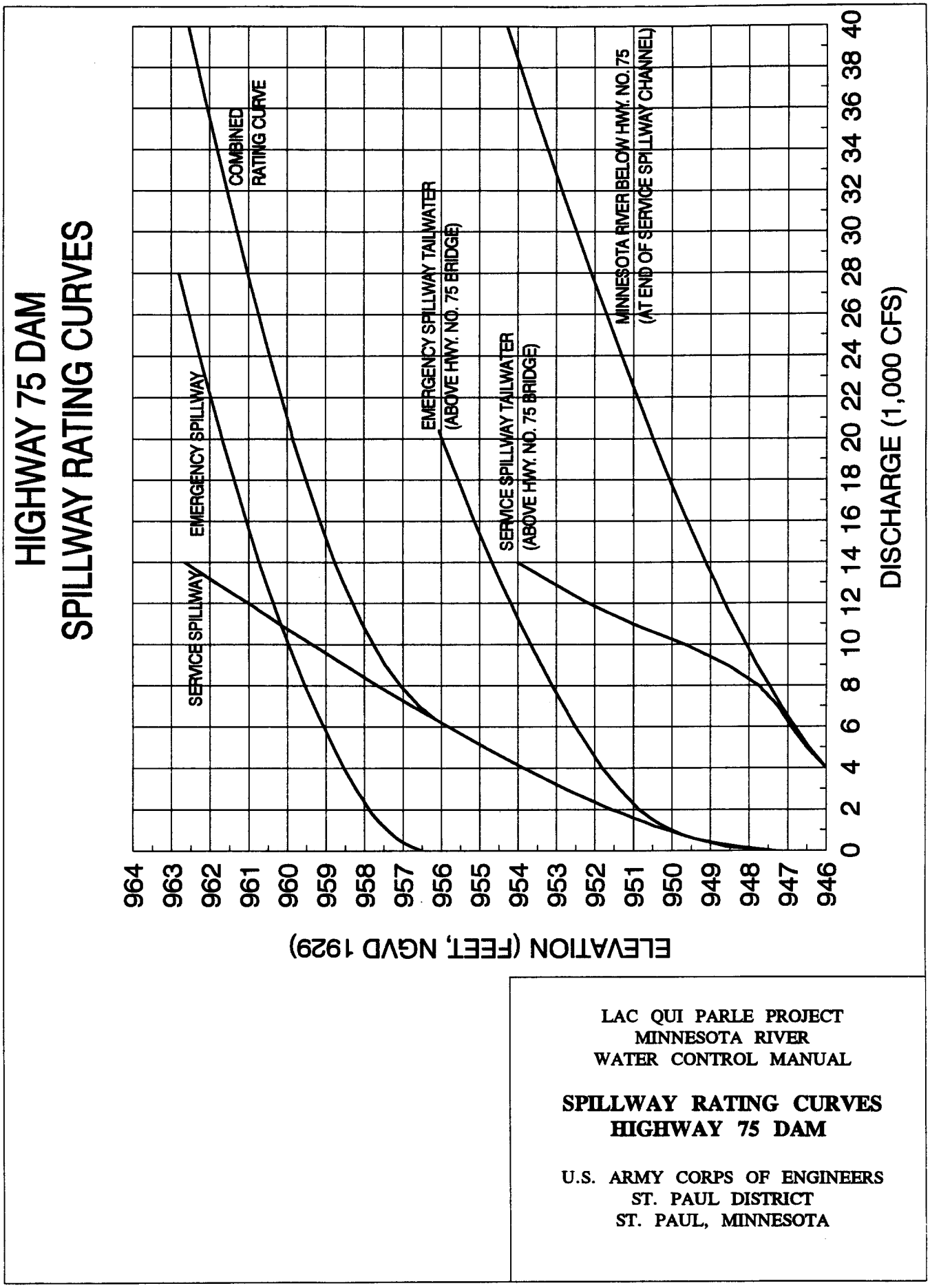


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

ELEVATION - STORAGE CAPACITY
HIGHWAY 75 DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/114 **PLATE 2-29**



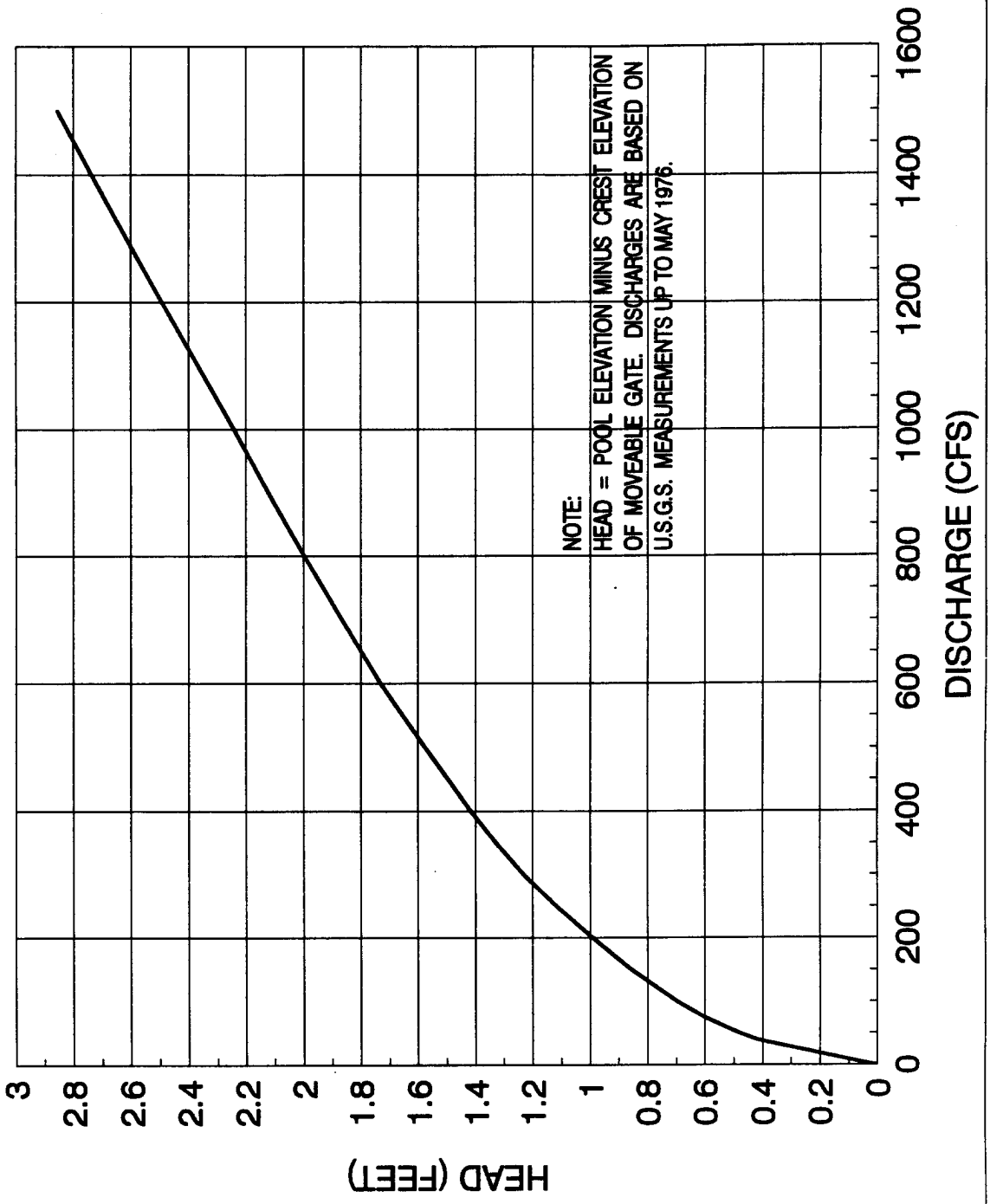
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

SPILLWAY RATING CURVES
HIGHWAY 75 DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/115 **PLATE 2-30**

HIGHWAY 75 DAM
SERVICE SPILLWAY RATING CURVE



LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

SERVICE SPILLWAY RATING CURVE
HIGHWAY 75 DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

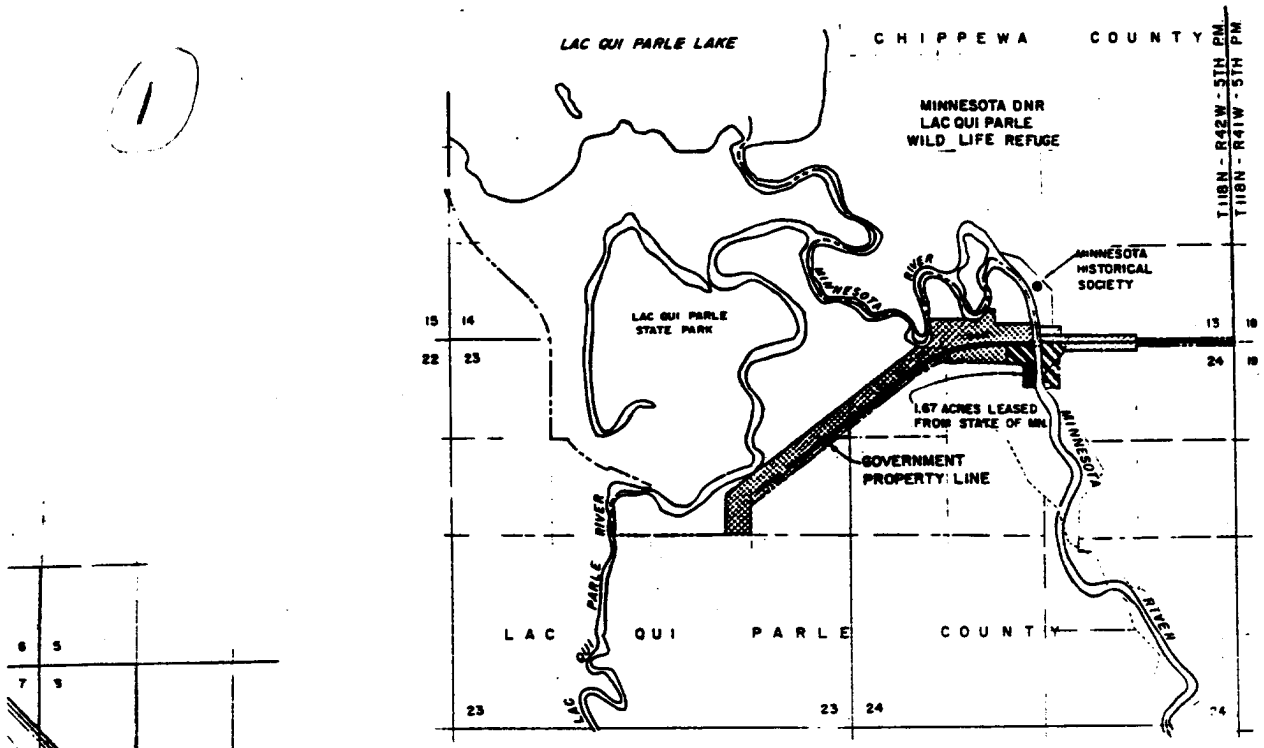
FILE NO. M34-R-LQP-5/116 PLATE 2-31

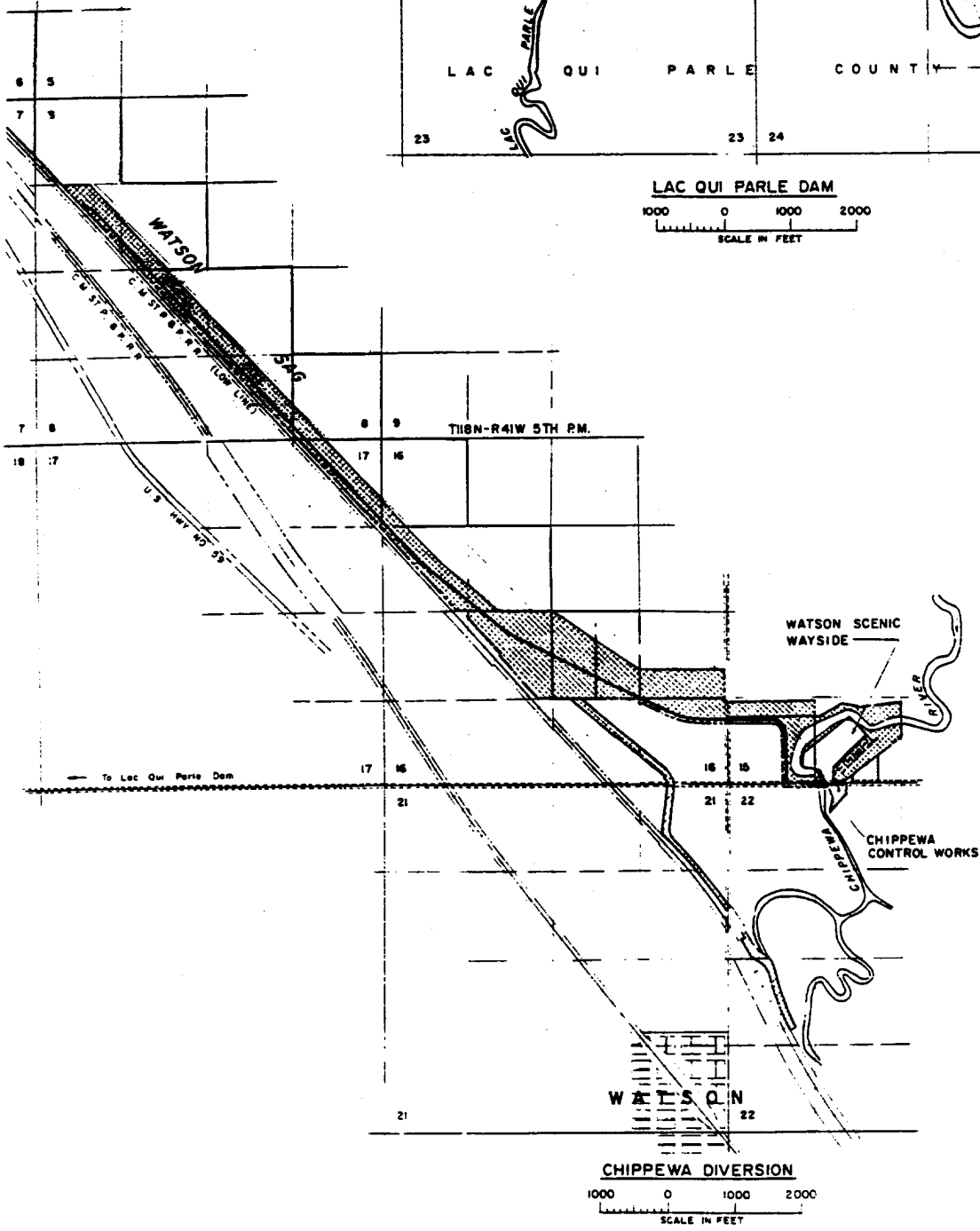
See Exhibit E for tables corresponding to this plate.

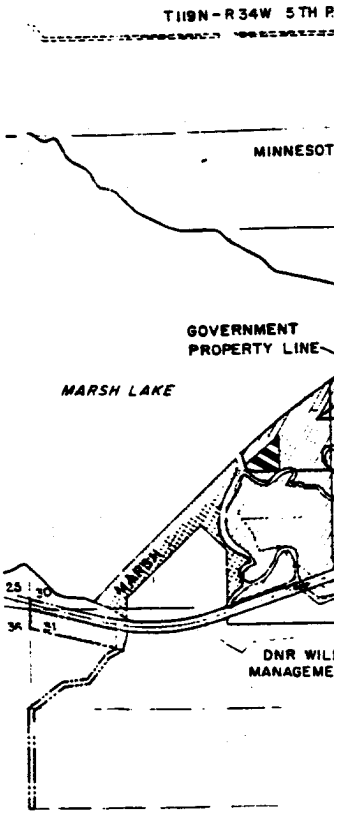
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

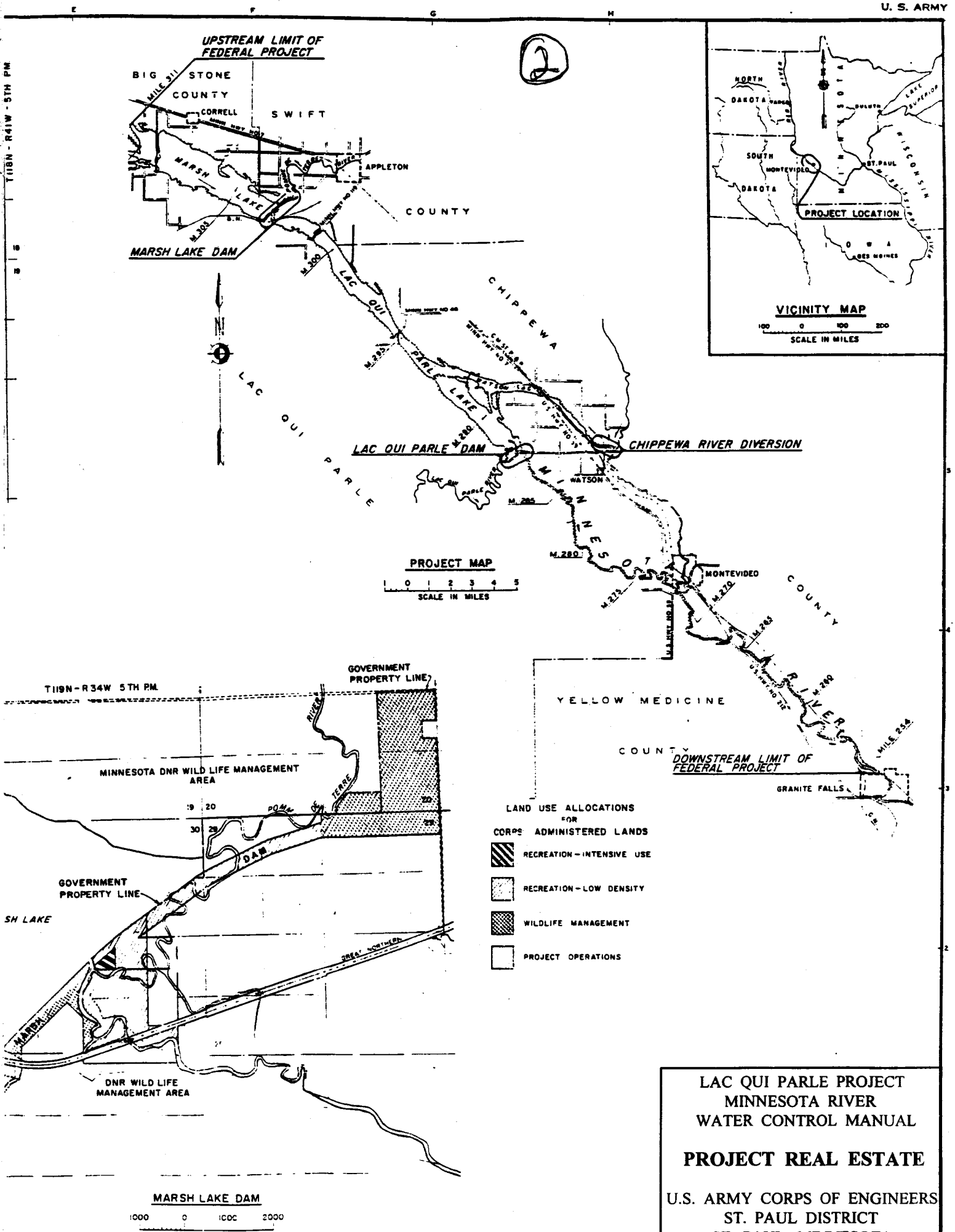
RATING CURVE
U.S.G.S. GAGE NO. 05293000
YELLOW BANK RIVER
NEAR ODESSA, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA


LAC QUI PARLE LAKE
CHIPPEWA COUNTY
MINNESOTA DNR
LAC QUI PARLE
WILD LIFE REFUGE
T118N - R42W - 5TH PM
T118N - R41W - 5TH PM
MINNESOTA HISTORICAL SOCIETY
LAC QUI PARLE STATE PARK
MINNESOTA RIVER
167 ACRES LEASED FROM STATE OF MN.
GOVERNMENT PROPERTY LINE
LAC QUI PARLE RIVER
LAC QUI PARLE COUNTY
LAC QUI PARLE DAM
1000 0 1000 2000
SCALE IN FEET


WATSON
C M ST P & P R R
C M ST P & P R R (Low Line)
T118N-R41W 5TH P.M.
U S Hwy No 59
WATSON SCENIC WAYSIDE
To Lac Qui Parle Dam
CHIPPEWA RIVER
CHIPPEWA CONTROL WORKS
WATSON
CHIPPEWA DIVERSION
1000 0 1000 2000
SCALE IN FEET


T119N-R34W 5TH P.
MINNESOT
GOVERNMENT PROPERTY LINE
MARSH LAKE
MARSH
DNR WILD MANAGEME



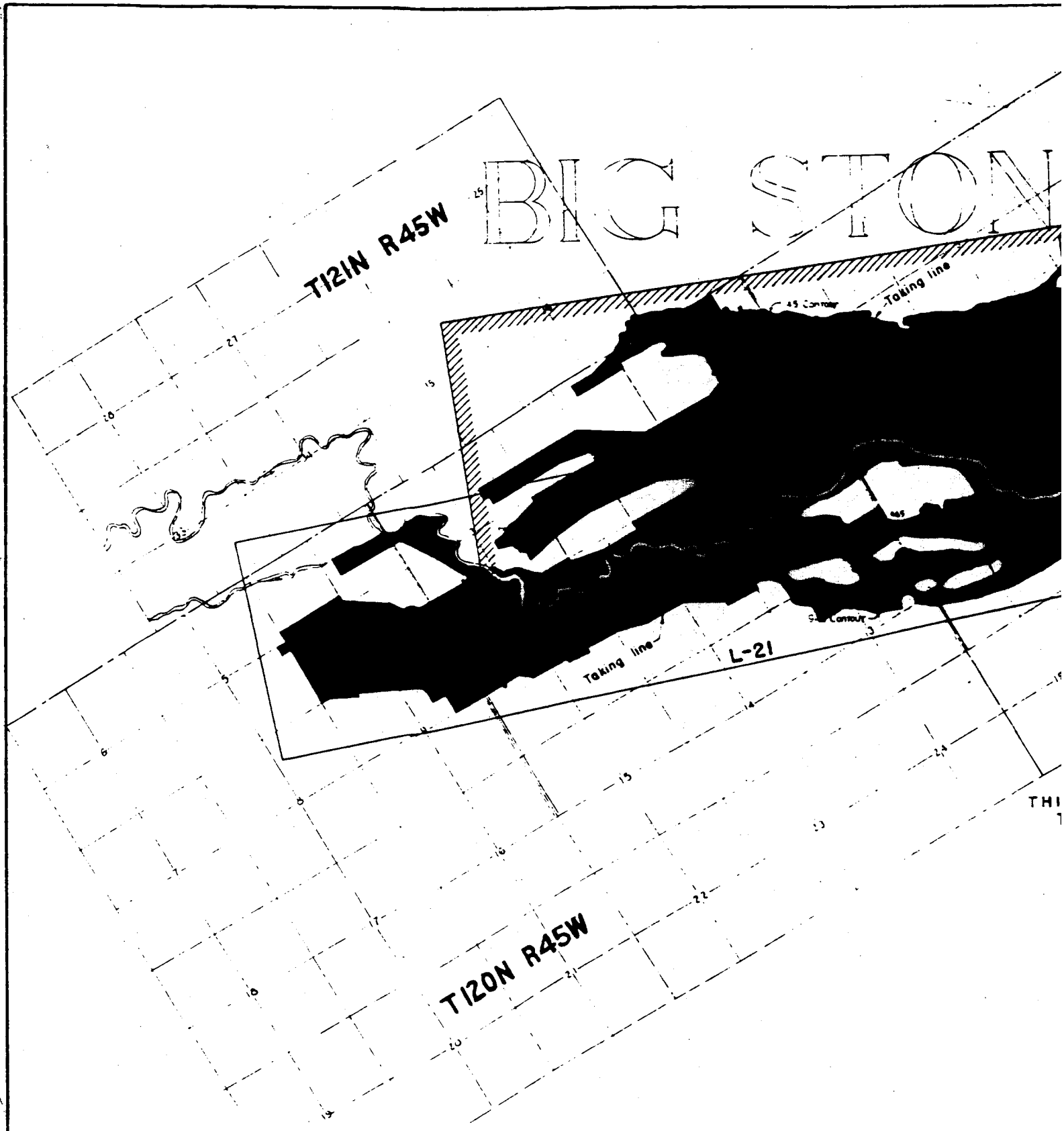
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PROJECT REAL ESTATE

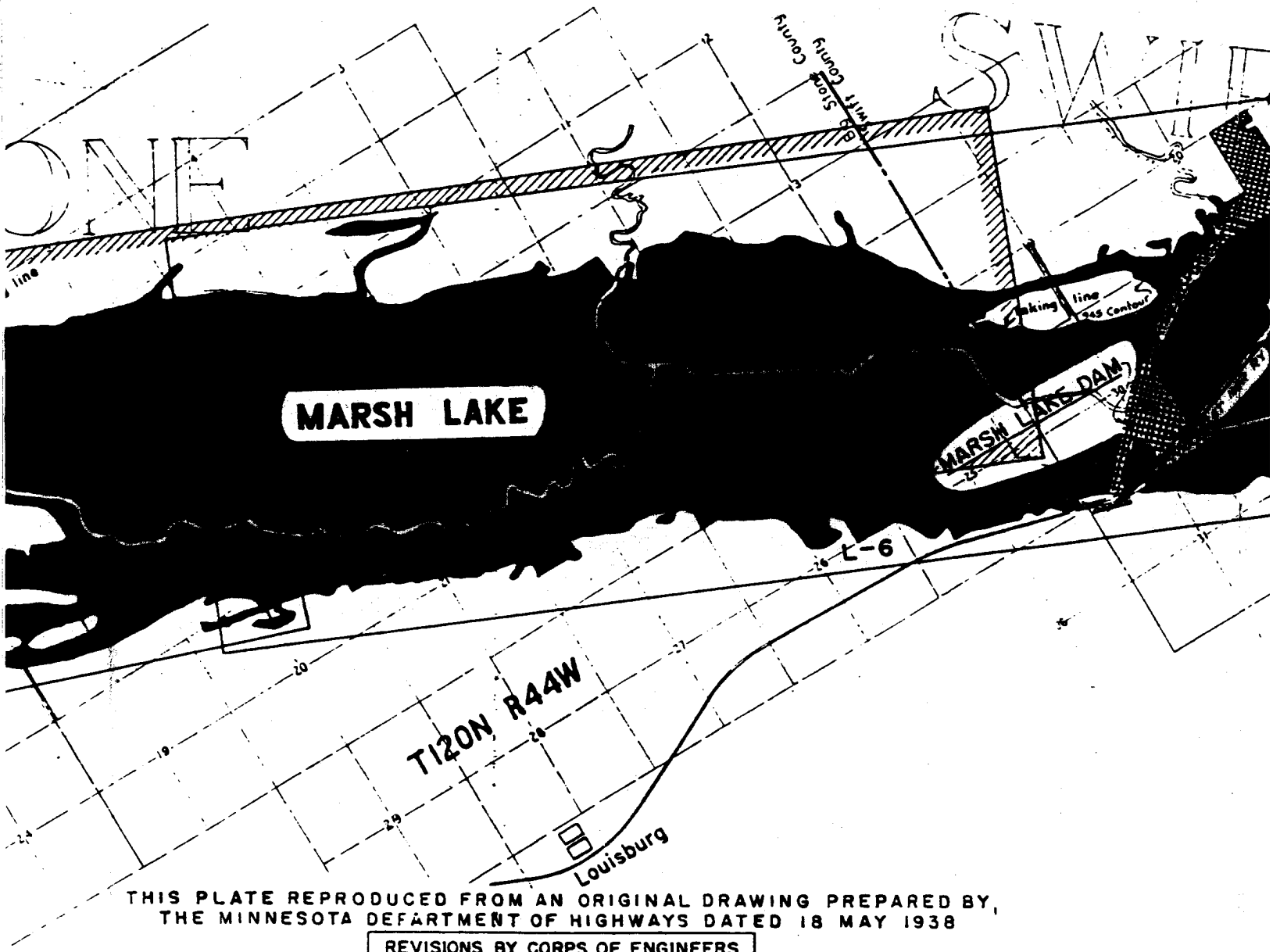
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/118 PLATE 2-33

(1)


BIG STON
T121N R45W
T120N R45W
Taking line
Taking line
L-21
45 Contour
THI

(2)



THIS PLATE REPRODUCED FROM AN ORIGINAL DRAWING PREPARED BY, THE MINNESOTA DEPARTMENT OF HIGHWAYS DATED 18 MAY 1938

REVISIONS BY CORPS OF ENGINEERS ST. PAUL, MINN. APRIL 1947
1. STRUCTURE SITE LIMITS INSERTED
2. TAKING LINE MODIFIED TO REFLECT LIMITS OF ACQUISITION BY U. S. GOVERNMENT

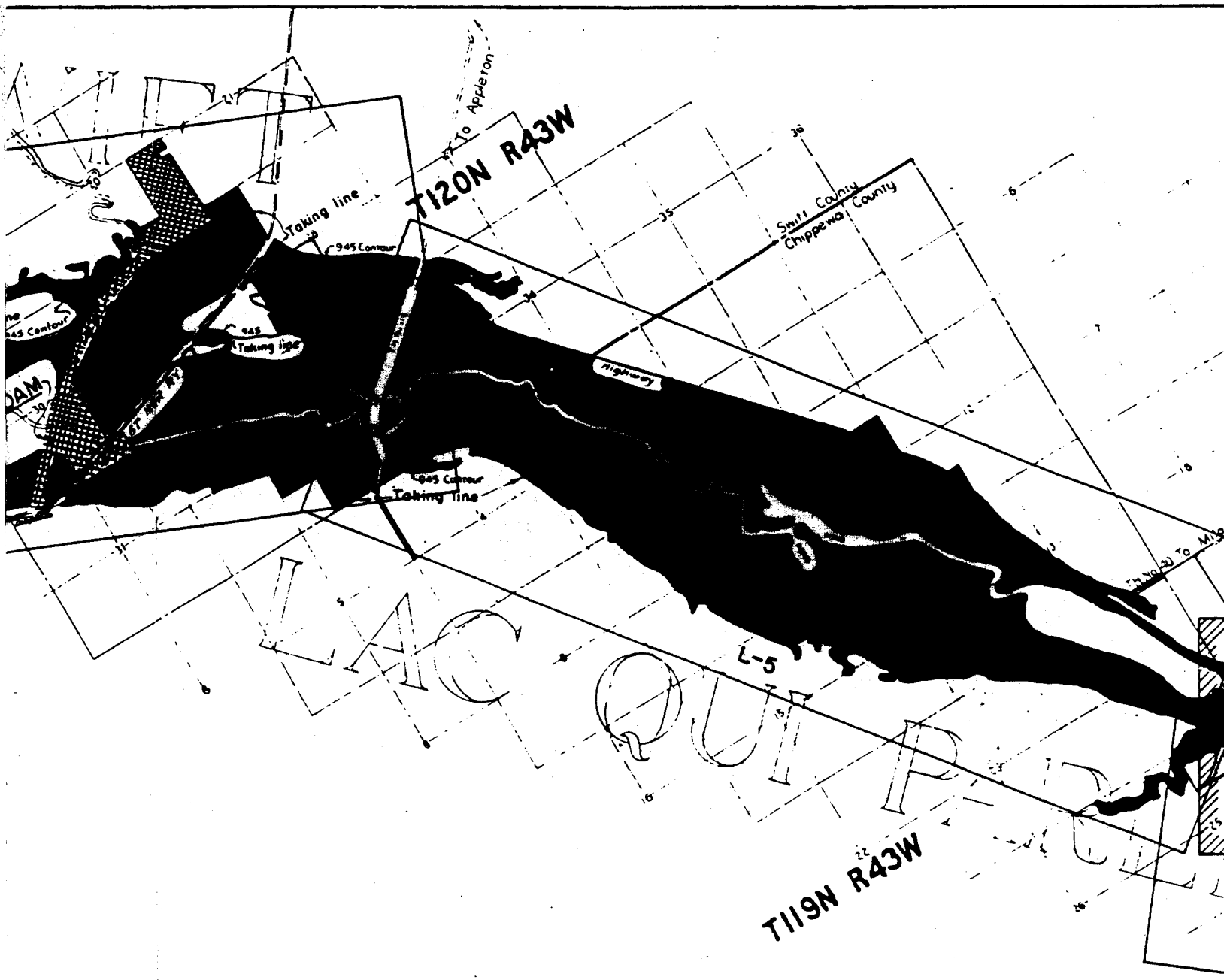
LEGEND

INTEREST TO BE ACQUIRED BY UNITED STATES

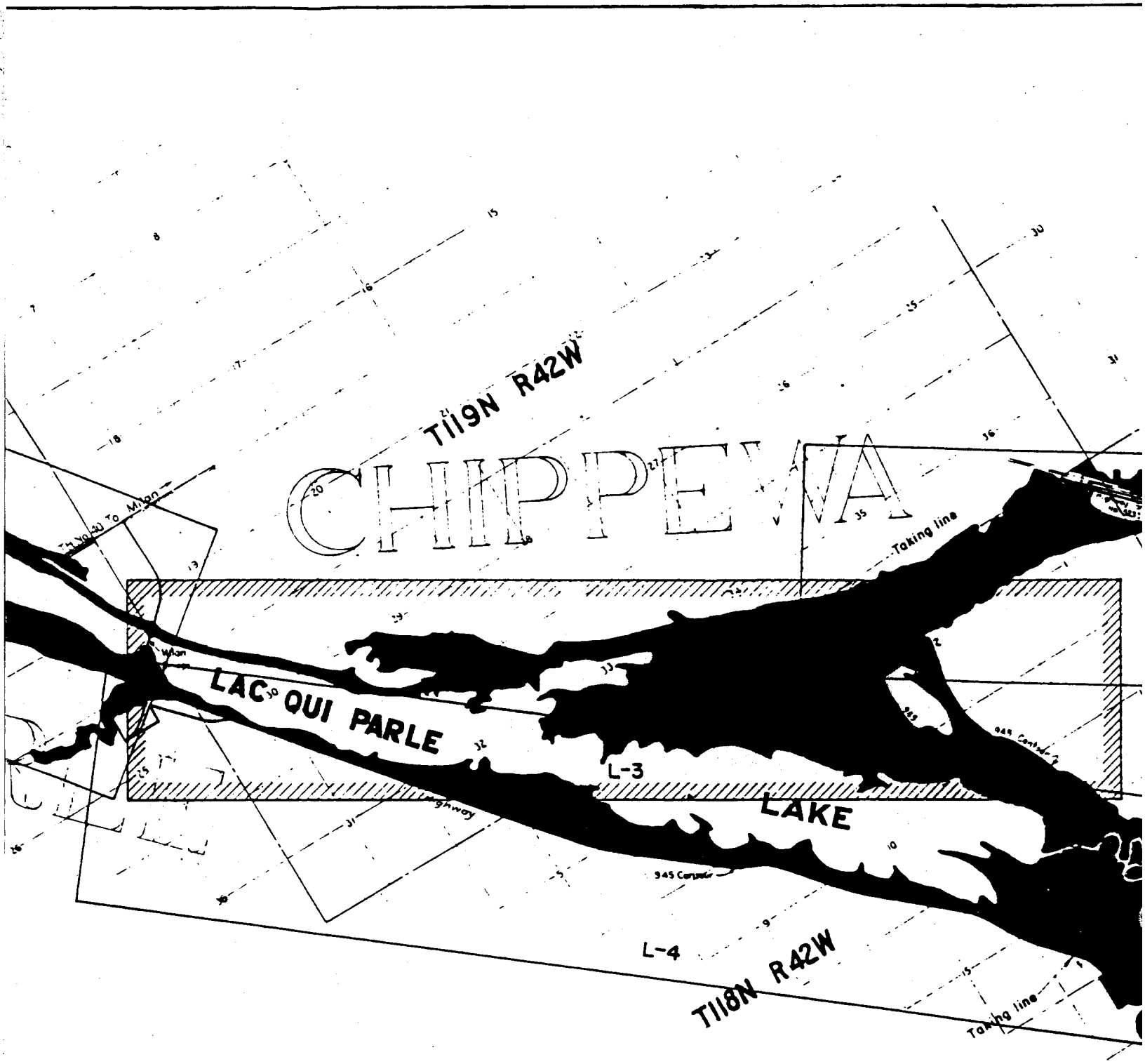
FEE SIMPLE TITLE

FLOWAGE EASEMENT

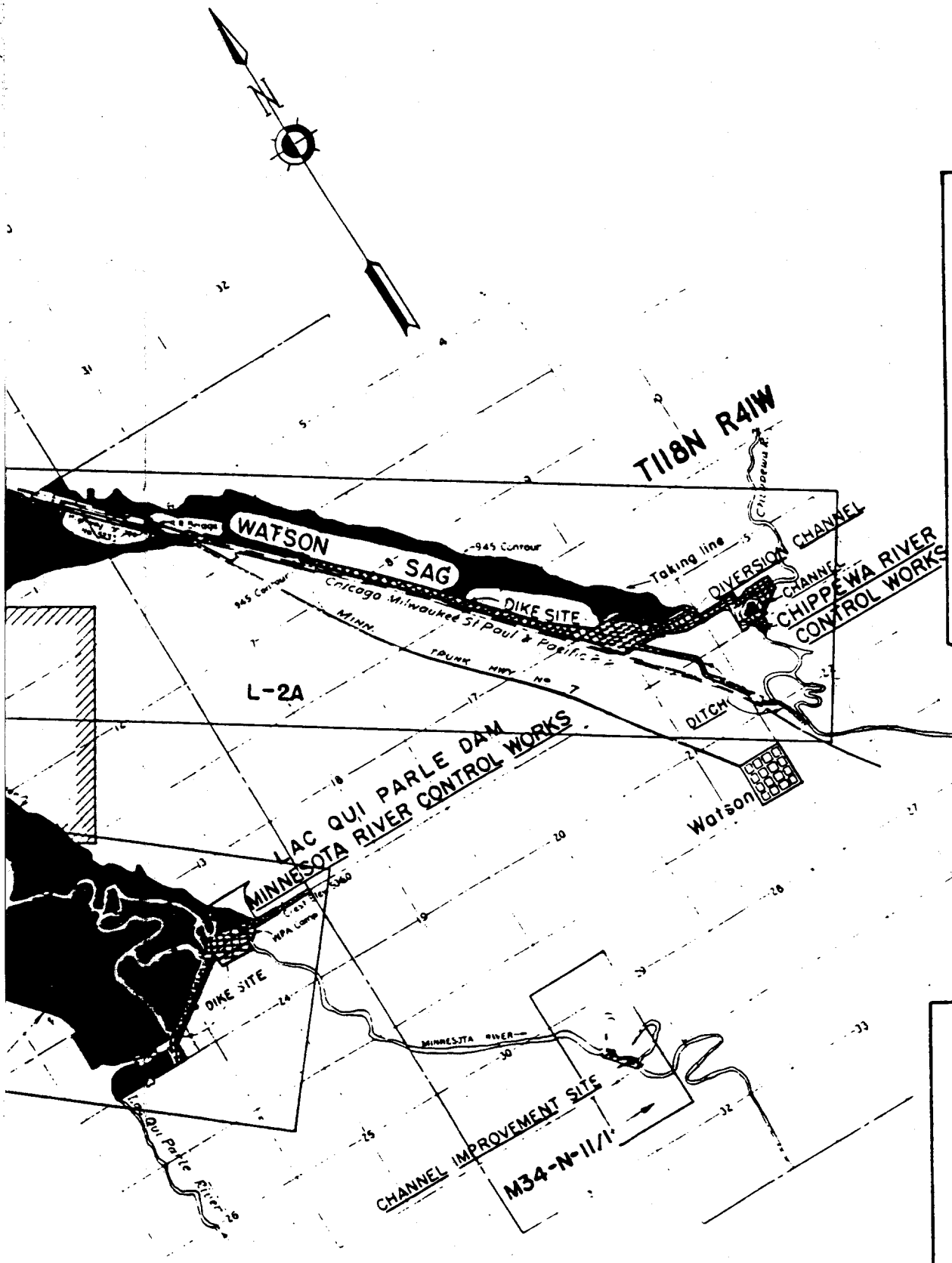
(3)

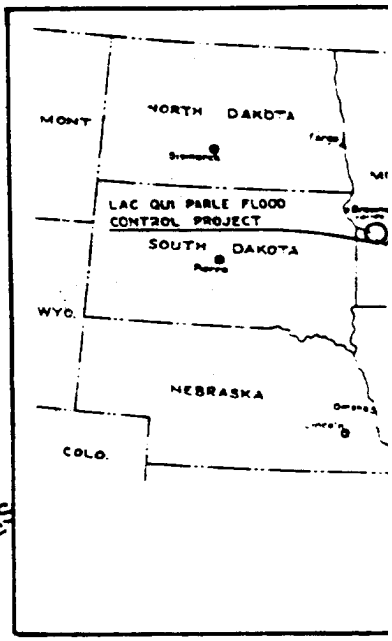

T120N R43W
To Appleton
Taking line
945 Contour
Taking line
945 Contour
Taking line
945 Contour
Still County
Chippewa County
Highway
L-5
T119N R43W

(4)


T119N R42W
CHIPPEWA
Taking line
LAC QUI PARLE
L-3
LAKE
L-4
T118N R42W
Taking line

(5)





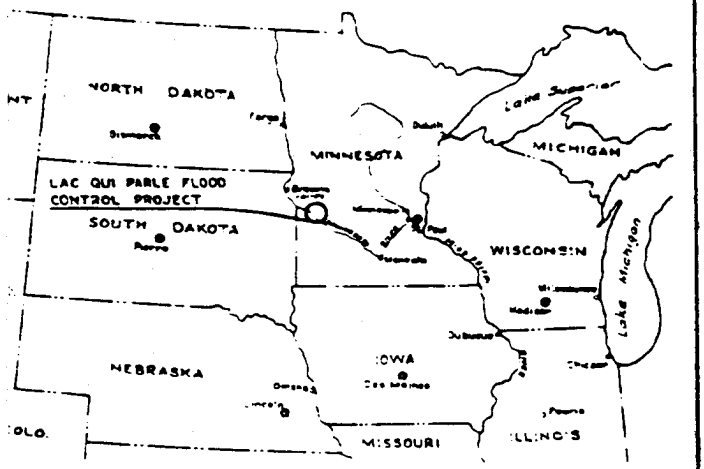
LAC QUI PARLE
MINNESOTA
WATER CONTRO

PROPERTY A
BY U.S. GOVE

U.S. ARMY CORPS
ST. PAUL DI
ST. PAUL, MI

FILE NO. M34-R-LQ

(6)



VICINITY MAP

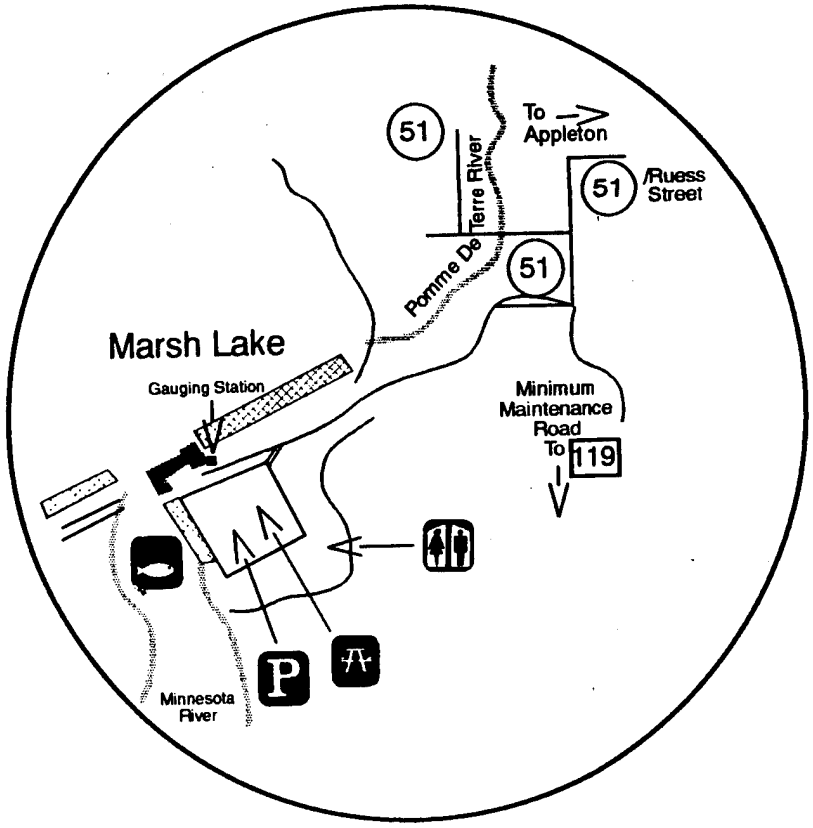
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PROPERTY ACQUIRED
BY U.S. GOVERNMENT

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

LE NO. M34-R-LQP-5/119 PLATE 2-34

Area A



Legend

- Boat Landing
- Canoe Portage
- City
- County Line
- Dam
- Drinking Water
- Fish Cleaning
- Handicap Facilities
- Hiking
- Hunting
- Parking
- Playground
- Picnic Area
- Rest Rooms
- State Highway
- Secondary Road
- Tailwater Fishing
- U.S. Route Marker

Day-Use Areas

A - Marsh Lake
B - Lac qui Parle
C - Watson Sag Weir

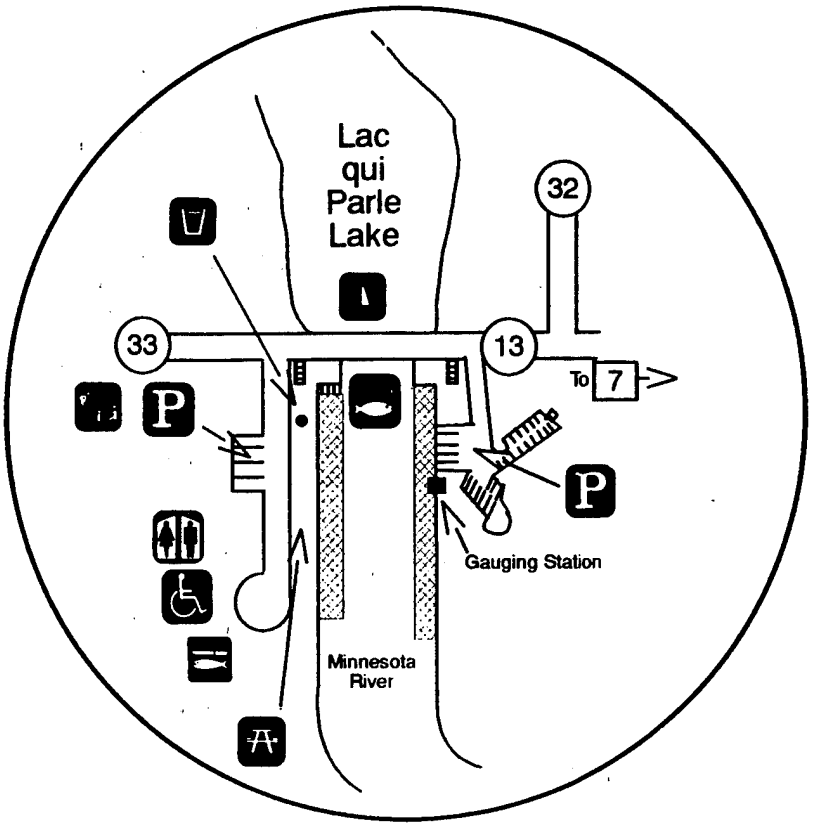
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

MARSH LAKE RESERVOIR
PUBLIC USE AREA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/120 **PLATE 2-35**

Area B



Legend

- Boat Landing
- Canoe Portage
- City
- County Line
- Dam
- Drinking Water
- Fish Cleaning
- Handicap Facilities
- Hiking
- Hunting
- Parking
- Playground
- Picnic Area
- Rest Rooms
- State Highway
- Secondary Road
- Tailwater Fishing
- U.S. Route Marker

Day-Use Areas

A - Marsh Lake
B - Lac qui Parle
C - Watson Sag Weir

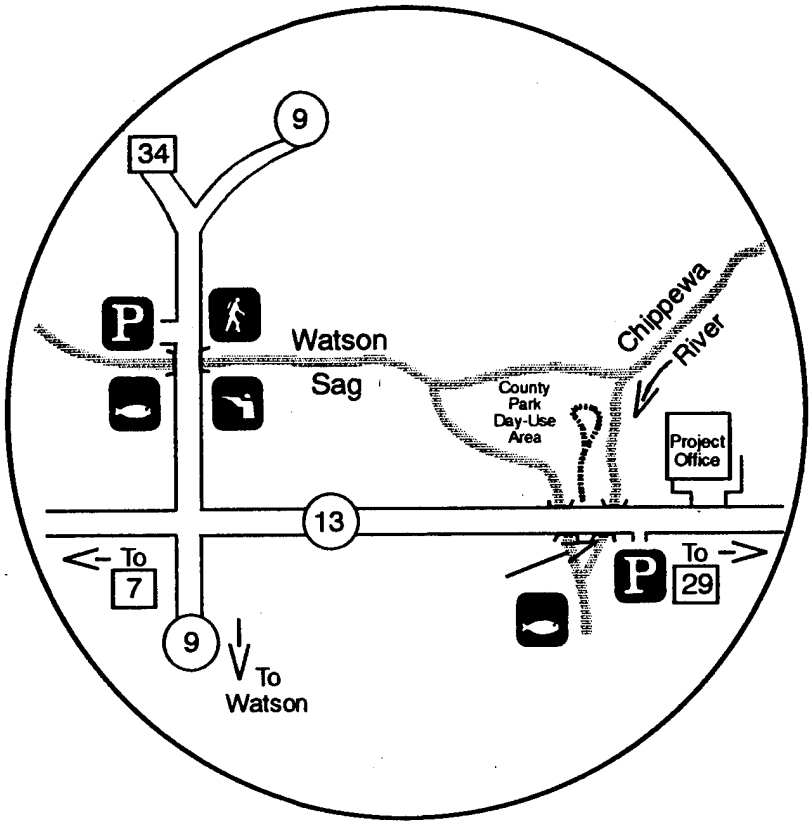
LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

LAC QUI PARLE RESERVOIR
PUBLIC USE AREA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/121 **PLATE 2-36**

Area C



Legend

- Boat Landing
- Canoe Portage
- City
- County Line
- Dam
- Drinking Water
- Fish Cleaning
- Handicap Facilities
- Hiking
- Hunting
- Parking
- Playground
- Picnic Area
- Rest Rooms
- State Highway
- Secondary Road
- Tailwater Fishing
- U.S. Route Marker

Day-Use Areas

A - Marsh Lake
B - Lac qui Parle
C - Watson Sag Weir

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

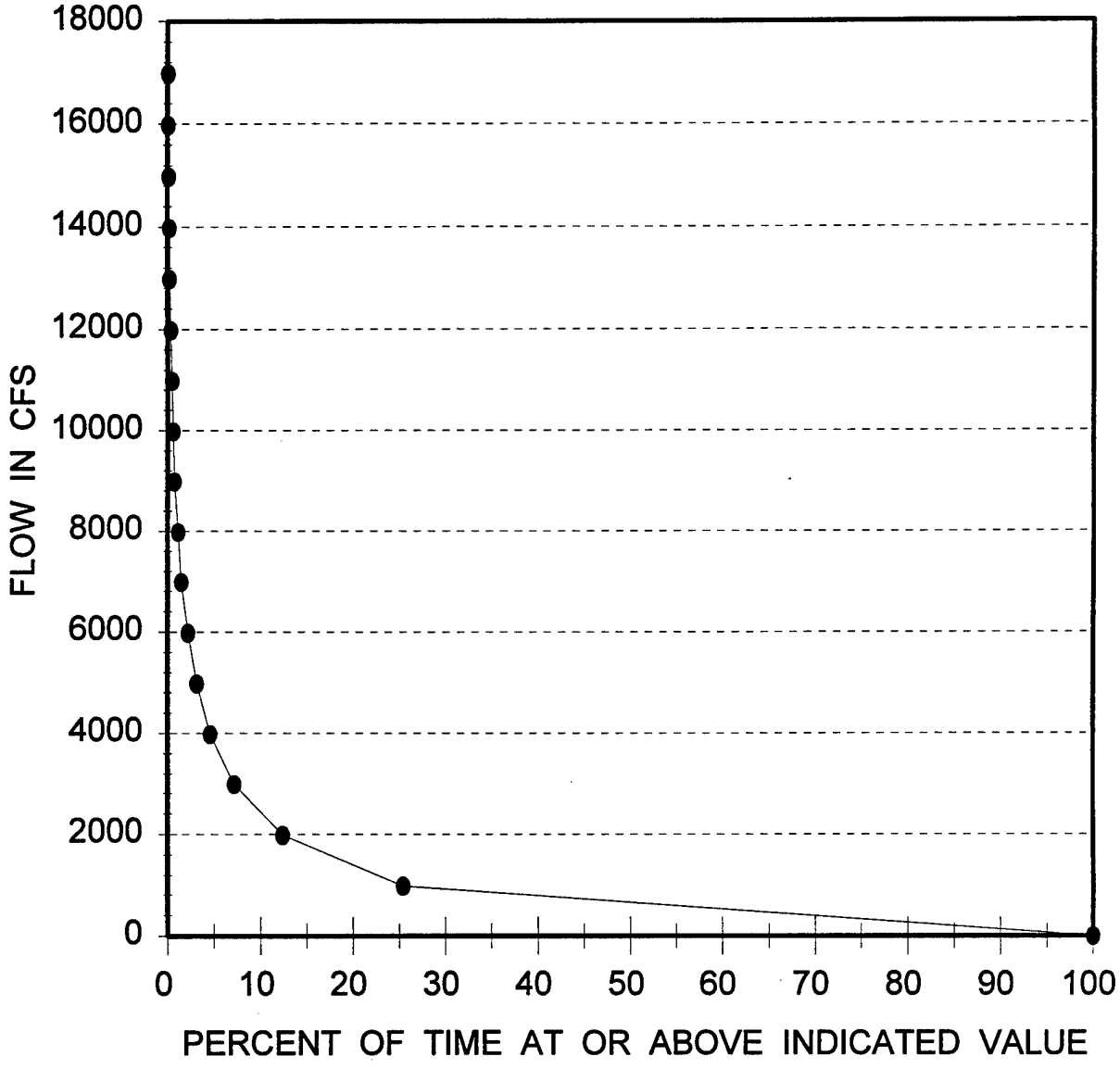
CHIPPEWA RIVER DIVERSION
PUBLIC USE AREA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/122 **PLATE 2-37**

LAC QUI PARLE PROJECT

RESERVOIR INFLOW - DURATION



PERIOD OF RECORD (1940 - 1993)

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

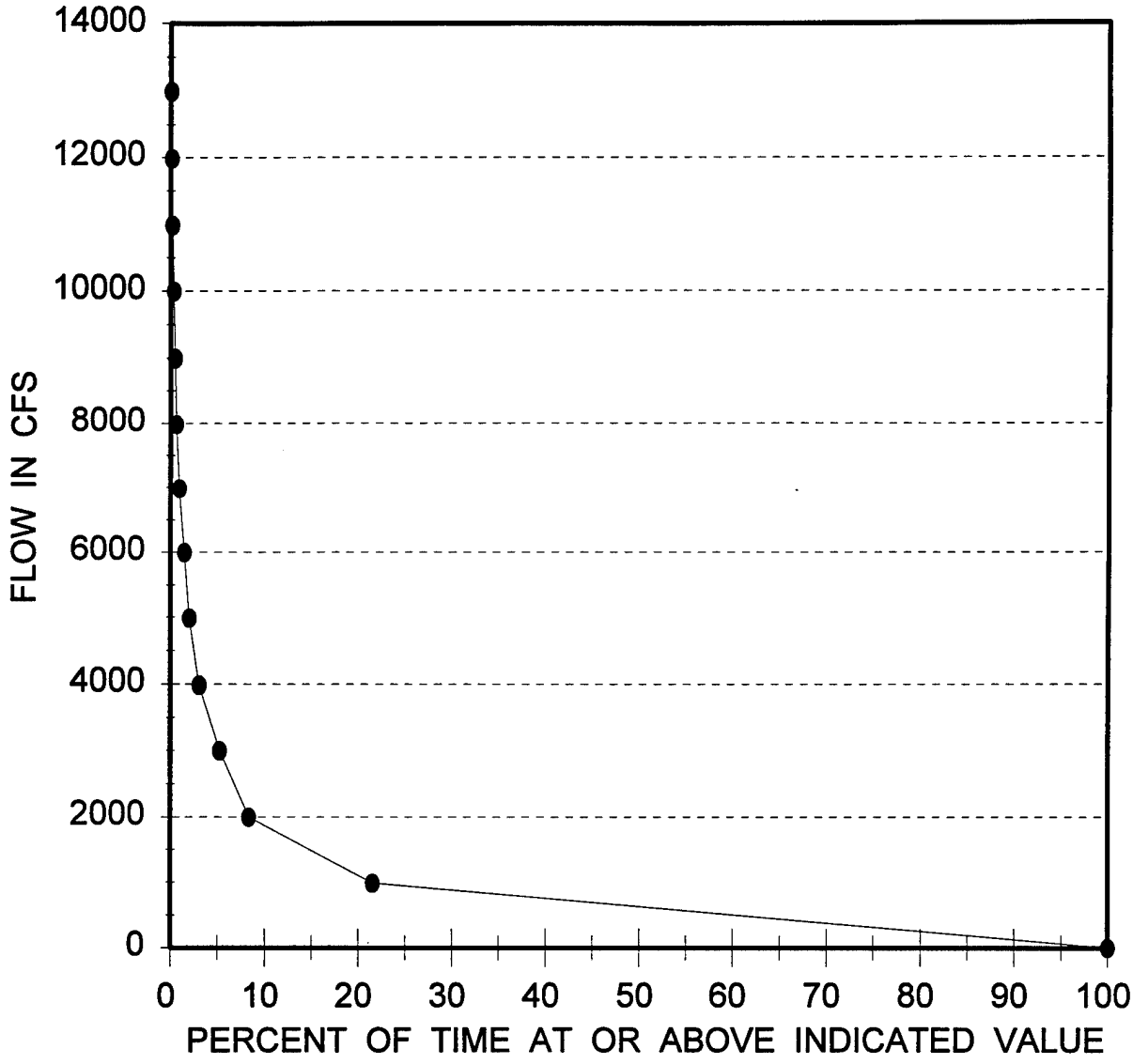
RESERVOIR INFLOW - DURATION (ANNUAL)

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/123 **PLATE 4-1**

LAC QUI PARLE PROJECT

RESERVOIR OUTFLOW - DURATION



PERIOD OF RECORD (1940 - 1993)

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

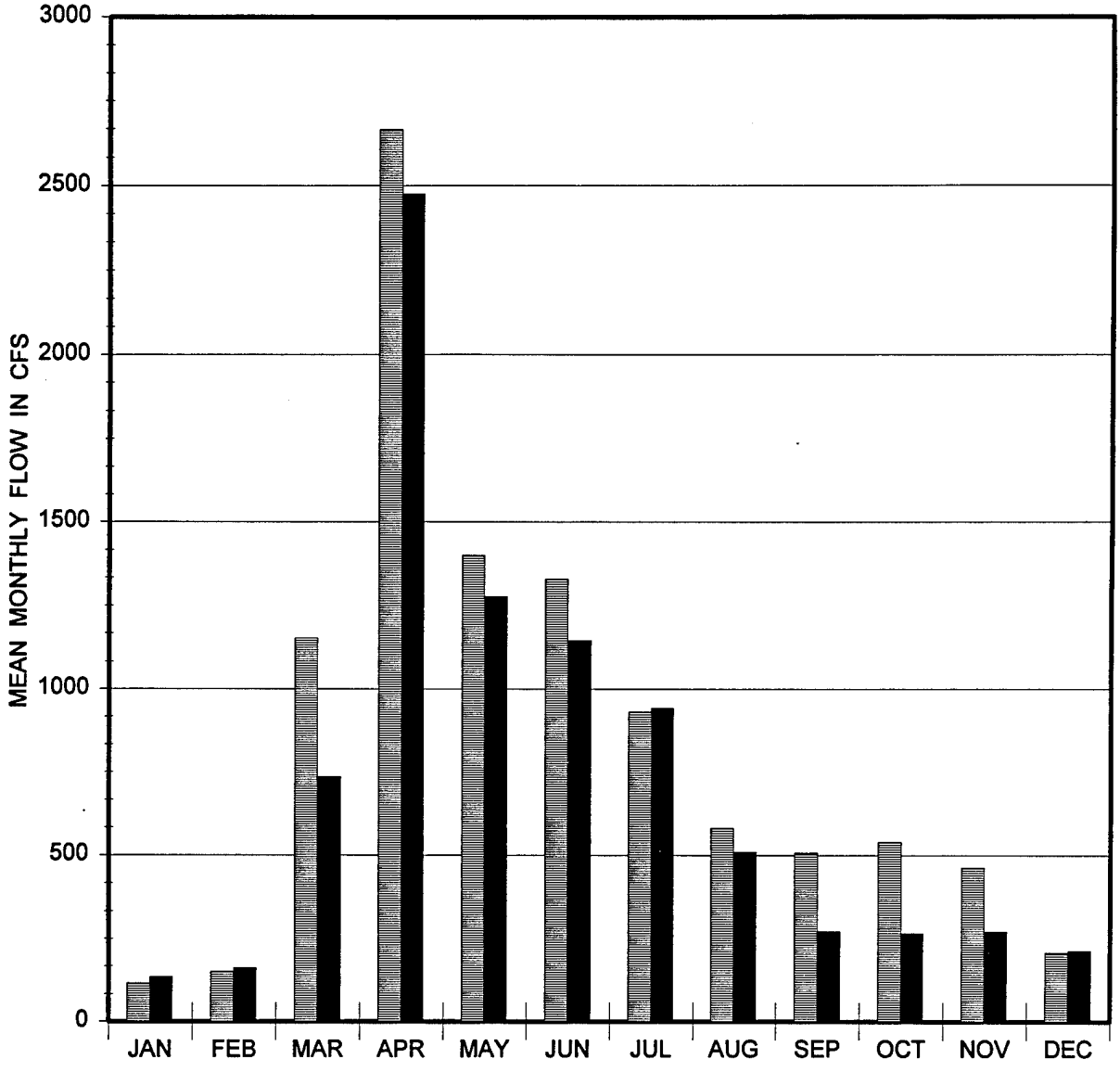
RESERVOIR OUTFLOW - DURATION (ANNUAL)

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/124 **PLATE 4-2**

LAC QUI PARLE PROJECT

RESERVOIR MONTHLY INFLOW - OUTFLOW



PERIOD OF RECORD (1940 - 1993)

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

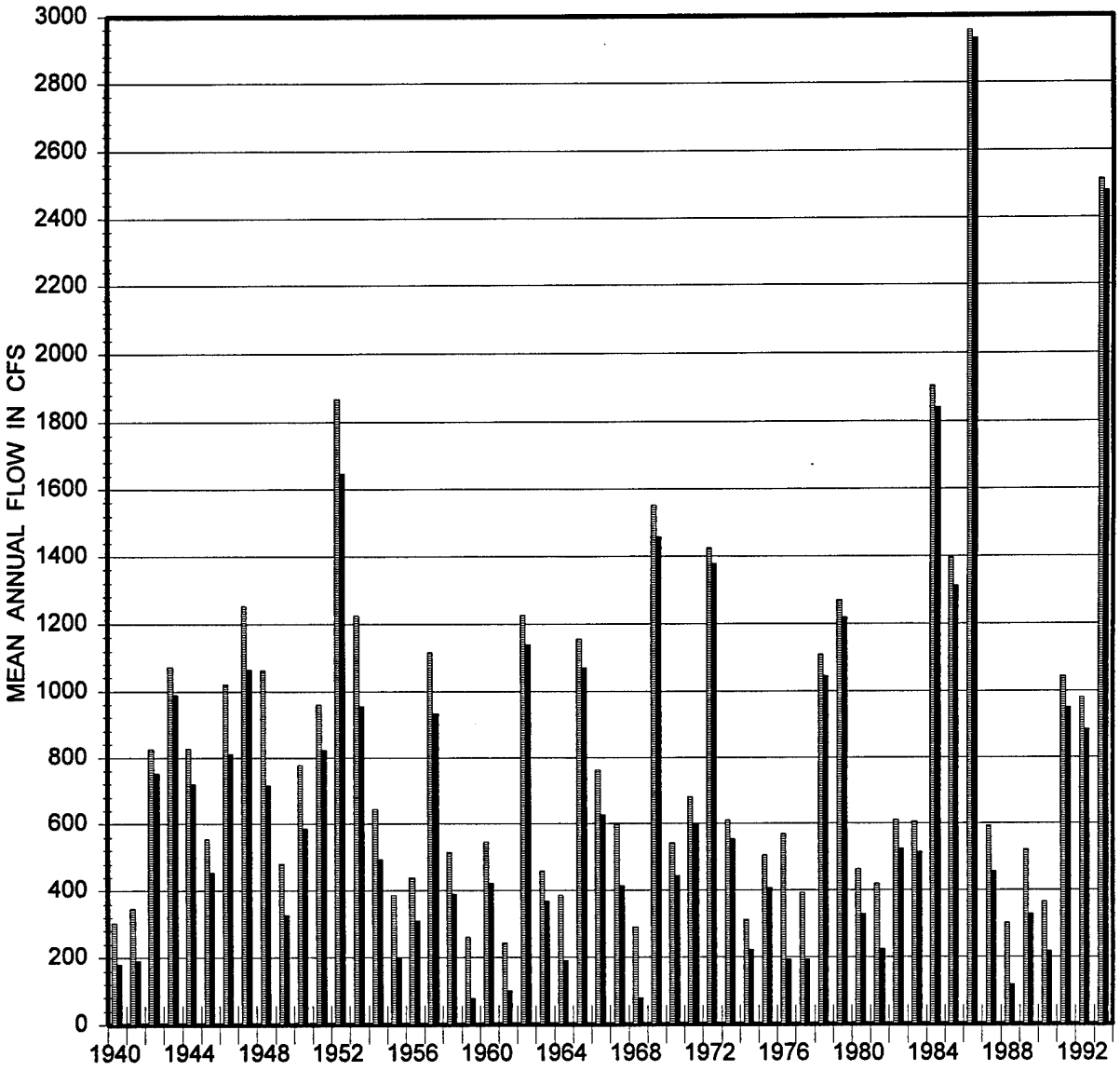
RESERVOIR
MONTHLY INFLOW - OUTFLOW

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/125 **PLATE 4-3**

LAC QUI PARLE PROJECT

RESERVOIR ANNUAL INFLOW - OUTFLOW



INFLOW OUTFLOW

PERIOD OF RECORD (1940 - 1993)

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

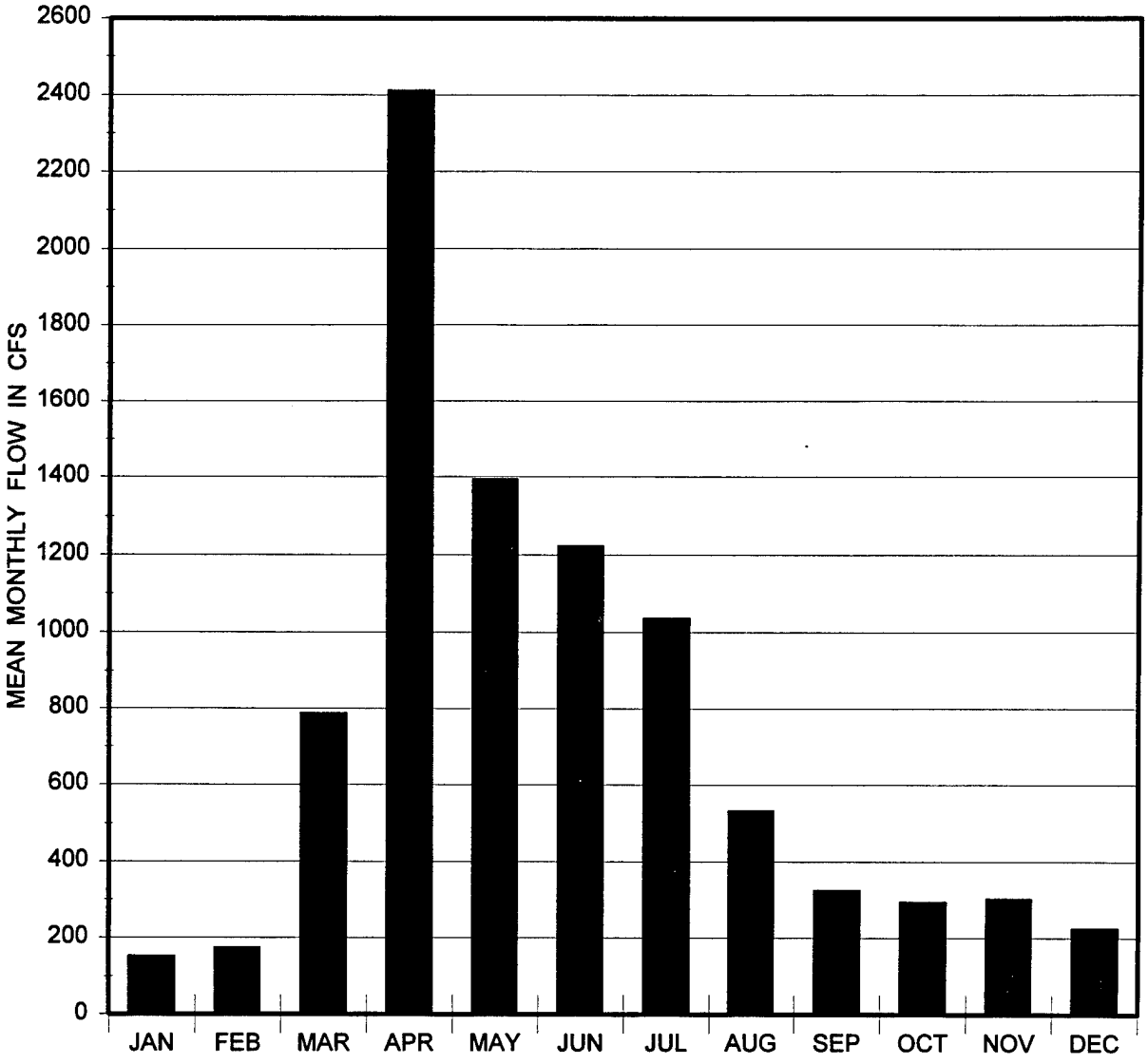
RESERVOIR ANNUAL INFLOW - OUTFLOW

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/126 **PLATE 4-4**

MINNESOTA RIVER
AT MONTEVIDEO, MN

MONTHLY STREAMFLOW DISTRIBUTION

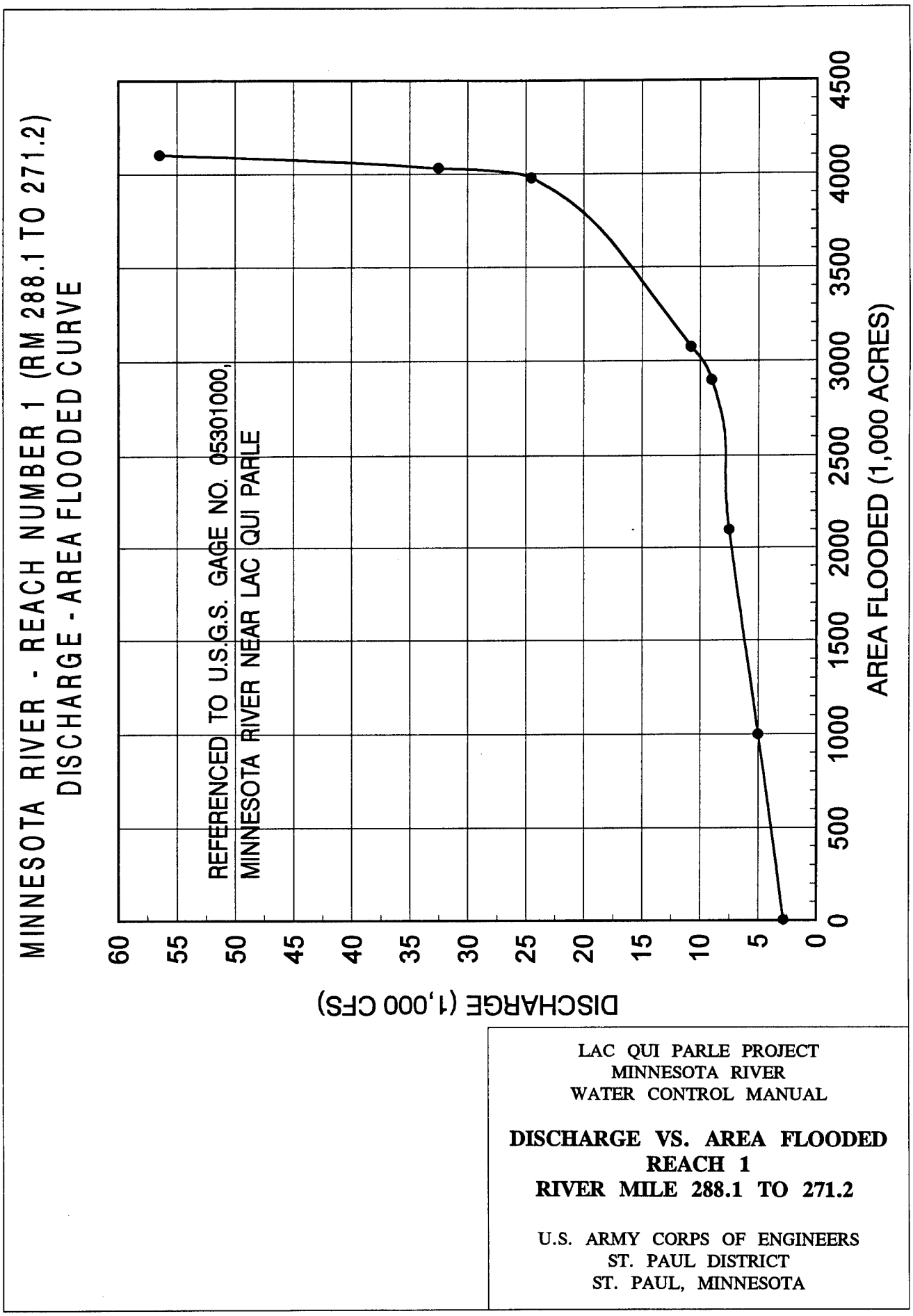


U.S.G.S. GAGE NO. 05051500
PERIOD OF RECORD (1909 - 1993)

LAKE TRAVERSE PROJECT
BOIS DE SIOUX RIVER
WATER CONTROL MANUAL

MINNESOTA RIVER AT MONTEVIDEO, MN MONTHLY STREAMFLOW DISTRIBUTION

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

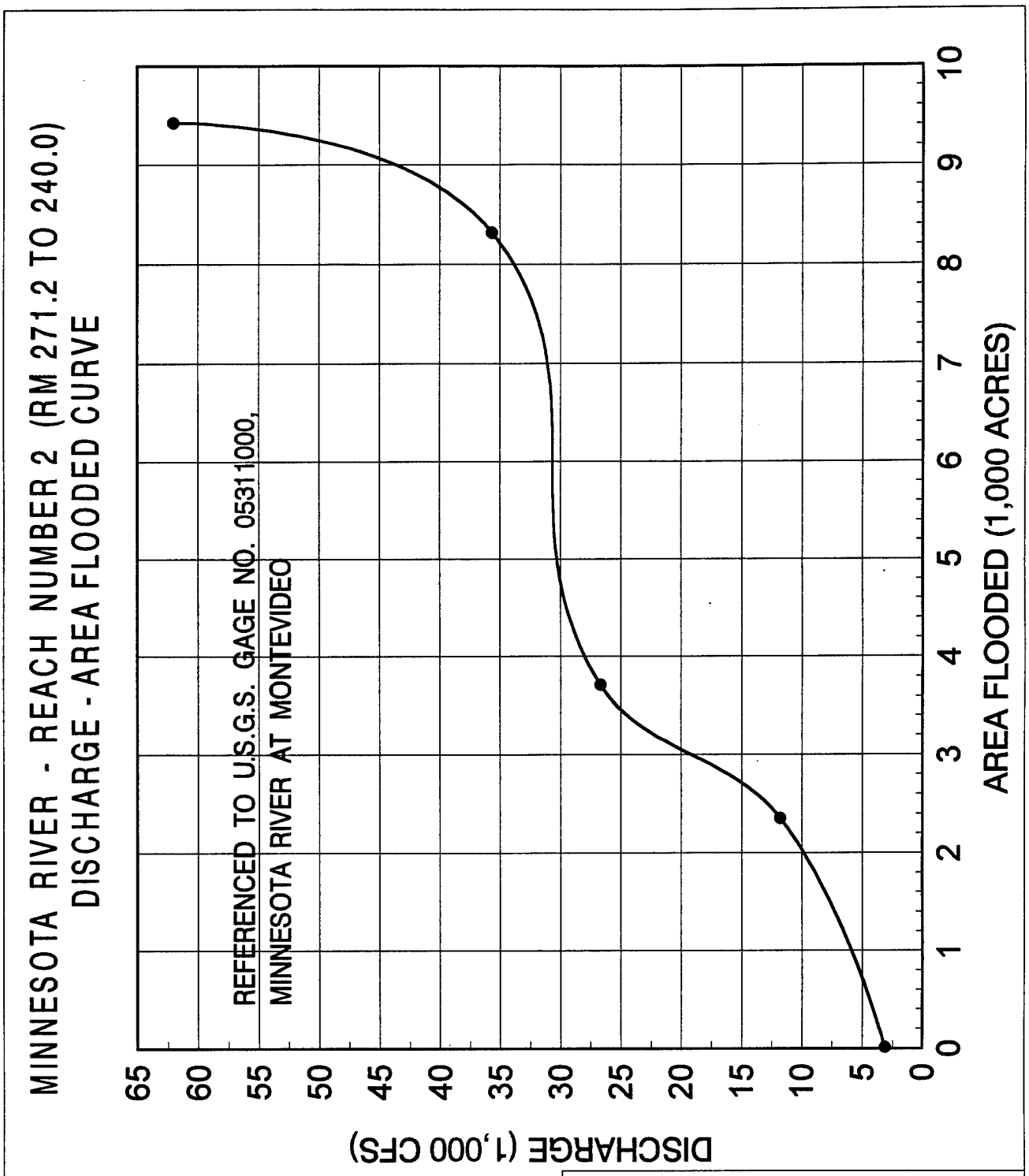


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE VS. AREA FLOODED
REACH 1
RIVER MILE 288.1 TO 271.2

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/128 **PLATE 4-6**

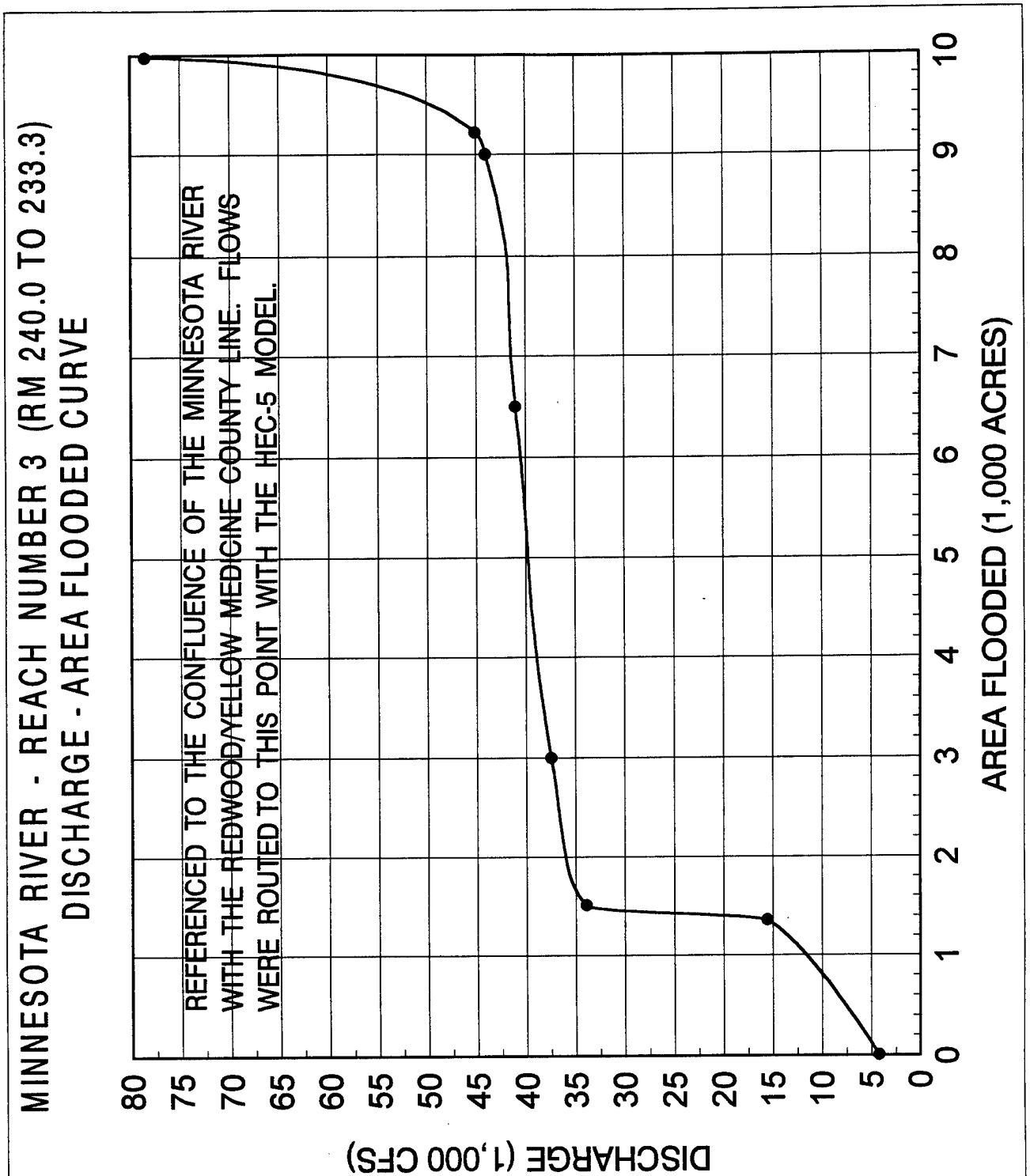


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE VS. AREA FLOODED
REACH 2
RIVER MILE 271.2 TO 240.0

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/129 **PLATE 4-7**

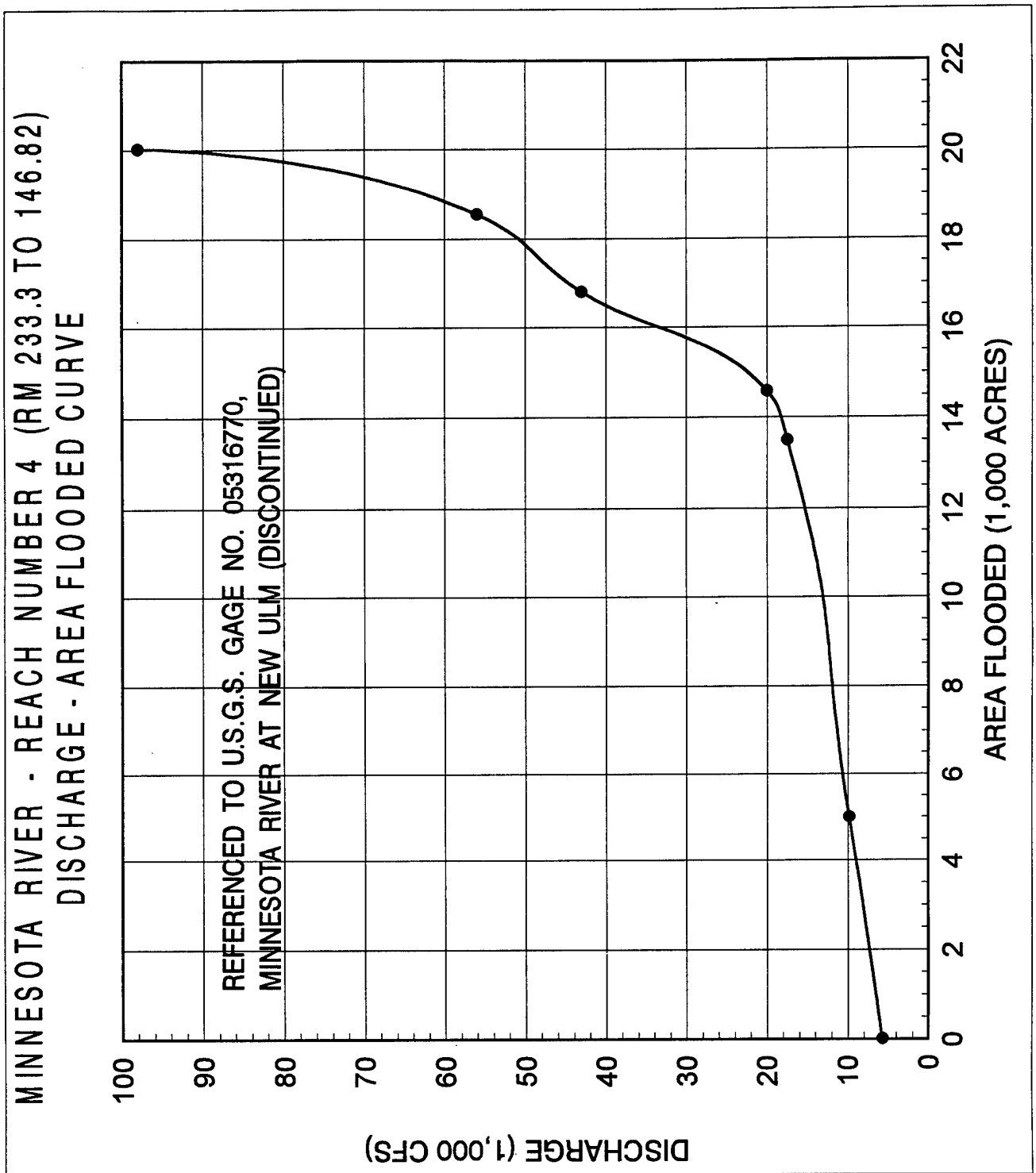


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE VS. AREA FLOODED
REACH 3
RIVER MILE 240.0 TO 233.3

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/130 **PLATE 4-8**

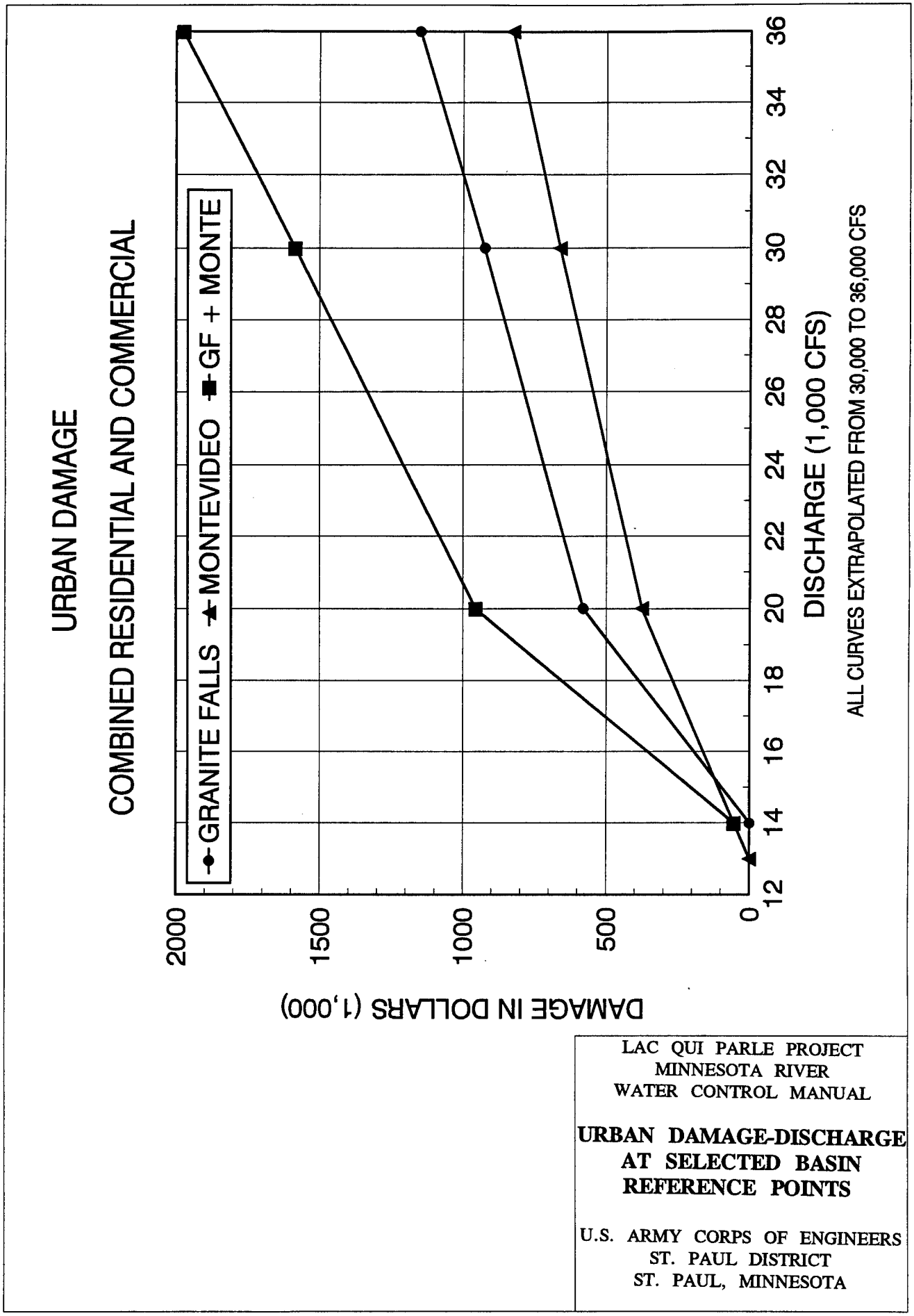


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE VS. AREA FLOODED
REACH 4
RIVER MILE 233.3 TO 146.82

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/131 **PLATE 4-9**

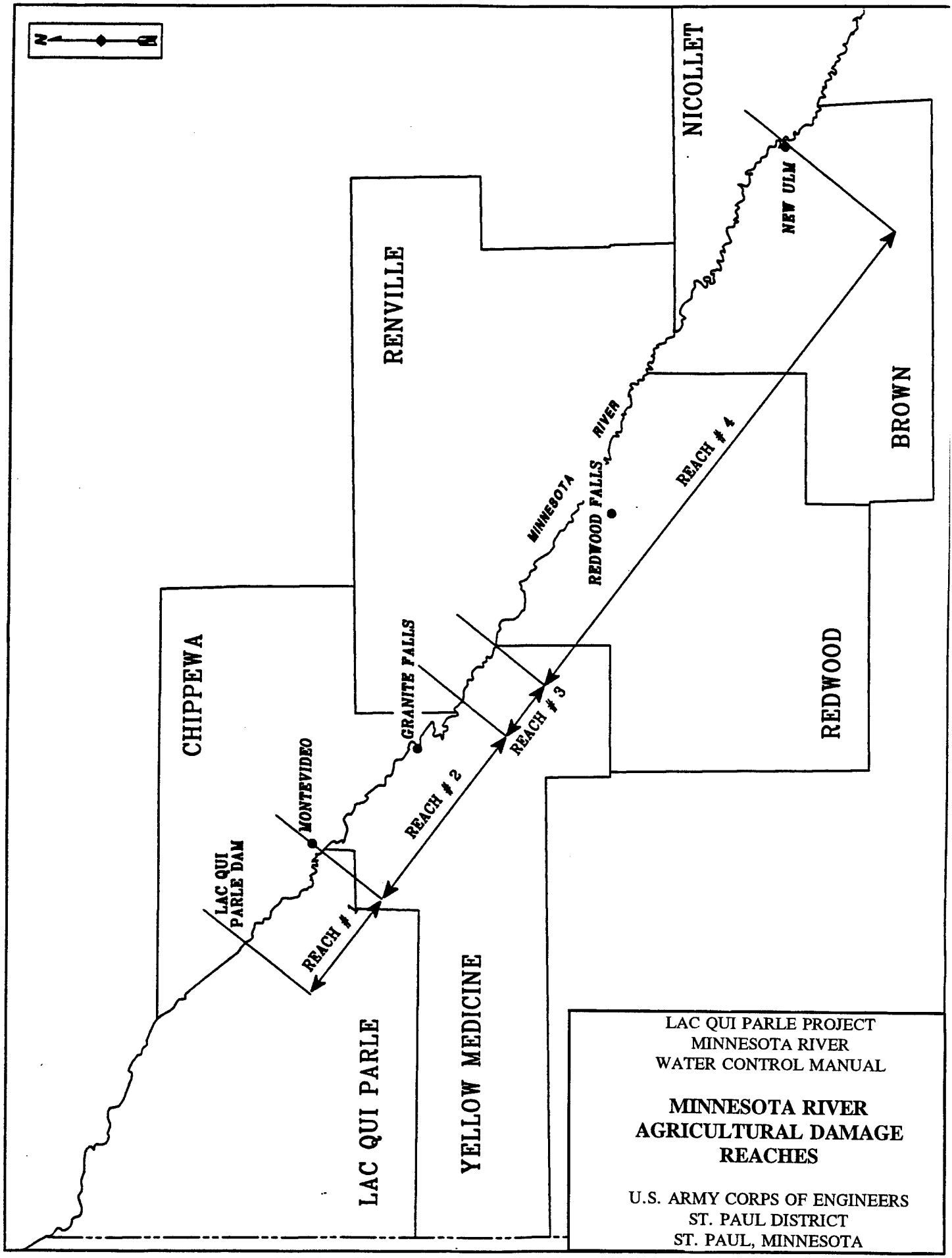


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

URBAN DAMAGE-DISCHARGE AT SELECTED BASIN REFERENCE POINTS

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/132 **PLATE 4-10**

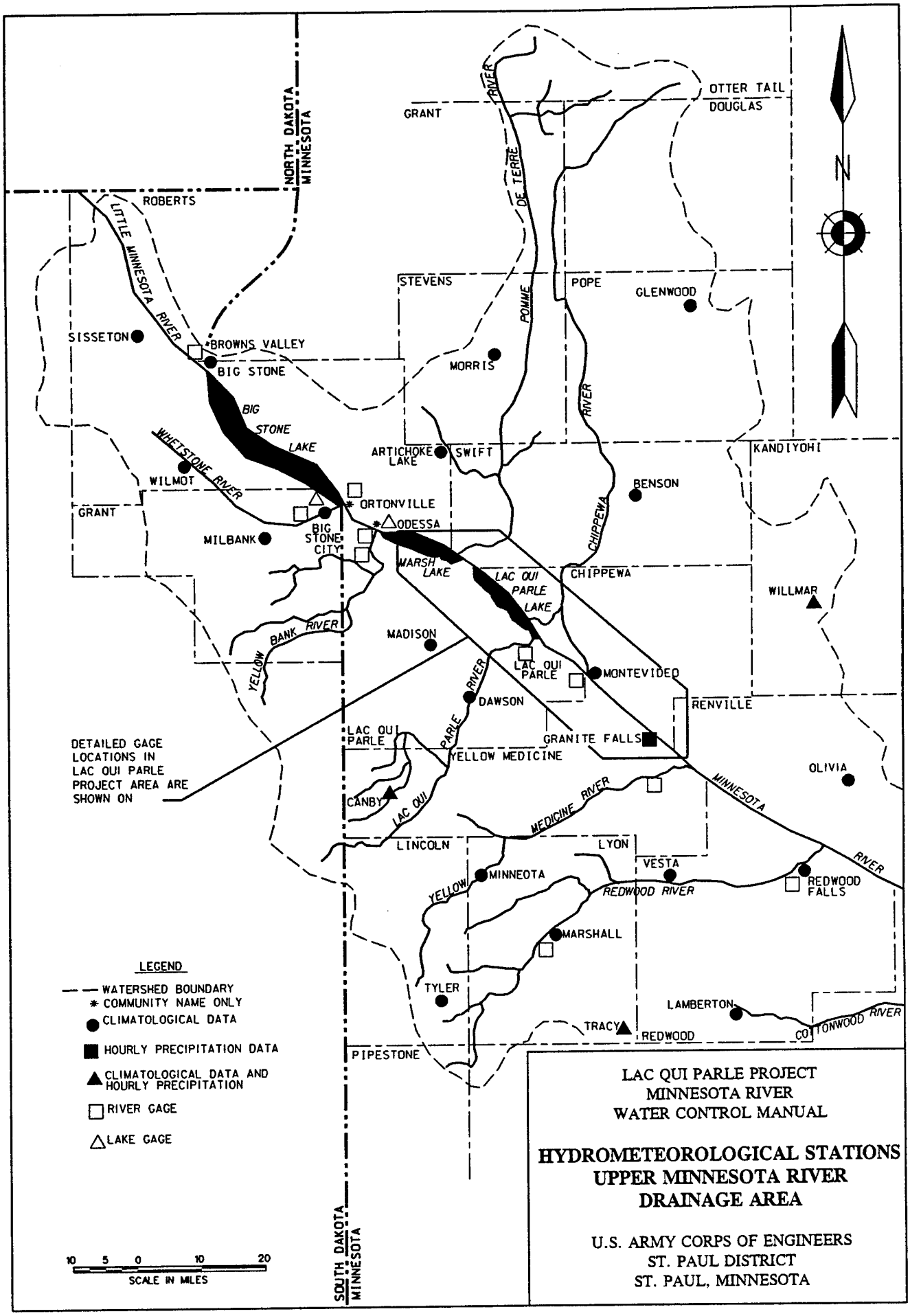


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

MINNESOTA RIVER AGRICULTURAL DAMAGE REACHES

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/133 PLATE 4-11

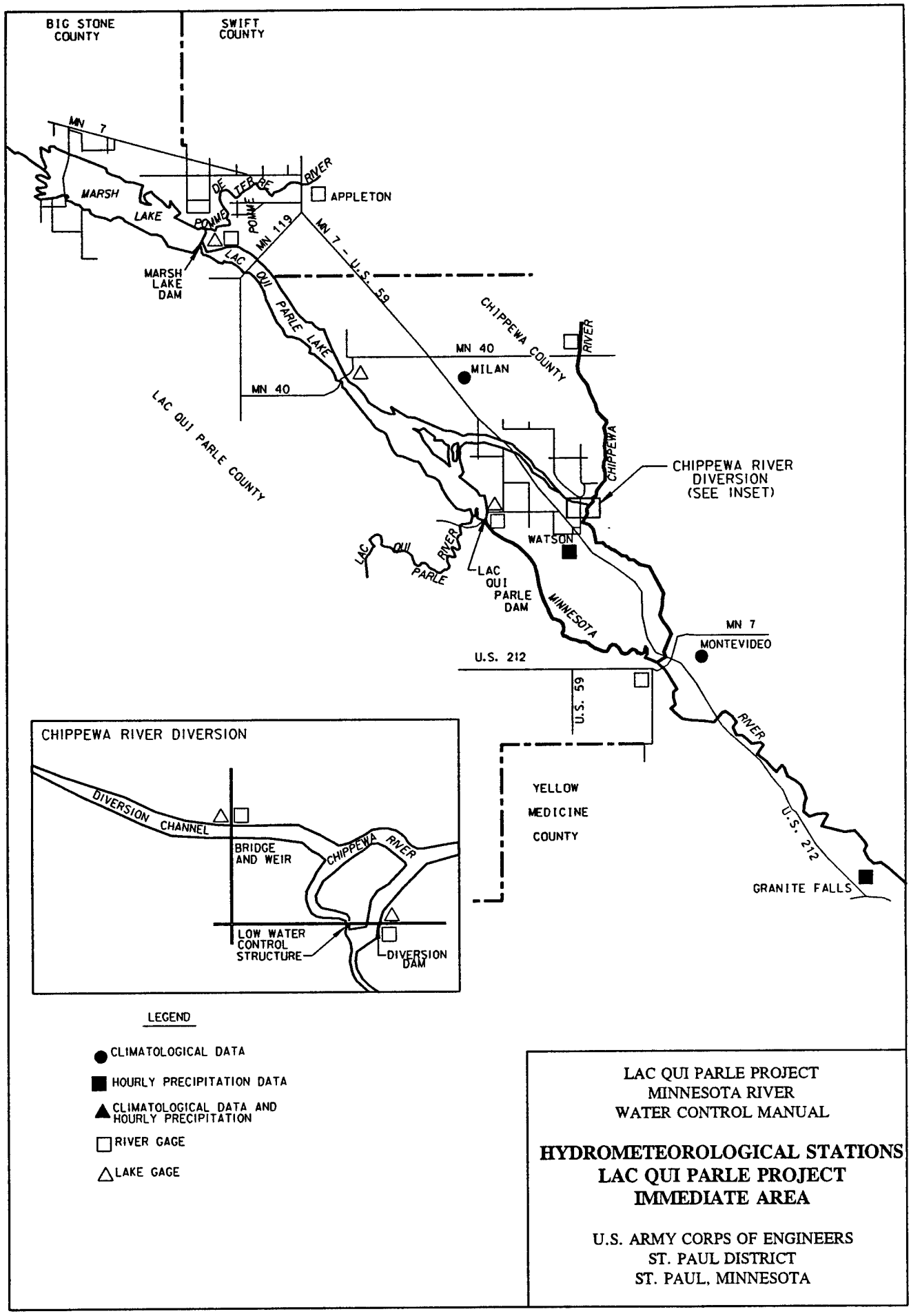


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

HYDROMETEOROLOGICAL STATIONS
UPPER MINNESOTA RIVER
DRAINAGE AREA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/134 **PLATE 5-1**

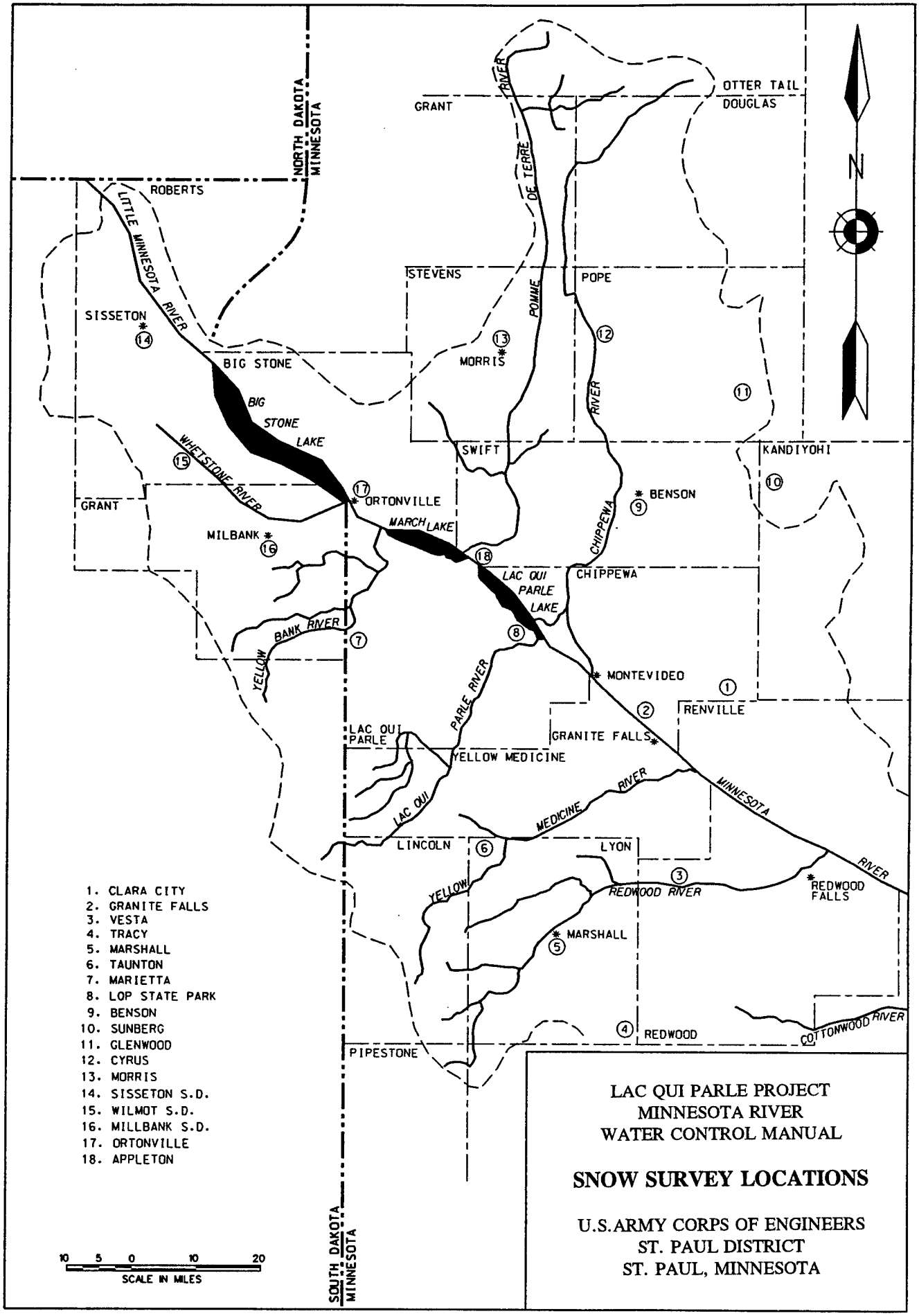


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

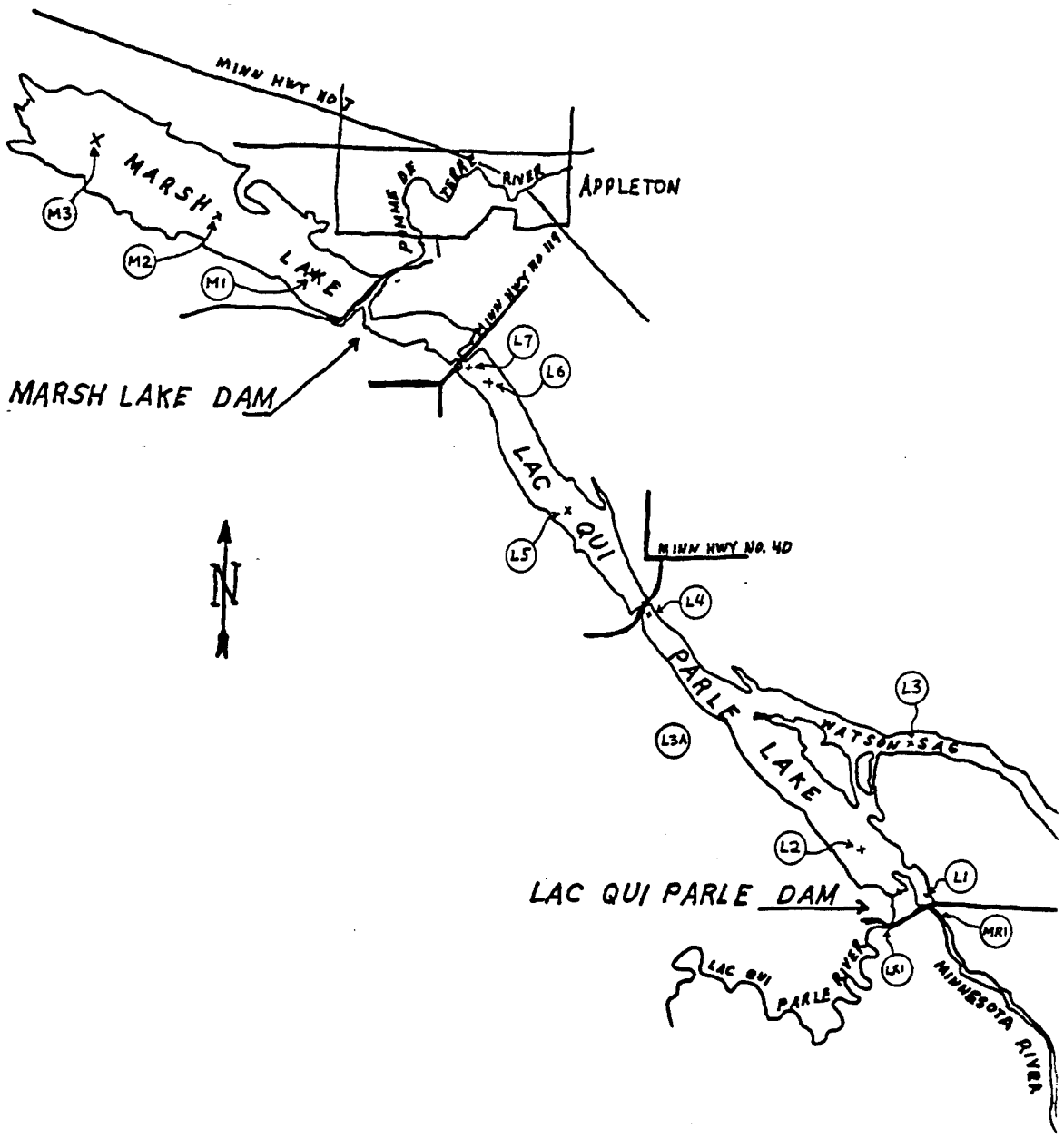
HYDROMETEOROLOGICAL STATIONS
LAC QUI PARLE PROJECT
IMMEDIATE AREA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/135 PLATE 5-2



FILE NO. M34-R-LQP-5/136 PLATE 5-3



LEGEND

M2 → x WATER QUALITY STATION

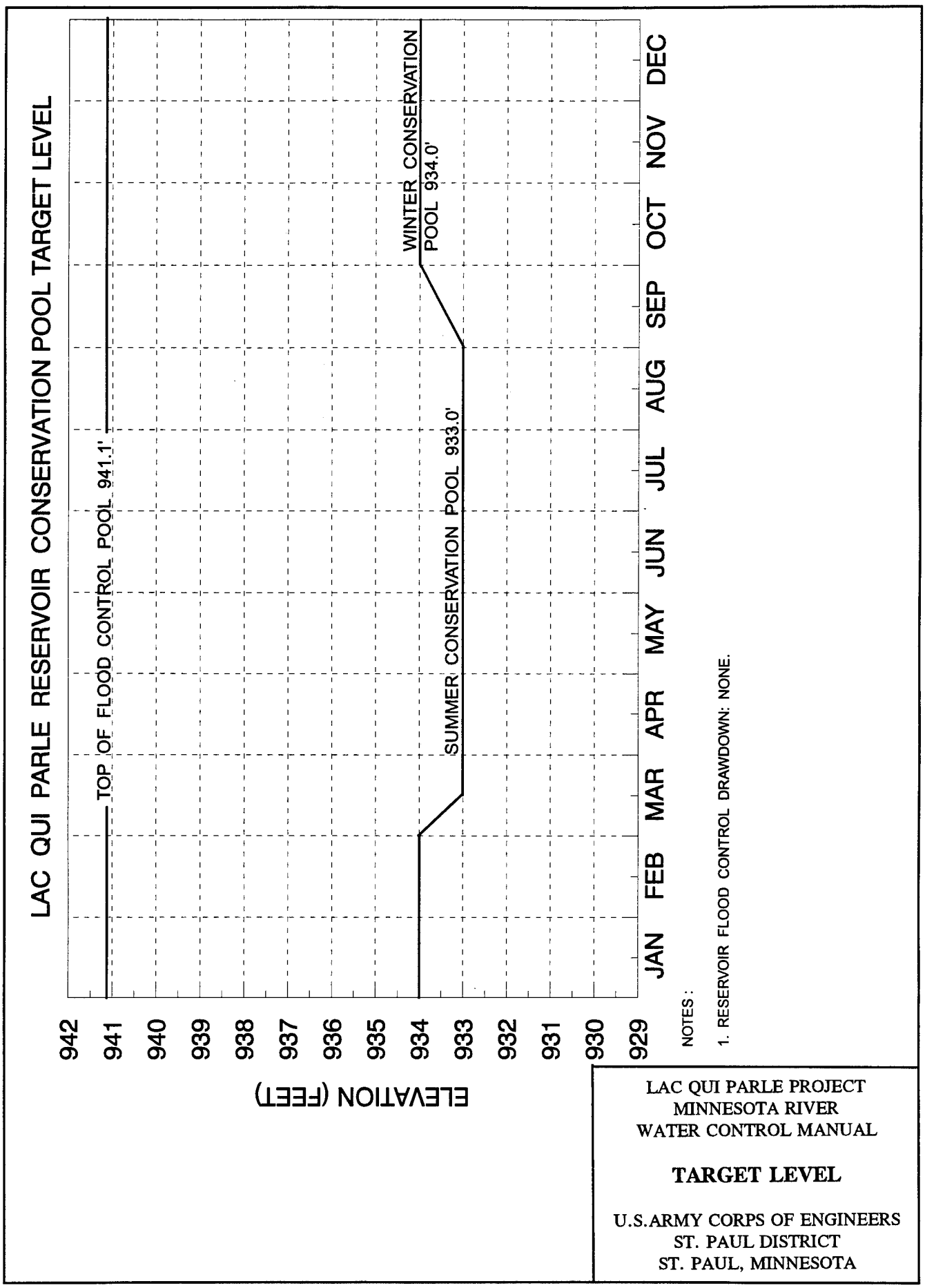
MAP NOT TO SCALE

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

WATER QUALITY STATIONS LOCATION MAP

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/137 PLATE 5-4



NOTES:

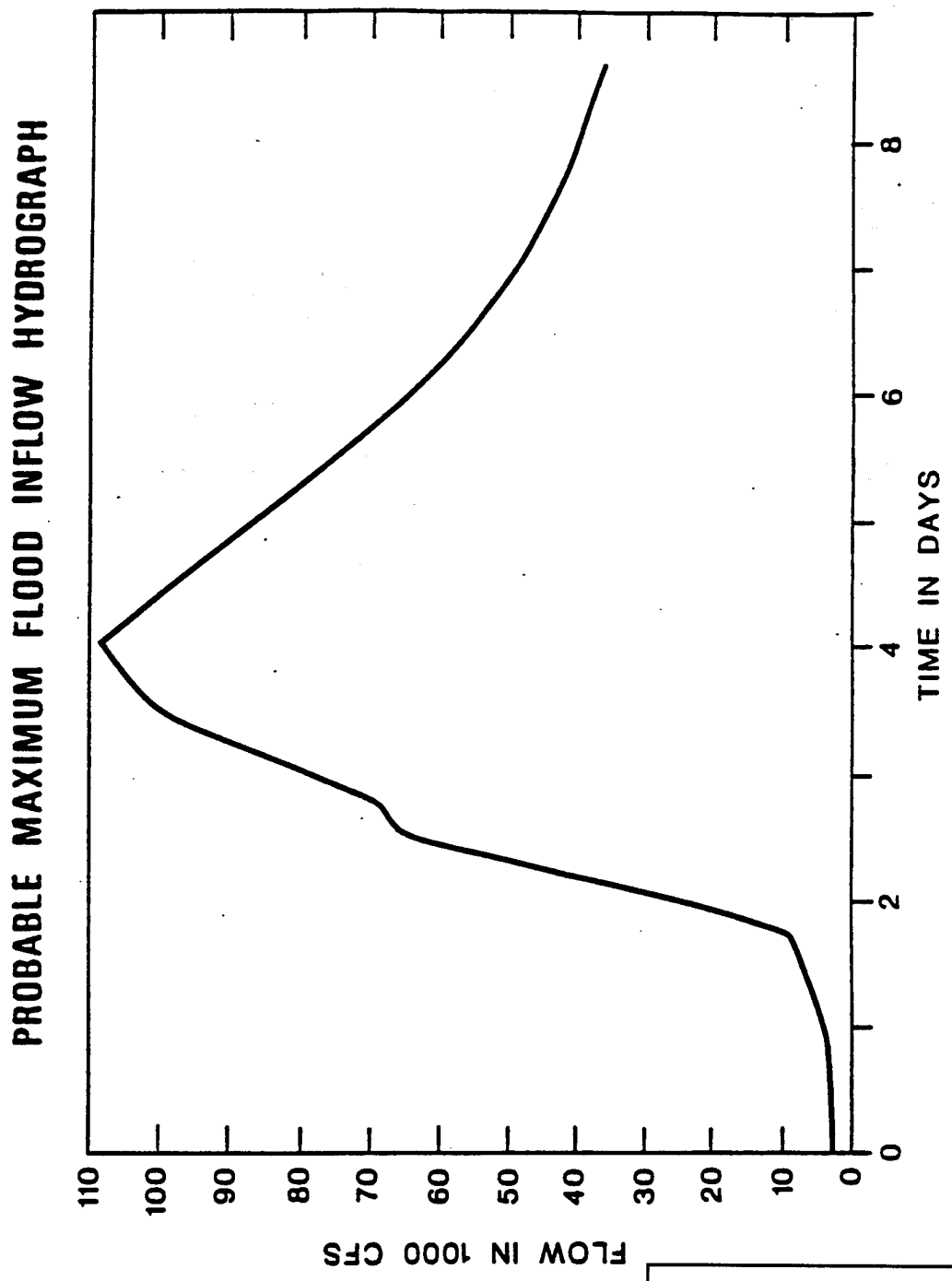
1. RESERVOIR FLOOD CONTROL DRAWDOWN: NONE.

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

TARGET LEVEL

U.S.ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/138 **PLATE 7-1**

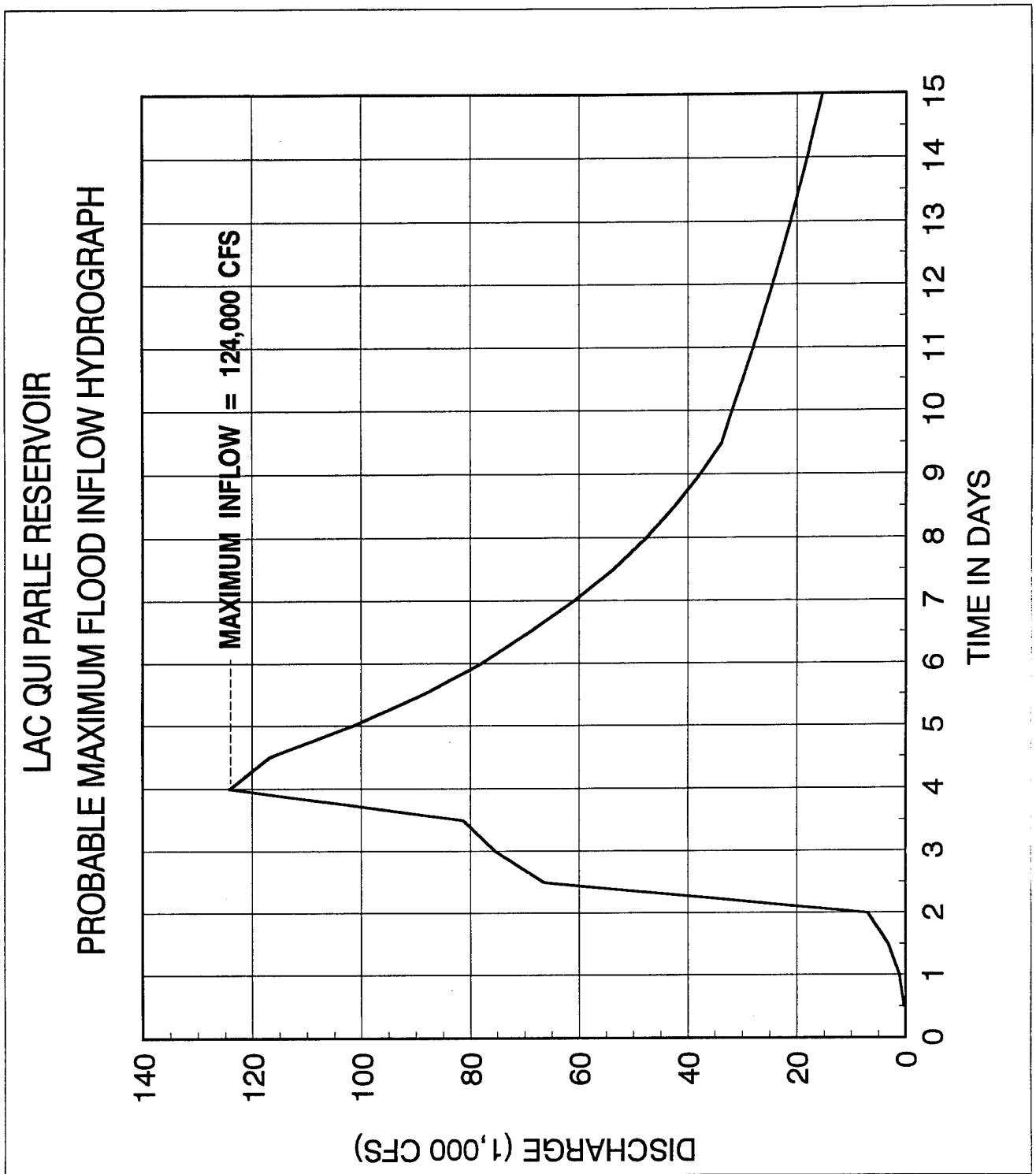


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PMF INFLOW HYDROGRAPH
MARSH LAKE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/139 **PLATE 8-1**

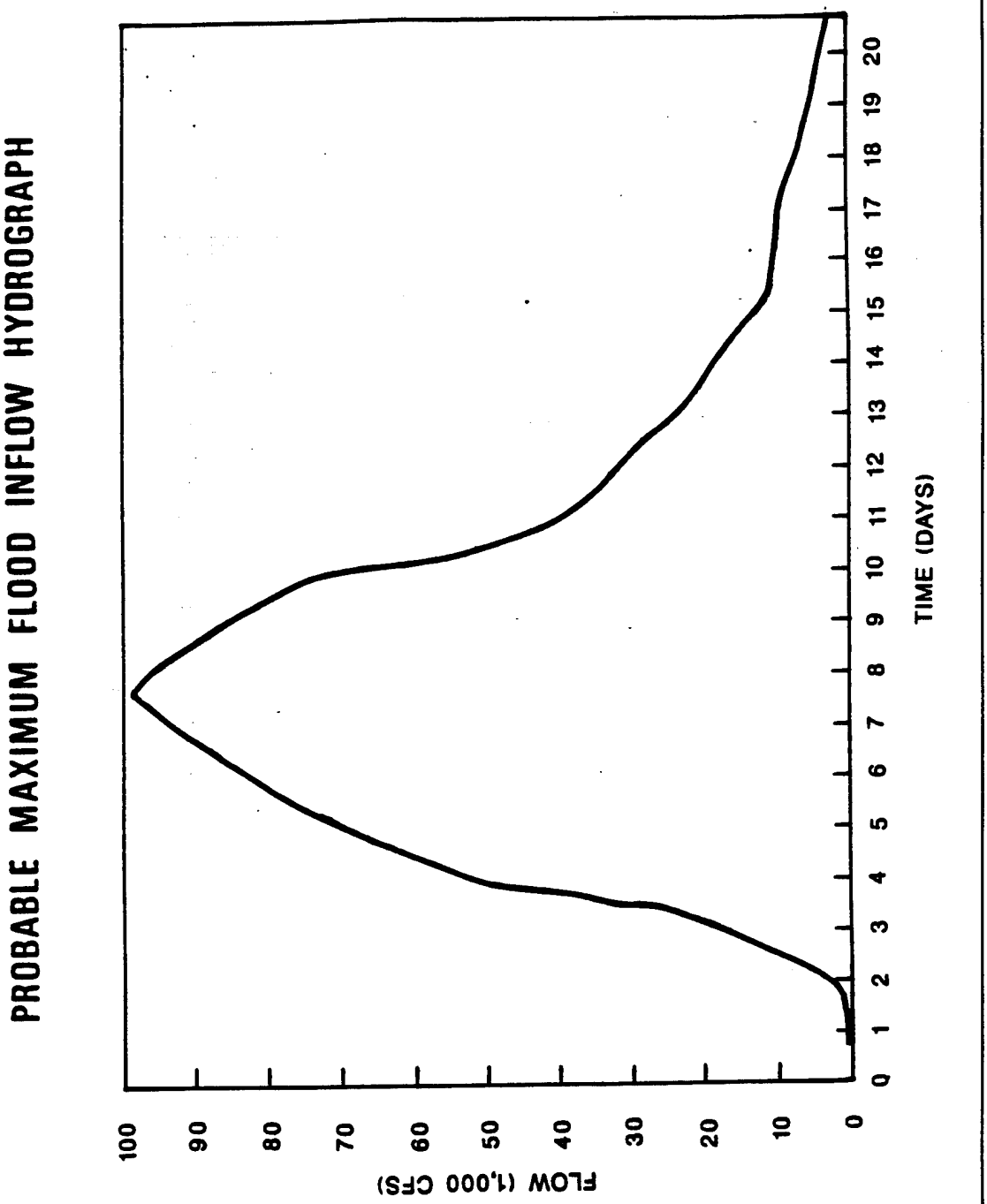


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PROBABLE MAXIMUM FLOOD INFLOW HYDROGRAPH LAC QUI PARLE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/140 **PLATE 8-2**

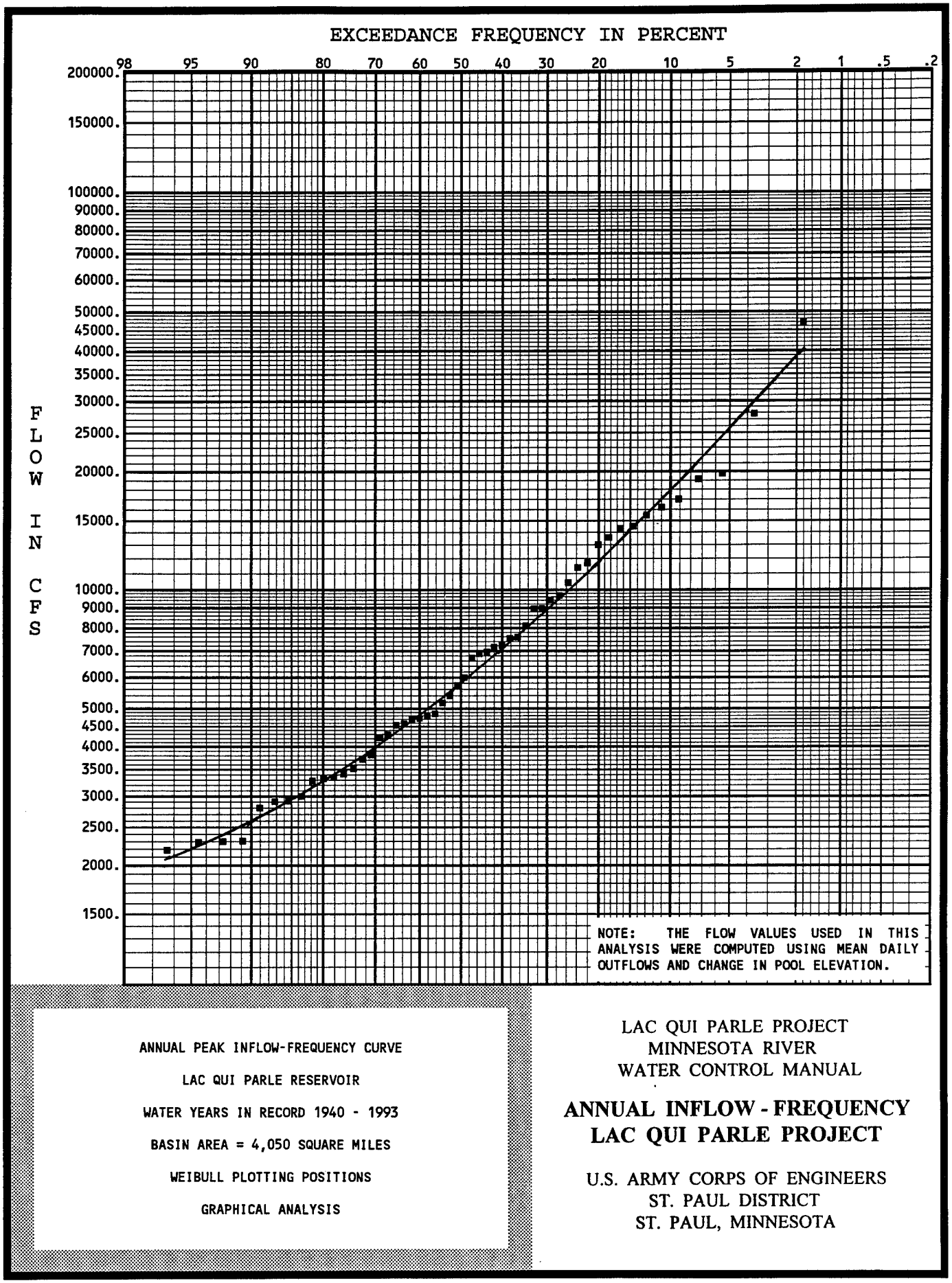


LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

PMF INFLOW HYDROGRAPH
CHIPPEWA RIVER
DIVERSION DAM

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/141 **PLATE 8-3**



ANNUAL PEAK INFLOW-FREQUENCY CURVE

LAC QUI PARLE RESERVOIR

WATER YEARS IN RECORD 1940 - 1993

BASIN AREA = 4,050 SQUARE MILES

WEIBULL PLOTTING POSITIONS

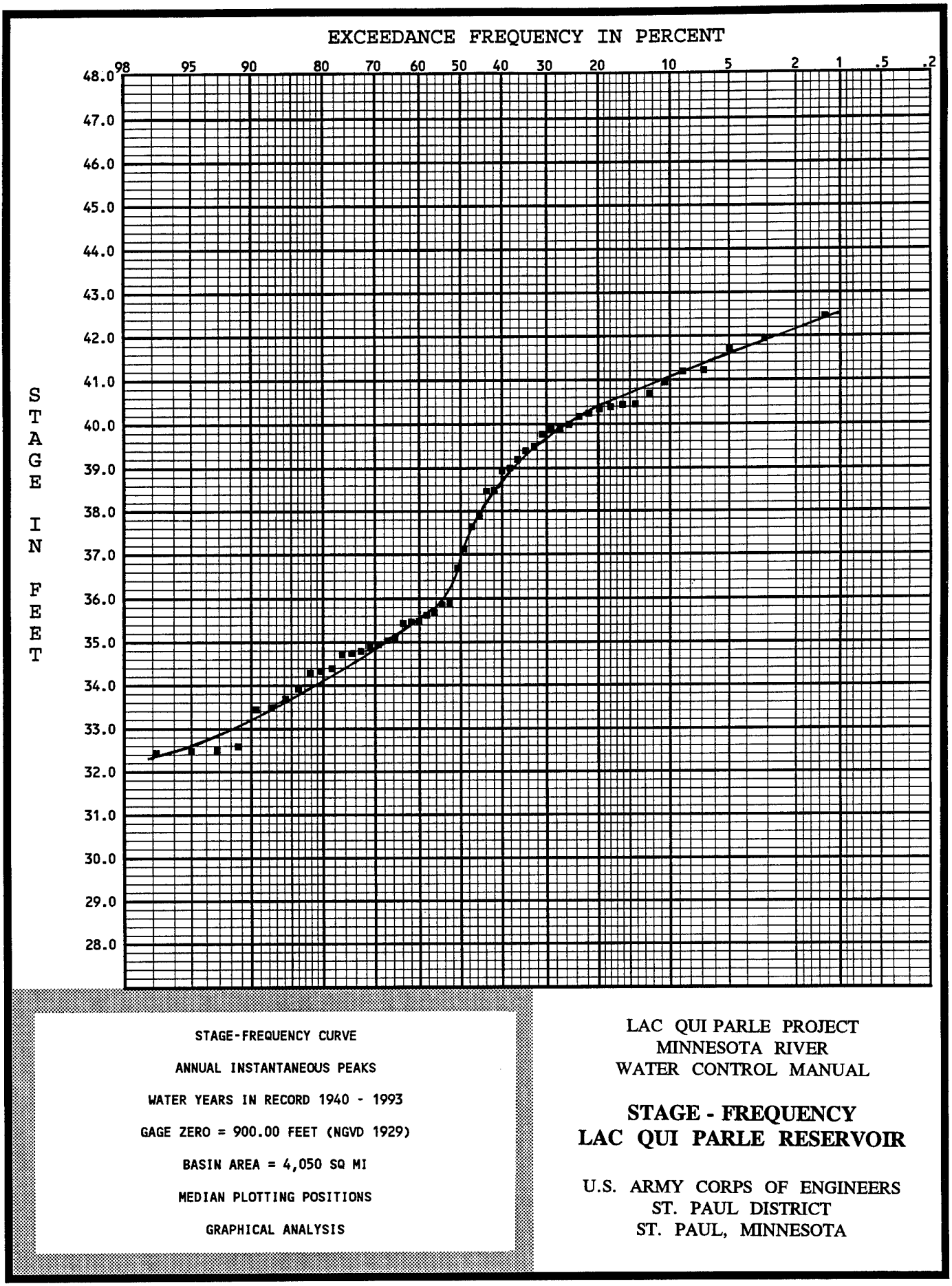
GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

ANNUAL INFLOW - FREQUENCY
LAC QUI PARLE PROJECT

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/142 **PLATE 8-4**



STAGE-FREQUENCY CURVE

ANNUAL INSTANTANEOUS PEAKS

WATER YEARS IN RECORD 1940 - 1993

GAGE ZERO = 900.00 FEET (NGVD 1929)

BASIN AREA = 4,050 SQ MI

MEDIAN PLOTTING POSITIONS

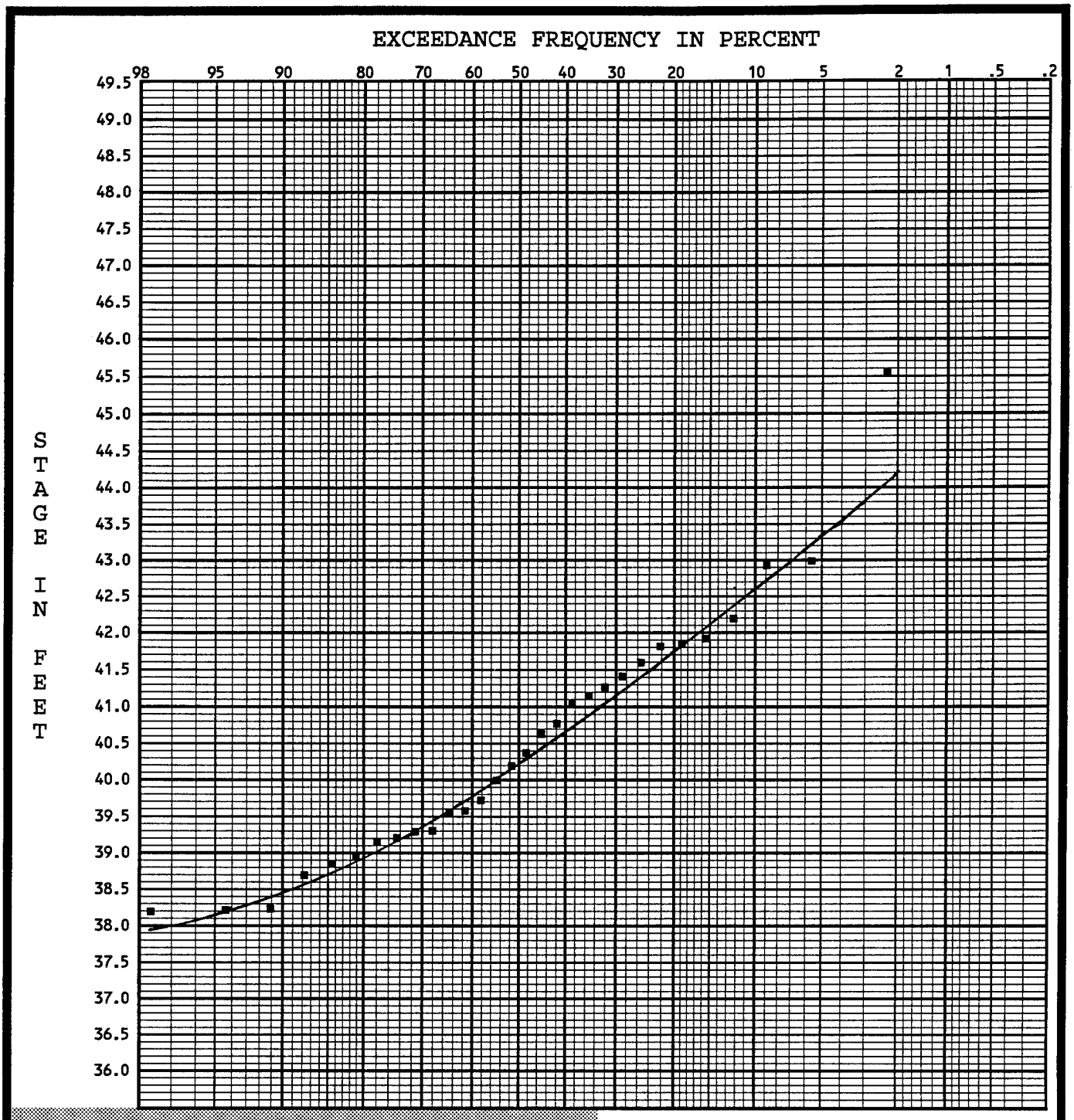
GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

STAGE - FREQUENCY
LAC QUI PARLE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/143 **PLATE 8-5**



STAGE-FREQUENCY CURVE

ANNUAL INSTANTANEOUS PEAKS

WATER YEARS IN RECORD 1964 - 1993

GAGE ZERO = 900.00 FEET (NGVD 1929)

BASIN AREA = 2,800 SQ MI

MEDIAN PLOTTING POSITIONS

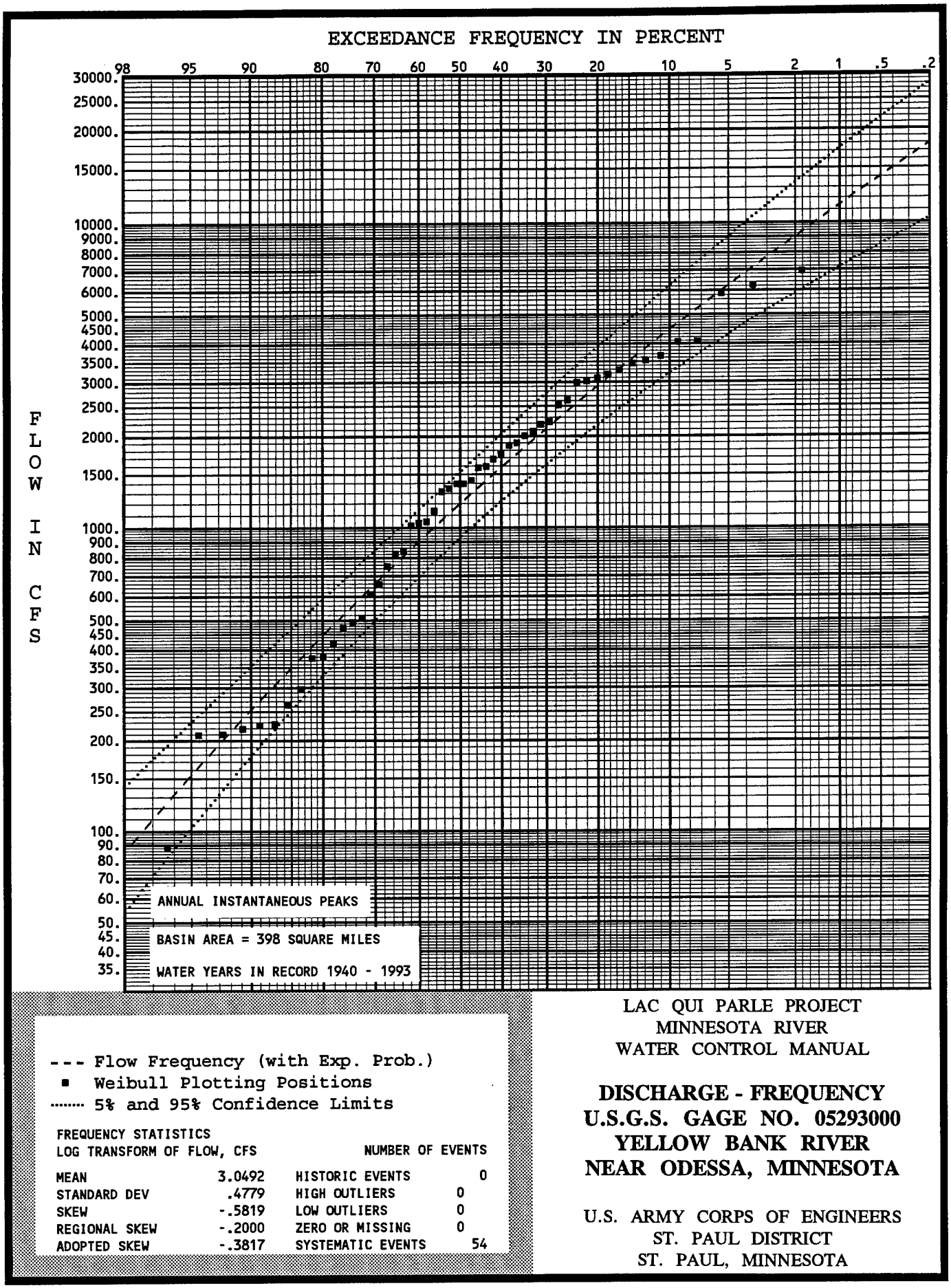
GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

STAGE - FREQUENCY
MARSH LAKE RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/144 **PLATE 8-6**



--- Flow Frequency (with Exp. Prob.)
■ Weibull Plotting Positions
····· 5% and 95% Confidence Limits

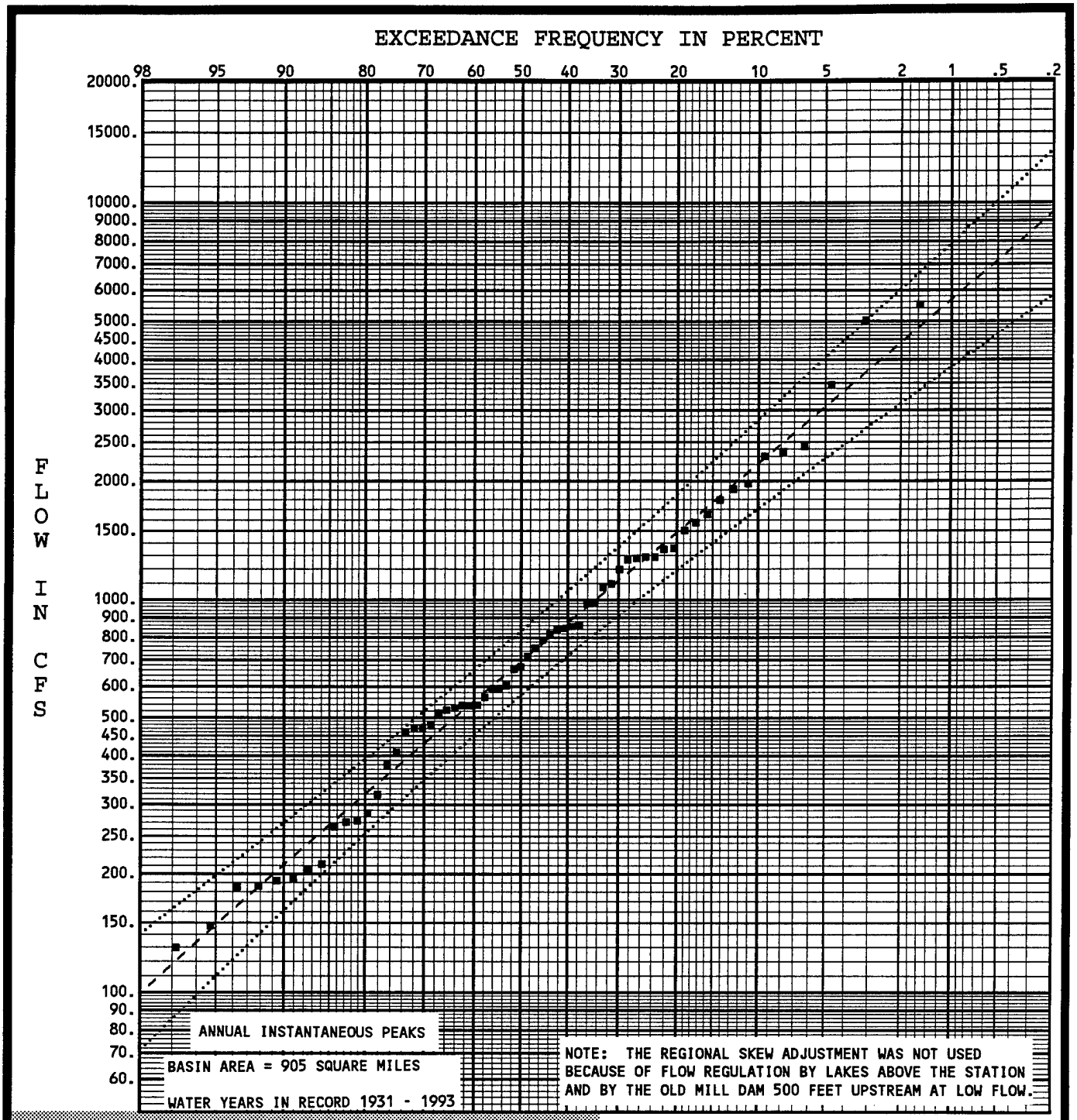
FREQUENCY STATISTICS LOG TRANSFORM OF FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.0492	HISTORIC EVENTS	0
STANDARD DEV	.4779	HIGH OUTLIERS	0
SKEW	-.5819	LOW OUTLIERS	0
REGIONAL SKEW	-.2000	ZERO OR MISSING	0
ADOPTED SKEW	-.3817	SYSTEMATIC EVENTS	54

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY
U.S.G.S. GAGE NO. 05293000
YELLOW BANK RIVER
NEAR ODESSA, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/145 **PLATE 8-7**



--- Flow Frequency (with Exp. Prob.)
▪ Weibull Plotting Positions
····· 5% and 95% Confidence Limits

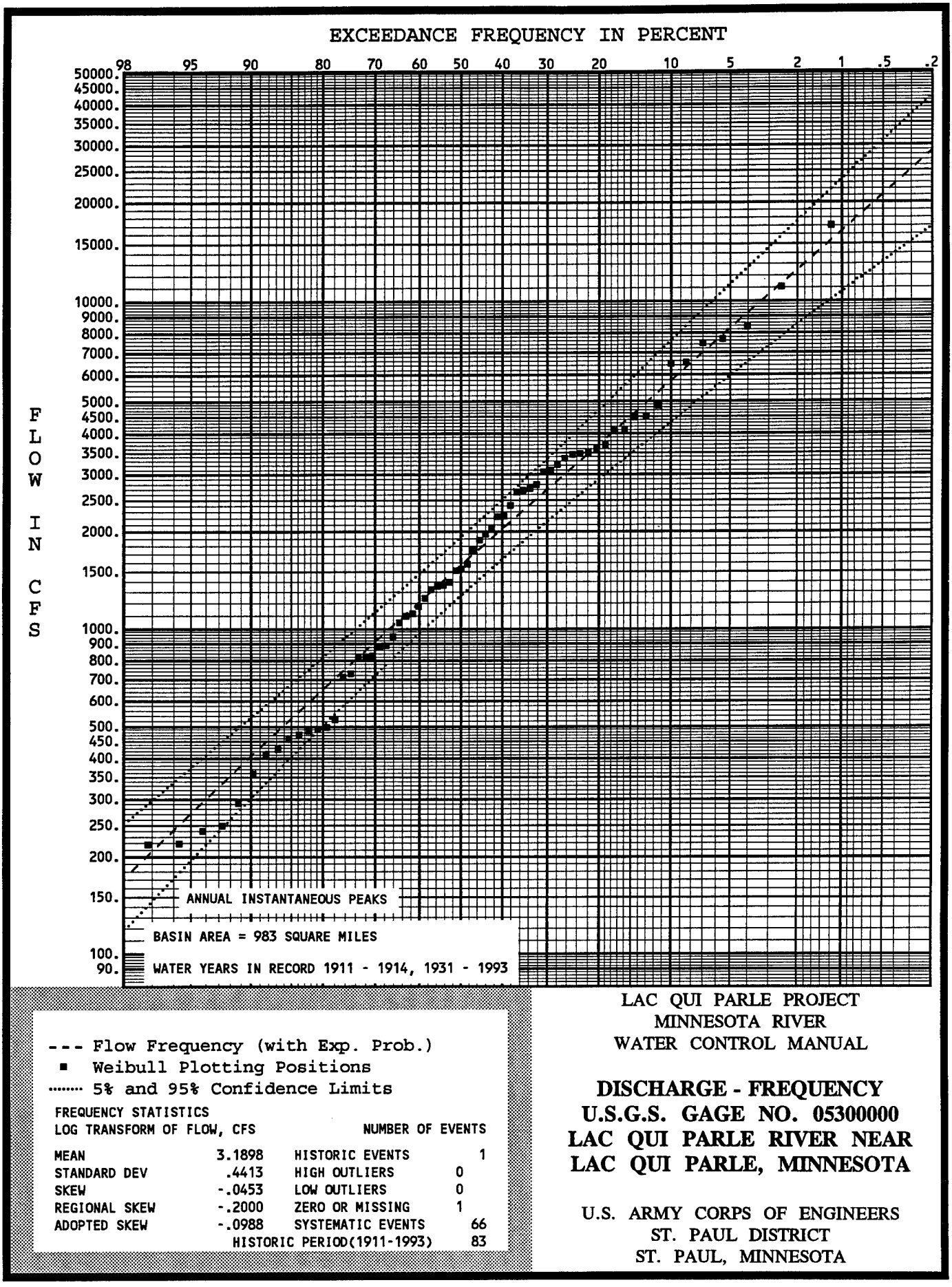
FREQUENCY STATISTICS LOG TRANSFORM OF FLOW, CFS		NUMBER OF EVENTS	
MEAN	2.8372	HISTORIC EVENTS	0
STANDARD DEV	.3904	HIGH OUTLIERS	0
SKEW	-.0698	LOW OUTLIERS	0
REGIONAL MAP SKEW	--	ZERO OR MISSING	0
ADOPTED SKEW	-.0698	SYSTEMATIC EVENTS	63

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY
U.S.G.S. GAGE NO. 05294000
POMME DE TERRE RIVER
AT APPLETON, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/146 **PLATE 8-8**



--- Flow Frequency (with Exp. Prob.)
■ Weibull Plotting Positions
····· 5% and 95% Confidence Limits

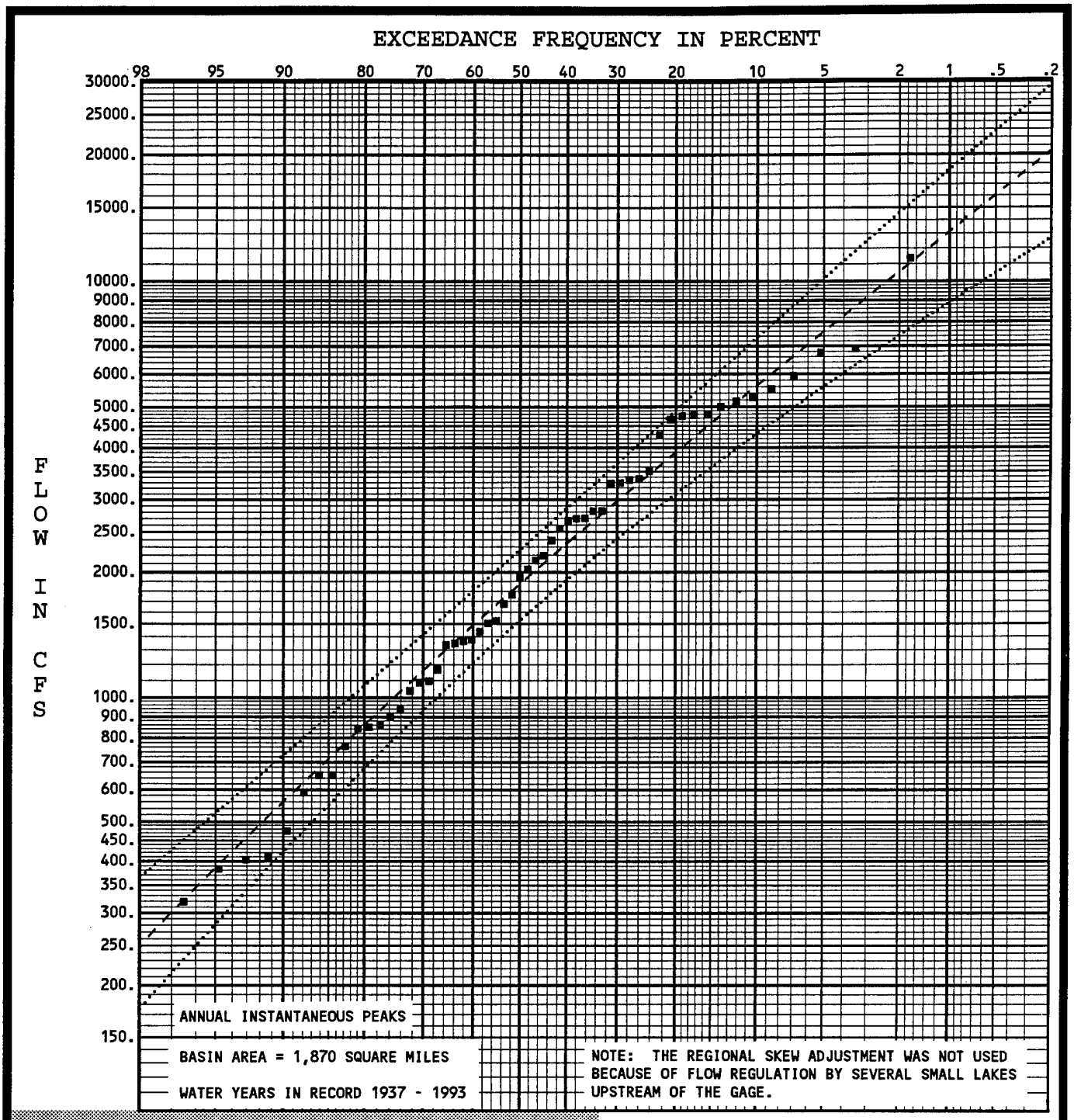
FREQUENCY STATISTICS LOG TRANSFORM OF FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.1898	HISTORIC EVENTS	1
STANDARD DEV	.4413	HIGH OUTLIERS	0
SKEW	-.0453	LOW OUTLIERS	0
REGIONAL SKEW	-.2000	ZERO OR MISSING	1
ADOPTED SKEW	-.0988	SYSTEMATIC EVENTS	66
		HISTORIC PERIOD(1911-1993)	83

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY
U.S.G.S. GAGE NO. 05300000
LAC QUI PARLE RIVER NEAR
LAC QUI PARLE, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/147 **PLATE 8-9**



--- Flow Frequency (with Exp. Prob.)
■ Weibull Plotting Positions
····· 5% and 95% Confidence Limits

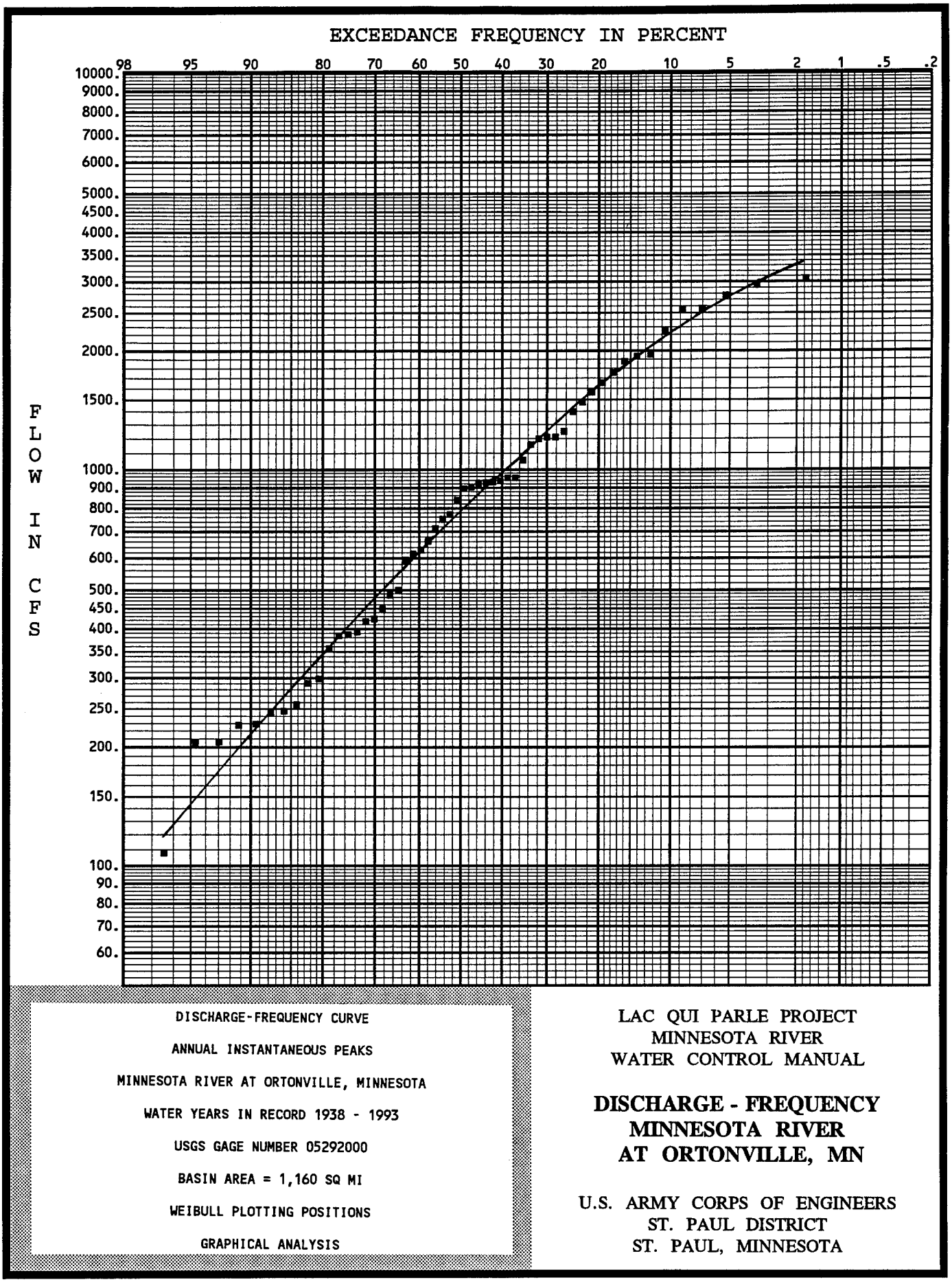
FREQUENCY STATISTICS LOG TRANSFORM OF FLOW, CFS		NUMBER OF EVENTS	
MEAN	3.2588	HISTORIC EVENTS	1
STANDARD DEV	.3834	HIGH OUTLIERS	0
SKEW	-.2132	LOW OUTLIERS	0
REGIONAL MAP SKEW	--	ZERO OR MISSING	0
ADOPTED SKEW	-.2132	SYSTEMATIC EVENTS	56
		HISTORIC PERIOD(1937-1993)	57

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY
U.S.G.S. GAGE NO. 05304500
CHIPPEWA RIVER
NEAR MILAN, MINNESOTA

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/148 **PLATE 8-10**



DISCHARGE-FREQUENCY CURVE

ANNUAL INSTANTANEOUS PEAKS

MINNESOTA RIVER AT ORTONVILLE, MINNESOTA

WATER YEARS IN RECORD 1938 - 1993

USGS GAGE NUMBER 05292000

BASIN AREA = 1,160 SQ MI

WEIBULL PLOTTING POSITIONS

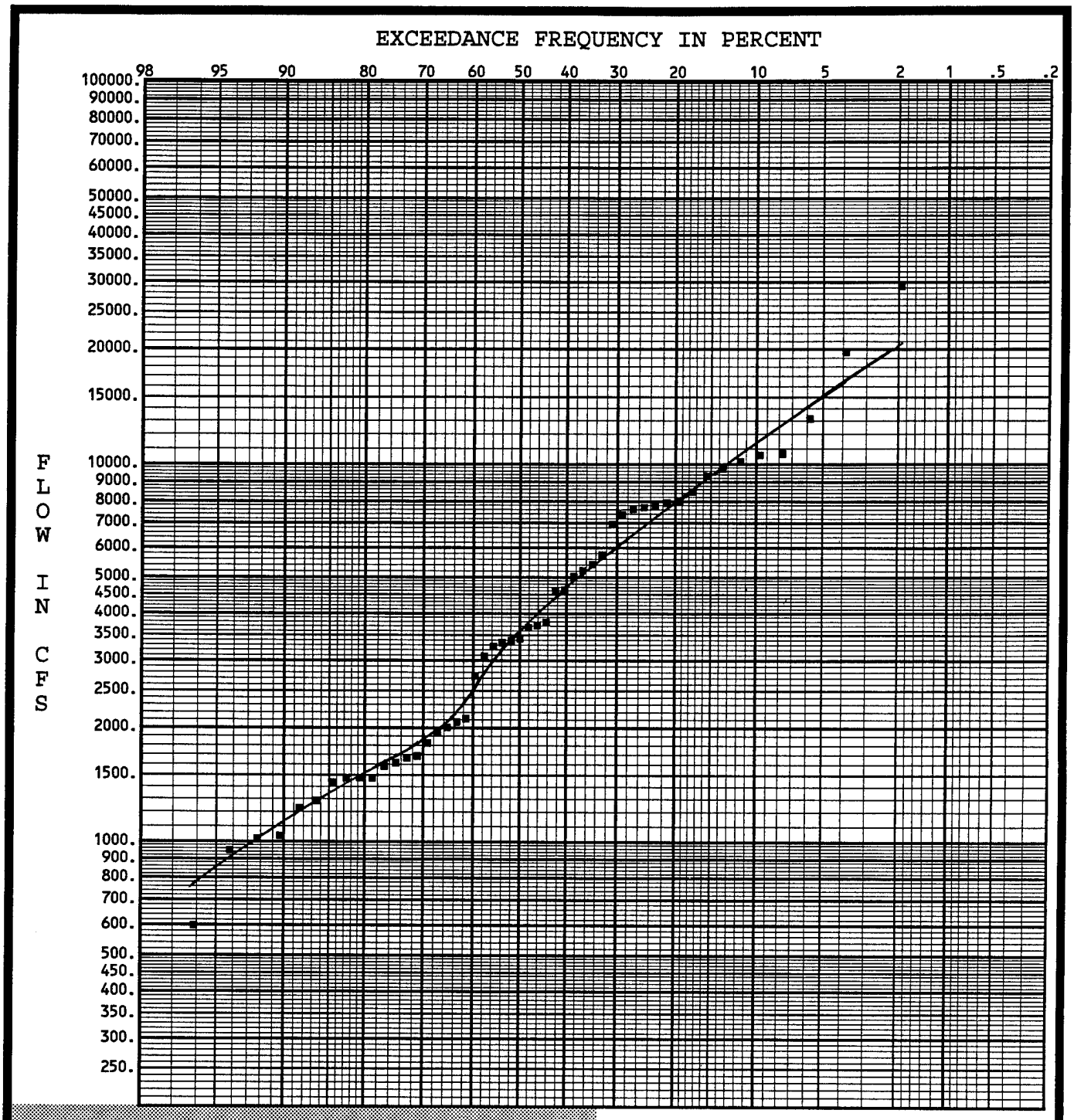
GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY MINNESOTA RIVER AT ORTONVILLE, MN

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/149 **PLATE 8-11**



DISCHARGE-FREQUENCY CURVE

ANNUAL INSTANTANEOUS PEAKS

MINNESOTA RIVER NEAR LAC QUI PARLE, MINNESOTA

WATER YEARS IN RECORD 1943 - 1993

USGS GAGE NUMBER 05301000

BASIN AREA = 4,050 SQ MI

WEIBULL PLOTTING POSITIONS

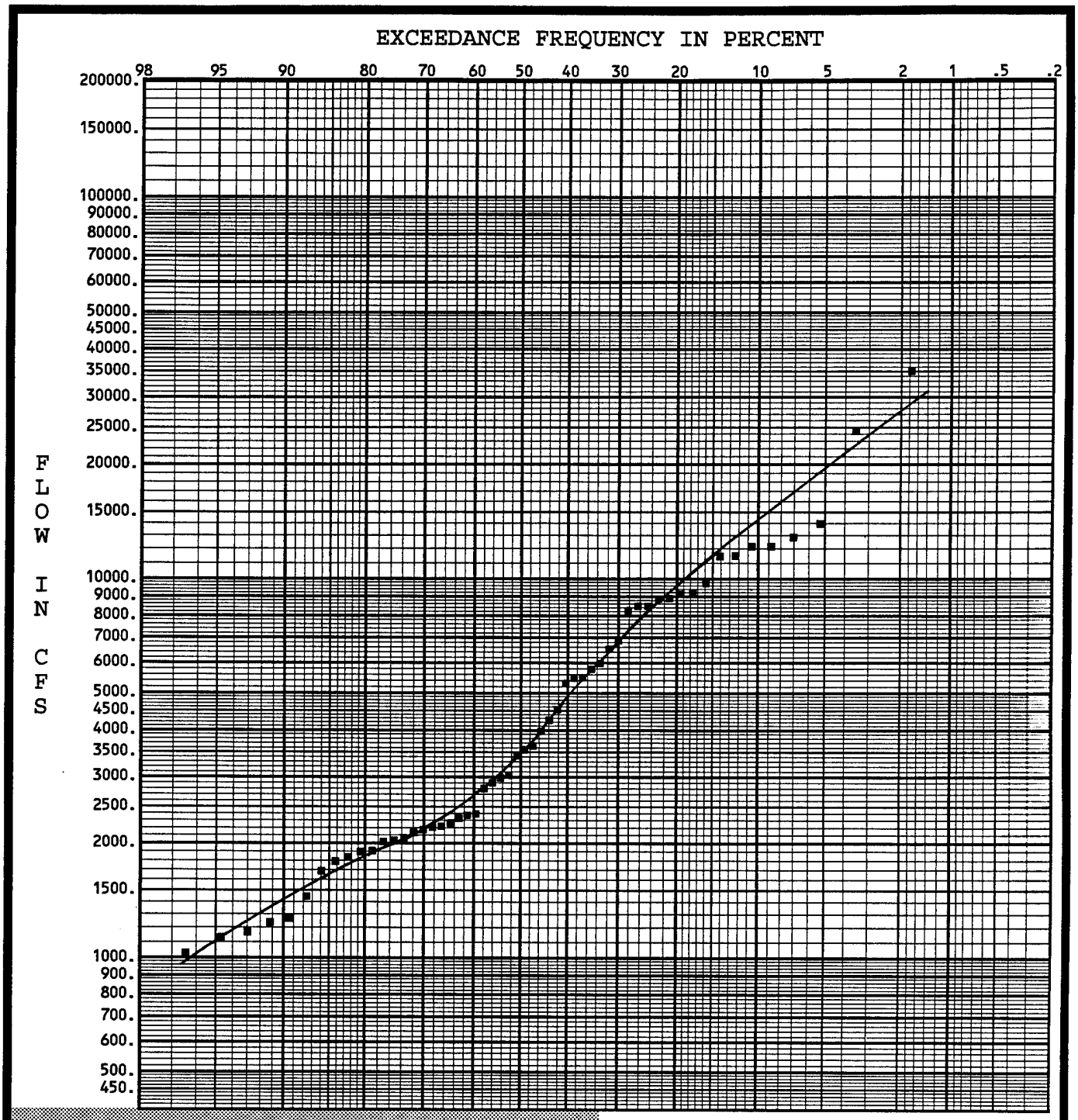
GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY
MINNESOTA RIVER
NEAR LAC QUI PARLE, MN

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

FILE NO. M34-R-LQP-5/150 **PLATE 8-12**



DISCHARGE-FREQUENCY CURVE

ANNUAL INSTANTANEOUS PEAKS

MINNESOTA RIVER AT MONTEVIDEO, MINNESOTA

WATER YEARS IN RECORD 1938 - 1993

USGS GAGE NUMBER 05311000

BASIN AREA = 6,180 SQ MI

WEIBULL PLOTTING POSITIONS

GRAPHICAL ANALYSIS

LAC QUI PARLE PROJECT
MINNESOTA RIVER
WATER CONTROL MANUAL

DISCHARGE - FREQUENCY MINNESOTA RIVER AT MONTEVIDEO, MN

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT
ST. PAUL, MINNESOTA

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