WATER CONTROL MANUAL

HOMME RESERVOIR

SOUTH BRANCH of the PARK RIVER
PARK RIVER, NORTH DAKOTA

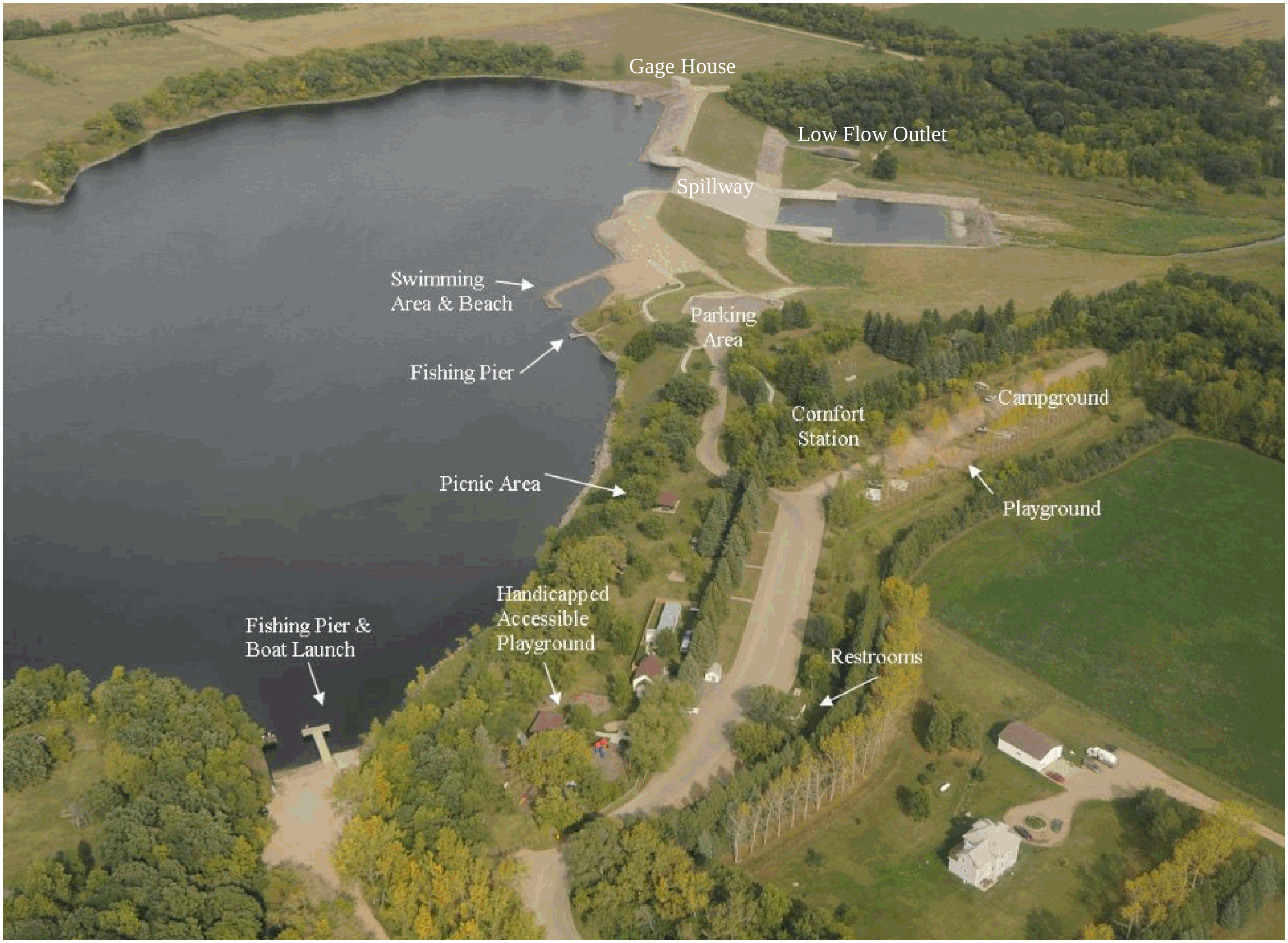
U.S. ARMY CORPS OF ENGINEERS
SAINT PAUL DISTRICT
SAINT PAUL, MINNESOTA

UPDATED NOVEMBER 2015

Updated from;
Reservoir Regulation Manual, February 2006
Reservoir Regulation Manual, July 1981
Reservoir Regulation Manual, December 1955

Homme Reservoir

Aerial Photo



Aerial Photo with labels.

Aerial Photo – Winter

NOTICE TO USERS OF THIS MANUAL

This Water Control Manual complies with the latest US Army Corps of Engineers guidelines regarding management of water control systems and preparation of water control manuals. The original "Regulation Manual" for Homme Reservoir is dated December 1955. This manual was updated to a "Water Control Manual" in July 1981. In 2006 the "Water Control Manual" was updated to the latest format and this manual serves as an update to that manual. The manual is printed in loose-leaf form to facilitate modifications. Only those sections, or parts thereof, requiring changes will be revised and printed.

Data in this manual are in NGVD29. To convert to NAVD88 add 1.15 feet.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during normal business hours, contact can be made by telephone to Water Management (651-290-5306). During non-duty hours, communication can be achieved by contacting, in the order listed below, one of the following personnel:

Water Management Regulation Assistance		
Elizabeth Nelsen	Hydraulic Engineer elizabeth.a.nelsen@usace.army.mil	Duty: 651-290-5306 [redacted]
Ferris Chamberlin	Chief, Water Control Section ferris.w.chamberlin@usace.army.mil	Duty: 651-290-5619 [redacted]
Farley Haase	Hydraulic Technician farley.r.haaase@usace.army.mil	Duty: 651-290-5633 [redacted]
Brian Johnson	Hydraulic Engineer brian.ke.johnson@usace.army.mil	Duty: 651-290-5652 [redacted]
Michael Knoff	Chief, Hydraulics &Hydrology Br. michael.r.knoff@usace.army.mil	Duty: 651-290-5602
Michael Bart	Chief, Engineering Division michael.j.bart@usace.army.mil	Duty: 651-290-5303

Homme Reservoir
South Branch of the Park River
Park River, North Dakota

U.S. Army Corps of Engineers
St. Paul District, January 2015

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Location: Homme Dam is located in Walsh County, North Dakota on the South Branch of the Park River about 4 river miles upstream of the city of Park River. The dam is located in Section 19, Township 157N, Range 55W, Latitude 48º24'20"N, Longitude 97º47'10"W.

Total Drainage Area: 226.0 square miles **Datum:** 1929 NGVD

To convert to NAVD88 add 1.15 feet to NGVD29 elevations.

Real Estate Guide Taking Line for Title in Fee or Easement: Contour elevation 1090.0 ft

Embankment

Type:	Compacted earth-fill	Freeboard @ max design:	3.0 feet
Total Length:	865.0 feet	Freeboard at project pool:	19.0 feet
Crest Elevation:	1099.0 feet		
Top Width:	20.0 feet		
Maximum Height:	67.0 feet		

Spillway

Type:	Ogee-Crest	Stilling Basin	
Crest Elevation:	1079.80 feet	Length:	75 feet
Crest Length:	218.0 feet	Width:	218 feet
Design Event:	PMF	End Sill:	Elevation 1024.60 feet
Design Discharge:	53,400 cfs	Baffle Block:	Elevation 1026.85 feet
Max Design Pool:	1096.0 feet	Floor:	Elevation 1022.60 feet

Low Flow Outlet Control

Culvert		Inlet Sluice Gates	
Diameter:	5.0 feet	Sluice Gate Type:	Chapman
Inlet Invert Elev.	1048.0 feet	Gate Size:	36 in by 60 in
Outlet Invert Elev.	1038.0 feet	Number of Inlets:	2
Discharge Capacity:	525 cfs	Inlet Gates:	2 per inlet
(pool elev 1080.0)		Operable Inlets:	1
Outlet		Outlet Sluice Gates	
Width at Outlet	7.0 feet	Number of Outlets:	1
Width Stilling Basin:	13.0 ft – 24.0 ft	Gate Size:	7 ft by 7ft
Stilling Basin Invert:	1027.0 feet		
Top of End Sill:	1030.0 feet		
Outlet Channel:	1032.0 feet		

Area-Capacity Data

	Elevation (feet)	Area (acres)	Storage (acre-feet)
Design Flood (PMF)	1096.0	307	7,025
Flood Control Pool	1079.8	187	2,850
Normal Drawdown	1074.0	141	1,825
Maximum Drawdown	1064.0	86	670
Dead Storage	1048.0	0	0

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I - INTRODUCTION

1-01. Authorization for the Manual. Authority to prepare a Reservoir Regulation Manual for Homme Dam and Reservoir was given by letter, 800.2 (Reservoirs) UMVGW, Upper Mississippi Valley Division, subject: "Manual of Regulation for Flood Control and Multiple Purpose Reservoirs," dated 30 August 1948. The interim Reservoir Regulation Manual was submitted as requested by first endorsement, UMVGB, Upper Mississippi River Valley Division, dated 8 October 1952, to letter, UMPRH 800.2 (Reservoirs), St. Paul District, subject: "Operation of Flood Control Reservoirs", dated 30 September 1952. Authority to continue to prepare "Reservoir Regulation Manuals" was granted by Engineering Regulation (ER) 1110-2-240, *Reservoir Regulation*, 1958. While the ER has been updated and amended many times since the date of issuance, the document continues to give the Corps of Engineers authority to prepare "Reservoir Regulation Manuals". "Reg Manuals", as they were called, became known as "Water Control Manuals" by ER 1110-2-240, *Water Control Management*, 1982. This manual is an update to the Reservoir Regulation Manual, dated February 2006. As part of the Corps of Engineers' environmental awareness, full consideration was given to ER 200-1-5, *Policy for Implementation and Integrated Application of the US Army Corps of Engineers Environmental Operating Principals* (EOP) *and Doctrine*, dated 30 October 2003. This manual was prepared in compliance with the guidelines presented in:

a. Engineering Regulation, ER 1110-2-240,*Water Control Management*, 8 Oct 1982, Amended 30 April 1987 and 1 March 1994.
b. Engineering Manual, EM 1110-2-3600, *Management of Water Control Systems*, 30 November 1987.
c. Division Regulation, DIVR 1110-2-240, *Preparation of Water Control Plans and Manuals*, 1 January 1992.
d. Engineering Regulation, ER 1110-2-8156, *Preparation of Water Control Manuals*, 31 August 1995.
e. Section 7 of 22 December 1944 Flood Control Act.

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

1-03. Related Manuals and Reports. Reports on flood control and navigation in the region date from 1907. The annual reports of the Chief of Engineers are a good source of pre-project information. The following is a list of reports pertaining to the project whereas related manuals and reports are presented in **Exhibit B**.

a. *Report on the Drainage of the Eastern Parts of Cass, Traill, Grand Forks, Walsh, and Pembina Counties, North Dakota,* US Department of Agriculture, Bulletin 189, 1907.
b. *Report to the Governor of North Dakota on Flood Control,* by Herbert A. Hard, Chief Engineer, 1919-20.
c. *North Dakota Crop Statistics by Counties,* Bureau of Agriculture Economics, Fargo, North Dakota, 1919-1936, 1938.
d. *Report of Drainage and Prevention of Overflow in the Valley of the Red River of the North*, US Department of Agriculture, Bulletin No. 1017, 1922.
e. *Report of the Interstate Committee on the Red River of the North Drainage Basin*, Interstate Committee, (Minnesota, North Dakota, and South Dakota) 1936.
f. *Drainage Basin Studies, Lower Red River Drainage Basin,* North Dakota State Planning Board, Grand Forks, North Dakota, 1936.
g. *Report of the Comprehensive Water Plan Proposed in the Report of the Interstate Committee on the Red River of the North Drainage Basin,* prepared at the request of the Works Progress Administration by the Corps of Engineers, 1937.
h. *Report on Stream Pollution, North Dakota,* North Dakota State Planning Board, published under Works Progress Administration, North Dakota Project No. 2299, 1937.
i. *Surface Waters in North Dakota,* North Dakota State Planning Board, 1937.
j. *Supplement to North Dakota Experiment Station Bulletin 232,* North Dakota Agricultural Experiment Station, Fargo, North Dakota, 1937.
k. *The Municipal Groundwater Supplies of North Dakota,* North Dakota Geological Survey, Bulletin 11, 1938.
l. *Red River Drainage Basin, North Dakota,* State Planning Board and Works Progress Administration, 1939.
m. *Preliminary Examination Report – Run-off and Waterflow Retardation and Soil Erosion Prevention for Flood Control Purposes; Pembina, Park, and Forest River Watersheds, North Dakota,* US Department of Agriculture, 1940.

n. *Brief Water Needs of the Red River Drainage Basin,* Minnesota-North Dakota Municipal Water Conservation Association, 1940.
o. *Survey of Water Supplies*, North Dakota Geological Survey in cooperation with the Works Progress Administration, 1940.
p. *Population Bulletin,* North Dakota, Sixteenth Census of the United States, US Department of Commerce, Bureau of the Census, 1940.
q. *United States Census of Agriculture,* North Dakota, US Department of Commerce, Bureau of the Census, 1940.
r. *Operation and Maintenance Manual,* Flood Control Project on Park River, North Dakota, St. Paul District, Corps of Engineers, May 1960.
s. *Envirinmental Impact Assessment of Homme Dam and reservoir, North Dakota*, Institute for Ecological Studies, Research Report No. 7, C.E Farmer, L.M. Winczewski, K.T. Killingbeck, G.E. Johnson, R.D. Ludtke, R.E. Pilatzke, A. Carmichael, J.P. Jorgenson, 1974.
t. *Probable Maximum Flood and Standard Project flood Discharge Curves for the Park River, North Dakota,* St. Paul District, Corps of Engineers, June 1981.
u. *Reconnaissance Report, Dam Safety Assurance Program, Homme Dam, South Branch Park River, North Dakota,* St. Paul District, Corps of Engineers, February 1994.
v. *Design Memorandum and Environmental Assessment, Homme Dam, Park River, North Dakota,* Dam Safety Assurance Program, St. Paul District, Corps of Engineers, September 1996.
w. *Hydraulic Model Study for Homme Dam Safety Improvements, Park River, North Dakota*, conducted for US Army Corps of Engineers, St. Paul District, by Barr Engineering Company, June 1998.
x. *Policy for Implementation and Integrated Application of the US Army Corps of Engineers (USACE) Environmental Operating Principals (EOP) and Doctrine*, Engineering Regulation (ER) 200-1-5, US Army Corps of Engineers, 30 October 2003.
y. *Climatological Data*, US Department of Agriculture, Weather Bureau.
z. *Surface Water Supply of the United States*, US Department of the Interior, Geological Survey.
aa. *Rainfall Intensity Frequency Data,* Miscellaneous Publication No. 204, US Department of Agriculture.
bb. *Storm Rainfall of Eastern United States*, The Miami Conservancy District, State of Ohio.
cc. *Studies of Relations of Rainfall and Run-off in the United States*, US Department of the Interior, Geological Survey, Water Supply Paper 772.

1-04. Project Owner. The United States Government is the owner of Homme Dam. The US Army Corps of Engineers, St. Paul District is responsible for the operation, regulation, and maintenance of the Homme Dam Project.

1-05. Operating Agency. Operation and maintenance of the Homme Dam Project is the responsibility of Operations Division, Recreation and Natural Resources Project Office (RNR). The project site is not staffed. Project maintenance is performed by personnel from the Baldhill Dam project office. Baldhill Dam is located about 120 miles south of Homme Dam, near Valley City, North Dakota. Water Management communicates all necessary gate changes by telephone with the North Dakota Flood Control Project Section Supervisor, who then directs the contract gage reader in Park River to move the gates. **Table 1-1** lists the names, addresses, and telephone numbers for the Homme Dam Project-related personnel.

1-06 Regulating Agency. Regulation of the Homme Project is under the supervision of the Water Management and Hydrology Section within the Hydraulics and Hydrology Branch, Engineering and Construction Division, of the St. Paul District, Corps of Engineers.

Table 1-1
Project Office Points of Contact

Names and Addresses	Telephone Numbers
Richard Schueneman, ND Section Supervisor Baldhill Dam Project, US Army Corps of Engineers 2630 114th Avenue SE Valley City, North Dakota 58072	Project Office: 701-845-2970 Cellular: 701-840-1732
Dennis Larson Gage Reader & Gate Operator Supt Light/Water Department Park River, North Dakota 58270	Duty: 701-284-6399 Cellular: 701-331-0678
Mark Wilmes, Operations Project Manager Recreation and Natural Resources Branch Project Office, US Army Corps of Engineers 15 South 21st Street, Room 102 Fargo, North Dakota 58103-1435	Fargo Office: 701-232-1894

II – DESCRIPTION OF PROJECT

2-01. Location of Project. Homme Dam is located in the northeast corner of North Dakota. It is centrally located in Walsh County on the South Branch of the Park River at river mile 62.1. The site is about 50 miles northwest of Grand Forks and about 2 miles west of the city of Park River. The dam is located at latitude 48^{o} 24' 20" and longitude 97^{o} 47' 10". Park River is a tributary to the Red River of the North. A basin map of the Park River is shown on **Plate 2-1**.

2-02. Purpose of the Project. Homme Dam and Reservoir is a dual-purpose project, designed primarily for water supply and pollution abatement during low flow periods and secondarily for flood control. The reservoir provides water for the following uses; 1) municipal use in the city of Park River, 2) periodic flushing of the sewage lagoons at Park River, 3) industrial washing of potatoes, and 4) irrigation of a local golf course. The reservoir is drawn down prior to spring runoff for the purpose of flood control. While flood control benefits are limited, the summer conservation pool provides recreational benefits. Recreation facilities for picnicking and boating are maintained at the site by Walsh County. The authorized purposes assigned by Congress are presented in **Table 2-1**.

Table 2-1
Authorized Purposes Assigned by Congress

Authorized Purpose	Public Law	Name
Water Control, Water Conservation	PL 78-534	Flood Control Act of 1944
Flood Control, Water Supply	PL 81-516	Flood Control Acts of 1948 and 1950
Fish and Wildlife	PL 85-624	Fish and Wildlife Coordination Act of 1958
Water Supply	PL 85-500	Water Supply Act of 1958
Recreation	PL 89-72	Federal Water Project Recreation Act of 1965
Water Quality	PL 92-500	Federal Water Pollution Control Act of 1972
Fish and Wildlife	PL 93-205	Conservation, Protection, and Propagation of Endangered Species Law of 1973

2-03. Physical Components. The project spillway is centrally located within the embankment that forms the reservoir. A sluice gate-controlled low flow conduit is located at the left (northeast) end of the embankment. The spillway was relocated from the right end (listed as existing spillway on **Plate 2-2**) of the embankment to the center (listed as proposed spillway on **Plate 2-2**) in 2003. The outlet channel of the low flow was adjusted to tie into the new spillway outlet (**Plate 2-2**). The relocation of the spillway allowed for the construction of a beach at the right end of the embankment (**Figure 2-1**). Aerial photos of the project are presented in **Introduction**. The following gives a brief description of each component.

Figure 2-1. Homme Public Beach

a. Embankment. The embankment consists of compacted earth fill, with a crest elevation of 1099.0 feet, a top width of 20 feet, and a length of 865 feet. The side slopes on the upstream and downstream embankment are 1V:3H. The maximum height is 67 feet. There is a five-foot wide bench at elevation 1077.0 feet on the downstream side. **Figure 2-2** shows the embankment during construction of the new spillway in 2003.

Figure 2-2. Homme Dam Embankment.

Scour protection extends from the base of the embankment to the top of the dam on the upstream side and to elevation 1056.0 feet on the downstream side. Protection consists of a 9-inch layer of bedding material topped with an 18-inch layer of riprap. A pervious drainage blanket, 4.5 feet thick, is provided at the downstream toe of the dam. A cut-off trench, 10 feet in width at the base and variable in depth, is excavated near the upstream toe of the dam. **Plate 2-3** shows details of the Homme Dam embankment.

b. Spillway. Flood flows are discharged by means of a reinforced concrete, gravity type, ogee crested spillway, located in the center of the embankment. The spillway was newly constructed in 2000-2003 replacing the original spillway, which was constructed in 1949-1950. The spillway has a design crest elevation of 1080.0 feet and a width of 218 feet. The approach channel was excavated to elevation 1072.8 feet resulting in an approach depth of 7.2 feet. A sheet pile cut off wall extends down to elevation 1044.0 feet. The approach channel is protected by a layer of 12-inch riprap (**Figure 2-3**).

Figure 2-3. Approach Channel to the Spillway.

The retaining walls are at elevation 1099.0 feet and slope down to elevation 1048.5 feet at the stilling basin. The spillway is ogee shaped followed by a 1V:10H section and a 1V:3H section. The two different slopes provide an economical transition between the crest and the stilling basin (**Figure 2-4**). See **Plate 2-4** for details of the spillway.

Figure 2-4. Homme Dam Spillway.

c. Stilling Basin and Outlet Channel. To provide tailwater of sufficient depth and the necessary cross sectional area to dissipate the energy from the Spillway Design Flood, a reinforced concrete, gravity type stilling basin was provided at the toe of the spillway chute (**Figure 2-5**). The stilling basin is 75 feet long, 218 feet wide, and has a starting floor slab elevation of 1022.6 feet. The floor slopes at a rate of 0.33 percent, thereby ending at elevation 1022.35 feet. The stilling basin contains two rows of baffle blocks 4.5 feet in height (top elevation 1027.1 feet). The baffle blocks are staggered, 4.33 feet apart in each row, and extend across the entire width of the stilling basin. The end sill has a 1V:1H slope on the upstream face with a top elevation of 1024.6 feet. The training walls have a top elevation of 1048.5 feet. See **Plate 2-4** for stilling basin and outlet channel details.

Figure 2-5. Homme Dam Stilling Basin and Outlet Channel.

The invert of the trapezoidal outlet channel is set one foot below the top of the end sill (*i.e.* at elevation 1023.6 feet). The outlet channel invert slopes upward at a four percent incline for a distance of 205.6 feet to elevation 1031.8 feet. This places the stilling basin in a hole with a water depth of 9.2 feet. The outlet channel then slopes downward to the natural channel at a slope of 0.47 percent for a distance of 658 feet. Side slopes of the channel are 1V:3H sloping up to around elevation 1040.0 feet on the left bank and elevation 1045.0 feet on the right bank. The Spillway Design Flood is mostly contained in the outlet channel.

Exit velocity from the stilling basin for the design flood is 10.3 feet per second. There is a 45-inch layer of 30-inch riprap downstream of the stilling basin. The riprap extends downstream 205.6 feet ($7d_2$) to the top of the inclined portion of the outlet channel. From this point, the layer thickness is reduced to 30 inches for a distance of 25 feet, followed by an 18-inch gradation for a distance of 25 feet where it meets natural ground. Laminar flow exists in the channel beyond the $10d_2$ distance.

d. Low Flow Outlet Works. The low flow outlet works is located at the left end of the embankment (**Figure 2-6**). It consists of a control tower, an access bridge, a gated conduit, a concrete chute spillway, a stilling basin, and an outlet channel.

Figure 2-6. Low Flow Outlet Control.

There are two 36-inch by 60-inch sluice-gated inlets to the conduit; however, only one is currently functional. Each service gate is preceded by a similar sized emergency sluice gate, which is normally left in the fully open position. All four gates are hand operated (with power drill assistance) from the top of the control tower by Armco 3456c sluice gate actuators. (Armco is out of business. Products are serviced by Hydrogate Corporation.) A 16-inch cast iron water supply line runs through the low flow conduit. The pipe passes through one of the inlet sluice gates that was grouted closed. Therefore, there is only one sluice gate to provide flow to the conduit.

The reinforced concrete conduit is five feet in diameter and 312 feet in length. The upstream invert is at elevation 1048.0 feet and downstream invert is at elevation 1038.0 feet. The outlet flares into a rectangular section equipped with a 7-foot by 7-foot sluice gate (**Figure 2-7**) that can be used in emergency situations to shut off flow through the conduit. The outlet immediately drops into a chute spillway. The chute is 7.0 feet wide and 29.0 feet long. At the end of the chute, the sidewalls flare from a width of 7.0 feet to approximately 13.0 feet over a distance of 20.0 feet. The invert at this point is elevation 1027.0 feet (*i.e.*, a drop of 11.0 feet). The stilling basin begins here. The stilling basin is 31.0 feet long and has two rows of staggered, stepped baffle blocks that are 2.5 feet high and 2.0 feet square at the base. The stepped end sill is 3.0 feet high (*i.e.*, elevation 1030.0 feet). The sidewalls continue to flare through the stilling basin from a width of 13.0 feet to 24.0 feet. Beyond the end sill, the channel remains flat for a distance of 20.0 feet. Over the next 20.0 feet, the channel then slopes upward to elevation 1032.0 feet. Therefore, there is often a five-foot deep pool of water in the stilling basin.

The outlet channel extends about 800 feet from the stilling basin to the river. This channel was excavated to elevation 1032.0 feet with a bottom width of 30 feet and 1V:1.5H side slopes. A layer of 18-inch riprap placed over a 9-inch bedding extends 120 feet downstream of the stilling basin. See **Plates 2-5, 2-6,** and **2-7** for plan, profile, and details of the outlet works and control tower.

Figure 2-7. Low Flow Outlet.

e. Water Supply Features. Homme Reservoir used to be the municipal water source for the city of Park River. A rock filled crib was constructed near the upstream left abutment/embankment interface that serves as an intake to the water supply line. Prior to construction of the original embankment, a 16-inch cast iron pipeline was installed. It ran from the rock-filled crib through the control tower and under the dam to a point below the dam's downstream toe of slope. In 1966 the pipe failed a pressure test and was replaced by a new 16-inch line installed through the outlet works and the old line was filled with grout. The water supply line is connected to the stilling well by way of a flange welded to the downstream sluice gate. Water is supplied to the stilling well by way of the upstream gate and a mid-level water quality gate at approximately elevation 1063.0 feet. The new line is suspended off to the west side of the crown of the outlet conduit. The line exits through the side of the conduit prior to the outlet and terminates in a manhole just downstream of the embankment.

In the past, Homme Reservoir provided a water supply to the cities of Park River and Grafton; however, in 1979 Grafton completed an alternative water supply via a pipeline to the Red River of the North. Park River tapped into the Fordville Aquifer on 1 January 2006. Homme Reservoir now acts as a redundant source of water supply. Water from the reservoir is used by industry for washing potatoes and by the local golf course for irrigation.

f. Reservoir. There is no emergency spillway at Homme Dam. Therefore, the Probable Maximum Flood (PMF) and the Spillway Design Flood (SDF) are one in the same. The maximum pool elevation for the PMF is 1096.0 feet. The top of flood control is the spillway crest, which has a design elevation of 1080.0 feet. The spillway crest elevation is the same as the conservation pool level. The pool is typically drawn down to elevation 1074.0 feet prior to spring runoff. Maximum drawdown is elevation 1064.0 feet. **Table 2-2** gives area-storage values at key pool elevations.

Table 2-2
Homme Reservoir – Area/Volume

Pool Condition	Pool Elevation (feet)	Surface Area (acres)	Total Volume (ac-ft)	Available Flood Storage
Design Flood (PMF)	1096.0	312	7,000	-
Design Conservation Pool Level/Top of Flood Control	1080.0	200	2,880	0
Intermediate Drawdown	1074.0	141	1,825	1,010
Maximum Drawdown	1064.0	86	670	2,150

At the design conservation pool level of 1080.0 feet, the reservoir has a length of approximately one-mile, a shoreline of 4.8 miles, and a storage capacity of 2,880 acre-feet. **Figure 2-8** shows the bathymetry of the lake and was prepared by the North Dakota Game and Fish Department. Reservoir area-capacity curves are shown on **Plate 2-8** and **Plate 2-9**.

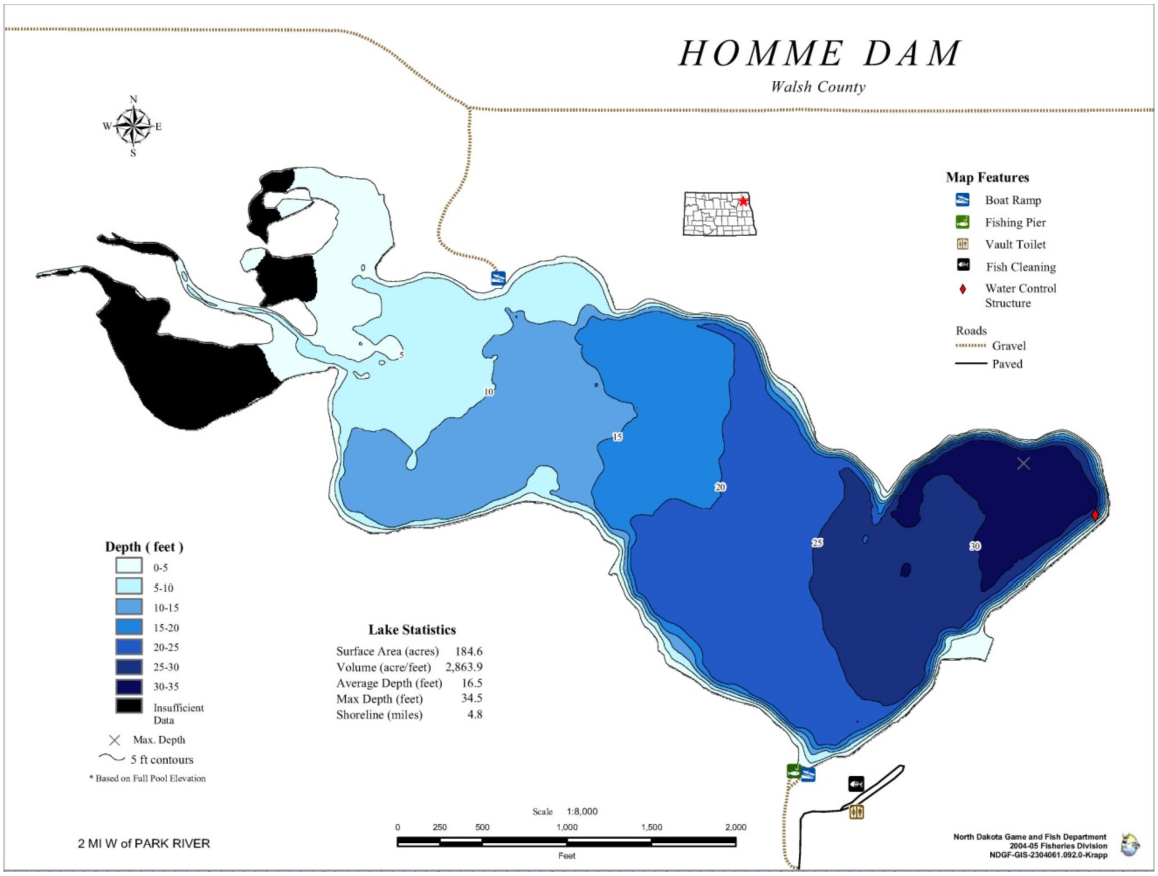

Figure 2-8. Homme Lake Bathymetry

2-04. Related Control Facilities. There are no related projects within the Park River Basin.

2-05. Real Estate Acquisition. Approximately 405 acres of land have been acquired in fee for Homme Reservoir project, and about 8 acres are under easement, making a total of 413 acres (below elevation 1090.0 feet) available for all uses. About 122 acres are now leased and managed by local interests.

2-06. Public Facilities. There is one recreation area located at the right abutment of the dam adjacent to the original spillway. The area has a public beach (**Figure 2-1**) and two boat launches. Near the beach area are restrooms, a fishing pier, and a fish cleaning station. These facilities (**Introduction page iii**) are maintained by Walsh County.

III – HISTORY OF PROJECT

3-01. Authorization. A report prepared by the North Dakota State Planning Board in 1936 described the water supply problem confronting the Park River Basin. In 1937, the Works Progress Administration requested the Corps of Engineers to review the comprehensive water plan proposed by the Interstate Committee on the Red River of the North Drainage. This report included a plan of improvement for the Park River for limited flood protection. In 1938, the North Dakota Water Conservation Commission made a dam site and flowage survey on the South Branch of the Park River approximately 500 feet upstream from the site recommended in the project plan. In April 1940, the Department of Agriculture released a preliminary examination report entitled *Runoff and Waterflow Retardation and Soil Erosion Prevention for Flood Control Purposes on the Pembina, Park, and Forest River Watersheds, North Dakota*. This report contained a complete description of the Park River Basin and its economic aspects.

The project document plan for flood control for the Park River Basin was submitted by the St. Paul District Engineer on 13 November 1941 and is contained in Senate Document Number 194, 78th Congress, second session, dated 11 May 1944. This report was submitted in accordance with a resolution by the Committee on Commerce of the United States Senate adopted 1 December 1938. The resolution requested the Board of Engineers for Rivers and Harbors to review the reports on the Red River of the North submitted in House Document No. 67, 56th Congress, first session, to determine if the project should be modified to provide flood control works on the Park River and its tributaries. The project document recommended construction of a storage reservoir on the South Branch of the Park River at river mile 62.1 for the dual purpose of reducing flood flows and augmenting low-water flows in the lower reaches of the South Branch. The project was authorized by the Flood Control Act approved 22 December 1944.

3-02. Planning and Design. Following the preparation of the preliminary report for flood control on the Park River, a public hearing was held at Grafton, North Dakota on 1 March 1939. Testimony was presented on damage caused by floods on the Park River and local water supply needs. Serious water supply problems had been experienced in the Park River Basin. The drought years of the 1930's had depleted the shallow aquifers, and water from artesian wells had highly saline and mineralized water. Residents along the lower reaches of the South Branch and the main stem of the Park River wanted protection from spring flooding and a dependable supply of water for domestic use. It was determined that a reservoir on the South Branch upstream of the city of Park River would alleviate the dual problems of spring flooding and shortage of water for domestic use. The proposed reservoir would be designed to provide water supply and pollution abatement during low flow periods and to store excess spring runoff.

Congress authorized the Park River Flood Control Project on 22 December 1944, subject to the conditions that local interests "make a cash contribution of $40,000 toward the construction costs and give assurances satisfactory to the Secretary of War that they will provide without cost to the United States all lands, easements, and rights of way necessary for the construction of the project; make necessary changes in roads, bridges, and utilities; maintain the channel below the reservoir; hold and save the United States free from damages due to the construction works; limit future construction of dams below the reservoir; and prevent the discharge of raw sewage into the river by municipalities."

The Definite Project Report on Park River Reservoir was submitted to the Chief of Engineers on 1 May 1947 by the St. Paul District Engineer and was approved on 28 August 1947. Local interests were required to contribute an additional $19,200 to pay for a water supply intake that was requested by the cities of Park River and Grafton.

By Public Law 435, the 80th Congress, second session, on 5 May 1948, changed the project name from the Park River Project to Homme Reservoir and Dam in honor of H.G. Homme, a prominent citizen of the city of Grafton.

Homme Dam was originally designed to pass the Standard Project Flood. A dam safety study was conducted in 1993 using current Probable Maximum Flood (PMF) hydrographs and Dam Safety Guidelines. Based on the results of the dam break analysis, Homme Dam was classified as a high hazard dam. Therefore the PMF was used as the basis for determining required spillway capacity and was adopted as the Spillway Design Flood (SDF). A study entitled "*Reconnaissance Report, Dam Safety Assurance Program*" dated 1994 identified a number of design alternatives that were considered. The selected plan supplemented the existing 150-foot spillway with a new spillway located in the center of the embankment. The new spillway was to be 210 feet wide with a crest elevation of 1084.0 feet. A Value Engineering study identified the most cost effective plan to be a 120-foot extension of the existing spillway. The lower crest resulted in a 90-foot reduction of the spillway width from the selected plan. During the Design Memorandum phase of the study, use of the existing spillway was rejected for geotechnical reasons. Various alternatives were again analyzed to determine the most cost effective option. The selected plan was to eliminate the old spillway at the right end of the embankment and construct a new one in the middle of the embankment. The new spillway was to have the same crest elevation as the old spillway (1080.0 feet) but was to be 68 feet longer (length of 218 feet). The maximum pool elevation for this design and the PMF is 1096.0 feet with a discharge of 53,400 cfs. Flows were routed using HEC-1. Peak inflow was 53,500 cfs. With a dam crest elevation of 1099.0 feet, there is 3.0 feet of freeboard. This is in accordance with Engineering Regulation ER 1110-8-2, *Inflow Design Floods for Dams and Reservoirs*. Only three feet of freeboard is required when the surcharge pool elevation is within 3.0 feet of the dam crest for less than 36-hours. In this instance it was 27-hours.

3-03. Construction. Construction of the Homme Dam and Reservoir Project began in April 1948 and was completed on 15 October 1950, just in time for the 1950 flood. The dam was slightly damaged and needed repair. The dam was not placed into operation until 1 December 1950. Construction of the new, larger spillway began in April 2000 and was completed in July 2003.

3-04. Related Projects. There are no other Corps of Engineers projects within the Park River basin.

3-05. Modifications to Regulations.

a. 1966-1967 Modification. In 1966, the 16-inch cast iron water supply line failed a pressure test. In 1967, this pipe was replaced with a new 16-inch pipe that extended through the low flow outlet works. The east sluice way was closed and a flange was welded on the gate thus allowing the pipe to enter the low flow conduit. This limited the inlet to the low flow conduit to one 30-inch by 60-inch sluice gate.

b. 1969 Modification. In 1969 it was discovered that Homme Dam spillway presented an attractive nuisance. While maintaining a conservation pool elevation of 1080.0 feet, excess inflow was allowed to trickle over the spillway. This provided a dangerous "water slide" for those willing to cross onto government property. Therefore, the regulation plan was modified in the summer of 1969 such that the low flow conduit was regulated to maintain a pool level about one-foot below the crest of the dam.

c. 1979 Modification. The cities of Park River and Grafton provided additional funding to the construction of Homme Dam for the purpose of water supply. Park River continues to obtain water from the reservoir; however, the city of Grafton constructed a pipeline to the Red River of the North. While Grafton obtains its water from the Red River, they can still exercise their rights to water from Homme Reservoir.

d. 2003 Modification. Fencing around the new spillway in 2003 greatly decreased the risk of people gaining access to the spillway. Because of this, the old conservation pool elevation of 1080.0 feet was restored. In addition, it was decided that conservation pool level would be regulated by flow over the spillway rather than through the low flow culvert. This change in the regulation plan did not require coordination with the Division Office because there was no change to conservation pool elevation, simply a change in the method of holding conservation pool. In the summer of 2003, the low flow sluice gate was closed and excess flow was allowed to pass over the spillway.

e. 2004-2005 Modification. In 2004, it was discovered that water was flowing over the dam when the pool gage was recording elevations of 1079.9 feet. In May 2005, St. Paul District's survey crew determined that the average crest elevation was 1079.80 feet (**Table 7-4**). A new elevation-discharge table was developed to reflect this (**Plate 7-1**). In addition, a new conservation pool band was established as elevation 1079.6 to 1080.2 feet.

f. 2005 Modification. After construction of the dam, maximum drawdown was established at elevation 1053.5 feet. Based on the 1953 sediment survey, this provided 53 acres of surface area with a volume of 329 acre-feet. The 1996 sediment survey indicates that this volume would occur at around elevation 1059.5 feet with a surface area of about 72 acres. Sediment surveys indicate that the average annual sedimentation rate is around 7.0 acre-feet per year (**4.04. Sediment**). Assuming this sediment rate for the next 50 years (starting in 1996), a volume of 329 acre-feet would occur at elevation 1064.0 feet. To error on the conservative side and ensure a safety margin for fish habitat, elevation 1064.0 feet was established as the maximum drawdown elevation.

g. 2005 Modification. Normal drawdown is from elevation 1080.0 feet to 1074.0 feet. This draw down is to occur between 1 November and 1 March. Typically drawdown will begin on 1 November and will be completed before the pool ices over. The Corps' Environmental Branch will assess the drawdown plan annually and may change target dates and discharges. Any additional drawdown required may extend to 31 March.

h. 2005 Modification. The previous operating plan called for maximum drawdown when snow water equilivant (SWE) was "anticipated to exceed 1.0 inch". If SWE was anticipated to exceed 1.0 inch, it was recommended that drawdown proceed to the maximum. Maximum drawdown, elevation 1064.0 feet, equates to around 1/6th of an inch of runoff over the entire basin. **Table 3-1** shows an eight-year history of runoff volumes for the preconstruction years of the new spillway.

Table 3-1
Flood Volume and Inches of SWE

Year	Flood Inflow Volume (acre-feet)	SWE (inches)	Draw-Down Elevation	Peak Pool Elevation
1999	29,365	2.44	1077.5	1082.6
1998	35,100	2.91	1076.4	1082.9
1997	78,270	6.49	1064.0	1083.3
1996	28,960	2.40	1067.8	1082.3
1995	40,725	3.38	1079.3	1082.4
1994	16,264	1.35	1075.6	1081.6
1993	2,945	0.24	1065.3	1080.6
1992	13,495	1.12	1075.6	1081.2

Table 3-1 shows that SWE quite often exceeds 1.0 inch. Peak pool elevations indicate that SWE volumes greater than 1.0 inch overwhelm the allotted flood control storage. An examination of the inflow and outflow hydrographs indicates that additional drawdown beyond normal drawdown has no impact on peak pool elevation. Therefore, while maximum drawdown remains at elevation 1064.0 feet, it is not anticipated that drawdown below elevation 1074.0 feet will occur.

i. 2005 Modification for Leakage and 2009 Joint Sealing and Waterstop Installation. During spring runoff of 2005, it was discovered that the drains along the sidewalls of the spillway were running at a high rate (**Figure 3-1**). At the end of spring runoff, the low flow gate was opened to take flow off the spillway. When the pool dropped below the spillway crest, flow through the drains was greatly reduced and eventually stopped. An investigation began in the summer of 2005. It was discovered that seepage only occurred when the spillway slab was cool (e.g. spring runoff). When the summer sun heated the spillway, the expansion of the concrete slab appeared to seal off the seepage route. While the matter was under investigation, there was no change in operation. The pool will continue to be held near the spillway crest elevation.

Figure 3-1. Flow Through a Spillway Drain.

Concrete cores were taken and non-destructive testing was completed in 2008. The cores showed poor concrete consolidation along the top layer of rebar in the spillway slabs. This was the likely path for seepage into the toe drain system causing the high flows. In 2009, a joint sealing and waterstop repair was completed. The repair consisted of installing rubber waterstops at the joints along the ogee crest, installing sealant along all horizontal and transverse spillway joints, and filling voids that intersected the spillway joints with grout. During the 2010 spring runoff, the amount of flow from the drains was reduced to an acceptable level (drips). Each spring runoff since the 2009 repair the spillway has been monitored and the flow from the toe drainage system remains acceptable.

j. 2015 Modification. An Environmental Assessment (EA) was completed in 2014 that looked at establishing a new winter drawdown plan. The selected alternative keeps a steady pool the majority of the winter to support the reservoir's winter uses and addresses downstream residents' concerns about ice jams by not lowering the reservoir during cold weather.

The new drawdown plan draws the pool down three feet in November. If there is more than an inch of snow water content (SWE) in the basin an additional three feet would be drawn down in March. Should the annual winter snow survey show that there is a significant amount of SWE in the basin, Water Management may choose to draw the pool down additional feet up to the maximum drawdown elevation of 1064.0 feet. Water Management will aim to complete the drawdown by the end of March, but the drawdown may be delayed due to weather conditions. Drawdown of the reservoir increases warning time for downstream communities.

3-06. Principal Regulation Problems.

a. Discharge. There is no tailwater gage at Homme Reservoir. Outflows are based on a spillway rating curve and a low flow discharge rating. Should the pool gage go down, pool observations would be required to determine the quantity of flow over the spillway. Use the manual wire weight on the low-flow tower for the pool elevation.

b. Erosion. A considerable amount of shoreline erosion has occurred since Homme Reservoir was first impounded. Over the years, many of the problem areas have been riprap protected.

IV – WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Park River basin, comprising a total area of 1,010 square miles, lies in the northeastern part of North Dakota, about 35 miles south of the International Boundary. The basin extends about 60 miles east to west and has an average width of 18 miles. (See **Plate 2-1**.)

The three main tributaries of the Park River are the South, Middle, and North Branches. The headwaters of the three branches are in the Drift Prairie Plateau of southeastern Cavalier County at approximately elevation 1650 feet. The three branches flow in a generally easterly and southeasterly direction to an almost common confluence about 3 miles west of Grafton to form the Park River. From this point, the main channel meanders eastward through the Red River Valley Plain to join the Red River of the North at about elevation 760 feet. The Red River flows northward and is part of the Hudson Bay drainage system. Homme Dam is located on the South Branch of the Park River in the central part of Walsh County, about four river miles upstream of the city of Park River and about 62 river miles upstream of the confluence with the Park River. The total length of the South Branch and the main stem of the Park River is approximately 110 miles. The drainage area above the dam totals about 226 square miles.

West of the city of Park River, the South Branch flows in a valley that is from 75 to 100 feet deep, about one half mile wide, and extends for 25 miles through the escarpment and drift prairie. The valleys of the Middle and North Branches are deeper than that of the South Branch but are not as long. When these streams leave the escarpment, the valley depths decrease rapidly until the channel banks are at the same level or slightly higher than the adjacent plain. The many tributaries of the three branches of the Park River are mostly small coulees and shallow ravines that are ordinarily dry except during spring break-up and after heavy rains.

4-02. Topography. The Park River watershed contains two well defined topographic subdivisions of the great interior plains region of North America. They are the Drift Prairie Plateau in the western part of the basin and the Red River Valley Plain in the eastern part of the basin. The two subdivisions are separated by the Pembina Escarpment. The Red River Valley Plain is very flat, ascending gradually toward the west from about elevation 800 feet to elevation 1000 feet at the base of the escarpment, a distance of 30 miles. The escarpment rises about 300 feet to elevation 1300 feet over a distance of 30 miles. The drift prairie has a gradual rise to elevation 1650 feet at the gently rolling, western limit of the basin.

4-03. Geology and Soils. During the last glacial period, the entire Park River watershed was covered by a continental glacier. When the glacier melted, it deposited a blanket of glacial drift consisting of a heterogeneous mass of clay, sand, gravel, and boulders. The depth of the deposit varies from only a few feet in the escarpment and portions of the drift prairie to 300 feet near the Red River. The Red River Valley Plain was once the lakebed for Glacial Lake Agassiz, which was formed about 9,000 years ago when an ice barrier to the north obstructed the flow of the Red River. The lake covered an area of approximately 110,000 square miles in Canada, western Minnesota, and eastern North Dakota. Below the glacial material, varying thicknesses of limestones and sandstones extend to depths of 600 feet. Granite has been found in the vicinity of Grafton at a depth of 903 feet below the ground surface.

4-04. Sediment. Seven sediment ranges were established in January 1953 to monitor the accumulation of sediment in Homme Lake (**Plate 4-1**). Each range was marked with a permanent monument. Soundings were taken through the ice at 50-foot intervals at each range. Elevations along Range 7 were sufficiently high that a survey was not necessary. Surveys were made in January 1953, March 1958, March 1964, December 1970, January 1976, February 1985, and February 1996. While it is known that a survey was performed in March of 1958, the results cannot be found in the Water Management files. In 1985, five additional ranges were established between the existing ranges. Range 7 was officially dropped from the survey. That made for a total of 11 sediment ranges. **Plate 4-1** shows the sediment range lines.

Range 4 of the 1985 survey required the survey crew to set a right-side endpoint because the permanent monument could not be located. The endpoint was set at the correct elevation but was roughly 200 feet west of the correct position. That meant the transect reached the right shore of the reservoir about 200 feet further north than all other surveys. Adjustments were made to reflect the historical end point location.

Before the start of the 1996 survey, surveyors from the Corps of Engineers assisted the U.S. Geological Survey by locating the sedimentation ranges and all permanent monuments. Seven of the monuments were not located because of deep snow, poor weather conditions, or because the monuments were missing. The Corps was able to mark the locations for the missing monuments with the exception of Range 6A. Therefore only 10 ranges were surveyed. The lack of Range 6A had minimal effect on the sedimentation analysis since all survey points along Range 6A were above elevation 1090.0 feet in past surveys. Elevation 1090.0 feet is the upper end of the sedimentation analysis.

End area method was used to calculate reservoir storage for all surveys. **Plate 4-2** shows the complete computed volumes for all surveys based on the original six cross-sections. The table indicates that since construction of Homme Dam the volume at conservation pool level has been reduced by about 1,000 acre-feet (1953-1996), which is about 25 percent of the original volume. However, the table also indicates that the lake has become more stabilized over the years. A comparison of the 1985 and 1996 surveys indicate a significant reduction in the sedimentation rate. **Table 4-1** shows the pool volumes for the 1985 and 1996 surveys based on 10 cross-sections.

Table 4-1 Sedimentation Survey Results in Acre-Feet Ten Cross-Sections								
Elev.	**1985**	**1996**	**Elev.**	**1985**	**1996**	**Elev.**	**1985**	**1996**
1049.0	7	0	**1063.0**	661	591	**1077.0**	2,358	2,312
1050.0	19	4	**1064.0**	746	672	**1078.0**	2,532	2,498
1051.0	35	16	**1065.0**	837	761	**1079.0**	2,716	2,689
1052.0	53	32	**1066.0**	930	854	**1080.0**	2,912	2,887
1053.0	73	50	**1067.0**	1,025	947	**1081.0**	3,119	3,093
1054.0	98	72	**1068.0**	1,125	1,047	**1082.0**	3,335	3,308
1055.0	127	96	**1069.0**	1,233	1,156	**1083.0**	3,559	3,530
1056.0	169	125	**1070.0**	1,351	1,276	**1084.0**	3,793	3,761
1057.0	223	171	**1071.0**	1,480	1,409	**1085.0**	4,037	4,001
1058.0	290	230	**1072.0**	1,617	1,547	**1086.0**	4,288	4,251
1059.0	361	297	**1073.0**	1,755	1,686	**1087.0**	4,545	4,509
1060.0	435	370	**1074.0**	1,898	1,826	**1088.0**	4,806	4,769
1061.0	510	444	**1075.0**	2,044	1,976	**1089.0**	5,073	5,032
1062.0	585	517	**1076.0**	2,194	2,136	**1090.0**	5,343	5,298

Table 4-2 was prepared to show the change in sedimentation rates at various elevations for all sediment surveys. The computed average annual sedimentation rate for the period 1976 to 1985 was based on six cross-sections, while the 1985 to 1996 time frame was based on 10 cross-sections. Rates are indicated for five-foot intervals.

Table 4-2 Average Annual Sedimentation Rates in Acre-Feet					
Pool Elevation	**1953 to 1964**	**1964 to 1970**	**1970 to 1976**	**1976 to 1985**	**1985 to 1996**
1050.0 ft	2.4	7.3	4.5	1.6	1.4
1055.0 ft	5.0	15.2	9.8	2.3	2.8
1060.0 ft	6.9	19.0	11.7	4.6	5.9
1065.0 ft	10.2	22.7	13.3	5.2	6.9
1070.0 ft	16.7	29.0	21.3	16.1	6.8
1075.0 ft	22.4	43.0	23.5	20.4	6.2
1080.0 ft	23.4	49.0	26.5	31.2	2.2
1085.0 ft	22.3	48.0	30.2	32.4	3.2
1090.0 ft	22.5	45.8	32.0	31.7	4.1

As part of the survey computations, lake surface area was computed for one-foot intervals. **Table 4-3** shows the results for pool levels in 10-foot increments. The areas shown for 1985 and 1996 are based on 10 cross-sections whereas all others are six cross-sections.

Table 4-3
Lake Surface Area at Various Pool Elevations in Acres

Pool Elevation	1953	1964	1970	1976	1985	1996
1050.0	35	27	19	14	14	10
1060.0	89	85	84	84	74	73
1070.0	189	165	156	153	123	126
1080.0	**219**	**220**	**215**	**206**	**201**	**201**
1090.0	266	263	267	264	271	267

4-05. Climate. The Park River basin has a variable climate with hot summers and cold winters, typical of continental conditions in the temperate zone. The climate is generally favorable for agricultural activity.

a. Temperature. The average monthly temperature for the northeast corner of North Dakota ranges from 3.8 ^{o}F in January to 67.7 ^{o}F in July. Normal mean monthly temperatures for the National Weather Service Stations near Homme Dam and Reservoir are shown in **Table 4-4**.

Table 4-4
Normal Mean Monthly Temperatures in ^{o}F

Location/ Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grafton, ND/ 1891-1999	4.1	10.0	23.9	41.6	55.9	65.2	69.8	67.8	57.2	45.2	26.3	19.4
Park River, ND/ 1903-1995	5.7	11.9	25.1	42.3	56.3	65.6	70.6	68.6	58.3	46.4	27.6	19.2
Langdon, ND/ 1897-2013	1.4	6.6	20.1	38.1	51.5	61.0	66.2	64.5	54.6	41.5	23.7	8.1
Cavalier, ND/ 1934-2013	3.0	7.9	20.4	37.0	49.2	58.4	62.7	60.1	50.9	39.7	23.5	9.6
Grand Forks, ND/ 1949-2013	4.6	10.6	23.7	41.4	54.7	64.3	69.1	67.3	56.9	44.3	26.6	11.2

b. Precipitation. The average annual precipitation at Grafton and Park River is respectively 17.82 and 18.80 inches. The majority of the annual precipitation occurs during the months of April through October, with the remainder falling mostly as snow during the months of November through March. Average monthly precipitation for the National Weather Service stations near Homme Dam and Reservoir are listed in **Table 4-5**.

Table 4-5
Average Monthly Precipitation in Inches

Location/ Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grafton, ND/ 1891-1999	0.60	0.44	0.89	1.52	2.28	3.07	2.64	2.17	1.82	1.22	0.64	0.53
Park River, ND/ 1903-1995	0.61	0.46	0.92	1.66	2.26	3.38	2.91	2.20	1.86	1.33	0.66	0.55
Adams, ND/ 1949-2013	0.59	0.42	0.74	1.21	2.42	3.41	3.11	2.47	1.73	1.36	0.67	0.52
Langdon, ND/ 1897-2013	0.57	0.49	0.74	1.18	2.28	3.25	2.83	2.57	1.96	1.23	0.77	0.58
Cavalier, ND/ 1927-2013	0.53	0.41	0.76	1.35	2.40	3.23	2.93	2.49	2.11	1.42	0.76	0.55
Grand Forks, ND/ 1949-2013	0.66	0.51	0.88	1.19	2.39	3.16	2.98	2.69	2.05	1.51	0.85	0.63

c. Evaporation. Evaporation represents a major portion of the water lost from the reservoir during the April-October period. The Climatic Atlas of the United States (June 1968) estimates the mean annual lake evaporation to be about 30 inches. Average monthly pan evaporation for open water months at the National Weather Service station at Fargo, North Dakota (gage is discontinued), is listed in **Table 4-6**.

Evaporation from lakes is less than pan evaporation due to cooler water temperatures. Assuming a pan coefficient of 0.7 provides a convenient means of estimating reservoir evaporation (Hydrology for Engineers, McGraw-Hill, 1958).

Table 4-6 Average Pan Evaporation at Fargo, North Dakota and Estimated Average Reservoir Evaporation in Inches								
Location	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Record**
Fargo	3.64	7.15	7.41	8.43	7.31	4.95	3.29	1963-80
Homme	2.55	5.01	5.19	5.90	5.12	3.47	2.30	------

d. Wind. The average wind speed in the area is about 10 miles per hour. The prevailing winds are from the northwest, but southeast winds are common during the summer months. **Table 4-7** shows the average annual high wind speeds recorded at the Devils Lake Airport based on a period of record from 1985 through 1995. The data were broken into four general directions and only open water months were considered (April through November). The "over-land" recordings were taken at the airport at an elevation of 16-feet. These wind speeds (U_{16}) were adjusted to an elevation of 33-feet, which is the start of constant stress layer, $U_{33} = U_{16}(33/16)^{1/7}$. Wind speeds were then adjusted to "over-water", to account for surface roughness (increased by 10 percent per Engineer Technical Letter (ETL) 1110-2-305). Finally, the over-water wind speed was adjusted to account for the nonlinear relationship between wind stress and wind speed, $U_{stress} = 0.589\ U^{1.23}$. The wind stress factor is used in forecasting wind generated wave heights.

Average wind based on Devils Lake Municipal Airport from 1990 to 2012 was summarized by weatherspark.com[1]. Wind generally ranges between 0 and 20 mph. Highest average wind speeds normally occur in May and the lowest average wind speeds normally occur in July. Wind is most often out of the NW/W/N/S/SE.

[1] https://weatherspark.com/averages/30104/Devils-Lake-North-Dakota-United-States

Table 4-7 Average Annual Wind Speeds (mph)					
Direction	**Angle**	**Over-Land Wind Speed (16 feet)**	**Elevation Adjusted (33 feet)**	**Over-Water Wind Speed**	**Wind Stress Factor**
North	315^o to 45^o	35.4	39.2	43.1	60.3
East	45^o to 135^o	27.1	30.0	33.0	43.4
South	135^o to 225^o	27.7	30.7	33.8	44.7
West	225^o to 315^o	34.5	38.2	42.0	58.4

e. Wind Generated Waves. Data on wind generated waves is used when considering how to best prevent shoreline erosion. The most typical form of protection is rock (riprap). Riprap designs for wind-generated waves must assume some risk and uncertainty to be cost effective. Design factors include wind speed, fetch length, side slope, and rock shape. Because the reservoir runs in an east-west direction, the longest fetch length along this path is a little over a mile. In the north-south direction, the fetch length is not much more than a quarter of a mile. Because of the limited fetch length, it would be difficult for a wave higher than 2.0 feet to be developed. This would require an over-water wind speed of 48 mph, at the longest fetch, for a sustained period of 15 minutes. Typical wave heights on Homme Reservoir will be one-foot or less.

f. Wind Setup. The wind blowing across the lake surface exerts a horizontal force on the water surface and induces a surface current in the general direction of the wind. The horizontal currents induced by the wind essentially cause water to "pile up" on the downwind side resulting in a water level rise downwind and a water level drop upwind. The lowering of the water surface is called "wind set down" and the rise in water level is called "wind setup". The rise in water can be estimated by the following equation taken from Engineering Manual (EM) 1110-2-1414:

$$S = (U^2 F) / (1400 D)$$

S=Wind Setup (ft)
U = Wind Speed (mph)
F = Fetch Length (miles)
D = Average Depth over Fetch (ft)

Computations using this equation suggest that it under predicts wind setup. ETL 1110-2-221 recommends doubling the fetch length; however, the ETL has been superseded. While it is recognized the relationship between wind speed and wind setup is not linear, a rule of thumb has been developed that seems to work well: for every ten miles per hour of wind speed, assume the pool level change is 0.1 feet. Therefore a northwest wind at 20 mph would cause a 0.2-foot rise in the pool surface at the dam. Conversely, a southeast wind of 10 mph would result in a lowering of the water surface at the dam by 0.1 feet.

4-06. Storms and Floods. Nearly all floods in the Park River basin have occurred in the spring of the year and are usually the result of rapid snowmelt, sometimes accompanied by rainfall. The new spillway completed in July 2003 was constructed to the same design elevation as the original spillway; however, it is 68 feet longer. The discharge rating was lowered by almost a foot. For example, the peak pool elevation established in April 1979 at 1084.58 feet would be 1083.62 feet with the same discharge today (**Plate 7-1**). A summary of selected peak elevations/stages and discharges are shown in **Plate 4-3.**

a. April-May 1950. The flood of 1950 is the flood of record for the Park River basin. This flood was caused by a combination of factors, namely: above normal antecedent soil moisture, heavy snowfall during a colder than normal winter, delayed melting of the snow cover until mid-April, above normal precipitation during the spring break-up, and a blockage of snow and ice in the Park River channel.

Precipitation in October 1949 was 2.20 inches above normal in eastern North Dakota, resulting in high soil moisture when the ground froze. Snowfall during the winter months was excessive, with about three times normal snowfall being recorded. The Corps of Engineers' snow survey of 13 March 1950 indicated that the snow-water-equivalent in the Park River basin was 3.5 inches. Temperatures in the basin remained below freezing until the middle of April 1950. The first basin-wide warm spell occurred during 15-23 April, in the two-day period from 15-16 April, most of the snow had melted. The rapid melt caused runoff to spread over parts of the basin in wide, shallow sheets. The town of Crystal on Cart Creek was isolated by overland flow, and farmlands west of the town of Park River were being flooded by 17 April. The normal river channel, partially blocked by ice and snow, was unable to carry much of the discharge. This caused much of the farmland in the Grafton area to be flooded. Highway 81 was submerged for miles, making travel very difficult. By 18 April, the entire city of Grafton was flooded, with Hill Avenue under 20 inches of water. The flood crested at Grafton between 0600 hours and 1100 hours on 19 April with a flow of 12,600 cfs and a stage of 20.13 feet (8.13 feet above flood stage).

Homme Dam, partially completed in April 1950, was slightly damaged by the flood. A temporary earth spillway on the north end of the dam failed on 24 April, releasing its stored water very quickly. A peak flow of 13,000 cfs overwhelmed the river channel resulting in overland flooding. While the stream gage in Grafton did not experience a second peak, it is thought that flow crossed Highway 18 south of Highway 17, thereby flooding the south side of Grafton while not impacting the Grafton gage.

Winter conditions returned again from 24 April to 9 May 1950, bringing additional snowfall. During this period the area received a water equivalent of about 4 inches. Melting of this snowpack resulted in a second flood crest at Grafton of 8,730 cfs on 9 May 1950 with a gage height of 19.31 feet.

b. Spring Flood 1979. The spring flood of 1979 within the Park River basin was caused by above normal precipitation and below normal temperatures until mid-April, when temperatures suddenly rose to nearly 60 ^{o}F. At the city of Park River, precipitation from November 1978 to April 1979 totaled 7.6 inches, 185 percent of normal. The 12 March 1979 snow survey indicated that snow on the ground within the Park River basin varied from 3 to 5 inches of water equivalent.

Runoff began in mid-April. Discharge peaked at 5,380 cfs on 20 March below Homme Dam and 8,740 cfs on 22 April at Grafton. Damages within the Park River basin totaled nearly 10 million dollars.

c. Spring Flood 1997. The spring flood of 1997 within the Park River basin was caused by extremely high antecedent moisture conditions in the fall followed by double the normal snowfall during the winter. The 15 March 1997 snow survey indicated that snow on the ground within the Park River basin varied from 4 to 6 inches of water content. Additionally, the basin was hit with a late spring storm on 5-6 April that dumped 2-3 inches of precipitation in the form of rain, freezing rain, and snow. Runoff began in mid-April. Discharge peaked at 3,125 cfs on 20 April below Homme Dam and 5,150 cfs on 21 April at Grafton. Emergency measures, which were built at Grafton, were estimated to have saved three million dollars in damages.

d. Spring and Summer Floods 2009. The fall of 2008 was very wet with September to December having above normal precipitation. There was flooding on the Red River of the North in October, followed by heavy rainfall in early November. There was extremely saturated soil moisture at freeze up along with minimal snow cover until mid-December. December had record snowfall totals along with below normal temperatures.

The reservoir was drawn down four feet in November 2008 and another two feet at the end of February 2009 (to meet the requirement of drawing down six feet between November and February). Snow surveys at the end of February showed a basin average SWE of 3-3.5 inches. In addition there was at least half an inch of ice on the ground that the cutter was not able to get, therefore the measurements were low. The decision was made to lower the reservoir to the maximum drawdown elevation (1064.0 feet). Melt started early on 22 March, therefore the pool only reached elevation 1066.70 feet before inflow caused it to start rising. On 23 March the first peak inflow was 3,300 cfs and the first peak outflow was 3,100 cfs. Due to the large amount of snow water equivalent left in the basin it was decided to draw the reservoir down again. The pool was lowered to elevation 1072.80 feet on 10 April when the second melt started. On 13 April the second peak inflow was 3,400 cfs and the second peak outflow was 3,200 cfs.

The basin experienced a wet spring and summer following the snow melt. Inflows were above 1,000 cfs twice in May and late June rains caused inflow to peak above 2,000 cfs.

e. Spring and Summer Floods 2013. Homme's basin was in a moderate drought going into winter in 2012. Four feet were drawn down in November and the late February 2013 drawdown was delayed due to cold weather. The low-flow was opened on 8 March to the level prescribed in the Water Control Plan for lowering the pool half a foot a day. Outflow was reduced on 15 March due to cold weather. Due to the cold March, the Corps received complaints about making releases. With the pool only 2.5 feet above maximum drawdown there was little risk in not achieving the drawdown and a deviation was approved to delay the remainder of the drawdown until warmer weather returned. Outflow was reduced to inflow on 19 March. On 3 April Homme was opened up in order to complete the drawdown. By 8 April the pool was at maximum drawdown and outflow equaled inflow.

Melt began on 27 April. At 1400 hours the pool was at elevation 1064.3 feet. The low-flow gate was operated according to the Water Control Plan as the pool climbed. The pool reached elevation 1080.0 feet on the evening of 28 April and the low-flow gate was closed (with all water passing over the spillway) per the Water Control Plan. The pool peaked at elevation 1082.74 feet (~3,600 cfs) at 0300 hours on 29 April.

May rains caused the pool to peak twice more in May. On 21 May the pool peaked at elevation 1082.1 feet (~2,500 cfs) and on 31 May the pool peaked at elevation 1081.9 feet (~2,190 cfs).

4-07. Runoff Characteristics. U.S. Department of Agriculture Bulletin No. 1017 includes a comprehensive study of flooding in the Red River Valley for the period 1893-1920. This study showed that snow has an important effect on runoff during March and April. Snow accumulates in varying quantities during the period of November through March. The runoff resulting from this stored precipitation was studied for the above period. It was found that when a considerable portion of the watershed was covered with snow to a depth exceeding 15 inches, and when 12 or more inches of accumulated snow was still on the ground on or about 1 March, high stages would result in the principal streams.

Historically, high flows in the Park River basin have resulted in the spring of the year as a result of rapid snowmelt, sometimes accompanied by rainfall. When large spring discharges from the north, middle, and south branches enter the Park River concurrently, flooding results along the main channel in the vicinity of Grafton. Flood flows inundate large areas of rural land because the valley slope is flat and the riverbanks are low. Damage in the Grafton area occurs at 1,500 cfs or a stage of 12.6 feet. Mobilization stage is 18.0 feet. The city of Park River is the primary damage center on the south branch. Channel capacity is 750 cfs. Floods in the Park River basin usually crest in five days and recede to normal in 20-25 days.

The U.S. Geological Survey maintained a streamflow gage located 0.5 miles downstream of Homme Dam from October 1949 to September 1994. **Table 4-8** shows the annual flow duration for the South Branch of the Park River below Homme Dam for water years 1950 through 1994. Reservoir inflows are computed based on change in reservoir storage and known outflow. This is computed once a day at 0800 hours and is therefore a 24-hour average. Hence an inflow duration table was not developed.

Table 4-8 Annual Flow Duration (cfs) Percent of Time Outflow is Equaled or Exceeded							
Discharge	1%	5%	10%	20%	30%	40%	50%
U.S.G.S. Gage (1950-1994)	600	70	30	13	7	5	2
Computed (1950-2014)	650	120	50	16	10	7.5	4.5

4-08. Water Quality. Homme Reservoir was identified as an impaired water body by the North Dakota Department of Health (NDDoH) as part of the 2010 Clean Water Act Section 303(d) impaired waters listing process. Based on a Trophic State Index (TSI) score, fish and other aquatic biota and recreation uses of Homme Dam are impaired due to nutrient/eutrophication/ biological indicators.

A water quality and watershed assessment of Homme Reservoir was completed from June 2010 to September 2011 by the Walsh County-Three Rivers Soil Conservation District (SCD). The water quality data indicated that Homme Reservoir was eutrophic to hypereutrophic due to nutrient inputs, such as phosphorus entering the lake from the surrounding agricultural watershed.

Land use in the Homme Reservoir watershed is largely agricultural with 63 percent of the land being active cropland according to the 2012 National Agricultural Statistical Service. Crops consist mainly of spring wheat, canola, dry beans and soybeans. The remainder of the basin consists of 19 percent pasture, 9 percent wetlands, and the remaining 7 percent is either forest, open water, barren, urban development, or fallow/idle cropland.

The St. Paul District monitored water quality in Homme Reservoir from 2000 to 2010 at two sites, one site at the outlet and the other in the deepest part of the reservoir. During the average growing season (April-November) total phosphorus concentrations were 0.224 mg/L and average chlorophyll-a concentrations were 24 μg/L. Winter Dissolved Oxygen levels were also occasionally measured.

4-09. Channel and Floodway Characteristics. The South Branch of the Park River has a natural, meandering, well-defined channel downstream of Homme Dam. The channel capacity is about 750 cfs at the city of Park River and increases to about 1,500 cfs in the vicinity of Grafton. Grafton is located about three river miles below the confluence of the South Branch with the main stem Park River. Homme Dam is located at about river mile 62, the city of Park River is located at about river mile 58, and Grafton is located at about river mile 30. Travel time between the dam and Grafton during flood periods is about 2 days. The discharge rating table for the Park River at Grafton is shown in **Exhibit-B**.

4-10. Upstream Structures. There are no structures upstream of Homme Dam.

4-11. Downstream Structures. There are no hydraulic structures between Homme Dam and its confluence with the main stem of the Park River. There are five National Resource Conservation Service (NRCS) dams located on the Middle Branch of the Park River with a combined storage capacity of about 10,000 acre-feet. Four of these dams were built between 1970 and 1973 with the fifth completed in 2001. The five dams control a combined drainage area of 124 square miles.

4-12. Economic Data.

a. Population. The Park River watershed lies in portions of three North Dakota counties: Walsh, Cavalier, and Pembina. Population in 1990 and 2000 for these counties and for the cities of Grafton and Park River were obtained from the Census Bureau. The results are presented in **Table 4-9**. As has been the trend nationally for rural counties and communities, the Park River area has experienced significant losses in populations in recent decades.

Table 4-9 Park River Basin – Population by County and City				
County/City	**1990 Census**	**2000 Census**	**2010 Census**	**Percent Change**
Walsh	13,840	12,389	11,119	-19.7%
Cavalier	6,064	4,831	3,993	-34.2%
Pembina	9,238	8,585	7,413	-19.8%
Grafton	4,884	4,516	4,284	-12.3%
Park River	1,725	1,535	1,403	-18.7%

Per capita income for the state of North Dakota and the counties of Cavalier, Pembina, and Walsh were obtained from the Bureau of Economic Analysis, Regional Economic Data. **Table 4-10** shows per capita income figures for 2013, 2008, and 2003 to give an incremental idea of the changes within the county over five-year spans.

Table 4-10 Per Capita Income by County and State				
Year	**North Dakota**	**Counties**		
		Cavalier	**Pembina**	**Walsh**
2013	$53,182	$53,834	$57,923	$49,312
2008	$40,917	$76,766	$50,023	$41,631
2003	$29,594	$40,551	$34,320	$28,187

b. Agriculture. Based on number of acres planted, grain farming is the dominant agricultural activity in the basin. Of the field crops planted in 2012 in Cavalier county, 42% were wheat, 40% were canola, and 7% were soybeans. In Pembina county, 37% were wheat, 24% were soybeans, and 15% were beans and in Walsh county, 39% were wheat, 17% were soybeans, and 16% were beans. Also prevalent in Pembina and Walsh counties were corn (9% and 10%, respectively) and sugar beets (11% and 8%, respectively).

c. Industry. The share of the employed labor force by industry is shown in **Table 4-11**. Figures are presented by county and, for comparative purposes, for the state as well. In October 2014, the state average unemployment rate was 2.8 percent. By comparison, Pembina and Walsh Counties were higher at unemployment rates of 4.1 percent and 3.7 percent respectively, while Cavalier County was slightly lower at 2.5 percent.

Table 4-11
County and State Employment by Industry (2012)

Industry	Walsh	Pembina	Cavalier	North Dakota
Agriculture	1.4 %	0.1 %	0.6 %	0.1 %
Construction and Mining	6.3 %	4.2 %	6.4 %	12.6 %
Finance, Insurance, Real Estate	4.5 %	4.5 %	7.9 %	6.6 %
Manufacturing	14.9 %	26 %	4 %	7.2 %
Retail Trade	15.2 %	15.1 %	17.0 %	14.3 %
Wholesale Trade	9.4 %	22.8 %	10.9 %	6.5 %
Trans, Communication, Utilities	6.0 %	7 %	16 %	6.5 %
Services	18.5 %	10 %	20 %	23.4 %
Management, Health Care, Art/Entertainment/Recreation	21.0 %	12 %	21 %	20.6 %

d. Flood Damages. To assess flood damages, the South Branch of the Park River was broken into two reaches plus the city of Grafton. The first reach extends from the dam to the confluence with the Middle Branch of the Park River and the second reach extends from the Middle Branch of the Park River to Interstate Highway 29 near the Red River of the North. In Reach 1, cropland begins flooding at a discharge of 900 cfs, and the 100-year flood inundates an area of approximately 45,000 acres. In Reach 2, cropland begins flooding at a discharge of 1,800 cfs, and the 100-year flood inundates an area of approximately 50,000 acres. The value of crop damage will vary depending upon the date of flooding and the type of crop planted. Early season floods occurring before planting may have relatively minor impact. Fertilizer applied in the fall may have to be replaced or additional herbicide may need to be applied or cultivation performed to fight flood-induced weed infestation. Floods during the growing season can destroy a crop resulting in total loss of income from the affected area.

Damage at Grafton starts at a discharge of approximately 3,000 cfs. At this flow, emergency measures may be initiated, and sewers and basements may start to flood. The 100-year discharge of 13,900 cfs floods over 1,500 residential, commercial, and public properties.

V – DATA COLLECTION AND COMMUNICATION NETWORK

5-01. Hydrometeorological Stations.

a. Facilities. The regulation and operation of the dam requires little in the form of data collection. The major requirement is a pool gage. This is provided by the U.S. Army Corps of Engineers (USACE). There is an additional gage located downstream on the Park River at Grafton. Both of these sites are Data Collection Platforms. The U.S. Geological Survey (USGS) operates and maintains both the pool gage and the Grafton gage. **Table 5-1** gives a "past and present" description of stream gages located in the basin. Gage locations are shown on **Plate 2-1** and listed in **Table 5-2**. As indicated in the following table, all streamflow gages have been discontinued except for the Grafton gage and the Homme pool gage.

Table 5-1
Park River Basin Stream Gages

Gage Owner	Drainage Area	Gage Name	Period of Record	
			From	To
USGS	214 sq-mi	South Branch Park River near Park River	Mar 1940	Sep 1950
USGS	16.9 sq-mi	Cart Creek at Mountain	Jun 1956	Sep 1984
USGS	15.3 sq-mi	Middle Branch Park River near Union	Oct 1965	Sep 1986
USACE	226 sq-mi	South Branch Park River below Homme Dam	Oct 1949	Sep 1994
USGS	695 sq-mi	Park River at Grafton	Apr 1931	Present
USACE	226 sq-mi	Homme Reservoir Pool near Park River	Sep 1949	Present

Table 5-2 Hydrometeorological Stations			
Location	**Data Type**	**Equipment**	**Notes**
Park River at Grafton	Stage	Sutron Satlink II Sutron Accubar H-3611 Radar GOES Telemetry Wire Weight	Satlink owned USACE. Radar & Accubar owned USGS. Maintained by USGS. Solar Panel Datum: 1929 NGVD Gage Zero: 811.0 feet
Homme Pool Gage	Elevation Precipitation	Sutron Satlink II H-3311 Shaft Encoder CS451-L Transducer Stilling Well GOES Telemetry Wire Weight H340 SDI-12 Tipping Bucket Staff Gage	Equipment owned by USACE and maintained by the USGS. AC Power Datum: 1929 NGVD Gage Zero: 1000.0 feet

1. Park River at Grafton. The Park River at Grafton gage is located on the Park River 3.5 miles downstream of the South Branch. The gage is on right bank just upstream of the Highway 81 bridge at latitude 48^{o} 25' 24"N and longitude 97^{o} 24' 30"W (**Figure 5-1**). Gage zero is elevation 811.0 feet NGVD 1929. The gage was partially funded by the USACE until 1999. The importance of the gage was sufficient for the USACE to share in gage operation by allowing the equipment to remain on site while it is maintained by the USGS. The gage site is a Data Collection Platform (DCP) with a Satlink 2 data logger, GOES telemetry, a Sutron Accubar Pressure Sensor along with a Design Analysis H-3611 radar stage sensor (for backup). The USACE owns the Satlink II, the rest of the equipment is owned by the USGS. The data logger is battery driven. The charge on the battery is maintained by a solar panel. Hourly data are available from the Water Management web site along with the USGS website. For backup and level verification purposes there is a wire weight gage on the Highway 81 bridge. A discharge rating table is presented in **Exhibit B**.

Figure 5-1. Grafton Gage House.

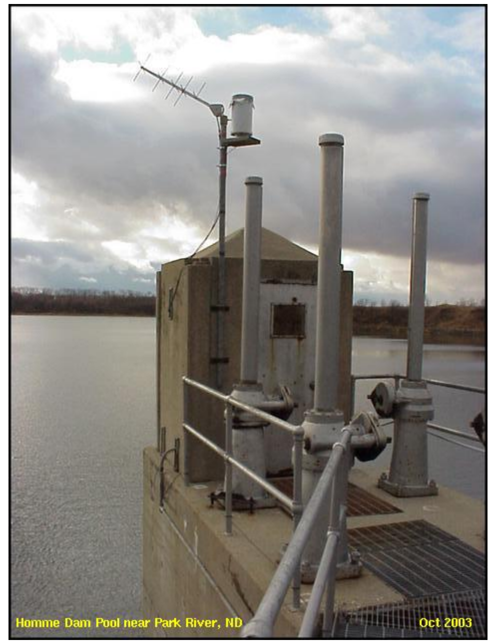

Figure 5-2. Homme Pool Gage.

2. Homme Pool Gage. The Homme pool gage is located at the low flow inlet on the northeast end of the embankment at latitude 48° 24' 20"N and longitude 97° 47' 10"W. Gage zero is elevation 1000.0 feet NGVD 1929. This station is housed in a concrete, AC powered walk-in style shelter on top of a concrete stilling well (**Figure 5-2**). It is a DCP with a Satlink II with Display, GOES telemetry, Design Analysis H-3311 Shaft Encoder, and Design Analysis H-340 SDI-12 Tipping Bucket. Installed but not yet hooked up as of 2014 is a Campbell Scientific CS451-L Pressure Transducer. Hourly data are available from the Water Management web site. In addition, there is a staff gage inside the well for tape verification and a wire-weight on the low-flow tower.

b. Reporting. The Park River Water Department records the 24-hour precipitation at their office every normal workday. The USACE has contracted with a private individual to report precipitation as well as make gate changes and take wire weight readings of the pool two times a week. This is typically done on Mondays and Fridays. The 24-hour precipitation and wire weight pool readings are reported to the Baldhill Dam ND Section Supervisor who in turn reports the data on the weekly log sheet for Baldhill Dam and Lake Ashtabula Project and enters it into the Water Management Database.

Hourly pool elevations are obtained from the Data Collection Platform (DCP) located at the dam site. Project personnel at the Baldhill Project Office compare the hourly pool elevations to the two wire weight pool readings to verify that the DCP is reading elevation correctly. The data path to the Water Management website starts at the DCP. The DCP sends a signal to the U.S. Geostationary Operational Environmental Satellite (GOES). The GOES satellite sends the signal to the Direct Readout Ground Station (DRGS) at Wallops Island, Virginia. The data is reformatted and sent to the Domestic Communication Satellite (DOMSAT), which transmits the data to the Local Readout Ground Station (LRGS) located on the roof of the St. Paul District Office. These values are electronically stored and are available from the Water Management website.

The NWS has a network of observers and gages that report directly to the NWS Chanhassen Office. Water Management accesses this information from the NWS website. The NWS provides the 24-hour mean aerial precipitation maps, five-day quantitative precipitation forecasts (QPF), and snow-water content maps. These sources of information are useful in forecasting the severity of a flood event.

Water Management conducts its snow survey of the Red River of the North basin the last week of February or the first week of March. If an appreciable amount of snow should fall after the survey is completed, another survey may be required. At least four samples are taken at each station (two if less than 50 percent snow cover). Reports are faxed to the Water Management office daily. There are two snow survey stations in the Park River basin: 1) one-half mile southeast of Adams and 2) just west of the Park River airport. The sites can be approximated on **Plate 2-1**. The snow survey information is reported to the National Weather Service, which uses the information to ground truth its airborne gamma ray remote sensing technology.

During flood conditions, reconnaissance teams are dispatched to the Red River of the North basin to gather information that is reported to Water Management via phone and email on a daily basis or more frequently depending on need.

c. Maintenance. The USGS operates and maintains the pool gage and the Grafton gage.

5-02. Water Quality Stations. The USGS performed water quality measurements on the South Branch of the Park River below Homme Dam from 1974 until the gage was discontinued on 1 October 1994. In addition to this gage site, the USGS started to collect water quality data on the Park River at Grafton in 1969 and continues to today. The data sets for both sites are sporadic with more complete surveys in March/April and August. Data sets include measurements of the following: discharge, PH, conductivity, temperature, total hardness, calcium, magnesium, potassium, sodium, chloride, fluoride, sulfate, dissolved solids, arsenic, iron, lead, lithium, mercury, molybdenum, selenium, and strontium. The data sets can be obtained from the annual USGS *Water Resources Data*, North Dakota water-data reports.

Between 2000 and 2010, the USACE collected water quality data at two sites, one at the outlet and the other at the deepest part of the reservoir. Data is available upon request to the St. Paul District Water Management's Water Quality staff.

5-03. Sediment Stations. There are no sediment stations in the vicinity of Homme Reservoir. The only sediment stations are the ranges that were established by the Corps of Engineers to monitor sedimentation of the reservoir. A complete discussion can be found in **4-04. Sediment**.

5-04. Recording Hydrologic Data. Water Management has three forms of recording and storing hydrologic data for Homme Reservoir: weekly log sheets (hard copy and digitally saved), the Hydrologic Engineering Center Data Storage System (HEC-DSS) and the Corps Water Management System (Oracle).

a. Weekly Log Sheets. Site personnel at Baldhill Dam record the daily pool elevation, and discharge from the dam on a weekly log sheet (CEMVP Form 416). All data correspond to 0800-hours. The log sheet is prepared, scanned, and placed on the St. Paul District's ECH server. The hard copy (on-site) and digital log sheets provide a permanent record to supplement the electronic files maintained on HEC-DSS/Oracle.

b. Hydrologic Engineering Center Data Storage System (HEC-DSS). In-coming data from the Data Collection Platforms at the Homme pool gage and the Grafton stream gage are stored in independent DSS files under *Real Time Data* accessible from the Water Management web site. The pool gage includes hourly precipitation. The following table shows the history of this data collection.

Table 5-3
Electronically Stored Hourly DCP Data

Data Type	Start Date
Homme Pool Elevation	1300-hrs 29 February 1996
Homme Precipitation	0400-hrs 18 June 2002
Grafton Stage	0100-hrs 01 September 1995

Site personnel at Baldhill Dam project office input, via remote terminal, the 0800-hour pool elevation, and reservoir outflow. Outflow is computed by the Baldhill Dam staff based on rating tables for the spillway and low flow outlet. The Reservoir Program computes the 24-hour inflow based on the recorded 0800-hour discharge and the 24-hour change in storage. The program assumes the 0800-

hour discharge was steady for the past 24-hours and thus does not account for wind effects at the pool gage. All of these data are stored in separate DSS files. **Table 5-4** shows the start date for all 0800-hour data that is electronically stored.

Table 5-4 **Electronically Stored Daily 0800-hour Data**	
Data Type	**Start Date**
Homme Pool Elevation	02 September 1949
Outflow (computed)	02 September 1949
Average Daily Inflow	01 October 1949
Precipitation	01 January 1965

While recorded outflows are instantaneous, computed inflows have been averaged over a 24-hour period. Therefore, a good comparison of inflows to outflows is not possible. Additionally, wind effects on pool readings and any mid-day changes in outflow are not accounted for in the computation of inflow. Therefore, the peak instantaneous outflow is typically higher than the average daily inflow.

c. Corps Water Management System (Oracle). In-coming data from the Data Collection Platforms at the Homme pool gage and the Grafton stream gage are stored in Water Management's Oracle database. **Table 5-3** shows the history of this data collection.

Site personnel at Baldhill Dam project office will input (once the system is operational – expected sometime in FY2016), via remote website, the gate setting. Outflow is computed by the Corps Water Management System (CWMS) based on rating tables for the spillway and low flow outlet. The CWMS computes the inflow based on the recorded gate settings and hourly change in storage.

5-05. Communication Network. The communication network consists of telephone, fax machine, computer terminal, T1 line, and a satellite system. The computer terminals allow communication between the office and field sites by e-mail and "Secure CRT"/remote website. Water Management receives DCP hourly data from the Homme pool and precipitation sensors via satellite. To ensure communication between Water Management and the National Weather Service, a dedicated phone line was installed. A T1 line ensures communication between Water Management and the Division Office (MVD) in Vicksburg, Mississippi. Elevation, discharge, and precipitation data is available to the public via the Water Management website.

Telephone communication serves as a backup to the remote terminal (Secure CRT). Backup satellite data are available from rivergages.com. Field or contract personnel can be deployed to make observations of wire weight gages to provide backup for the DCP's. During flood events, reconnaissance teams communicate field information to Water Management by cellular phone, email or facsimile.

5-06. Communication with Project.

a. Regulating Office with Project Office. Upon review of daily stages and climatologic data, Water Management determines if any change to the low flow gate is necessary. At approximately 0900-hours, the regulating office (Water Management) communicates any changes in operation by email or telephone with the Baldhill Dam ND Section Supervisor, who then communicates those changes to the contract gage reader at Park River. Flood events or downstream activities may require additional gate movements during the day. During flood events, stages are monitored by Water Management for additional changes that may be required.

In the event the pool gage was to stop functioning, Water Management would contact the ND Section Supervisor at Baldhill Dam and coordinate a schedule for reading the wire weight until the gage could be repaired. The ND Section

Supervisor would in turn coordinate this schedule with the local gage reader in Park River to make the necessary gage readings. The USGS would be alerted, and the gage would be repaired as soon as practical.

During floods or other emergencies, Water Management contacts the Baldhill Dam Project ND Section Supervisor by telephone or email whenever a gate change is needed. Special reports are transmitted by telephone, facsimile, or by email as directed by Water Management. If a telephone call must be made after regular business hours or non-duty days, project personnel are to call Water Management staff using the office phone numbers listed on **page iii** of the **Introduction**. If Water Management cannot be contacted, call one of the regulators at home, in the order shown.

b. Between Project Office and Others. Local residents have access to lake level information by contacting the Baldhill Project ND Section Supervisor or by accessing data through the Water Management website. Notifications of severe weather or impending unusual conditions are dealt with by local law enforcement and civil defense authorities.

5-07. Project Reporting Instructions. Baldhill Dam Project Office staff report hydrologic and climatic conditions for Homme Dam to Water Management every normal workday via remote terminal. Log sheets are uploaded to the District's server on a weekly basis.

5-08. Warnings. Should project field staff become aware of any emergency conditions, the District Office should be notified immediately by telephoning, in the order shown, one of the personnel listed on **page v** of the **Introduction**. In the event of an emergency, it may be necessary to contact local officials. **Plate 5-1** is a list of officials provided for this purpose.

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VI – HYDROLOGIC FORECASTS

6-01. General. Forecasting of river-stage information for public release rests with the National Weather Service as mandated by Congress. The Corps of Engineers, St. Paul District provides present reservoir conditions and advisory forecasts of reservoir regulations.

a. Role of Corps of Engineers. The present role of the U.S. Army Corps of Engineers (USACE) is to assist the National Weather Service (NWS) in its forecasting efforts by providing information on the 0800-hour outflow, 24-precipitation, and Water Management's plan of regulation. Snow surveys are taken the last week of February or the first week of March. This information is provided to the NWS as soon as it becomes available.

The USACE does not provide any forecast information for public release. However, Water Management does keep the public informed of changes in reservoir regulation by providing advisory forecasts of reservoir inflow/outflow and pool elevation changes through the USACE Public Affairs Office (PAO). All "news releases" are coordinated through the ND Flood Control Project Section Supervisor (Baldhill Dam Project Office) as well as the Operations Project Manager (Recreation and Natural Resources Project Office). There may be times when PAO is not able to react fast enough to meet print and radio deadlines. Under these circumstances, the Resource Manager is authorized to advise the public of an ongoing situation without coordinating through PAO.

b. Role of Other Agencies. The NWS North Central River Forecast Center (NCRFC) is responsible for river forecasts. In the spring of 2001, the NWS switched to the Advanced Hydrologic Prediction Service (AHPS) for the Red River Valley. AHPS enables the NWS to provide long-range probabilistic river outlooks. Under this method, a minimum of one Flood Outlook is generated every month. Because the outlook includes the climatological forecast, which comes out around the middle of every month, the Flood Outlook comes out shortly thereafter. Therefore, the Flood Outlook includes current conditions as well as the long-range climatological forecast. The outlook is presented in text and color graphics for each forecast site along the Red River of the North. The nearest forecast site to Homme Dam is Grafton.

When runoff is under way and river levels are approaching Flood Stage, the NWS issues a River Forecast that projects five days into the future. This is typically updated daily but may be updated more often. The five-day forecast is based on current river data and the 24-hour quantitative precipitation forecast (QPF). Forecasts can be accessed from the National Weather Service website or Water Management website.

6-02. Flood Condition Forecasts. There are no streamflow gaging stations located upstream of the dam, making it difficult to forecast flood conditions. Snow surveys of the Park River basin are taken annually. The snow-water content provides an indicator of the potential volume of spring runoff. Runoff from snowmelt generally begins in early April with inflows cresting several days later. Summer rainfall events are dealt with as they occur.

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

6-04. Long Range Forecasts. There are no long range forecasts available for Homme Reservoir or the Park River Basin.

6-05. Drought Forecast. There are no drought forecasts for the Park River other than the National Weather Service's *US Drought Monitor* and *US Seasonal Drought Outlook*. These can be obtained through the Water Management website.

VII – WATER CONTROL PLAN

7-01. General Objectives. Homme Dam and Reservoir is a dual purpose project, designed primarily for water supply and pollution abatement during low flow periods and secondarily for storage of spring runoff (i.e. flood control). The dam supplied drinking water to the city of Park River until 1 January 2006 when the city completed its connection to the Fordville Aquifer. The reservoir now provides a redundant source of water for the city. Low water discharge from the reservoir is still used to flush the sewage lagoons in Park River. The reservoir is also used as water supply for irrigation of the local golf course and the industrial washing of potatoes. There are very few lakes in the vicinity of Park River, therefore, Homme Reservoir is heavily used for recreation. Facilities for swimming, picnicking, camping, and boating are maintained by Walsh County.

7-02. Constraints.

a. Flood Control Storage. The most severe constraint concerning the regulation of Homme Dam is the limited flood control storage available in the reservoir. The latest elevation-storage table is shown in **Exhibit C**. From maximum drawdown (elevation 1064.0 feet) to the top of flood control/ conservation pool level (elevation 1079.8 feet), there are 2,180 acre-feet of available flood control storage. **Table 7-1** shows the pool characteristics for a given pool condition.

Table 7-1
Pool Conditions and Properties

Pool Condition	Pool Elevation (feet)	Storage Volume (acre-feet)	Surface Area (acres)
Dead Storage	1048.0	0	0
Maximum Drawdown	1064.0	670	86
Normal Drawdown	1074.0	1,825	141
Top of Flood Control/ Conservation Pool Level	1079.8	2,850	187
Top of Survey	1090.0	5,298	265

With the expansion of the spillway in 2003 from 150 feet to 218 feet, one would suspect that surcharge benefits were greatly reduced. A hydraulic analysis was performed to answer this question as part of the Design Memorandum and Environmental Assessment (**Chapter I, reference u**). Twenty-four historic floods, as well as the Probable Maximum Flood, were routed through the reservoir using Modified Puls. The results indicated there was a "negligible difference in outflow". When inflow is greater than outflow, the pool rises rapidly such that the head on the spillway equalizes outflow with inflow. Because the inflow and outflow equalize, the spillway expansion did not increase outflow. Therefore, the primary difference is the resulting pool elevation.

b. Low Flow Outlet. There are two inlets to the low flow culvert controlled by four sluice gates on the low flow inlet. The sluice gates operate in tandem in that one gate acts as an emergency closure. A water supply line was run through the low flow conduit in 1966 resulting in one of the sluice gates being grouted closed. Therefore, the low flow is constrained to one inlet. The low flow inlet is controlled by one 3.0 feet wide, 5.0 feet high sluice gate with an identical gate located upstream for emergency closure. The inlet area is significantly smaller than the pipe flow area. With the gate wide open, the inlet area is 15.0 square feet. The rectangular inlet culvert transitions to a circular pipe 5.0 feet in diameter, giving it a flow area of 19.6 square feet. The highest tailwater elevation recorded for a normal flood event was 1031.5 feet in 1979 (period of record 1949 -1994: gage was discontinued in 1994). The inlet and outlet inverts are elevation 1048.00 feet and 1038.0 feet respectively. Therefore, there is no tailwater influence to outflow. A check with a culvert program ensured that the pipe was under inlet control for all pool conditions. The orifice equation was used to compute outflow:

$$\mathbf{Q = CA(2gH)^{1/2}}$$

where, C = inlet coefficient
A = inlet area (sq ft)
H = head (ft)

Head was measured from the pool surface to the center of the inlet opening. As the gate is opened, inlet flow transitions from a "sharp edge" entry with contraction on three sides to a "short tube" entry when completely open. Based on *Orifices and Nominal Coefficients* presented in Vernard and Street's *Elementary Fluid Mechanics*, the inlet coefficient can vary from 0.61 for "sharp edge" entry to 0.80 for "short tube" entry. For most gate openings, the entrance is "sharp edge" on three sides. When the gate is fully open, the entrance is "short tube". Therefore, the inlet coefficient was allowed to vary linearly from 0.70 at a zero gate opening to 0.80 when fully open at 5.0 feet. **Table 7-2** shows the computed discharges for small gate openings at four lake levels. For small gate openings near conservation pool, a rule of thumb is to assume 8.0 cfs per one-inch of gate opening. For large gate openings, assume 100 cfs per foot.

Table 7-2
Low Flow Discharge Rating for Small Gate Openings (cfs)

Pool Elevation (feet)	**Gate Opening in Inches / Coefficient "C"**										
	1/2	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.72	0.72
1065.0	2.9	5.8	12	18	23	29	35	41	47	53	59
1070.0	3.3	6.6	13	20	27	33	40	46	53	60	67
1075.0	3.6	7.3	15	22	30	37	44	52	59	67	74
1080.0	**4.0**	**8.0**	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**73**	**81**

Table 7-3
Low Flow Discharge Rating for Large Gate Openings (cfs)

Pool Elevation (feet)	**Gate Opening in Feet / Coefficient "C"**								
	1.0	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**
	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80
1065.0	72	106	143	179	216	253	291	329	367
1070.0	80	122	163	206	249	292	336	380	425
1078.0	94	143	192	242	293	345	397	451	505
1079.0	96	145	195	246	298	351	404	459	514
1080.0	**97**	**147**	**198**	**250**	**303**	**357**	**411**	**467**	**523**
1081.0	99	150	202	254	308	363	418	475	532

c. Spillway Capacity. The spillway was designed to pass the Probable Maximum Flood with 3.0 feet of freeboard. The design crest elevation was 1080.0 feet; however, it was constructed to a lower elevation. A survey was performed in May 2005, and the results are presented in **Table 7-4**. The average spillway crest elevation is 1079.80 feet.

Table 7-4
Survey of the Spillway Crest (Datum 1000.00 ft)

Point	A-2	A-3	AF-1	A-4	A-5	A-6	A-7	AF-2	A-8	A-9
Elevation	79.87	79.85	79.75	79.77	79.75	79.77	79.80	79.78	79.87	79.87

The weir crest is ogee shaped (**Figure 2-3**) with a 1H:1V slope on the upstream face (**Figure 2-2**). The Design Memorandum for the *Dam Safety Assurance Program*, dated September 1996, developed a curve for head and crest discharge coefficient versus discharge over the spillway. The weir coefficient varied from 3.2 for 2,500 cfs to 3.9 for 53,000 cfs. Flood event discharges rarely exceed 5,500 cfs (**Plate 4-3**). Based on this discharge and the weir coefficient table, a weir coefficient of 3.3 was selected for the range of pool elevations shown in **Plate 7-1**. Discharge was computed by:

$$Q = CLH^{3/2}$$

where C = 3.3
L = 218 (feet)
H = head on the weir

Because there is no tailwater gage, **Plate 7-1** is to be used to determine discharge over the spillway.

7-03. Overall Plan for Water Control. Homme Reservoir is regulated between a minimum elevation of 1064.0 feet (maximum drawdown) and a maximum elevation of 1079.8 feet (spillway crest). The pool can be surcharged to elevation 1096.0 feet to pass flood flows.

a. Winter Drawdown. Normal drawdown to elevation 1077.0 feet is to begin on 1 November and is to be completed by 20 November. If there appears to be more than one inch of snow water over the basin above the dam, another three feet of drawdown will occur in March (to elevation 1074.0 feet). Should the annual winter snow survey show that there is a significant amount of snow water in the basin, Water Management may determine to further drawdown the Reservoir up to the maximum drawdown elevation of 1064.0 feet. Drawdown will be targeted to be complete by the end of March. Drawdown may be delayed due to weather conditions. See **Table 7-5** for suggested drawdown targets based on snow water (SWE).

Table 7-5
Suggested Drawdown Targets based on SWE

SWE (inches)	Suggested Drawdown Elevation (ft)	Flood Control Storage Available (acre-ft)
< 1.0	1077.0	535
> 1.0 but < 2.5	1074.0	1025
> 2.5	1064.0	2180

General guidance on March drawdown: Once maximum temperatures are forecasted to remain above 25 degrees Fahrenheit and minimum temperatures are forecasted to remain above zero degrees Fahrenheit a drawdown rate of 0.5/0.75 feet a day should be targeted. This rate should occur regardless of the target drawdown elevation. This will allow time to reach maximum drawdown in case of additional snowfall. Water Management may begin to release water regardless of temperature in mid-March in order to reach maximum drawdown by the end of March.

b. Spring Runoff. When spring runoff begins, the low flow gate is to be opened to pass inflow. The spring inflow hydrograph is typically very steep making it difficult if not impossible to keep up with the rising limb. Once flow is over the spillway, the low flow gate is to be closed. The gate is to remain closed until the pool falls back to the spillway crest, at which time Summer Regulation begins.

c. Summer/Fall Regulation. Summer regulation consists of maintaining the pool near the spillway crest within a tolerance of 1079.6 to 1080.2 feet. As long as inflows are below 180 cfs, the pool may be self regulated with the low flow gate closed.

7-04. Standing Instructions to Project Staff. Staff at the Baldhill Project Office are to input the daily Homme project data via remote terminal. All data are 0800-hour values. The data set includes pool elevation, reported precipitation and computed outflow. The pool elevation is obtained from the Water Management website for the Data Collection Platform (DCP). Outflow is computed from **Tables 7-2**, **7-3**, and **Plate 7-1**. Precipitation is occasionally entered and is obtained from the "gage reader/operator" located at the Water Works Department in Park River who reads a standard eight-inch precipitation gage at the department office. Once CWMS is fully implemented staff at the Baldhill Project Office will continue to enter precipitation but instead of entering the 0800-hour pool elevation and outflow the staff will record gate changes as they occur to the nearest 15 minutes. The Homme log sheet is contained within the Baldhill Dam Weekly Log Sheet. Water Management will contact the Baldhill Project Office with any gate changes. This is typically done by email but may involve the telephone. Gate changes are relayed by the Project Office to the gate operator.

The upstream (emergency) sluice gate is to be fully opened at all times except in case of failure of the inlet sluice gate. The inlet sluice gate is used to regulate the conduit outflow. The inlet gate is to regulate outflow for winter drawdown. During the summer months, the gate is used to maintain a conservation pool in that the gate may be opened when the pool exceeds 1080.2 feet. The gate is also used in preparation for spring runoff. The gate is to be opened in an effort to maintain the drawdown elevation at the start of spring runoff. Once spring runoff is well underway and the pool is in excess of 1080.2 feet, the low flow gate will be closed.

In the event of failure of the computer system, field staff will maintain contact with Water Management by telephone. If Water Management Section cannot be contacted at the District Office, one of the Water Management managers should be contacted at home, in order of preference as shown in the introduction to this manual.

7-05. Flood Control. The pool is to be drawn down to elevation 1077.0 feet every fall between 1 November and 20 November. Typically this drawdown will be performed before the pool freezes over. Water Management may decide further drawdown is needed based on snow conditions. Maximum drawdown is elevation 1064.0 feet. Any additional drawdown would start after the annual snow surveys and be targeted to be complete by the end of March. Drawdown may be delayed due to weather conditions. At the start of spring runoff, the low flow sluice gate is to be operated in an effort to maintain the drawn down pool elevation. The pool can be expected to rise rather quickly as the rising limb of the inflow hydrograph enters the reservoir. Once flow overtops the spillway, the low flow sluice gate is to be closed.

7-06. Recreation. Day-use recreation facilities are located at the dam site and are maintained by Walsh County. Fishing, swimming, sightseeing, picnicking, camping, and water skiing are among the recreational uses available at the project.

7-07. Water Quality. Homme Reservoir is a moderately eutrophic lake with water quality characteristics typical of other small impoundments located in primarily agricultural watersheds in northeastern North Dakota. Though eutrophic, Homme

Reservoir is not known to produce nuisance algae blooms and does not experience problems associated with low dissolved oxygen and fish mortality.

7-08. Fish and Wildlife. Maximum drawdown was established at elevation 1064.0 feet to ensure adequate water supply for fish habitat. As a further benefit to fish habitat, the drawdown elevation of 1074.0 feet is rarely exceeded. The South Branch of the Park River is an intermittent stream. The North Dakota Game and Fish Department concurs with this description. Therefore, outflows of zero cfs, while not preferred, are allowed.

7-09. Water Supply. The city of Park River changed its primary water supply from Homme Reservoir to the Fordville Aquifer on 1 January 2006. Since that change, Homme Reservoir acts as a redundant source. Water from the reservoir is used for irrigation of the local golf course and by industry for the washing of potatoes. Releases are also made for the periodic flushing of the sewage lagoons in Park River.

7-10. Hydroelectric Power. There is no hydroelectric power on the South Branch of the Park River.

7-11. Navigation. Navigation is not an authorized use of the Homme Reservoir project.

7-12. Drought Contingency Plans. Several droughts have occurred in the Park River basin before and after construction of Homme Reservoir. While not desirable, outflows may be reduced to zero to maintain water supply within the reservoir. Drought conditions may require periodic releases from the reservoir in order to augment low flows in the Park River for pollution abatement and industry use. The project-authorizing document made no provision for specific allocations of storage to local project sponsors *(i.e.* Park River and Grafton). There are no known contracts between the U.S. Government and any local project sponsor to receive and/or provide reservoir storage at Homme Dam. Homme Dam and

Reservoir is unique in that the Federal Government through the Secretary of the Army and the Corps of Engineers is authorized by Congress to regulate the project in accordance with project purposes without being permitted by the state of North Dakota to store water. At the same time all other uses of Homme Reservoir storage are required, under the State's appropriative water law, to be permitted. In this unusual situation, the Corps of Engineers controls the ultimate use of the storage. In past practice, close cooperation between the St. Paul District and the North Dakota State Water Commission has resulted in no major difficulties, and none are expected in future regulation of the project.

When outflows from the reservoir fall below 5 cfs, the Drought Phase for Homme Reservoir goes into a Drought Watch. Falling below 5 cfs is not uncommon. It is, however, an alert to check the National Weather Service's Drought Monitor and Seasonal Drought Outlook. When outflow goes to zero, Homme Reservoir goes into the Conservation Phase. If outflow is sustained at zero cfs, flow monitoring is intensified and an awareness program among users is initiated. The Drought Management Plan is described in detail in the *Drought Contingency Plan for Homme Reservoir*. It is a stand-alone document dated September 1992.

7-13. Flood Emergency Action Plans. There is an *Emergency Action Plan for Homme Dam and Reservoir on the Park River near Park River, North Dakota*, dated February 1999. It is a stand-alone document. It outlines procedures to be followed under various emergency conditions. The report includes the following: 1) emergency identification plan, 2) emergency operations and repair plan, 3) emergency notification list, and 4) inundation map. The spillway is designed to pass the Probable Maximum Flood.

7-14. Other. See rest of manual.

7-15. Deviation from Normal Regulation. Unusual circumstances that require deviations from the normal regulation must have the official concurrence of the

Division Office (MVD). St. Paul District's Water Management office will coordinate the deviation request with the ND Flood Control Project Section Supervisor, the District's Environmental Branch and local concerns (e.g. Walsh County, Park River, Grafton) before submitting the request to MVD. For deviations that become necessary with little advance notice, Water Management will obtain verbal approval from the District Engineer, or the designated representative, and the Division Commander, with supporting documentation provided as soon as possible after the fact. Water Management personnel may authorize necessary short term changes under extreme emergency conditions until approval from higher authority is obtained.

Every five years the low flow outlet system and the spillway stilling basin are inspected through the periodic inspection program (PI). The inspection requires both stilling basins to be pumped dry. Prior to the inspection, the pool is drawn down to provide the storage needed during the zero outflow period. The draw down of the pool prior to inspection will require a deviation to be coordinated through the MVD. Draw down elevation will depend upon inflow rate, time needed to perform the inspection, and the time to pump out the stilling basins. The low flow outlet basin is relatively small and there is no planning requirement to pump it out. However, the extremely large volume of the spillway stilling basin requires pumping to begin days in advance of the inspection. The time required for pumping depends on the available pumps and the volume of water. To aid in the computation, the stilling basin volume was computed based on it being completely full;

Spillway Slope Volume	[0.5 (1031.8 – 1022.6) 27.6] 218	27,677 ft^3
+ Stilling Basin Volume	+ [75 (1031.8 – 1022.6)] 218	+ 150,420 ft^3
+ Outlet Slope Volume	+ [0.5 (1031.8 – 1023.6) 205] 218	+ 183,229 ft^3
Total		361,326 ft^3

Neglecting baffle block volume and basin side slopes gives a volume of around 361,300 cubic feet or about 2,700,000 gallons.

Because drawdown impacts water levels at the beach area and boat launch Walsh County has asked for consideration on the timing of the inspection. Walsh County has requested that the inspections be performed before Memorial Day weekend or after Labor Day weekend to lesson impacts on swimming and boating activity during the summer. In consideration of Walsh County's request, an attempt will be made to schedule inspections after Labor Day weekend.

7-16. Rate of Release Change. The only control at Homme Reservoir is the low flow sluiceway. Outflow at normal pool swings from zero cfs when the gate is closed to 523 cfs when the gate is fully opened. While this swing in outflow is within the range of changes observed in normal conditions, a large increase in outflow could lower the pool at an undesirably fast rate. A standard rule of thumb is to not allow the pool to fall faster than 0.5 feet per day due to the potential for bank sloughing. One-half of a foot equates to approximately 50 cfs over a 24-hour period. Therefore, when drawing the pool down from conservation level, the daily outflow may not exceed 50 cfs above the computed inflow.

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VIII – EFFECT OF WATER CONTROL PLAN

8-01. General. The primary benefit from the project is derived from water supply to the city of Park River. Park River uses the reservoir as a redundant municipal water supply source. The reservoir provides the necessary flows for flushing the city's sewage lagoons and for the industrial washing of potatoes. In addition, water from the reservoir is used to irrigate the local golf course. Homme Reservoir is the only lake in the vicinity for many miles. Therefore, there are huge recreational benefits attributable to the reservoir.

8-02. Flood Control.

a. Spillway Design Flood. The spillway design flood for the new spillway was the Probable Maximum Flood (PMF). The PMF was developed in the following report: *Probable Maximum Flood and Standard Project Flood Discharges for the Park River, North Dakota*, 1981. An HEC-1 model was developed for the basin and calibrated to four historic events and the existing discharge-frequency curve. The all-season Probable Maximum Precipitation (PMP) was applied to the HEC-1 model with an initial loss rate of 1.0 inch and a uniform loss rate of 0.05 inches per hour. The resultant all-season PMF hydrograph had a peak reservoir inflow of 53,500 cfs. The PMF was routed through the reservoir with a starting pool elevation of 1080.0 feet. The maximum reservoir pool elevation reached 1096.0 feet with a maximum outflow of 53,400 cfs.

b. Standard Project Flood. The Standard Project Flood (SPF) inflow to Homme Dam was estimated to be 40 percent of the Probable Maximum Flood inflow. The peak SPF inflow based on this analysis was 21,300 cfs.

8-03. Recreation. The current water control plan for Homme Reservoir provides dependable and stable summer lake levels for recreational use. Fishing, swimming, boating, camping, and picnicking are some of the recreational opportunities at the project.

8-04. Water Quality. Because the water stored from spring runoff is generally of better quality than the runoff from the remainder of the year, the quality of the water supply has improved. However, algae growth produced from non-point nutrient runoff has caused taste and odor problems in the water supply.

8-05. Fish and Wildlife. Drawdown is limited to elevation 1064.0 feet to provide an adequate volume of water for fish habitat. Dissolved oxygen (DO) measurements were taken in the winter of 2004-05 with the lake at elevation 1064.0 feet. There was no noticeable depletion of oxygen due to drawdown. There are no reservoir releases required for fish and wildlife needs. DO measurements were again taken in 2010-2011 with no noticeable depletion of oxygen.

8-06. Water Supply. The South Fork of the Park River is classified as an intermittent stream by the North Dakota State Water Commission. This means that there are times when the flow in the river naturally goes to zero. There are no provisions for making releases from Homme Reservoir to maintain a live stream. Low flows in the basin occur during late summer and fall when evapotranspiration rates are high and during midwinter when the Park River is ice-covered.

An interim survey report on municipal water supply needs in 1973 identified the forecasted water consumption rates for the cities of Park River and Grafton (**Table 8-1**). Water supply releases from the reservoir for the city of Grafton were determined to be problematic due to in-stream transmission losses. In 1961, the U.S. Geological Survey conducted a study which demonstrated that of 210 acre-feet of water released from Homme Reservoir, only 62 acre-feet or 30 percent of the water reached Grafton. The tests indicated that losses resulting from infiltration to groundwater and evapotranspiration were estimated to be 80 acre-feet or 38 percent of the water released at the dam. The remainder of the loss, estimated to be 68 acre-feet or 32 percent of the reservoir release, was attributed to channel storage between the cities of Park River and Grafton. As a result of this study, the city of Grafton developed an alternate water supply route from the

Red River of the North in 1979. While the city of Park River had a reliable supply of water from the Homme Reservoir, the city chose to obtain its water from the Fordville Aquifer and use the reservoir as back up. The supply line to the aquifer was completed in January 2006. Water from the reservoir is still used for the industrial washing of potatoes and irrigating the local golf course. In addition, releases are periodically made for a few days for the purpose of dilution of effluent releases from the city of Park River's wastewater lagoons.

The loss of water between the city of Park River and Grafton was seen in October of 2012 when releases were made at Homme Reservoir for Grafton. In order to fill Grafton's pools on the river Water Management had to release a larger volume of water than what was needed to fill them.

Table 8-1
Municipal Water Supply Needs

Community	Year	Population	Per capita Water Use (gpcd)	Total Water Use		
				Mgd	cfs	ac-ft/day
Grafton	1970 2000 2030	5,950 7,900 10,900	115 125 150	0.7 1.0 1.6	1.1 1.5 2.5	2.1 3.0 5.0
Park River	1970 2000 2030	1,680 2,000 2,200	80 100 110	0.1 0.2 0.2	0.2 0.3 0.4	0.4 0.6 0.7

8-07. Hydroelectric Power. There is no hydroelectric power generation at the site.

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

8-09. Drought Contingency Plan. The *Drought Contingency Plan* is a stand–alone document dated September 1992. The plan provides a basic reference for water management decisions and responses to a water shortage in the Park River basin induced by climatological droughts. The plan includes a plan formulation process for the release of low flows and an interagency coordination matrix.

8-10. Flood Emergency Action Plans. The spillway was designed to pass the Probable Maximum Flood. Should an emergency condition arise, the *Emergency Action Plan for Homme Dam and Reservoir on the Park River near Park River, North Dakota*, February 1999, would be consulted for procedural requirements.

8-11. Frequencies.

a. Reservoir Inflow Duration. There are no stream gaging stations located upstream of the reservoir. Inflow to the reservoir is computed daily based on the 0800-hour calculated outflow and the 24-hour change in storage volume in the reservoir. Therefore, there are no known instantaneous peak inflow rates. The following inflow duration table (**Table 8-2**) was generated for these 24-hour values for the years 1949 through 2014.

Table 8-2
Inflow Duration (24-hour average)
Percent of Time at or Above Indicated Discharge

Discharge	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2500			0.1	0.9	0.1		0.1					
2000			0.1	1.3	0.3		0.2					
1500			0.3	2.2	0.5	0.1	0.2					
1000			1.3	5.2	1.0	0.2	0.3					
500			3.0	10.8	2.8	0.6	0.7	0.1				
400			3.6	13.2	3.4	0.9	0.8	0.3			0.1	
300			4.8	17.8	4.9	1.7	0.9	0.5	0.1		0.1	
200			6.2	24.4	7.3	3.0	1.2	0.8	0.4		0.1	
150	0.1	0.2	7.5	28.3	9.5	4.1	1.6	1.0	0.5	0.2	0.2	
100	0.2	0.4	10.1	35.5	13.9	7.9	2.7	1.2	0.6	0.5	0.8	
50	0.6	0.9	15.6	46.4	22.5	15.5	7.5	1.7	2.1	1.5	1.3	0.1
40	0.6	1.0	17.0	51.4	26.1	19.2	9.7	2.2	3.3	2.2	1.6	0.1
30	0.8	1.1	19.1	56.5	30.8	23.4	12.6	3.4	4.6	3.2	2.1	0.1
20	1.0	1.5	22.7	63.0	40.7	30.4	17.7	6.1	6.8	4.9	2.8	0.4
10	4.9	5.3	31.3	73.5	60.3	46.2	30.3	11.3	12.6	12.7	9.8	4.9
0	70.9	76.9	86.7	97.6	93.3	86.5	73.3	53.7	59.2	67.4	76.9	77.3

b. Pool Elevation Duration and Frequency. A duration analysis of daily pool elevation data from 1954 through 2013 shows the following statistics: elevation 1080.2 feet (top of flood control/conservation) is exceeded 10% of the time, elevation 1079.8 feet (spillway crest) is exceeded 30% of the time, and elevation 1064.0 feet (current maximum drawdown) is exceeded 99% of the time.

A duration analysis of the hourly pool elevation data from 2006 through 2013 (those years after the last major water management modification) shows the following statistics: elevation 1080.2 feet (top of flood control/conservation) is exceeded 7% of the time, elevation 1079.8 feet (spillway crest) is exceeded 40% of the time, and elevation 1064.0 feet (current maximum drawdown) is exceeded 99.5% of the time.

A peak elevation - percent chance exceedance curve was developed for the reservoir based on the 43-year period of record 1951-1952, 1954-1994. The year 1953 is not included because the pool was drawn down for the entire year. The data points presented in **Plate 8-1** are Median Plotting Positions.

c. Reservoir Outflow Probability. Before construction of the Homme Dam, a stream gage was located in the vicinity from 1940 to 1950. In 1950 it was relocated such that it became the tailwater gage for Homme Reservoir. The gage was discontinued in 1994 (**Section 5-01**). A peak discharge - percent chance exceedance curve was developed for the South Branch of the Park River below Homme Dam based on this 55-year period of record. Flows from discharge records for the period before completion of Homme Dam in October 1950 were routed by reservoir routing procedures to obtain modified discharges to reflect operation of Homme Dam as it existed prior to the new spillway. The data points presented in **Plate 8-2** are Weibull Plotting Positions.

d. Discharge-Frequency Downstream. A stream gage is located downstream of Homme Reservoir on the Park River at the city of Grafton. The period of record is from April 1931 to the present. A discharge - percent chance exceedance curve was developed based on the period of record from 1932 through 1999. The discharge-frequency curve presented in **Plate 8-3** is the flow frequency without expected probability. The confidence limits are 5 and 95 percent.

8-12. Other Studies. No additional studies.

IX – WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. International, Federal, and State agencies that have an interest in the regulation of Homme Reservoir are listed in **Table 9-1**.

Table 9-1
Organizations with an Interest in Homme Reservoir Water Management Activities

FEDERAL AGENCIES	U.S. Army Corps of Engineers U.S. Fish and Wildlife Service U.S. Environmental Protection Agency U.S. Geological Survey National Weather Service Federal Emergency Management Agency
STATE OF NORTH DAKOTA	State Water Commission Game and Fish Department State Conservationist Walsh County
INTERSTATE	Tri-State Waters Commission Red River Watershed Management Board
INTERNATIONAL	International Joint Commission

The following is a brief summary of each agency's responsibility.

a. Corps of Engineers. The U.S. Army Corps of Engineers (USACE) is the owner, operator, and regulator of Homme Dam and Reservoir. The USACE Water Management office has direct day to day responsibility for the regulation of flows from the dam. Operation and maintenance of the project is the responsibility of Operations Division, Recreation and Natural Resources (RNR) Branch and the North Dakota (ND) Flood Control Project Office.

b. Other Federal Agencies. The National Weather Service (NWS) provides the USACE with the radar-derived mean aerial 24-hour precipitation and the five-day

Quantitative Precipitation Forecast (QPF). In addition, the NWS has the responsibility for all hydrologic forecasts within the Park River basin. The U.S. Geological Survey (USGS) maintains the USACE equipment at the pool and Grafton gages. The USGS also collects data on the discharges at various stations within the Park River basin.

c. State and County Agencies. The North Dakota State Water Commission (NDSWC) has a distinct interest in the regulation of Homme Reservoir. Any change in the operating plan would have to be coordinated with the NDSWC. Other interested parties include North Dakota Game and Fish and Walsh County.

9-02. Interagency Coordination.

a. Local Press and Corps Bulletins. Information concerning the regulation of Homme Dam is provided by the St. Paul District's Public Affairs Office (PAO) to the local media in response to their requests. All "news releases" associated with regulation of the reservoir are reviewed by Water Management, RNR Branch Operation Project Manager and the ND Flood Control Project Section Supervisor. In fact, Water Management typically initiates the news releases. These releases may include forecasts at the project site (e.g. expected pool crest) but do not provide forecasts of downstream river stages.

b. National Weather Service. The St. Paul District provides regulation information regarding Homme Reservoir to the NWS through the internet, e-mail, and telephone. The NWS directly pulls in all DCP data and the USACE transits via local data manager (ldm) all project data to the NWS. Because of the small size of Homme Reservoir and the minor impact the reservoir has on peak outflow, little contact with the NWS is necessary regarding the regulation of the reservoir.

c. U.S. Geological Survey. Maintaining the vast network of stream gages needed for regulation of the USACE reservoirs located in the Red River of the North basin is a costly undertaking. Because the USGS has an existing stream gage infrastructure, the St. Paul District enters into a co-operative agreement with the USGS on an annual basis to maintain several gages throughout the Red River basin (**Table 5-1**). The USGS maintains the Homme Reservoir pool gage (there is no tailwater gage). The stream gage located at Grafton is not funded by the USACE, however, the equipment at the site is the Corps' property. The USGS maintains this equipment.

9-03. Interagency Agreements. There are none.

9-04. Commissions, River Authorities, Compacts, and Committees.

a. Tri-State Waters Commission. There is a compact among the states of Minnesota, South Dakota, and North Dakota regarding the management of the waters of the Red River of the North. This compact is spelled out in a Congressional Act dated 2 April 1938, which established the Tri-State Waters Commission. By this compact, each of the three states agrees to cooperate with the other two for the most advantageous utilization of the waters of the river for the control of floods and the prevention of pollution.

b. Red River Watershed Management Board. The Red River Watershed Management Board was created by legislative act in 1976. Its purpose is to institute, coordinate, and finance projects to alleviate flooding and to assure the beneficial uses of water in the Red River of the North and its tributaries. It consists of eight watershed districts in the Red River of the North basin.

9-05. Non-Federal Hydropower. There is no hydropower.

9-06. Reports. Table 9-2 presents a listing of reports compiled by Water Management regarding the regulation of Homme Reservoir.

Table 9-2 Reports		
Report Name	**Compiled**	**Form**
Compiled by Water Management Section		
Reservoir Bulletin	Daily	Web Site
DCP Pool Gage Records	Hourly	Computer Archived
Pool Elevation, Outflow, and Precipitation	Daily	Computer Archived
Compiled by Field Offices for Water Management Section		
Weekly Log Sheet	Weekly	CEMVP-416
Snow Survey	Last Week of February	CEMVP-430
Emergency Reports	Daily	Phone or Fax

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA

GENERAL INFORMATION

Location:	Red River of the North Basin South Branch of the Park River River Mile – 62.4 Walsh County, North Dakota
Type of Project:	Dam and Reservoir
Objectives of Regulation:	Water Supply Flood Control
Project Owner:	U.S. Army Corps of Engineers
Operating Agency:	U.S. Army Corps of Engineers St. Paul District - Operations Division
Regulating Agency:	U.S. Army Corps of Engineers St. Paul District - Water Management Section
Closure Date:	1 December 1950

RESERVOIR

Reservoir

Approx. Length:	1.0 mile
Average Width:	0.3 mile
Shoreline Length:	4.8 miles
Average Depth:	16.5 feet
Maximum Depth:	34.5 feet
Surface Area:	187 acres
Volume:	2,850 acre-feet

Real Estate

Purchased:	405 acres
(Elevation. 1090.0 ft)	
Easement:	8 acres

Zero-Damage Flow Rate

Park River:	750 cfs
Grafton:	1,500 cfs

	Elevation (feet)	Area (acres)	Storage (acre-feet)
Top of Dam	1099.0	327	7900
Top of Surcharge Pool	1096.0	307	7025
Project Pool	1079.8	187	2850
Normal Drawdown	1074.0	141	1825
Maximum Drawdown	1064.0	86	670
Dead Storage	1048.0	0	0

Available Flood Storage

Drawdown:	1074.0 feet	Volume Available:	1,025 acre-feet
Drawdown:	1064.0 feet	Volume Available:	2,180 acre-feet

HYDROLOGY

Drainage Area :	226 square miles
Probable Maximum Flood	
Max Water Surface Elevation:	1096.0 feet
Peak Inflow:	53,500 cfs
Peak Outflow:	53,400 cfs
Climate:	Temperate
Reservoir Runoff	
1-inch runoff equals:	12,053 acre-feet
1/6th inch runoff equals:	2,009 acre feet
1/12th inch runoff equals:	1,004 acre-feet
Maximum Pool Elevation:	1084.58 feet (20 Apr1979)
Minimum Pool Elevation:	1063.75 feet (24 Apr 2013)
Maximum Instantaneous Flow:	13,000 cfs (24 Apr 1950) Result of Dam Failure 5,380 cfs (20 Apr 1979)
Maximum Daily Flow	
Pre-Reservoir:	4,900 cfs (18 Apr 1948)
Post-Reservoir:	4,870 cfs (20 Apr 1979)
Minimum Daily Flow:	0 cfs on many occasions
Key Streamflow Stations:	Homme Pool Gage Grafton, North Dakota
Data Recorded at Baldhill:	Homme Pool (0800-hrs) Homme Precipitation (24-hr) Homme Discharge (0800-hrs)
Snow Survey Sites in Basin:	1/2 mile SE of Adams W of Park River airport
Sediment Ranges	
Survey Jan 1953:	7 Ranges
Survey Mar 1958:	6 Ranges (7th range eliminated)
Survey Feb1985:	11 Ranges (5 ranges added)
Survey Feb 1996:	11 Ranges

EMBANKMENT

Location:	2 miles west of the City of Park River Latitude 48° 24' 20" Longitude 97° 47' 10"
Purpose:	Impoundment for Water Supply
Type of Construction:	Roller Compacted Earth Fill
Crest Elevation:	1099.0 feet
Top Width:	20 feet
Length:	865 feet
Elevation of Toe:	1038.0 feet
Side Slopes	
Upstream:	1V:3H
Downstream:	1V:3H
Bench:	5-feet at Elevation 1077.0 feet
Slope Protection:	9-inch Bedding - 18 inch Riprap
Upstream:	Toe to Top of Bank
Downstream:	Toe to Elevation 1056.0 feet
Maximum Height:	67.0 feet
Fill Volume:	331,900 cubic yards

SPILLWAY, STILLING BASIN, AND OUTLET CHANNEL

Spilllway

Location:	Center of Embankment
Type:	Reinforced Concrete Uncontrolled Ogee Crest
Construction Date:	2000 - 2003
Design Crest Elevation:	1080.0 feet
Actual Crest Elevation:	1079.8 feet
Approach Channel Invert:	1072.8 feet
Width:	218.0 feet
Top of Retaining Wall:	1099.0 feet
Spillway Slope	
Upper Portion:	1V:10H
Lower Portion:	1V:3H

Stilling Basin

Energy Dissipator:	Gravity Type Stilling Basin
Length:	75.0 feet
Width:	218.0 feet
Floor Elevation:	1022.6 feet
Baffle Blocks	
Rows:	Two Staggered Rows
Height:	4.50 feet high
Width to Flow:	4.25 feet wide
Length with Flow:	5.50 feet long
Top of Baffle Blocks:	1026.85 feet
End Sill	
Slope:	1H:1V
Height:	2 feet
Top of End Sill:	1024.6 feet
Top of Training Walls:	1048.5 feet
Depth of Water in Stilling Basin:	9.2 feet
Pump Out Volume:	361,300 cubic feet 2,700,000 gallons

Outlet Channel

Channel Shape:	Trapezoidal
Invert Downstream of End Sill:	1023.6 feet (one-foot below end sill)
Outlet Channel:	From End Sill to 205.6 ft Downstream
Channel Slope:	4% incline
Start Invert Elevation:	1023.6 feet
End Invert Elevation:	1031.8 feet
Side Sloes:	1V:3H
Scour protection:	30-inch Riprap (45-inches thick)

LOW FLOW CONTROL

Location:	Left End of Embankment
Purpose:	Low Flow Augmentation
Circular Conduit	
Diameter:	5 feet
Length:	312 feet
Inlet Invert Elevation:	1048.0 feet
Outlet Invert Elevation:	1038.0 feet
Water Supply Line:	16-inch case iron pipe
Inlet Gates	
Number of Inlets:	2
Number of gates per Inlet:	2
Number of Operable Inlets:	1
Type of Gate:	hand operated sluice gates
Sluice Gate Size:	36-inch wide by 60-inch high
Outlet Gate	
Shape of Outlet:	circular pipe transitioning to a rectangular opening
Number of Gates:	1
Type of Gate:	hand operated sluice gate
Sluice Gate Size:	7 feet by 7 feet
Discharge Capacity at Project Pool:	525 cfs

Outlet Channel

	Channel Width (feet)	Channel Length (feet)	Start Invert (feet)	End Invert (feet)
Chute	7.0	29.0	1038.0	1038.0
Flare	7.0 to 13.0	20.0	1038.0	1027.0
Stilling Basin	13.0 to 24.0	31.0	1027.0	1027.0
End Sill	24.0	2.0	1027.0	1030.0
Channel	24.0	20.0	1030.0	1030.0
Channel	24.0 to 30.0	20.0	1030.0	1032.0

Depth of water in stilling Basin:	5.0 feet
Length of Outlet Channel:	800 feet
Excavated Side Slopes:	1V:1.5H
Scour Protection	
Location:	120 feet downstream of stilling basin
Bedding Material:	9-inches
Riprap:	18-inch

U.S. DEPARTMENT OF THE INTERIOR - U.S. GEOLOGICAL SURVEY - WATER RESOURCES

STATION:05090000 PARK RIVER AT GRAFTON, ND TYPE:STREAM AGENCY:USGS STATE:38 COUNTY:099
LATITUDE: 482529 LONGITUDE: 0972442 NAD27 DRAINAGE AREA:695 CONTRIBUTING DRAINAGE AREA: DATUM:811.11 NGVD29
Date Processed: 2015-01-09 08:55 By cdlaveau
Rating for Discharge Radar (ft3/s)
RATING ID: 15.0 TYPE: stage-discharge EXPANSION: logarithmic STATUS: approved
Created by smrobins on 12-06-2005 @ 09:12:19 CST, Updated by smrobins on 12-06-2005 @ 10:01:25 CST

RATING REMARKS: Same as 14.1 below 8.4 ft

OFFSET: 5.90 BREAK,OFFSET: (6.60,6.50)

EXPANDED RATING TABLE

Gage height, feet	Discharge (ft3/s) .00	.01	.02	.03	.04	(EXPANDED PRECISION) .05	.06	.07	.08	.09	DIFF IN Q PER .1 UNITS
5.90	0.000*	0.007	0.014	0.020	0.027	0.034	0.041	0.047	0.054	0.061	0.068
6.00	0.068	0.074	0.081	0.088	0.095	0.101	0.108	0.115	0.122	0.128	0.067
6.10	0.135	0.142	0.149	0.155	0.162	0.169	0.176	0.182	0.189	0.196	0.068
6.20	0.203	0.209	0.216	0.223	0.230	0.236	0.243	0.250	0.257	0.263	0.067
6.30	0.270*	0.278	0.286	0.294	0.302	0.310	0.318	0.326	0.334	0.342	0.080
6.40	0.350*	0.362	0.374	0.386	0.398	0.411	0.423	0.436	0.449	0.462	0.125
6.50	0.475*	0.493	0.511	0.530	0.549	0.568	0.588	0.608	0.628	0.649	0.195
6.60	0.670*	0.702	0.732	0.762	0.790	0.817	0.843	0.868	0.893	0.917	0.270
6.70	0.940*	0.976	1.01	1.05	1.08	1.11	1.15	1.18	1.21	1.25	0.340
6.80	1.28*	1.34	1.39	1.45	1.51	1.57	1.63	1.69	1.75	1.81	0.590
6.90	1.87*	1.96	2.05	2.14	2.23	2.32	2.42	2.52	2.62	2.72	0.950
7.00	2.82*	2.97	3.13	3.29	3.45	3.62	3.80	3.98	4.16	4.35	1.73
7.10	4.55*	4.90	5.26	5.65	6.05	6.48	6.94	7.41	7.92	8.45	4.45
7.20	9.00*	9.69	10.42	11.19	12.01	12.88	13.79	14.76	15.78	16.86	9.00
7.30	18.00*	19.28	20.63	22.06	23.57	25.16	26.84	28.61	30.47	32.44	16.50
7.40	34.50*	36.63	38.86	41.20	43.65	46.22	48.92	51.74	54.69	57.78	26.50
7.50	61.00*	63.53	66.14	68.82	71.59	74.44	77.38	80.40	83.51	86.71	29.00
7.60	90.00*	92.74	95.53	98.38	101.3	104.3	107.3	110.4	113.5	116.7	30.00
7.70	120.0*	123.1	126.2	129.3	132.6	135.8	139.2	142.5	146.0	149.5	33.00
7.80	153.0*	156.5	160.0	163.6	167.2	170.8	174.6	178.3	182.2	186.1	37.00
7.90	190.0*	194.0	198.0	202.0	206.1	210.3	214.5	218.8	223.2	227.6	42.00
8.00	232.0*	236.1	240.2	244.4	248.7	252.9	257.3	261.6	266.0	270.5	43.00
8.10	275.0*	279.2	283.5	287.8	292.1	296.5	300.9	305.4	309.9	314.4	44.00
8.20	319.0*	323.3	327.6	331.9	336.2	340.6	345.0	349.5	354.0	358.5	44.00
8.30	363.0*	367.3	371.6	375.9	380.3	384.7	389.1	393.5	398.0	402.5	44.00
8.40	407.0*	411.3	415.6	420.0	424.3	428.7	433.1	437.6	442.0	446.5	44.00
8.50	451.0*	455.7	460.4	465.1	469.9	474.7	479.5	484.3	489.2	494.1	48.00
8.60	499.0*	504.0	509.0	514.0	519.1	524.2	529.3	534.4	539.6	544.8	51.00
8.70	550.0*	555.1	560.2	565.4	570.5	575.7	580.9	586.2	591.4	596.7	52.00
8.80	602.0*	607.2	612.4	617.7	622.9	628.2	633.5	638.9	644.2	649.6	53.00
8.90	655.0*	660.4	665.8	671.3	676.7	682.2	687.7	693.3	698.8	704.4	55.00
9.00	710.0*	715.4	720.8	726.3	731.8	737.3	742.8	748.3	753.8	759.4	55.00
9.10	765.0*	770.4	775.9	781.3	786.8	792.3	797.8	803.3	808.9	814.4	55.00
9.20	820.0*	825.4	830.9	836.3	841.8	847.3	852.8	858.3	863.9	869.4	55.00
9.30	875.0*	880.4	885.9	891.4	896.8	902.3	907.8	913.4	918.9	924.4	55.00
9.40	930.0*	935.4	940.9	946.4	951.8	957.3	962.9	968.4	973.9	979.4	55.00
9.50	985.0*	990.5	995.9	1001	1007	1012	1018	1023	1029	1034	55.00
9.60	1040*	1046	1051	1057	1062	1068	1073	1079	1085	1090	56.00

Exhibit B

U.S. DEPARTMENT OF THE INTERIOR - U.S. GEOLOGICAL SURVEY - WATER RESOURCES

STATION:05090000 PARK RIVER AT GRAFTON, ND TYPE:STREAM AGENCY:USGS STATE:38 COUNTY:099
LATITUDE: 482529 LONGITUDE: 0972442 NAD27 DRAINAGE AREA:695 CONTRIBUTING DRAINAGE AREA: DATUM:811.11 NGVD29
Date Processed: 2015-01-09 08:55 By cdlaveau
Rating for Discharge Radar (ft3/s)
RATING ID: 15.0 TYPE: stage-discharge EXPANSION: logarithmic STATUS: approved
Created by smrobins on 12-06-2005 @ 09:12:19 CST, Updated by smrobins on 12-06-2005 @ 10:01:25 CST

RATING REMARKS: Same as 14.1 below 8.4 ft

OFFSET: 5.90 BREAK,OFFSET: (6.60,6.50)

EXPANDED RATING TABLE

Gage height, feet	Discharge (ft3/s) .00	.01	.02	.03	.04	(EXPANDED PRECISION) .05	.06	.07	.08	.09	DIFF IN Q PER .1 UNITS
9.70	1096*	1102	1107	1113	1119	1124	1130	1136	1142	1147	57.00
9.80	1153*	1159	1164	1170	1176	1181	1187	1193	1199	1204	57.00
9.90	1210*	1216	1221	1227	1233	1238	1244	1250	1256	1261	57.00
10.00	1267	1273	1279	1284	1290	1296	1302	1308	1313	1319	58.00
10.10	1325	1331	1337	1343	1349	1354	1360	1366	1372	1378	59.00
10.20	1384	1390	1396	1402	1408	1414	1420	1426	1432	1438	60.00
10.30	1444	1450	1456	1462	1468	1474	1480	1486	1493	1499	61.00
10.40	1505	1511	1517	1523	1529	1536	1542	1548	1554	1560	62.00
10.50	1567	1573	1579	1585	1592	1598	1604	1610	1617	1623	62.00
10.60	1629	1636	1642	1648	1655	1661	1667	1674	1680	1687	64.00
10.70	1693	1699	1706	1712	1719	1725	1732	1738	1745	1751	64.00
10.80	1757	1764	1771	1777	1784	1790	1797	1803	1810	1816	66.00
10.90	1823	1829	1836	1843	1849	1856	1863	1869	1876	1883	66.00
11.00	1889	1896	1903	1909	1916	1923	1929	1936	1943	1950	67.00
11.10	1956	1963	1970	1977	1983	1990	1997	2004	2011	2018	68.00
11.20	2024	2031	2038	2045	2052	2059	2066	2073	2079	2086	69.00
11.30	2093	2100	2107	2114	2121	2128	2135	2142	2149	2156	70.00
11.40	2163	2170	2177	2184	2191	2198	2205	2212	2219	2226	71.00
11.50	2234	2241	2248	2255	2262	2269	2276	2284	2291	2298	71.00
11.60	2305	2312	2319	2327	2334	2341	2348	2356	2363	2370	72.00
11.70	2377	2385	2392	2399	2406	2414	2421	2428	2436	2443	73.00
11.80	2450	2458	2465	2472	2480	2487	2495	2502	2509	2517	74.00
11.90	2524	2532	2539	2547	2554	2561	2569	2576	2584	2591	75.00
12.00	2599	2606	2614	2622	2629	2637	2644	2652	2659	2667	75.00
12.10	2674	2682	2690	2697	2705	2712	2720	2728	2735	2743	77.00
12.20	2751	2758	2766	2774	2781	2789	2797	2805	2812	2820	77.00
12.30	2828	2836	2843	2851	2859	2867	2874	2882	2890	2898	78.00
12.40	2906	2914	2921	2929	2937	2945	2953	2961	2969	2977	78.00
12.50	2984	2992	3000	3008	3016	3024	3032	3040	3048	3056	80.00
12.60	3064	3072	3080	3088	3096	3104	3112	3120	3128	3136	80.00
12.70	3144	3152	3160	3168	3176	3184	3193	3201	3209	3217	81.00
12.80	3225	3233	3241	3250	3258	3266	3274	3282	3290	3299	82.00
12.90	3307	3315	3323	3331	3340	3348	3356	3364	3373	3381	82.00
13.00	3389	3398	3406	3414	3423	3431	3439	3448	3456	3464	84.00
13.10	3473	3481	3489	3498	3506	3514	3523	3531	3540	3548	84.00
13.20	3557	3565	3573	3582	3590	3599	3607	3616	3624	3633	84.00
13.30	3641	3650	3658	3667	3675	3684	3692	3701	3710	3718	86.00
13.40	3727	3735	3744	3753	3761	3770	3778	3787	3796	3804	86.00

STATION:05090000 PARK RIVER AT GRAFTON, ND TYPE:STREAM AGENCY:USGS STATE:38 COUNTY:099
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OFFSET: 5.90 BREAK,OFFSET: (6.60,6.50)

EXPANDED RATING TABLE

Gage height, feet	Discharge (ft3/s) .00	.01	.02	.03	.04	(EXPANDED PRECISION) .05	.06	.07	.08	.09	DIFF IN Q PER .1 UNITS
13.50	3813	3822	3830	3839	3848	3856	3865	3874	3882	3891	87.00
13.60	3900	3909	3917	3926	3935	3944	3952	3961	3970	3979	88.00
13.70	3988	3996	4005	4014	4023	4032	4041	4049	4058	4067	88.00
13.80	4076	4085	4094	4103	4112	4120	4129	4138	4147	4156	89.00
13.90	4165	4174	4183	4192	4201	4210	4219	4228	4237	4246	90.00
14.00	4255	4264	4273	4282	4291	4300	4309	4318	4327	4336	90.00
14.10	4345	4355	4364	4373	4382	4391	4400	4409	4418	4428	92.00
14.20	4437	4446	4455	4464	4473	4483	4492	4501	4510	4519	92.00
14.30	4529	4538	4547	4556	4566	4575	4584	4593	4603	4612	92.00
14.40	4621	4631	4640	4649	4658	4668	4677	4686	4696	4705	94.00
14.50	4715	4724	4733	4743	4752	4761	4771	4780	4790	4799	94.00
14.60	4809	4818	4827	4837	4846	4856	4865	4875	4884	4894	94.00
14.70	4903	4913	4922	4932	4941	4951	4960	4970	4980	4989	96.00
14.80	4999	5008	5018	5027	5037	5047	5056	5066	5075	5085	96.00
14.90	5095	5104	5114	5124	5133	5143	5153	5162	5172	5182	96.00
15.00	5191	5201	5211	5221	5230	5240	5250	5260	5269	5279	98.00
15.10	5289	5299	5308	5318	5328	5338	5348	5357	5367	5377	98.00
15.20	5387	5397	5407	5417	5426	5436	5446	5456	5466	5476	99.00
15.30	5486	5496	5506	5515	5525	5535	5545	5555	5565	5575	99.00
15.40	5585	5595	5605	5615	5625	5635	5645	5655	5665	5675	100.0
15.50	5685	5695	5705	5715	5725	5735	5746	5756	5766	5776	101.0
15.60	5786	5796	5806	5816	5826	5837	5847	5857	5867	5877	101.0
15.70	5887	5897	5908	5918	5928	5938	5948	5959	5969	5979	102.0
15.80	5989	6000	6010	6020	6030	6041	6051	6061	6071	6082	103.0
15.90	6092	6102	6113	6123	6133	6144	6154	6164	6175	6185	103.0
16.00	6195	6206	6216	6226	6237	6247	6258	6268	6278	6289	104.0
16.10	6299	6310	6320	6331	6341	6352	6362	6372	6383	6393	105.0
16.20	6404	6414	6425	6435	6446	6456	6467	6478	6488	6499	105.0
16.30	6509	6520	6530	6541	6551	6562	6573	6583	6594	6604	106.0
16.40	6615	6626	6636	6647	6658	6668	6679	6690	6700	6711	107.0
16.50	6722	6732	6743	6754	6764	6775	6786	6797	6807	6818	107.0
16.60	6829	6840	6850	6861	6872	6883	6893	6904	6915	6926	108.0
16.70	6937	6947	6958	6969	6980	6991	7002	7012	7023	7034	108.0
16.80	7045	7056	7067	7078	7088	7099	7110	7121	7132	7143	109.0
16.90	7154	7165	7176	7187	7198	7209	7220	7231	7242	7253	110.0
17.00	7264	7275	7286	7297	7308	7319	7330	7341	7352	7363	110.0
17.10	7374	7385	7396	7407	7418	7429	7440	7451	7463	7474	111.0
17.20	7485	7496	7507	7518	7529	7540	7552	7563	7574	7585	111.0
17.30	7596	7607	7619	7630	7641	7652	7663	7675	7686	7697	112.0

U.S. DEPARTMENT OF THE INTERIOR - U.S. GEOLOGICAL SURVEY - WATER RESOURCES

STATION:05090000 PARK RIVER AT GRAFTON, ND TYPE:STREAM AGENCY:USGS STATE:38 COUNTY:099
LATITUDE: 482529 LONGITUDE: 0972442 NAD27 DRAINAGE AREA:695 CONTRIBUTING DRAINAGE AREA: DATUM:811.11 NGVD29
Date Processed: 2015-01-09 08:55 By cdlaveau
Rating for Discharge Radar (ft3/s)
RATING ID: 15.0 TYPE: stage-discharge EXPANSION: logarithmic STATUS: approved
Created by smrobins on 12-06-2005 @ 09:12:19 CST, Updated by smrobins on 12-06-2005 @ 10:01:25 CST

RATING REMARKS: Same as 14.1 below 8.4 ft

OFFSET: 5.90 BREAK,OFFSET: (6.60,6.50)

EXPANDED RATING TABLE

Gage height, feet	Discharge (ft3/s) .00	.01	.02	.03	.04	(EXPANDED PRECISION) .05	.06	.07	.08	.09	DIFF IN Q PER .1 UNITS
17.40	7708	7720	7731	7742	7753	7765	7776	7787	7798	7810	113.0
17.50	7821	7832	7844	7855	7866	7878	7889	7900	7912	7923	113.0
17.60	7934	7946	7957	7968	7980	7991	8003	8014	8025	8037	114.0
17.70	8048	8060	8071	8083	8094	8105	8117	8128	8140	8151	115.0
17.80	8163	8174	8186	8197	8209	8220	8232	8243	8255	8266	115.0
17.90	8278	8289	8301	8313	8324	8336	8347	8359	8370	8382	116.0
18.00	8394	8405	8417	8428	8440	8452	8463	8475	8487	8498	116.0
18.10	8510	8522	8533	8545	8557	8568	8580	8592	8603	8615	117.0
18.20	8627	8639	8650	8662	8674	8685	8697	8709	8721	8733	117.0
18.30	8744	8756	8768	8780	8791	8803	8815	8827	8839	8851	118.0
18.40	8862	8874	8886	8898	8910	8922	8934	8945	8957	8969	119.0
18.50	8981	8993	9005	9017	9029	9041	9053	9064	9076	9088	119.0
18.60	9100	9112	9124	9136	9148	9160	9172	9184	9196	9208	120.0
18.70	9220	9232	9244	9256	9268	9280	9292	9304	9316	9328	121.0
18.80	9341	9353	9365	9377	9389	9401	9413	9425	9437	9449	121.0
18.90	9462	9474	9486	9498	9510	9522	9534	9547	9559	9571	121.0
19.00	9583	9595	9607	9620	9632	9644	9656	9669	9681	9693	122.0
19.10	9705	9717	9730	9742	9754	9767	9779	9791	9803	9816	123.0
19.20	9828	9840	9853	9865	9877	9890	9902	9914	9927	9939	123.0
19.30	9951	9964	9976	9988	10000	10010	10030	10040	10050	10060	129.0
19.40	10080	10090	10100	10110	10120	10140	10150	10160	10170	10190	120.0
19.50	10200	10210	10220	10240	10250	10260	10270	10290	10300	10310	120.0
19.60	10320	10340	10350	10360	10370	10390	10400	10410	10420	10440	130.0
19.70	10450	10460	10480	10490	10500	10510	10530	10540	10550	10560	130.0
19.80	10580	10590	10600	10610	10630	10640	10650	10660	10680	10690	120.0
19.90	10700	10720	10730	10740	10750	10770	10780	10790	10800	10820	130.0
20.00	10830	10840	10860	10870	10880	10890	10910	10920	10930	10950	130.0
20.10	10960	10970	10980	11000	11010	11020	11030	11050	11060	11070	130.0
20.20	11090	11100	11110	11120	11140	11150	11160	11180	11190	11200	130.0
20.30	11220	11230	11240	11250	11270	11280	11290	11310	11320	11330	120.0
20.40	11340	11360	11370	11380	11400	11410	11420	11440	11450	11460	130.0
20.50	11470	11490	11500	11510	11530	11540	11550	11570	11580	11590	140.0
20.60	11610	11620	11630	11640	11660	11670	11680	11700	11710	11720	130.0
20.70	11740	11750	11760	11780	11790	11800	11820	11830	11840	11850	130.0
20.80	11870	11880	11890	11910	11920	11930	11950	11960	11970	11990	130.0
20.90	12000*										

"*" indicates a rating descriptor point

Rating Type: Rating Type: stage-discharge
ID Starting Date Ending Date A Comments

Exhibit C
Homme Reservoir
Elevation (1929 NGVD) - Storage (acre-feet)
1996 Survey - Ten Cross Sections

Elev.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1049	0	0	1	1	2	2	2	3	3	4
1050	4	5	6	8	9	10	11	12	14	15
1051	16	18	19	21	22	24	26	27	29	30
1052	32	34	36	37	39	41	43	45	46	48
1053	50	52	54	57	59	61	63	65	68	70
1054	72	74	77	79	82	84	86	89	91	94
1055	96	99	102	105	108	111	113	116	119	122
1056	125	130	134	138	143	148	153	157	162	166
1057	171	177	183	189	195	201	206	212	218	224
1058	230	237	243	250	257	264	270	277	284	290
1059	297	304	312	319	326	334	341	348	355	363
1060	370	377	385	392	400	407	414	422	429	437
1061	444	451	459	466	473	481	488	495	502	510
1062	517	524	532	539	547	554	561	569	576	584
1063	591	599	607	615	623	632	640	648	656	664
1064	672	681	690	699	708	717	725	734	743	752
1065	761	770	780	789	798	808	817	826	935	845
1066	854	863	873	882	891	901	910	919	928	938
1067	947	957	967	977	987	997	1,007	1,017	1,027	1,037
1068	1,047	1,058	1,069	1,080	1,091	1,102	1,112	1,123	1,134	1,145
1069	1,156	1,168	1,180	1,192	1,204	1,216	1,228	1,240	1,252	1,264
1070	1,276	1,289	1,303	1,316	1,329	1,343	1,356	1,369	1,382	1,396
1071	1,409	1,423	1,437	1,450	1,464	1,478	1,492	1,506	1,519	1,533
1072	1,547	1,561	1,575	1,589	1,603	1,617	1,630	1,644	1,658	1,372
1073	1,686	1,700	1,714	1,728	1,742	1,756	1,770	1,784	1,798	1,812
1074	1,826	1,841	1,856	1,871	1,886	1,901	1,916	1,931	1,946	1,961
1075	1,976	1,992	2,008	2,024	2,040	2,056	2,072	2,088	2,104	2,120
1076	2,136	2,154	2,171	2,189	2,206	2,224	2,242	2,259	2,277	2,294
1077	2,312	2,331	2,349	2,368	2,386	2,405	2,424	2,442	2,461	2,479
1078	2,498	2,517	2,536	2,555	2,574	2,594	2,613	2,632	2,651	2,670
1079	2,689	2,709	2,729	2,748	2,768	2,788	2,808	2,828	2,847	2,867
1080	2,887	2,908	2,928	2,949	2,969	2,990	3,011	3,031	3,052	3,072
1081	3,093	3,115	3,136	3,158	3,179	3,201	3,222	3,244	3,265	3,287

Homme Reservoir

Elevation (1929 NGVD) - Storage (acre-feet)
1996 Survey - Ten Cross Sections

Elev.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1082	3,308	3,330	3,352	3,375	3,397	3,419	3,441	3,463	3,486	3,508
1083	3,530	3,553	3,576	3,599	3,622	3,646	3,669	3,692	3,715	3,738
1084	3,761	3,785	3,809	3,833	3,857	3,881	3,905	3,929	3,953	3,977
1085	4,001	4,026	4,051	4,076	4,101	4,126	4,151	4,176	4,201	4,226
1086	4,251	4,277	4,303	4,328	4,354	4,380	4,406	4,432	4,457	4,483
1087	4,509	4,535	4,561	4,587	4,613	4,639	4,665	4,691	4,717	4,743
1088	4,769	4,795	4,822	4,848	4,874	4,901	4,927	4,953	4,979	5,006
1089	5,032	5,059	5,085	5,112	5,138	5,165	5,192	5,218	5,245	5,271

STANDING INSTRUCTIONS TO THE PROJECT MANAGER FOR WATER CONTROL
Exhibit D

HOMME RESERVOIR
SOUTH BRANCH of the PARK RIVER
PARK RIVER, NORTH DAKOTA
RED RIVER OF THE NORTH DRAINAGE BASIN

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

SEPTEMBER 2015

Homme Reservoir
U.S. Army Corps of Engineers
St. Paul District

Table of Contents

PERTINENT DATA

Location: Homme Dam is located in Walsh County, North Dakota on the South Branch of the Park River about 4 river miles upstream of the city of Park River. The dam is located in Section 19, Township 157N, Range 55W, Latitude 48°24'20"N, Longitude 97°47'10"W.

Total Drainage Area: 226.0 square miles **Datum:** 1929 NGVD

To convert to NAVD88 add 1.15 feet to NGVD29 elevations.

Real Estate Guide Taking Line for Title in Fee or Easement: Contour elevation 1090.0 ft

Embankment

Type:	Compacted earth-fill	Freeboard @ max design:	3.0 feet
Total Length:	865.0 feet	Freeboard at project pool:	19.0 feet
Crest Elevation:	1099.0 feet		
Top Width:	20.0 feet		
Maximum Height:	67.0 feet		

Spillway

Type:	Ogee-Crest	Stilling Basin	
Crest Elevation:	1079.80 feet	Length:	75 feet
Crest Length:	218.0 feet	Width:	218 feet
Design Event:	PMF	End Sill:	Elevation 1024.60 feet
Design Discharge:	53,400 cfs	Baffle Block:	Elevation 1026.85 feet
Max Design Pool:	1096.0 feet	Floor:	Elevation 1022.60 feet

Low Flow Outlet Control

Culvert		Inlet Sluice Gates	
Diameter:	5.0 feet	Sluice Gate Type:	Chapman
Inlet Invert Elev.	1048.0 feet	Gate Size:	36 in by 60 in
Outlet Invert Elev.	1038.0 feet	Number of Inlets:	2
Discharge Capacity:	525 cfs	Inlet Gates:	2 per inlet
(pool elev 1080.0)		Operable Inlets:	1
Outlet		Outlet Sluice Gates	
Width at Outlet	7.0 feet	Number of Outlets:	1
Width Stilling Basin:	13.0 ft – 24.0 ft	Gate Size:	7 ft by 7ft
Stilling Basin Invert:	1027.0 feet		
Top of End Sill:	1030.0 feet		
Outlet Channel:	1032.0 feet		

Area-Capacity Data

	Elevation (feet)	Area (acres)	Storage (acre-feet)
Design Flood (PMF)	1096.0	307	7,025
Flood Control Pool	1079.8	187	2,850
Normal Drawdown	1074.0	141	1,825
Maximum Drawdown	1064.0	86	670
Dead Storage	1048.0	0	0

1) Background and Responsibilities

a. General Information

i. **Project Compliance:** These Standing Instructions to the Project Manager for Water Management for Homme Lake were prepared in compliance with DIVR 110-2-240, paragraph 5 and page A-9-12. A copy of the Homme Water Control Manual must be kept on hand at the Baldhill Dam Project Office at all times, and any deviation from the Instructions will require approval of the District Commander.

ii. **Project Purposes:** Homme Dam and Reservoir is a dual-purpose project, designed primarily for water supply and pollution abatement during low flow periods and secondarily for flood control. The reservoir provides water for the following uses; 1) municipal use in the city of Park River, 2) periodic flushing of the sewage lagoons at Park River, 3) industrial washing of potatoes, and 4) irrigation of a local golf course. The reservoir is drawn down prior to spring runoff for the purpose of flood control. While flood control benefits are limited, the summer conservation pool provides recreational benefits. Recreation facilities for picnicking and boating are maintained at the site by Walsh County. The authorized purposes assigned by Congress are water control, water conservation, flood control, water supply, fish and wildlife, recreation, and water quality.

iii. **Project Location:** Homme Dam is located in the northeast corner of North Dakota. It is centrally located in Walsh County on the South Branch of the Park River at river mile 62.1. The site is about 50 miles northwest of Grand Forks and about 2 miles west of the city of Park River. The dam is located at latitude 48° 24' 20" and longitude 97° 47' 10". Park River is a tributary to the Red River of the North. A basin map of the Park River is shown on **Plate 2-1**.

iv. **Project Description:** The project spillway is centrally located within the embankment that forms the reservoir. A sluice gate-controlled low flow conduit is located at the left (northeast) end of the embankment. The spillway was relocated in 2003 (to the proposed location on **Plate 2-2**) and the outlet channel of the low flow was adjusted to tie into the new spillway outlet. The relocation of the spillway allowed for the construction of a beach at the right end of the embankment. An aerial photo of the project is presented in the **Introduction**.

v. **Project Constraints:** The most severe constraint concerning the regulation of Homme Dam is the limited flood control storage available in the reservoir. In addition, the spillway crest was designed to be elevation 1080.0[1] feet, however, it was constructed to elevation 1079.8 feet.

vi. **Project Owner and Operating Agency:** Homme Reservoir is owned and operated by the U.S. Army Corps of Engineers (USACE). The gages are maintained by the U.S. Geological Survey (USGS).

b. Role of Project Manager

i. **Normal Hydrometeorological Conditions (including floods and droughts):** The Project Manager will be instructed by Water Management in the St. Paul District

[1] All elevations cited within these Standing Instructions are in terms of NGVD29.

office on a day-to-day basis for water control actions under normal hydrometeorological conditions. The Project Manager will then relay the instructions to the gate operator.

ii. **Emergency Conditions:** The Project Manager will issue adequate warning or otherwise alert all affected interests to possible hazards caused by project regulation.

2) Hydrometeorological Data Collection and Reporting

a. **Normal Hydrometeorological Conditions (including floods and droughts):** Staff at the Baldhill Project Office are to input the daily Homme project data via remote terminal. All data are 0800-hour values. The data set includes pool elevation, reported precipitation and computed outflow. The pool elevation is obtained from the Water Management website for the Data Collection Platform (DCP). Outflow is computed from **Tables 7-2**, **7-3**, and **Plate 7-1**. Precipitation is occasionally entered and is obtained from the "gage reader/operator" located at the Water Works Department in Park River who reads a standard eight-inch precipitation gage at the department office. Once CWMS is fully implemented staff at the Baldhill Project Office will continue to enter precipitation but instead of entering the 0800-hour pool elevation and outflow the staff will record gate changes as they occur to the nearest 15 minutes. The Homme log sheet is contained within the Baldhill Dam Weekly Log Sheet. Water Management will contact the Baldhill Project Office with any gate changes. This is typically done by email but may involve the telephone. Gate changes are relayed by the Project Office to the gate operator.

b. **Emergency Conditions:** The Project Manager will be informed by the District Office of regional hydrometeorological conditions that (may/will) impact the structure.

3) Water Control Action and Reporting

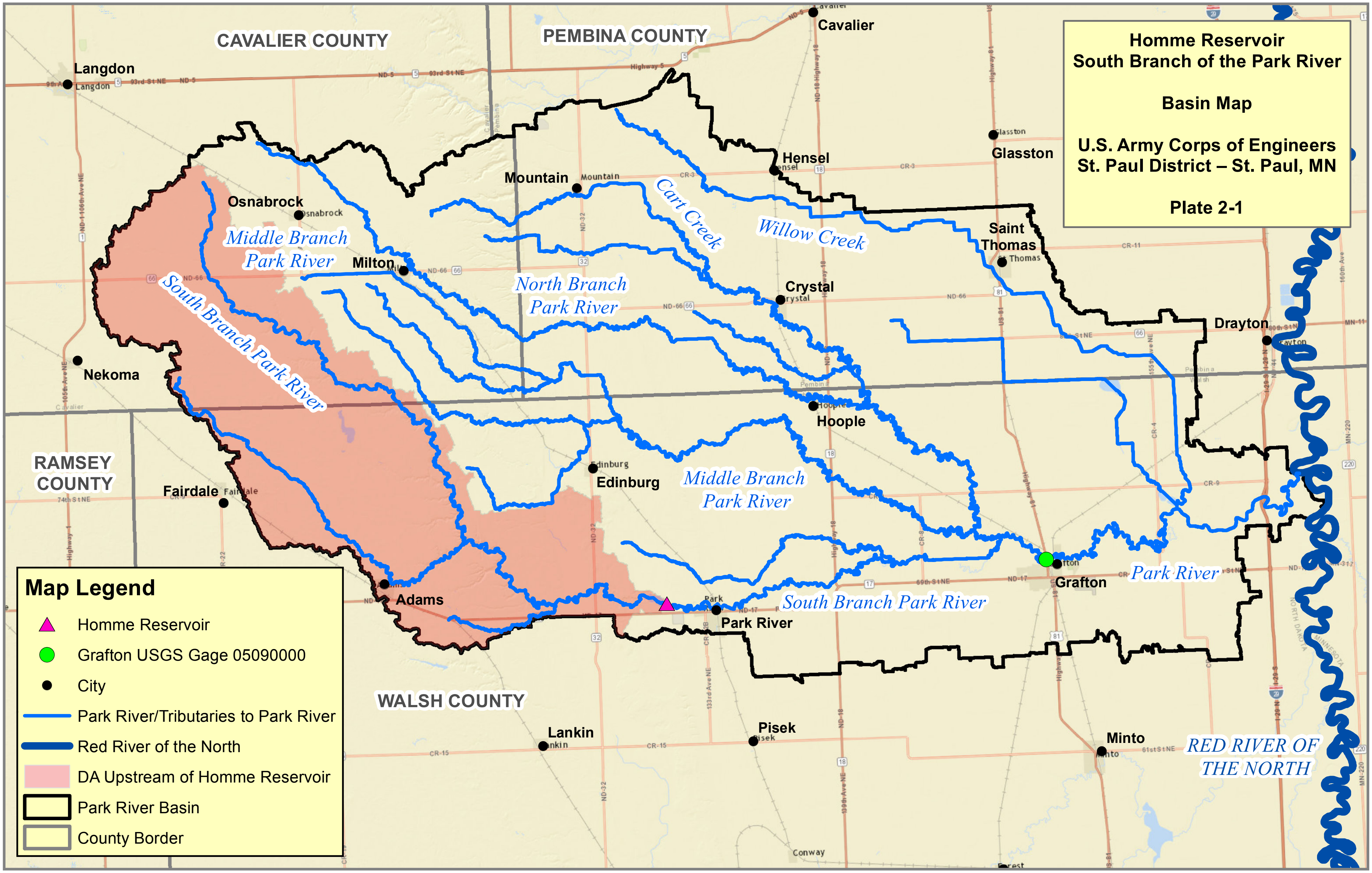
a. **Normal Hydrometeorological Conditions (including floods and droughts):** The upstream (emergency) sluice gate is to be fully opened at all times except in case of failure of the inlet sluice gate. The inlet sluice gate is used to regulate the conduit outflow. The inlet gate is to regulate outflow for winter drawdown. During the summer months, the gate is used to maintain a conservation pool in that the gate may be opened when the pool exceeds 1080.2 feet. The gate is also used in preparation for spring runoff. The gate is to be opened in an effort to maintain the drawdown elevation at the start of spring runoff. Once spring runoff is well underway and the pool is in excess of 1080.2 feet, the low flow gate will be closed.

b. **Emergency Conditions:** The Project Manager may temporarily deviate from these Standing Instructions in the event it is necessary for emergency reasons to protect the safety of the structure, to avoid health hazards, or to avoid any other critical situation that may arise. Such action will be reported immediately to Water Management.

c. **Inquiries:** All significant inquires received by the Project Manager from citizens, constituents or interest groups regarding water control procedures or actions must be referred to Water Management.

d. **Water Control Problems:** Water Management must be contacted immediately by the most rapid means available in the event an operational malfunction, erosion, or other incident occurs that could impact project integrity in general or water control capability in particular.

e. **Communication Outage:** In the event of failure of the computer system, field staff will maintain contact with Water Management by telephone and will continue to follow the water control actions within the Standing Instructions along with Chapter 7 of the Water Control Manual.

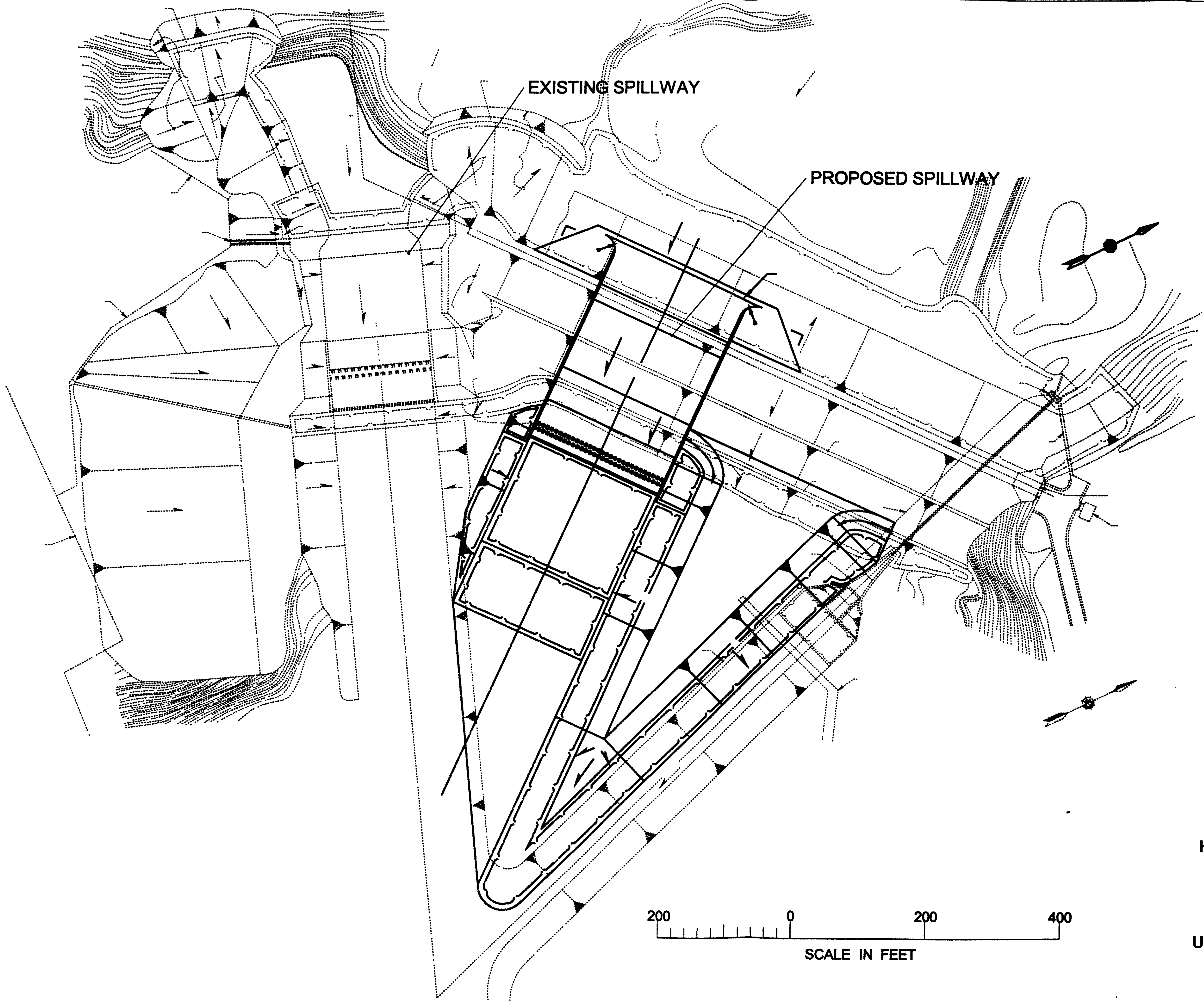


St. Paul District
US Army Corps of Engineers®

Park River Basin - Homme Reservoir

0 3 6 12 18 Miles
1 in = 6 miles

N



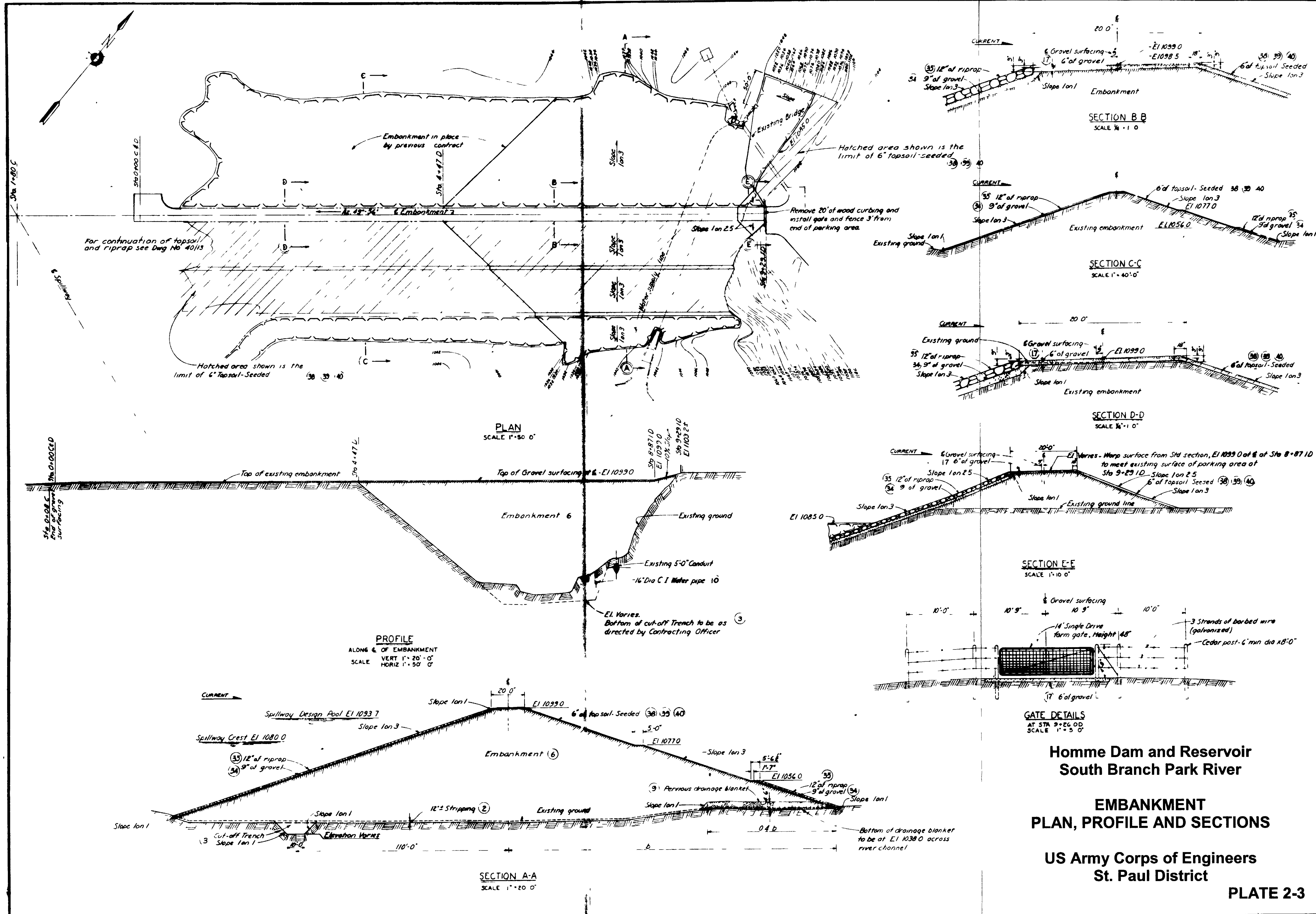
Homme Dam and Reservoir
South Branch Park River

GENERAL PLAN

US Army Corps of Engineers
St. Paul District

PLATE 2-2

CORPS OF ENGINEERS US ARMY

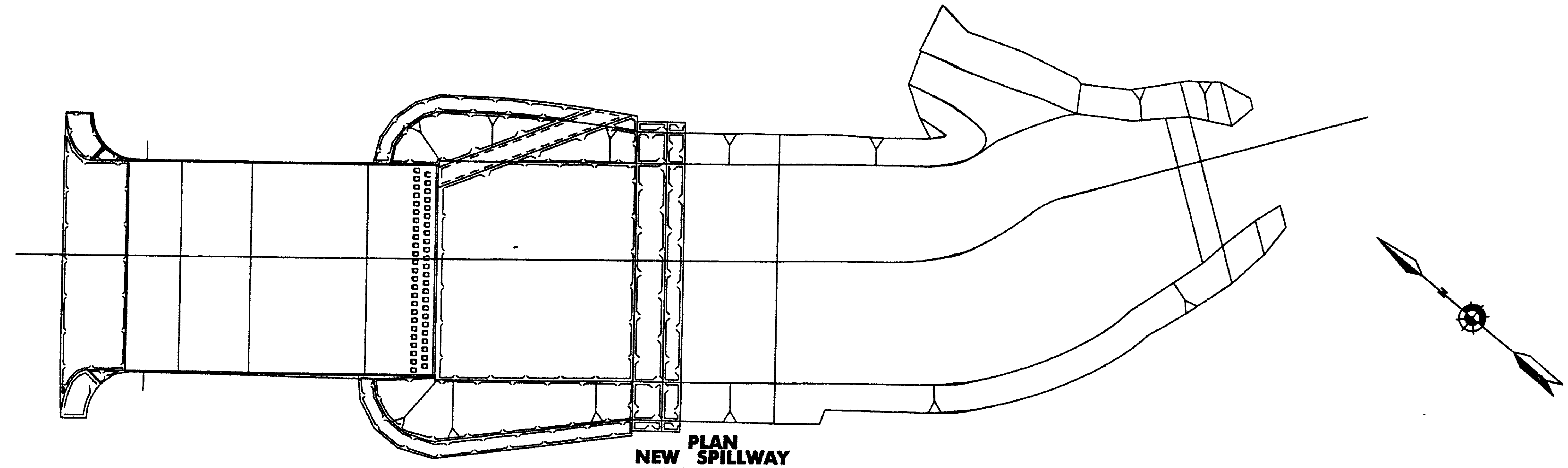


Homme Dam and Reservoir
South Branch Park River

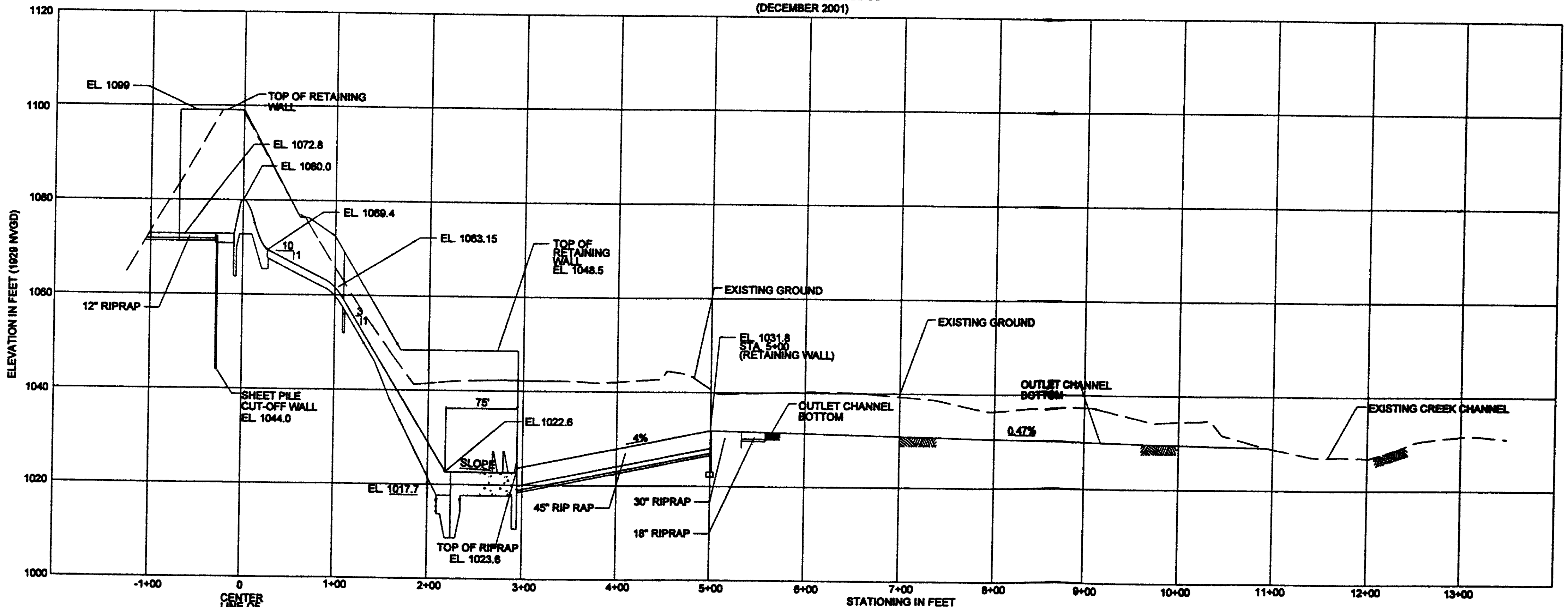
EMBANKMENT
PLAN, PROFILE AND SECTIONS

US Army Corps of Engineers
St. Paul District

PLATE 2-3



PLAN
NEW SPILLWAY
(DECEMBER 2001)



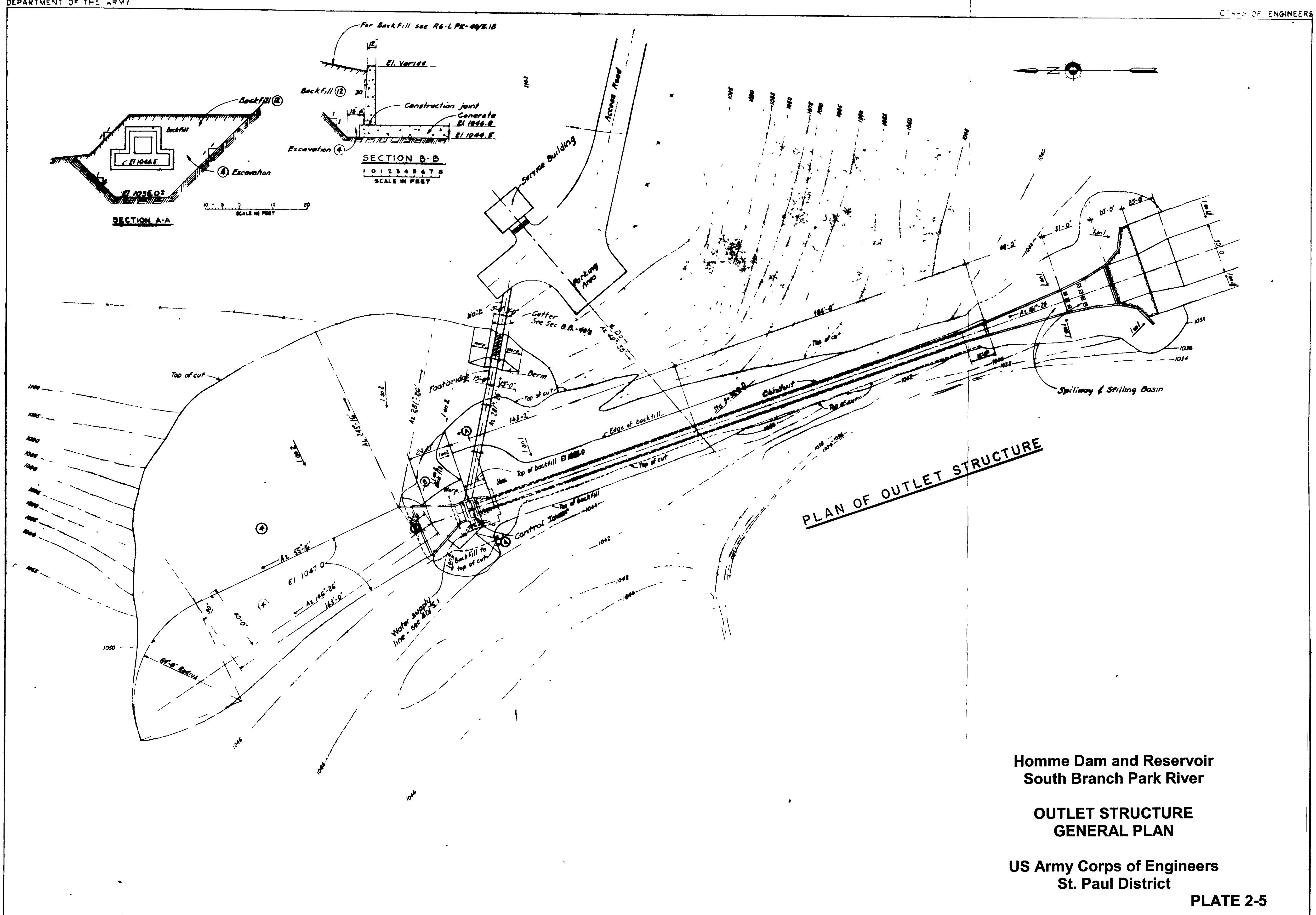
PROFILE
NEW SPILLWAY
(DECEMBER 2001)

Homme Dam and Reservoir
South Branch Park River

SPLILLWAY & STILLING BASIN
PLAN & PROFILE

US Army Corps of Engineers
St. Paul District

PLATE 2-4

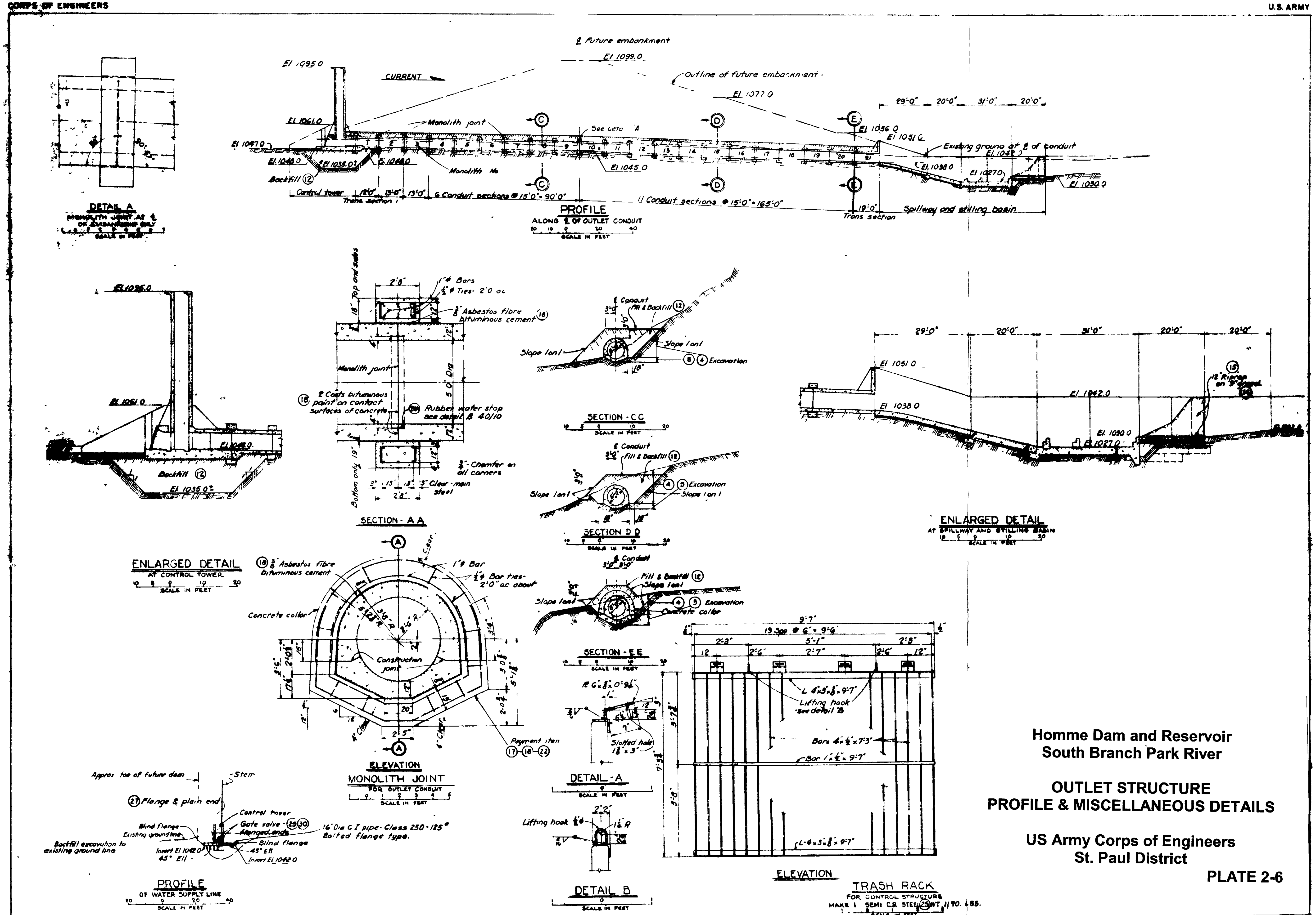


Homme Dam and Reservoir
South Branch Park River

OUTLET STRUCTURE
GENERAL PLAN

US Army Corps of Engineers
St. Paul District

PLATE 2-5

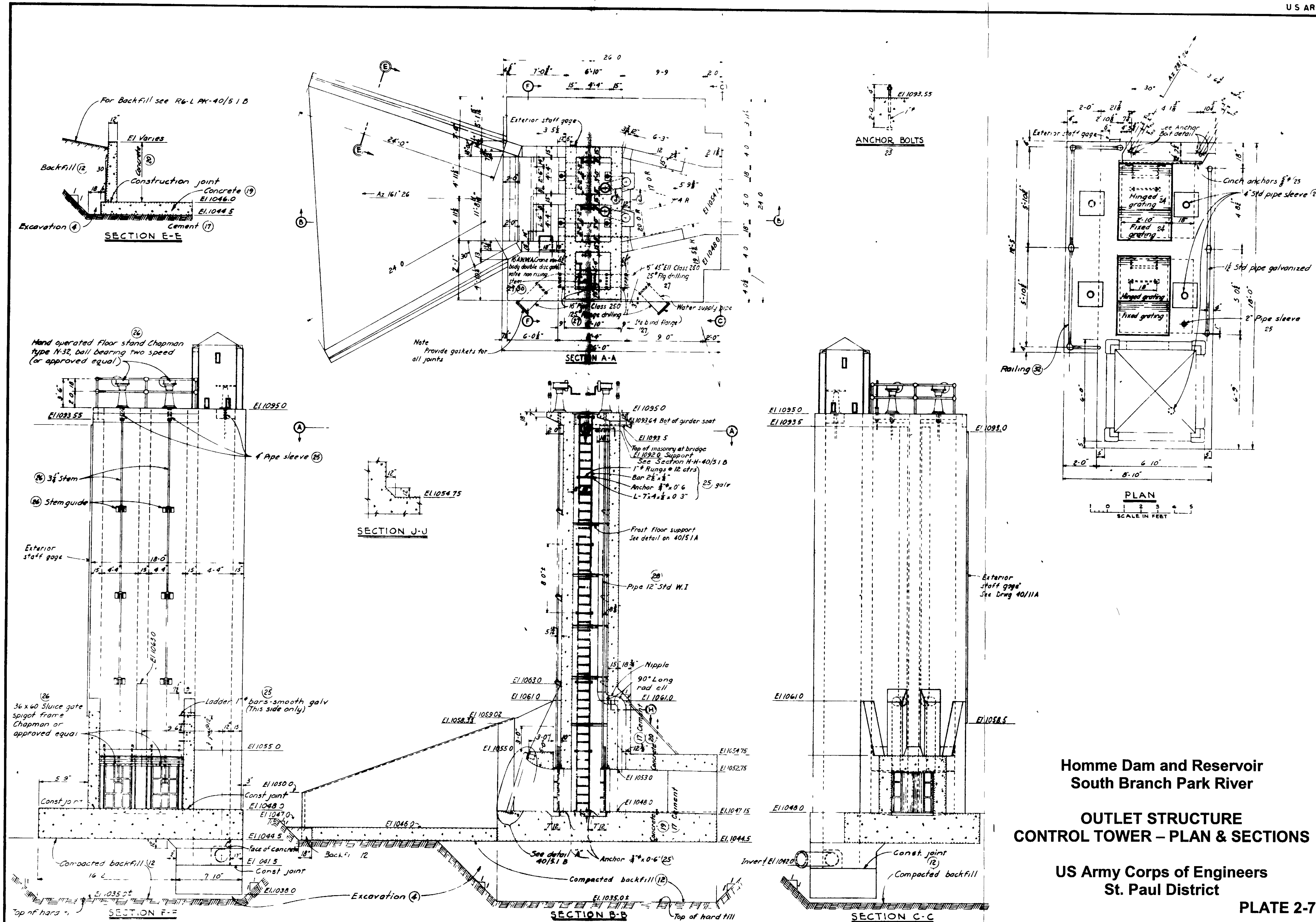


Homme Dam and Reservoir
South Branch Park River

OUTLET STRUCTURE
PROFILE & MISCELLANEOUS DETAILS

US Army Corps of Engineers
St. Paul District

PLATE 2-6



Homme Dam and Reservoir
South Branch Park River

OUTLET STRUCTURE
CONTROL TOWER – PLAN & SECTIONS

US Army Corps of Engineers
St. Paul District

PLATE 2-7

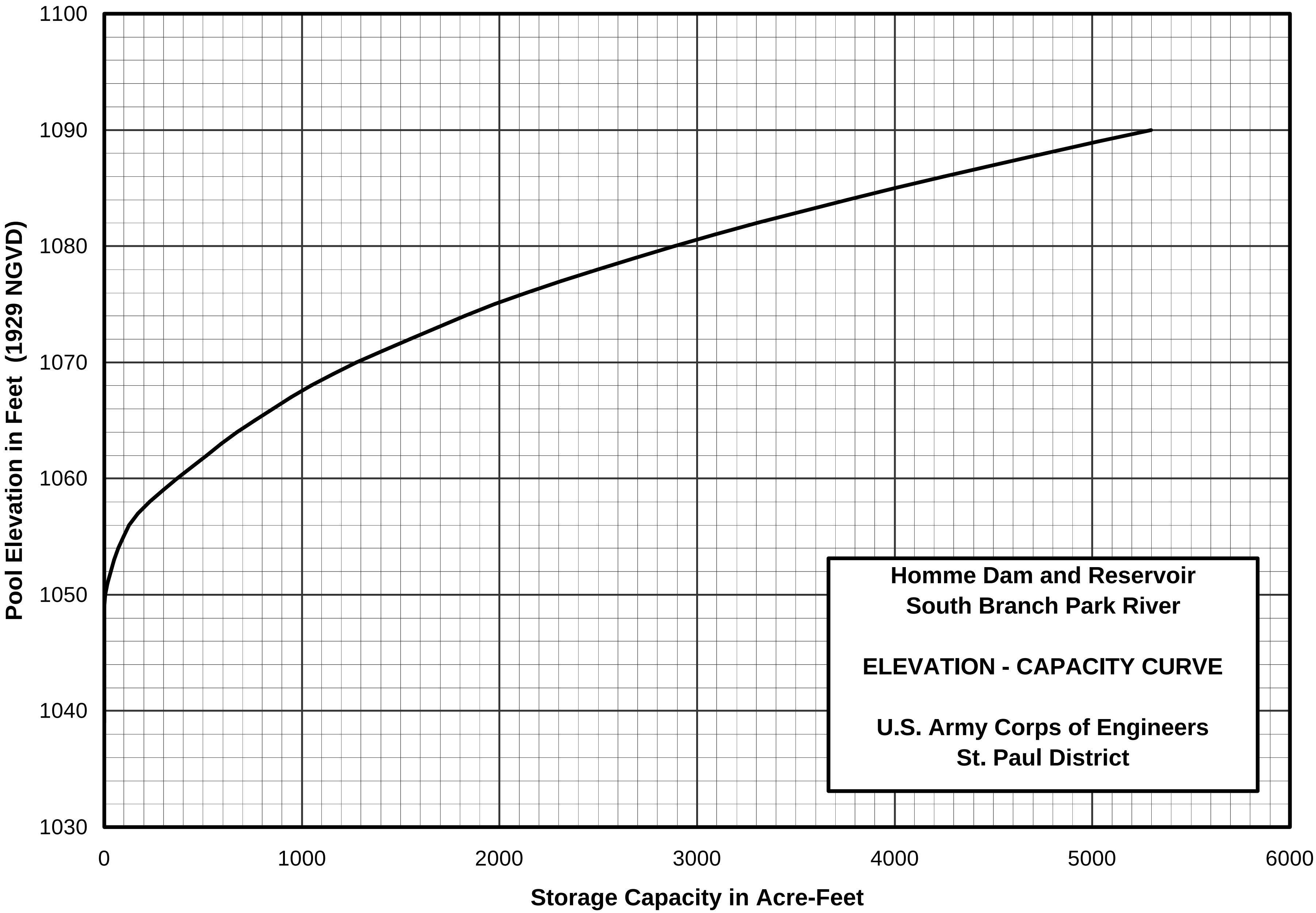

Homme Dam and Reservoir
South Branch Park River
ELEVATION - CAPACITY CURVE
U.S. Army Corps of Engineers
St. Paul District
Pool Elevation in Feet (1929 NGVD)
1100
1090
1080
1070
1060
1050
1040
1030
0
1000
2000
3000
4000
5000
6000
Storage Capacity in Acre-Feet

PLATE 2-8

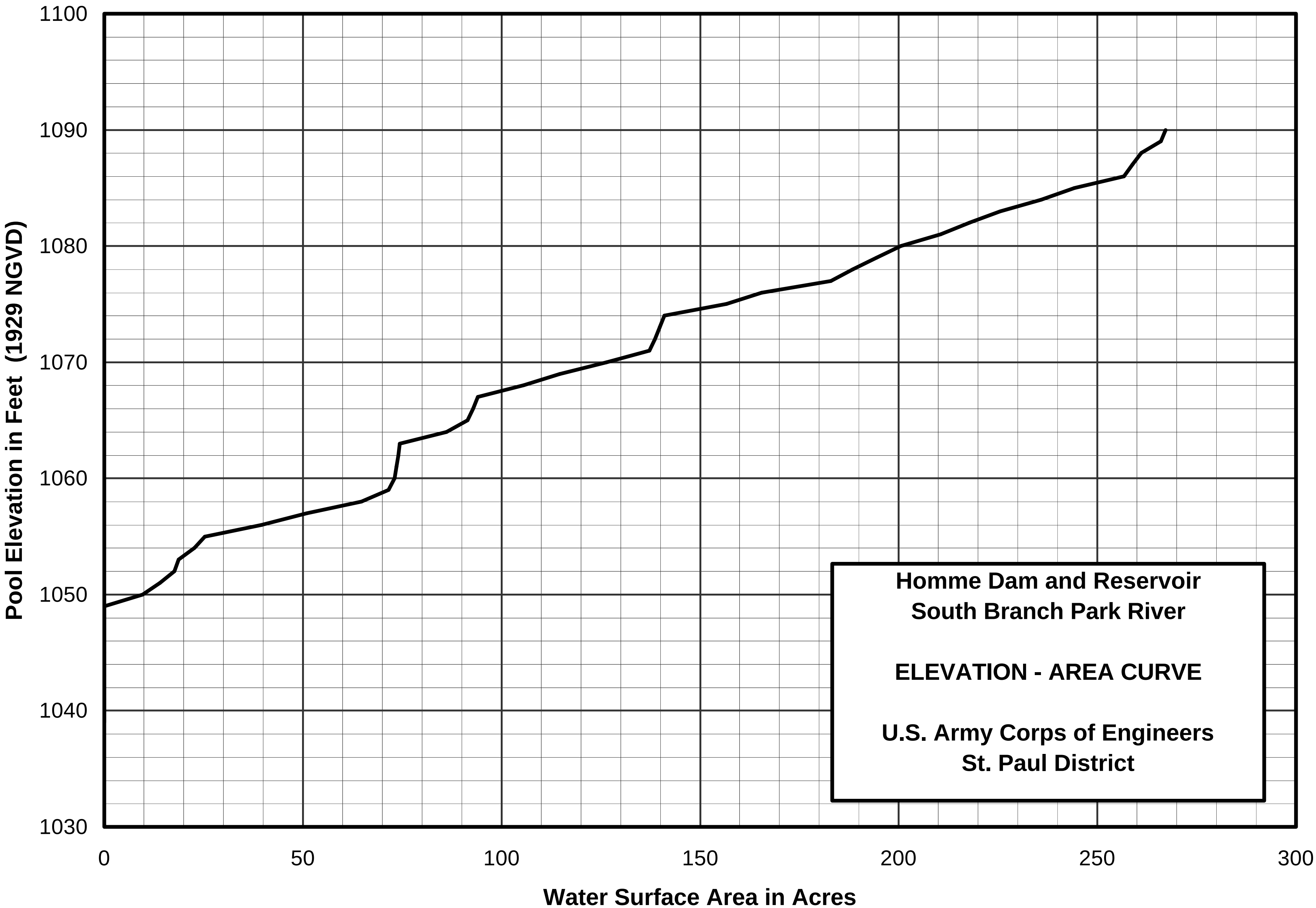
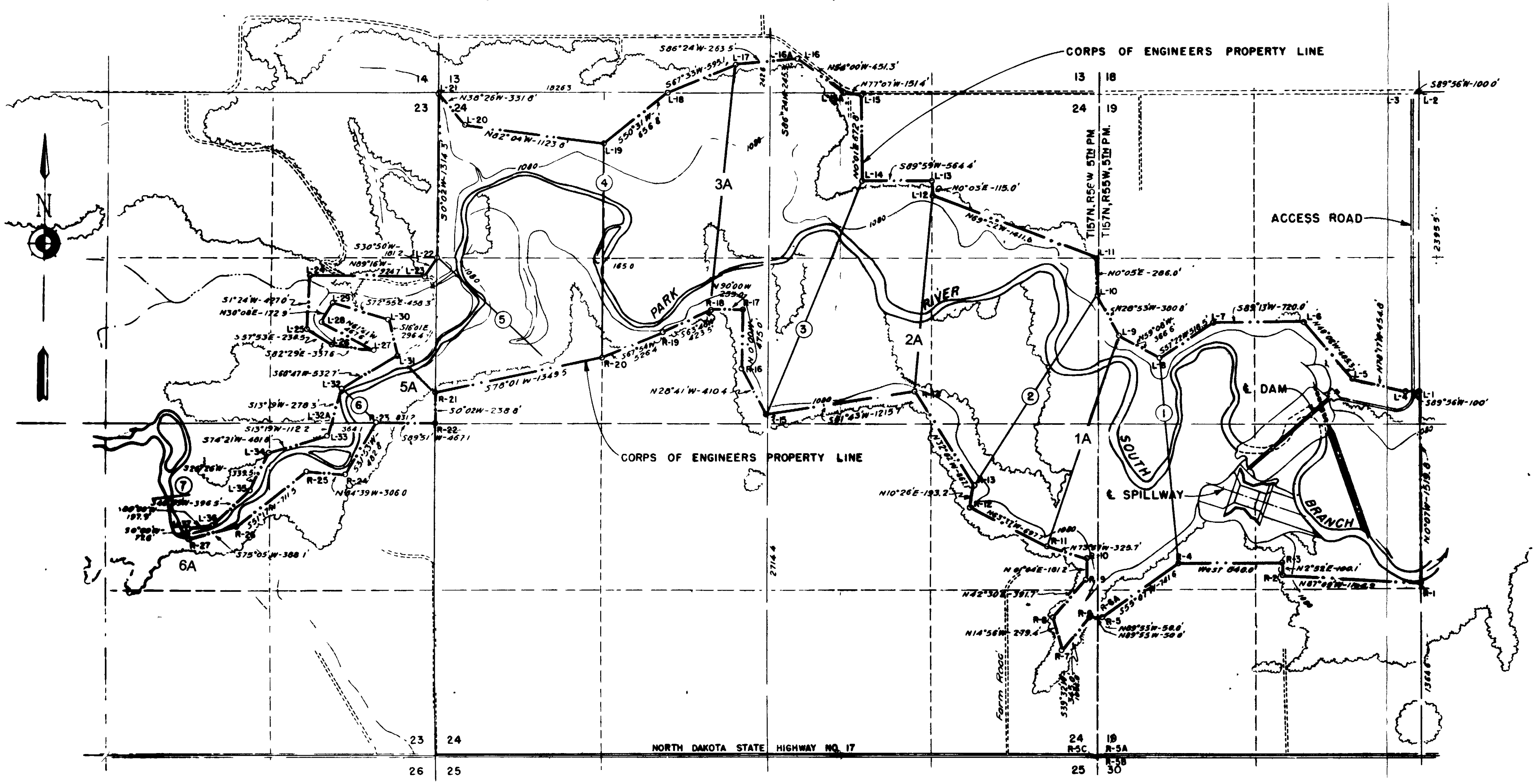

1100
1090
1080
1070
1060
1050
1040
1030
Pool Elevation in Feet (1929 NGVD)
0
50
100
150
200
250
300
Water Surface Area in Acres
Homme Dam and Reservoir
South Branch Park River
ELEVATION - AREA CURVE
U.S. Army Corps of Engineers
St. Paul District

PLATE 2-9



NORTH DAKOTA

WALSH COUNTY

PLAN

500 250 0 500 1000

SCALE IN FEET

LEGEND

—(3)— SEDIMENTATION RANGE

M-62 MILES ABOVE MOUTH

Homme Dam and Reservoir
South Branch Park River

SEDIMENTATION RANGES

US Army Corps of Engineers
St. Paul District

PLATE 4-1

Plate 4-2
Sedimentation Survey Results in Acre-Feet
Six Cross-Sections

Elev.	1953 Volume	1964 Volume	1970 Volume	1976 Volume	1985 Volume	1996 Volume
1040.0	1					
1041.0	3					
1042.0	6	1				
1043.0	10	5				
1044.0	17	12				
1045.0	27	21	1			
1046.0	41	31	9	0		
1047.0	60	44	19	4		
1048.0	82	60	30	13	0	
1049.0	108	82	46	24	9	0
1050.0	140	109	65	38	24	5
1051.0	179	140	89	56	45	21
1052.0	226	182	116	80	68	42
1053.0	276	229	150	108	95	66
1054.0	329	279	191	141	126	93
1055.0	388	333	242	183	162	123
1056.0	455	396	299	235	205	156
1057.0	532	467	364	296	259	199
1058.0	616	549	437	370	328	257
1059.0	705	633	520	450	409	330
1060.0	794	718	604	534	493	413
1061.0	884	805	691	619	578	497
1062.0	977	893	778	704	663	581
1063.0	1,075	983	867	790	749	666
1064.0	1,180	1,078	957	879	835	751
1065.0	1,297	1,185	1,049	969	922	837
1066.0	1,423	1,303	1,155	1,063	1,009	923
1067.0	1,561	1,431	1,276	1,172	1,097	1,010
1068.0	1,715	1,572	1,410	1,297	1,197	1,109
1069.0	1,887	1,724	1,559	1,434	1,312	1,227
1070.0	2,073	1,889	1,715	1,587	1,442	1,360
1071.0	2,264	2,057	1,874	1,745	1,589	1,513
1072.0	2,459	2,234	2,033	1,904	1,745	1,670
1073.0	2,655	2,418	2,198	2,065	1,902	1,829
1074.0	2,852	2,610	2,369	2,232	2,061	1,989
1075.0	3,051	2,805	2,547	2,406	2,222	2,154
1076.0	3,251	3,004	2,735	2,593	2,384	2,329
1077.0	3,455	3,207	2,929	2,785	2,549	2,514
1078.0	3,665	3,411	3,127	2,981	2,722	2,704
1079.0	3,880	3,622	3,331	3,181	2,908	2,899
1080.0	4,099	3,842	3,546	3,387	3,106	3,100
1081.0	4,319	4,065	3,769	3,602	3,316	3,308
1082.0	4,543	4,290	3,995	3,825	3,535	3,525
1083.0	4,769	4,518	4,224	4,053	3,760	3,749
1084.0	5,003	4,755	4,463	4,289	3,996	3,982
1085.0	5,249	5,004	4,715	4,534	4,242	4,224
1086.0	5,501	5,258	4,971	4,787	4,496	4,475
1087.0	5,758	5,513	5,228	5,043	4,753	4,732
1088.0	6,018	5,773	5,490	5,302	5,013	4,991
1089.0	6,280	6,033	5,754	5,565	5,277	5,253
1090.0	6,544	6,296	6,021	5,829	5,544	5,520

Plate 4-3
Summary of Peak Discharges (cfs) and Elevations/Stages (feet)

Homme Reservoir			Grafton Gage		
Date	Pool Elevation	Peak Discharge	Date	Peak Stage	Peak Discharge
18 Apr 1948	---	11,000[1]	20 Apr 1948	20.06	11,700
18 Apr 1950	---	5,200[1]	19 Apr 1950	20.13	12,600
24 Apr 1950[3]	---	13,000[1]	---	---	---
11 Apr 1965	1083.70	3,100[1]	13 Apr 1965	18.21	5,710
20 Apr 1979	1084.58	5,380[1]	22 Apr 1979	19.56	8,740
28 Jul 1993	1083.23	4,210[1]	30 Jul 1993	12.22	2,420
20 Apr 1997	1083.29	4,293[2]	21 Apr 1997	15.40	5,250
27 Mar 1998	1082.92	2,500[1]	30 Mar 1998	12.94	3,260
27 Mar 2004	1082.73	3,600[2]	29 Mar 2004	16.15	5,900
13 Apr 2009	1082.44	3,280[2]	16 Apr 2009	15.71	6,230
28 Apr 2013	1082.74	3,900[2]	01 May 2013	16.03	6,230

1. Discharge measured at USGS gage site 0.5 miles downstream of Homme Dam.
2. Computed peak discharge from the dam based on peak pool elevation.
3. Cofferdam break resulting in a sudden large discharge.

Plate 5-1
Points of Contact for Emergency Notification

Point of Contact	**Telephone**
Walsh County, ND:	
Emergency Management Coordinator	701-352-2311
Sheriff	701-352-2041
Cavalier County, ND:	
Sheriff	701-256-2555
Pembina County, ND:	
Emergency Management Coordinator	701-265-4849
Sheriff	701-265-4122
Park River, ND:	
Police (or 911)	701-284-6644
Grafton, ND:	
Police (or 911)	701-352-1411
Drayton, ND:	
Police (or 911)	701-265-8605
Minnesota Division of Emergency Management	651-649-5451
Statewide Emergency Number	800-422-0798
North Dakota Division of Emergency Management	701-224-2111

Plate 7-1
Spillway Discharge Rating - cfs

Elevation	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
1079.8	0	1	2	4	6	8	11	13	16	19
1079.9	23	26	30	34	38	42	46	50	55	60
1080.0	64	69	74	79	85	90	95	101	107	112
1080.1	118	124	130	136	143	149	155	162	169	175
1080.2	182	189	196	203	210	217	224	232	239	247
1080.3	254	262	270	278	285	293	301	310	318	326
1080.4	334	343	351	360	368	377	386	395	403	412
1080.5	421	430	440	449	458	467	477	486	496	505
1080.6	515	524	534	544	554	564	574	584	594	604
1080.7	614	625	635	645	656	666	677	687	698	709
1080.8	719	730	741	752	763	774	785	796	807	819
1080.9	830	841	853	864	876	887	899	910	922	934
1081.0	946	957	969	981	993	1,005	1,017	1,030	1,042	1,054
1081.1	1,066	1,079	1,091	1,103	1,116	1,128	1,141	1,154	1,166	1,179
1081.2	1,192	1,204	1,217	1,230	1,243	1,256	1,269	1,282	1,295	1,308
1081.3	1,322	1,334	1,348	1,361	1,375	1,388	1,402	1,415	1,429	1,442
1081.4	1,456	1,470	1,483	1,497	1,511	1,525	1,539	1,553	1,567	1,581
1081.5	1,595	1,609	1,623	1,637	1,651	1,665	1,680	1,694	1,708	1,723
1081.6	1,737	1,752	1,766	1,781	1,796	1,810	1,825	1,840	1,854	1,869
1081.7	1,884	1,899	1,914	1,929	1,944	1,959	1,974	1,989	2,004	2,020
1081.8	2,035	2,050	2,065	2,081	2,096	2,112	2,127	2,143	2,158	2,174
1081.9	2,189	2,205	2,221	2,236	2,252	2,268	2,284	2,300	2,316	2,332
1082.0	2,347	2,364	2,380	2,396	2,412	2,428	2,444	2,460	2,477	2,493
1082.1	2,509	2,526	2,542	2,559	2,575	2,592	2,608	2,625	2,641	2,658
1082.2	2,675	2,692	2,708	2,725	2,742	2,759	2,776	2,793	2,810	2,827
1082.3	2,844	2,861	2,878	2,895	2,912	2,929	2,947	2,964	2,981	2,999
1082.4	3,016	3,033	3,051	3,068	3,086	3,103	3,121	3,139	3,156	3,174
1082.5	3,192	3,209	3,227	3,245	3,263	3,281	3,299	3,317	3,335	3,353
1082.6	3,371	3,389	3,407	3,425	3,443	3,461	3,480	3,498	3,516	3,534
1082.7	3,553	3,571	3,590	3,608	3,627	3,645	3,664	3,682	3,701	3,719
1082.8	3,738	3,757	3,776	3,794	3,813	3,832	3,851	3,870	3,889	3,908
1082.9	3,927	3,946	3,965	3,984	4,003	4,022	4,041	4,060	4,080	4,099
1083.0	4,118	4,137	4,157	4,176	4,196	4,215	4,234	4,254	4,273	4,293
1083.1	4,313	4,332	4,352	4,372	4,391	4,411	4,431	4,451	4,470	4,490
1083.2	4,510	4,530	4,550	4,570	4,590	4,610	4,630	4,650	4,670	4,690
1083.3	4,711	4,731	4,751	4,771	4,792	4,812	4,832	4,853	4,873	4,893
1083.4	4,914	4,934	4,955	4,975	4,996	5,017	5,037	5,058	5,079	5,099
1083.5	5,120	5,141	5,162	5,182	5,203	5,224	5,245	5,266	5,287	5,308
1083.6	5,329	5,350	5,371	5,392	5,413	5,435	5,456	5,477	5,498	5,519
1083.7	5,541	5,562	5,583	5,605	5,626	5,648	5,669	5,691	5,712	5,734
1083.8	5,755	5,777	5,798	5,820	5,842	5,863	5,885	5,907	5,929	5,951
1083.9	5,972	5,994	6,016	6,038	6,060	6,082	6,104	6,126	6,148	6,170
1084.0	6,192	6,214	6,236	6,259	6,281	6,303	6,325	6,348	6,370	6,392
1084.1	6,415	6,437	6,459	6,482	6,504	6,527	6,549	6,572	6,594	6,617
1084.2	6,640	6,662	6,685	6,708	6,730	6,753	6,776	6,799	6,822	6,844
1084.3	6,867	6,890	6,913	6,936	6,959	6,982	7,005	7,028	7,051	7,074
1084.4	7,098	7,121	7,144	7,167	7,190	7,214	7,237	7,260	7,283	7,307
1084.5	7,330	7,354	7,377	7,401	7,424	7,448	7,471	7,495	7,518	7,542
1084.6	7,565	7,589	7,613	7,636	7,660	7,684	7,708	7,732	7,755	7,779
1084.7	7,803	7,827	7,851	7,875	7,899	7,923	7,947	7,971	7,995	8,019
1084.8	8,043	8,067	8,091	8,116	8,140	8,164	8,188	8,213	8,237	8,261

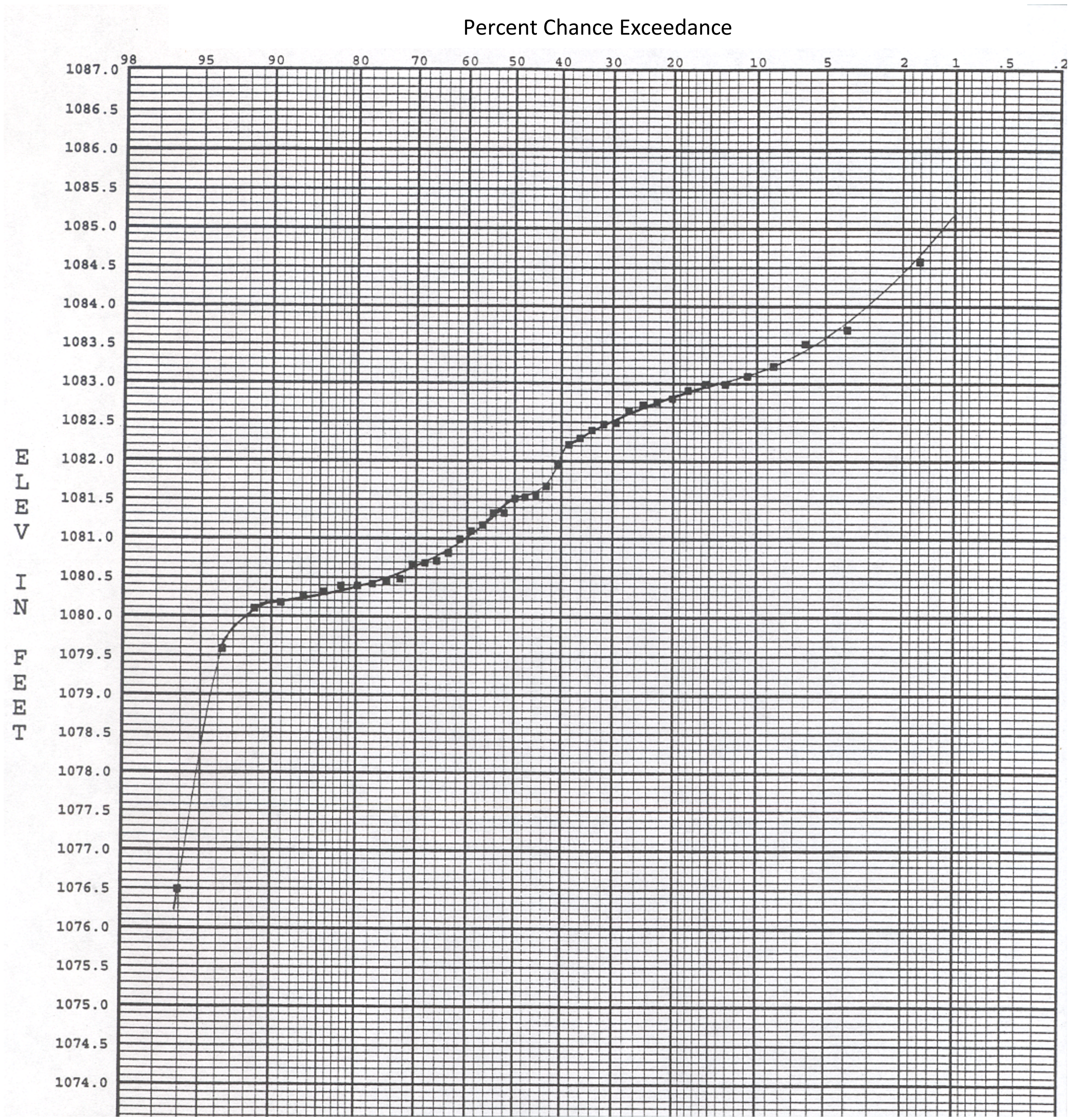


Plate 8-1. Homme Reservoir, Elevation-Frequency Curve

Data is from 1951-1952 and 1954-1994 (in 1953 the pool was drawn down for the entire year)

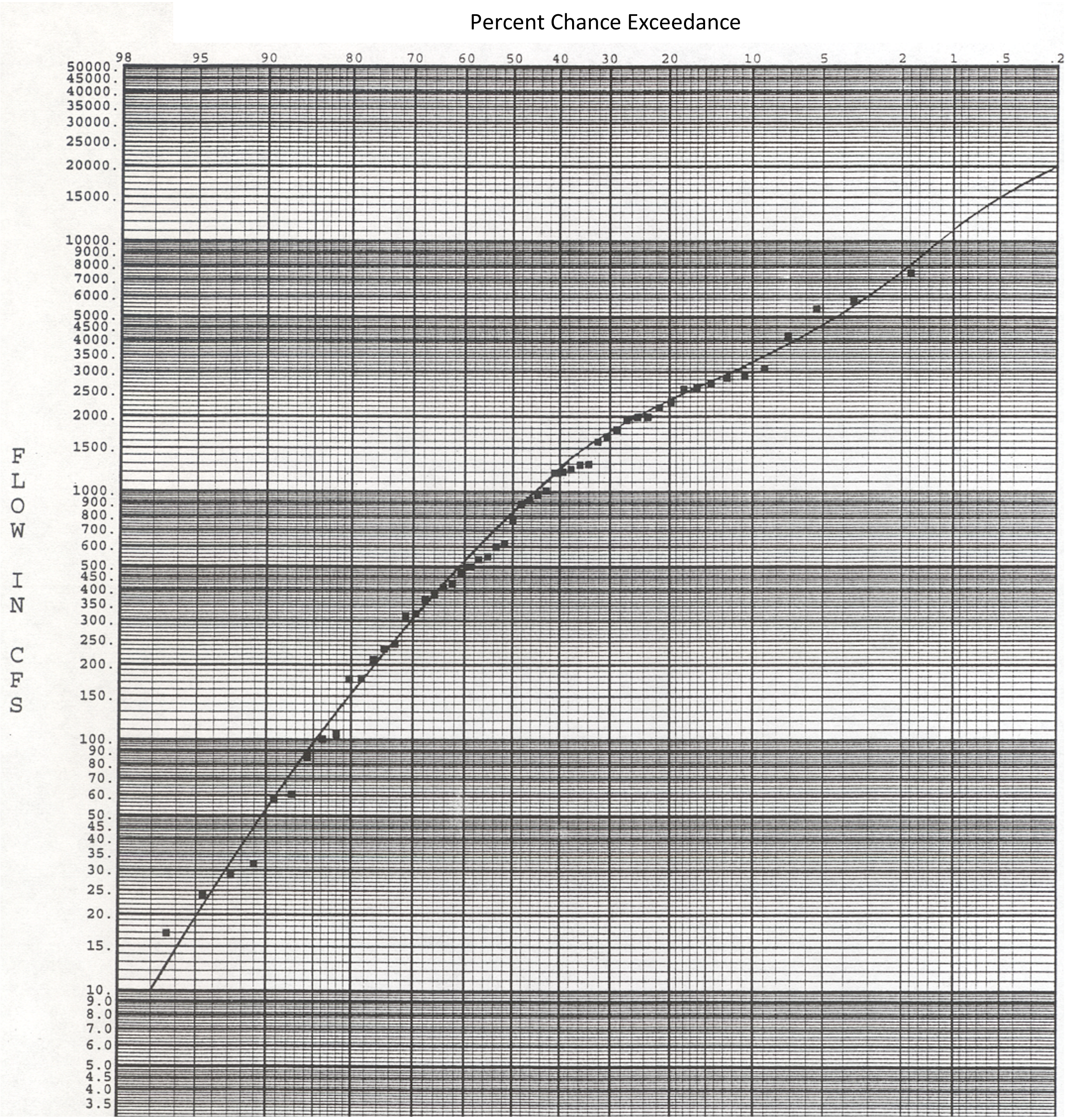


Plate 8-2. Homme Reservoir, Discharge-Frequency Curve

Data is from 1940-1994

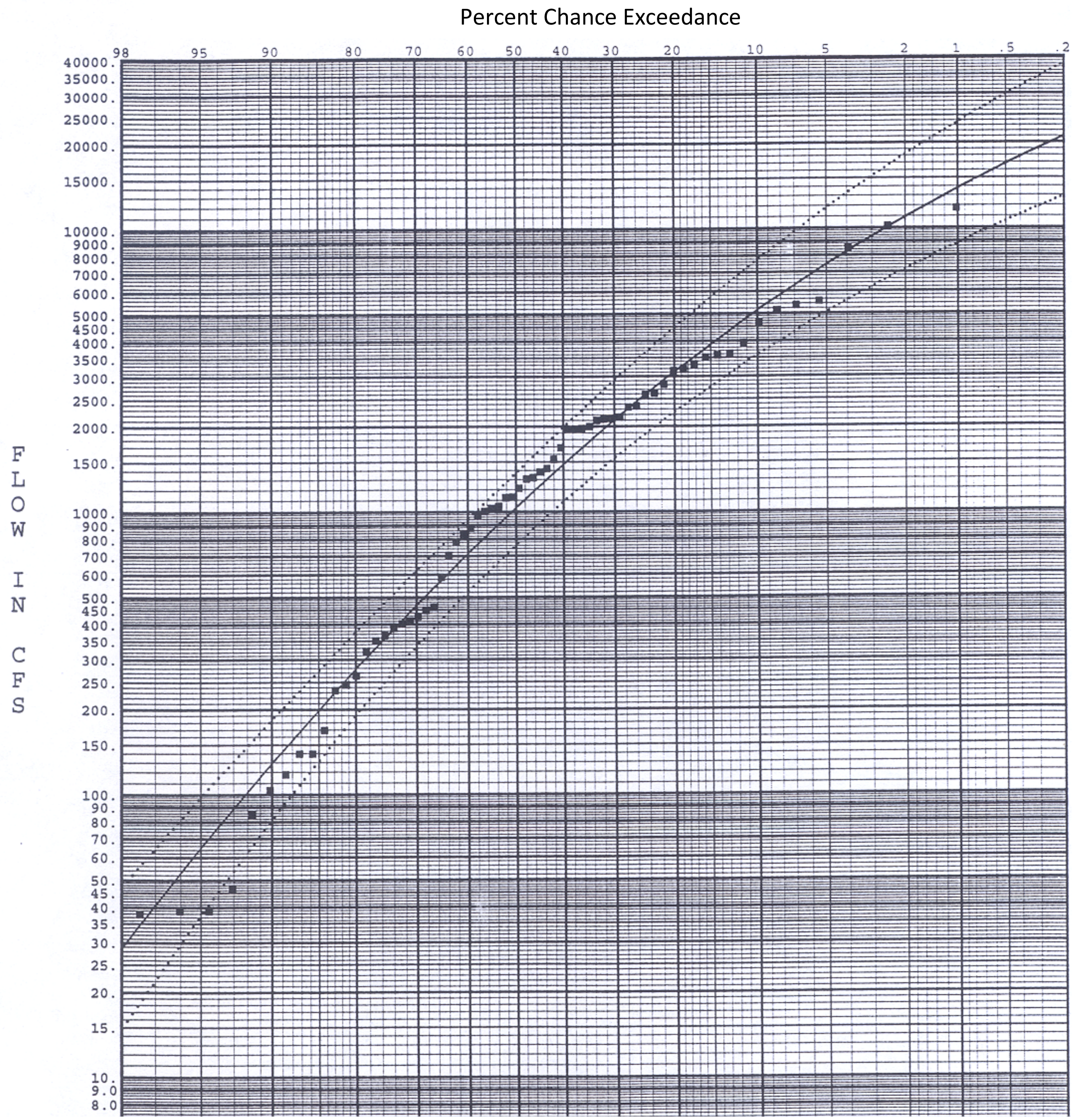


Plate 8-3. Park River at Grafton, Discharge-Frequency Curve

Data is from 1932-1999