US Army Corps
of Engineers
Omaha District

WATER CONTROL MANUAL

GLENDO DAM AND RESERVOIR
GLENDO, WYOMING

DECEMBER 1997

CENWD-MR-ET-R (CENWO-ED-HA/4 Feb 98) (11-2-240a) 3d End
Mr. Baker/alw/697-2684
SUBJECT: Glendo Water Control Manual

DA, Northwestern Division, Missouri River Regional Headquarters, Corps of Engineers,
12565 West Center Road, Omaha, NE 68144-3869 17 SEP 1998

FOR Commander, Omaha District, ATTN: CENWO-ED-HA

The subject Water Control Manual is approved.

FOR THE COMMANDER:

[redacted]

4 Encls
wd all encls

for JAMES L. CREWS, P.E.
Director, Engineering and
Technical Services

WATER CONTROL MANUAL

US Bureau of Reclamation
Glendo Dam and Reservoir
Glendo, Wyoming

Prepared for
U.S. Army Corps of Engineers
Northwestern Division
Missouri River Region
Omaha District
Omaha, Nebraska

Prepared by
Hydrology and Water Control Section
U.S. Army Corps of Engineers
Omaha District

December 1997

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in a hard copy binder with loose leaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is the Division approval date.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during nonduty hours, communication can be achieved by contacting, in the order listed, one of the following personnel:

DIRECTORY OF FLOOD CONTROL REGULATION PERSONNEL
GLENDO DAM AND RESERVOIR

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GLENDO DAM AND RESERVOIR
PERTINENT DATA

AUTHORIZATION

Flood Control Act, December 1944, Public Law 534, Senate Documents 191 and 475, 78th Congress, 2d Session
Reauthorized by Public Law 503, 83d Congress, July 1954

LOCATION

On the North Platte River, approximately 6 miles southeast of the town of Glendo in Platte County, Wyoming.

DRAINAGE AREA

Area	Contributing Area (sq mi)	Noncontributing Area (sq mi)	Total Drainage Area (sq mi)
North Platte River upstream of Glendo Reservoir	14,330	1,215	15,545
North Platte River upstream of Alcova Reservoir	10,066	700	10,766
Drainage Area Between Alcova Reservoir and Glendo Reservoir	4,264	515	4,779

ELEVATIONS

	Feet msl
Top of Dam	4675.0
Maximum Surcharge - Spillway Design Flood	4669.0
Spillway Crest	4653.0
Top of Flood Control Pool	4653.0
Top of Conservation Pool	4635.0
Top of Inactive Pool	4570.0

RESERVOIR DATA

Purpose	Pool Elevation (ft. above msl)	1960 DPR Allocation (Acre-Feet)	1965 Resurvey Capacity (Acre-Feet)	1972 Resurvey Capacity (Acre-Feet)
Dead Storage	4508 - 4545	12,100	11,495	11,033
Inactive	4545 - 4570	100,000	100,000	52,115
Conservation*	4570 - 4635	413,500	411,812	454,337
Flood Control	4635 - 4653	272,800	271,889	271,917
Surcharge	4653 - 4669	329,700	328,912	329,251
Total		**1,128,100**	**1,124,108**	**1,118,653**

* Head requirement for power generation is elevation 4570 ft msl. Power generation is a result from irrigation or flood control releases.

DAM

Type	Zoned earthfill
Structural Height	190 feet
Hydraulic Height	145 feet
Top Width	35 feet
Maximum Base Width	1,066 feet
Crest Length	2,096 feet
Crest Elevation	4675.0 feet
Abutment Formation	sandstone shale
Date of Closure	June 1956
Date of Initial Fill (Cons. Pool)	May 1959

OUTLET WORKS

Intake structure on south side of reservoir about 0.5 miles upstream from dam, controlled by one 16.5-foot by 21-foot fixed wheel gate, a 21-foot diameter concrete-lined tunnel through neck of land formed by loop in the river below the dam, terminating near powerplant, about 0.75 miles south of dam.

Capacity at elevation 4669.0 feet msl (with power outlets closed)	13,000 cfs

RIVER OUTLETS

Three branches from outlet conduit, each controlled by one 7.25-foot by 7.75-foot slide gate.

POWER OUTLETS

Two penstock branches from outlet conduit

SPILLWAY

Crest Type	Ungated Ogee Weir
Crest Elevation	4653.0 feet msl
Crest Width	45 feet

DOWNSTREAM CHANNEL

Capacity	10,000 cfs (approx)
Channel length to d/s Guernsey	26 miles (approx)

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I - INTRODUCTION

1-01. Authorization. This water control manual has been prepared in compliance with instructions in ER 1110-2-8156 Preparation of Water Control Manuals, and covers the pertinent topics of information specified in ER 1110-2-240 Water Control Management, Chapter 6 of EM 1110-2-3600 Management of Water Control Systems, and Section 7 of the 1944 Flood Control Act.

1-02. Purpose and Scope. This manual presents information pertinent to the regulation of the flood control storage in Glendo Dam and Reservoir. The normal and emergency reservoir regulation procedures and schedules that apply to the flood control storage regulation of Glendo Dam and Reservoir are also contained in this manual.

1-03. Related Manuals and Projects. Glendo Dam and Reservoir, Regulation Manual, Omaha District, Corps of Engineers, 1962; Glendo Dam and Reservoir, Preliminary Information Report, Omaha District, Corps of Engineers, April 1970; Glendo Dam and Reservoir, Standard Operating Procedures (SOP), United States Bureau of Reclamation, last updated April 1991.

1-04. Project Owner. The United States Bureau of Reclamation (Reclamation) completed construction of Glendo Dam in October 1957.

1-05. Operating Agency. The operation and maintenance of Glendo Dam is the responsibility of the Bureau of Reclamation, Wyoming Area Office, Mills, Wyoming. The operating duties are determined by the Water and Land Division and implemented by remote supervisory control from the Casper Control Center. Powerplant personnel perform onsite operating duties only in the rare event of failure of the remote control system and do not independently operate unless all communications are also lost.

1-06. Regulating Agencies. The Bureau of Reclamation has prime responsibility for operation and maintenance of Glendo Dam, Dikes, Reservoir, and Powerplant. The U.S. Army Corps of Engineers (Corps) is responsible for prescribing regulation for storage in space allocated to flood control in Glendo Reservoir.

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II - DESCRIPTION OF PROJECT

2-01. Location of Dam. Glendo Dam is located on the North Platte River, approximately 6 miles southeast of the town of Glendo in Platte County, Wyoming.

2-02. Purpose of Project. Glendo Reservoir is the only reservoir on the North Platte River with storage space specifically allocated for flood control. The flood control storage space is intended for reduction or prevention of flood damages in the North Platte River Valley from Glendo Dam to Lake McConaughy (Kingsley Dam). Other authorized purposes for Glendo Dam and Reservoir include irrigation, power generation, fish and wildlife conservation, recreation, sediment retention, pollution abatement, and improvement of the quality of municipal and industrial water supply. A location map of the North Platte River Basin is located on Plate 1. A profile of the North Platte River is displayed on Plate 2.

2-03. Physical Components. Glendo Dam is a three-zoned earthfill structure and was constructed in a horseshoe bend in the North Platte River. Plates 3 and 4 show general plans of Glendo Dam. This location permitted construction of a combined outlet works and power tunnel through the narrow ridge formed by the meander of the river, thereby increasing available head to the powerplant. A cutoff trench below the dam extends to firm unweathered shale onto sandstone. A concrete grout cap extends the length of the bottom of the cutoff trench and up the abutments. A grout curtain extends downward from the grout cap to a depth of 160 feet under the dam. A Platte County road crosses the dam along the crest. Glendo Dam plan and sections are show on Plate 5.

Three dikes were constructed in low areas of the undulating ridge running along the south shore of Glendo Reservoir. The dikes are earthfill structures with cross sections and zoned construction similar to the top portion of the dam. A 20-foot wide cutoff trench, 10 feet under the embankment sections, extends the full length of each dike. The three dikes contain 156,639 cubic yards of zone 1 material, 69,451 cubic yards of zone 2 material, and 16,895 cubic yards of riprap. The 25-foot crest of each dike is at elevation 4675.0 feet above mean sea level (feet msl) without camber, and carries the access road from Glendo, Wyoming to the Glendo Dam and Powerplant.

The spillway of Glendo Dam is located near the right abutment and has natural shales and sandstones as its foundation.

2-03a. Dam and Embankment. Table 2-1 lists dam and embankment attributes of Glendo Dam.

Table 2-1
Glendo Dam and Embankment Dimensions

Dam crest elevation	4675 feet msl
Length along crest	2096 feet
Hydraulic length	145 feet
Structural height	190 feet
Top width	35 feet
Maximum base width	1066 feet
Construction period	1955-1958
Date of closure	October 17, 1957
Volume	2,676,000 c.y.

2-03b. Glendo Dam Dikes. Refer to Table 2-2 and Plate 6 for information regarding the three dikes located along the south shore of Glendo Reservoir.

Table 2-2
Glendo Dam Dike Dimensions

	No. 1	No. 2	No. 3
Crest length (feet)	1000	590	850
Hydraulic height (feet)	5	13	45
Structural height (feet)	46	57	88
Top width (feet)	25	25	25
Maximum base width (feet)	165	230	390
Construction period	1955-58	1955-58	1955-58

2-03c. Spillway. The reinforced concrete spillway has an ungated ogee crest. The crest is at elevation 4653.0 feet msl, the top of the flood control pool. The crest length is 45 feet. The concrete-lined chute is 45 feet in width and about 524 feet in length, terminating at a concrete stilling basin. The spillway capacity at elevation 4669.0 feet msl (6 feet below the crest of the dam) is 10,335 cfs. Spillway plan and sections are shown on Plate 7. The spillway discharge curve is shown on Plate 8.

2-03d. Outlet Works. The outlet works for Glendo Dam consists of an inlet channel; a tower-type intake structure; a pressure conduit; a 16-foot 6-inch by 21-foot fixed-wheel emergency gate with a gate shaft and shaft house; a pressure tunnel; a surge tank; three 7-foot 3-inch by 7-foot 9-inch guard gates with three 7-foot 3-inch by 7-foot 9-inch regulating gates; a control house; a stilling basin; and a short outlet channel which directs the flow into the stream. The distance from the centerline of the intake structure to the end of the stilling basin is 2,648 feet. The intake structure is located approximately 2,540 feet upstream from the dam axis. The outlet channel meets the river channel approximately 12,000 feet downstream from the dam axis. The outlet works plan and sections are shown on Plate 9. The outlet works gate discharge curves are shown on Plate 10.

2-03e. Low Flow Outlet. In 1993 an additional low flow outlet was constructed in the right abutment to provide flow for environmental purposes of 25 to 40 cfs on a year-round basis. The facility consists of a pipe conduit with a control valve, which discharges into the spillway stilling basin.

2.03f. Power Plant. The plans for the Glendo powerplant are shown on Plate 11.

2-04. Reservoir. Glendo Reservoir is limited in capacity by a thin rim section in the southwest portion of the reservoir area. Rerouting the CB&Q Railroad and diking the railroad cut in the rim section was necessary to obtain the maximum reservoir capacity. Capacity curves and tables are shown on Plates 12 and 13. The storage capacity allocations, latest reservoir resurvey capacity, and pool elevations for Glendo Reservoir are shown in Table 2-3. Reference Appendix A for the detailed (to nearest .01 foot) area-capacity table.

2-05. Relocations. To obtain the full reservoir capacity of the site required, the relocation and raising of the grade of approximately 3.8 miles of U. S. Highway 87 and approximately 3.0 miles of the CB&Q railroad so that the base of rail and top of the highway were at or above elevation 4657 feet msl. The railroad was also relocated where it leaves the basin in the southwest rim of the reservoir. The cut through the rim was limited to elevation 4675 feet msl, the elevation of the crest of the dam. Relocation of telephone, power lines, and county roads were also required.

2-06. Recreation. The Wyoming State Parks and Historic Sites, a division of the Wyoming Department of Commerce, entered into a Memorandum of Understanding (MOU) with the Bureau of Reclamation May 28, 1992 to administer the Glendo Reservoir land as a Wyoming State Park. The MOU allows the State Parks Department to collect fees and use them for improvement of the recreation facilities within the state park. Camping, picnicking, boating, water sports, and hunting for waterfowl are available at Glendo Reservoir. The Wyoming Game and Fish Department (WG&F) patrols the Glendo Reservoir and the area below Glendo Dam to monitor compliance with state regulations. They also stock the reservoir and the North Platte River with fish.

Table 2-3
Glendo Reservoir Capacity Allocations

Purpose	Pool Elevation (feet msl)	1960 DPR Allocation (Acre-Feet)	1965 Resurvey Capacity (Acre-Feet)	1972 Resurvey Capacity (Acre-Feet)
Dead Storage	4508 - 4545	12,100	11,495	11,033
Irrigation	4545 - 4570	100,000	100,000	52,115
Conservation	4570 - 4635	413,500	411,812	454,337
Flood Control	4635 - 4653	272,800	271,889	271,917
Surcharge	4653 - 4669	329,700	328,912	329,251
Total		**1,128,100**	**1,124,108**	**1,118,653**

III - HISTORY OF PROJECT

3-01. Authorization. The Glendo Unit, which includes Glendo Dam and Reservoir, was authorized for construction under the Flood Control Act of December 22, 1944, Public Law 534, which approved the general plan set forth in Senate Documents 191 and 475, as revised and coordinated by Senate Document 247, 78th Congress, 2d session. The project was reauthorized by Public Law 503, 83d Congress, on July 16, 1954.

3-02. Planning and Design.

3-02a. Early History. From the beginning of the early settlement, livestock ranching has been the principal economic activity in the area. The North Platte River Valley served as a passage for early explorers and later as a route for settlers from the eastern States through the high plain to the Rocky Mountains and the western States. Sites of stations, which served the Pony Express, the Overland Stage, and the first transcontinental telegraph, are still to be found.

The first irrigation systems in the valley were built shortly after 1880 without large storage reservoirs. The North Platte Project, authorized by the Congress in 1903, was completed in 1927. Pathfinder Dam and Reservoir were built during 1905-09. The Guernsey Dam and Reservoir were completed in 1927. The Kendrick Project was first investigated in 1904, and construction started in 1936. Seminoe and Alcova Dams were completed in 1939.

3-02b. Investigations. Preliminary investigations for the Glendo Unit started in 1944. It was included in Senate Document 191 as part of the Missouri River Basin Project and was authorized for construction under the Flood Control Act of 1944. The original authorization provided for a storage capacity of approximately 150,000 acre-feet in the Glendo Reservoir for additional sediment storage and replacement of capacity lost to sediment in Guernsey Reservoir; re-regulation of return flows from upstream irrigation; and flood control and the development of power. Subsequent investigations disclosed the necessity for increasing the capacity of Glendo Reservoir to provide for adequate control in the highly developed reach of the North Platte River Valley in Wyoming and Nebraska below the Glendo Reservoir site and the re-regulation of upstream power release so river water could be utilized more effectively for hydroelectric power production. As a result of the investigations, the total storage capacity was increased to 798,000 acre-feet, exclusive of a flood surcharge capacity of an additional 330,000 acre-feet.

3-02c. Irrigation. The irrigation water from Glendo Reservoir is delivered to water users in the North Platte River valley downstream of Guernsey Dam, a feature of the North Platte Project. These water users have early natural flow water rights and require storage water to develop dependable water supply which is provided by water from Glendo Reservoir.

3-03. Construction. The construction period for Glendo Dam was 1955-1958; the date of closure was October 1957; reservoir pool initially reached the top of the conservation pool (elev. 4635.0 feet msl) in May 1959; and start of hydropower generation began in 1958.

3-04. Related Projects. The Glendo Unit is a multiple-purpose natural resource development. It consists of Glendo Dam, Reservoir, and Powerplant; Fremont Canyon Powerplant; and Gray Reef Dam and its reregulating reservoir. The unit features are located on the North Platte River in eastern and central Wyoming and are adjacent to, and work in conjunction with, other units of the Pick-Sloan Missouri Basin Program and the Kendrick and North Platte Projects (see Plate 14).

3-04a. Kortes Unit. The Kortes Unit, consisting of Kortes Dam, Reservoir, and Powerplant, is in central Wyoming in a narrow gorge of the North Platte River 2 miles below Seminoe Dam in the Kendrick Project, and about 60 miles southwest of Casper, Wyoming. It was the first unit initiated by the Bureau of Reclamation under the Missouri River Basin Project. The 40,000-kilowatt powerplant generates more than 140 million kilowatt-hours annually.

3-04b. Kendrick Project. The Kendrick Project (Casper-Alcova Irrigation District) conserves the waters of the North Platte River for irrigation and electric power generation. Major features of the project are Seminoe Dam and Powerplant, Alcova Dam and Powerplant, the Casper Canal and laterals, and drainage and power distribution systems. About 24,000 acres of irrigable project lands lie in an irregular pattern on the northwest side of the North Platte River between Alcova and Casper, Wyoming.

3-04c. North Platte Project. The North Platte Project extends 111 miles along the North Platte River valley from Guernsey, Wyoming to Bridgeport, Nebraska. The main feature of the project is Pathfinder Dam which is located over 160 miles upstream of Guernsey Reservoir. The project provides full service irrigation for about 226,000 acres that are divided into four irrigation districts. A supplemental irrigation service is furnished to nine water-user associations serving a combined area of about 109,000 acres. Projects features include five storage dams; four diversion dams; one pumping plant; one powerplant; and about 2,000 miles of canals, laterals, and drains. Electric power is generated at Guernsey Powerplant and supplied to the project area by four substations and about 160 miles of transmission lines.

3-04d. Project Summary. Listed in downstream order.

1) SEMINOE
(Kendrick Project, Wyoming)
Concrete arch dam
295 feet high, 530 feet long
Completed in 1939
Reservoir capacity - 1,017,273 AF
Powerplant capacity - 51,000 KW

2) KORTES
(Kortes Unit, Wyoming)
Concrete gravity dam
244 feet high, 440 feet long
Completed in 1951
Reservoir capacity - 4,765 AF
Powerplant capacity - 40,000 KW

3) PATHFINDER
(North Platte Project, Wyoming)
Masonry arch gravity-type dam
214 feet high, 432 feet long
Completed in 1909
Reservoir capacity - 1,016,507 AF

4) FREMONT CANYON POWERPLANT
(Glendo Unit, Wyoming)
Initial operation in 1961
Installed capacity - 66,800 KW
(3-mile, 18-foot pressure tunnel
from Pathfinder Reservoir to
Fremont Canyon Powerplant)

5) ALCOVA
(Kendrick Project, Wyoming)
Earthfill dam
265 feet high, 763 feet long
Completed in 1938
Reservoir capacity - 184,405 AF
Powerplant capacity - 36,000 KW

6) GRAY REEF
(Glendo Unit, Wyoming)
Earthfill dam
36 feet high, 650 feet long
Completed in 1961
Reservoir capacity - 1,804 AF
Provides river regulation to maintain
stable flows and measurement point
for Alcova Reservoir releases

7) GLENDO
(Glendo Unit, Wyoming)
Earthfill dam
190 feet high, 2,096 feet long
Completed in 1958
Reservoir capacity - 789,402 AF
Powerplant capacity - 38,000 AF

8) GUERNSEY
(North Platte Project, Wyoming)
Diaphragm-type earthfill dam
135 feet high, 560 feet long
Completed in 1927
Reservoir capacity - 45,612 AF
Powerplant capacity - 4,800 KW

9) LAKE ALICE DAMS
(North Platte Project, Wyoming)
Earthfill dams
37 and 24 feet high
Completed in 1912 and 1913
Reservoir capacity - 11,034 AF
Offstream storage

10) LAKE MINATARE
(North Platte Project, Nebraska)
Earthfill dam, concrete-paved
upstream face
114 feet high, 3,760 feet long
Completed in 1915
Reservoir capacity - 58,795 AF
Offstream storage

3-05. Modification to Regulations. Since closure, the project purposes have remained unchanged. Water deliveries from the Glendo Unit irrigation storage have increased over time as contracts and demands have occurred. Presently, all but 10,350 acre-feet of the 40,000 acre-feet allocated to irrigation is under contract. This storage has been set aside for a project not yet built as of October 1997. In 1993 an additional low flow outlet was constructed in the right abutment to provide flow for environmental purposes of 25 to 40 cfs on a year-round basis.

3-06. Principal Regulation Problems. In years when the reservoir filled to high levels, the areas downstream of the dike embankments became saturated due to seepage. A filling restriction of elevation 4650.0 feet msl was established in November 1983. Seepage berms were constructed to control the excessive seepage, and upon their completion the filling restriction was released in February of 1990.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics.

4-01a. Drainage Areas. Table 4-1 lists the drainage areas pertinent to Glendo Dam and Reservoir.

Table 4-1
Glendo Dam and Reservoir Drainage Areas

Area	Contributing Area (sq mi)	Noncontributing Area (sq mi)	Total Drainage Area (sq mi)
North Platte River upstream of Glendo Reservoir	14,330	1,215	15,545
North Platte River upstream of Alcova Reservoir	10,066	700	10,766
Drainage Area Between Alcova Reservoir and Glendo Reservoir	4,264	515	4,779

* Drainage areas obtained from 1995 Water Year United States Geological Survey Water Resources Data Report, Wyoming.

4-01b. Slope, Shape, and Vegetation. The average slope of the North Platte River from Alcova Dam to Glendo Dam is 6 feet per mile. The drainage basin between Alcova Dam and Glendo Reservoir measures approximately 120 miles long and 80 miles wide. The elevation range in the drainage area from Alcova Dam to Glendo Reservoir varies from 8795 feet msl to 4635 feet msl (top of conservation pool). The primary vegetation is upland grasses. The relative density of the vegetation is sparse to moderate. The higher mountainous regions are densely vegetated with conifer and mountain grasses.

4-01c. Tributaries. Significant North Platte River tributaries between Alcova Dam and Glendo Reservoir are Bates Creek, Casper Creek, Smith Creek, Otter Creek, Beaver Creek, Pole Creek, Deer Creek, Box Elder Creek, La Bonte Creek, and La Prele Creek. Plate 15 shows the contributing tributary basins to the North Platte River above Glendo Reservoir. Plate 16 displays miscellaneous hydrologic information regarding the tributaries.

4-02. Topography and Geology. From Alcova Dam, the North Platte River descends 2 miles through a widening valley to Gray Reef Dam. From Gray Reef to Casper the river is superposed across many complicated structures involving sediment from Cambrian to Cretaceous. From Casper to Glendo the river meanders through a generally wider valley consisting of gently dipping soft gray Upper Cretaceous shales to Careyhurst, across Paleocene Fort Union clays to Douglas, and across White River volcanic ash beds and Miocene deposits of nearly the same character to Glendo Reservoir. From Glendo to Guernsey, the river has cut a shallow canyon in the Pennsylvanian and Permian limestone, sandstone, and shales. At Guernsey Dam, the river course is established in a broad valley cut in the flat-lying Oligocene and Miocene volcanic ash beds and sandstones.

4-03. Soils. The soil types in the basin are influenced by several factors such as parent material, age, and presence of organic material. The soil in the mountainous areas is generally sandy loam and is conducive to good production in the mountain valleys. Top soil is shallow and organic content is low. Care must be used in most irrigated areas due to excessive alkalinity and salinity. The eastern portion of the basin from Guernsey to the state line has predominantly dark brown soils with higher fertility.

4-04. Sediment. In general, the bed material of the North Platte River consists of sand and gravel.

4-05. Climate. The climate of the Glendo Reservoir drainage basin is semi-arid. Most of the air masses reaching this area move in from the Pacific. The mountains to the west of the Glendo drainage basin are effective moisture barriers. About 50 percent of the annual precipitation occurs during the growing season of late spring and summer, April through July, mostly in thunderstorms. Monthly snowfall amounts are unusually uniform from November through February, and a bit heavier in March and April. Snow has occurred as early in the season as September and as late as early June.

The basin experiences large diurnal and annual temperature ranges. This is due to the advent of both warm and cold air masses and the relatively high elevation which permits rapid incoming and outgoing radiation. The mean daily temperature averages about 71 degrees in summer and 22 degrees in winter. Temperatures during winter months average a few degrees higher and summer temperatures average several degrees cooler than locations in the Missouri Valley to the east. Windy days are quite frequent during winter and spring months. Usually the stronger winds are from the southwest and this tends to raise the temperature because the air is moving downslope. Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is September 22 and the average last occurrence in the spring is May 22. Historical climatological data for Casper, Wyoming obtained from the National Climatic Data Center (NCDC) is presented in Table 4-2.

Table 4-2

Historical Climatological Data for Casper, Wyoming

Station	CASPER WSO AP			Parameter	PRCP, SNOW, TMIN, TMAX
County	NATRONA			Record Cnt	45
State	WY			Coverage %	97
ID	1570	Latitude	42:55:00	Begin Date	8 /1948
Elevation	5340.00 ft	Longitude	106:28:00	End Date	5 /1992

Summary of Precipitation, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Avg	0.02	0.02	0.03	0.05	0.07	0.05	0.04	0.02	0.03	0.03	0.02	0.02	0.03
Month Cnt	44	44	44	44	44	43	43	44	44	44	44	44	43
Max Month	1.42	1.42	2.43	3.92	6.46	4.15	3.05	2.66	3.40	2.63	2.72	3.71	20.48
Max Year	1987	1987	1954	1974	1978	1982	1951	1979	1982	1986	1983	1982	1982
Min Month	0.00	0.15	0.25	0.08	0.30	0.03	0.09	0.02	0.07	0.00	0.04	0.03	6.56
Min Year	1957	1953	1992	1966	1956	1956	1991	1950	1956	1965	1949	1952	1988
Av Month	0.53	0.57	0.98	1.44	2.11	1.39	1.14	0.63	0.90	0.92	0.74	0.59	11.98

Summary of Snowfall, in inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Avg	0.34	0.36	0.45	0.42	0.13	0.01	0.00	0.00	0.04	0.19	0.34	0.34	0.22
Month Cnt	44	44	44	44	44	43	43	44	44	44	44	44	43
Max Month	39.20	23.80	36.20	56.30	24.60	3.00	0.00	0.00	11.50	22.40	37.10	62.80	137.60
Max Year	1949	1952	1975	1973	1978	1969	1951	1990	1982	1949	1983	1982	1982
Min Month	0.30	1.50	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	39.00
Min Year	1959	1957	1953	1992	1985	1988	1991	1991	1990	1965	1949	1952	1963
Av Month	10.57	10.11	14.09	12.55	4.17	0.17	0.00	0.00	1.11	5.76	10.35	10.60	80.25

Summary of Minimum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Avg	12	16	21	30	39	48	54	53	43	33	22	15	32
Month Cnt	44	44	44	44	44	43	43	44	44	44	44	44	43
Max Month	23	25	29	34	44	55	59	58	49	41	29	23	35
Max Year	1986	1954	1986	1987	1958	1988	1954	1955	1963	1963	1962	1957	1954
Min Month	-5	2	8	25	34	44	48	48	34	27	8	0	29
Min Year	1949	89	65	51	1950	1969	1972	1974	1965	1984	1985	1983	1985

Summary of Maximum Temperature, in degrees Fahrenheit

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Avg	33	38	45	56	66	78	87	85	74	61	44	35	59
Month Cnt	44	44	44	44	44	43	43	44	44	44	44	44	43
Max Month	44	49	57	65	74	90	93	92	81	69	57	46	62
Max Year	1981	1954	1986	1987	1966	1988	1954	1983	1969	1963	1949	1980	1981
Min Month	17	22	33	47	59	69	81	80	61	49	32	22	56
Min Year	1949	1989	1965	1973	1950	1951	1950	1968	1965	1969	1985	1983	1951

4-06. Flood History. On the mainstem of the North Platte River basin, major floods have occurred in 1909, 1922, 1923, 1924, 1965, 1970, 1971, 1973, 1983, 1984, 1991, 1995, and 1997. There were no abnormal discharge concentrations on the mainstem due to the physical characteristics of the basin with its mountain barriers, and the divergence and sandy composition of the drainage courses. The floods in 1971 and 1973 were the only floods of any consequence since completion of the reservoir system in the North Platte Basin.

4-06a. Flood of 1965. Heavy rains above Glendo were experienced during May and June. The recorded discharge at the Orin gaging station above Glendo Reservoir on 14 June far exceeded the previous maximum of record. The maximum daily inflow to Glendo was 18,840 cfs on 15 May. The average daily inflow for the month of May was 3,860 cfs. The Glendo Reservoir reached its maximum storage of the season of about 566,000 acre-feet, on 18 June, of which 41,000 acre-feet was in the flood control pool. The flood storage was evacuated by 8 July at rates consistent with flood flows originating below Guernsey Reservoir. High flows between the state line and Bridgeport, Nebraska required that Glendo outflows be varied between 15 cfs and 4,120 cfs through May and June to avoid flooding in this reach. Hydrographs of the actual regulation of the May-June 1965 floods are also displayed on Plate 17.

4-06b. Flood of 1970. The seasonal mountain snowpack that drains into the North Platte River was much above average. Forecast into the river system increased from 139 percent of normal on 1 February to 174% on 1 May. On the 26th of May the Glendo Reservoir pool reached a peak elevation of 4639.9 feet msl. With a falling pool, on the 11th and 12th of June a major storm occurred in southeastern Wyoming. Rainfall ranged from 2 to 5 inches along the area of the North Platte River to as much as 6 to 10 inches along some of the tributaries. This resulted in 143,500 of the 271,900 acre-feet total flood control zone being utilized. This was the highest pool level (elevation 4645.34 feet msl) attained since closure in 1956. The pool was in the flood control zone for 69 days. The peak inflow was 17,560 cfs on 13 June. Outflow from Glendo on this date was 500 cfs. Peak outflow for the events was 6,160 cfs on 6 August. Downstream flooding was prevented. See Plate 18 for Glendo Reservoir inflow, outflow and elevation during the 1970 flood.

4-06c. Flood of 1971. The flood of May 1971 in the North Platte River basin was due to large rainfalls occurring during the week on 4 through 11 May. The streams were slightly swollen with lower elevation mountain snowmelt runoff. The week began with 2.5- to 3-inch rainfalls occurring on the 4th and 5th of May throughout the majority of the basin west of Mitchell, Nebraska. This rain thoroughly saturated the soil and caused the first peak. An additional 10 inches of rainfall occurred later in the week in the Laramie River basin, causing the second peak in the reach from Morrill to Lewellen, Nebraska. The second peak caused substantial damage in the Laramie River basin and in the North Platte River basin in the reach from Ft. Laramie to Morrill, Nebraska. Flooding also occurred in the headwater of Lake McConaughy.

Flood damages were observed along a 140-mile reach of the North Platte River. Total damages were estimated at $210,000 which was the worst flood since 1924 in the basin. Glendo

Reservoir was credited with preventing an additional $940,000 in damages. Direct damage included flooded pastureland in the reach from Morrill to Lisco, Nebraska; a restaurant and trailer park were flooded and damaged at Terrytown, Nebraska; basements suffered seepage damage at Torrington, Wyoming and at Scottsbluff, Nebraska, basements were flooded and erosion damage to roads occurred. Table 4-3 indicates the peak stage and discharge at selected sites along with pertinent reservoir data for the 1971 flood. See Plate 19 for Glendo Reservoir inflows, outflows and elevations during the 1971 flood.

Table 4-3
1971 Flood Table - Peak Stages and Discharges

Station	River	Peak Stage (feet)	Peak Flow (cfs)	Date	Period of Record	
					Max GH/Q	Date
Alcova, WY	North Platte	4.89	4,070	16 June	11.5/13,400	1905
Orin, WY	North Platte	8.18	14,000	5 May	10.0/23,800	1965
Bl Glendo, WY	North Platte	9.99	7,260	8 June	9,200	June 1959
Bl Guernsey, WY	North Platte	7.29	8,160	2 June	11.5/30,000	June 1908
Bl Whalen,WY	North Platte	6.31	8,280	4 June	9.85/22,000	June 1955
Nr Ft. Laramie,WY	Laramie	8.04	5,610	6 May	Maximum of Record	
Nr Lingle, WY	North Platte		9,480	16 May	Maximum of Record	
Wy/Ne State Line	North Platte	6.32	9,860	6 June	7.04/17,900	June 1929
Mitchell, NE	North Platte	8.28	12,200	2 June	27,500	June 1909
Minatare, NE	North Platte		14,900	2 June	19,500	June 1917
Bridgeport, NE	North Platte		16,400	3 June	24,900	June 1899
Lisco, NE	North Platte	4.05	13,200	3 June	20,100	June 1917
Lewellen, NE	North Platte		13,500	4 June	Maximum of Record	
Nr Keystone, NE	North Platte	7.25	8,850	10 June	20,300	June 1917
Nr Sutherland, NE	North Platte	5.98	9,090	8 June	20,300	June 1917
Reservoir	**River**	**Peak Elevation**	**Storage (AF)**	**Date**	**Period of Record**	
Glendo	North Platte	4649.08	727,100	24 May	Maximum of Record	
Guernsey	North Platte	4418.72	42,240	8 May	4420.95 - October 1929	
Lake McConaughy	North Platte	3269.1	1,920,000	12-16 July	Maximum of Record	

4-06d. Flood of 1973. The flood of May - June, 1973 on the North Platte River resulted primarily from snowmelt runoff from tributary streams including the Laramie River, the principal tributary to the North Platte River. With the exception of some isolated flash flooding on minor drainages, the flooding in the North Platte River basin was characterized by prolonged peak flows from small uncontrolled tributary streams. Inflow hydrographs, discharges, and reservoir elevations are displayed on Plate 20.

Flooding in the North Platte River basin in Wyoming and Nebraska occurred concurrently with flooding in the South Platte River basin in Nebraska. Isolated flash flooding took place on May 9th, 1973 on a drainage course of the Laramie River between the communities of Rock River and Bosler, Wyoming. The flash flood washed out a 20-foot high abandoned railroad grade, derailed 4 engines and 41 cars of a Union Pacific freight train, and swept an automobile off Highway 30, in Wyoming. Two passengers in the auto were drowned. Also notable was one unconfirmed report of a man drowned in the North Platte River near Scottsbluff, Nebraska. Minor lowland flooding occurred along the Bates, Deer, Horseshoe, Box Elder, and La Bonte Creeks which are rightbank tributaries of the North Platte River in Wyoming. Lowland flooding also occurred along the mainstem of the river between Gray Reef Dam and Glenrock, Wyoming and from the Wyoming-Nebraska state line to North Platte, Nebraska, where the North Platte and South Platte Rivers converge. The extended warming trend throughout the North Platte River basin resulted in continuing snowmelt runoff during the remainder of May and through the month of June. The river between Alcova Dam and Glendo Reservoir remained at or near bankfull during June.

Rural damages in the North Platte River basin were estimated from data obtained by field surveys and by interviews with property owners. Lands affected by flooding were primarily agricultural and timbered lands. Total area flooded in the North Platte River basin was estimated to be 40,000 acres. Approximately 30 persons were displaced by the flood. Urban damages were estimated at $40,000. Transportation losses in the North Platte River basin were estimated to be $400,000, primarily in the category of damage to railroads. Scattered reports of secondary road closings due to flooding on tributaries of the North Platte River were documented. Flood damages to crop and pasture lands and to irrigation structures totaled $560,000. Total damages sustained from the 1973 flood in the North Platte River basin were estimated at $1,000,000. Table 4-4 indicates the peak stage and discharge at selected sites along with pertinent reservoir data for the 1973 flood. Inflow hydrographs, discharges, and reservoir elevations are displayed on Plate 20.

4-06e. Flood of 1983. Precipitation during the month of March of 1983 varied from 200 to 400 percent of normal throughout the North Platte River basin. A 20 to 25 percent improvement was reported in basin snowpack (from 15 percent below normal in February). Heavy snows along Casper Mountain brought snowpack to a near record level for 1 April. Reservoir storage in Seminoe and Pathfinder Reservoirs were 158 and 135 percent of average, respectively. Ninety-one percent of the North Platte ownership was full, while the Kendrick Project and the Glendo Project users occupied 57 percent and percent of their ownerships, respectively. Runoff forecasts for the Alcova to Glendo reach were estimated at 157 percent of normal.

Table 4-4
1973 Flood Table - Peak Stages and Discharges

Station	River	Peak Stage (feet)	Peak Flow (cfs)	Date	Period of Record	
					Max GH/Q	Date
Nr Sinclair, WY	North Platte	8.28	10,400	16 June	9.72/14,500	June 1957
Alcova, WY	North Platte	6.28	7,330	3 June	11.5/13,400	June 1905
Nr Glenrock, WY	North Platte	6.65	13,500	21 May	6.10/16,000	May 1965
Orin, WY	North Platte	8.45	16,000	21 May	10.0/23,800	May 1965
Bl Glendo, WY	North Platte	10.97	9,700	1 June	Maximum of Record	
Bl Guernsey, WY	North Platte	8.00	10,000	7 June	11.5/30,000	June 1908
Bl Whalen, WY	North Platte	6.98	7,540	8 June	9.85/22,000	June 1955
Nr Lingle, WY	North Platte		8,440	25 May	Maximum of Record	
Wy/Ne State Line	North Platte	6.38	8,700	26 May	7.04/17,900	June 1929
Mitchell, NE	North Platte	8.54	8,840	26 May	27,500	June 1909
Nr Minatare, NE	North Platte		8,640	27 May	19,500	July 1917
Bridgeport, NE	North Platte		10,500	28 May	5.39/24,900	June 1899
Lisco, NE	North Platte	3.68	9,690	29 May	20,100	June 1917
Lewellen, NE	North Platte		9,770	27 May	13,500	June 1971
Nr Keystone, NE	North Platte	7.19	7,620	3 June	20,300	June 1917
Nr Sutherland, NE	North Platte	5.32	6,870	12 June	20,300	June 1917

Reservoir	River	Peak Elevation	Storage (AF)	Date	Period of Record	
					Elevation	Date
Seminoe	North Platte	6356.44	999,700	22 July	6359.44	June 1949
Pathfinder	North Platte	5851.90	1,056,000	6-9 June	5858.86	June 1917
Alcova	North Platte	5499.48	183,000	15 May	5499.92	August 1952
Glendo	North Platte	4650.94	758,800	28 May	Maximum of Record	
Guernsey	North Platte	4416.31	36,850	29 April	4420.95	October 1929
Lake McConaughy	North Platte	3265.5	1,808,000	30 June	3269.1	July 1971

June precipitation values ranged from 90 percent to 125 percent of normal from Pathfinder Dam to Kingsley Reservoir. However, the headwaters above Seminoe Reservoir in the North Park area of Colorado had precipitation reported at 190 percent of normal. No significant single runoff event occurred within the basin, rather the June precipitation was a result of random scattered showers throughout the basin.

The operation of the North Platte system was effective in reducing four major flood peaks in addition to providing a significant flow reduction through the month of July. Holdouts from the North Platte Reservoir system were instrumental in reducing the gage height at the Wyoming/Nebraska state line by approximately 3 feet. The flow at the state line gage peaked on 23 July at a stage of 6.57 feet, approximately 8,550 cfs. It was estimated that without the protection afforded by the North Platte Reservoir System, flows of 18,400 cfs and a stage of 9.5 feet would have been experienced at the state line gage.

Since construction of the reservoirs on the North Platte River, a gradual reduction in channel capacity has occurred due to channel changes and encroachment on the channel. The lower than normal river flows resulting from reservoir control and coincident low rainfall runoff have resulted in aggradation and braiding of the streambed. With the advance of channel deterioration and the continuation of low runoff years, vegetation growth has developed. Ranchers have also begun developing the area for agricultural and livestock feeding purposes. Actual operating experience during the spring and summer of 1983 have indicated channel capacities and nondamaging flows to be as noted in Table 4-5. During the Spring of 1995, discharges from Glendo Dam resulting in approximately 5,700 cfs, corresponding to a stage of 5.7 feet, at the Wyoming/Nebraska state line gaging station caused no discernable damages from Glendo Dam to Kingsley Dam. Inflow hydrographs, discharges, and reservoir elevations are displayed on Plate 21.

Table 4-5
1983 Flood Channel Peaks, Capacities and Nondamaging Flows

Reach	Station	Max – 1983 Flow	Max – 1983 Date	Channel Capacity (cfs)	Non-damage Flow (cfs)
Alcova-Glendo	Casper	8,220	08 Jul	7,000	8,000
Glendo-Guernsey	Glendo Rel	10,060	26 Aug	10,000	10,000
Guernsey-Whalen Div	Guernsey Rel	10,280	23 Jul	10,000	10,000
Whalen-Laramie River	Whalen Rel	9,290	23 Jul	8,000	8,000
Laramie River-Tri-St Div	State Line	8,550	23 Jul	6,000	7,000
Tri-St Div-Bridgeport	Tri-St Rel	7,010	17 Jun	5,000	6,000
Bridgeport-Lake Mac	Bridgeport	8,290	28 Jun	5,000	6,000

4-06f. Flood of 1984. The major flooding in the basin occurred on the tributary streams and on the North Platte River upstream from Seminoe Reservoir. The high water conditions experienced downstream from the North Platte Reservoirs were prompted by two factors:

a. The total system storage for the reservoirs on the North Platte River of 2,305,000 acre-feet on 1 March 1984 was the highest carryover value since Glendo Reservoir was filled in 1959. Some of this storage was vacated during March and April prior to the high runoff.

b. The average snowwater content for the eleven stations upstream from Seminoe Reservoir established a maximum 1 May record of 26.2 inches.

The high sustained flows through the Casper, Wyoming reach and downstream from Guernsey Reservoir, however, caused no significant damage. Complaints were received regarding basement flooding, channel erosion, pasture flooding, and adverse effects on recreation.

To accommodate the fluctuations in flows from the Laramie River and the demand for irrigation deliveries, the releases from Glendo Reservoir were adjusted to provide downstream flood control. Adjustments in the releases from Glendo Reservoir were issued by the Omaha District to target flows passing the Wyoming-Nebraska state line gaging station as follows:

14 May - 7,500 cfs
17 May - 8,000 cfs
15 June - 7,500 cfs
19 June - 7,000 cfs
22 June - 6,500 cfs

The flood storage zone was occupied for 51 days. On 5 July, the responsibility for determining the release rates from Glendo Reservoir was returned to the Bureau of Reclamation. The elevation restriction imposed for Glendo Reservoir in December 1983 (elevation 4650 ft msl) reduced the available flood storage to 80 percent and precluded the use of the spillway and surcharge storage zone. The reservoir storage and the inflow/outflow hydrograph for Glendo Reservoir are illustrated on Plate 22. As a system, the North Platte River Reservoirs reduced the peak flow Wyoming-Nebraska state line by 18,430 cfs. Actual peak flow at the state line gage was 8,370 cfs; natural peak flow was calculated to be 26,800 cfs.

Because of the high stages of the Missouri River tributaries after the spring flooding, the snowpack that remained in the eastern slopes, and the high pool elevations of the reservoirs in the North Platte River basin, the Governor of Nebraska requested that the Corps construct advance measures projects at Bridgeport, Scottsbluff, and North Platte, Nebraska. Field investigations were performed and proposals developed for each site. After review of the proposed project for Bridgeport, the locals performed the necessary work themselves and brought their levee system up to the required specifications. The project developed for Scottsbluff was approved by the Office of the Chief of Engineers; however, the local assurances could not be obtained. Because the project lacked local support, it was not completed. The advance measures project for North Platte was approved, subject to imminent need. It was not constructed because the high water conditions did not materialize. A total of $9,175 was expended in the investigation and preparation of the advance measures projects in the State of Nebraska. No significant damage was reported in the North Platte River basin.

4-06g. Flood of 1991. Heavy precipitation in the North Platte River basin directly upstream of Glendo Reservoir in early June caused the pool to enter the flood control zone. Releases were increased from 16 cfs on 5 June to a maximum of 3,160 cfs on 8 June. Inflows, which had been steady at approximately 1,500 cfs, rose to a maximum of 5,858 cfs on 3 June. The pool was in the flood control zone from 2 June to 29 June. No damages were incurred downstream.

4-06h. Flood of 1995. Large snowfall amounts in mid-May downstream of Alcova Dam set the area for larger than normal snowmelt runoff. The upstream projects, Seminoe and Pathfinder, were only 30 to 40 percent full, so releases from those projects was kept minimal.

June 1 snowfall amounts at Casper mountain snow pillow station was 26.0 inches of snow water equivalency. The 30-year average for June 1 at the station is 3.5 inches. Likewise, the Reno Hill snow pillow station registered 24.1 inches June 1, with a 30-year average of only 2.9 inches.

Glendo entered the flood control pool May 21 at 1400 hours MDT. Releases were 0 cfs and inflow was 4,700 cfs. The Corps increased releases to 3400 cfs, full power plant capacity, over a 4-day period. Reclamation issued a press release outlining the releases and advised citizens to remain alert to changing river and reservoir conditions.

Large rains in the upper Laramie River basin downstream of Glendo Dam caused inflows into the Grayrocks Reservoir, owned and operated by Basin Power Electric, to increase from 950 cfs to 3,000 cfs. The releases were uncontrolled from Grayrocks. Therefore, releases from Glendo were reduced to minimize downstream flooding.

The discharges from Glendo were eventually increased to 3,200 cfs to lower the pool. See Plate 23 for the inflow hydrograph, discharges and reservoir elevations.

The North Platte River gaging station at the state line peaked at a stage of 5.72 feet and a discharge of approximately 5,700 cfs. No damages were incurred in downstream cities due to releases. Refer to Table 4-6 for peak discharges, natural and regulated, from the 1995 flood.

Table 4-6
1995 Flood Natural and Regulated Peaks

North Platte River at	Natural Peak (cfs)	Regulated Peak (cfs)
State Line	19,800	5,660
Lewellen	21,400	7,240

4-06i. Flood of 1997. In April 1997, two Corps personnel traveled to Scottsbluff, Nebraska to assess the flood impact potential as part of Emergency Management Advance Measure Program. The results of the field reconnaissance and ensuing HEC-2 model runs indicated that the Scottsbluff proper area had an in-channel conveyance capacity of approximately 10,000 cfs. The Cottonwood Glen housing development located upstream, northwest of Scottsbluff proper, would receive some damages from North Platte River flows exceeding 6,000 cfs. No advance measure construction (e.g. dike, channel cutoff, levee) was initiated. Flows exceeding 6,000 cfs do inundate some biking/walking trails in the Scottsbluff area.

Several considerations are given in determining releases from Glendo Dam: 1) incremental inflows downstream from Glendo Dam and upstream of the re-regulating Guernsey Dam, which has a total storage capacity of only 30,000 acre-feet; 2) downstream irrigation canal diversions from the North Platte River; 3) releases from Grayrocks Dam on the Laramie River; and 4) incremental inflows between Guernsey Dam and the Nebraska communities along the North Platte River including Mitchell, Scottsbluff, Bridgeport, Lisco, and Lewellen.

Glendo Reservoir entered the flood control pool 31 May at 0600 hours MDT. The discharge was 3,000 cfs. The inflows into Glendo Reservoir rose from 4,500 cfs on 30 May to over 5,300 cfs on 1 June. Inflows remained high and were expected to remain high due to the upper reservoir system releases. Glendo releases were increased to 3,700 cfs on 3 June but were later reduced back to 3,000 cfs the same day to ease downstream concerns. The North Platte River at Bridgeport was peaking at the time from large localized rains. Residents were concerned that increased Glendo releases would add to the flooding.

On 5 June, the North Platte River flows at Bridgeport had peaked and the Bureau of Reclamation had decided to increase upper system (Seminoe, Pathfinder, Alcova, Gray Reef) releases. In response, the Corps increased Glendo releases to 4,000 cfs. Glendo inflows were 4,760 cfs.

On 9 June, with upper system releases maintained and the downstream channel showing adequate capacity, the Glendo releases were increased to 5,000 cfs. The Kingsley Dam/Lake McConaughy manager voiced his concerns that high peaking South Platte River flows along with the high North Platte River flows would force him to increase Kingsley Dam increases and add to the peak on the Platte River. The Corps would monitor the situation, and if needed, reduce Glendo releases by 2,000 cfs to 3,000 cfs for a 5 to 7 day period to reduce downstream flooding.

On 16 June, the Kingsley Dam/Lake McConaughy manager informed the Corps that Federal Energy Regulatory Commission (FERC) had given permission to store an additional 60,000 acre-feet in Lake McConaughy. Thus, no release reductions from Glendo Dam were necessary.

On 19 June, releases from Glendo Dam were increased 150 cfs to a total of 5,150 cfs. The increase was needed to stabilize Guernsey Reservoir. No increase in Guernsey Reservoir release resulted.

On 26 June, the Platte River peaked past the areas of Kearney, Grand Island, and Cozad, Nebraska. Glendo Reservoir releases were increased to 5,500 cfs to begin evacuating water from the flood control pool.

On 3 July, silt run operations began. Glendo Reservoir releases were lowered to 1,400 cfs for a 5-day period to draw Guernsey Reservoir down. Glendo Reservoir releases were then increased to 5,500 cfs to flush sediment from Guernsey Reservoir to the channel banks of downstream irrigation canals. The Glendo Reservoir discharge of 5,500 cfs was maintained until Glendo Reservoir exited the flood control pool on 25 July.

Maximum pool attained was 4,639.24 ft msl on 9 July. Maximum daily inflow was 5,964 cfs attained 16 June. See Plate 24 for the inflow hydrograph, discharges, and reservoir elevations.

4-07. Runoff Characteristics. Plates 46 and 47 display the storage volume probabilities and pool elevation probabilities, respectively, for Glendo Reservoir. The volume probabilities are determined by 1) selecting the consecutive high 1-day, 15-day, 30-day, and 60-day daily storages for each year (1958-1993) and 2) using Log Pearson Type III analysis to determine the corresponding frequencies. The closeness of the four curves on Plate 46 indicate how Glendo Reservoir storages have not fluctuated a great deal historically. Plate 48 shows the historical pool elevations for Glendo Reservoir. Plates 49 and 50 show historical maximum daily elevations, inflows, and outflows and historical monthly inflows, respectively.

4-07a. Infiltration Losses. The estimated infiltration rate of the soil from Alcova Dam to Glendo Dam varies from .15 inches per hour to .50 inches per hour.

4-07b. Streamflow. Tables 4-7 and 4-8 present USGS station data relating to Glendo Dam and Reservoir. The frequencies were estimated using the USGS historical flow information retrieved from the WATSTOR database and Log Pearson Type III analysis with the USGS program J407. No refinements to the frequency curves were made. It should be noted that these estimates are preliminary as analyzed curves were derived using regulated flows. The flow in the North Platte River has a seasonal pattern. During the winter, there is very little flow. The river develops an ice cover, but a flow continues based on the release from Gray Reef. In the early spring, the melting of snow in the mountains is accompanied by precipitation which causes the river to rise.

Table 4-7
North Platte River and Tributary Peaks

Station ID	Station	Period of Record	Record Peak (cfs)	Date of Peak	Frequency of Peak
06642000	North Platte River at Alcova, WY	1904-	13,400	06/06/05	> 100 yrs
06643500	North Platte River near Goose Egg, WY	1951-	8,850	06/12/84	na
06645000	North Platte River below Casper, WY	1929-59	13,800	05/30/29	> 50 yrs
06645150	Smith Cr abv Otter Cr, nr Casper, WY	1979-	25	05/10/88	na
06646164	Otter Cr at mouth, near Casper, WY	1988-	25	05/13/88	na
06645166	Smith Cr blw Otter Cr, nr Casper, WY	1988-	53	06/02/91	na
06645174	Beaver Cr abv Pole Cr, nr Casper, WY	1988-	28	06/02/91	na
06645178	Pole Cr near Casper, WY	1988-	41	06/02/91	na
06646000	Deer Cr in Canyon, nr Glenrock, WY	1946-	3,200	06/10/86	> 25 yrs
06646600	Deer Cr bl Millar WW, at Glenrock, WY	1961-	14,200	06/12/70	na
06646800	North Platte River near Glenrock, WY	1960-	16,000	05/14/65	> 50 yrs
06647500	Box Elder Cr at Boxelder, WY	1946-	4,530	05/14/65	> 100 yrs
06649000	La Prele Cr near Douglas, WY	1920-	17,300	06/12/70	> 100 yrs
06652000	North Platte River at Orin, WY	1895-	23,800	05/15/65	> 25 yrs
06652800	North Platte River blw Glendo Res	1958-	10,300	06/29/84	50 yr
06653300	Horseshoe Cr near Cassa, WY	1962-	7,850	06/14/65	na
06653500	Horseshoe Cr near Glendo, WY	1928-	11,900	05/30/35	> 50 yrs
06656000	North Platte River blw Guernsey Res	1903-	30,000	06/02/08	> 100 yrs

Note: Frequency of peak was not calculated for streams with records less than 30 consecutive years.

Table 4-8
North Platte River and Tributary Flow Frequencies

Station ID	Station	5-Yr Flow (cfs)	10-Yr Flow (cfs)	25-Yr Flow (cfs)	50-Yr Flow (cfs)	100-Yr Flow (cfs)
06642000	North Platte River at Alcova, WY	6,470	7,940	9,890	11,460	13,100
06645000	North Platte River blw Casper, WY	8,320	9,690	11,500	13,100	14,700
06646600	Deer Cr in Canyon, nr Glenrock, WY	1,280	1,960	3,080	4,260	5,380
06646800	North Platte River nr Glenrock, WY	6,940	8,990	12,200	15,200	18,700
06647500	Box Elder Cr at Boxelder, WY	1,090	1,630	2,510	3,380	4,400
06649000	La Prele Cr near Douglas, WY	1,370	2,290	4,040	5,960	8,520
06652000	North Platte River at Orin, WY	11,200	15,700	23,000	30,300	39,000
06652800	North Platte River blw Glendo Res	8,240	8,880	9,690	10,200	10,900
06653500	Horseshoe Cr near Glendo, WY	1,130	2,250	4,850	8,310	13,600
06656000	North Platte River blw Guernsey Res	7,870	9,320	11,400	13,200	15,200

Note: All stations have at least 30 years of continuous record. Preliminary estimates of frequency based on analytical analysis of regulated flows.

4-07c. Travel Times. North Platte River flow travel times vary depending on the flowrate in the river. Table 4-9 illustrates near bankfull travel times.

4-08. Water Quality. The major contribution to water quality occurs in the Gray Reef to Glendo river section, which is one of the more heavily populated areas of Wyoming. Providing a live flow in the river year-round, significantly increases winter flow past Casper, Douglas, and other communities. Water quality is monitored at a number of sites in the watershed by the United States Geological Society. Frequency and location of sampling varies each year as funding is available.

4-09. Channel and Floodway Characteristics. The channel length downstream of Glendo Dam to the headwaters of Guernsey Reservoir is approximately 20 miles. The capacity of the downstream channel is 10,000 cfs. Rating curves for stations upstream and downstream of Glendo Dam are presented on Plates 25 through 41. Discharge relationships of key stations upstream and downstream of Glendo Dam are shown on Plate 42. The locations of the stations are shown on Plate 43. Additional flow from the Laramie River below Guernsey may cause Glendo releases to be reduced to maintain a safe channel capacity flow at the Wyoming/Nebraska state line to avoid flooding in Scottsbluff and Gering, Nebraska. Refer to Table 4-5 for downstream channel capacities and non-damaging flows. No other significant channel restrictions or encroachments are currently present.

Table 4-9
North Platte & Laramie River Travel Times

RIVER	FROM	TO	TRAVEL TIME
North Platte	Alcova Dam	Gray Reef Dam	1 hour
North Platte	Gray Reef Dam	Orin, Wy gaging station	2 days
North Platte	Orin gaging station	Glendo Dam	1 day
North Platte	Glendo Dam	Guernsey Dam	12 hours
North Platte	Guernsey Dam	Confluence N. Platte/ Laramie River	14 hours
Laramie	Grayrocks Dam	Confluence N. Platte/ Laramie Rivers	8 hours
North Platte	Confluence N. Platte/ Laramie Rivers WY	WY/NE state line	16 hours
North Platte	WY/NE Stateline	Mitchell, NE gaging station	24 hours
North Platte	Mitchell, NE gaging station	Scottsbluff, NE	12 hours
North Platte	Scottsbluff, NE	Minatare, NE gaging station	12 hours
North Platte	Minatare, NE gaging station	Kingsley Dam	2 days

4-10. Upstream Structures. Dikes upstream of Glendo Dam are discussed in Section 2-03b and upstream Dams and Reservoirs are referenced in Section 3-04. Non-Reclamation structures between Alcova and Glendo consist of the Amoco oil refinery diversion dam at Casper, the Dave Johnston Powerplant water intake near Glenrock, municipal water intakes, highway bridges, railroad bridges, and pipeline crossings.

4-11. Downstream Structures Between Glendo Dam and Guernsey Reservoir. Besides the Glendo Powerplant and outlet works, the Bureau of Reclamation has three low water crossings in the river between Glendo Dam and the Glendo Powerplant. One is used by Reclamation to permit access to and maintenance of the Glendo Dam low flow outlet and the base of the dam. One is no longer used for access by vehicles but has pedestrian access across a foot bridge. The other low water crossing provides recreational access to Reclamation and state lands across the river from the powerplant. A private bridge exists across the river several miles below Glendo Dam.

4-12. Economic Data.

4-12a. Population. Census information on the State of Wyoming, counties, and cities are presented in Table 4-10.

Table 4-10
State of Wyoming Census Information

Population							
Location	1990	1980	1970	1960	1950	1940	1930
State of Wyoming	453588	469,557	332,416	330,066	290,529	250,742	225,565
Converse County, WY	11,128	14,069	5,938	6,366	5,933	6,631	7,145
Natrona County, WY	61,226	71,856	51,264	49,623	31,437	23,858	24,272
Platte County, WY	8,145	11,975	6,486	7,195	7,925	8,013	9,695
City of Casper, WY	46,742	51,016	39,361	38,930			
City of Douglas, WY	5,076	6,030	2,677	2,822			
City of Glendo, WY	195	367	210	292			
City of Glenrock, WY	2,153	2,736	1,515	1,584			

4-12b. Agriculture. The major crops of the North Platte Valley below Guernsey Dam are sugar beets, dry edible beans, corn, and alfalfa hay.

4-12c. Flood Damages. Total flood damages prevented by the North Platte River projects are shown in Table 4-11.

Table 4-11
North Platte Reservoir System - Flood Damages Prevented

	Seminoe		Pathfinder		Alcova		Glendo		Guernsey	
		Cumulative		Cumulative		Cumulative		Cumulative		Cumulative
	Damages	Damages	Damages	Damages	Damages	Damages	Damages	Damages	Damages	Damages
Year	Prevented	Prevented	Prevented	Prevented	Prevented	Prevented	Prevented	Prevented	Prevented	Prevented
	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)
1958							0	0		
1959							0	0		
1960							0	0		
1961							0	0		
1962							0	0		
1963							0	0		
1964							0	0		
1965							1,830	1,830		
1966							0	1,830		
1967							0	1,830		
1968							0	1,830		
1969							0	1,830		
1970							1,700	3,530		
1971							940	4,470		
1972							0	4,470		
1973							2,450	6,920		
1974							18	6,938		
1975							36	6,974		
1976	0	4,360	0	660	0	150	0	6,974	0	430
1977	0	4,360	0	660	0	150	0	6,974	0	430
1978	40	4,400	9	669	1	151	1,080	8,054	0	430
1979	0	4,400	0	669	0	151	220	8,274	0	430
1980	74	4,474	27	696	1	152	2,000	10,274	0	430
1981	0	4,474	0	696	0	152	0	10,274	0	430
1982	45	4,519	0	696	2	154	2,360	12,634	0	430
1983	2,110	6,629	2,110	2,806	0	154	1,890	14,524	0	430
1984	2,620	9,249	1,950	4,756	17	171	4,310	18,834	12	442
1985	0	9,249	0	4,756	0	171	548	19,382	0	442
1986	590	9,839	3	4,759	25	196	9,070	28,452	0	442
1987	0	9,839	0	4,759	0	196	453	28,905	0	442
1988	0	9,839	0	4,759	0	196	0	28,905	0	442
1989	0	9,839	0	4,759	0	196	0	28,905	0	442
1990	0	9,839	0	4,759	0	196	0	28,905	0	442
1991	200	10,039	40	4,799	17	213	4,730	33,635	0	442
1992	0	10,039	0	4,799	0	213	440	34,075	0	442
1993	3,170	13,209	540	5,339	17	230	3,000	37,075	0	442
1994	0	13,209	0	5,339	0	230	1,920	38,995	0	442
1995	5,770	18,979	1,570	6,909	46	276	3,700	42,695	0	442
1996	1,010	19,989	480	7,389	100	376	3,160	45,855	0	442

Note: The Corps of Engineers officially began calculating flood damages prevented for non-flood control projects on the North Platte River system in 1976.

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V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations.

5-01a. Facilities. Plate 43 displays the USGS streamflow stations and Natural Resources Conservation Service (NRCS) hydrometeorological stations in the Platte River basin. Hydrologic inflow forecasting is discussed in Section 6-01.

5-01b. Reporting. Data Collection Platforms (DCPs) are located at streamflow stations are shown on Plate 43. River stages are transmitted via telemetry and are received in the Corps Water Control Office. Reclamation's Wyoming Area Office computes daily inflow, storage and outflow at the Reclamation projects upstream and downstream of Glendo Dam. The USBR maintains the hourly elevation and storage and daily computed inflow and outflow data on its VAX computer in its Billings, Montana regional office. The Natural Resource Conservation Service (NRCS) maintains the snow course and snow pillow information on its computer database in Portland, Oregon. The National Weather Service (NWS) in Cheyenne, Wyoming maintains a database of all observer readings. The Omaha District, Corps of Engineers, Water Control office accesses the Reclamation's database daily and the NRCS database at least monthly to download data. The NWS office transmits observer precipitation readings via facsimile each month and after significant events. Plates 44 and 45 display the precipitation and snow course stations in the North Platte River basin, respectively.

5-02. Water Quality Stations. Monthly water quality samplings were obtained by the USGS in cooperation with the Wyoming State Department of Environmental Quality and Reclamation from 1984 to 1991 at Deer Creek in the canyon, near Glenrock, WY and at the North Platte River at Orin, WY. The samplings were obtained to detect chemical, microbiological and pesticide amounts. The water quality data are stored in the USGS database WATSTOR and the EPA's database STORET.

5-03. Sediment Stations. At the present time, no sediment sampling is done between Alcova Dam and Guernsey Reservoir.

5-04. Recording Hydrologic Data. Historical average daily records are stored on the USGS permanent database WATSTOR. The Corps Hydrology and Water Control Office also stores the historical and real-time information in their HECDSS database.

5-05. Communication Network. Flood control operations will be initiated by the Reclamation's Wyoming Area Projects office staff under the direction and regulation of the Corps' Hydrology and Water Control Section, Omaha District, in Omaha, Nebraska.

If increased releases from the powerplant and/or river outlet works are required, and these will cause flooding downstream, the Casper Control Center will ensure that all local downstream residents and public agencies are contacted. The Communications Directory is shown in Appendix A.

5-06. Communication Between Reclamation and the Corps.

5-06a. Regulating Office with Area Office. The Corps of Engineers has flood control regulating responsibilities of Glendo Dam and Reservoir. The USBR Wyoming Area office will contact the Casper Control Center who will then contact the Corps' Water Control Section via telephone when the pool has entered the flood control pool to receive release regulation instructions. All release orders will be provided in writing. The information to be reported should include:

1) Current reservoir water surface elevation;

2) Observed rate of filling of reservoir;

3) Weather conditions in the vicinity - past, present, and predicted;

4) Discharge conditions of the North Platte River above and below the reservoir; and

5) Known conditions at Guernsey Dam and Reservoir and discharge through Guernsey Powerplant and outlet gates.

5-06b. Communication Between Reclamation and Others. Reclamation's Wyoming Area Office is charged with making the appropriate communications regarding potential flood control releases. The Area Office and the Corps will coordinate the contacting of the appropriate county and city emergency operations offices.

5-07. Reporting Instructions. Reference the Field Working Agreement, Appendix B, Exhibit II.

5-08. Warnings. Reference Appendix A for the Communications Directory.

VI - HYDROLOGIC FORECASTS

6-01. General. Reservoir inflow forecasting is completed on a routine basis. Reclamation provides a monthly inflow forecast for April-July snowmelt runoff. The forecasts are completed 1 February, 1 March, 1 April, and 1 May each year. Spring runoff is composed of a combination of three components: 1) existing soil moisture during October and November prior to the winter freeze, referred to antecedent runoff; 2) the winter snowfall, referred to as snowpack; and 3) the spring rainfall during the months of April, May, and June, referred to as precipitation. Multiple linear regression correlation studies were made relating independent variables (antecedent runoff, snowpack, and precipitation) to the dependent variable (April through June runoff). The forecast development was based on thirty years (1966 to 1995) of data.

The USBR, NRCS and Corps complete independent inflow forecasts. To ensure that the values calculated are independent, the forecast methods are not shared between agencies. The three agencies' forecasts are all listed on the USBR monthly bulletin that is distributed to all interested parties. The USBR uses their forecast to determine necessary releases so as not to encroach into the flood control pool. The NRCS uses their forecast to ascertain the accuracy of their snow stations and overall snowmelt runoff. The Corps of Engineers uses their forecasts to anticipate if encroachment into the flood control pool will occur. And if encroachment will occur, the Corps uses the forecast to determine the extent of releases necessary for flood control regulation.

6-01a. Role of Corps. The Water Control office is responsible for providing their in-house April-June inflow forecasts for Glendo Reservoir each month starting 1 February to 1 May. The original forecasting procedure was developed in November of 1971 and updated in September of 1973. The forecast procedure was updated in early 1996 and was utilized during the 1996 runoff season. Inflow forecasting is dependent on drainage basin events plus releases by Reclamation from the upstream reservoir system.

a. Dependent Variable. Natural incremental runoff downstream of Alcova Dam is the dependent variable in the forecast procedure. The natural incremental runoff is the inflow to Glendo Dam less releases lagged from upstream Alcova Dam.

b. Independent Variables.

1. Antecedent Runoff. Natural incremental inflow during October and November represents initial moisture conditions prior to snowpack and spring precipitation. The antecedent runoff is calculated similarly to the natural incremental runoff.

2. Snowpack. Snowpack snowwater content data is available from the Natural Resources Conservation Services (NRCS) SNOTEL (SNOw TELemetry) system. The seven

snow stations used in the forecast procedure are Boxelder, Buck Creek, Casper Mountain, LaBonte, LaPrele, Reno Hill, and Windy Peak.

3. Spring Precipitation. Precipitation data for the months of April, May, and June were obtained from the NRCS. The three precipitation stations used in the forecast procedure are Casper WSO AP, Gas Hills 4E, and Glenrock 5ESE.

6-01b. Role of Other Agencies. Computer programs are utilized by the Water and Land Operations Division at the Wyoming Area Office each October to develop water supply forecasts and operation plans for North Platte River reservoirs, which include Glendo Reservoir. These operation plans are published in the Annual Operating Plan. Operating plans are prepared for the reasonable maximum, most probable, and reasonable minimum conditions of water supply and requirements. The plans are restudied and revised during the first week of February, March, April, and May to reflect new information and changing conditions. The plans serve as a general guide to assist in management decisions of the North Platte River Projects. The plans also help to use the most probable water supply without jeopardizing operations should either reasonable maximum or reasonable minimum conditions occur.

6-02. Flood Condition Forecasts.

6-02a. Requirements. Reclamation and the Corps both rely on the NWS forecasts during the summer months for information on severe rainstorms which could potentially cause flood conditions.

6-02b. Methods. The Corps accesses the NWS forecasts via telephone modem and the internet several times each day.

6-03. Conservation Purpose Forecasts. Under the requirements of the Reclamation Reform Act, most of the irrigation districts having contracts to receive water from Glendo Reservoir are required to prepare and submit conservation plans to Reclamation. Forecasts are provided to water user entities to encourage water conservation and management. Individual storage and carryover storage accounts for Glendo contractors encourage water user entities to conserve water and carry it over for use in subsequent years. These forecasts are solely the responsibility of the USBR. The USBR has the responsibility of regulating the project in all zones except the authorized flood control zone which extends from elevation 4635 to 4653 feet msl in Glendo Reservoir.

6-04. Long-Range Forecasts. See sections 4-07 and 6-0 for discussion on inflow forecasts.

6-05. Drought Forecast. Neither the USBR or the Corps calculate drought forecasts for Glendo Dam and Reservoir.

VII - WATER CONTROL PLAN

7-01. General Objectives. The objective of the water control plan is the prevention or reduction of flood damages along the North Platte River in Wyoming and Nebraska from Glendo Dam to Lake McConaughy (Kingsley Dam). Storage accumulated in the flood control operation of Glendo Reservoir shall be evacuated as rapidly as practicable consistent with downstream limitations. Exhibit I in Appendix B, Flood Control Regulations, Part 208, outlines the authority and responsibilities pursuant to flood control regulation of Glendo Dam and Reservoir. Plate 51 shows a schematic of Glendo Reservoir storage zones. The Reservoir Regulation schedule is located on Plate 52. The schedule should be used in accordance with paragraphs (a) through (e) of the Flood Control Regulations. Flood control releases from Glendo Dam shall be scheduled as required to pass Alcova Reservoir outflows together with that portion of the incremental flow originating between Alcova and Glendo Reservoirs

7-02. Constraints. The maximum outlet works discharge is 13,000 cfs. The maximum spillway discharge is 10,335 cfs. The maximum safe channel capacity between Glendo Dam and Guernsey Reservoir is 10,000 cfs. Guernsey Reservoir has virtually no storage capacity. Thus, any releases from Glendo Dam will ultimately be pass through Guernsey Dam. North Platte River channel capacities and non-damage flows are shown in Table 4-5 and discussed in paragraph 4-09.

7-03. Overall Plan for Water Control. The Field Working Agreement between the Corps and Reclamation, Appendix B Exhibit II, describes working relationships and responsibilities between the two agencies. Located in Appendix B, Exhibit III is a Memorandum of Understanding between the Corps and Reclamation written after the 1983 North Platte River flood.

7-04. Standing Instructions to Facility Manager. The Standing Instructions to the facility manager for flood control regulation of Glendo Dam and Reservoir during periods when communications fail is located in Appendix B, Exhibit IV.

7-05. Flood Control.

7-05a. Normal Flood Control Regulation. Normal flood control regulation is defined to occur when the reservoir elevation is in the flood control pool (4635.0 feet to 4653.0 feet msl) and when 1) supervisory control is functioning and telephone or radio communication between the Wyoming Area Office and the Corps in Omaha is available or when 2) telephone and radio communication is not available **but** hydrologic and meteorological conditions are such that flooding, flood damages or rapid pool elevation increases are not anticipated. Instructions for normal regulation for flood control are located in Standing Instructions (see Appendix B, Exhibit IV).

7-05b. Emergency Flood Control Regulation. Emergency flood control regulation will only occur if 1) The Wyoming Area Office cannot communicate with the Corps; 2) the Wyoming Area Office loses supervisory control of Glendo Dam; or 3) the facility manager cannot communicate with the Corps or the Wyoming Area Office. Regulation action other than required in the latest available regulation orders may be necessary in order that the project may properly fulfill its objective of flood control. Instructions have been formulated to provide as high a degree of flood protection as practicable, within the safe capability of the project, and based only on meteorological and hydrologic conditions of which the facility manager has knowledge. The instructions for emergency regulation for flood control are also located in the Standing Instructions (see Appendix B, Exhibit IV). Included in the Standing Instructions is Figure C-1, Emergency Regulation Schedule.

7-06. Recreation. No special releases or constraints for recreation exist.

7-07. Water Quality. Compliance with Public Law 92-500 requires that all federal facilities be managed, operated, and maintained to protect and enhance the quality of water and land resources through conformance with applicable federal, state, interstate, and local substantive standards.

Glendo Reservoir impounds sediment, aids in pollution abatement, and improves the quality of municipal and industrial water. The major contribution to water quality occurs in the Gray Reef to Glendo Dam river section, which is one of the more heavily populated areas of Wyoming. Providing a minimum flow in the river year-round in accordance with public law significantly increases winter flows past Casper, Douglas, and other communities. These releases are normally accomplished through conservation releases which are the responsibility of the USBR.

7-08. Fish and Wildlife. The Wyoming Game and Fish department patrols the area to monitor compliance with Fish and Wildlife and boating regulations and stocks Glendo Reservoir with fish. The flow of water below Glendo is critical during the hot summer months in so far as fish habitat is concerned. Currently Reclamation is not required to follow any special regulation provisions that may alleviate or respond to emergency conditions, such as fish kills, flow augmentation for pollution abatement, or aesthetics. No mandated minimum instream flows are required below Glendo Dam. Historically, at the close of the irrigation season, Glendo Powerplant was shut down for the winter and all releases from Glendo Reservoir were discontinued until the following spring. However, in 1992 Reclamation installed a low flow outlet works in the dam which allows for low flows to be released for fish and wildlife habitat improvement below the dam. The low flow outlet has been operated to provide flows of approximately 25 cfs throughout the year since March 24, 1993.

7-09. Water Supply. The Amended Supreme Court decree (1953) between Wyoming, Nebraska, and Colorado allows for the use of a maximum of 40,000 acre-feet per year of Glendo water for irrigation. Of this amount, 15,000 acre-feet is available for irrigation in Wyoming. Below Guernsey, 25,000 acre-feet is available for irrigation in western Nebraska.

7-10. Hydroelectric Power. Reclamation is responsible for all hydropower generation at Glendo. Power generation is incidental to the primary purposes of regulating river flows for irrigation and flood control. The minimum head needed for power generation is reservoir elevation 4570.00 feet msl.

7-11. Navigation. The North Platte River is classified as a non-navigable river.

7-12. Drought Contingency Plans. Currently, Glendo Reservoir does not have a drought contingency plan.

7-13. Flood Emergency Action Plans. Reclamation's SOP contains an Emergency Preparedness Plan section, complete with notification procedures and 21 inundation maps which cover from Glendo Dam to Lewellen, Nebraska.

7-14. Deviation from Normal Regulation. The District Commander is occasionally requested to deviate from normal flood control regulation of the Reservoir. Prior approval for a deviation is required from the Missouri River Region Engineer except as noted in Section 7-14a. Deviation requests usually fall into the following categories:

7-14a. Emergencies. Examples of some emergencies that can be expected to occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. The District must inform the Missouri River Region as soon as practicable. The District will prepare a written confirmation of the deviation and a description of the cause and furnish it to the Missouri River Region water control manager.

7-14b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal flood control regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threat, condition of the reservoir, water supply demands, fishery and instream flows, and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied providing there are no foreseen adverse effects on the overall regulation of

the project for the authorized purposes or adverse environmental consequences. Approval for these minor deviations normally will be obtained from the Missouri River Region office by telephone. Written confirmation explaining the deviation and its cause will be furnished to the Missouri River Region water control manager.

7-14c. Planned Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, reservoir and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the District recommendation, will be presented by letter or facsimile to the Missouri River Region for review and approval.

7-15. Rate of Release Change. Table 7-1 displays the normal allowable rate of increase and decrease in releases of the Glendo Powerplant.

Table 7-1

Schedule for Shutdown of the North Platte River
Glendo Powerplant Discharge
End of Irrigation Season

1. Discharge can be reduced to 1,500 cfs at any desired rate.
2. When dropping below 1,500 cfs, use the following schedule:
   Assume that 1,500 cfs is reached at 6:00 a.m.
   A. Discharge 1,500 cfs, 3-hour minimum, to 9:00 a.m.
   B. Discharge 1,000 cfs, 2-hour minimum, to 11:00 a.m.
   C. Discharge 500 cfs, 2-hour minimum, to 1:00 p.m.
   D. Discharge 350 cfs, 2-hour minimum, to 3:00 p.m.
      (Requires outlet gate open 4-1/2 inches).
   E. Discharge 260 cfs, 2 days (48 hours)
      No peaking periods should be introduced into this step.
      (Requires outlet gate open about 3-1/2 inches).
   F. Shut off discharge to 0 cfs.

Note: Steps 2A through 2E require 1,710 acre-feet to accomplish.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. Overall effects and benefits from the projects include mainly irrigation and flood control. Secondary benefits include recreation, power generation, fish and wildlife conservation, sediment retention, pollution abatement, and improvement of the quality of municipal and industrial water supply.

8-02. Flood Control.

8-02a. Spillway Design Flood. The spillway design flood for Glendo Dam and Reservoir was developed by the Bureau of Reclamation. The spillway design flood is a rare hypothetical flood composed of a snowmelt component from the drainage area above Pathfinder Reservoir and a rainstorm flood component from the drainage area between Alcova Dam and Glendo Dam. The flood has a peak inflow of 180,000 cfs and 15-day volume of 849,000 acre-feet. The flood was routed through the reservoir assuming the reservoir to be at the bottom of the flood control zone at the beginning of inflow, outflow equal to inflow until inflow exceeded 10,000 cfs, and discharge limited to 10,000 cfs until storage level reached the spillway crest, elevation 4653.0 feet msl. This routing resulted in a maximum water surface of 4669.0 feet msl and a maximum combined outlet works and spillway discharge of 23,185 cfs. This flood routing is illustrated on Plate 54.

8-02b. Project Design Flood. The Standard Project Storm and Flood (SPF) for the Glendo drainage area developed in 1949 was used in determining the flood control storage requirements for Glendo Reservoir. The SPF has a peak discharge of 125,800 cfs and a total flood volume of 368,000 acre-feet. The SPF was routed through Glendo Reservoir assuming the reservoir level was at the base of the flood control zone at the beginning of the flood, that Alcova releases would be reduced to required Gray Reef minimum flows (Alcova water in transit at beginning of flood would contribute to Glendo inflow), and that Glendo Reservoir would be operated such that outflow would equal inflow until 10,000 cfs was being released. This routing results in a maximum storage of 270,000 acre-feet in the flood control pool. It was recommended that 275,000 acre-feet of flood control space be provided. This total storage capacity provides 5,000 acre-feet for operational lag time at the Alcova and Glendo Dams. The design routing is illustrated on Plate 53.

The standard project flood was also routed utilizing the regulation schedule (Plate 52) and the January 1965 capacity tables. This routing, referred to as the Reservoir Design Flood Routing, is shown on Plate 55. This routing resulted in a maximum water surface elevation of 4653.6 feet msl and a maximum storage of 806,290 acre-feet.

8-02c. Probable Maximum Flood. The original Inflow Design Flood (IDF), otherwise referred to as the spillway design flood, was approved on June 22, 1951, and resulted in a peak inflow of 180,000 cfs with a 15-day volume of 849,000 acre-feet. This flood was based on the transposition and adjustment of the Warrick, Montana storm on June 2-8, 1906 to the surface drainage area between Alcova and Glendo Dams. The flood event consisted of a rainfall induced

flood superimposed upon a snowmelt flood. Rainfall duration was 9 hours. Refer to Paragraph 8-02a and Plate 54.

A revised IDF, now termed a Probable Maximum Flood (PMF), for Glendo Dam and Reservoir, dated April 28, 1989, has been prepared, reviewed, and approved by Reclamation's Denver Office. The PMF consists of a June general rain-on-snow flood (72-hour duration) for the intervening area between Pathfinder Dam and Glendo Dam, a concurrent flood between Seminoe Dam and Pathfinder Dam, and a concurrent flood above Seminoe Dam. The three floods have the characteristics listed in Table 8-1.

Table 8-1

PMF Flood Peak Discharges and Volumes

Flood Event	Peak Discharge (cfs)	15-Day Volume (acre-feet)
Glendo to Pathfinder, Intervening Area	251,000	1,217,000
Concurrent Flood, Seminoe to Pathfinder	222,000	858,000
Concurrent Flood, above Seminoe Dam	82,000	731,000

The hydrographs for the PMF are shown on Plates 56 through 58. The PMF and concurrent floods were routed through each of their respective dams assuming: 1) an initial reservoir water surface elevation of 6357.00 feet msl at Seminoe Dam, 5850.10 feet msl at Pathfinder, and 4635.00 feet msl at Glendo Dam (all top of active conservation storage); 2) the two Glendo powerplant units were not discharging at the time; 3) the Glendo river outlet works was flowing at a maximum discharge of 13,000 cfs; and, 4) the Glendo Dam uncontrolled spillway discharging a maximum flow of 10,335 cfs. During the routing of the PMF, Glendo Dam is overtopped by 8.18 feet for a maximum duration of 180 hours.

It was assumed that during the PMF event, operations of the Glendo powerplant and river outlet works would consist of full releases of the 2 power units until 6,600 cfs discharge was reached at the river outlet works. At that time, the power units would be shutdown, and discharge would continue up to a maximum of 13,000 cfs out of the river outlet works only. As the reservoir water surface elevation continued to rise above 4653.00 feet above msl (spillway crest), discharge would increase accordingly from the dam's uncontrolled spillway.

A second revision to the IDF, now termed the "critical PMF" (the PMF which causes the critical flood) was completed and approved by the Denver Reclamation Office in December 1993. In the case of Glendo Dam and Dikes, the storm centered between Seminoe and Pathfinder Dams was the critical flood (the critical flood is whichever PMF centering flood caused overtopping with the smallest percent of that PMF centering flood, and generated the greatest overtopping depth). Glendo Dam and Dikes needs to be modified to prevent failure of the dam up to an acceptable level, which has been identified as 80 percent of the Pathfinder Dam PMF (based on criteria of cost effectiveness of additional protection). The flood has a peak discharge of 627,000 cfs and a 15-day volume of 2,197,000 acre-feet.

8-03. Recreation. Glendo Reservoir provides recreation opportunities in camping, boating and fishing as a portion of the state park system.

8-04. Water Quality. The USGS acquires water quality information on Glendo Reservoir intermittently.

8-05. Fish and Wildlife. Glendo Reservoir provides habitat for fish, waterfowl, and some riparian habitat along the shoreline for various species of mammals.

8-06. Water Supply. Several communities and industries along the North Platte River have access to the water.

8-07. Hydroelectric Power. Increased hydroelectric power generation upstream during the winter is possible because water can be released from Pathfinder Reservoir to be passed through the Fremont Canyon and Alcova Powerplants and then be recaptured downstream in Glendo Reservoir without being spilled from the system.

8-08. Irrigation. The reservoir provides a supplemental irrigation supply to farmers in Wyoming and Nebraska.

8-09. Drought Contingency Plans. Presently, there is no drought contingency plan for Glendo Reservoir.

8-10. Flood Emergency Action Plans. The USBR prepared an emergency preparedness plan (EPP) for Glendo Dam in April 1987, revised in April 1990. The EPP also contains 21 dam failure inundation maps from Glendo Dam to Lewellen, Nebraska. Several copies of the EPP are located in the Corps District Water Control office.

8-11. Frequencies.

8-11a. Peak Inflow Probability. Reference Plates 46 and 47 for storage volume and pool elevation probability curves, respectively.

8-11b. Pool Elevation Duration and Frequencies. Plate 48 displays the historical pool elevations. Table 4-7 indicates the streamflow frequencies of upstream and downstream stations. Plate 59 displays a pool elevation duration curve for Glendo Reservoir.

8-11c. Key Control Points. The key control point for inflow is at Orin, Wyoming. The key control point for releases are the North Platte River stateline gage and the Bridgeport, Nebraska gage. Reference Plates 25 through 42 for USGS rating curves of streamgaging stations. Reference Plate 43 for location of streamgaging stations.

8-12. Other Studies.

8-12a. Examples of Regulation. Reference Section 4-06 and Plates 17 through 24 for the regulation history during the 1965, 1970, 1971, 1973, 1983, 1984, 1995, and 1997 events.

8-12b. Channel and Floodway Improvements. In 1964 riprap placement was made in several locations in settlement of damage to lands associated with project operation. In 1994, approximately 500 cubic yards of riprap were placed along the river for riverbank protection about 11 miles southeast of Glendo, Wyoming, as maintenance of previously constructed bank protection.

8-12c. Corrective Action Study. Hydrologic studies by Reclamation show dams of the North Platte River will be overtopped in 25 percent to 40 percent of the Probable Maximum Flood (PMF) event resulting in failure of Pathfinder, Seminoe, Alcova, Glendo, and Guernsey Dams. Therefore modifications to correct the deficiencies have been investigated under Safety of Dams, Corrective Action Studies (CAS). The investigation culminated in a Decision Memorandum which was signed by Reclamation in December, 1993. The memorandum identified, among other things, the need to modify Glendo Dam and Dikes to withstand 80 percent of the PMF at a cost of $15 million. Proposed modifications at Glendo Dam and Dikes consist of raising the dam and dikes 5 feet and providing a 540-foot wide fuseplug auxiliary spillway.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization.

9-01a. General. The organization for regulation of the Glendo Dam and Reservoir is based on a division of regulating responsibilities between the Bureau of Reclamation and the Corps of Engineers. In accordance with Flood Control Act of 1944, the Corps of Engineers is responsible for prescribing regulations for the use of storage in the Glendo project allocated to flood control. All other regulatory functions are the responsibility of the Bureau of Reclamation.

9-01b. Corps of Engineers. The Corps of Engineers, Omaha District, Water Control Section, is directly responsible for prescribing flood control regulations for Glendo Reservoir. Throughout the year, the section maintains a continuing surveillance of project operations. During flood periods, the section issues regulation orders to the Bureau of Reclamation for the control of releases from the flood control zone (between water surface elevation 4635.0 and 4653.0 feet msl) so as to attain optimum flood control benefits and control of project flood control storage to assure regulation in conformance with the authorized functions of the project. The Corps is also responsible for providing to the Bureau, via letter, its April-June inflow forecast calculated February 1, March 1, April 1, and May 1. The forecast procedure is discussed in paragraph 6-01a.

The Standing Instructions to the facility manager for the flood control regulation for of Glendo Reservoir are located in Appendix B as Exhibit IV.

9-01c. Other Federal Agencies.

The Bureau of Reclamation's Wyoming Area Office at Mills, Wyoming, has the primary responsibility for operation and maintenance of Glendo Dam, Dikes, Reservoir, and Powerplant. The projects office has jurisdiction over Reclamation facilities in southeastern Wyoming and western Nebraska. The Area office operates under the guidance of and in cooperation with the Great Plains Regional Office in Billings, Montana.

The Operations and Maintenance Division is responsible for the operation and maintenance of the projects' dams, reservoirs, and powerplants on the North Platte River. The specific features are described in later parts of this section. All power-related facilities, except Reclamation powerplants, are operated and maintained by the Department of Energy, Western Area Power Administration (WAPA).

The Water and Land Operations Division is responsible for water scheduling, water supply forecasting, reservoir regulation, Reclamation's Safety of Dams program, Natural Resource Management, land management, and environmental matters related to all projects' facilities on the North Platte River. The division also provides liaison between the Area office and the irrigation districts, recreational users, wildlife agencies, and the public.

for storage water from Federal Facilities. Responsibilities of the Water Management Branch also include the storage water and natural flow, and the scheduling of Reservoir releases.

Power water releases for power generation are coordinated through the Bureau of Reclamation/WAPA joint operations center in Loveland, Colorado; however, power releases will at no time take precedence over irrigation storage, restorage, or irrigation releases, as determined by the Water and Land Operations Division of the Wyoming Area Office.

9-01d. State and County Agencies. The Wyoming Game and Fish Department (WG&F) patrols the Glendo Reservoir and the area below Glendo Dam to monitor compliance with state regulations. They also stock the Reservoir and the North Platte River with fish.

The Platte County Civil Defense and Disaster Agency is an emergency cooperator for Glendo Dam, Powerplant, and downstream areas. The Platte County Sheriff also provides law enforcement in the Glendo Dam, Reservoir, and Powerplant areas. The Wyoming State Parks and Historic Sites (WSPHS) and WF&G law enforcement personnel also enforce their regulations and assist the county and other state law enforcement personnel in the area.

9-01e. Private Organization. Presently no private organizations have any regulatory or operation responsibilities for Glendo Dam and Reservoir.

9-02. Interagency Coordination.

9-02a. Local Press and Corps Bulletin. Non-flood control regulation of Glendo Dam and Reservoir is the responsibility of Reclamation. Under normal conditions, public notification is handled by means of standard news releases to radio and newspapers. The monthly reservoir inflow forecasts in the spring are also provided to the media. A public meeting is held each spring to address operation of the North Platte River System. Public notification for emergency purposes is handled through television, radio, and newspaper, as well as a 1-800 information telephone line.

9-02b. National Weather Service. The State Meteorologist in Cheyenne, Wyoming, furnishes storm warnings to the Chief, Water and Land Operations Division of the area office. This is particularly important whenever any or all of the major reservoirs in the North Platte River system begin to fill and a heavy rainstorm could produce a spillway discharge.

9-02c. United States Geological Survey. The Bureau of Reclamation provides daily hydrologic data to the USGS for the North Platte River system. Data includes storage, inflow, and outflow at each of the reservoirs. The USGS compiles the data in its publication "Water Resources Data for Wyoming." The USGS operates gaging stations at selected points within the basin and measures and estimates peak flood events.

9-02d. Natural Resources Conservation Service. The Natural Resources Conservation Service monitors snow courses at about 50 sites in the North Platte River basin. The record extends back to 1919 at some of the sites, while others date from the 1930s. Thirty years of

records are available at nearly all sites. Four bulletins are published each year on a regular basis following February 1, March 1, April 1, and May 1. Snow depths, water content, streamflow forecasts and other data are included. The Natural Resources Conservation Service issues special bulletins, usually on May 15 and June 1, when conditions warrant to assist Reclamation in estimating inflow to the reservoir systems.

9-02e. Department of Energy, WAPA. The Bureau of Reclamation and WAPA signed an agreement March 27, 1980, defining their jurisdictional responsibilities and identifying functions to be performed and property to be transferred between the two agencies. Under the agreement, WAPA is charged with the responsibility for marketing power and for transmission functions, including construction, operation, and maintenance of transmission lines, substations and attendant facilities. WAPA provides information to the Water and Lands Operation Division, Mills, Wyoming via the Joint Operations Center, Loveland, Colorado, for consideration in water release decisions to optimize utilization of power resources, and set power rates, and is responsible for power dispatching. The agreement also provides for establishment of a joint, electric power resources transmission research development and testing program.

9-02f. Bureau of Land Management. The Bureau of Land Management (BLM) administers the leasing of Reclamation lands for oil and gas subject to prior review and comment by Reclamation. Payments in lieu of state and county taxes are made by BLM with reimbursements from Reclamation.

9-02g. Wyoming and Nebraska State Engineer's Offices. The Wyoming State Engineer must be kept fully informed of reservoir and streamflow conditions, water ownership and utilization for compliance with state water rights, and safety of dams within the state. Applications for and perfection of water rights are also processed through that office. The Nebraska State Engineer (Department of Water Resources) is kept informed by the USBR in respect to water accounting by means of the daily North Platte River water accounting bulletin.

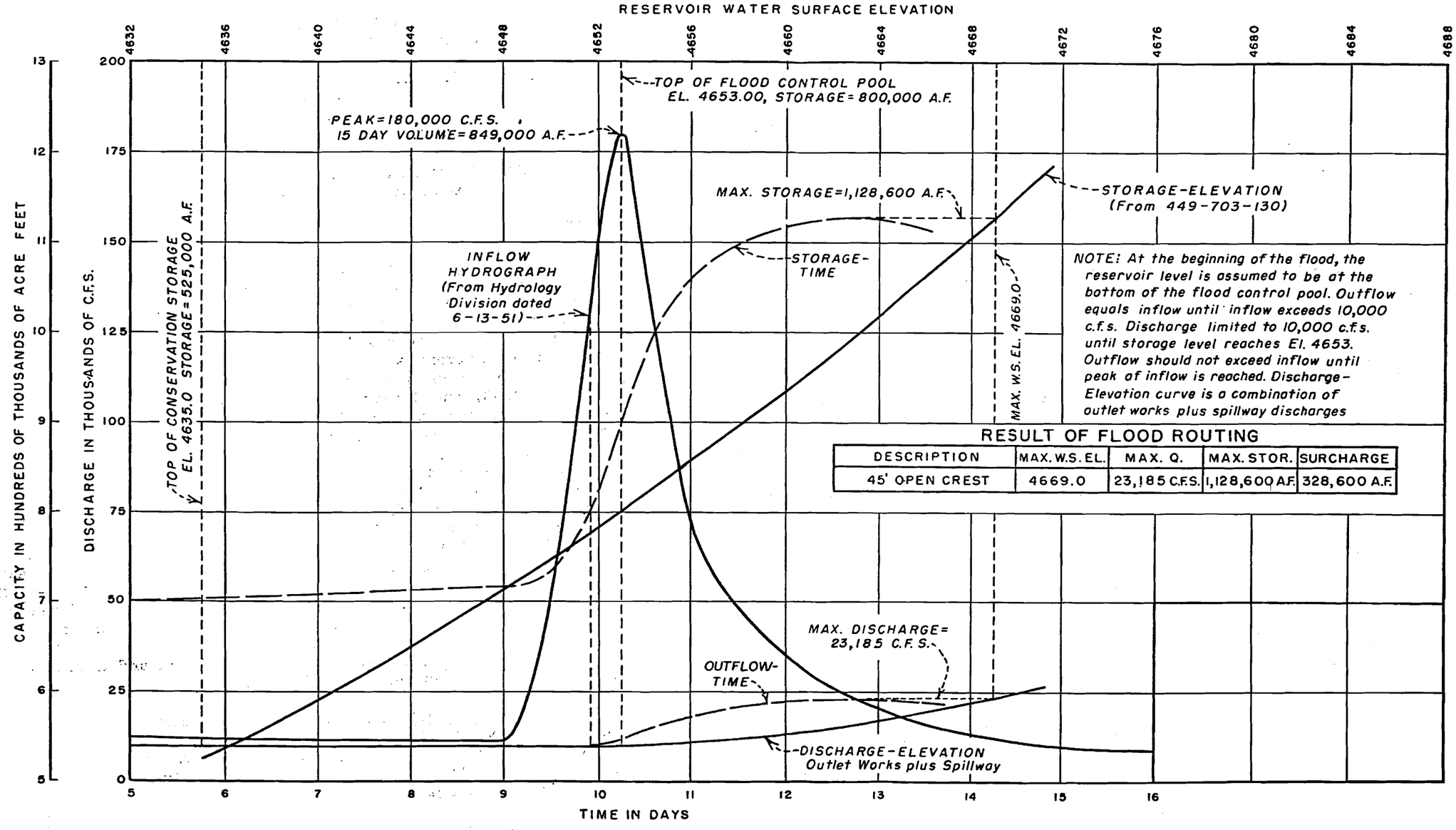
9-03. Interagency Agreement. Regulation of Glendo Dam and Reservoir is under Section 7 of the 1944 Flood Control Act. A Field Working Agreement is located in Appendix B as Exhibit II.

9-04. Commissions, River Authorities, Compacts and Committees. River and reservoir operations are governed by U.S. Supreme Court decree (see Exhibits V and VI, Appendix B). Many organizations are interested in (but may not necessarily be involved in the control of) the North Platte River basin water control activities. Some of these interested parties include WAPA, Wyoming State Engineer's Office, Nebraska Department of Water Resources, irrigation districts, wildlife organizations, and recreation organizations.

9-05. Non-Federal Hydropower. No non-federal hydropower facilities exist at Glendo Dam.

9-06. Reports. Bureau of Reclamation documents the Glendo Reservoir hourly elevations and discharges. Average inflows are calculated daily. The Corps of Engineers records and files the average daily elevations, inflows, outflows, and storages, which are provided by the Bureau of Reclamation. The USBR prepares a daily "North Platte Ownership Accounting" report that

indicates the North Platte River project elevations, inflows, outflows, evaporation, ownership, deliveries, and canal and river diversions. Power generation is documented in the Water Supply and Utilization Report that is distributed monthly.



RESULT OF FLOOD ROUTING

DESCRIPTION	MAX. W.S. EL.	MAX. Q.	MAX. STOR.	SURCHARGE
45' OPEN CREST	4669.0	23,185 C.F.S.	1,128,600 A.F.	328,600 A.F.

Prepared By: RH
Reviewed By: TG

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Spillway Flood Routing Curves
October 5, 1956

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

STANDING INSTRUCTIONS FOR FLOOD CONTROL REGULATION OF GLENDO DAM AND RESERVOIR

SECTION A

GENERAL

A-1. Purpose of Instructions. These instructions are issued for use as a guide to procedure to be used in reservoir regulation, both under normal and emergency flood conditions. A copy of these instructions should be posted in such a manner that it is readily accessible at all times for reference and emergency use. It will be the responsibility of the Facility Manager to make certain that any person temporarily charged with the operation of the dam and reservoir is familiar with these instructions.

A-2. Agency Responsibility. The Corps of Engineers is responsible for determining releases from the reservoir, exceeding those required for conservation purposes, when the reservoir elevation is in the flood control zone (Elevation 4635.0 to 4653.0 feet). The Bureau of Reclamation is responsible at all other elevations. Reclamation is responsible regardless of reservoir elevation in the maintenance of adequate releases for conservation purposes and whenever safety of the project is affected.

A-3. Required Flood Control Observations and Reports. When storms or excessive stream flows are occurring in the North Platte River basin below Alcova Reservoir or any of the conditions on Table A-1 are known by the Facility Manager or Area Manager to exist, they will be immediately reported to personnel of the Corps of Engineers Water Control Section. The names and phone numbers of personnel designated to receive such reports are listed on Table A-2. Calls will be made either at their offices or homes as necessary to assure that such regulation personnel have been notified. If these observations cannot be so communicated, they may provide a basis for emergency action as defined by paragraph C-3.

A-4. Regulation Records. The Glendo Facility Manager and/or the Area Manager's Water and Land Operations Division, as applicable, shall maintain a log or record which will include regulation instructions received; exact times, dates, pool levels, and changes in project releases when gates were regulated; and all precipitation amounts and stream gage heights received. The log or record shall be complete enough to reconstruct the events and activities at the project during the flood period. Copies of such record will be furnished the District Engineer's Water Control Section upon request.

A-5. **Information to Public on Potential Flood Disaster**. Pending the completion and issuance of more specific instructions by Reclamation and Corps of Engineers as applicable to the Glendo Project, it will be understood that news releases to the public of project operations (inflows, reservoir levels, releases, etc.) will be made by the Bureau of Reclamation. Reclamation will also be responsible for notifying downstream interests of actual or impending rises in water levels and of probable prolonged releases which might cause damage to irrigation facilities and other public works below the project. The Corps of Engineers will assist Reclamation in this endeavor as may be required.

A-6. **Safety of the Dam**. The following regulation procedures are not intended to restrict the Glendo Facility Manager from taking such additional measures as are necessary to insure the safety of the dam and appurtenant works, during times when no communications can be established.

TABLE A-1

FLOOD CONTROL OBSERVATIONS REQUIRING IMMEDIATE REPORT TO CORPS OF ENGINEERS

1. Reservoir pool level rises above elevation 4635.0 feet.

2. Reservoir pool level rises in excess of 0.5 foot in a 6-hour period.

3. Initial gage reading of 7.0 feet or more at Orin Junction gage.

4. While above 7.0 feet, the Orin Junction gage reading has increased 1.0 foot since last report.

5. Rainfall reported in excess of 2 inches in a 6-hour period at any station in the North Platte basin between Alcova and Guernsey Dams.

6. Flooding or flood damage is occurring or appears imminent in the river below Glendo Dam.

NOTE:

See Table A-2 for Directory of Water Control Personnel.
Section C outlines emergency action to be taken by Reclamation.

SECTION B

NORMAL REGULATION FOR FLOOD CONTROL

B-1. Regulation Objectives. Glendo Dam and Reservoir will be regulated to maintain nondamaging flows (currently estimated as less than 10,000 cfs at Glendo Dam) on the river below Glendo Dam to the maximum extent possible. In addition, regulation will be based on providing the maximum service to the other purposes for which the project was intended insofar as this regulation is consistent with the flood control function.

B-2. Definition of Normal Flood Control Regulation. For the purpose of these instructions, normal flood control regulation is defined to occur at all times while the pool elevation is between elevations 4635.0 and 4653.0 feet, m.s.l. and when:

a. Rapid communication (telephone or radio) between the Facility Manager and either the Project Manger's office or the Omaha District Engineer's office is possible.

b. Rapid communication between the Facility Manager the regulatory offices referenced above is impaired; however, hydrologic and meteorologic conditions are such that flooding, flood damages or rapid increase in the Glendo pool elevation (defined in Section C "Emergency Regulation") are not occurring or are not anticipated in the near future.

B-3. Regulation Instructions. Flood Control Regulation Orders during periods of Normal Regulation are furnished the Project Manager's Water and Land Operations Division by the District Engineer's Water Control Section. The Water and Land Operations Division will in turn relay the operating instructions to the Control Center for immediate action and will also notify the Facility Manager on site. Regulation orders are issued through the Water and Land Operations Division to permit coordination with other North Platte System projects.

B-4. Personnel. Table A-2 of these instructions lists offices and personnel to whom reports and questions related to flood control regulation may be directed.

SECTION C

EMERGENCY REGULATIONS FOR FLOOD CONTROL

C-1. Purpose of Emergency Instructions. Normally regulation of the Glendo Dam and Reservoir will be accomplished by specific regulation orders to the Plant Superintendent from the Omaha District Water Control Section thru the Area Manager's Water and Land Operations Division. However, it is conceivable that interruptions in remote supervisory control and communications between the Facility Manager and both these offices may occur at times when regulation action other than required in the latest available regulation order may be necessary in order that the project may properly fulfill its objective of flood control.

For this reason, emergency instruction, as given in the following paragraphs, have been developed to provide the Facility Manager with instructions for the regulation of releases from the reservoir during periods of communication failure. These instructions have been formulated to provide as high a degree of flood protection as practicable, within the safe capability of the project, and involve action by the Facility Manager based only on meteorologic and hydrologic conditions of which the Facility Manager has knowledge.

C-2. Definition of Emergency. For the purpose of these instructions, an emergency is defined to begin with a failure in remote control telemetry communications between the Glendo Dam Office and both the Area Manager's office and the District Engineer's office at a time when a report from the Glendo Dam Office is required for any of the conditions listed in Table A-1. Emergency regulation procedures will be initiated only if communications cannot be established within 6 hours after such time that notification is required by paragraph A-3 and it appears probable that the communication outage may continue for an additional 24 hours. Every possible effort will be made by the Facility Manager to establish communications. Communications are defined as 1) operations performed via microwave transmissions from Casper; 2) telephone and FTS; and 3) radio communication. If all three are unusable, communications will then be considered to have failed.

Emergency conditions will continue until such time personnel of the Area Manager's Water and Land Operations Division or the Omaha District Water Control Section have been contacted and appropriate instructions are received by the Facility Manager. During the progress of the emergency as defined above, the Glendo Facility Manager shall proceed and regulate the Glendo Reservoir in accordance with conditions and instructions which follow. The manager shall continue to record data and provide for safety and public information insofar as possible.

C-3. Re-establishment of Communications. During an emergency, every effort shall be made by the Facility Manager to re-establish communications to the Area Manager's or District Engineer's personnel by any means available, including the use of a courier traveling by any available means to the nearest point where such rapid means of communication may be available. However, the Facility Manager shall first insure that the dam is attended at all times during the emergency.

C-4. Emergency Action to be Taken by Facility Manager. In the event of an emergency as defined in paragraph C-3, it shall be the duty of the Facility Manager to make adjustments to reservoir discharge as follows:

a. Follow the last regulation order received for 6-hours after the emergency condition occurs before adjusting releases as provided below.

b. Reservoir elevations will be observed at least once each hour and corresponding rates of rise in reservoir elevation computed. Emergency releases will be based on these computed rates of pool rise but gate settings will not be adjusted more often than at 6-hour intervals.

c. With the reservoir level above elevation 4635.0 and after the waiting period as described in "a" above, releases will be adjusted to the level given in the following schedule:

POOL CONDITION AND ELEVATION	EMERGENCY ACTION
Elevation 4635.0 - 4640.0, rising pool	Maintain current releases
Elevation 4640.0 - 4653.0, rising pool	Release the greater of: (1) Release specified in latest Flood Control Regulation Order. (2) Discharge as required by Regulation Schedule on Figure C-1. (3) Power Plant Capacity. (If one or both of the power units are inoperative, release the equivalent flow through the outlet works.)
Elevation 4653.0 - 4648.5, stationary or falling pool	Release 10,000 cfs

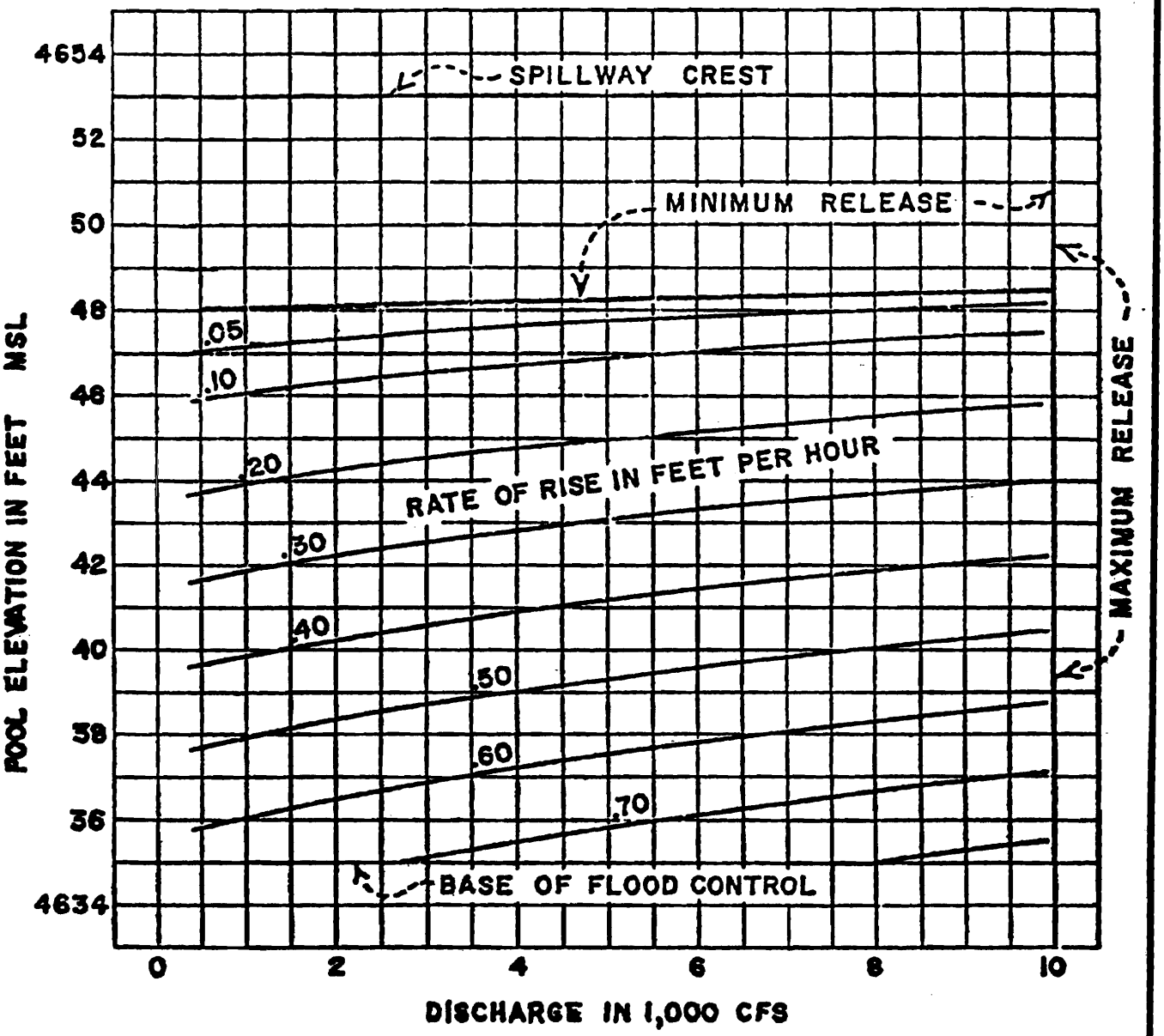
POOL CONDITION AND ELEVATION	EMERGENCY ACTION
Elevation 4648.5 - 4645.0, stationary or falling pool	Release the lesser of: (1) Release specified in the latest Regulation Order. (2) The discharge of current gate openings. (3) 7,000 cfs
Elevation 4645.0 - 4635.0, stationary or falling pool	Release the lesser of: (1) Release specified in the latest Regulation Order. (2) Power Plant Capacity. (If one or both of the power units are inoperative, release the equivalent flow through the outlet works.)

d. In case of rain in excess of 1 inch in 6-hours in the basin between Glendo and Guernsey Dams and/or knowledge exists of heavy runoff downstream.

While pool level is below Elevation 4648.5	Reduce releases to conservation requirements if above that rate. Maintain this rate for 24 hours, then return to the release schedule in paragraph c. above.
While pool level is between Elevation 4648.5 and 4653.0	Maintain release schedule given in paragraph c. above.

C-5. Special Reports of Emergency Operations. It is essential that the Facility Manager's records be complete enough to reconstruct the events and regulation activities at the project during the flood period, as noted in paragraph A-4. All conversations, especially with personnel outside the Corps, relative to flooding, flood damages, requests for regulation of releases, etc. should be noted in detail. The Facility Manager's records should note his attempts to re-establish communications. The records should note insofar as practicable, the basis for each regulation operation performed by the Facility Manager under these emergency conditions. A copy of the Facility Manager's records will be

furnished the Corps of Engineers' Water Control Section as soon as possible after conclusion of the Flood Emergency, as defined herein.



Note:

1. Schedule limited to rainfall occurrences only in basin below Alcova Dam.

2. Add discharge from this schedule to Alcova outflow to obtain Glendo releases.
   Maximum Glendo release: 10,000 cfs while pool level is between 4635 and 4653 ft.

Prepared By: _____

Reviewed By: _____

Water Control Manual
Glendo Dam and Reservoir, Colorado

Emergency Regulation Schedule

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

APPENDIX A

COMMUNICATIONS DIRECTORY

Contents

GLENDO DAM, RESERVOIR, AND POWERPLANT
Pick-Slaon Missouri Basin Program, Wyoming

OPERATING AGENCY

Bureau of Reclamation
North Platte River Projects Office
P.O. Box 1630
705 Pendell Boulevard
Mills, Wyoming 82644-1630

COMMUNICATIONS

[redacted]

* All radio and telephone conversations with the Casper Control Center are recorded.

ROUTE TO DAMSITE

Powerplant is located 0.9 miles southwest of Glendo Dam. Access is by Interstate Highway I-25 to Glendo, then southeast on county road for 7.1 miles.

SUPERVISORY OFFICE

Great Plains Regional Office
(See Regional Office Directory Sheet)

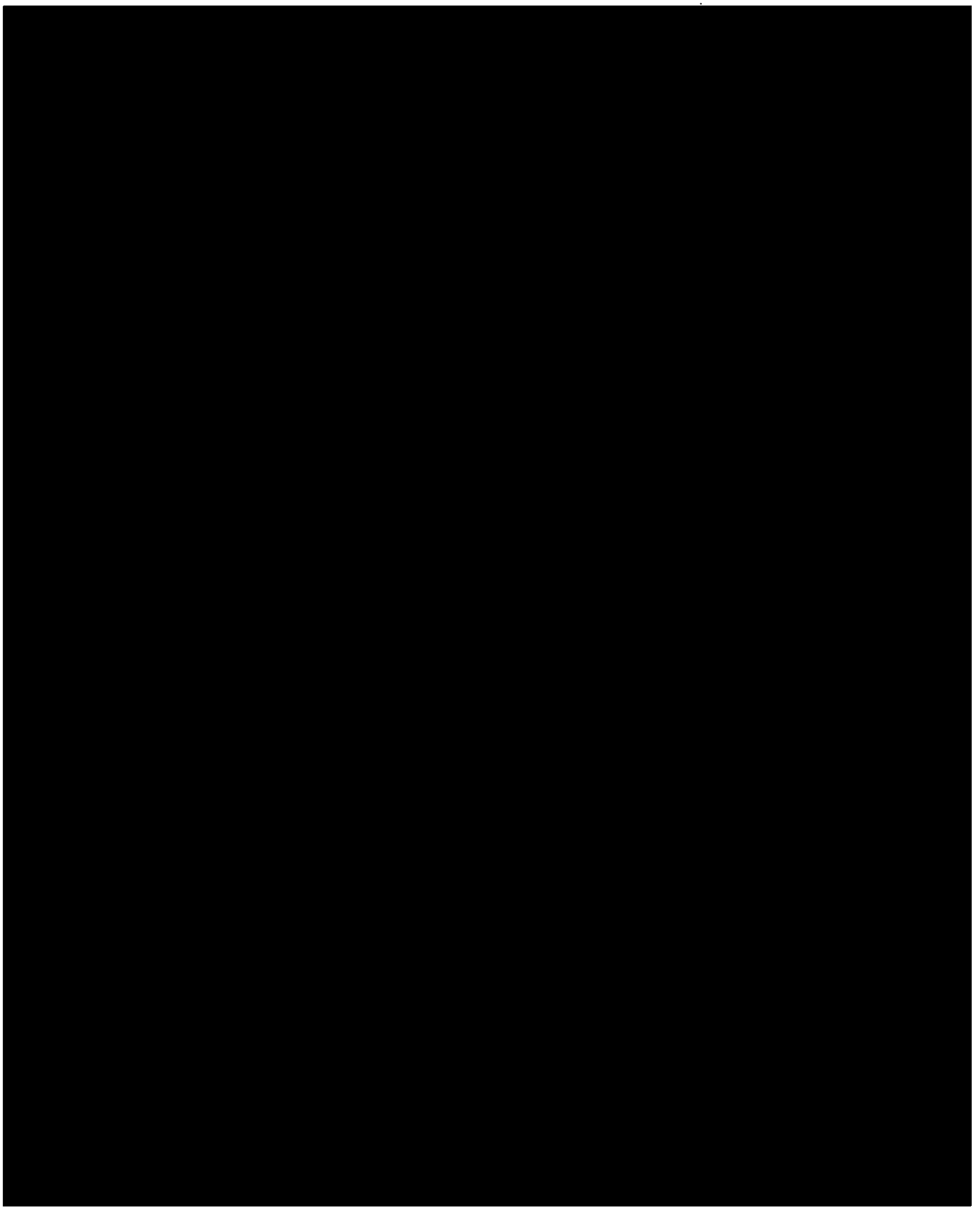
BUREAU OF RECLAMATION
NORTH PLATTE RIVER PROJECTS OFFICE
P.O. BOX 1630
705 PENDELL BOULEVARD
MILLS, WYOMING 82644-1630

Office Hours:
7:45 - 11:45 & 12:30 - 4:30 (MST)

TWO-WAY RADIO COMMUNCIATION SYSTEM FOR THE NORTH PLATTE RIVER PROJECTS

NPRP - NORTH PLATTE RIVER PROJECTS
MT - MOUNTAIN
PP - POWERPLANT
USBR - BUREAU OF RECLAMATION

Location	Call Code	Transmitter/Receiver Location
[redacted]		



REPORTING UNUSUAL CONDITIONS OR
EMERGENCY SITUATIONS TO
DENVER OFFICE
BUREAU OF RECLAMATION
DENVER, COLORADO

Office Hours:
7:30 - 4:00 (MST)

In emergencies or potential emergencies, such as impending failure of a dam, major power interruptions, large canal breaks, and impending flood conditions, reports of the situations shall be made to the Denver Office at the earliest possible time. Unusual events or conditions which could cause interruption in operations, such as fires, earthquakes, landslides, or severe storms, are also to be reported. When failure or impending failure is involved and immediate technical information is needed, reports should be made by telephone to the officials listed below, and followed up by faxogram. Reports to other key officials at the Denver Office will be made or coordinated by the key official listed below who receives the report.

COMMISSIONER'S OFFICE
INTERIOR BUILDING
WASHINGTON, DC

Office Hours:
7:45 - 5:30 (EST)

During Office Hours

Key personnel often are in the office until 6:00 or 7:00 p.m. Call office prior to calling a person's home.

After Office Hours and During Nonwork Days

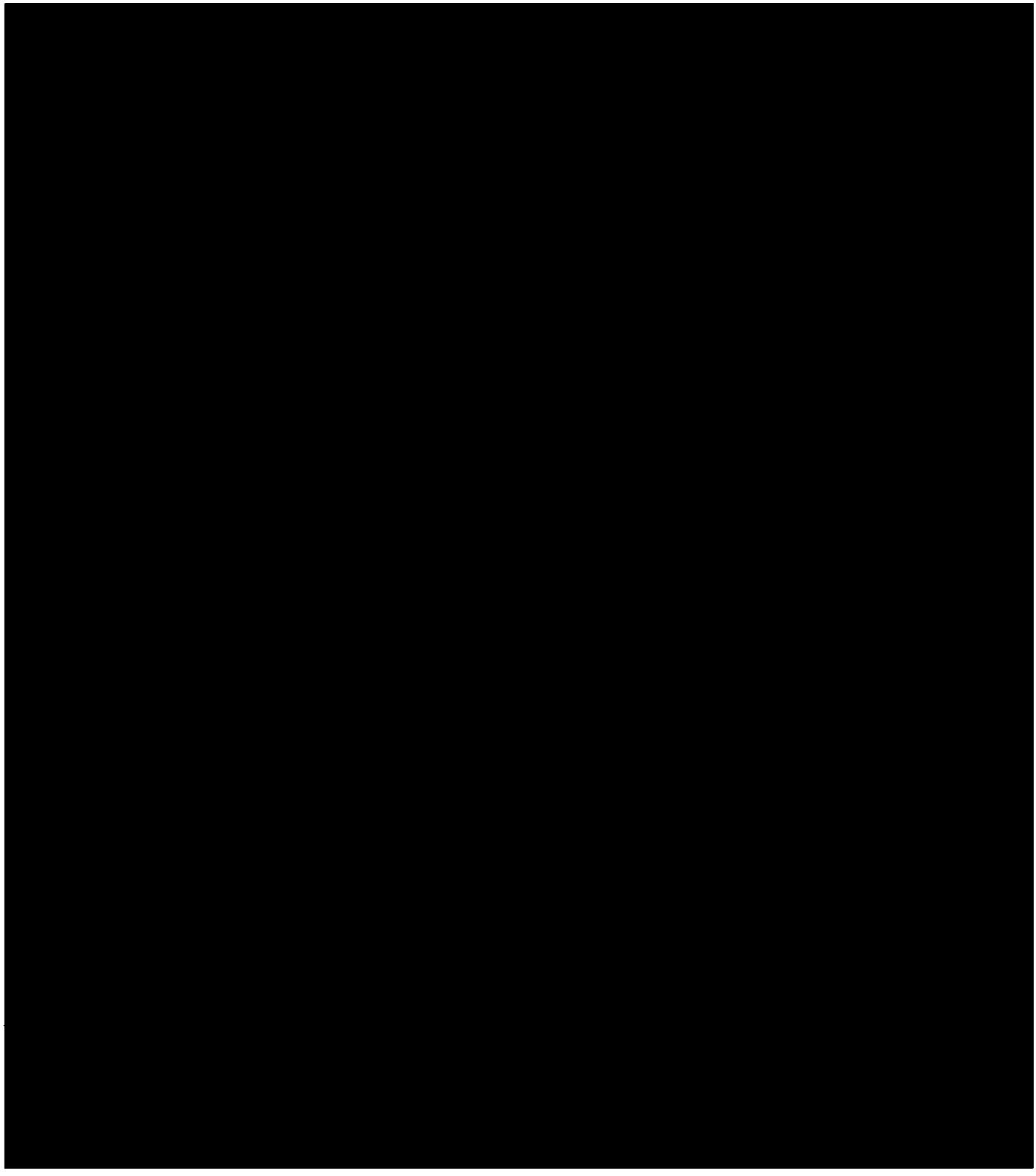
Area code and home telephone number listed below.

In emergencies that warrant a direct call to the Commissioner:

NOTE: Telephone calls should be confirmed by faxogram as soon as details are known. The report should include recommendation for corrective action and source of funding required.

GENERAL COMMUNICATIONS DIRECTORY

Agency | Telephone Numbers



[redacted]

1. National Earthquake Information Service
   U.S. Geological Survey, Denver, CO (24 hour) 1-800-525-7848
   Earthquake Information

2. Oil and Other Hazardous Material Spill

National Emergency Response - Washington DC	1-800-424-8802
Environmental Protection Agency	(303) 293-1723
Emergency Response Branch - Denver, CO (24 Hrs)	(303) 293-1788
State of Wyoming, Dept. of Environmental Quality	
Division of Water Quality, Cheyenne, WY	(307) 777-7781

E. Medical Facilities

1. Hospitals and Clinics

Wheatland - Platte County Memorial Hospital	(307) 322-3636
Douglas - Converse County Memorail Hospital	(307) 358-4240
	or (307) 358-2122

2. Ambulance Service

Glendo	911

F. Fire and Rescue Department

Glendo	911
Wyoming Parks and Historic Sites -	
Glendo State Park	(307) 735-4433

Agency | Telephone Numbers

[redacted]

APPENDIX B

Exhibit I

Flood Control Regulation, Part 208

Title 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, Department of the Army

PART 208—FLOOD CONTROL REGULATIONS

Glendo Dam and Reservoir, North Platte River, Platte County, Wyo.

Pursuant to the applicable provisions of sections 7 and 9 of the Act of Congress approved December 22, 1944 (58 Stat. 890, 891; 33 U.S.C. 709), the following regulations are hereby prescribed to govern the use of storage capacity for flood control purposes in the Glendo Reservoir on the North Platte River, Platte County, Wyo., and the operation of the Glendo Dam for flood control purposes.

§ 208.52 Glendo Dam and Reservoir, North Platte River, Platte County, Wyo.

The Bureau of Reclamation, Department of Interior, represented by its appropriate Project Manager, hereinafter referred to as the Project Manager, shall operate Glendo Dam and Reservoir in the interest of flood control in accordance with instructions received from the District Engineer, Corps of Engineers, Department of the Army, in charge of the locality, hereinafter referred to as the District Engineer, as follows:

(a) Operation of the reservoir while the water surface is between elevations 4,635 feet m.s.l. and 4,653 feet m.s.l. (presently amounting to 271,829 acre-feet) shall be construed as flood control operation and releases shall be determined by the District Engineer, subject to minimum releases necessary for irrigation and other downstream conservation requirements.

(b) Flood Control releases from Glendo Dam shall be scheduled as required to pass the Alcova Reservoir outflows together with that portion of the incremental flow originating between Alcova and Glendo Reservoirs which the District Engineer considers necessary, based on known hydrologic conditions at the time, with the objective of prevention or reduction of flood damages along the North Platte River in Wyoming and Nebraska from Glendo Dam to Lake McConaughy. Storage accumulated in the flood control operation of Glendo Reservoir shall be evacuated as rapidly as practicable consistent with downstream limitations.

(c) Maximum releases shall not exceed 10,000 c.f.s. while the reservoir is between elevation 4,635 feet and 4,653 feet unless otherwise directed by the District Engineer.

(d) Oral instructions from the District Engineer to the Project Manager regarding flood control operations shall be confirmed in writing under the date of the day issued.

(e) The discharge characteristics of the outlet works (having a capacity of 12,130 c.f.s. with reservoir level at elevation 4,653) shall be maintained in accordance with the construction plans (Bureau of Reclamation Specification No. DC-4255 as modified by the as-built drawings).

(f) Proposed schedules of irrigation releases and storage changes, if available, and current operating data shall be provided to the District Engineer by the Project Manager. These data shall be tabulated daily and furnished periodically as required, and shall include such items as: reservoir elevation, reservoir storage, inflow, discharge, and pertinent available hydrologic data.

(g) Whenever the reservoir level reaches or exceeds elevation 4,635 or when flood discharges appear imminent, the Project Manager shall report at once to the District Engineer by telephone, telegraph, or radio, and as requested thereafter until the reservoir level falls to elevation 4,635 or below, and flood discharge ceases.

(h) Nothing in the regulations in this section shall be construed to require that releases shall be made at rates or in a manner inconsistent with requirements for protecting the dam and reservoir from major damage or inconsistent with safe routing of the inflow spillway design flood.

(i) Nothing in the regulations in this section shall be construed to restrict releases necessary for irrigation.

(j) All elevations stated in this section are at the Glendo Dam and are referred to a datum giving 4,653 feet m.s.l. as the elevation of the spillway crest.

(Regs., Mar. 9, 1971: secs. 7 and 9, 58 Stat. 890, 891, 58 Stat. 891, 33 U.S.C. 709)

For the Adjutant General.

R. B. BELNAP,
Special Advisor to TAG.

[FR Doc.71-4674 Filed 4-5-71;8:48 am]

Exhibit II

Field Working Agreement

FIELD WORKING AGREEMENT BETWEEN
DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION
AND
DEPARTMENT OF THE ARMY, Corps OF ENGINEERS,
REGARDING OPERATION OF
GLENDO DAM AND RESERVOIR
NORTH PLATTE RIVER, PLATTE COUNTY, WYOMING

THIS AGREEMENT, made and entered into this 12th day Of May, 1971 between the Bureau of Reclamation and the Corps of Engineers

WITNESSETH
THAT:

WHEREAS, the Department of the Interior, acting through the Bureau of Reclamation, represented by its appropriate Project Manager, hereinafter referred to as the Project Manager, has constructed the Glendo Dam and Reservoir on the North Platte River near Glendo, Wyoming, and is responsible for safety of the structure and for irrigation deliveries to Glendo adapplicants from such irriga~ion water stored in said reservoir, and,

WHEREAS, the Department of the Army, acting through the Corps of Engineers, represented by its appropriate District Engineer, hereinafter referred to as the District Engineer, is responsible for flood control regulation of said dam and reservoir, and,

WHEREAS, Flood Control Regulations in accordance with the Flood Control Act of 22 December 1944, have been agreed to between the parties hereto and published in the Federal Register (a copy of these regulations is attached hereto as Appendix A), and

WHEREAS, there is a need for a working agreement to implement the Flood Control Regulations in order that there will be a clear understanding between the District Engineer and the Project Manager as to reservoir regulation for flood control, including details of storage allocations and possible reallocations, hydrologic data collection and reporting arrangements.

NOW THEREFORE, it is mutually understood and agreed by and between the parties hereto as follows:

1. Storage capacity allocations. The storage capacity allocations of Glendo Reservoir, exclusive of surcharge storage capacity above elevation 4653.0 feet, m.s.1., which is provided in combination with spillway capacity to insure safety of the structure, as defined in the following subparagraphs:

a. Flood control storage capacity allocation shall include the storage capacity between elevation 4635.0 feet, m.s.1., and elevation 4653.0 feet, m.s.1., (presently amounting to 271,889 acrefeet) and for which there have been constructed suitable outlet works to provide discharges as expressly indicated herein.

b. Active conservation. Active conservation storage capacity allocation for irrigation use and power generation shall include the capacity between elevation 4570 feet, m.s.l., and elevation 4635 feet, m.s.1. (presently amounting to 458,527 acre-feet, of which 34,005 acre feet are provided for the accumulation of sediment, leaving a net planned active conservation storage capacity allocation of 424,522 acre-feet).

c. Inactive storage. Inactive storage capacity allocation to maintain minimum power head shall include the capacity between elevation 4545.0 feet, m.s.1., and elevation 4570.0 feet, m.s.1. (presently amounting to 53,285 acre-feet, of which 14,304 acre-feet are provided for the accumulation of sediment, leaving a net planned inactive storage capacity allocation of 38,981 acre-feet)

d. Dead storage. Dead storage capacity allocation includes the storage capacity between stream bed elevation of 4508.0 feet, m.s.1., and elevation 4545.0 feet, m.s.1. (presently amounting to 11,495 acre-feet). This capacity is established by the elevation of the outlet works and provides for the accumulation of 9,191 acre-feet of sediment (in addition to the 48,309 acre-feet provided in the inactive and active conservation pools).

2. Storage reallocation. The Project Manager shall at reasonable intervals make necessary field surveys and office studies to prepare estimates of the volume and locations of sediment deposits in the reservoir. If the results of these studies show that the net planned storage for flood control or active conservation is reduced by an amount exceeding 10 percent of the allocation for either purpose, the operating plan described herein with respect to elevation limits of the storage allocations shall be reviewed with the view of equitably distributing the loss of reservoir capacity between the primary reservoir uses. Any redistribution of storage capacity allocations is to be contingent on paragraph 6.

3. Plan of operation. The Project Manager shall operate Glendo Dam and Reservoir in the interest of flood control in accordance with the Flood Control Regulations attached hereto as Appendix A. Operation of the reservoir while the water surface is between elevations 4635.0 feet, m.s.1. and 4653.0 feet, m.s.1. (flood control zone) shall be construed as flood control operation and releases shall be determined by the District Engineer, except for minimum releases for irrigation and other downstream requirements. In the interest of flood control, the District Engineer shall issue instructions to the Project Manager regarding such flood control releases. Oral instructions from the District Engineer to the Project Manager shall be confirmed in writing, under the date of the day issued, on the first subsequent work day thereafter.

4. When the reservoir level is in the surcharge or active conservation pools the District Engineer may make recommendations to the Project Manager for operation in the interest of flood control, but such recommendations shall not be considered mandatory, inasmuch as operation of such storage is the responsibility of the Project Manager.

5. Collection and assembly of hydrologic data and reporting arrangements. Proposed schedules of irrigation release and storage changes, if available and current operating data shall be provided to the District Engineer by the Project Manager. These data shall be tabulated daily and furnished periodically as required, and shall include such items as reservoir elevation, reservoir storage, inflow and discharge. Available reports from precipitation and stream flow stations pertinent to the operation of Glendo Dam and Reservoir which are collected by the Project Manager will also be relayed to the District Engineer by the most expeditious method of communication under detailed arrangements as may be made from time to time.

6. Design limitations. When the reservoir water surface is between elevations 4635 and 4653, the outlet works discharge shall be limited to 6,600 c.f.s. without prior approval. This flow combined with powerplant releases of 3,400 c.f.s. will provide the 10,000 c.f.s. release that may be required while the reservoir level is in the flood control pool.

Should the powerplant not be fully operative, the offices of the Director, Design and Construction, and the Regional Director of the Bureau of Reclamation should be immediately contacted for approval to exceed 6,600 c.f.s. in release through the outlet works to compensate for powerplant flow decreases if such releases are desired. It is recognized that any changes in the discharge characteristics of the outlet or spillway
structures resulting from reallocation of storage capacities, or for any other reasons, which otherwise are mutually acceptable to the Corps of Engineers and the Bureau of Reclamation, must be approved by the Director, Office of Design and Construction, Bureau of Reclamation. It is further recognized, in connection with subparagraph (e) of the Flood Control Regulations that the flood control storage capacity will be required for routing the inflow spillway design flood. Hence, whenever any of the flood control storage capacity is utilized, releases shall be made with the objective of evacuating this capacity as rapidly as practicable consistent with downstream releases limitations and with primary consideration given to the safety of the structure.

7. IN WITNESS WHEREOF, the parties hereto have caused thisMemorandum of Agreement to be executed as of the day and datefirst above written.

CORPS OF ENGINEERS

BUREAU OF RECLAMATION

North Platte River Projects Office
Casper, Wyoming

Exhibit III

Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING
FOR THE 1983-1984 POST FLOOD ASSESSMENT
BETWEEN THE BUREAU OF RECLAMATION AND CORPS OF ENGINEERS
REGARDING THE
NORTH PLATTE RIVER RESERVOIR SYSTEM, WYOMING

The purpose of this assessment is to document observations and actions that were taken during periods of high flow in 1983 and 1984 on the North Platte River. The experience gained during these events should be used to minimize adverse effects that could result from similar future flood events.

1. Background. The following facts are understood:

a. All of the Federal reservoirs on the North Platte River in Wyoming were planned, designed, and constructed and are operated by the Bureau (Bureau of Reclamation). The Department of the Interior, acting through the Bureau and represented by the Project Manager, North Platte River Projects Office, Mills, Wyoming, is responsible for the regulation and safety of the Federal North Platte River reservoirs and dams for compliance with the authorized project purposes. The primary water uses are irrigation during the May through September period and year-round hydropower production. The storage system provides irrigation water for use on more than 400,000 acres of land in Wyoming and Nebraska.

b. The Department of the Army, acting through the Corps of Engineers and represented by the Omaha District Commander, is responsible for the flood control operation of Glendo Dam and Reservoir. As outlined in the Field Working Agreement dated May 12, 1971, the Omaha District Commander is responsible for directing the releases from its 270,000 acre-foot flood storage zone.

c. The scheduled operation of releases within and from the System (North Platte River Federal Reservoir System) prior to an encroachment into the Glendo Reservoir flood storage zone can influence the function of this zone and the authorized project purpose.

d. Although the only reservoir within the system with flood control as an authorized project purpose is Glendo Reservoir, the residents of each State have come to rely on the inherent flood control aspects of the other upstream Federal reservoirs.

e. In December 1983, a pool level restriction was established at Glendo Reservoir because of seepage problems in the Glendo dikes. As a result, the useable flood storage zone in the reservoir was reduced by 20 percent.

2. Observation 1983-84.

a. In 1983, the unusual combination of prolonged cool spring temperatures and a heavy and widespread late spring snowpack produced near record high inflows throughout the System. The early evacuation of ownership water that was initiated in April 1983 permitted the passage of a

record April through September streamflow volume with little or no resulting flood damage downstream from Guernsey Reservoir. At the end of January 1984, reservoir storage was 159 percent of normal and the February 1 snowpack was at near record levels in some areas. These combined conditions prompted the Bureau to schedule four public meetings held at 1-month intervals to present updated plans for operating the North Platte River reservoirs to minimize the potential for flood damage. This effort resulted in an agreement between the irrigators and representatives of Wyoming and Nebraska that permitted the early release of irrigation ownership water beginning on February 10, 1984.

b. In anticipation of flooding in 1984, the Corps held two public meetings to discuss flood control projects that could be constructed. Projects for several urban areas were planned for implementation as needed. These planned flood control projects were emergency measure facilities and not permanent Corps flood control projects.

c. Although flood damages downstream from Guernsey Reservoir in Wyoming were minor in both 1983 and 1984, the necessary high sustained releases resulted in stages from 1 to 1.5 foot overbank in western Nebraska. This condition left virtually no buffer zone in the channel along the river to accommodate the potential major damaging effects of rainfall runoff downstream from the dams.

d. Following the mid-May 1984 period, precipitation downstream from Alcova Reservoir was much below average. If widespread heavy rainfall had occurred immediately downstream from the North Platte River system of Federal reservoirs, there could have been severe downstream problems during the May through August 1983-84 high pool and release periods.

e. In the interest of the irrigation water right owners, there were continued demands by the State of Wyoming to delay releases and retain excess water in storage. Adherence to these demands could adversely contribute to required higher releases later in the season to evacuate flood inflows.

f. The periodic interagency and public meetings that were set up by the Bureau provided a beneficial forum for notifying interested parties of the anticipated high streamflow and proposed reservoir operations. The 1984 meetings were also used to inform the States of Wyoming and Nebraska and the irrigators that early releases from the System were needed to reduce the potential for flooding.

g. Complaints from residents along the river during periods of high water were generally related to basement flooding, channel erosion, pasture flooding, and adverse effects on recreation.

h. For further observations, reference is made to the Bureau's 1983 Flood Operations Report for the Lower Missouri Region and 1984 Flood Operations for the North Platte River Basin and the Corps' Report on Reservoir Regulation Platte River Basin April - August 1983 and Report on Reservoir Regulation North Platte River Basin January - July 1984.

3. Conclusions. It was learned and is mutually understood that:

a. High priority should be given to continuation of investigation activities, scheduling of any necessary design and construction activities, and requesting of funds for performing the necessary repairs at Glendo Dam in order to rescind the flood storage elevation restriction.

b. The total System storage and forecasted reasonable minimum inflows on/or prior to April 1 of each year should be adequate to meet irrigation and conservation needs; however, storage must be minimized to accommodate flood control. The Bureau and the Corps will analyze the studies and assumptions utilized in routing the project design flood for the Glendo Reservoir exclusive flood pool in order to quantify the vacant storage space in Seminoe and Pathfinder Reservoirs required during such a flood event. The Bureau will attempt to maintain sufficient vacant storage capacity above Alcova Dam necessary to aid the routing of such a flood event through Glendo Reservoir without injury to the higher priority storage rights.

c. In addition to the annual operating plan review held in the fall of each year, the Bureau will coordinate and host public and/or inter-agency meetings in the spring if it appears to be necessary to inform the public as well as the Corps and the States of the proposed reservoir regulation plan for the current year.

d. The Bureau will not schedule deliberate encroachment into the Glendo Reservoir exclusive flood storage zone as a normal operating practice.

e. The Project Manager and the District Commander shall continue to act in the spirit of cooperation in the regulation of the System.

CORPS OF ENGINEERS

[redacted]

Missouri River Division

Date 28 Aug 1985

BUREAU OF RECLAMATION

Lower Missouri Region

Date 9-30-85

Exhibit IV

Standing Orders for

a. General
b. Normal Flood Control Regulation
c. Emergency Flood Control Regulation

of Glendo Dam and Reservoir

STANDING INSTRUCTIONS FOR FLOOD CONTROL REGULATION OF GLENDO DAM AND RESERVOIR

SECTION A

GENERAL

A-1. Purpose of Instructions. These instructions are issued for use as a guide to procedure to be used in reservoir regulation, both under normal and emergency flood conditions. A copy of these instructions should be posted in such a manner that it is readily accessible at all times for reference and emergency use. It will be the responsibility of the Facility Manager to make certain that any person temporarily charged with the operation of the dam and reservoir is familiar with these instructions.

A-2. Agency Responsibility. The Corps of Engineers is responsible for determining releases from the reservoir, exceeding those required for conservation purposes, when the reservoir elevation is in the flood control zone (Elevation 4635.0 to 4653.0 feet). The Bureau of Reclamation is responsible at all other elevations. Reclamation is responsible regardless of reservoir elevation in the maintenance of adequate releases for conservation purposes and whenever safety of the project is affected.

A-3. Required Flood Control Observations and Reports. When storms or excessive stream flows are occurring in the North Platte River basin below Alcova Reservoir or any of the conditions on Table A-1 are known by the Facility Manager or Area Manager to exist, they will be immediately reported to personnel of the Corps of Engineers Water Control Section. The names and phone numbers of personnel designated to receive such reports are listed on Table A-2. Calls will be made either at their offices or homes as necessary to assure that such regulation personnel have been notified. If these observations cannot be so communicated, they may provide a basis for emergency action as defined by paragraph C-3.

A-4. Regulation Records. The Glendo Facility Manager and/or the Area Manager's Water and Land Operations Division, as applicable, shall maintain a log or record which will include regulation instructions received; exact times, dates, pool levels, and changes in project releases when gates were regulated; and all precipitation amounts and stream gage heights received. The log or record shall be complete enough to reconstruct the events and activities at the project during the flood period. Copies of such record will be furnished the District Engineer's Water Control Section upon request.

A-5. Information to Public on Flood Disaster. Pending the completion and issuance of more specific instructions by Reclamation and Corps of Engineers as applicable to the Glendo Project, it will be understood that news releases to the public of project operations (inflows, reservoir levels, releases, etc.) will be made by the Bureau of Reclamation. Reclamation will also be responsible for notifying downstream interests of actual or impending rises in water levels and of probable prolonged releases which might cause damage to irrigation facilities and other public works below the project. The Corps of Engineers will assist Reclamation in this endeavor as may be required.

A-6. Safety of the Dam. The following regulation procedures are not intended to restrict the Glendo Facility Manager from taking such additional measures as are necessary to insure the safety of the dam and appurtenant works, during times when no communications can be established.

TABLE A-1

FLOOD CONTROL OBSERVATIONS REQUIRING IMMEDIATE REPORT TO CORPS OF ENGINEERS

1. Reservoir pool level rises above elevation 4635.0 feet.

2. Reservoir pool level rises in excess of 0.5 foot in a 6-hour period.

3. Initial gage reading of 7.0 feet or more at Orin Junction gage.

4. While above 7.0 feet, the Orin Junction gage reading has increased 1.0 foot since last report.

5. Rainfall reported in excess of 2 inches in a 6-hour period at any station in the North Platte basin between Alcova and Guernsey Dams.

6. Flooding or flood damage is occurring or appears imminent in the river below Glendo Dam.

NOTE:

See Table A-2 for Directory of Water Control Personnel.
Section C outlines emergency action to be taken by Reclamation.

TABLE A-2

DIRECTORY OF REGULATION PERSONNEL
GLENDO DAM AND RESERVOIR

[redacted]

SECTION B

NORMAL REGULATION FOR FLOOD CONTROL

B-1. Regulation Objectives. Glendo Dam and Reservoir will be regulated to maintain nondamaging flows (currently estimated as less than 10,000 cfs at Glendo Dam) on the river below Glendo Dam to the maximum extent possible. In addition, regulation will be based on providing the maximum service to the other purposes for which the project was intended insofar as this regulation is consistent with the flood control function.

B-2. Definition of Normal Flood Control Regulation. For the purpose of these instructions, normal flood control regulation is defined to occur at all times while the pool elevation is between elevations 4635.0 and 4653.0 feet, m.s.l. and when:

a. Rapid communication (telephone or radio) between the Facility Manager and either the Project Manger's office or the Omaha District Engineer's office is possible.

b. Rapid communication between the Facility Manager the regulatory offices referenced above is impaired; however, hydrologic and meteorologic conditions are such that flooding, flood damages or rapid increase in the Glendo pool elevation (defined in Section C "Emergency Regulation") are not occurring or are not anticipated in the near future.

B-3. Regulation Instructions. Flood Control Regulation Orders during periods of Normal Regulation are furnished the Project Manager's Water and Land Operations Division by the District Engineer's Water Control Section. The Water and Land Operations Division will in turn relay the operating instructions to the Control Center for immediate action and will also notify the Facility Manager on site. Regulation orders are issued through the Water and Land Operations Division to permit coordination with other North Platte System projects.

B-4. Personnel. Table A-2 of these instructions lists offices and personnel to whom reports and questions related to flood control regulation may be directed.

SECTION C

EMERGENCY REGULATIONS FOR FLOOD CONTROL

C-1. Purpose of Emergency Instructions. Normally regulation of the Glendo Dam and Reservoir will be accomplished by specific regulation orders to the Plant Superintendent from the Omaha District Water Control Section thru the Area Manager's Water and Land Operations Division. However, it is conceivable that interruptions in remote supervisory control and communications between the Facility Manager and both these offices may occur at times when regulation action other than required in the latest available regulation order may be necessary in order that the project may properly fulfill its objective of flood control.

For this reason, emergency instruction, as given in the following paragraphs, have been developed to provide the Facility Manager with instructions for the regulation of releases from the reservoir during periods of communication failure. These instructions have been formulated to provide as high a degree of flood protection as practicable, within the safe capability of the project, and involve action by the Facility Manager based only on meteorologic and hydrologic conditions of which the Facility Manager has knowledge.

C-2. Definition of Emergency. For the purpose of these instructions, an emergency is defined to begin with a failure in remote control telemetry communications between the Glendo Dam Office and both the Area Manager's office and the District Engineer's office at a time when a report from the Glendo Dam Office is required for any of the conditions listed in Table A-1. Emergency regulation procedures will be initiated only if communications cannot be established within 6 hours after such time that notification is required by paragraph A-3 and it appears probable that the communication outage may continue for an additional 24 hours. Every possible effort will be made by the Facility Manager to establish communications. Communications are defined as 1) operations performed via microwave transmissions from Casper; 2) telephone and FTS; and 3) radio communication. If all three are unusable, communications will then be considered to have failed.

Emergency conditions will continue until such time personnel of the Area Manager's Water and Land Operations Division or the Omaha District Water Control Section have been contacted and appropriate instructions are received by the Facility Manager. During the progress of the emergency as defined above, the Glendo Facility Manager shall proceed and regulate the Glendo Reservoir in accordance with conditions and instructions which follow. The manager shall continue to record data and provide for safety and public information insofar as possible.

C-3. Re-establishment of Communications. During an emergency, every effort shall be made by the Facility Manager to re-establish communications to the Area Manager's or District Engineer's personnel by any means available, including the use of a courier traveling by any available means to the nearest point where such rapid means of communication may be available. However, the Facility Manager shall first insure that the dam is attended at all times during the emergency.

C-4. Emergency Action to be Taken by Facility Manager. In the event of an emergency as defined in paragraph C-3, it shall be the duty of the Facility Manager to make adjustments to reservoir discharge as follows:

a. Follow the last regulation order received for 6-hours after the emergency condition occurs before adjusting releases as provided below.

b. Reservoir elevations will be observed at least once each hour and corresponding rates of rise in reservoir elevation computed. Emergency releases will be based on these computed rates of pool rise but gate settings will not be adjusted more often than at 6-hour intervals.

c. With the reservoir level above elevation 4635.0 and after the waiting period as described in "a" above, releases will be adjusted to the level given in the following schedule:

POOL CONDITION AND ELEVATION	EMERGENCY ACTION
Elevation 4635.0 - 4640.0, rising pool	Maintain current releases
Elevation 4640.0 - 4653.0, rising pool	Release the greater of: (1) Release specified in latest Flood Control Regulation Order. (2) Discharge as required by Regulation Schedule on Plate 40 (see Section 7-01 for further explanation of Plate 40). (3) Power Plant Capacity. (If one or both of the power units are inoperative, release the equivalent flow through the outlet works.)

POOL CONDITION AND ELEVATION	EMERGENCY ACTION
Elevation 4653.0 - 4648.5, stationary or falling pool	Release 10,000 cfs
Elevation 4648.5 - 4645.0, stationary or falling pool	Release the lesser of: (1) Release specified in the latest Regulation Order. (2) The discharge of current gate openings. (3) 7,000 cfs
Elevation 4645.0 - 4635.0, stationary or falling pool	Release the lesser of: (1) Release specified in the latest Regulation Order. (2) Power Plant Capacity. (If one or both of the power units are inoperative, release the equivalent flow through the outlet works.)

d. In case of rain in excess of 1 inch in 6-hours in the basin between Glendo and Guernsey Dams and/or knowledge exists of heavy runoff downstream.

While pool level is below Elevation 4648.5	Reduce releases to conservation requirements if above that rate. Maintain this rate for 24 hours, then return to the release schedule in paragraph c. above.
While pool level is between Elevation 4648.5 and 4653.0	Maintain release schedule given in paragraph c. above.

C-5. Special Reports of Emergency Operations. It is essential that the Facility Manager's records be complete enough to reconstruct the events and regulation activities at the project during the flood period, as noted in paragraph A-4. All conversations, especially with personnel outside the Corps, relative to flooding, flood damages, requests

for regulation of releases, etc. should be noted in detail. The Facility Manager's records should note his attempts to re-establish communications. The records should note insofar as practicable, the basis for each regulation operation performed by the Facility Manager under these emergency conditions. A copy of the Facility Manager's records will be furnished the Corps of Engineers' Water Control Section as soon as possible after conclusion of the Flood Emergency, as defined herein.

Exhibit V

U.S. Supreme Court Decree, 1945

Nebraska vs. Wyoming

*[589]

*STATE OF NEBRASKA, Complainant,

v.

STATE OF WYOMING, Defendant, and State of Colorado, Impleaded Defendant, United States of America, Intervenor.

(325 US 589-672.)

*[665]

*The following decree was entered on October 8, 1945:

This cause having been heretofore submitted on the report of the Special Master and the exceptions of the parties thereto, and the Court being now fully advised in the premises:

It is ordered, adjudged and decreed that:

I. The State of Colorado, its officers, attorneys, agents and employees, be and they are hereby severally enjoined

(a) From diverting or permitting the diversion of water from the North Platte River and its tributaries for the irrigation of more than a total of 135,000 acres of land in Jackson County, Colorado, during any one irrigation season;

(b) From storing or permitting the storage of more than a total amount of 17,000 acre feet of water for irrigation purposes from the North Platte River and its tributaries in Jackson County, Colorado, between October 1 of any year and September 30 of the following year;

(c) From exporting out of the basin of the North Platte River and its tributaries in Jackson County, Colorado, to any other stream basin or basins more than 60,000 acre feet of water in any period of ten consecutive years reckoned in continuing progressive series beginning with October 1, 1945.

II. Exclusive of the Kendrick Project and Seminoe Reservoir the State of Wyoming, its officers, attorneys, agents and employees, be and they are hereby severally enjoined

(a) From diverting or permitting the diversion of water from the North Platte River above the Guernsey Reservoir and from the tributaries entering the North Platte River above the Pathfinder Dam for the

*[666]

*irrigation of more than a total of 168,000 acres of land in Wyoming during any one irrigation season.

(b) From storing or permitting the storage of more than a total amount of 18,000 acre feet of water for irrigation purposes from the North Platte River and its tributaries above the Pathfinder Reservoir between October 1 of any year and September 30 of the following year.

III. The State of Wyoming, its officers, attorneys, agents and employees, be and they are hereby severally enjoined from storing or permitting the storage of water in Pathfinder, Guernsey, Seminoe and Alcova Reservoirs otherwise than in accordance with the relative storage rights, as among themselves, of such reservoirs, which are hereby defined and fixed as follows:

First, Pathfinder Reservoir;

Second, Guernsey Reservoir;

Third, Seminoe Reservoir; and

Fourth, Alcova Reservoir;

Provided, however, that water may be impounded in or released from Seminoe Reservoir, contrary to the foregoing rule of priority operation for use in the generation of electric power when and only when such storage or release will not materially interfere with the administration of water for irrigation purposes according to the priority decreed for the French Canal and the State Line Canals.

IV. The State of Wyoming, its officers, attorneys, agents and employees be and they are hereby severally

L ed 1283, 53 S Ct 671; 309 US 569, 84 L ed 953, 60 S Ct 789; 311 US 107, 85 L ed 73, 61 S Ct 154; 313 US 547, 85 L ed 1513, 61 S Ct 831, 832.

enjoined from storing or permitting the storage of water in Pathfinder, Guernsey, Seminoe or Alcova Reservoirs, and from the diversion of natural flow water through the Casper Canal for the Kendrick Project between and including May 1 and September 30 of each year otherwise than in accordance with the rule of priority in relation to the appropriations of the Nebraska lands supplied by the French Canal and by the State

*[667]

Line Canals, which said *Nebraska appropriations are hereby adjudged to be senior to said four reservoirs and said Casper Canal, and which said Nebraska appropriations are hereby identified and defined, and their diversion limitations in second feet and seasonal limitations in acre feet fixed as follows:

Lands	Canal	Limitation in Sec. Feet	Seasonal Limitation in Acre Ft.
Tract of 1025 acres	French	15	2,227
Mitchell Irrigation District	Mitchell	195	35,000
Gering Irrigation District	Gering	193	86,000
Farmers Irrigation District	Tri-State	748	183,050
Ramshorn Irrigation District	Ramshorn	14	3,000

V. The natural flow in the Guernsey Dam to Tri-State Dam section between and including May 1 and September 30 of each year, including the contribution of Spring Creek, be and the same hereby is apportioned between Wyoming and Nebraska on the basis of twenty-five per cent to Wyoming and seventy-five per cent to Nebraska, with the right granted Nebraska to designate from time to time the portion of its share which shall be delivered into the Interstate, Fort Laramie, French and Mitchell Canals for use on the Nebraska lands served by these canals. The State of Nebraska, its officers, attorneys, agents and employees, and the State of Wyoming, its officers, attorneys, agents and employees, are hereby enjoined and restrained from diversion or use contrary to this apportionment, provided that in the apportionment of water in this section the flow for each day, until ascertainable, shall be assumed to be the same as that of the preceding day, as shown by the measurements and computations for that day, and provided further, that unless and until Nebraska, Wyoming and the United States agree upon a modification thereof, or upon another formula, reservoir evaporation and transportation losses in the segregation of natural flow and storage shall be computed in accordance with the following formula taken from United States' Exhibit 204A:

*[668]

Reservoir Evaporation Losses. Seminoe, Pathfinder and Alcova Reservoirs.

Evaporation will be computed daily based upon evaporation from Weather Bureau Standard 4 foot diameter Class "A" pan located at Pathfinder reservoir. Daily evaporation will be multiplied by area of water surface of reservoir in acres and by co-efficient of 70% to reduce pan record to open water surface.

Guernsey Reservoir.

Compute same as above except use pan evaporation at Whalen Dam.

River Carriage Losses.

River carriage losses will be computed upon basis of area of river water surface as determined by aerial surveys made in 1939 and previous years and upon average monthly evaporation at Pathfinder reservoir for the period 1921 to 1939, inclusive, using a co-efficient of 70% to reduce pan records to open water surface.

Daily evaporation losses in second-feet for various sections of the river are shown in the following table:

TABLE

River Section	Area Acres	Daily Loss—Second Feet May	June	July	Aug.	Sept.
Alcova to Wendover	8360	53	76	87	76	56
Guernsey Res. to Whalen	560	4	5	6	5	4
Whalen to State Line	2480	16	22	25	22	16

Above table is based upon mean evaporation at Pathfinder as follows: May .561 ft.; June .767 ft.; July .910 ft.; Aug. .799 ft.; Sept. .568 ft. Coefficient of 70% to reduce pan record to open water surface:

Above table does not contain computed loss for section of river from Pathfinder dam to head of Alcove reservoir (area 170 acres) because this area is less than submerged area of original river bed in Alcova reservoir and is, therefore, considered as off-set.

*[669]

*Likewise the area between Seminoe dam and head of Pathfinder reservoir is less than area of original river bed through Pathfinder reservoir—considered as off-set. Evaporation losses will be divided between natural flow and storage water flowing in any section of river channel upon a proportional basis. This proportion will ordinarily be determined at the upper end of the section except under conditions of intervening accruals or diversions that materially change the ratio of storage to natural flow at the lower end of the section. In such event the average proportion for the section will be determined by using the mean ratio for the two ends of the section.

In the determination of transportation losses for the various sections of the stream, such time intervals for the passage of water from point to point shall be used as may be agreed upon by Nebraska, Wyoming and the United States, or in the absence of such agreement, as may be decided upon from day to day by the manager of the government reservoirs, with such adjustments to be made by said manager from time to time as may be necessary to make as accurate a segregation as is possible.

VI. This decree is intended to and does deal with and apportion only the natural flow of the North Platte River. Storage water shall not be affected by this decree and the owners of rights therein shall be permitted to distribute the same in accordance with any lawful contracts which they may have entered into or may in the future enter into, without interference because of this decree.

VII. Such additional gauging stations and measuring devices at or near the Wyoming-Nebraska state line, if any, as may be necessary for making any apportionment herein decreed, shall be constructed and maintained at the joint and equal expense of Wyoming and Nebraska to the extent that the costs thereof are not paid by others.

VIII. The State of Wyoming, its officers, attorneys, agents and employees be and they are hereby sev-

*[670]

erally *enjoined from diverting or permitting the diversion of water from the North Platte River or its tributaries at or above Alcova Reservoir in lieu of or in exchange for return flow water from the Kendrick Project reaching the North Platte River below Alcova Reservoir.

IX. The State of Wyoming and the State of Colorado be and they hereby are each required to prepare and maintain complete and accurate records of the total area of land irrigated and the storage and exportation of the water of the North Platte River and its tributaries within those portions of their respective jurisdictions covered by the provisions of paragraphs I and II hereof, and such records shall be available for inspection at all reasonable times; provided, however, that such records shall not be required in reference to the water uses permitted by paragraph X hereof.

X. This decree shall not affect or restrict the use or diversion of water from the North Platte River and its tributaries in Colorado or Wyo-

ming for ordinary and usual domestic, municipal and stock watering purposes and consumption.

XI. For the purposes of this decree:

(a) "Season" or "seasonal" refers to the irrigation season, May 1 to September 30, inclusive;

(b) The term "storage water" as applied to releases from reservoirs owned and operated by the United States is defined as any water which is released from reservoirs for use on lands under canals having storage contracts in addition to the water which is discharged through those reservoirs to meet natural flow uses permitted by this decree;

(c) "Natural flow water" shall be taken as referring to all water in the stream except storage water;

(d) Return flows of Kendrick Project shall be deemed to be "natural flow water" when they have reached the North Platte River, and subject to the same diversion and use as any other natural flow in the stream.

*[671]

*XII. This decree shall not affect:

(a) The relative rights of water users within any one of the States who are parties to this suit except as may be otherwise specifically provided herein;

(b) Such claims as the United States has to storage water under Wyoming law; nor will the decree in any way interfere with the ownership and operation by the United States of the various federal storage and power plants, works and facilities.

(c) The use or disposition of any additional supply or supplies of water which in the future may be imported into the basin of the North Platte River from the water shed of an entirely separate stream, and which presently do not enter said basin, or the return flow from any such supply or supplies.

(d) The apportionment heretofore made by this Court between the States of Wyoming and Colorado of the waters of the Laramie River, a tributary of the North Platte River;

(e) The apportionment made by the compact between the States of Nebraska and Colorado, apportioning the water of the South Platte River.

XIII. Any of the parties may apply at the foot of this decree for its amendment or for further relief. The Court retains jurisdiction of this suit for the purpose of any order, direction, or modification of the decree, or any supplementary decree, that may at any time be deemed proper in relation to the subject matter in controversy. Matters with reference to which further relief may hereafter be sought shall include, but shall not be limited to, the following:

(a) The question of the applicability and effect of the Act of August 9, 1937, 50 Stat 564, 595-596, upon the rights of Colorado and its water users when and if water hereafter is available for storage and use in connection with the Kendrick Project in Wyoming.

*[672]

*(b) The question of the effect upon the rights of upstream areas of the construction or threatened construction in downstream areas of any projects not now existing or recognized in this decree;

(c) The question of the effect of the construction or threatened construction of storage capacity not now existing on tributaries entering the North Platte River between Pathfinder Reservoir and Guernsey Reservoir;

(d) The question of the right to divert at or above the headgate of the Casper Canal any water in lieu of, or in exchange for, any water developed by artificial drainage to the river of sump areas on the Kendrick Project;

(e) Any question relating to the joint operation of Pathfinder, Guernsey, Seminoe and Alcova Reservoirs whenever changed conditions make such joint operation possible.

(f) Any change in conditions making modification of the decree or the granting of further relief necessary or appropriate.

XIV. The costs in this cause shall be apportioned and paid as follows: the State of Colorado one-fifth; the

State of Wyoming two-fifths; and the State of Nebraska two-fifths. Payment of the fees and expenses of the Special Master has been provided by a previous order of this Court.

XV. The clerk of this Court shall transmit to the chief magistrates of the States of Colorado, Wyoming, and Nebraska, copies of this decree duly authenticated under the seal of this Court.

Exhibit VI

U.S. Supreme Court Stipulation, 1953

Nebraska vs. Wyoming and Colorado

*[981]

*Order Modifying and Supplementing Decree.

No. 5, Original. STATE OF NEBRASKA, Plaintiff, v. STATE OF WYOMING (State of Colorado, Impleaded Defendant, and the United States, Intervener).

Clarence S. Beck, Attorney General of Nebraska, and Bert L. Overcash, both of Lincoln, Nebraska, for the State of Nebraska, Howard B. Black, Attorney General of Wyoming, for the State of Wyoming, Duke W. Dunbar, Attorney General of Colorado, H. Lawrence Hinkley, and Jean S. Breitenstein, all of Denver, Colorado, for the State of Colorado, and Acting Solicitor General Robert L. Stern, of Washington, D. C., for the United States.

June 15, 1953. The joint motion for approval of a stipulation and to modify and supplement the decree is granted and the following order is entered in compliance with the stipulation:

The parties to this cause having filed a stipulation, dated January 14, 1953, and a joint motion for approval of the stipulation and to modify and supplement the decree entered on October 8, 1945 (325 US 665, 89 L ed 1857, 66 S Ct 1) and the Court being fully advised:

The stipulation dated January 14, 1953, is approved; and

IT IS ORDERED that the decree of October 8, 1945, is hereby modified and supplemented as follows:

1. In paragraph I (a) of the decree the figure "145,000" is substituted for the figure "135,000."

2. Paragraph XIII is amended by striking the first sentence and substituting for it the following:

Any of the parties may apply at the foot of this decree for its amendment or for further relief, except that for a period of five years from and after June 15, 1953, the State of Colorado shall not institute any proceedings for the amendment of the decree or for further relief. In the event that within said period of five years any other party applies for an amendment of the decree or for further relief, then the State of Colorado may assert any and all rights, claims or defenses available to it under the decree as amended.

3. Two new paragraphs, as follows, are added to the decree:

XVI. Whatever claims or defenses the parties or any of them may have in respect

*[982]

to the application, *interpretation or construction of the Act of August 9, 1937 (50 Stat 564–595) shall be determined without prejudice to any party arising because of

any development of the Kendrick Project occurring subsequent to October 1, 1951.

XVII. When Glendo Dam and Reservoir are constructed, the following provisions shall be effective:

(a) The construction and operation of the Glendo Project shall not impose any demand on areas at or above Seminoe Reservoir which will prejudice any rights that the States of Colorado or Wyoming might have to secure a modification of the decree permitting an expansion of water uses in the natural basin of the North Platte River in Colorado or above Seminoe Reservoir in Wyoming.

(b) The construction and operation of Glendo Reservoir shall not affect the regimen of the natural flow of the North Platte River above Pathfinder Dam. The regimen of the natural flow of the North Platte River below Pathfinder Dam shall not be changed, except that not more than 40,000 acre feet of the natural flow of the North Platte River and its tributaries which cannot be stored in upstream reservoirs under the provisions of this decree may be stored in the Glendo Reservoir during any water year, in addition to evaporation losses on such storage, and, further, the amount of such storage water that may be held in storage at any one time, including carryover storage, shall never exceed 100,000 acre feet. Such storage water shall be disposed of in accordance with contracts to be hereafter executed, and it may be used for the irrigation of lands in the basin of the North Platte Riv-

*[983]

er in western Nebraska to the extent *of 25,000 acre feet annually, and for the irrigation of lands in the basin of the North Platte River in southeastern Wyoming below Guernsey Reservoir to the extent of 15,000 acre feet annually, provided that it shall not be used as a substitute for storage water contracted for under any existing permanent arrangements. The above limitation on storage of natural flow does not apply to flood water which may be temporarily stored in any capacity allocated for flood control in the Glendo Reservoir, nor to water originally stored in Pathfinder Reservoir which may be temporarily re-stored in Glendo Reservoir after its release from Pathfinder and before its delivery pursuant to contract; nor to water which may be impounded behind Glendo Dam, as provided in the Bureau of Reclamation Definite Plan Report for the Glendo Unit dated December 1952, for the purpose of creating a head for the development of water power.

(c) Paragraph III of the decree is amended to read as follows:

III. The State of Wyoming, its officers, attorneys, agents and employees, be and they are hereby severally enjoined from storing or permitting the storage of water in Pathfinder, Guernsey, Seminoe, Alcova and Glendo Reservoirs otherwise than in accordance with the relative storage rights, as among themselves, of such reservoirs, which are hereby defined and fixed as follows:

First, Pathfinder Reservoir;
Second, Guernsey Reservoir;
Third, Seminoe Reservoir;
Fourth, Alcova Reservoir; and
Fifth, Glendo Reservoir;

*[984]

*Provided, however that water may be impounded in or released from Seminoe Reservoir, contrary to the foregoing rule of priority operation for use in the generation of electric power when and only when such storage or release will not materially interfere with the administration of water for irrigation purposes according to the priority decreed for the French Canal and the State Line Canals.

Storage rights of Glendo Reservoir shall be subject to the provisions of this paragraph III.

(d) Paragraph IV of the decree is amended to read as follows:

IV. The State of Wyoming, its officers, attorneys, agents and employees be and they are hereby severally enjoined from storing or permitting the storage of water in Pathfinder, Guernsey, Seminoe, Alcova and Glendo Reservoirs, and from the diversion of natural flow water through the Casper Canal for the Kendrick Project between and including May 1 and September 30 of each year otherwise than in accordance with the rule of priority in relation to the appropriations of the Nebraska lands supplied by the French Canal and by the State Line Canals, which said Nebraska appropriations are hereby adjudged to be senior to said five reservoirs and said Casper Canal, and which said Nebraska appropriations are hereby identified and defined, and their diversion limitations in second feet and seasonal limitations in acre feet fixed as follows:

Lands	Canal	Limitation in Sec. Feet	Seasonal Limitation in Acre Ft.
Tract of 1025 acres	French	15	2,227
Mitchell Irrigation District	Mitchell	195	35,000
Gering Irrigation District	Gering	193	36,000
Farmers Irrigation District	Tri-State	748	183,050
Ramshorn Irrigation District	Ramshorn	14	3,000

*[985]

*(e) Paragraph V of the decree is amended to read as follows:

V. The natural flow in the Guernsey Dam to Tri-State Dam section between and including May 1 and September 30 of each year, including the contribution of Spring Creek, be and the same hereby is apportioned between Wyoming and Nebraska on the basis of twenty-five per cent to Wyoming and seventy-five per cent to Nebraska, with the right granted Nebraska to designate from time to time the portion of its share which shall be delivered into the Interstate, Fort Laramie, French and Mitchell Canals for use on the Nebraska lands served by these canals. The State of Nebraska, its officers, attorneys, agents and employees, and the State of Wyoming, its officers, attorneys, agents and employees, are hereby enjoined and restrained from diversion or use contrary to this apportionment, provided that in the apportionment of water in this section the flow for each day, until ascertainable, shall be assumed to be the same as that of the preceding day, as shown by the measurements and computations for that day, and provided further, that unless and until Nebraska, Wyoming and the United States agree upon a modification thereof, or upon another formula, reservoir evaporation and transportation losses in the segregation of natural flow and storage shall be computed in accordance with the following formula taken from United States' Exhibit 204A and the stipulation of the parties dated January 14, 1953, and filed on January 30, 1953:

Reservoir Evaporation Losses.

Seminoe, Pathfinder and Alcova Reservoirs.

Evaporation will be computed daily based upon evaporation from Weather

*[986]

Bureau Standard *4 foot diameter Class "A" pan located at Pathfinder Reservoir. Daily evaporation will be multiplied by area of water surface of reservoir in acres and by co-efficient of 70% to reduce pan record to open water surface.

Glendo and Guernsey Reservoirs.

Compute same as above except use pan evaporation at Whalen Dam.

River Carriage Losses.

River carriage losses will be computed upon basis of area of river water surface as determined by aerial surveys made in 1939 and previous years and upon average monthly evaporation at Pathfinder reservoir for the period 1921 to 1939, inclusive, using a co-efficient of 70% to reduce pan records to open water surface.

Daily evaporation losses in second-feet for various sections of the river are shown in the following table:

TABLE

River Section	Area Acres	Daily Loss—Second Feet May	June	July	Aug.	Sept.
Alcova to Glendo Reservoir	6,740	43	61	70	61	45
Guernsey Reservoir to Whalen	560	4	5	6	5	4
Whalen to State Line	2,480	16	22	25	22	16

Above table is based upon mean evaporation at Pathfinder as follows: May .561 ft.; June .767 ft.; July .910 ft.: Aug. .799 ft.; Sept. .568 ft. Co-efficient of 70% to reduce pan record to open water surface.

Above table does not contain computed loss for section of river from Glendo Dam to head of Guernsey Reservoir (area 680 acres) because this area is less than submerged area of original river bed (940

*[987]

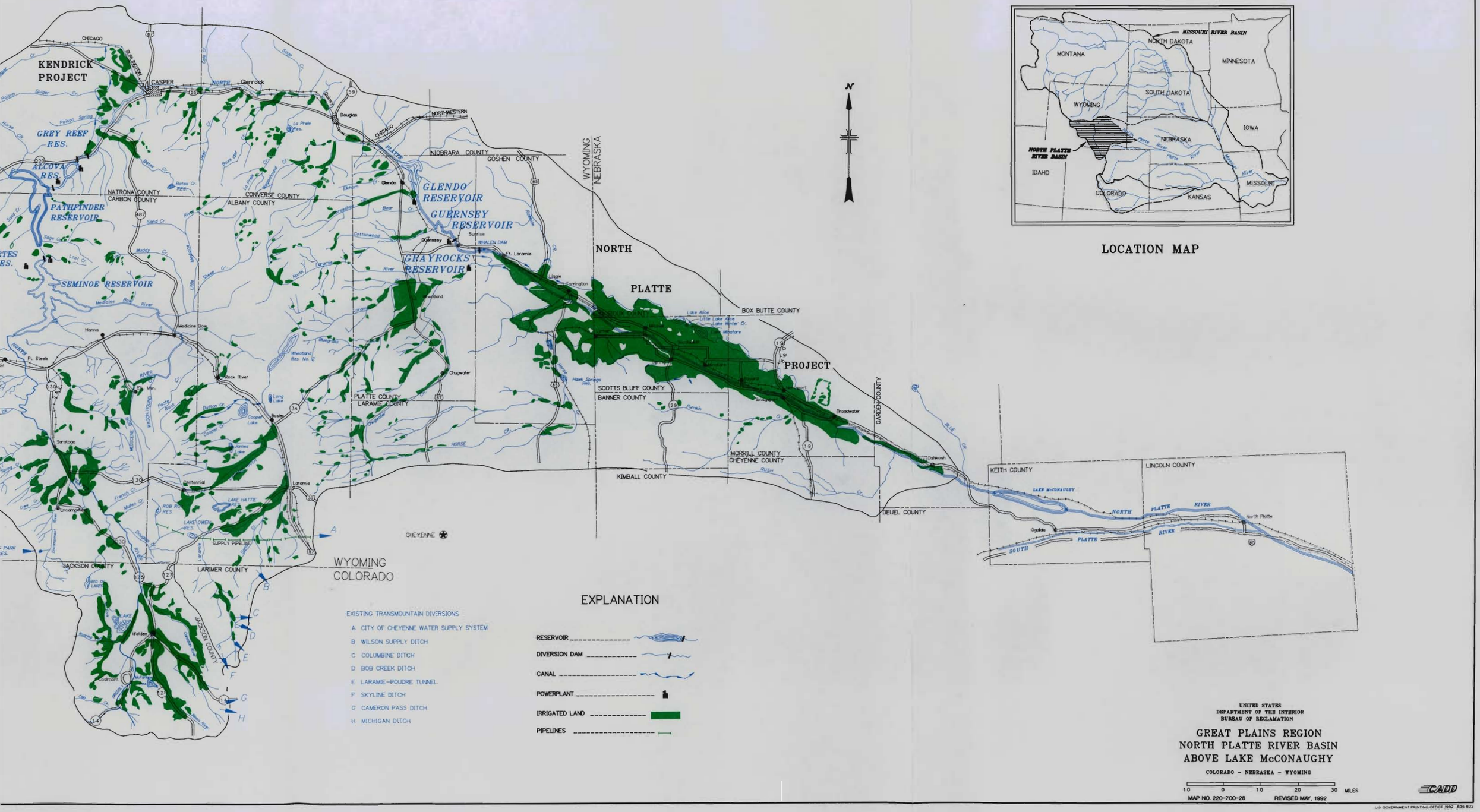
*acres) in Glendo Reservoir and is, therefore, considered as off-set.

Above table does not contain computed loss for section of river from Pathfinder Dam to head of Alcova Reservoir (area 170 acres) because this area is less than

submerged area of original river bed in Alcova Reservoir and is, therefore, considered as off-set.

Likewise the area between Seminoe Dam and head of Pathfinder Reservoir is less than area of original river bed through Pathfinder Reservoir—considered as off-set. Evaporation losses will be divided between natural flow and storage water flowing in any section of river channel upon a proportional basis. This proportion will ordinarily be determined at the upper end of the section except under conditions of intervening accruals or diversions that materially change the ratio of storage to natural flow at the lower end of the section. In such event the average proportion for the section will be determined by using the mean ratio for the two ends of the section.

In the determination of transportation losses for the various sections of the stream, such time intervals for the passage of water from point to point shall be used as may be agreed upon by Nebraska, Wyoming and the United States, or in the absence of such agreement, as may be decided upon from day to day by the manager of the government reservoirs, with such adjustments to be made by said manager from time to time as may be necessary to make as accurate a segregation as is possible.



U.S. GOVERNMENT PRINTING OFFICE 1992 - 836-832

Plate 1

KENDRICK PROJECT

NORTH PLATTE PROJECT

GREY REEF RES.

ALCOVA RES.

PATHFINDER RESERVOIR

KORTES RES.

SEMINOE RESERVOIR

GLENDO RESERVOIR

GUERNSEY RESERVOIR

GRAYROCKS RESERVOIR

HOG PARK RES.

CASPER

CHEYENNE

FREMONT COUNTY
SWEETWATER COUNTY
NATRONA COUNTY
CARBON COUNTY
CONVERSE COUNTY
ALBANY COUNTY
NIOBRARA COUNTY
GOSHEN COUNTY
PLATTE COUNTY
LARAMIE COUNTY
JACKSON COUNTY
LARIMER COUNTY
BOX BUTTE COUNTY
SCOTTS BLUFF COUNTY
BANNER COUNTY
MORRILL COUNTY
CHEYENNE COUNTY
KIMBALL COUNTY
DEUEL COUNTY
KEITH COUNTY
GARDEN COUNTY

WYOMING
NEBRASKA

WYOMING
COLORADO

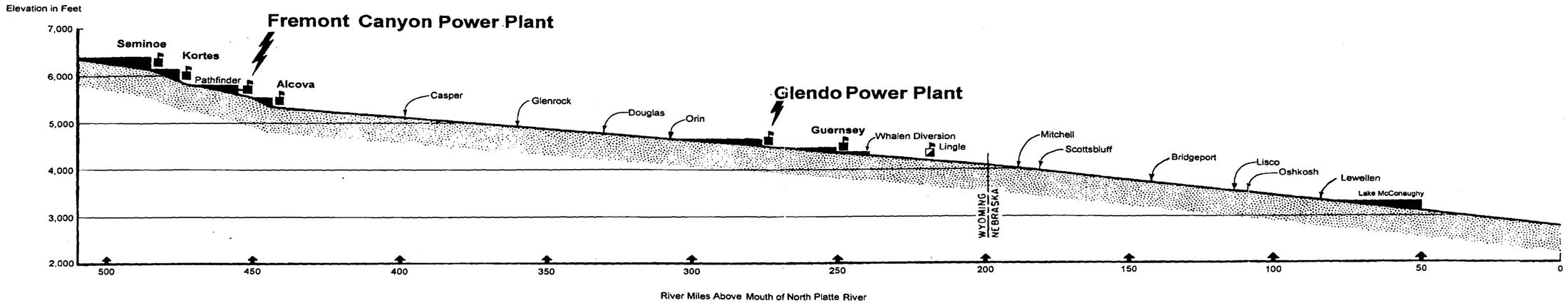
EXISTING TRANSMOUNTAIN DIVERSIONS

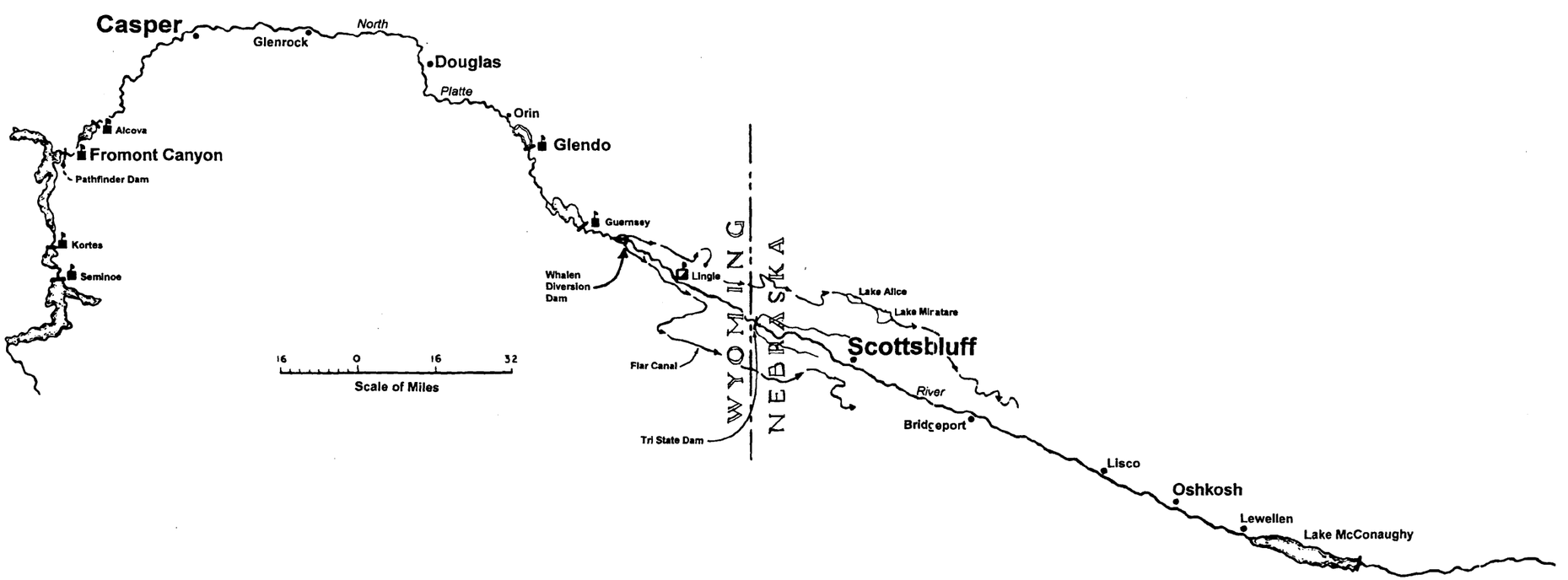
A CITY OF CHEYENNE WATER SUPPLY SYSTEM
B WILSON SUPPLY DITCH
C COLUMBINE DITCH
D BOB CREEK DITCH
E LARAMIE-POUDRE TUNNEL
F SKYLINE DITCH
G CAMERON PASS DITCH
H MICHIGAN DITCH

EXPLANATION

RESERVOIR
DIVERSION DAM
CANAL
POWERPLANT
IRRIGATED LAND
PIPELINES

Printed on Recycled Paper





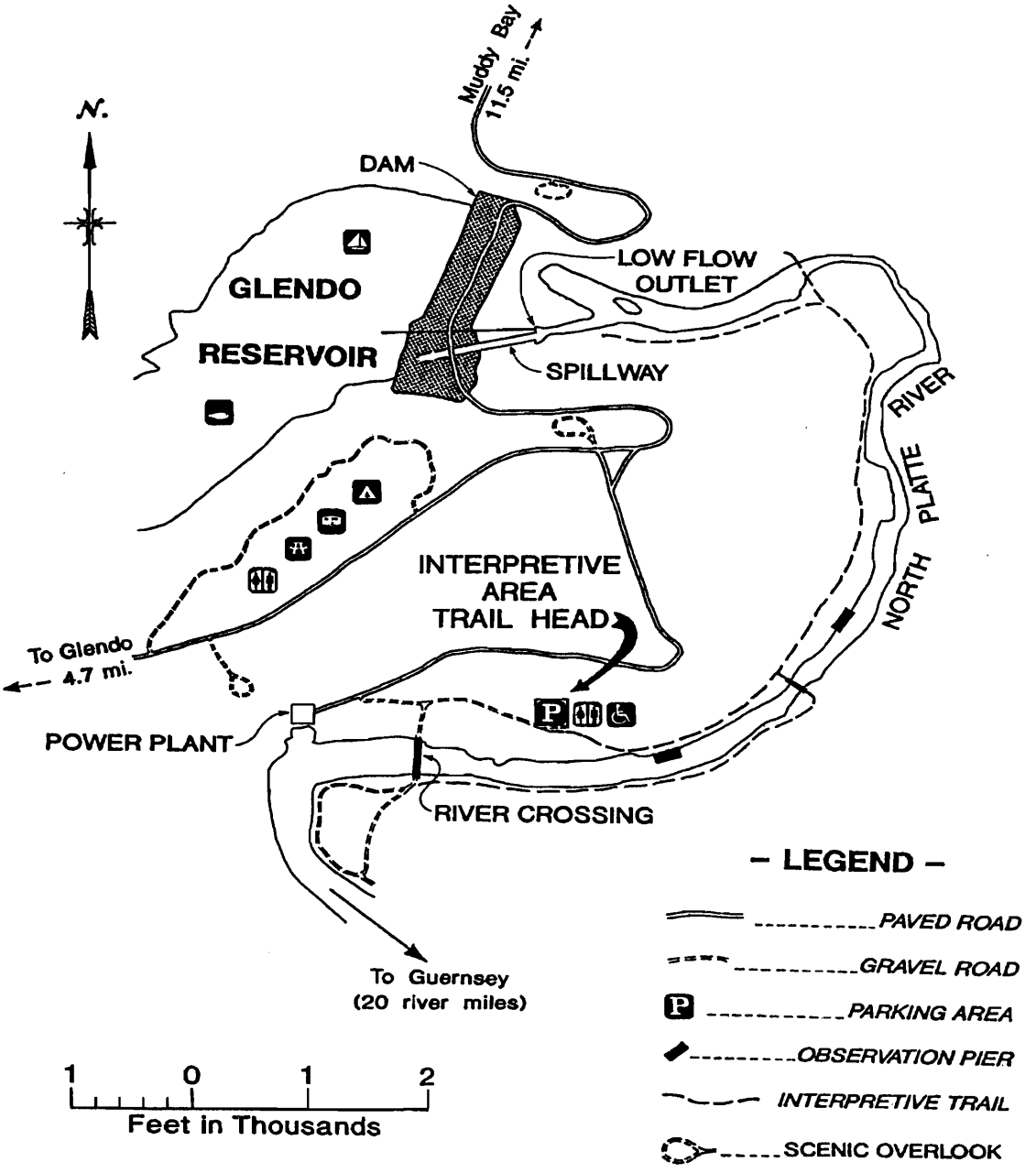
Prepared By: BH
Reviewed By: BC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

North Platte River Profile

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

GLENDO DAM WETLANDS INTERPRETIVE AREA



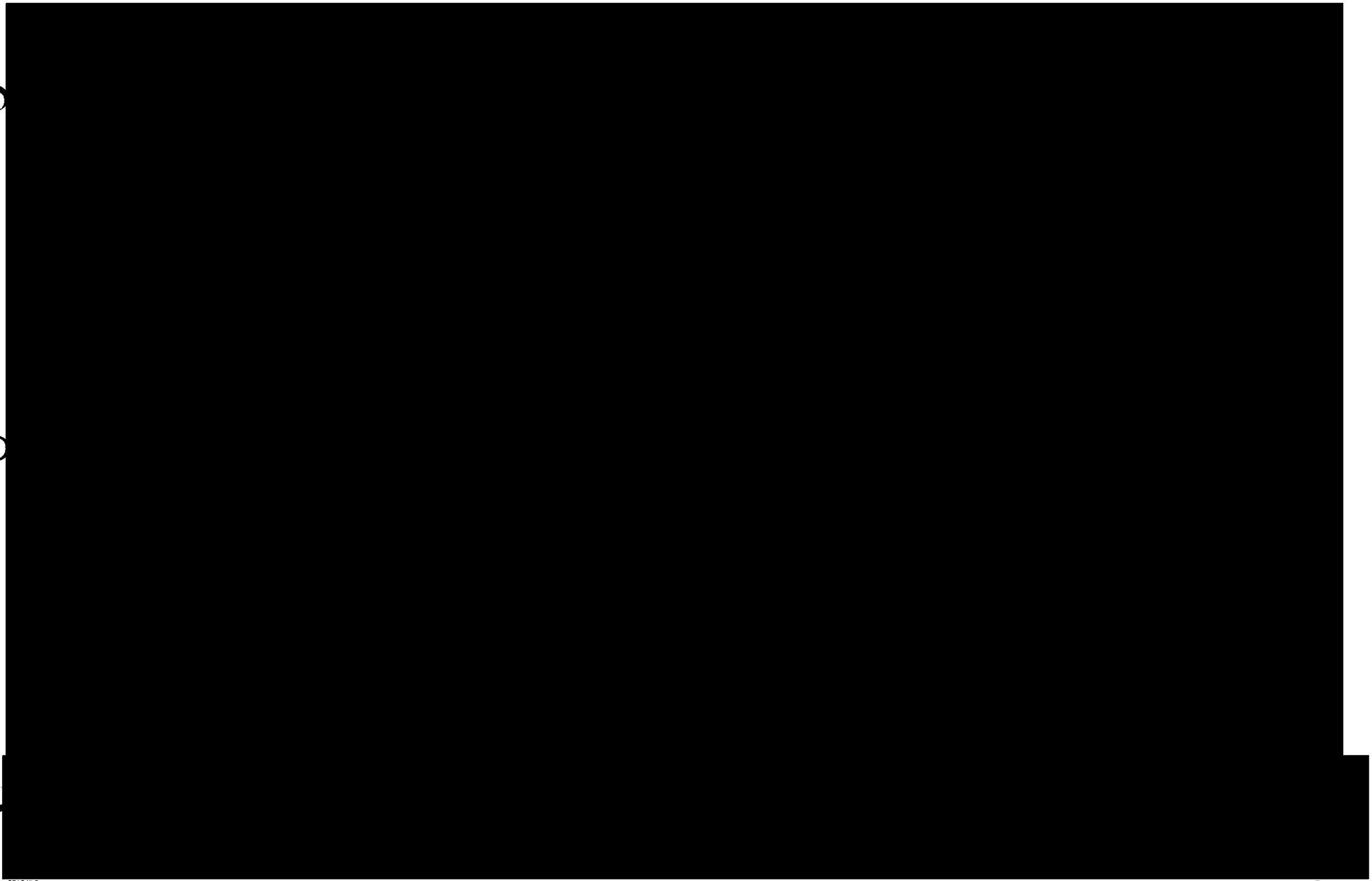
DEPARTMENT of the INTERIOR
BUREAU of RECLAMATION

Water Control Manual
Glendo Dam and Reservoir, Colorado

Glendo Dam Wetlands Interpretive Area

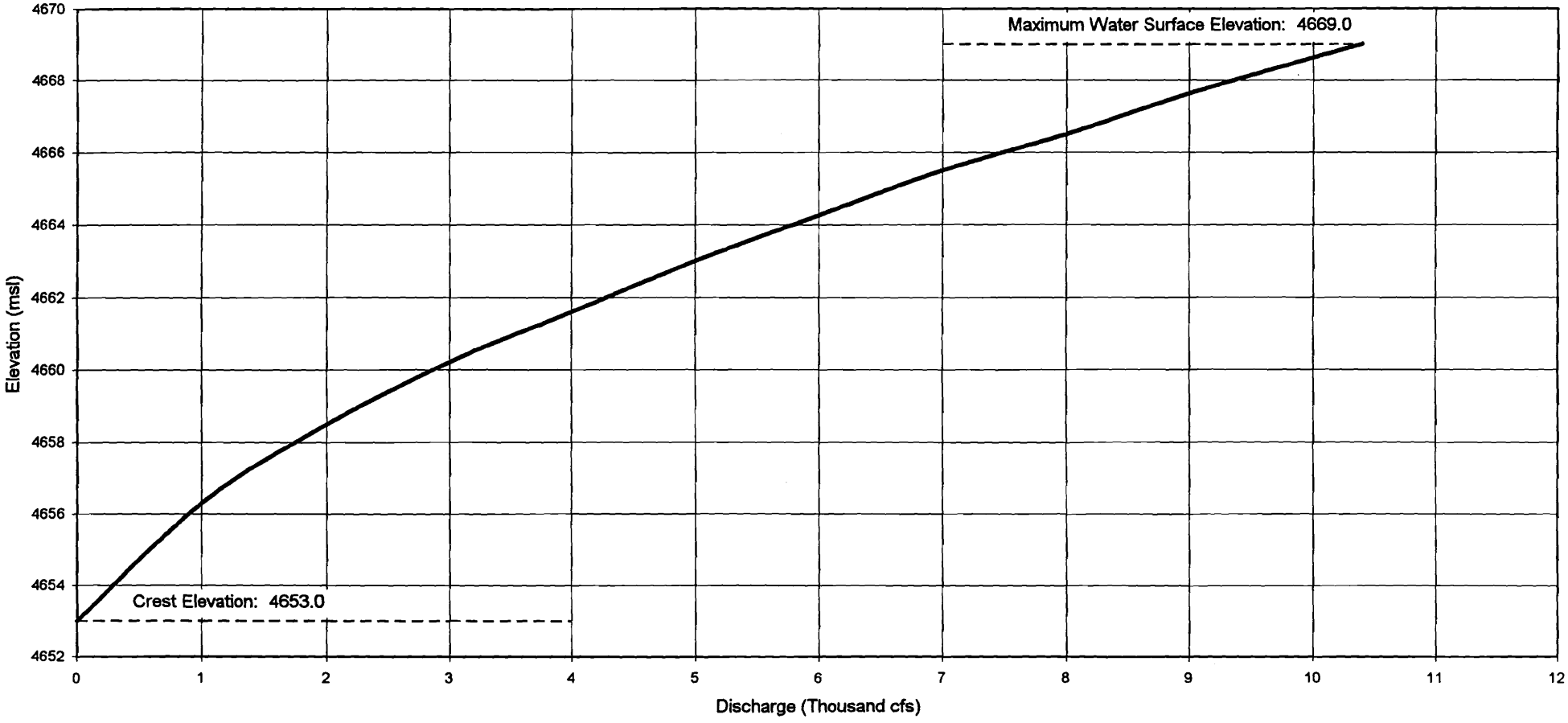
U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By: RH
Reviewed By: RJC



SDC XLS

Spillway Discharge Rating Curve



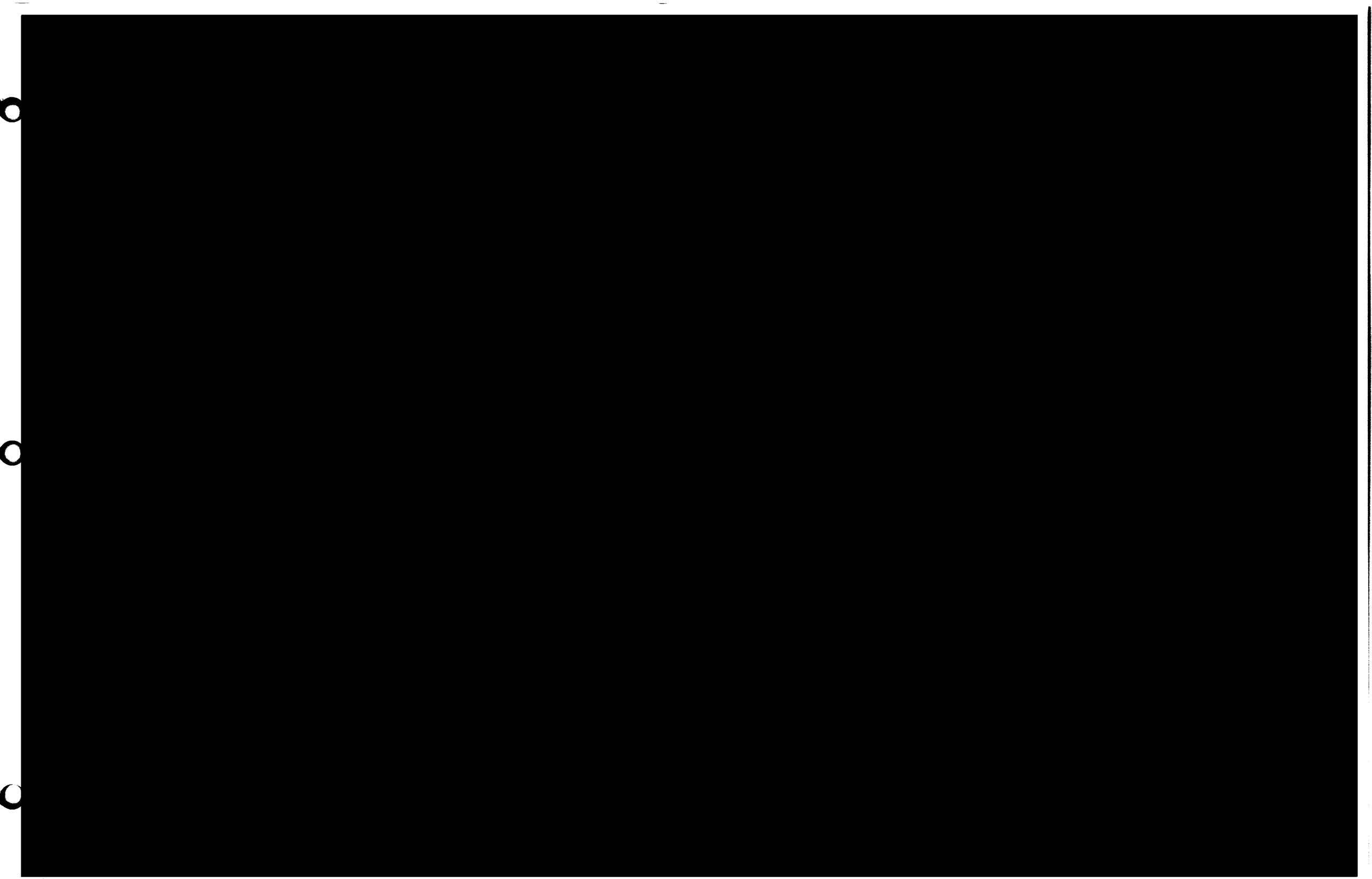
Prepared By: RH

Reviewed By: DJC

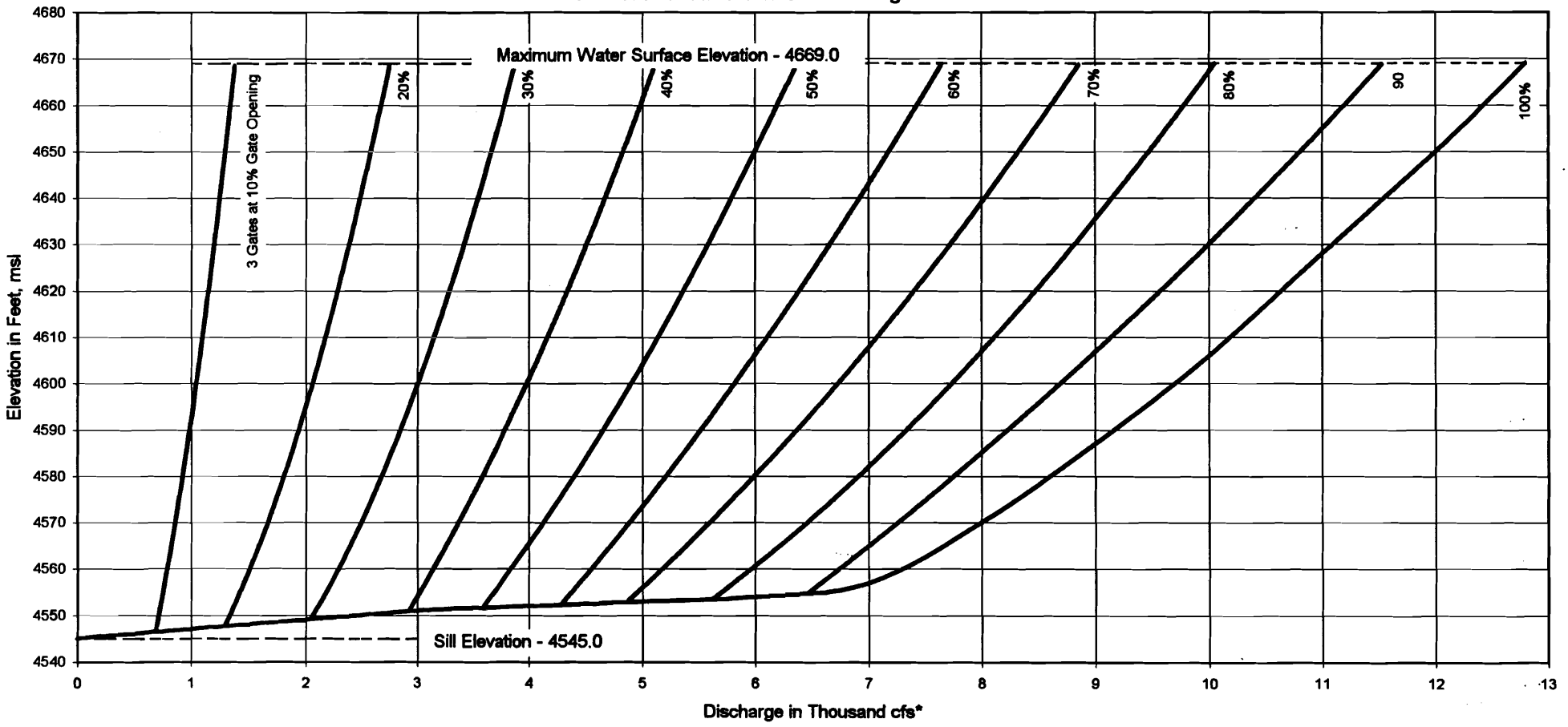
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Spillway Discharge Curve

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997



Outlet Works
7'-3" x 7'-9" H.P. Gates - Discharge Curves



* Based on Hydraulic Studies (Power Plant not Operating)

Notes:
Any variation in discharge from these curves, as determined by measurements of flow downstream from the outlet works, should be reported to the Assistant Commissioner and Chief Engineer.

Regulating Gates: Three 7'-3" x 7'-9" high pressure slide gates.

Source of Data: Glendo Standard Operating Procedures (SOP), Bureau of Reclamation, March 1991.

Prepared By: RH
Reviewed By: MC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

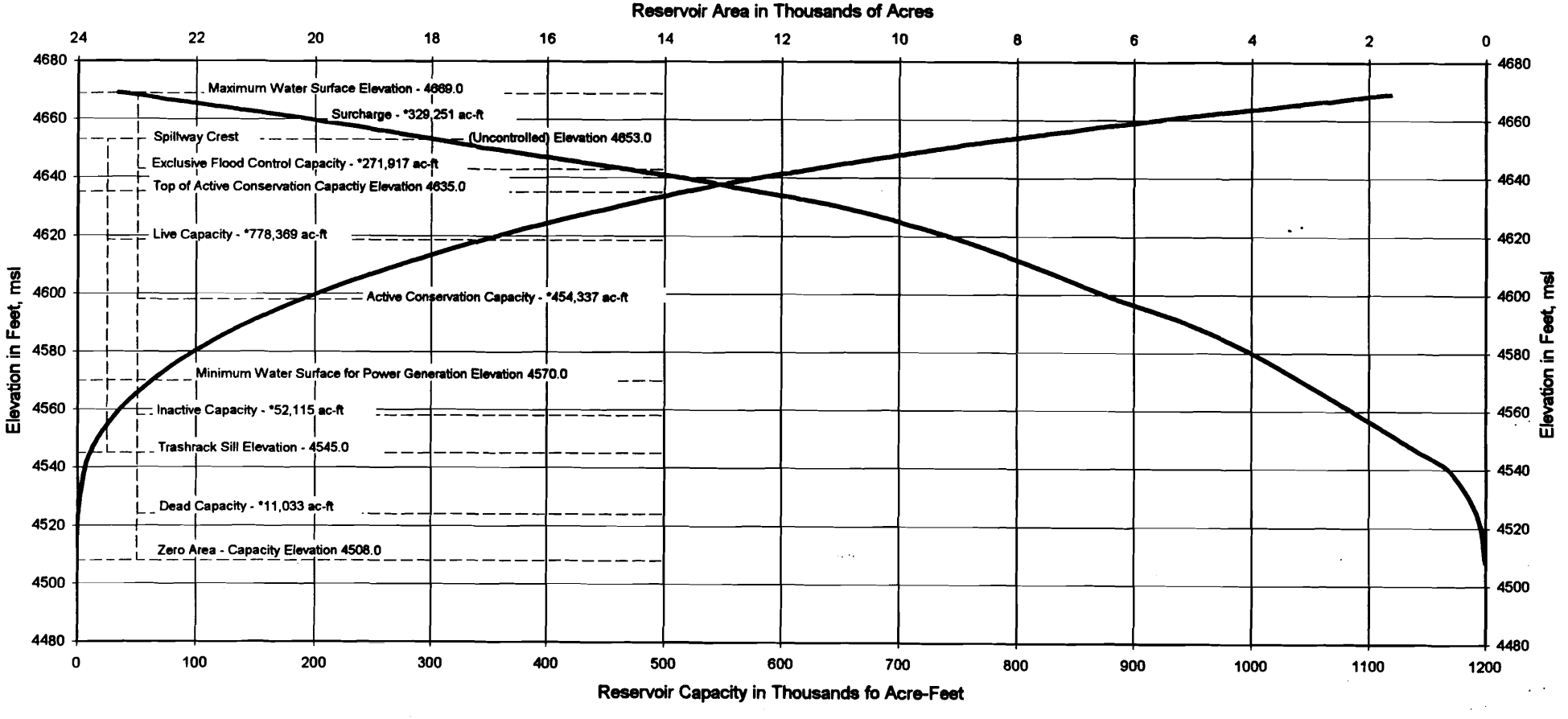
Outlet Works
7'-3" x 7'-9" H.P. Gates - Discharge Curves

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 10

Acc.xls

Area Capacity Data



This is a computation of area and capacity data superseding Drawing Number 449-703-557, Glendo Wyoming, dated January 11, 1965 and corresponding pertinent tables. The above area-elevation data are from a 1972 sedimation survey that was conducted by the Flood and Sedimentation Section of the Engineering and Research Center. The areas were derived via the width ratio method. A sedimentation report, "1972 Survey of Glendo Reservoir," dated April 1975, contains the information pertaining to the reservoir survey and its results. Electronic computer program CARCAP was used to compile area and capacity data from a smooth curve through all control points.

* Storage capacities indicated as available are for the 1972 resurvey conditions of sedimentation and may ultimately be encroached upon by sediment accumulation.

Surcharge is not included in general statements of capacity of the reservoir.

Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Area - Capacity Curves

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 12

Glendo Reservoir										
1972 Capacity Table in Acre-Feet										
Elev (feet	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4508	0	0	0	0	1	1	2	2	3	4
4509	5	5	6	8	9	10	12	13	15	16
4510	18	20	22	24	26	28	30	32	34	36
4511	39	41	44	46	49	51	54	57	59	62
4512	65	68	71	74	77	80	84	87	90	94
4513	97	101	104	108	112	115	119	123	127	131
4514	135	139	143	147	151	156	160	164	169	173
4515	178	183	187	192	197	202	207	212	217	222
4516	227	232	237	243	248	253	259	264	270	276
4517	281	287	293	299	305	310	317	323	329	335
4518	343	348	354	360	367	373	380	387	393	400
4519	407	414	421	428	435	442	449	456	463	471
4520	478	485	493	501	509	517	526	535	544	553
4521	562	573	581	591	601	611	622	633	643	655
4522	666	677	689	701	713	725	738	750	763	776
4523	790	803	817	831	845	859	873	888	903	918
4524	933	949	964	980	996	1012	1029	1046	1062	1079
4525	1097	1114	1132	1150	1168	1186	1204	1223	1242	1261
4526	1280	1300	1319	1339	1359	1379	1400	1420	1441	1462
4527	1484	1505	1527	1548	1570	1593	1615	1638	1661	1684
4528	1707	1730	1754	1778	1802	1826	1850	1875	1900	1925
4529	1950	1975	2001	2027	2053	2079	2105	2132	2159	2186
4530	2213	2240	2268	2297	2325	2354	2383	2413	2443	2474
4531	2504	2536	2567	2599	2631	2664	2697	2730	2764	2798
4532	2833	2868	2903	2939	2974	3011	3048	3085	3122	3160
4533	3198	3237	3276	3315	3354	3395	3435	3476	3517	3558
4534	3608	3647	3685	3728	3771	3815	3859	3904	3948	3994
4535	4039	4085	4131	4178	4225	4273	4320	4369	4471	4466
4536	4515	4565	4615	4665	4716	4767	4818	4870	4923	4975
4537	5028	5081	5135	5189	5244	5298	5351	5409	5465	5521
4538	5578	5635	5692	5750	5808	5867	5925	5985	6044	6104
4539	6164	6225	6286	6348	6409	6472	6534	6597	6660	6724
4540	6768	6853	6918	6984	7051	7119	7188	7258	7328	7399
4541	7471	7544	7618	7693	7768	7844	7921	7999	8078	8157
4542	8238	8319	8401	8484	8567	8652	8737	8823	8910	8998
4543	9087	9176	9266	9357	9449	9542	9636	9730	9825	9921
4544	10018	10116	10215	10314	10414	10515	10617	10720	10823	10928
4545	11033	11139	11246	11354	11462	11571	11682	11792	11904	12017
4546	12130	12245	12360	12476	12593	12710	12829	12948	13068	13189
4547	13311	13433	13557	13681	13806	13932	14058	14186	14314	14444
4548	14574	14704	14836	14969	15102	15236	15371	15507	15644	15781
4549	15819	16059	16198	16339	16481	16623	16767	16911	17056	17201

Plate 13

Elev (feet	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4550	17248	17495	17644	17793	17942	18093	18245	18397	18550	18704
4551	18858	19014	19178	19327	19485	19644	19804	19964	20125	20287
4552	20450	20614	20778	20943	21109	21276	21444	21612	21782	21952
4553	22122	22294	22467	22640	22814	22989	23165	23341	23519	23697
4554	23876	24056	24236	24418	24600	24783	24967	25152	25337	25523
4555	25710	25898	26087	26277	26267	26658	26850	27043	27236	27431
4556	27626	27822	28019	28216	28415	28614	28814	29015	29217	29419
4557	29622	29827	30032	30237	30444	30651	30859	31068	31278	31489
4558	31700	31912	32125	32339	32554	32769	32985	33202	33420	33639
4559	33858	34079	34300	34522	34745	34968	35192	35418	35644	35870
4560	36898	36326	36556	36786	37017	37249	37481	37715	37949	38184
4561	38420	38657	38895	39134	39373	39614	39855	40097	40340	40583
4562	40828	41073	41320	41567	41815	42064	42313	42564	42815	43067
4563	43320	43574	43829	44085	44341	44599	44857	45116	45376	45636
4564	45898	46160	46424	46688	46953	47219	47485	47753	48021	48290
4565	48560	48831	49103	49376	49649	49924	50199	50475	50752	51029
4566	51308	51587	51868	52149	52431	52714	52997	53282	53667	53853
4567	54140	54428	54717	55007	55297	55589	55881	56174	56468	56752
4568	57958	57354	57652	57958	58249	58589	58849	59151	59453	59756
4569	60060	60365	60671	60978	61285	61594	61903	62213	62524	62835
4570	63148	63461	63776	64091	64407	64724	65042	65360	65680	66000
4571	66321	66644	66967	67291	67615	67941	68267	68595	68923	69252
4572	69582	69913	70245	70577	70911	71245	71580	71916	72253	72591
4573	73929	73269	73609	73951	74293	74636	74980	75325	75670	76017
4574	76364	76712	77061	77411	77762	78114	78466	78820	79174	79529
4575	79885	80242	80600	80959	81318	81679	82040	82402	82765	83129
4576	83494	83860	84226	84594	84962	85331	85701	86072	86443	86816
4577	87189	87564	87939	88315	88692	89070	89449	89828	90209	90590
4578	90972	91355	91739	92124	92509	92896	93283	93672	94061	94451
4579	94842	95233	95626	96019	96414	96809	97205	97602	98000	98398
4580	98798	99199	99600	100003	100407	100812	101218	101625	102033	102442
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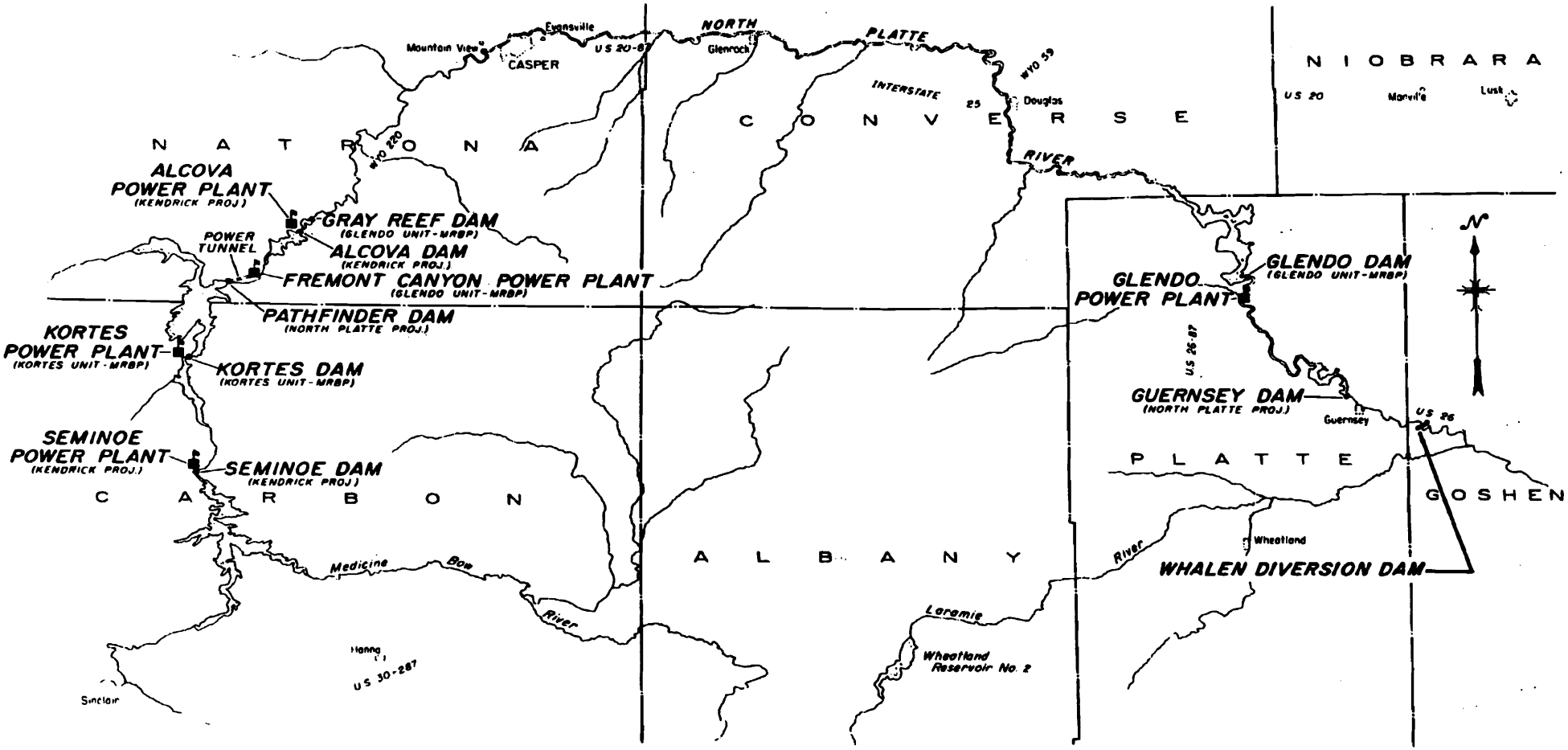


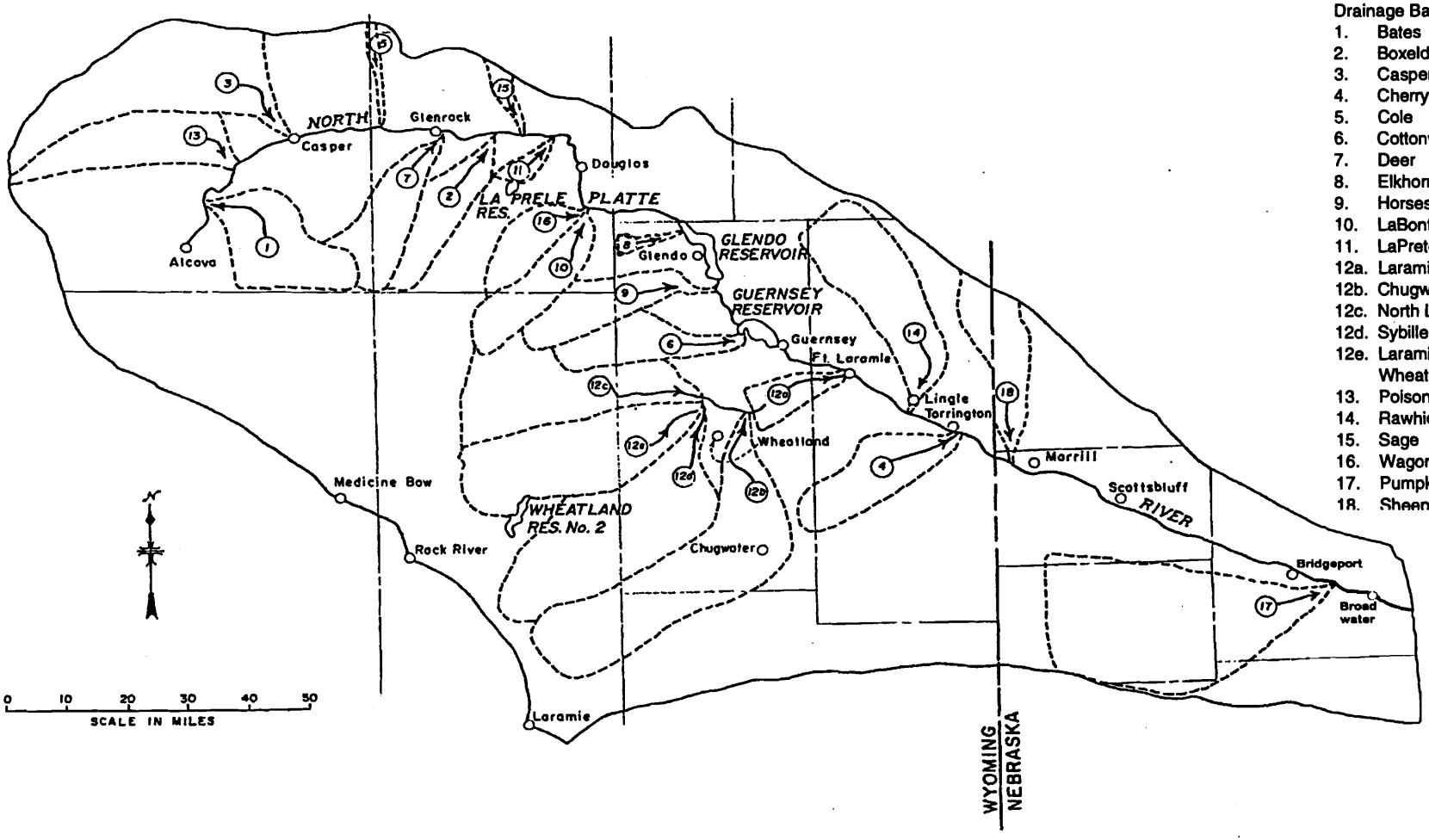
Water Control Manual
Glendo Dam and Reservoir, Wyoming

North Platte River System Projects

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By: RH
Reviewed By: ADC

PLATE 14



Drainage Basins

1. Bates
2. Boxelder
3. Casper
4. Cherry
5. Cole
6. Cottonwood
7. Deer
8. Elkhorn
9. Horseshoe
10. LaBonte
11. LaPrete
12a. Laramie River from North Platte to Uva
12b. Chugwater
12c. North Laramie River
12d. Sybille
12e. Laramie River, from sybille to Wheatland Reservoir No. 2
13. Poison Spider
14. Rawhide
15. Sage
16. Wagonhound
17. Pumpkin Creek, NE
18. Sheep Creek, NE-WY

Notes:

All basins contribute flow directly to the North Platte River, except basins 12 - b, - c, - d, - e, which flow directly to the Laramie River, and in turn to the North Platte.

Approximate Drainage boundries are indicated by dashed lines.

Arrows indicate direction of flow.

Prepared By: RH

Reviewed By: RG

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Drainage Basins Affecting the North Platte River

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Plate 15

North Platte Flood Study

Drainage Basin	Total Drainage Area (sq. mi.)	Contributing Drainage Area (sq. mi.)	Channel Length (miles)	Time of Concentration (hours)	Minimum Infiltration Rate (in/hr)	Results of 24-Hour 4-inch Rain Over Drainage Area: Depth of runoff (inches)	Total Volume of Runoff (ac-ft)	Hydrograph (hour occurring): Beginning	Peak	Ending	Peak Flow Rate (cfs)	Results of 24-Hour 6-inch Rain Over Drainage Area: Depth of Runoff (inches)	Total Volume of Runoff (ac-ft)	Hydrograph (hour occurring): Beginning	Peak	Ending	Peak Flow Rate (cfs)	Drainage Basin Characteristics	Affects on the North Platte River
1 Bates	393	373	46.2	11.3	0.02	2.64	52,500	4th	14th	44th	34,310	4.5	89500	2nd	12th	44th	59900	Poor pasture and range	
2 Boxelder	202	182	52.6	10.7	0.05	1.22	11,850	2nd	16th	43rd	8,145	2.75	26700	2nd	14th	43rd	17280	65% good grazing land 25% fair timber 10% irrigated meadows	
3 Casper	668	570	102.6	34.5	0.05	1.57	47,700	2nd	28th	81st	16,730	3.2	97400	2nd	28th	81st	33255	95% fair pasture and range	
4 Cherry	356	214	39	12.2	0.05	1.1	12,560	2nd	16th	39th	8,955	2.65	30270	2nd	16th	45th	19320	50% fair rangeland 50% good farmland	
5 Cole	70	69	24.1	7.9	0.1	0.1	368	6th	14th	28th	428	0.58	2135	4th	14th	28th	2315	Nearly 100% fair grazing land, high infiltration	
6 Cottonwood	196	186	43	9.7	0.05	1.1	10,920	2nd	14th	41st	8,280	2.6	25800	2nd	14th	41st	17430	25% good timber 75% good grazing land	
7 Deer	212	191	49.7	11.1	0.05	1.18	12,000	2nd	16th	43rd	8,500	2.75	28000	2nd	16th	43rd	18485	80% good grazing land 20% fair timber	
8 Elkhorn	47	45	17.8	4.8	0.05	0.64	1,535	4th	12th	33rd	1,340	1.9	4550	3rd	8th	33rd	3490	Good pasture and range but light soil	
9 Horseshoe	211	200	51.5	11.8	0.05	0.9	9,600	2nd	16th	45th	6,485	2.3	24500	2nd	16th	45th	16105	40% forest area 60% hay meadow	
10 La Bonte	287	273	38.5	8.7	0.05	1.52	22,100	3rd	10th	39th	17,670	3.24	47200	2nd	10th	39th	31290	95% fair pasture and range	
11 La Prele	177	168	23.1	8.9	0.05	1.08	9,680	3rd	14th	40th	7,090	2.52	22580	3rd	14th	40th	16010	80% fair pasture and range 20% meadows (good)	
12. a. Laramie River from North Platte to Uva Station	106	106	28	17.5	0.05	0.63	3,652	4th	20th	54th	1,938	1.9	10471	2nd	20th	54th	5278	95% pasture and range 5% hay meadows	
12. b. Chugwater	667	634	96	26.2	0.05	1.29	43,620	2nd	24th	67th	18,650	2.9	98194	2nd	24th	67th	40147	90% good grazing land 10% irrigated hay meadow	
12. c. North Laramie River	370	296	84.9	19.3	0.05	1.1	17,500	2nd	20th	51st	9,375	2.65	41800	2nd	20th	57th	20790	80% good grazing land 20% good forest	
12. d. Sybille	507	507	55.6	12.3	0.01	2.35	63,544	2nd	16th	45th	39,087	4.18	113027	2nd	16th	45th	67567	Fair grazing land. Highest runoff potential due to topography.	
12. e. Laramie River from Sybille to Wheatland Res. No. 2	655	622	55	13.4	0.05	1.29	42,793	2nd	16th	47th	27,902	2.9	96202	2nd	16th	47th	57800	90% good grazing land 10% hay meadows	
13 Poison Spider	301	271	63.7	18.3	0.05	1.5	21,700	2nd	18th	55th	12,460	3.2	46200	2nd	18th	55th	24485	99% fair pasture and range	
14 Rawhide	376	357	65.2	18.6	0.05	1.23	23,420	2nd	20th	49th	13,185	2.82	53690	2nd	20th	55th	27475	90% good pasture and range 10% good hay meadows	
15 Sage	182	182	43.5	14.9	0.05	0.62	6,020	2nd	18th	49th	3,350	1.8	17500	2nd	18th	49th	9400	good pasture and range	
16 Wagonhound	112	101	30.9	7	0.05	1.52	8,200	3rd	10th	37th	7,700	3.18	17150	2nd	10th	37th	15820	95% fair pasture and range	
17 Pumpkin, NE	1080	918	57.2	20.8	0.05	0.94	46,020	2nd	22nd	53rd	23,765	2.38	116525	2nd	22nd	59th	55110	50% farmland (good) 50% pasture and range (good)	
18 Sheep, NE	357	332	39.5	15.3	0.1	0.15	2,655	6th	18th	38th	1,975	0.82	14520	2nd	18th	44th	9085	33% row crop 17% alfalfa meadow 50% pasture (good)	

Prepared By: _____
Reviewed By: _____

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Hydrologic Information
North Platte River and Tributary Flood Study

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

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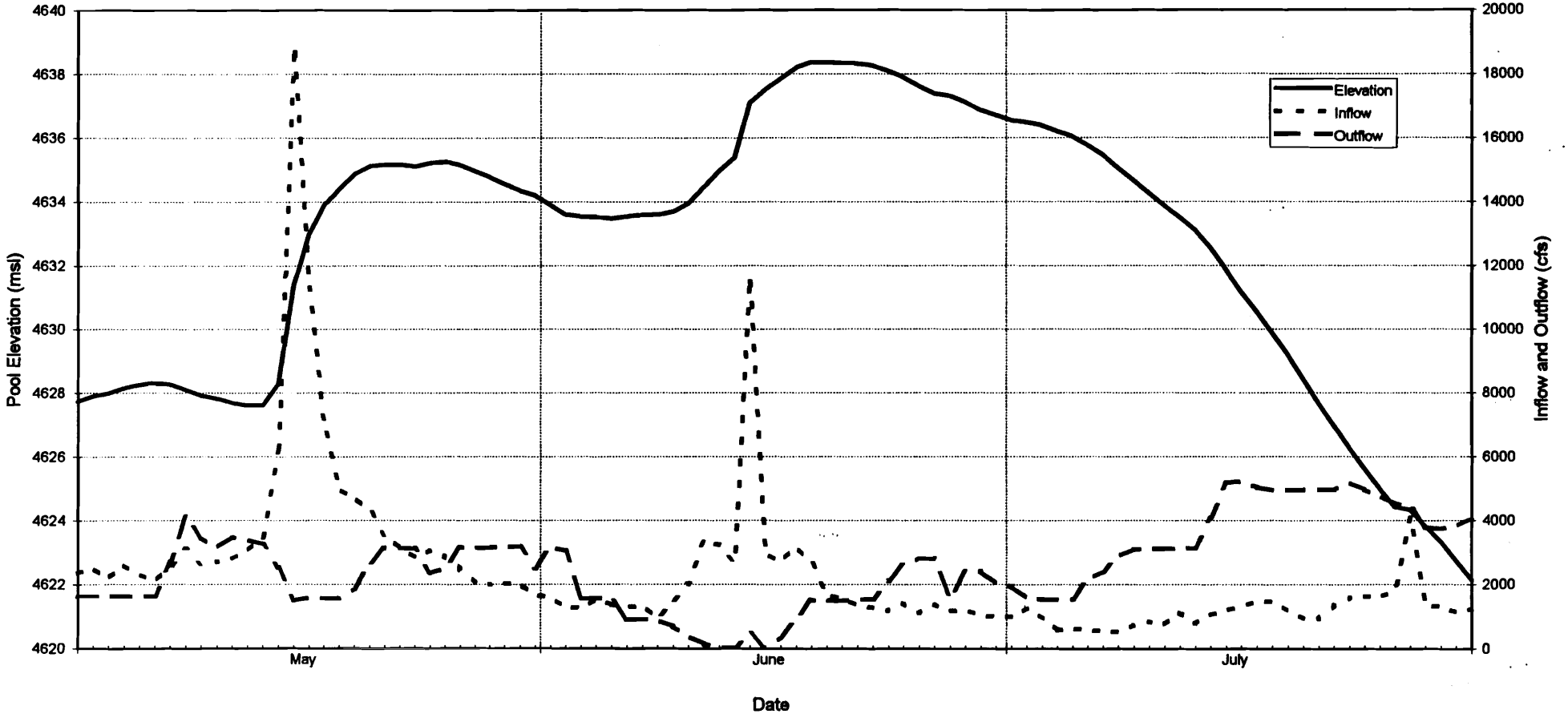
PLATE 16

Glendo Dam and Reservoir
1965 Flood Routing



REGULATION PLAN: During inflow period, releases determined by regulation schedule until flood peak has passed and inflow becomes less than outflow.

EVACUATION PLAN: Set releases to evacuate accumulated flood storage as soon as practicable, Maximum - 10,000 cfs; Minimum - Power Plant capacity unless lower releases are necessary to prevent downstream flooding.

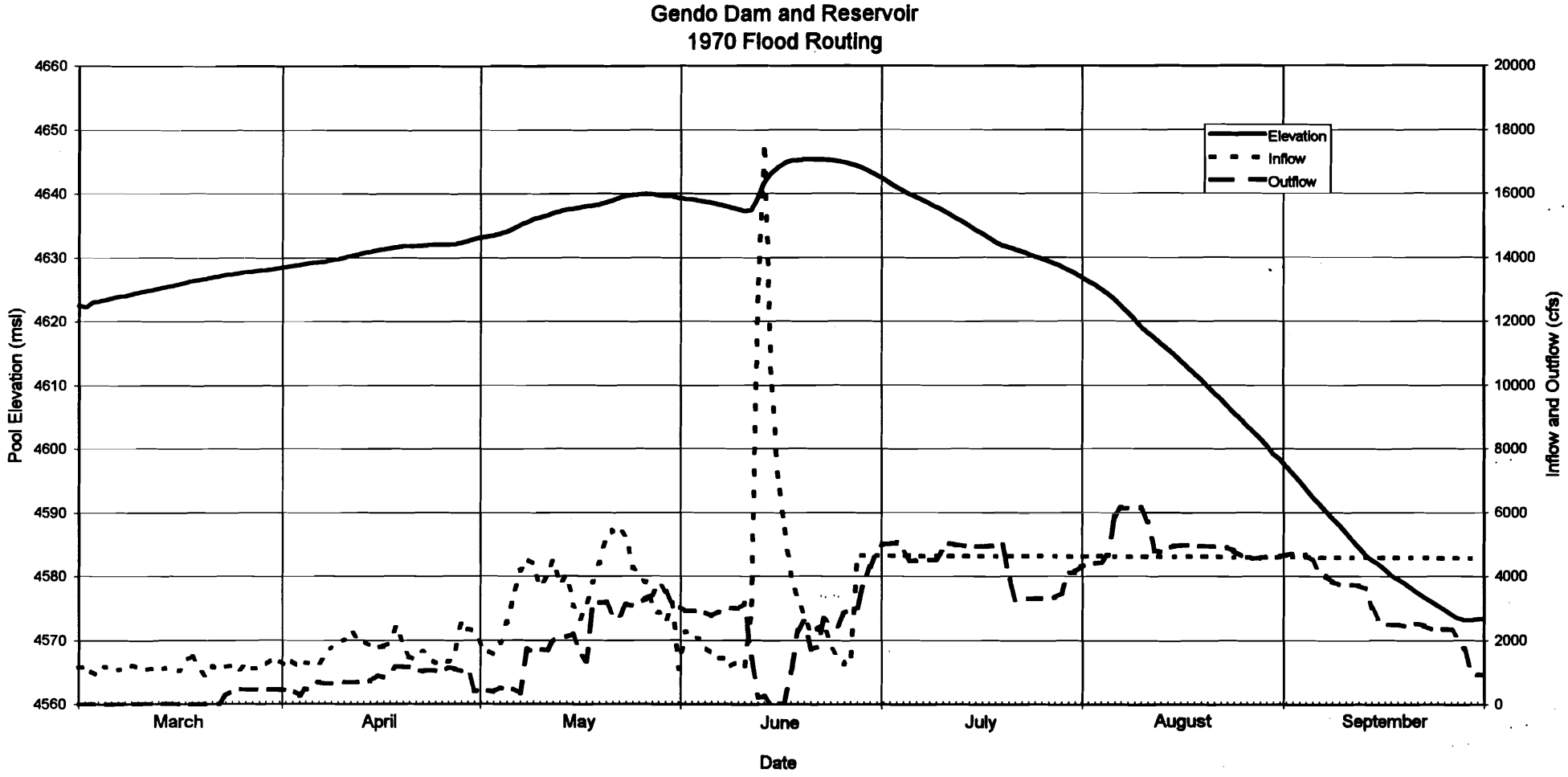
Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1965 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 17



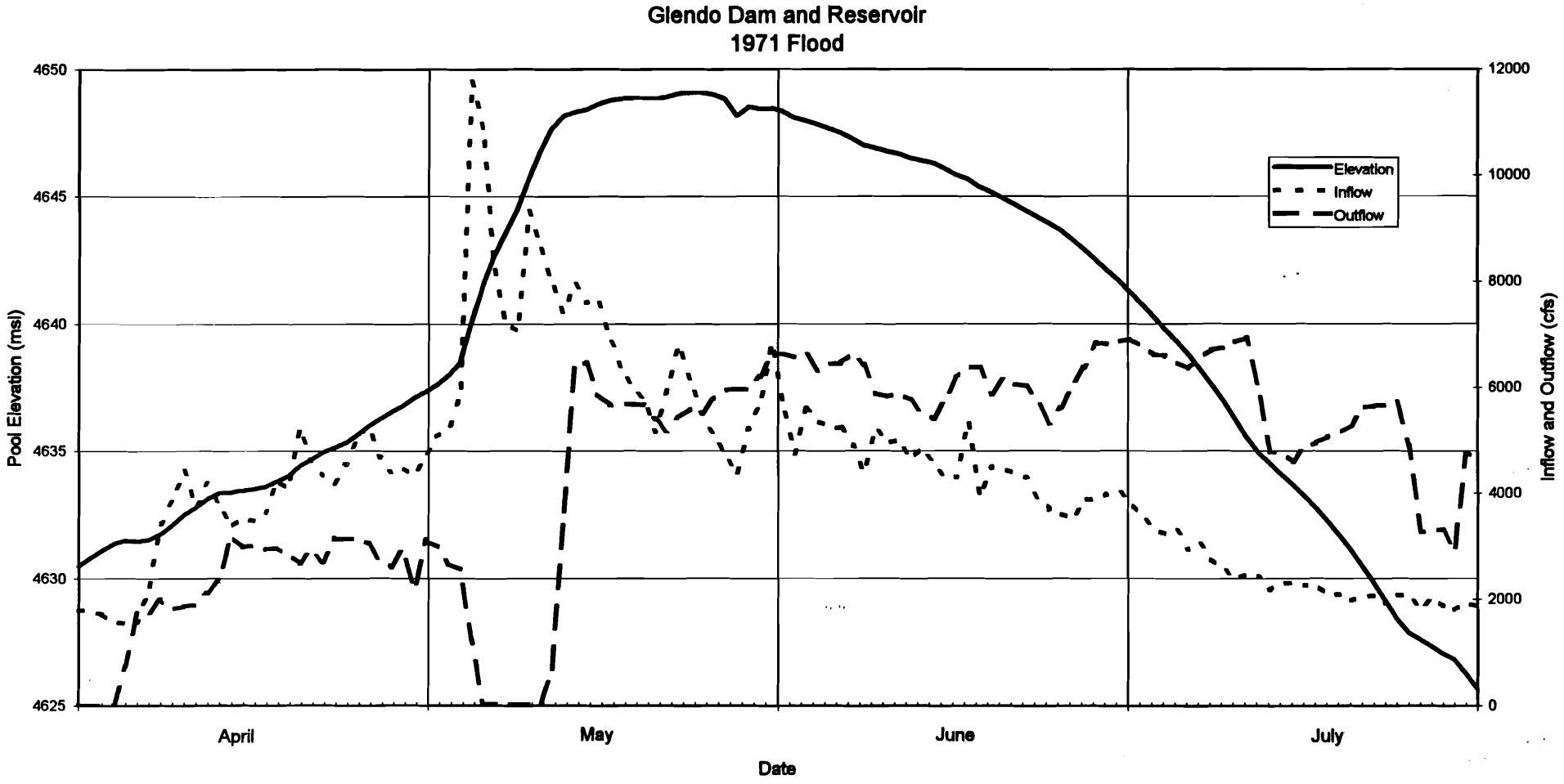
Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1970 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 18



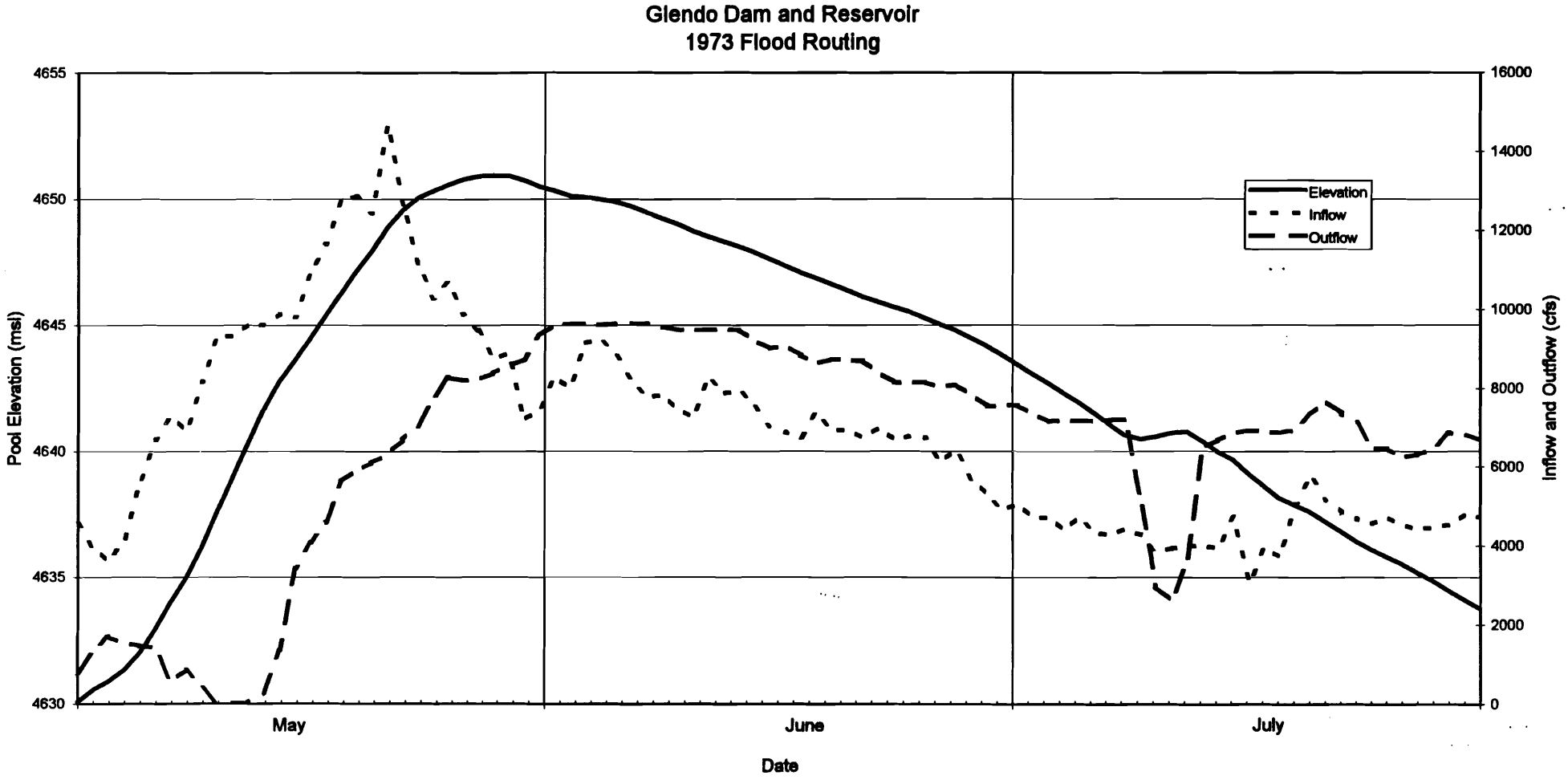
Water Control Manual
Glendo Dam and Reservoir, Wyoming

1971 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By: RH
Reviewed By:

PLATE 19



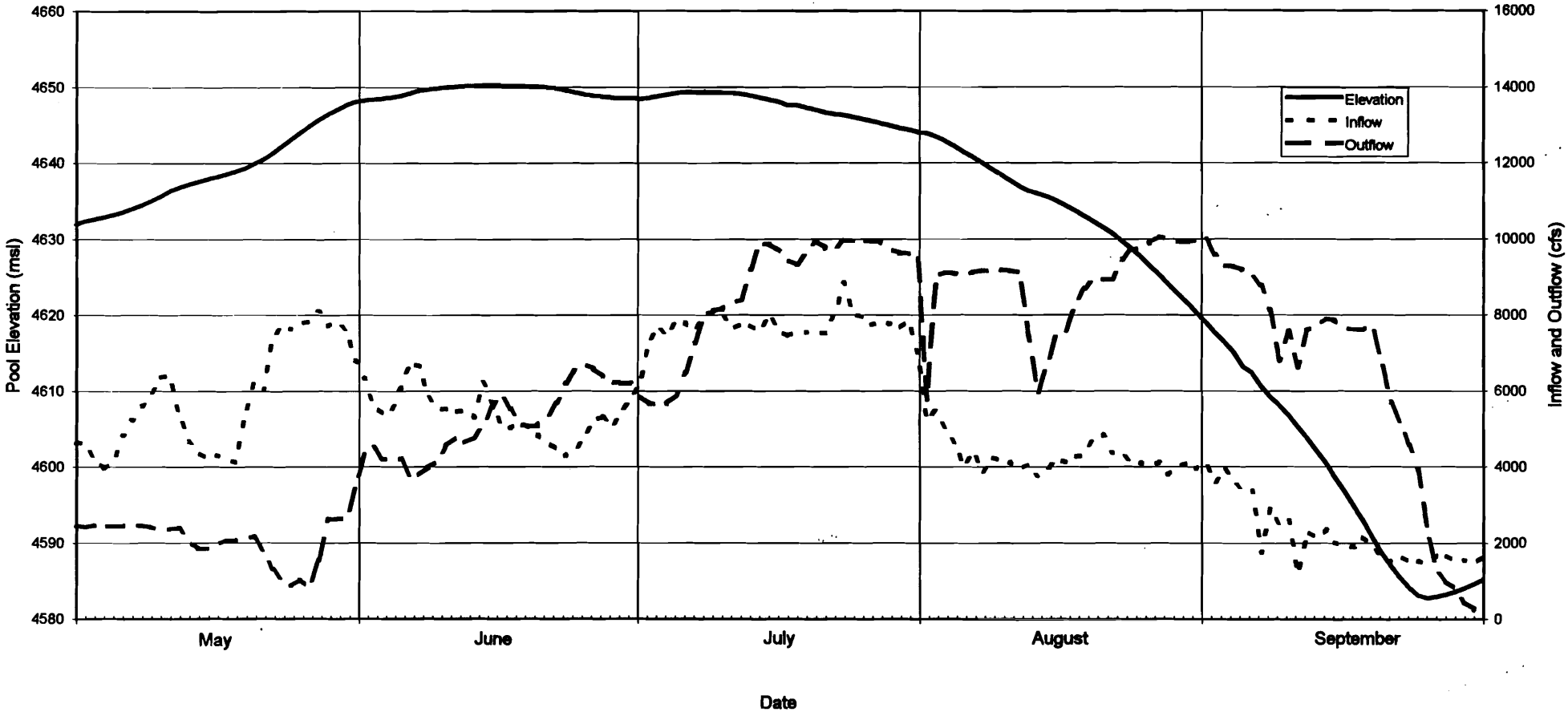
Prepared By: RH
Reviewed By:

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1973 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 20



Prepared By: RH
Reviewed By: DC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1983 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 21

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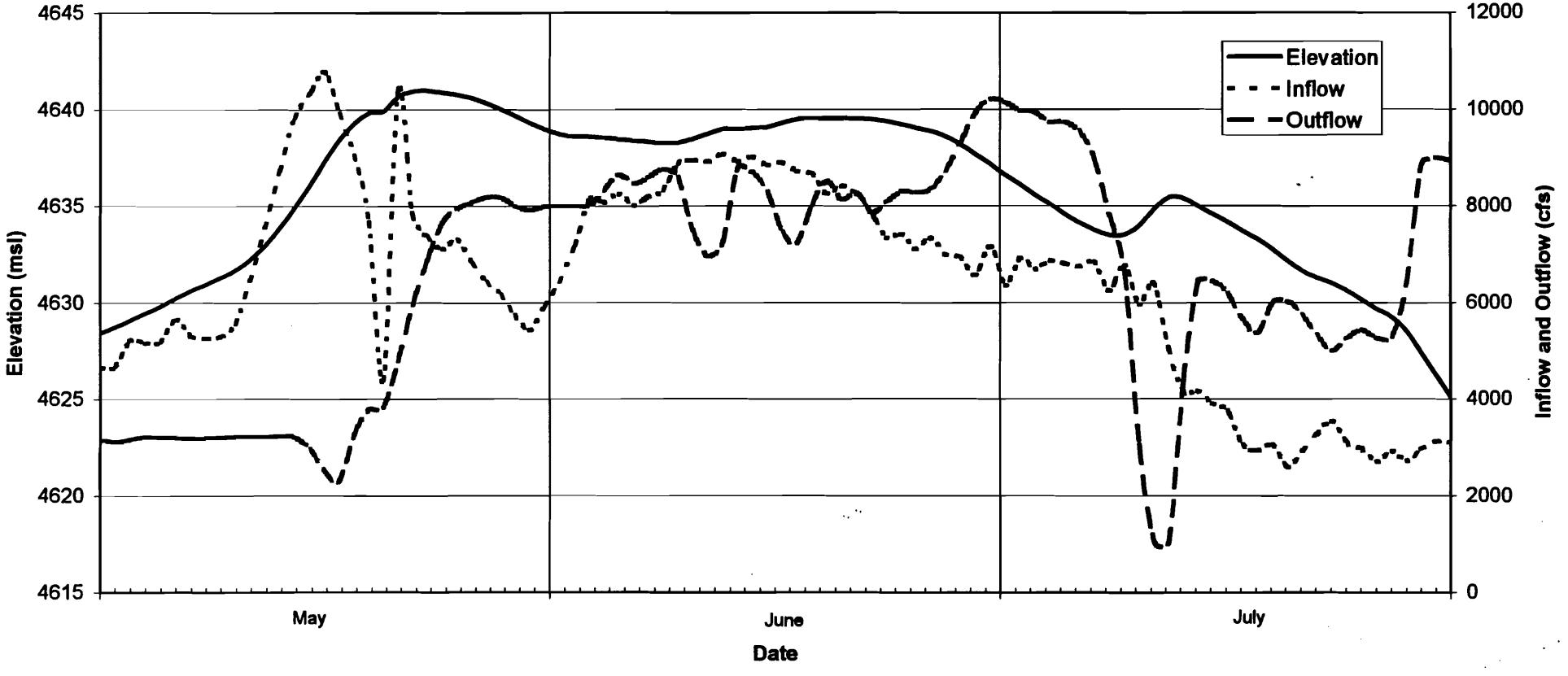
Glendo Dam and Reservoir
1984 Flood Routing



Prepared By: DJ
Reviewed By: AJC

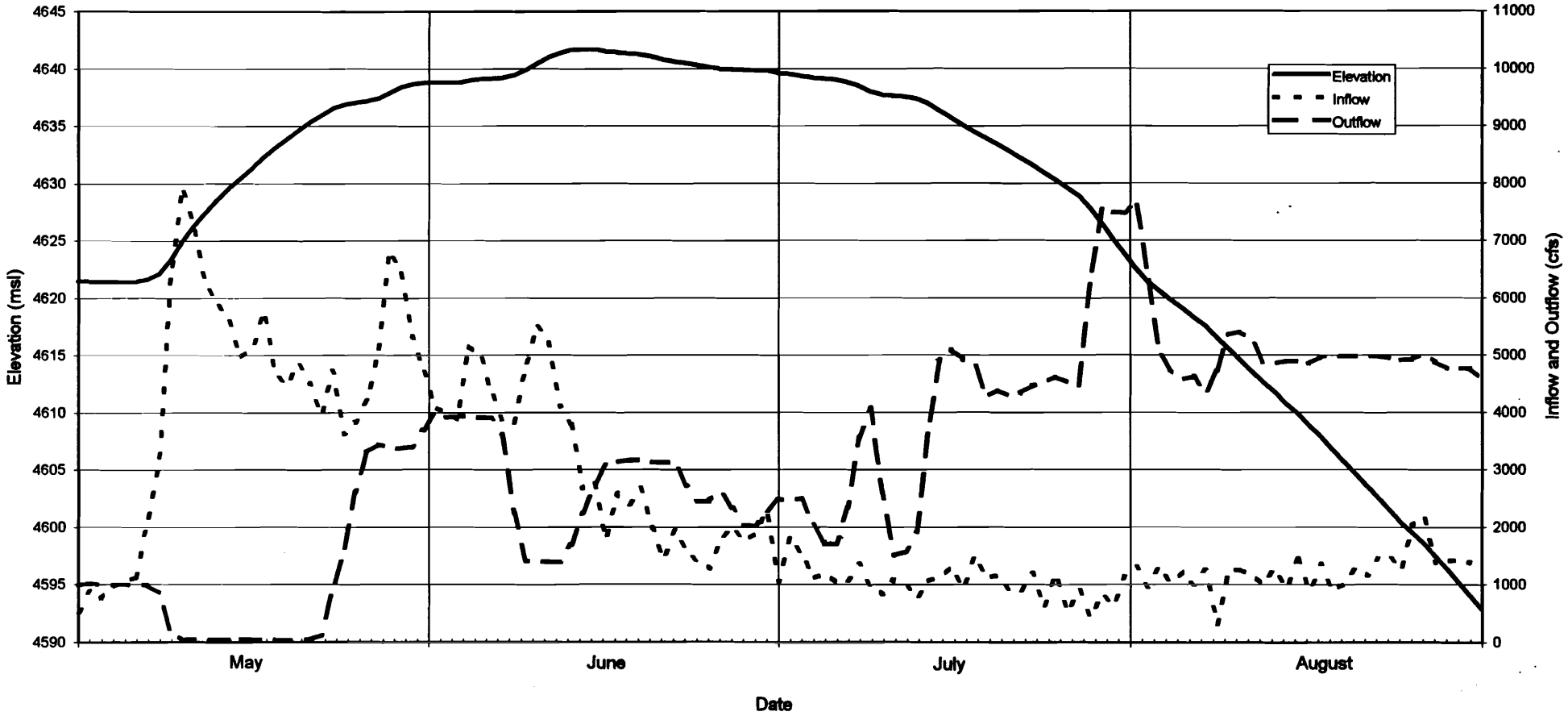
Water Control Manual
Glendo Dam and Reservoir, Wyoming

1984 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 22

Glendo Dam and Reservoir
1995 Flood Routing



Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1995 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 23

1997fr.x

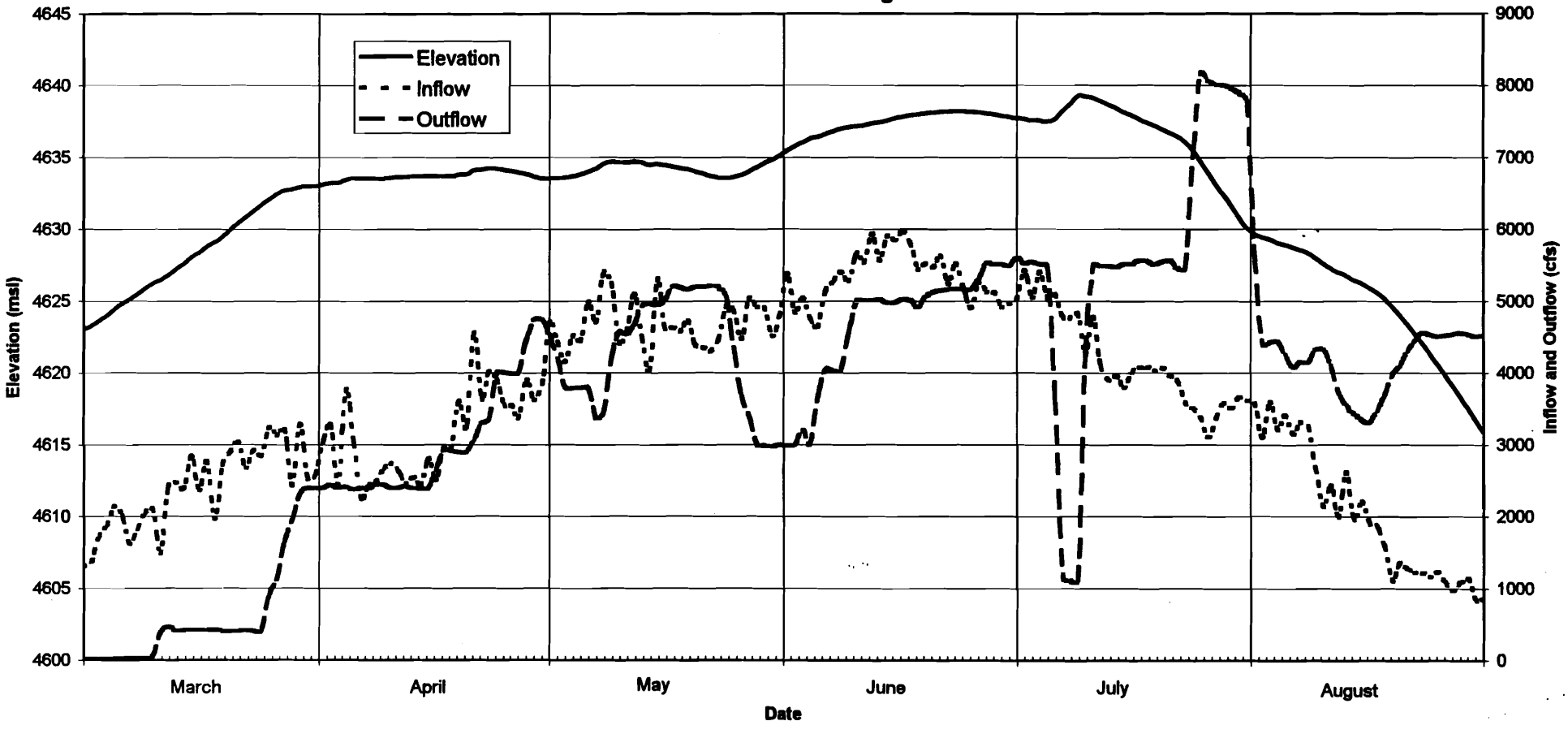


PLATE 24

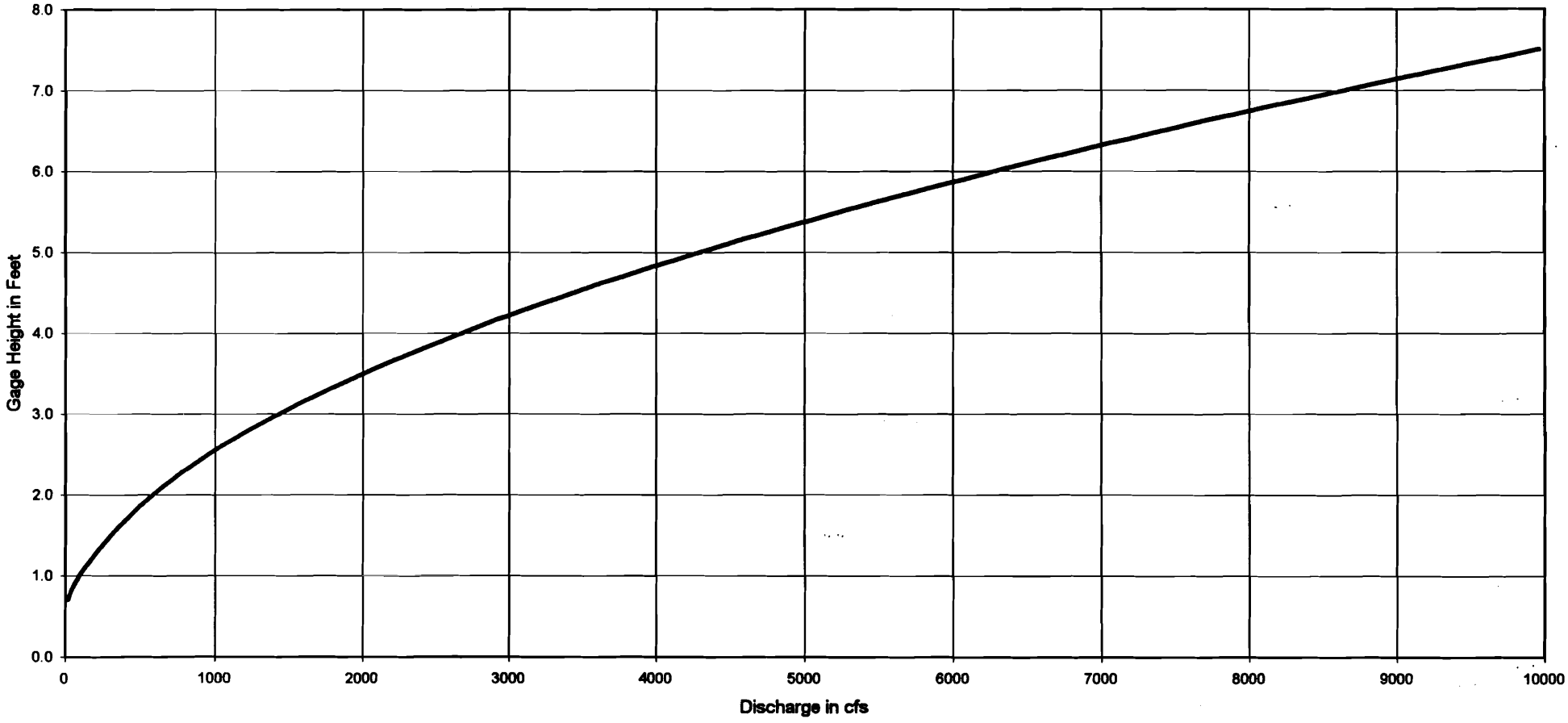
Prepared By:
Reviewed By:

Water Control Manual
Glendo Dam and Reservoir, Wyoming

1997 Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Discharge Rating Curve
North Platte River at Alcova, WY



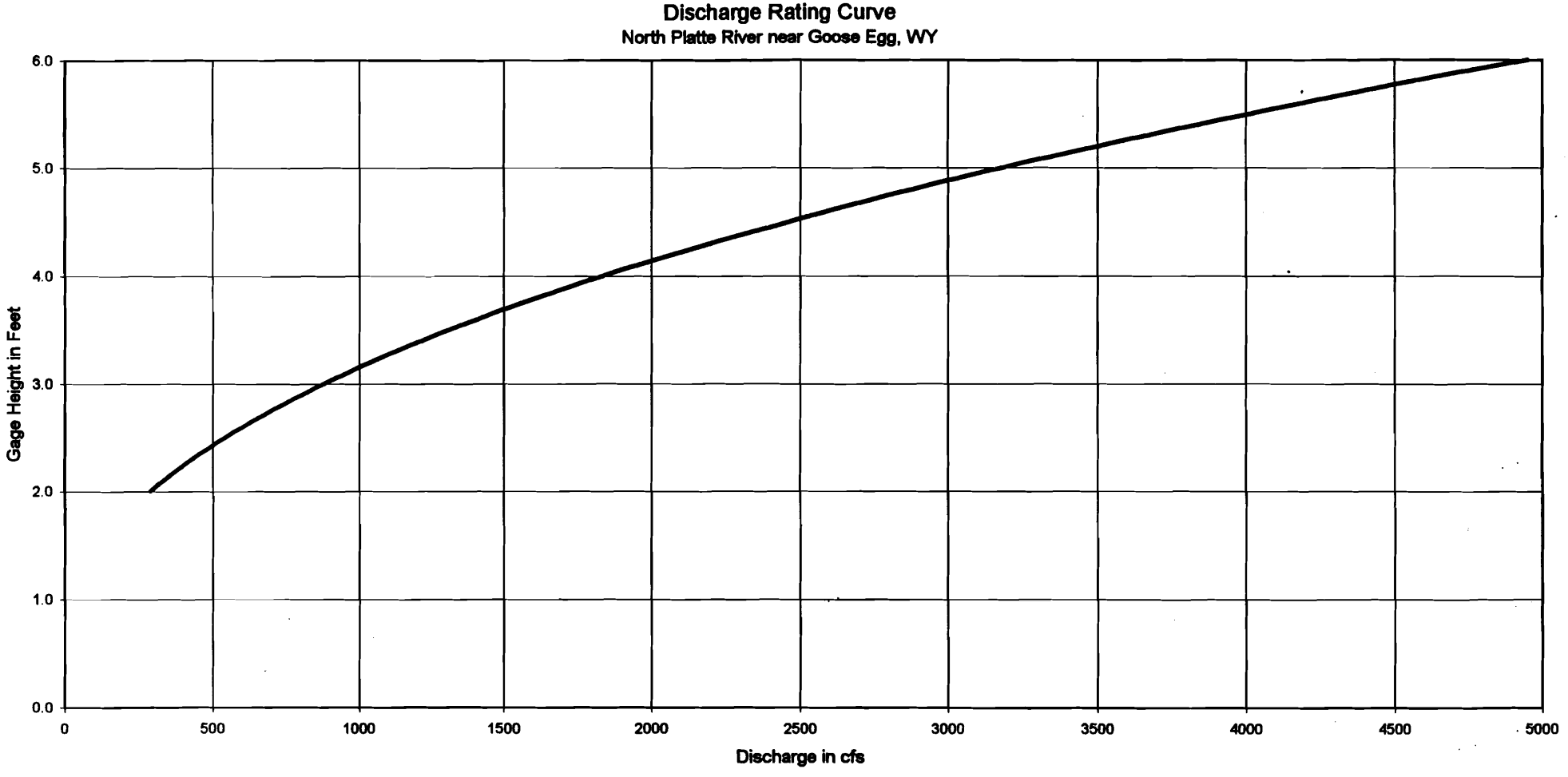
Prepared By: RH
Reviewed By: AC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
North Platte River at Alcova, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 25



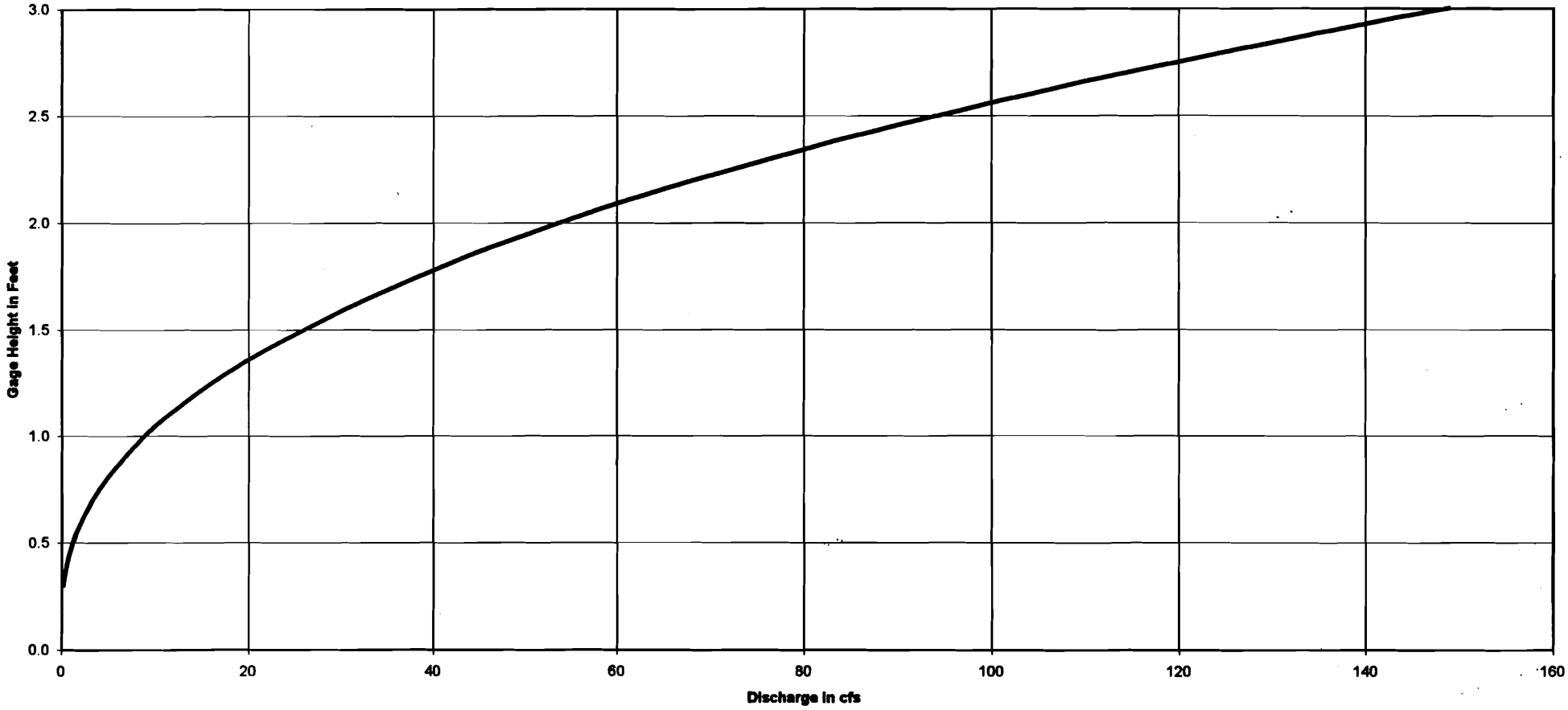
Prepared By: RH
Reviewed By: ADC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
North Platte River near Goose Egg, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Discharge Rating Curve
Smith Creek above Otter Creek Near Casper, WY



Prepared By: DH
Reviewed By: AJC

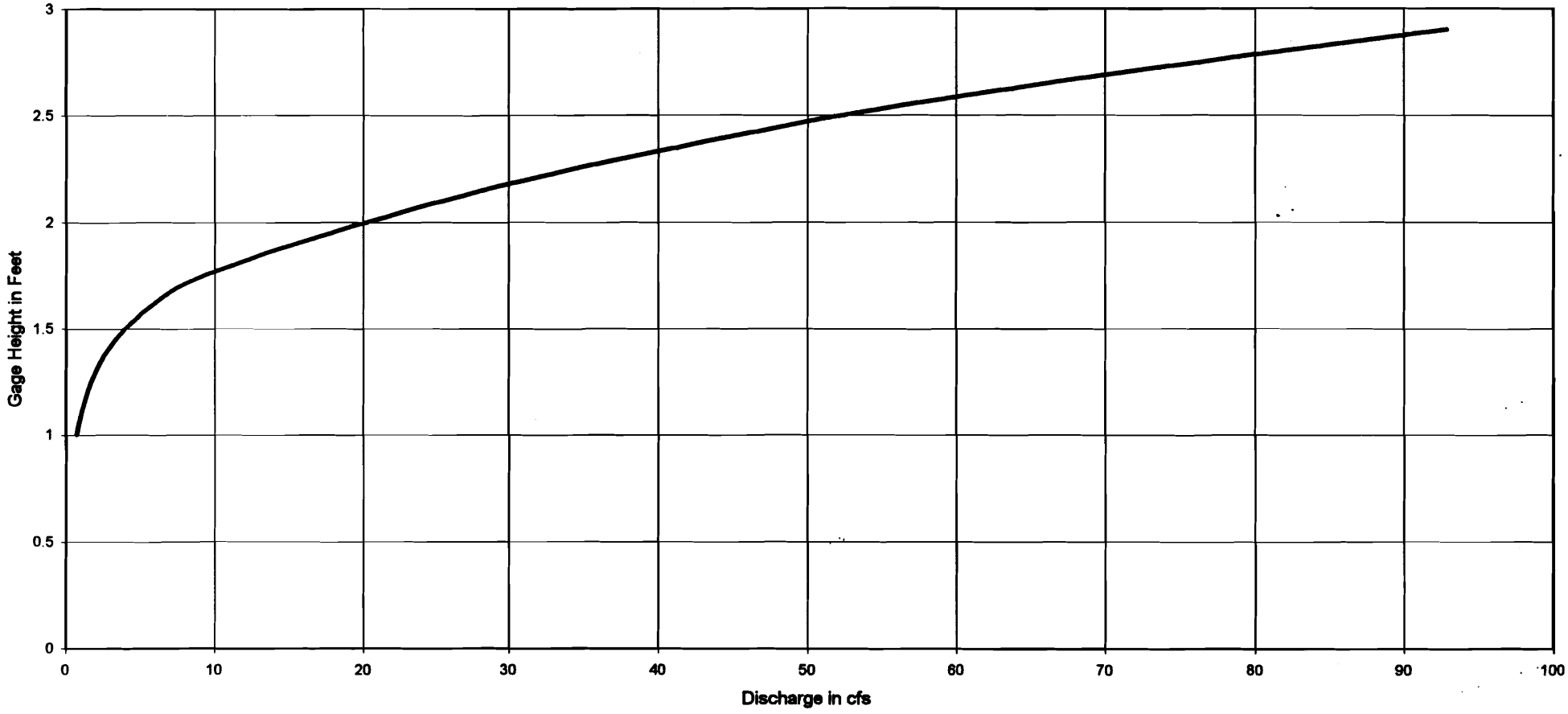
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Smith Creek above Otter Creek Near Casper, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 27

Discharge Rating Curve
Otter Creek at Mouth near Casper, WY



Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

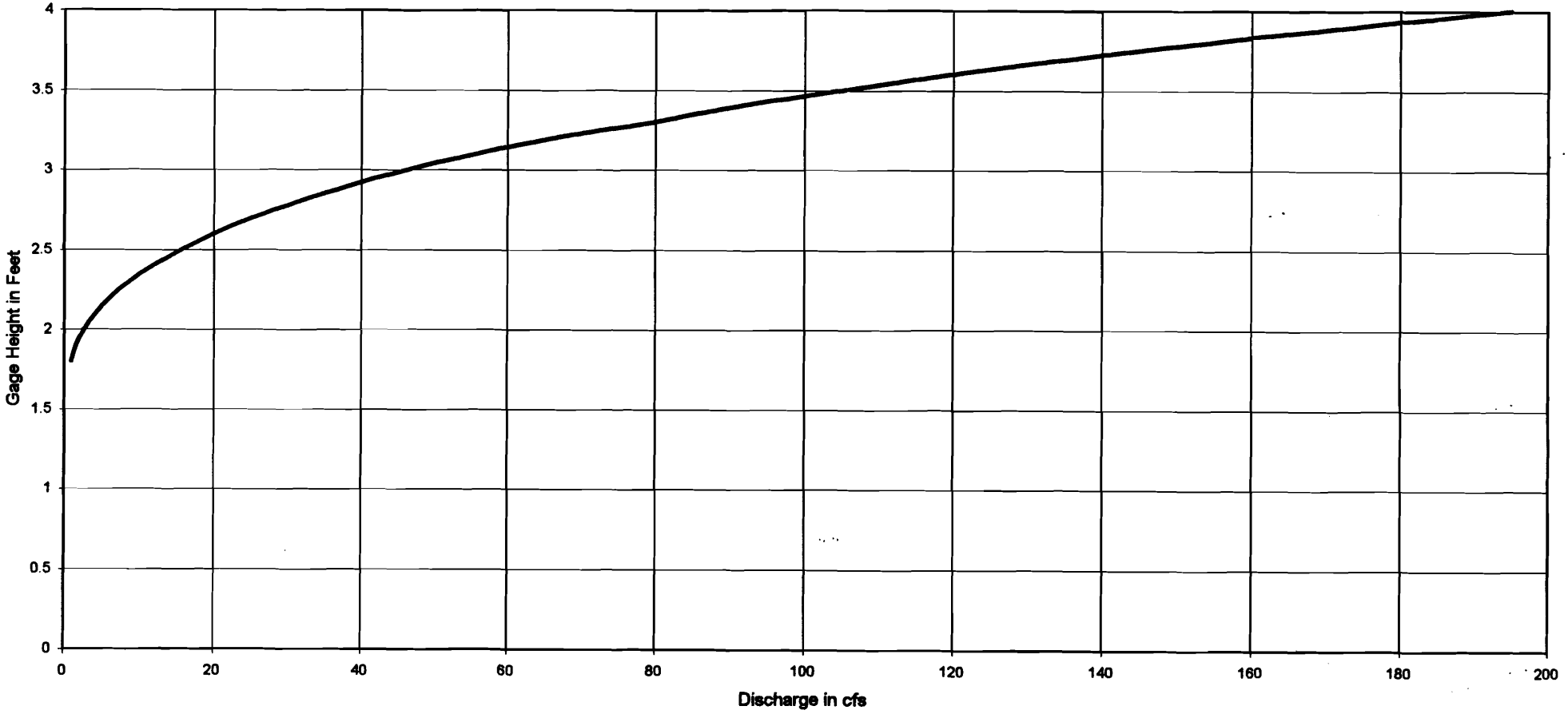
Discharge Rating Curve
Otter Creek at Mouth near Casper, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 28

Discharge Rating Curve

Smith Creek Below Otter Creek near Casper, WY



Prepared By: RH

Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

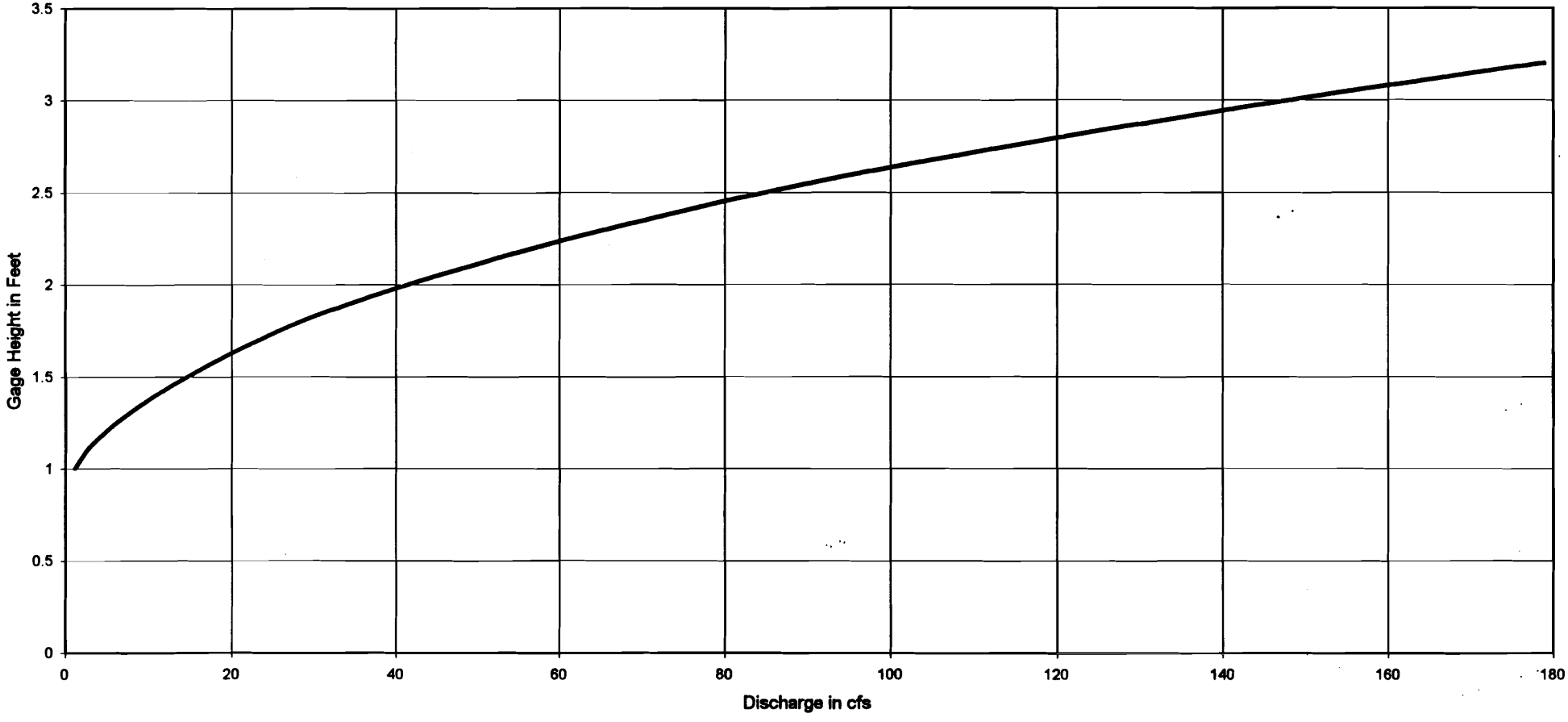
Discharge Rating Curve
Smith Creek Below Otter Creek near Casper, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 29

Discharge Rating Curve

Beaver Creek above Pole Creek near Casper,WY



Prepared By: RH
Reviewed By: ADC

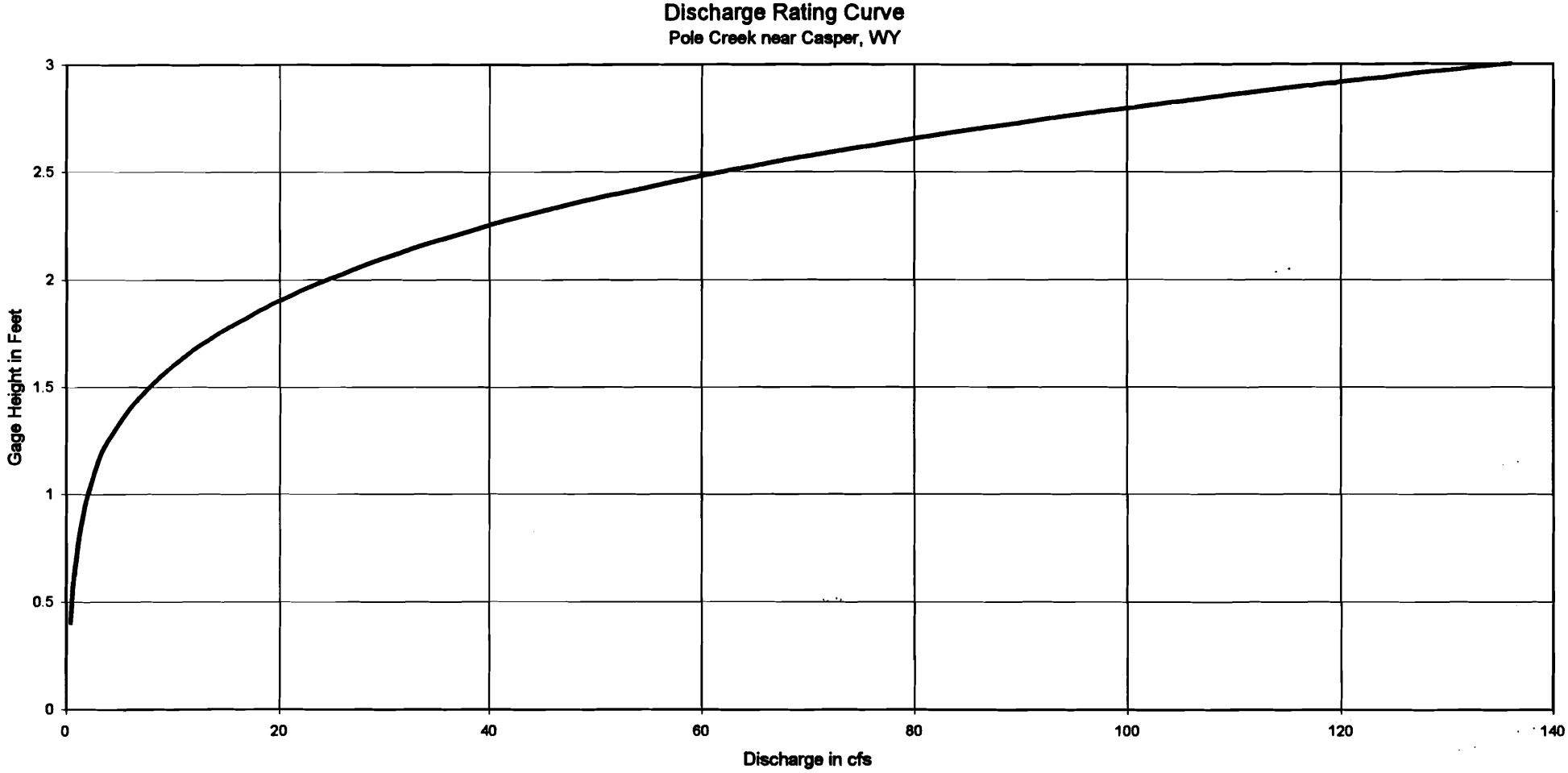
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Beaver Creek above Pole Creek near Casper, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 30

DRCPC.XLS



Prepared By: RH
Reviewed By: DC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

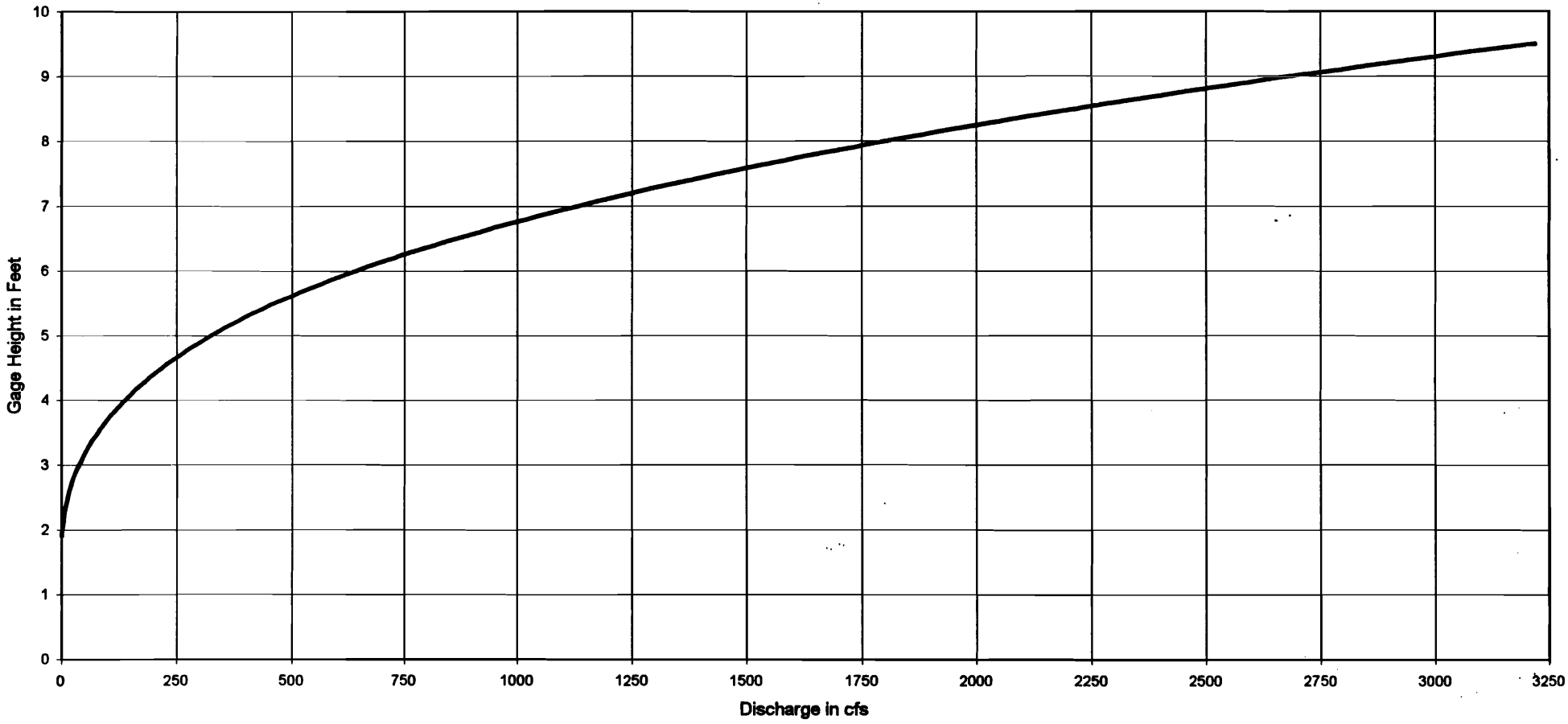
Discharge Rating Curve
Pole Creek near Casper, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 31

DR[illegible]G.XLS

Discharge Rating Curve
Deer Creek in Canyon near Glenrock, WY



Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Deer Creek in Canyon near Glenrock, WY

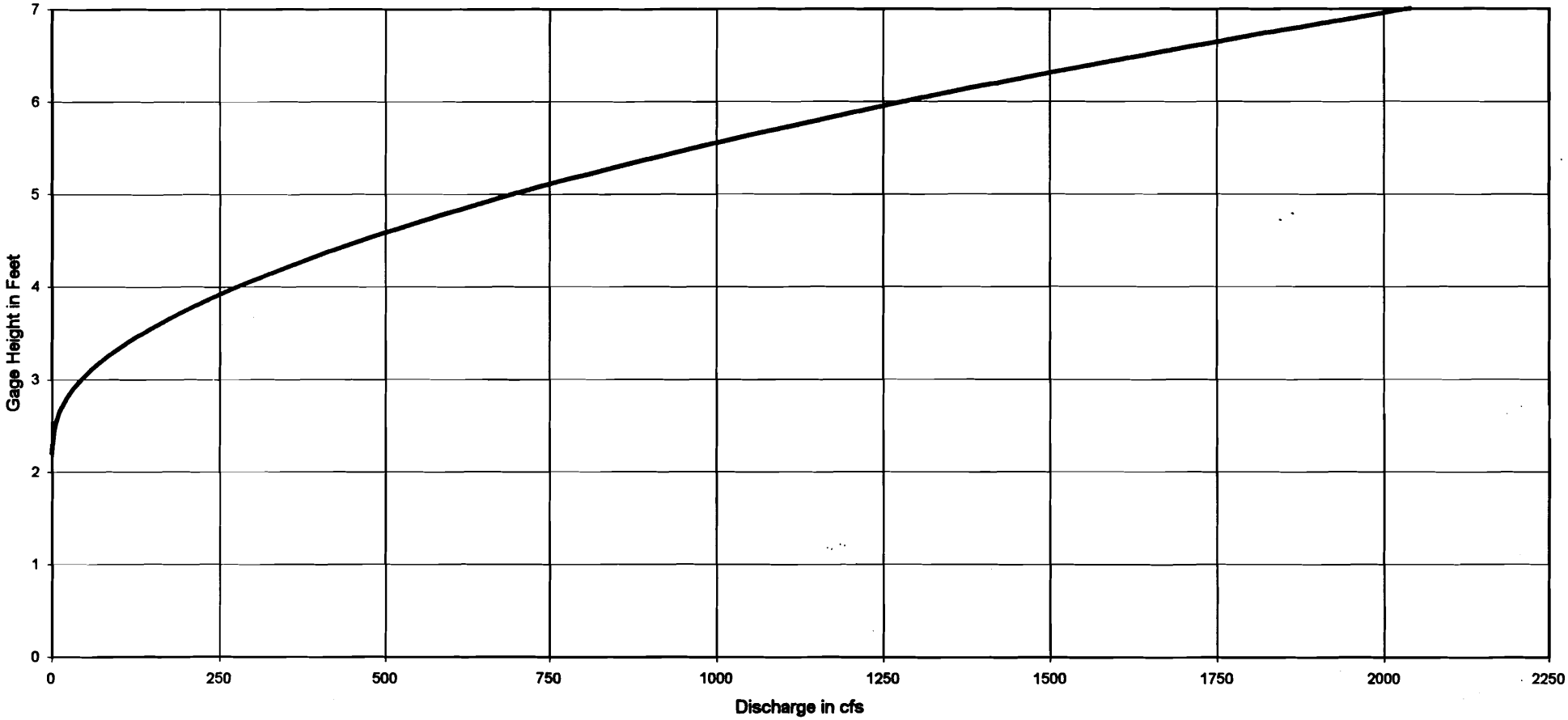
U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 32

DRCDMWG.XLS

Discharge Rating Curve

Deer Creek below Millar Wasteway at Glenrock, WY



Prepared By: RH

Reviewed By: AJC

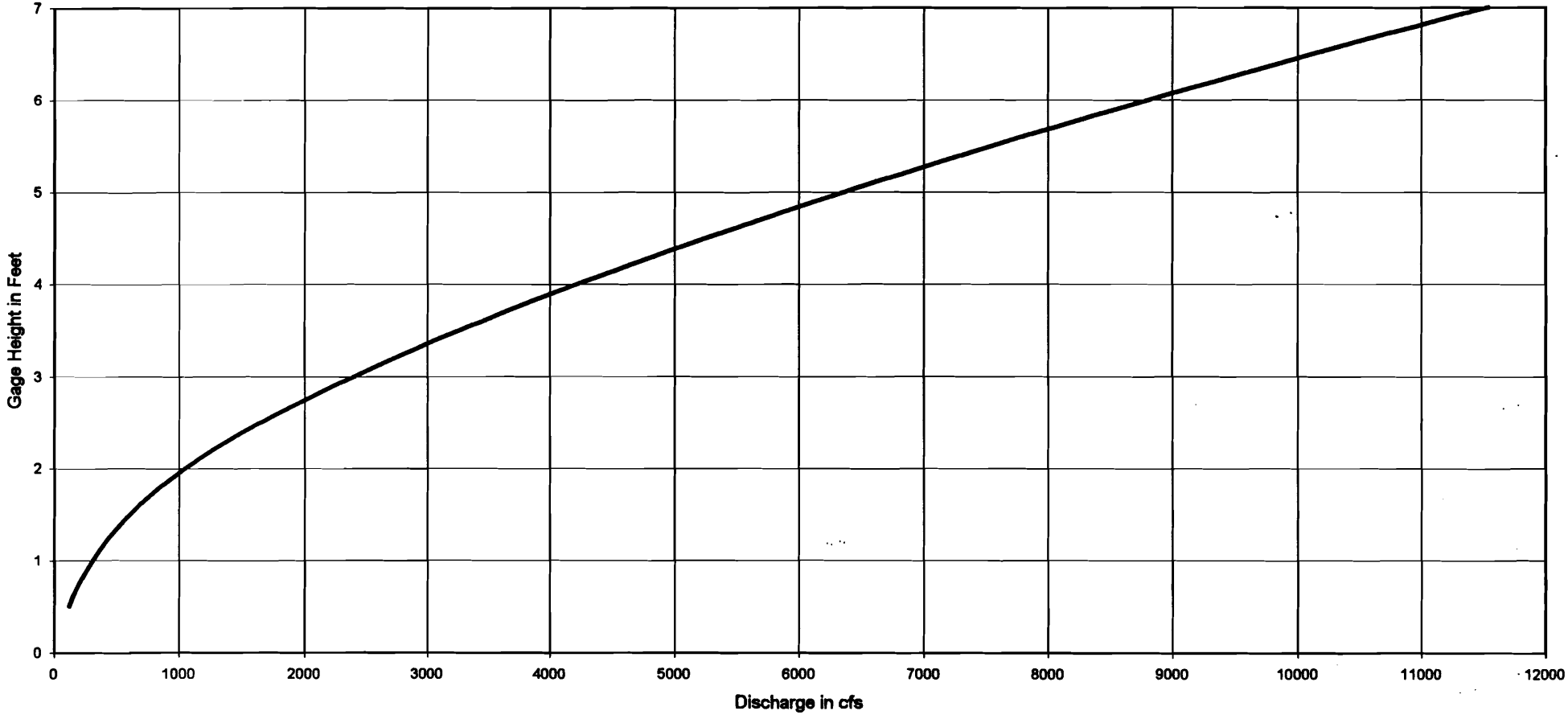
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Deer Creek below Millar Wasteway at Glenrock, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 33

Discharge Rating Curve
North Platte River near Glenrock, WY



Prepared By: RH
Reviewed By: AJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Dischage Rating Curve
North Platte River near Glenrock, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

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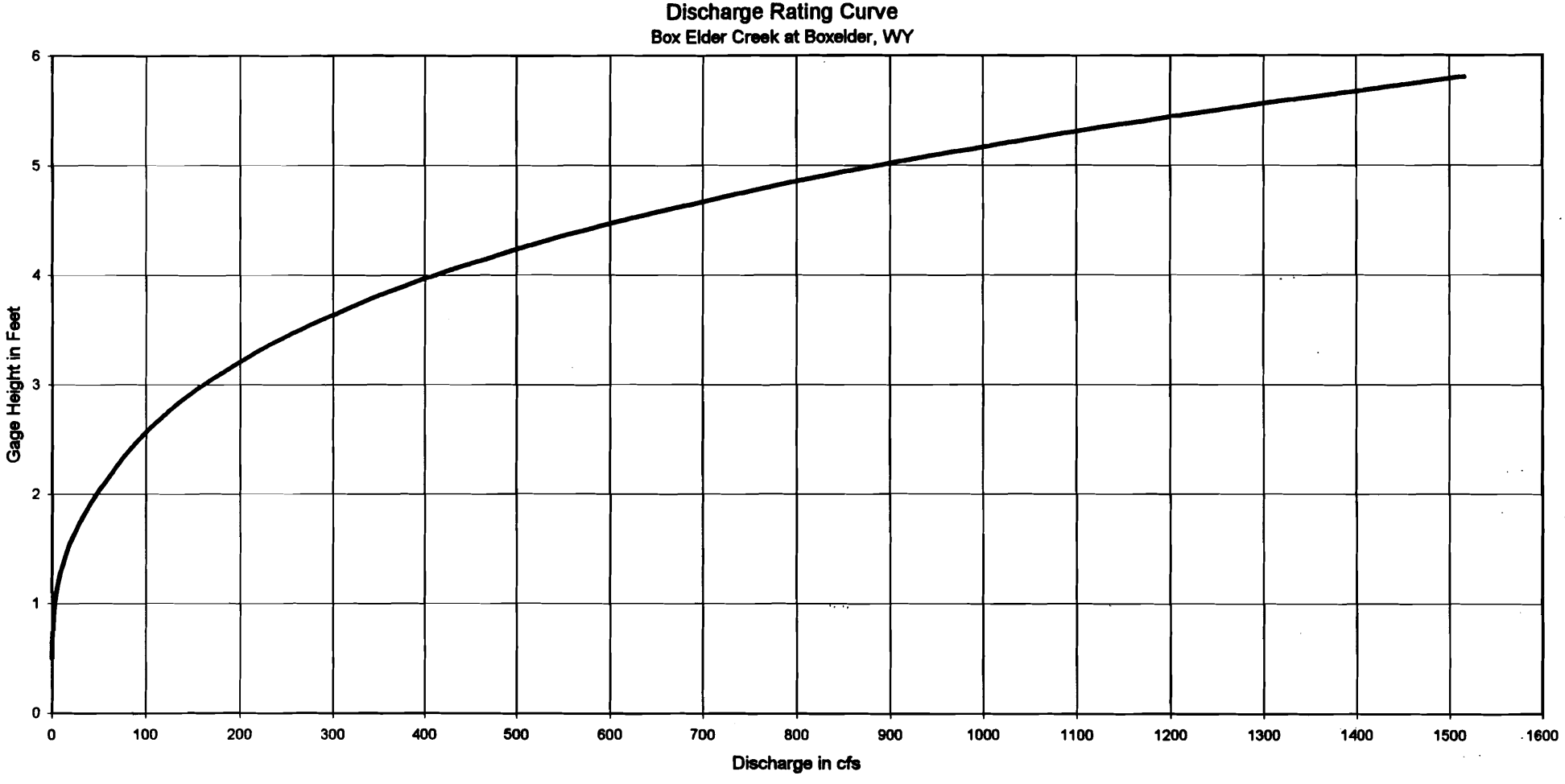


Prepared By: RH
Reviewed By: DC

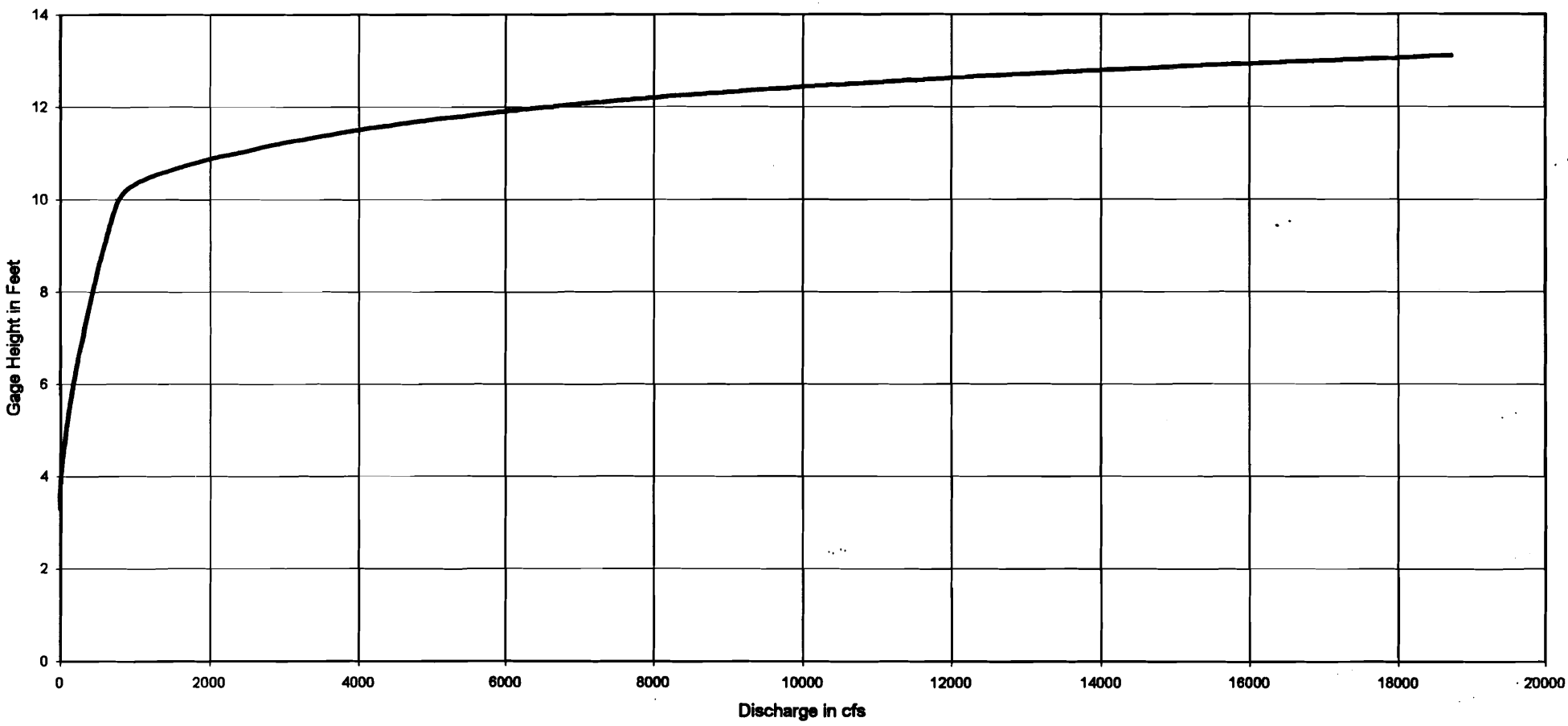
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Box Elder Creek at Boxelder, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 35

DRC[illegible].XLS



Prepared By: RH
Reviewed By: AC

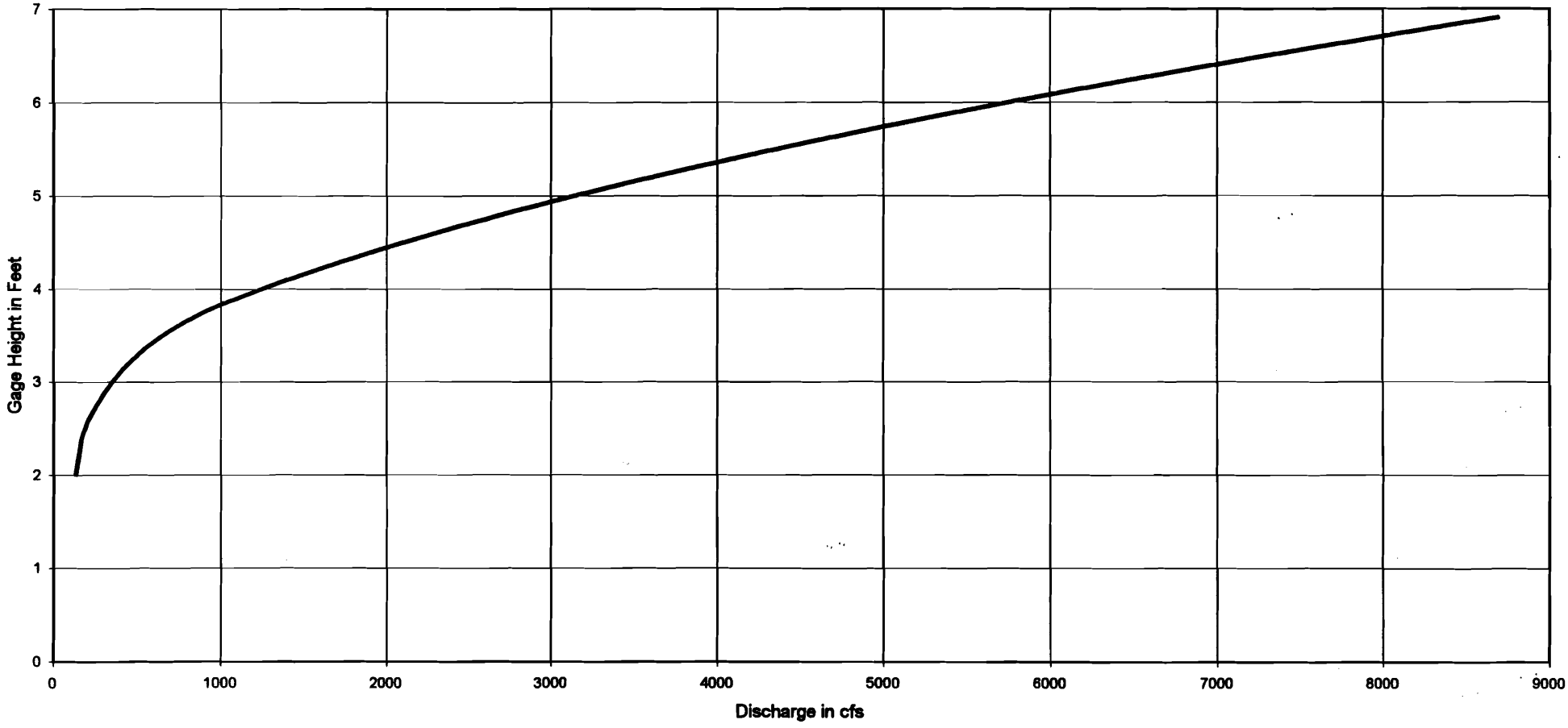
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
LaPrele Creek near Douglas, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 36

DRGNPO.XLS



Prepared By: BH
Reviewed By: DJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

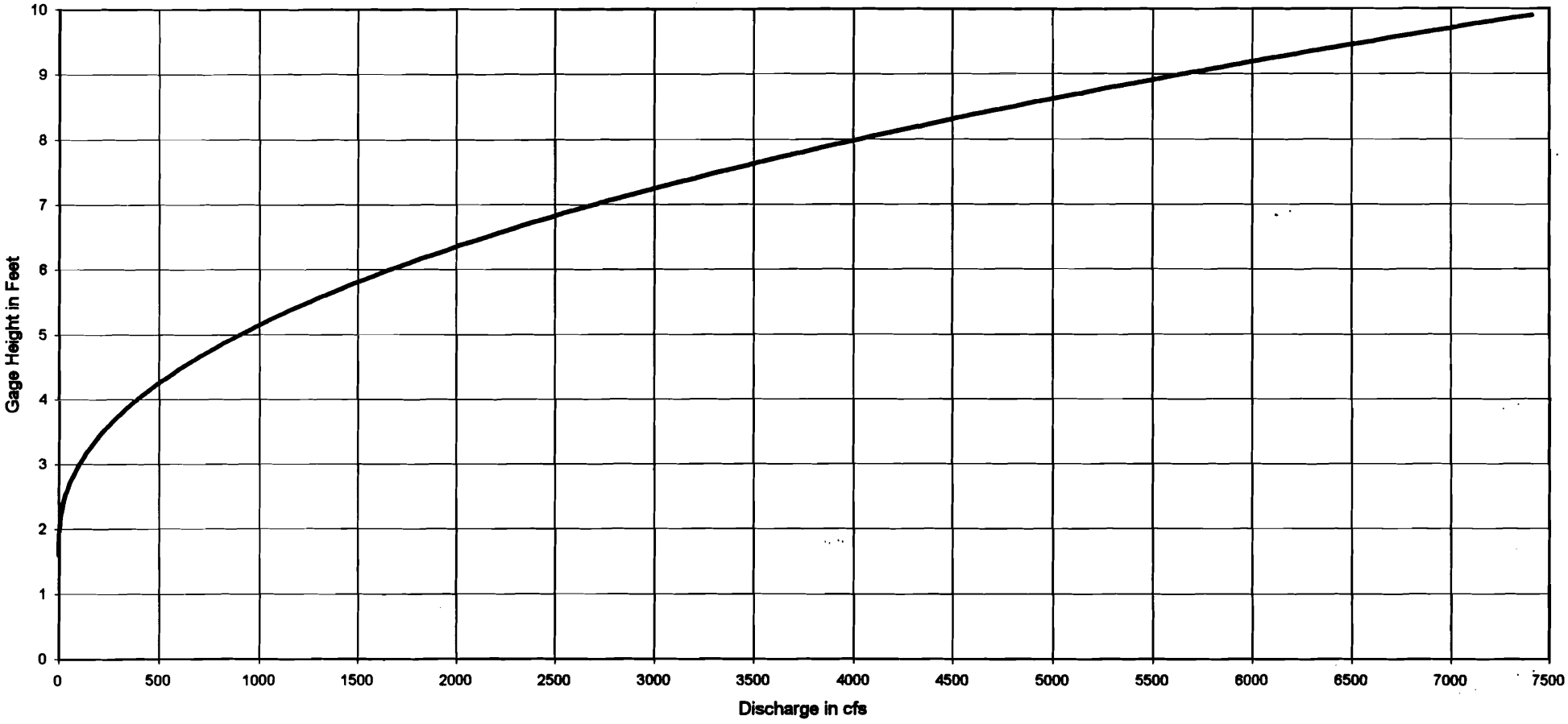
Discharge Rating Curve
North Platte River at Orin, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 37

DRC GR.XLS

Discharge Rating Curve
North Platte River below Glendo Reservoir, WY



Prepared By: _____

Reviewed By: _____

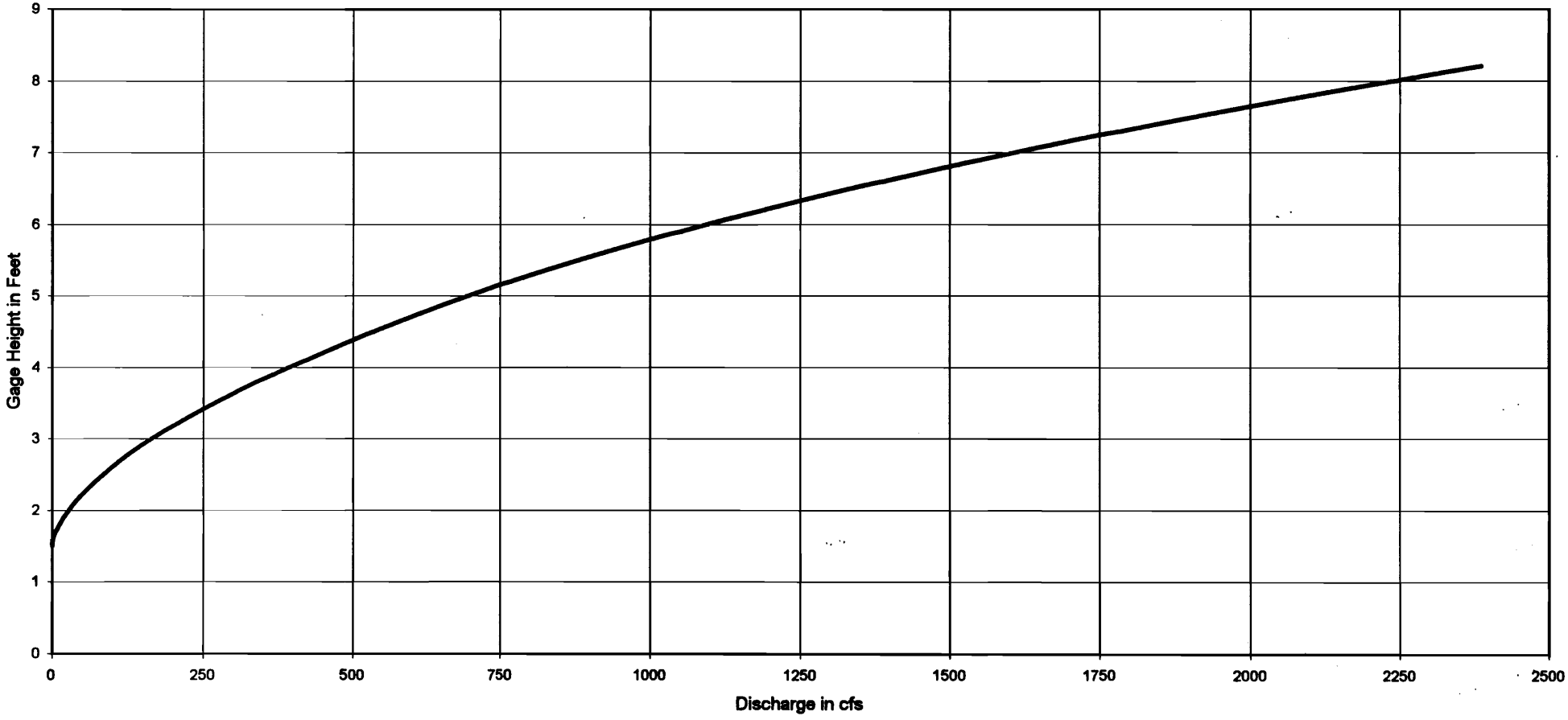
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
North Platte River below Glendo Reservoir, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 38

Discharge Rating Curve
Horseshoe Creek near Cassa, WY



Prepared By: RH
Reviewed By: RC

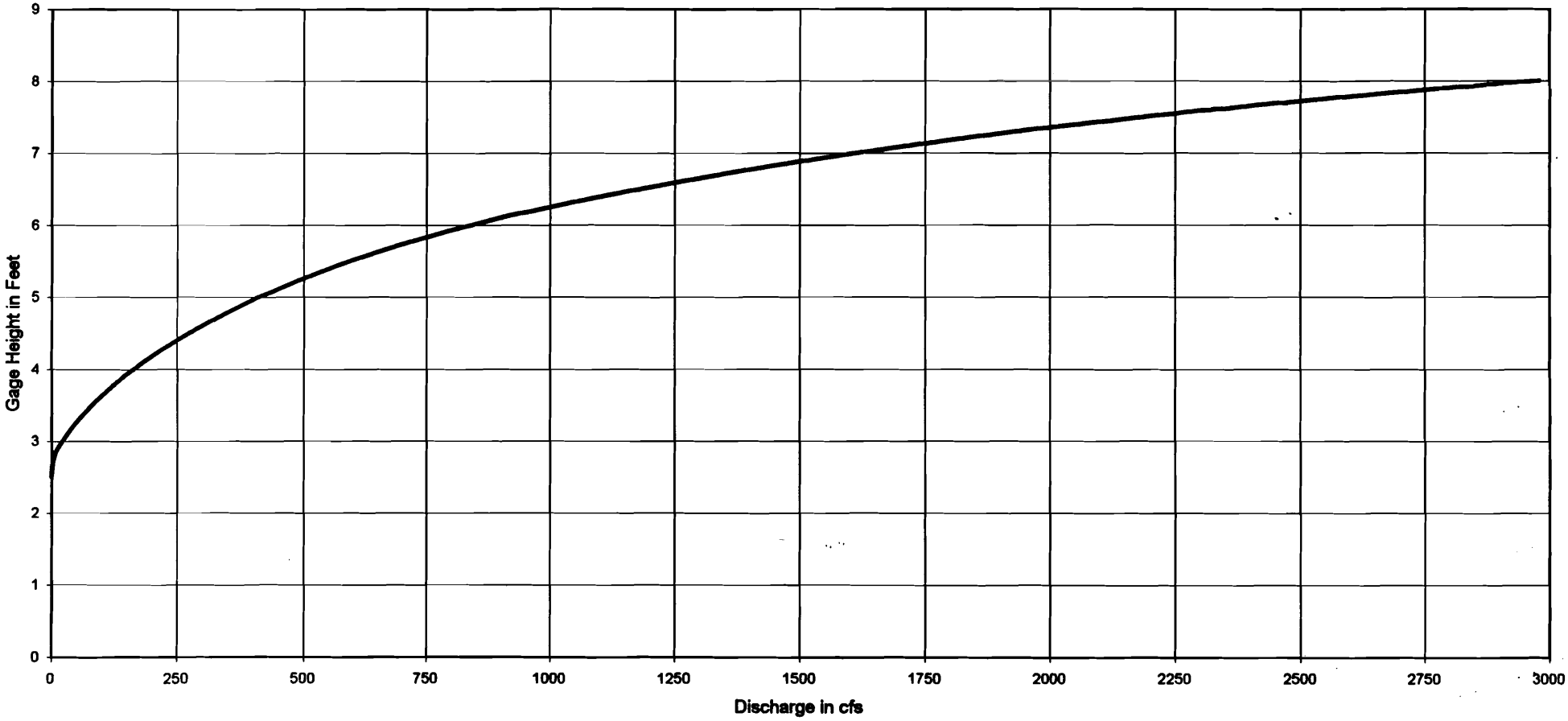
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Horseshoe Creek near Cassa, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 39

Discharge Rating Curve
Horseshoe Creek near Glendo, WY



Prepared By: RH
Reviewed By: AC

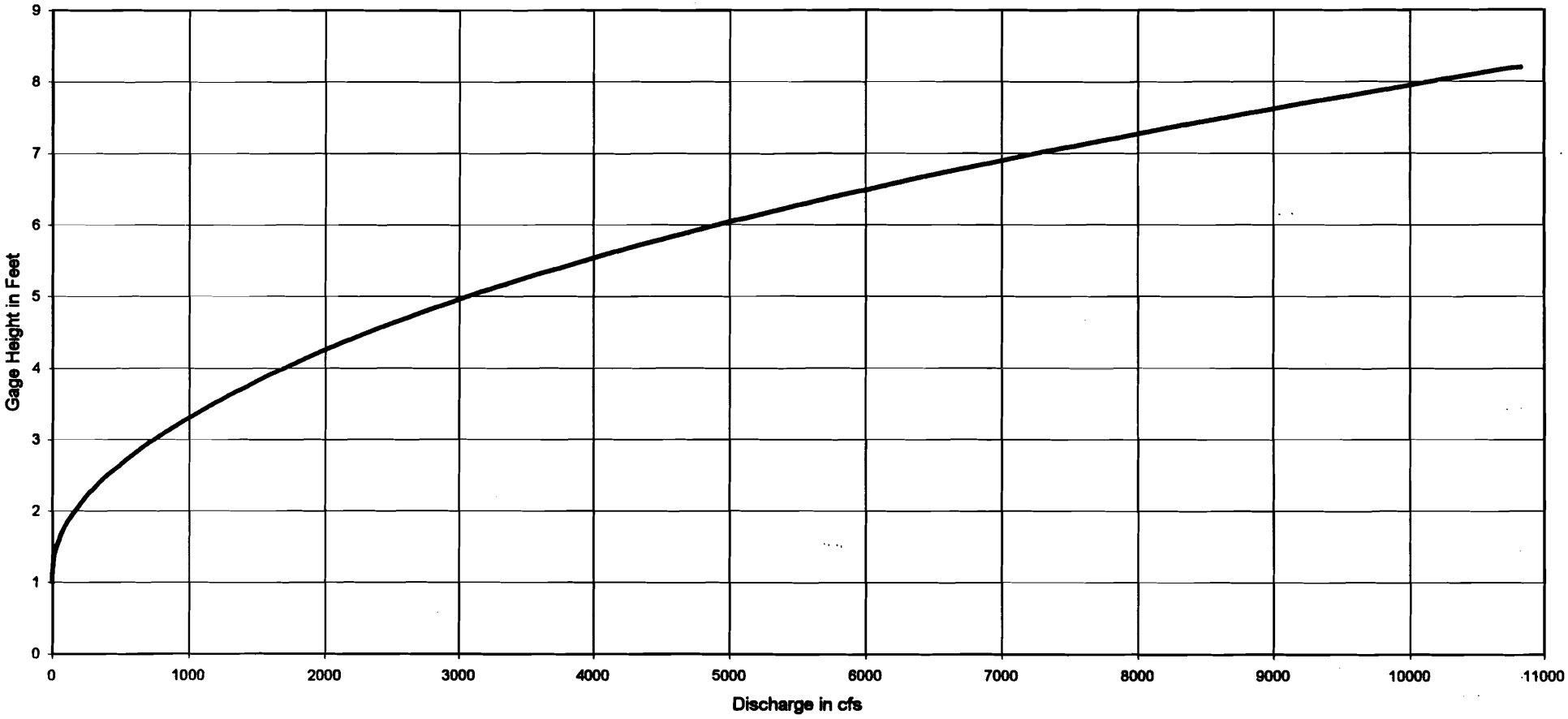
Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
Horseshoe Creek near Glendo, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 40

Discharge Rating Curve
North Platte River below Guernsey Reservoir, WY



Prepared By: RH
Reviewed By: DC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Discharge Rating Curve
North Platte River below Guernsey Reservoir, WY

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 41

Sdrt.xls

RIVER STAGE - DISCHARGE RELATIONSHIP TABLE
FOR
GAGING STATIONS ON NORTH PLATTE RIVER

GAGE HEIGHT (FEET)	NEAR GLENROCK WYOMING (06646800)	ORIN WYOMING (06652000)	BELOW GLENDO DAM (06652800)	BELOW GUERNSEY DAM (06656000)	BELOW WHALEN DAM (06657000)	LARAMIE RIVER NEAR FT. LARAMIE WYOMING (06670500)	WYOMING - NEBRASKA STATE LINE (06674500)	BRIDGEPORT NEBRASKA (06684498)	LISCO NEBRASKA (06686000)	LEWELLEN NEBRASKA (06687500)
	Rating #11	Rating #13	Rating #11	Rating #12	Rating #19	Rating #22	Rating #22	Rating #16	Rating #18	Rating #17
DRAINAGE AREA (SQ MI)	139	14888	15548	16237	16425	4564	23218	25300	26700	28600
GAGE DATUM (FT MSL)	5640	4656.85	4488.94	4340	4250	4220	4021.35	3656.14	3474.5	3285.88
Discharge in cfs										
0										
1	310			0.12					351.7	
2	1045		4.75	165.3		53	153		1499	
3	24055		103.4	745.1		248	991		3400	
4	4222	1260	392.3	1703		566	2485		6000	423
5	6367	3110	906.3	3071	140.7	1000	4255		9500	967
6	8814	5508	1673	4918	767	1622	6230	401		2040
7	11535	8408	2711	7278	1804	2504		1023		3750
8		12060	4040	10180	3173	3712		2224		7575
9			5673		4839			3858		14500
10			7626		6778			5915		
11			9911					8407		
12								12000		

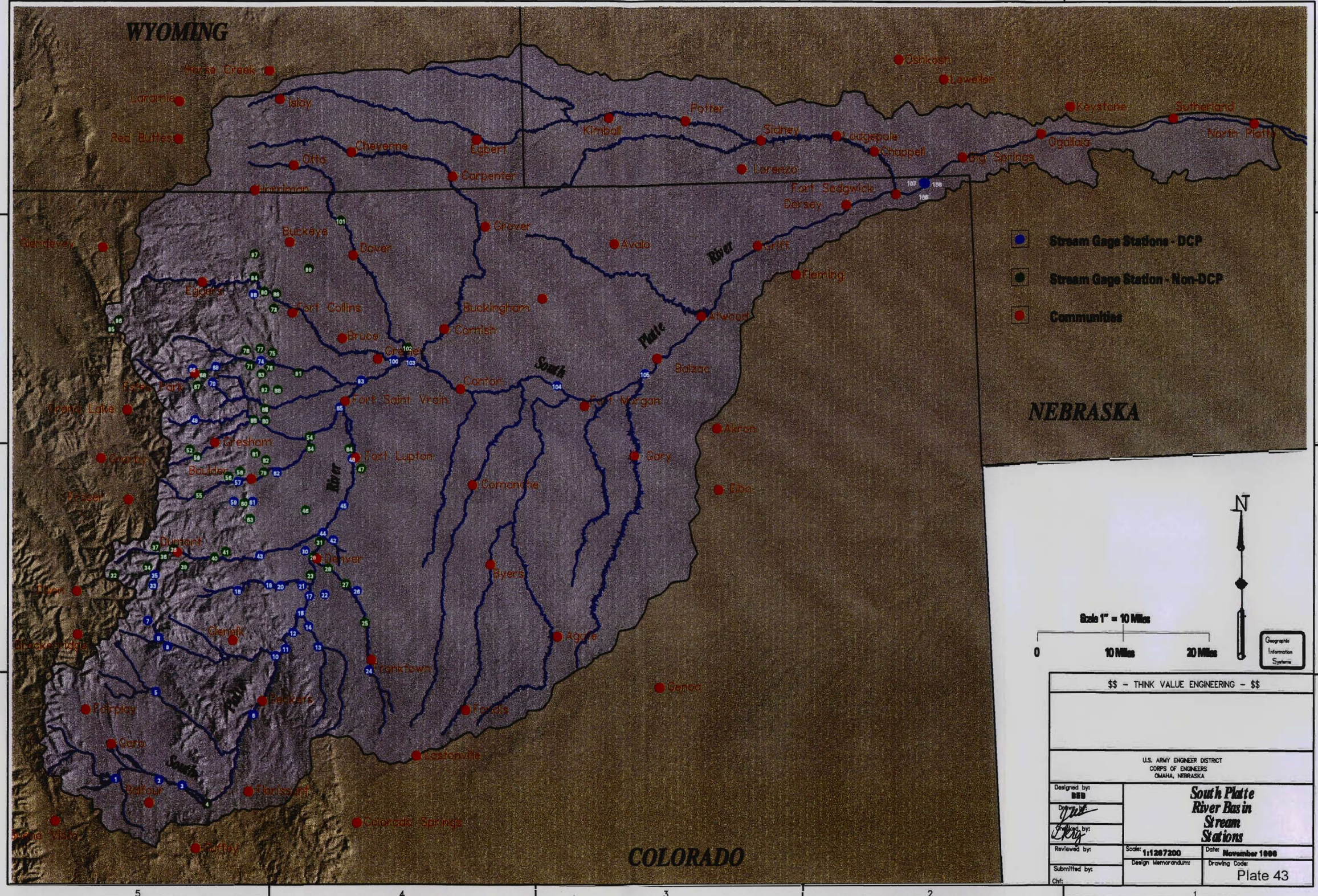
Prepared By: RH
Reviewed By: kug

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Stage-Discharge Relationship Table

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Plate 42



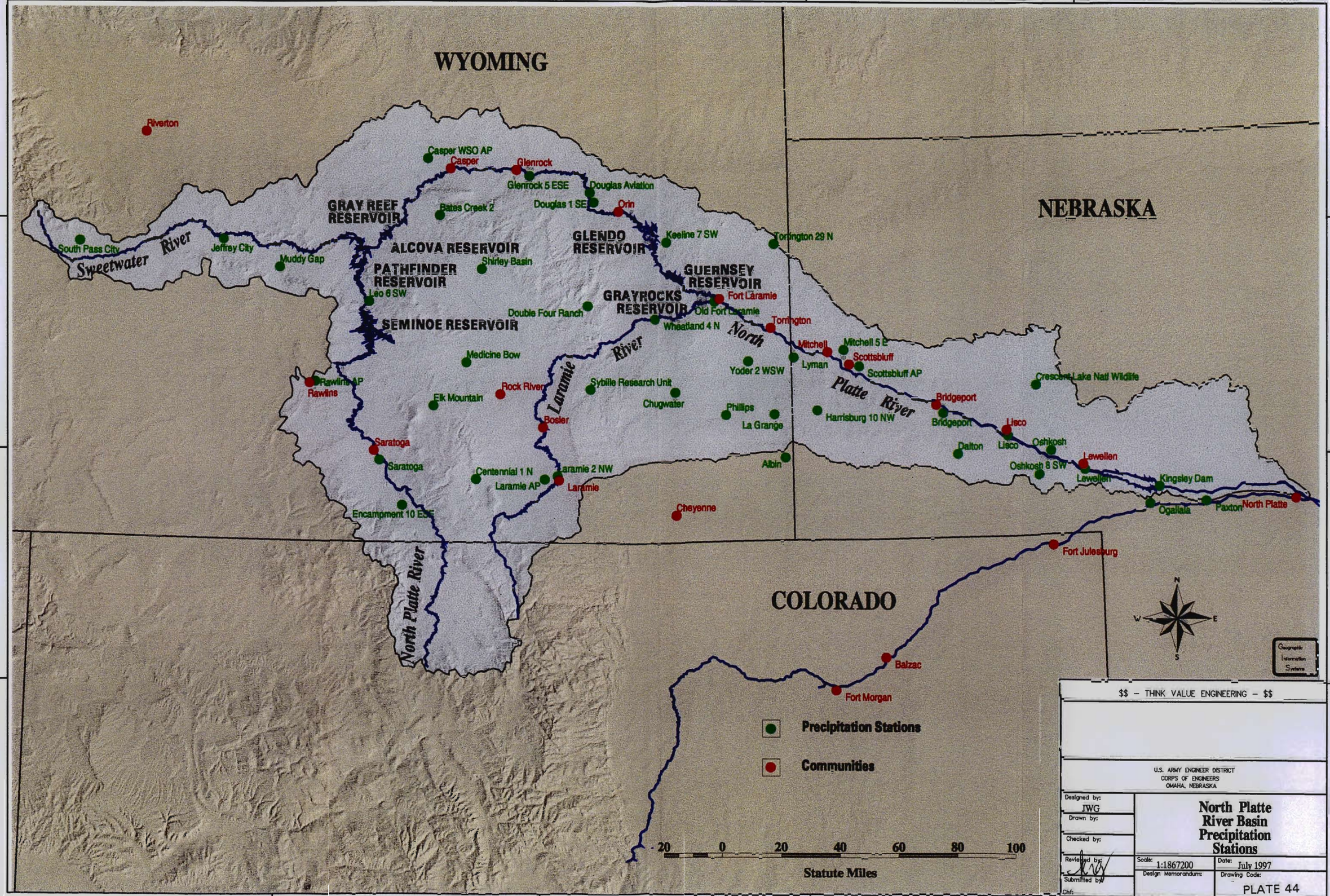
$$ - THINK VALUE ENGINEERING - $$

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: BEB	South Platte River Basin Stream Stations
Drawn by:	
Checked by:	
Reviewed by:	Scale: 1:1267200
Submitted by: Chf:	Date: November 1998
	Design Memorandums:
	Drawing Code: Plate 43

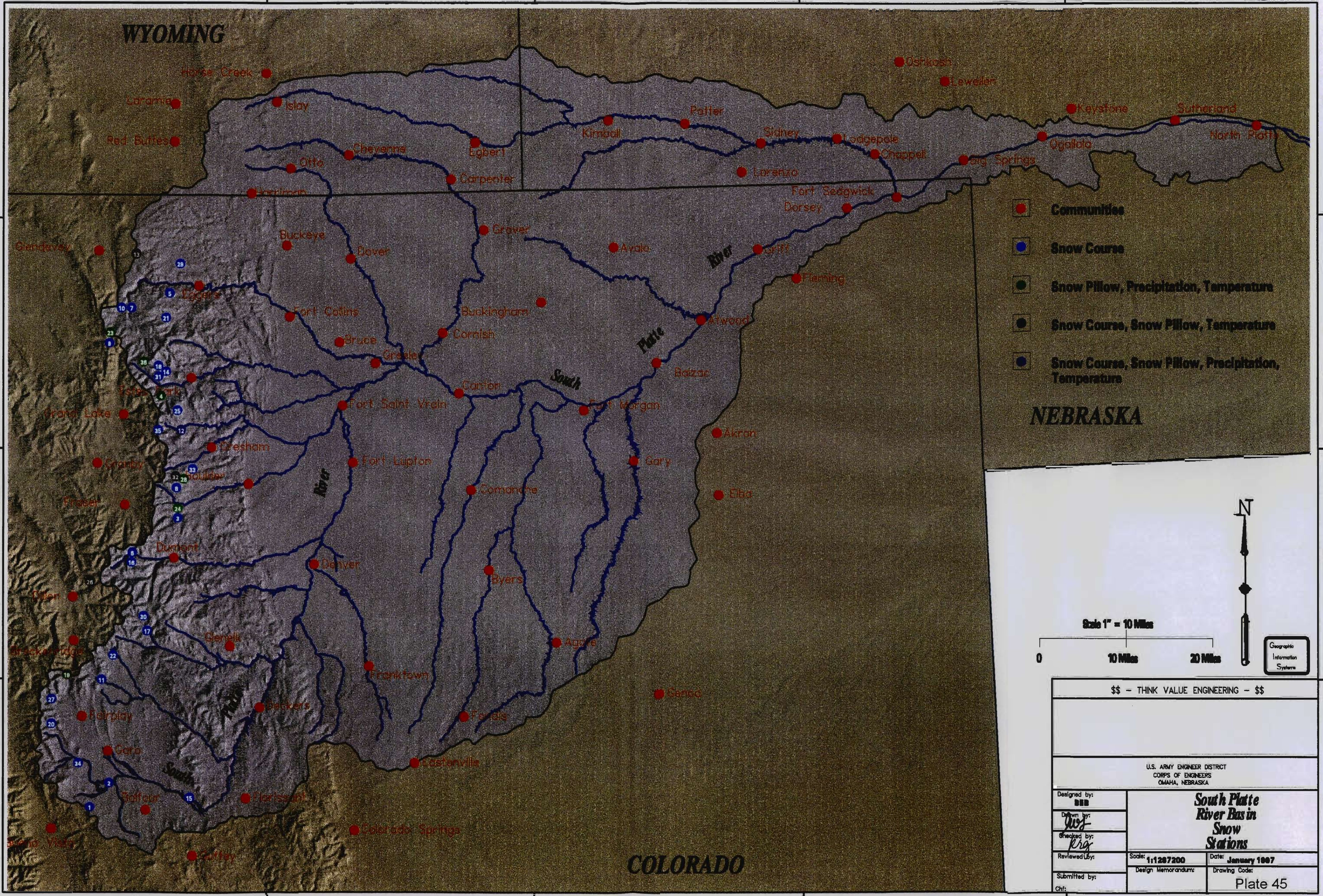
North Platte River Basin - Streamgaging Stations

No.	Station No.	Agency	Description	Latitude	Longitude	Datum	Fld Stg	Yrs of Rcd	DCP	NESID	COE ID
1	6620000	GS	North Platte River (head of Platte River) near Northgate, CO	40.9375	-106.33778	7810.39		1915-	Y	514A3286	NGWY
2	6622700	GS	North Brush Creek (head of Brush Creek) near Saratoga, WY	41.370278	-106.52056	8020 el	4.4	1960-	Y	13303688	SAWY
3	6622900	GS	South Brush Creek near Saratoga, WY	41.343889	-106.52583	8100 el		1960-	N		
4	6623800	GS	Encampment River above Hog Park Creek, near Encampment, WY	41.023611	-106.82417	8270 el		1964-	N		
5	6625000	GS	Encampment River at mouth, near Encampment, WY	41.303333	-106.71472	6970 el		1940-	N		
6	6627800	GS	Jack Creek above Coyote Draw, near Saratoga, WY	41.439167	-106.97111	7050 el		1990-	N		
7	6628900	BR	Pass Creek near Elk Mountain, WY	41.566667	-106.61111	7230 el		1957-	N		
8	6630000	GS	North Platte River above Seminoe Reservoir, near Sinclair, WY	41.672222	-107.05694	6400.75		1939-	Y	F33063F2	SIWY
9	6632400	GS	Rock Creek above King Canyon Canal, near Arlington, WY	41.585278	-106.22222	7790 el		1965-	N		
10	6634620	GS	Little Medicine Bow River at Boles Spring, near Medicine Bow, WY	41.961111	-106.20861	6570 el		1973-	N		
11	6635000	GS	Medicine Bow River above Seminoe Reservoir, near Hanna, WY	42.009722	-106.5125	6415.4		1939-	Y	F330451E	MBWY
12	6635500	BR	Seminoe Reservoir near Leo, WY	42.155833	-106.90806	6190		1939-	N		
13	6639000	BR	Sweetwater River near Alcova, WY	42.49	-107.13333	5690 el		1913-	Y	F3305668	SWWY
14	6640500	BR	Pathfinder Reservoir near Alcova, WY	42.468333	-106.85333	5678.1		1909-	N		
15	6641500	BR	Alcova Reservoir at Alcova, WY	42.547778	-106.71889	5320		1938-	N		
16	6642000	GS	North Platte River at Alcova, WY	42.574167	-106.69194	5299.4		1934-	N		
17	6643500	GS	North Platte River near Goose Egg, WY	42.710556	-106.55944	5210 el		1917-1995	N		
18	6645000	GS	North Platte River below Casper, WY	42.861111	-106.21472		6.4	1990-	N		
19	6645150	GS	Smith Creek above Otter Creek, near Casper, WY	42.649722	-106.17944	6550 el		1974-1996	N		
20	6645164	GS	Otter Creek at mouth, near Casper, WY	42.657778	-106.16333	6370 el		1987-1996	N		
21	6645166	GS	Smith Creek below Otter Creek, near Casper, WY	42.672222	-106.15083	5980 el		1987-1996	N		
22	6645174	GS	Beaver Creek above Pole Creek, near Casper, WY	42.713889	-106.18222	5800 el		1987-1996	N		
23	6645178	GS	Pole Creek near Casper, WY	42.696667	-106.17833	5880 el		1987-1996	N		
24	6646000	GS	Deer Creek in canyon, near Glenrock, WY	42.711667	-106.02861	5640 el		1965-	N		
25	6647500	GS	Box Elder Creek at Boxelder, WY	42.612222	-105.85806	6710 el		1971-	N		
26	6652000	GS	North Platte River at Orin, WY	42.652778	-105.15889	4660 el		1895-	Y	1661 E172	NPOW
27	6646800	GS/COE	North Platte River near Glenrock	42.836111	-105.75833	4920 el	3.5	1959-1992	Y	CE7853A4	GRWY
28	6652700	BR	Glendo Reservoir near Glendo, WY	42.4725	-104.95778	4543.5		1957-	N		
29	6652800	GS	North Platte River below Glendo Reservoir, WY	42.456944	-104.94722	4488.94	11	1957-	Y	34577030	GLWY
30	6653300	GS	Horseshoe Creek near Casea, WY	42.465833	-105.07278	4700 el		1988-1996	N		
31	6653500	GS	Horseshoe Creek near Glendo, WY	42.4525	-104.96972	4500 el		1916-1996	N		
32	6655500	BR	Guernsey Reservoir near Guernsey, WY	42.269722	-104.76333	4370		1928-	N		
33	6656000	GS	North Platte River below Guernsey Reservoir, WY	42.280556	-104.75417	4340 el	6.5	1900-	N		
34	6657000	GS	North Platte River below Whalen diversion dam, WY	42.238056	-104.62806	4260 el	4.5	1909-	Y	34578084	GOWY
35	6659500	GS	Laramie River and Pioneer Canal near Woods, WY	41.138056	-105.96028	7388.99		1912-	N		
36	6659580	GS	Sand Creek at Colorado-Wyoming State line	40.993611	-105.7625	7580 el		1968-	N		
37	6661000	GS	Little Laramie River near Filmore, WY	41.295	-105.03389	7610 el		1902-	N		
38	6661585	GS	Laramie River near Bosler, WY	41.554722	-105.67778	7030 el		1972-	N		
39	6662000	GS	Laramie River near Lookout, WY	41.762222	-105.69472	6962.68		1912-	N		
40	6664400	GS	Sybille Creek above Mule Creek, near Wheatland, WY	41.844167	-105.22028	5340 el		1974-	N		
41	6665790	GS	Sybille Creek above Canal No. 3, near Wheatland, WY	41.911111	-105.11861	5040 el		1960-	N		
42	6669050	GS	Wheatland Creek below Wheatland, WY	42.084722	-104.96583			1983-	N		
43	6670500	GS/COE	Laramie River near Fort Laramie, WY	42.200556	-104.54222	4220 el		1915-	Y	CE785D76	FLWY
44	6674500	GS/COE	North Platte River at Wyoming-Nebraska State line	41.968611	-104.05083	4025	4.5	1929-	Y	CE519108	HEWY
45	6677500	GS	Horse Creek near Lyman	41.939167	-103.99972	3992.84		1931-	N		
46	6679500	DWR	North Platte River at Mitchell	41.927222	-103.81333	3928.3	6.5	1901-	N	MODEM	
47	6684500	DWR	North Platte River at Bridgeport	41.661667	-103.08472	3856.14		1898-1991	N	MODEM	
48	6686000	DWR	North Platte River at Lisco	41.49	-102.62694	3474.5	4	1931-	N	MODEM	
49	6687500	DWR	North Platte River at Lewellen	41.316944	-102.11861	3285.88		1940-1991	N	MODEM	
50	6690000	GS	Lake McConaughy near Keystone	41.2125	-101.67778	sea level		1941-	N		
51	6690500	GS	North Platte River near Keystone	41.206333	-101.62694	3105.59	6.7	1939-	N		
52	6693000	GS	North Platte River at North Platte	41.153611	-101.7625	2792.14	7	1895-	N		


WYOMING
NEBRASKA
COLORADO
Riverton
Casper WSO AP
Casper
Glenrock
Glenrock 5 ESE
Douglas Aviation
Douglas 1 SE
Orin
Bates Creek 2
GRAY REEF RESERVOIR
ALCOVA RESERVOIR
GLENDO RESERVOIR
Keeline 7 SW
Torrington 29 N
South Pass City
Jeffrey City
Muddy Gap
Sweetwater River
Shirley Basin
PATHFINDER RESERVOIR
GUERNSEY RESERVOIR
Leo 6 SW
GRAYROCKS RESERVOIR
Fort Laramie
Double Four Ranch
Old Fort Laramie
Wheatland 4 N
SEMINOE RESERVOIR
Torrington
North Platte River
Mitchell
Mitchell 5 E
Scottsbluff
Scottsbluff AP
Lyman
Yoder 2 WSW
Medicine Bow
Laramie River
Rawlins AP
Rawlins
Rock River
Sybille Research Unit
Chugwater
Elk Mountain
Phillips
La Grange
Harrisburg 10 NW
Platte River
Bridgeport
Bridgeport
Lisco
Crescent Lake Natl Wildlife
Bosler
Dalton
Lisco
Oshkosh
Oshkosh 8 SW
Lewellen
Lewellen
Kingsley Dam
Saratoga
Saratoga
Albin
Centennial 1 N
Laramie 2 NW
Laramie AP
Laramie
Ogallala
Paxton
North Platte
Cheyenne
Encampment 10 ESE
North Platte River
Fort Julesburg
Balzac
Fort Morgan
Precipitation Stations
Communities
20 0 20 40 60 80 100
Statute Miles
N
W
E
S
Geographic Information Systems
$$ – THINK VALUE ENGINEERING – $$
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA
Designed by: JWG
Drawn by:
Checked by:
Reviewed by:
Submitted by:
Chf:
North Platte River Basin Precipitation Stations
Scale: 1:1867200
Date: July 1997
Design Memorandum:
Drawing Code:
PLATE 44

North Platte River Basin - Precipitation Stations					
Station	Latitude	Longitude	Elevation	Years of Record	Clim, Pre or Both
UPPER PLATTE					
Bates Creek 2	42.6333	-106.3833	6010	29	Clim
Centennial 1 N	41.3167	-106.1333	4160	80	Clim
Elk Mountain	41.6833	-106.4167	7265	74	Clim
Encampment 10 ESE	41.1833	-106.6167	7385	68	Clim
Jeffrey City	42.5	-107.8333	6320	24	Clim
Laramie AP	41.3167	-105.6833	7266	56	Clim
Laramie 2 NW	41.3333	-105.6	7140	31	Clim
Leo 6 SW	42.2	-106.85	6035	66	Clim
Medicine Bow	41.9	-106.2	6570	49	Both
Muddy Gap	42.3667	-107.45	6245	47	Clim
Rawlins AP	41.8	-107.2	6736	100	Both
Saratoga	41.45	-106.8167	6786	77	Clim
Shirley Basin	42.3667	-106.1	7055	20	Both
South Pass City	42.4667	-108.8	7840	79	Clim
LOWER PLATTE					
Albin	41.4167	-104.1	5345	53	Clim
Archer	41.15	-104.65	6010	72	Clim
Carpenter	41.05	-104.3667	5389	53	Clim
Casper WSO AP	42.9167	-106.4667	5338	59	Both
Cheyenne WSFO AP	41.15	-104.8167	6126	126	Clim
Chugwater	41.75	-104.8167	5304	92	Clim
Double Four Ranch	42.1833	-105.4	6199	54	Clim
Douglas 1 SE	42.75	-105.3667	4870	1	Precip
Douglas Aviation	42.75	-105.3833	4805	34	Both
Glenrock 5 ESE	42.8333	-105.7833	4948	54	Clim
Hecla 1 E	41.15	-105.1667	6690	18	Clim
Keeline 7 SW	42.5	-104.8667	5090	10	Clim
La Grange	41.6333	-104.1667	4590	76	Clim
Old Fort Laramie	42.2	-104.55	4250	8	Clim
Phillips	41.6333	-104.4833	4982	59	Both
Pine Bluffs 5 W	41.1667	104.15	5180	85	Both
Pine Bluffs 10 NW	41.3	104.1833	5330	1	Clim
Sybille Research Unit	41.7667	-105.3833	6100	33	Clim
Torrington Exp Farm	42.8333	-104.2167	4098	75	Both
Torrington 29 N	42.4833	-104.15	4860	2	Clim
Wheatland 4 N	42.1167	-104.95	4638	83	Both
Yoder 2 WSW	41.9	-104.3333	4289	72	Clim
NEBRASKA PANHANDLE					
Agate 3 E	42.45	-103.8333	4669	57	Clim
Alliance 1 WNW	42.1	-102.9	3994	100	Clim
Big Springs	41.0667	-102.0833	3370	59	Both
Bridgeport	41.6667	-103.1	3666	98	Both
Chadron 1 SSW	42.8167	-103	3510	82	Both
Crawford	42.7	-103.4167	3670	112	Clim
Crescent Lake Nat Wlr	41.75	-102.4333	3818	60	Clim
Dalton	41.41.67	-102.9667	4272	75	Clim
Ellsworth	42.05	-102.2833	3905	52	Clim
Ellsworth 24 NNE	42.3833	-102.15	3860	42	Clim
Ellsworth 15 NNE	42.2667	-102.2	3970	34	Clim
Gordon 6 N	42.8833	-102.2167	3700	94	Clim
Harrisburg 10 NW	41.65	-103.8833	4459	82	Clim
Harrison	42.6833	-103.8833	4850	82	Clim
Hay Springs	42.6833	-102.6833	3855	113	Clim
Hay Springs 12 S	42.5	-102.7	3805	45	Clim
Hemingford	42.35	-103.0833	4270	34	Clim
Kimball 2 N	41.25	-103.6667	4759	108	Clim
Lewellen	41.3167	-102.1333	3290	2	Clim

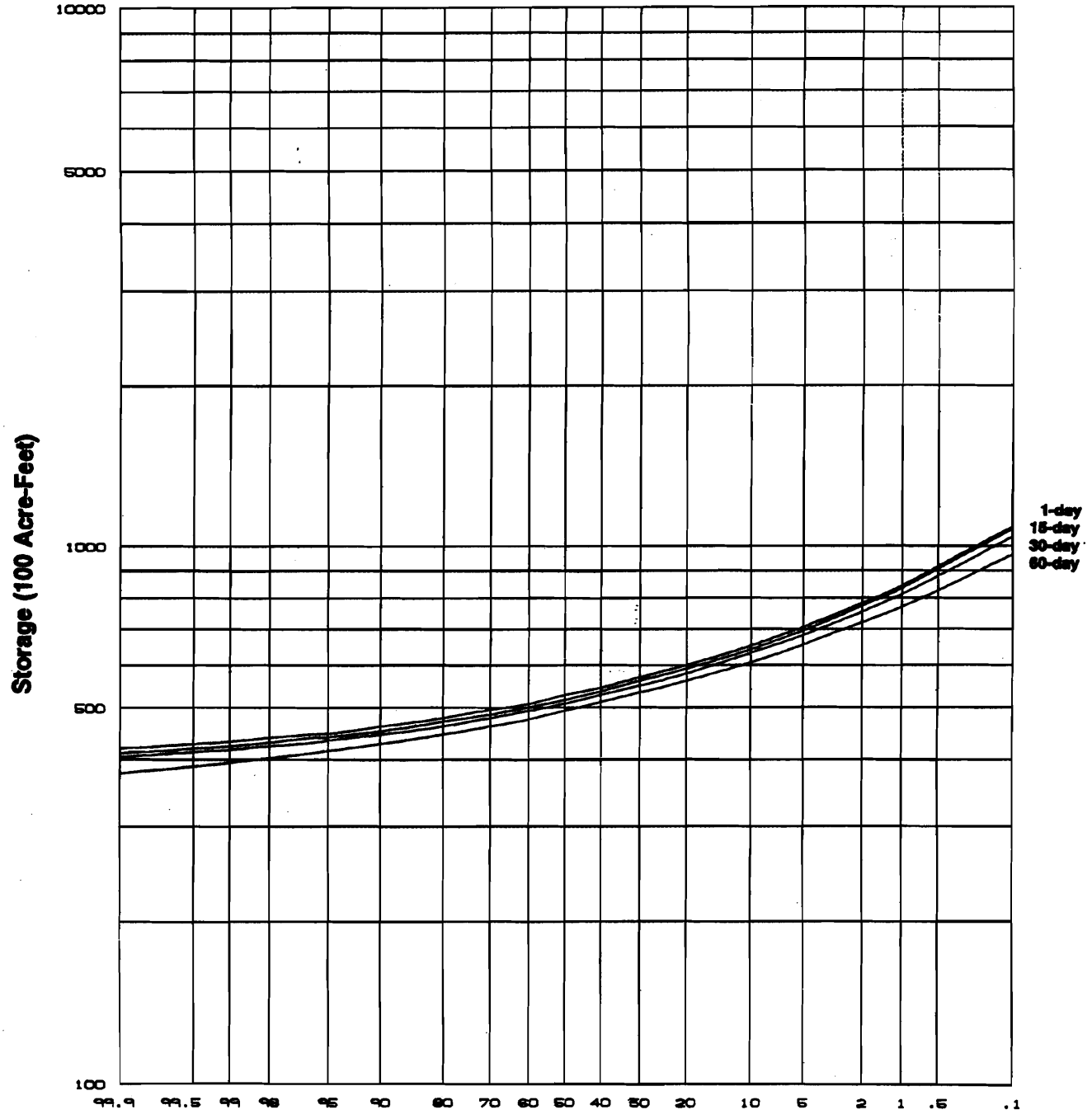
Lisco	41.5	-102.6333	3515	19	Clim
Lodgepole	41.15	-102.6333	3832	98	Clim
Lyman	41.9167	-104.0333	4050	71	Clim
Mitchell 5 E	41.95	-103.7	4080	83	Clim
Oshkosh	41.4167	-102.35	3379	83	Clim
Oshkosh 8 SW	41.3	-102.4333	3826	44	Clim
Potter	41.2167	-103.3167	4430	75	Clim
Rushville	42.7167	-102.4333	3759	54	Clim
Scottsbluff AP	41.8667	-103.6	3945	107	Both
Sidney 6 NNW	41.2333	-103	4320	68	Both
SOUTHWEST					
Benkelman	40.05	-101.5333	3024	92	Both
Culbertson	40.2167	-100.8333	2599	108	Clim
Curtis 3 NNE	40.6667	-100.5	2720	98	Both
Enders Lake	40.4167	-101.2167	3078	45	Clim
Eustis 2 NW	40.6833	-100.05	2690	52	Clim
Haigler	40.0167	-101.9333	3280	100	Clim
Hayes Center	40.5167	-101.0167	3051	102	Both
Hershey 5 SSE	41.1	-100.9667	2952	54	Clim
Imperial	40.5167	-101.6333	3277	105	Clim
Kingsley Dam	41.2167	-101.65	3318	57	Both
Lamar 3 SSE	40.5333	-101.9667	3540	45	Clim
Madrid	40.85	-101.5333	3200	105	Clim
McCook	40.2	-100.6	2530	110	Precip
McCook 17 NNW	40.45	-100.7	2745	46	Clim
Medicine Creek Dam	40.3833	-100.2167	2387	45	Clim
Moorefield	40.6833	-100.4	2828	46	Clim
North Platte WSO Arpt //R	41.1333	-100.6833	2775	56	Both
North Platte Exp Farm	41.0667	-100.75	3024	78	Clim
Ogallala	41.1333	-101.7167	3229	79	Clim
Palisade	40.35	-101.1167	2770	67	Clim
Paxton	41.1333	-101.35	3075	87	Clim
Red Willow Dam	40.35	-100.65	2561	34	Clim
Stockville	40.5333	-100.3833	2450	46	Clim
Stratton	40.1333	-101.2333	2880	97	Clim
Trenton Dam	40.1667	-101.0667	2810	47	Clim
Wallace 2 W	40.8333	-101.2	3100	48	Clim
Wauneta	40.4167	-101.3667	3020	98	Clim
Wellfleet	40.75	-100.7333	2816	45	Clim


WYOMING
NEBRASKA
COLORADO
Horse Creek
Laramie
Red Buttes
Islay
Cheyenne
Otto
Egbert
Carpenter
Kimball
Potter
Sidney
Lodgepole
Chappell
Lorenzo
Oshkosh
Lewellen
Keystone
Sutherland
North Platte
Ogallala
Big Springs
Fort Sedgwick
Dorsey
Buckeye
Dover
Grover
Avalo
Fleming
Buckingham
Fort Collins
Bruce
Cornish
Greeley
Atwood
Balzac
Carlton
Fort Saint Vrain
Fort Morgan
Akron
Gresham
Fort Lupton
Gary
Comanche
Elba
Grand Lake
Dumont
Denver
Byers
Agate
Frankfown
Keenesburg
Castleville
Fairplay
Como
Colorado Springs
River
Platte
South
Communities
Snow Course
Snow Pillow, Precipitation, Temperature
Snow Course, Snow Pillow, Temperature
Snow Course, Snow Pillow, Precipitation, Temperature
Scale 1" = 10 Miles
0
10 Miles
20 Miles
N
Geographic Information Systems
$$ - THINK VALUE ENGINEERING - $$
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA
Designed by:
Drawn by:
Checked by:
Reviewed by:
Submitted by:
South Platte River Basin Snow Stations
Scale: 1:1267200
Date: January 1997
Design Memorandum:
Drawing Code:
Plate 45

North Platte River Basin - Snow Stations				
Site Number/Name	Elevation	Latitude	Longitude	Site Configuration
LOWER BASIN				
1 - Albany	9120	41.1833	-106.1667	SC
2 - Boxelder	7280	42.5667	-105.8667	SC
3 - Brooklyn Lake	10220	41.3667	-106.2333	SC, S, P, T
4 - Buck Creek	7900	42.567	-105.9667	SC
5 - Casper Mountain	7850	42.7333	-106.3167	SC, S, P, T
6 - Christina Lake	9980	42.5833	-108.9167	S, P, T
7 - Foxpark	9060	41.0533	-106.1667	SC, P
8 - Grannier Meadows	8860	42.5667	-108.8333	SC
9 - Hairpin Turn	9460	41.3333	-106.2	SC
10 - LaBonte	7750	42.3	-105.65	SC
11 - Laprele Creek	8375	42.4333	-105.8667	S, P, T
12 - Larsen Creek	9020	42.6	-109.8333	SC
13 - Libby Lodge	8750	41.3167	-106.1833	SC
14 - Pole Mountain	8360	41.25	-105.4167	SC, P
15 - Reno Hill	8500	42.5667	-106.0833	S, P, T
16 - South Pass	9040	42.5667	-108.8333	SC, S, P, T
17 - Windy Peak	7900	42.2833	-105.5833	S, P, T
18 - Big South	8600	40.6167	-105.8167	SC
19 - Cameron Pass	10285	40.5167	-105.8833	SC
20 - Chambers Lake	9000	40.6	-105.8333	SC, P
21 - Deadman Hill	10220	40.8	-105.7667	SC, S, P, T
22 - McIntyre	9100	40.7833	-105.9333	SC
23 - Roach	9700	40.8667	-106.05	SC, S, P, T
UPPER BASIN				
24 - Deep Lake	10500	41.4	-106.2833	SC
25 - Moss Lake	9880	41.4	-106.3667	SC
26 - North Barrett Creek	9430	41.3167	-106.4333	SC
27- North French Creek	10130	41.3333	-106.3667	S, P, T
28 - Purgatory Gulch	8970	41.1333	-106.7333	SC
29 - Rock Creek	9980	41.4667	-106.2833	SC, P
30 - Ryan Park	8350	41.3167	-106.5	SC
31 - Sand Lake	10050	41.4667	-106.2833	S, P, T
32 - South Brush Creek	8440	41.333	-106.5	S, P, T
33 - Webber Springs	9250	41.1667	-106.9333	SC, S, P, T
34 - Columbine Lodge	9400	40.3833	-106.6	SC, S, P, T
35 - Joe Wright	10120	40.5333	-105.8833	SC, S, P, T
36 - Northgate	8550	40.9333	-106.2833	SC, P
37 - Park View	9160	40.3667	-106.1	SC
38 - Rabbit Ears	9400	40.3667	-106.7333	SC
39 - Tower	10500	40.5333	-106.6667	SC, S, P, T
40 - Willow Creek Pass	9540	40.35	-106.0533	SC, S, P, T

SC = Snow Course
S = Snow Pillow
P = Precipitation
T = Temperature

Glendo Dam and Reservoir
Storage Volume Probabilities



Curves represent the annual exceedance frequencies for various durations of Maximum storages in Glendo Reservoir. Curves are statistically derived based on the 36 (1958 - 1993) water years over the period of record. Refer to Section 4-07 for further explanation.

Prepared By: _____

Reviewed By: _____

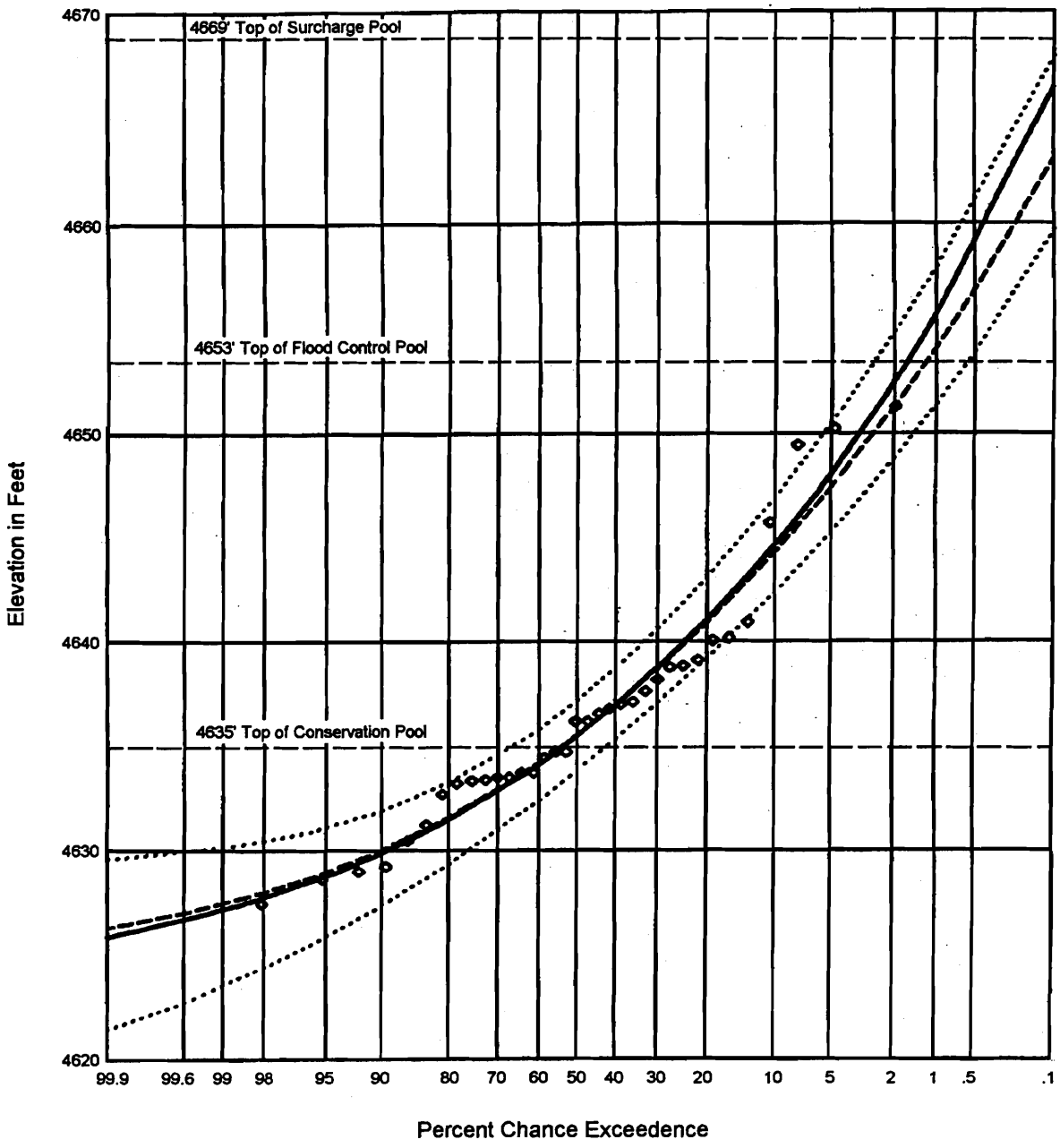
Water Control Manual
Glendo Dam and Reservoir, Colorado

Storage Volume Probabilities

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

GDRSVP.XLS

Glendo Dam and Reservoir
Pool Elevation Probabilities



Curves represent the annual exceedance frequencies for various durations of maximum storages in Glendo Reservoir. Curves are statistically derived based on the 36 (1959 - 1993) water years over the period of record. Refer to Section 4-07 for further explanation.

Prepared By: _____

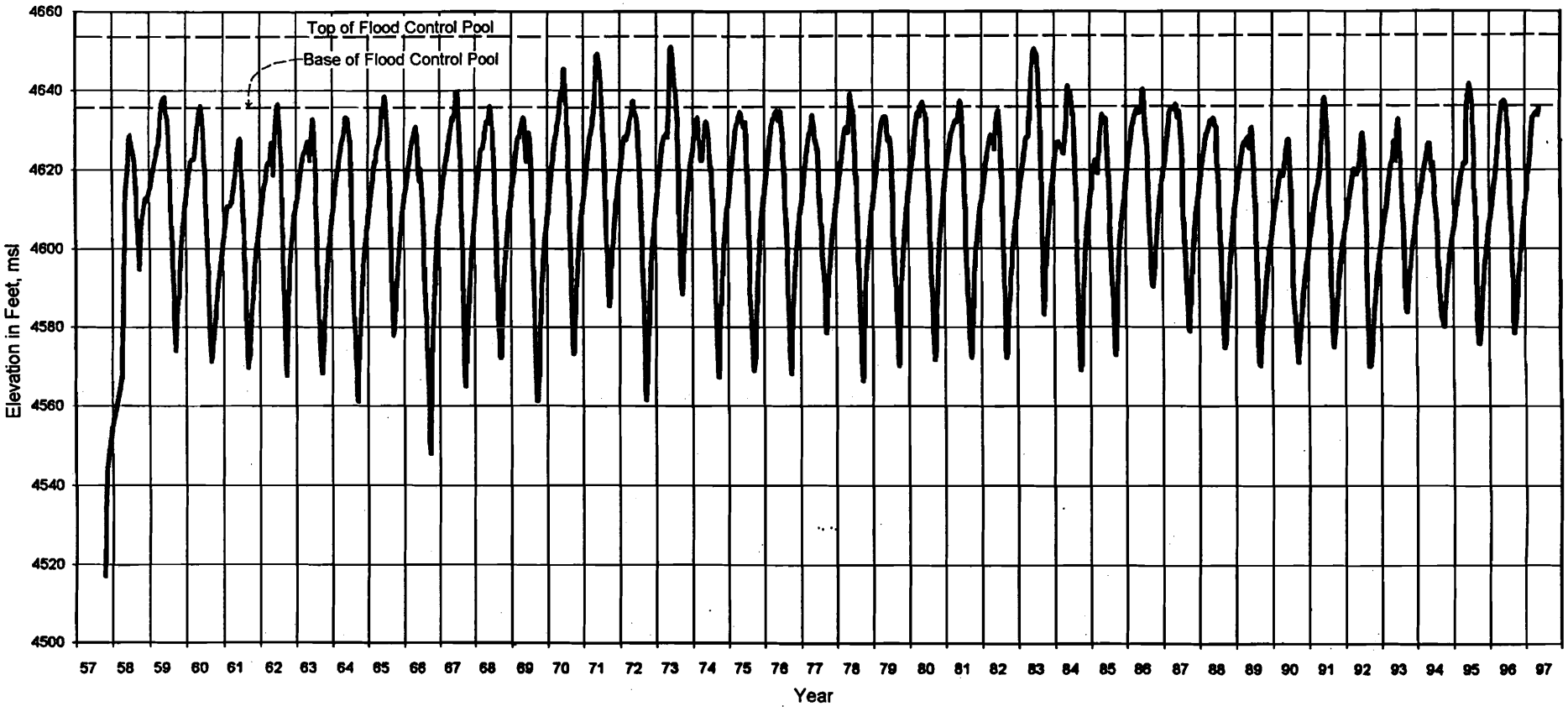
Reviewed By: _____

Water Control Manual
Glendo Dam and Reservoir, Colorado

Pool Elevation Probabilities

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Glendo Dam and Reservoir Historical Elevation



Prepared By: _____

Reviewed By: _____

Water Control Manual
Glendo Dam and Reservoir, Colorado

Historical Pool Elevation

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 48

Glendo Dam and Reservoir
Maximum Daily Elevations, Inflows, and Outflows

Year	Elevation (ft msl)	Date	Inflow (cfs)	Date	Outflow (cfs)	Date
1958	4628.56	30-Jun	5,280	20-Apr	5,550	15-Jul
1959	4638.19	9-Jun	4,300	5-May	7,070	10-Aug
1960	4635.91	30-May	2,640	10-Aug	6,170	28-Jul
1961	4627.97	25-Jun	2,120	8-Jul	5,540	7-Jul
1962	4636.33	2-Jul	6,760	16-Jun	7,270	9-Aug
1963	4632.65	24-Jun	4,800	19-Jun	6,610	21-Jul
1964	4633.07	23-May	4,240	21-May	6,500	30-Jul
1965	4638.35	18-Jun	**18,800**	**15-May**	6,600	21-Aug
1966	4630.74	4-May	3,930	19-Aug	6,600	28-Jul
1967	4639.64	29-Jun	3,950	25-Jun	6,800	20-Aug
1968	4635.73	13-Jun	4,050	9-Jun	6,512	24-Jul
1969	4632.88	11-May	3,030	13-Jun	6,620	4-Aug
1970	4645.34	21-Jun	17,600	13-Jun	6,160	6-Aug
1971	4649.08	24-May	11,800	5-May	6,930	11-Jul
1972	4637.16	18-May	3,610	1-Jul	6,750	1-Jul
1973	**4650.94**	**28-May**	14,700	21-May	9,640	2-Jun
1974	4633.01	21-Feb	6,730	27-Apr	7,330	27-Jun
1975	4634.28	4-May	4,380	31-Oct	7,040	30-Jul
1976	4634.70	6-May	3,790	3-Aug	7,030	31-Jul
1977	4633.52	4-May	4,310	13-Jul	6,510	11-Aug
1978	4639.12	22-May	8,600	18-May	6,880	6-Aug
1979	4633.20	13-May	4,150	18-Aug	7,160	6-Aug
1980	4636.80	17-May	6,670	24-Apr	7,090	2-Aug
1981	4637.07	1-Jun	2,950	26-Aug	7,480	1-Aug
1982	4634.72	27-Jun	4,080	21-May	7,150	8-Aug
1983	4650.27	14-Jun	8,830	23-Jul	10,100	26-Aug
1984	4640.95	23-May	10,800	16-May	**10,210**	**30-Jun**
1985	4633.72	6-May	3,860	22-Aug	7,040	26-Jul
1986	4640.15	22-Jun	9,470	11-Jun	8,490	30-Jun
1987	4636.17	13-May	3,120	22-Jul	7,630	26-Jul
1988	4632.72	23-May	4,360	5-Jul	7,680	26-Jul
1989	4630.41	14-Jun	5,760	9-Jul	7,610	1-Aug
1990	4627.45	12-Jun	3,490	20-Aug	7,820	31-Jul
1991	4638.13	7-Jun	10,100	16-May	7,410	28-Jul
1992	4629.00	28-Jun	3,410	18-Jul	7,350	26-Jul
1993	4632.56	27-Jun	5,790	19-May	7,670	28-Jul
1994	4626.54	30-Apr	4,500	26-Jul	7,540	26-Jul
1995	4641.67	14-Jun	7,930	10-May	7,690	1-Aug
1996	4637.17	3-Jun	4,860	15-May	7,500	27-Jul
1997	4639.24	9-Jul	5,960	16-Jun	8,160	25-Jul

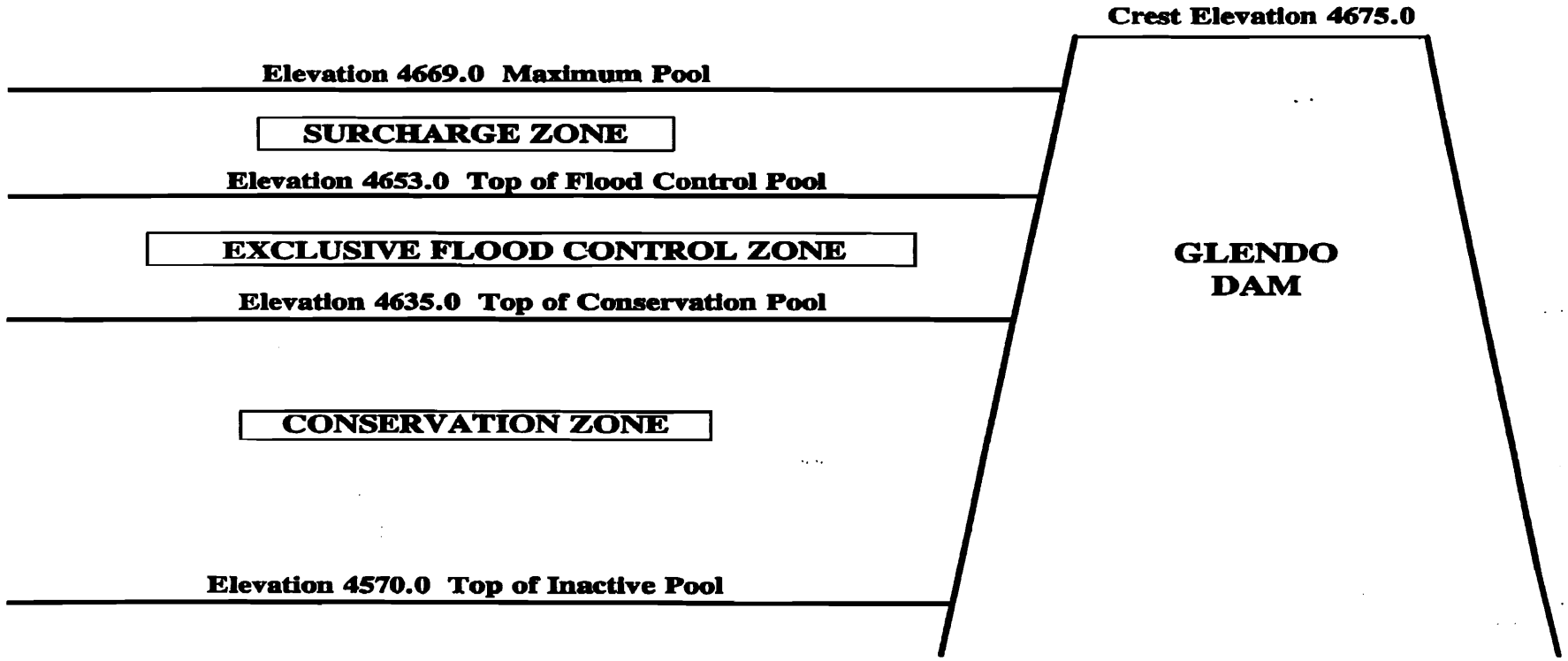
Glendo Dam and Reservoir
Historical Monthly Inflow (Acre-Feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1958	6,613	9,852	12,195	175,117	277,583	228,188	248,864	199,546	57,462	75,030	35,550	36,390
1959	37,050	32,810	45,340	127,030	108,500	74,920	95,330	105,130	101,990	70,310	75,580	55,950
1960	54,140	50,650	56,470	90,500	105,740	77,150	91,800	108,470	72,920	36,720	44,970	41,470
1961	43,740	48,610	47,910	75,230	79,050	59,670	84,450	77,580	54,460	55,890	56,250	47,590
1962	50,450	68,750	63,910	118,080	166,290	130,620	69,230	65,080	68,360	101,780	63,750	49,980
1963	54,910	63,690	63,870	81,770	127,600	119,950	103,700	127,670	133,750	82,230	65,290	57,300
1964	58,390	57,910	67,490	88,780	163,060	104,560	101,500	131,400	137,190	71,050	64,880	54,670
1965	54,720	55,090	65,590	108,820	237,210	123,090	73,730	83,070	59,760	62,700	65,220	55,760
1966	47,880	51,690	74,440	102,850	122,310	101,240	145,750	180,030	62,840	85,000	88,850	74,660
1967	56,000	48,180	67,790	107,840	120,790	114,830	70,270	44,150	43,150	71,050	75,990	60,580
1968	69,470	66,060	71,270	112,950	159,210	113,660	128,790	126,370	119,690	88,840	71,860	55,550
1969	63,810	64,100	68,180	100,830	119,290	141,030	137,580	116,340	118,570	82,130	75,380	69,530
1970	66,530	62,440	71,110	101,920	216,700	197,410	77,790	69,430	65,070	79,160	75,700	61,380
1971	71,950	64,210	78,900	216,580	415,160	270,880	148,510	115,220	77,140	77,800	76,380	63,010
1972	62,040	83,340	144,310	116,090	142,880	173,960	157,860	97,320	55,230	85,660	85,580	65,120
1973	67,150	64,010	77,550	118,560	556,210	432,600	274,670	183,660	125,290	110,640	74,290	65,450
1974	68,580	65,310	135,410	269,300	285,260	236,550	219,360	123,040	96,900	87,020	83,250	57,880
1975	65,770	61,910	71,010	89,310	139,750	138,740	122,530	168,870	153,910	99,060	87,150	64,900
1976	64,630	69,520	67,110	86,510	122,020	103,960	126,450	167,240	122,120	82,640	65,090	62,200
1977	55,890	63,150	60,390	94,600	116,160	105,280	125,570	164,470	90,460	67,620	56,910	54,290
1978	54,580	59,320	67,300	60,090	204,020	62,270	118,870	141,720	104,060	95,580	62,090	56,590
1979	63,920	68,190	75,180	75,040	90,730	113,050	117,830	181,310	105,840	94,520	68,680	66,540
1980	56,600	84,310	71,510	129,950	200,100	155,050	138,210	148,100	143,250	106,650	69,120	67,410
1981	63,330	51,930	38,530	41,170	100,490	67,170	109,150	147,100	122,990	96,640	60,450	49,840
1982	49,750	53,620	53,240	63,310	153,130	60,680	103,780	112,130	104,600	75,625	57,460	46,770
1983	60,130	48,560	61,130	120,735	359,335	321,500	473,100	262,515	127,610	91,190	71,970	62,130
1984	75,110	70,290	173,760	249,150	422,785	478,450	274,715	163,840	100,040	101,615	84,545	63,095
1985	65,085	66,485	106,795	153,890	186,705	127,735	155,805	201,985	168,955	110,790	60,155	64,745
1986	72,725	63,955	83,565	165,240	211,165	251,445	280,490	164,920	116,950	105,550	127,080	68,850
1987	59,265	71,575	82,640	91,730	68,780	94,720	122,090	134,110	60,730	72,287	68,615	57,214
1988	63,059	57,077	59,223	87,510	121,061	79,548	152,351	158,436	140,388	69,204	64,853	57,785
1989	58,589	46,400	47,495	66,179	104,152	98,923	121,283	131,542	92,134	48,347	48,347	43,476
1990	44,559	37,551	48,490	48,363	69,144	62,507	78,726	173,014	44,249	43,456	43,500	35,524
1991	41,673	43,560	38,722	81,734	169,829	114,477	87,581	115,317	97,263	45,237	49,107	41,556
1992	40,001	39,658	46,860	45,786	47,776	111,245	130,338	77,054	78,179	48,748	40,672	40,444
1993	46,586	38,476	57,972	79,495	144,897	135,505	132,750	137,867	48,842	54,979	44,040	45,718
1994	41,814	36,645	48,110	60,154	102,831	139,882	178,370	211,029	108,973	52,307	48,935	42,506
1995	36,893	43,302	45,156	38,603	132,961	182,395	64,134	76,740	40,855	65,011	55,405	47,592
1996	42,225	47,854	76,617	153,394	238,702	222,231	140,725	125,958	58,940	60,772	59,404	55,631
1997	60,767	59,281	147,154	186,792	287,078	318,050	257,272					
Average	55,409	55,983	70,992	109,525	179,911	156,128	146,033	136,379	94,387	77,201	65,958	55,566

PLATE 50

PEZ ᵛᴵ S

GLENDO DAM AND RESERVOIR
POOL ELEVATIONS AND ZONES



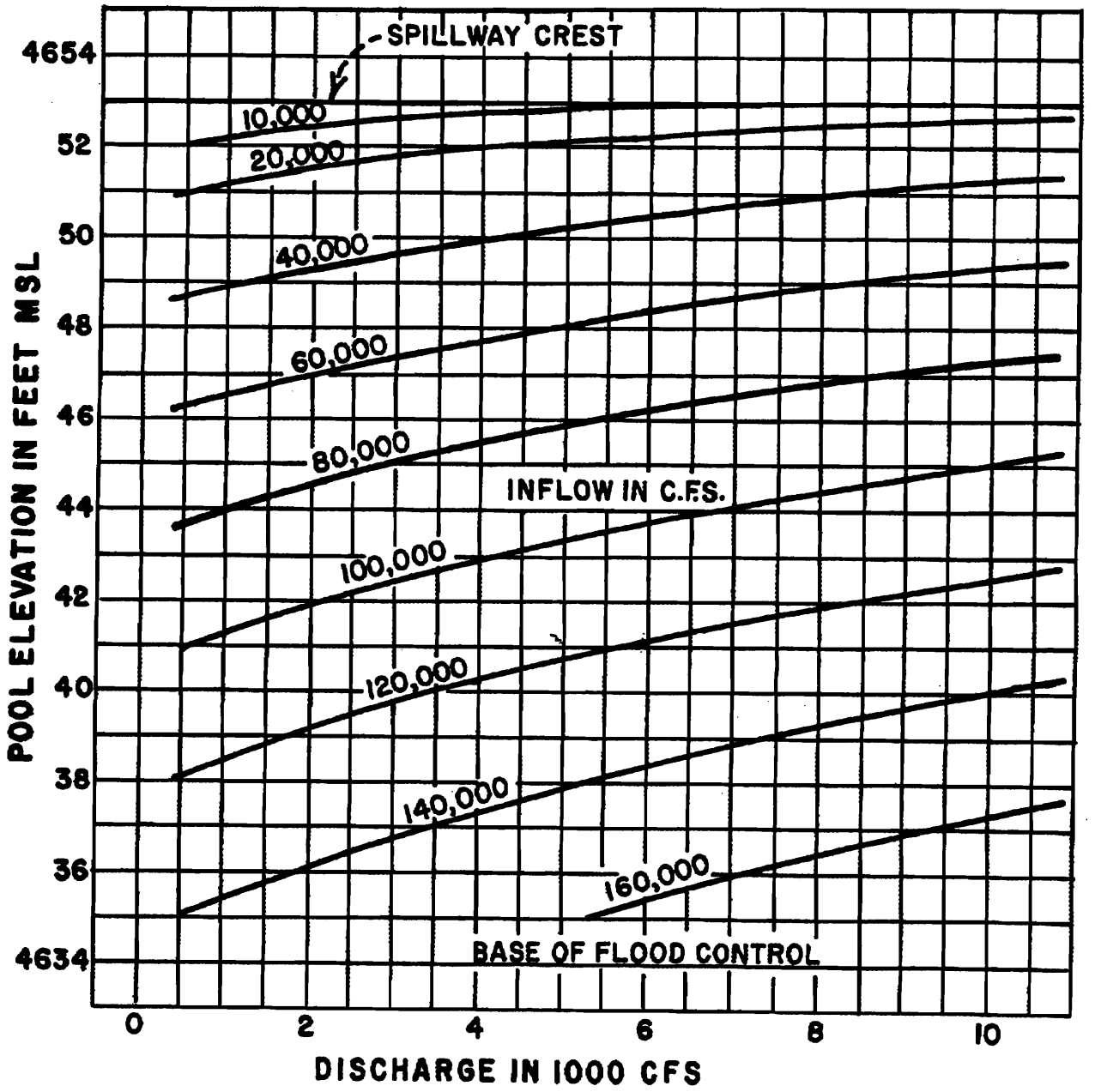
Prepared By: RH
Reviewed By: ADC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Pool Elevations and Zones

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 51



Refer to Section 7-01 of the manual for further explanation of this Regulation Schedule.

Limited to Rainfall occurrences only.

Prepared By: RH

Reviewed By: [illegible]

Water Control Manual
Glendo Dam and Reservoir, Colorado

Reservoir Regulation Schedule

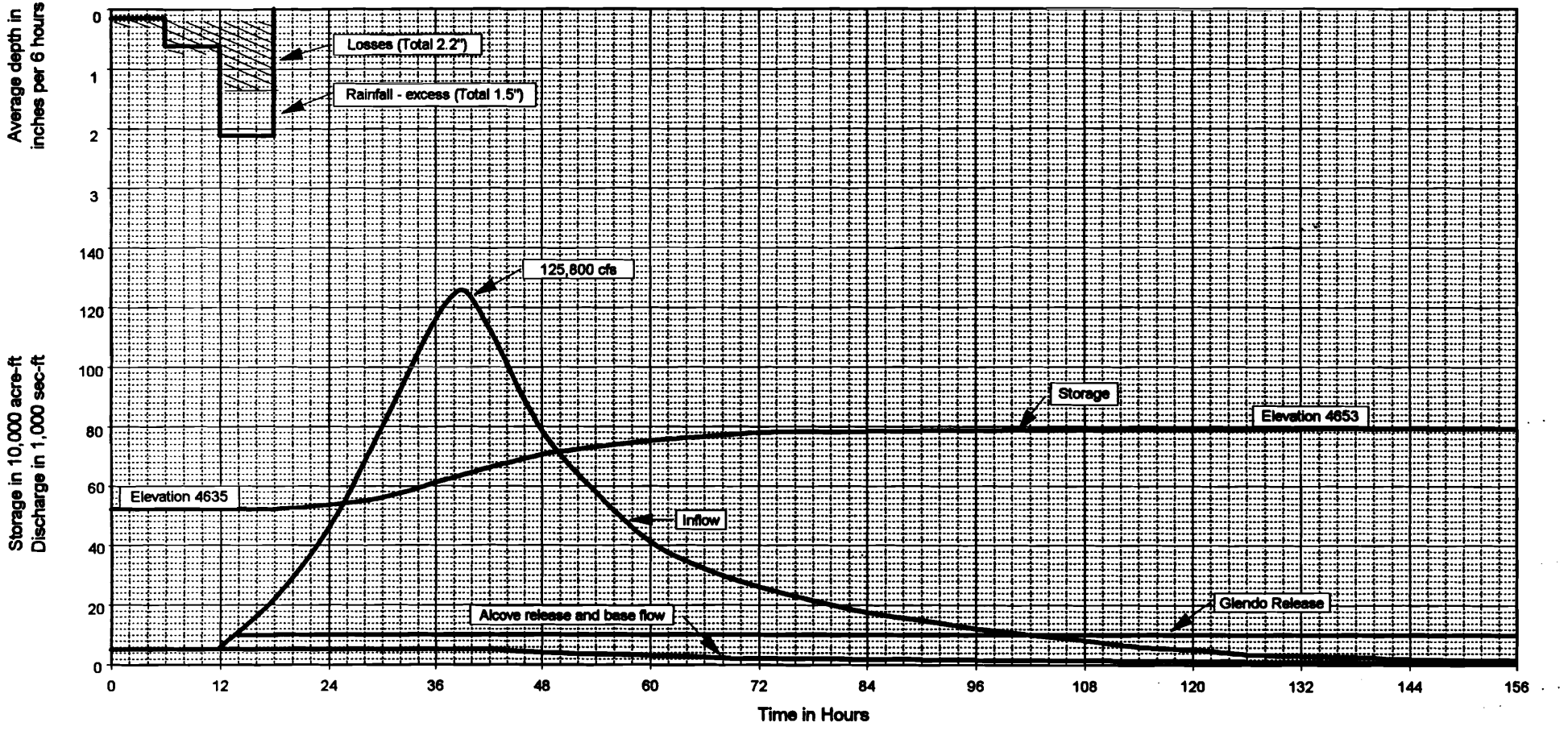
U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

RRS.XLS

PLATE 52

SPFH.XL

Standard Project Flood Hydrograph



Storm runoff	336,000 ac-ft
Alcova release and base flow at Glendo	32,000 ac-ft
Total flood volume	368,000 ac-ft
Storage capacity required to control the flood to 10,000 cfs release	270,000 ac-ft

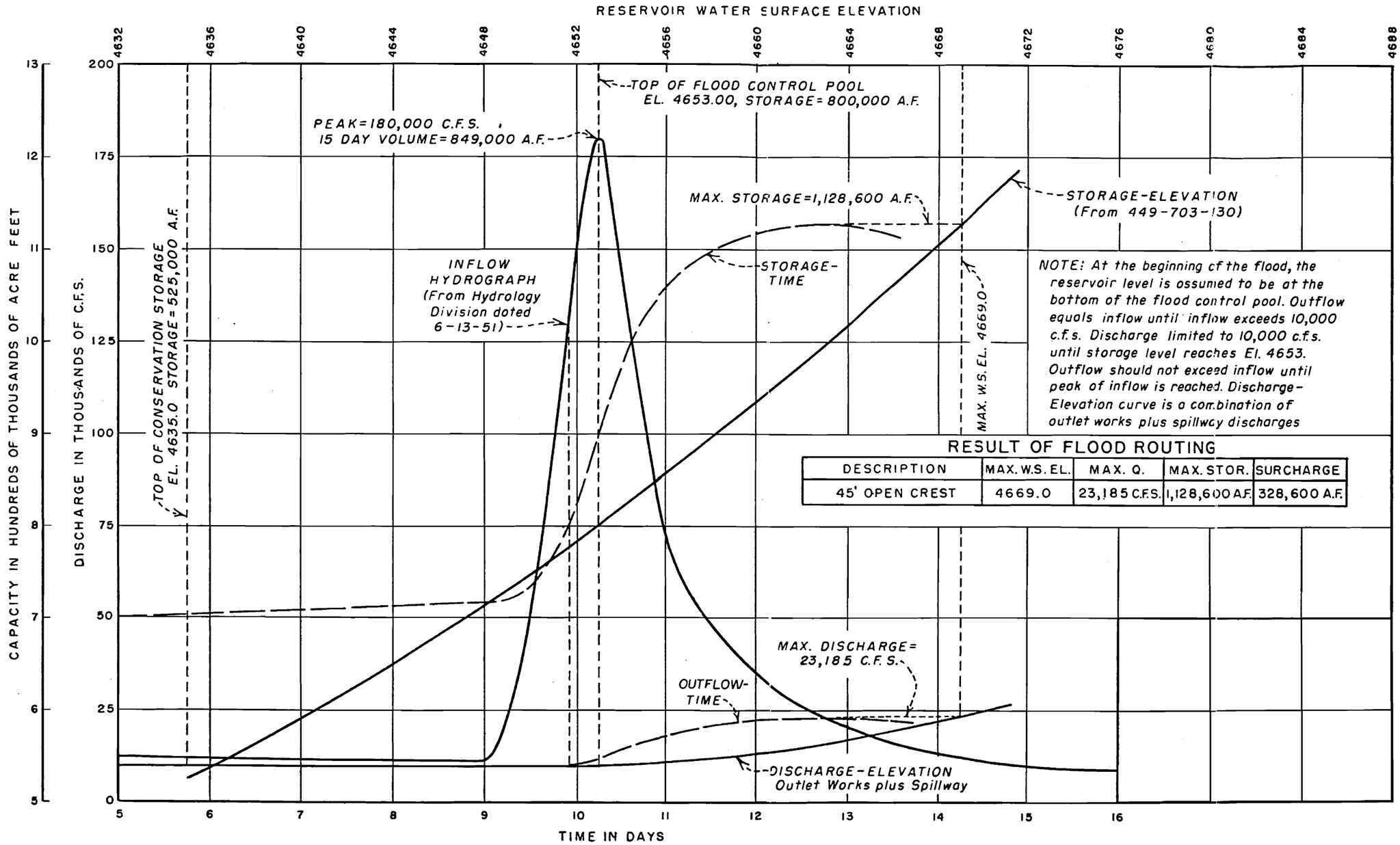
Prepared By: RW
Reviewed By: WC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Standard Project Flood Hydrograph

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

PLATE 53



RESULT OF FLOOD ROUTING

DESCRIPTION	MAX. W.S. EL.	MAX. Q.	MAX. STOR.	SURCHARGE
45' OPEN CREST	4669.0	23,185 C.F.S.	1,128,600 A.F.	328,600 A.F.

Prepared By: RH
Reviewed By: EJC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

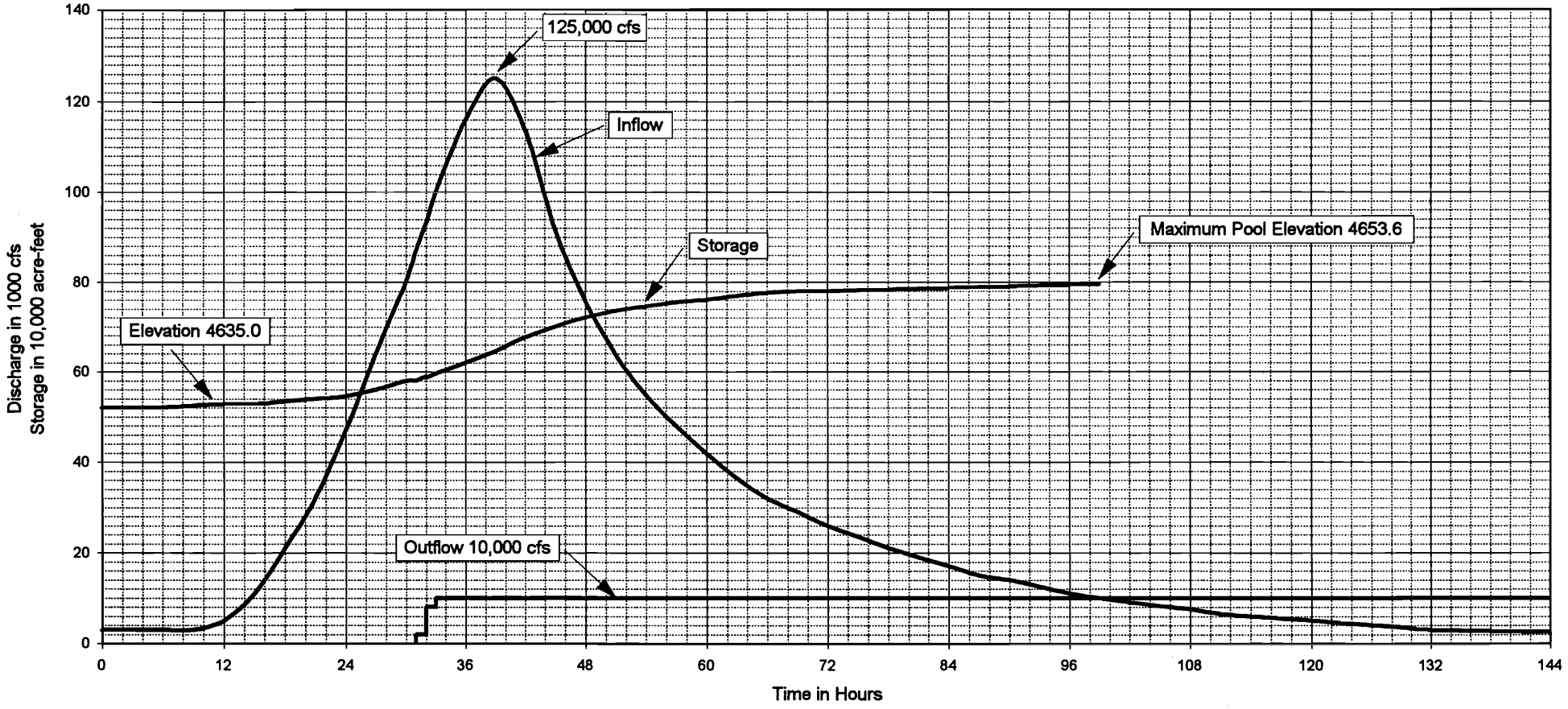
Spillway Flood Routing Curves

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

SFRC.XLS

PLATE 54

Reservoir Design Flood Routing

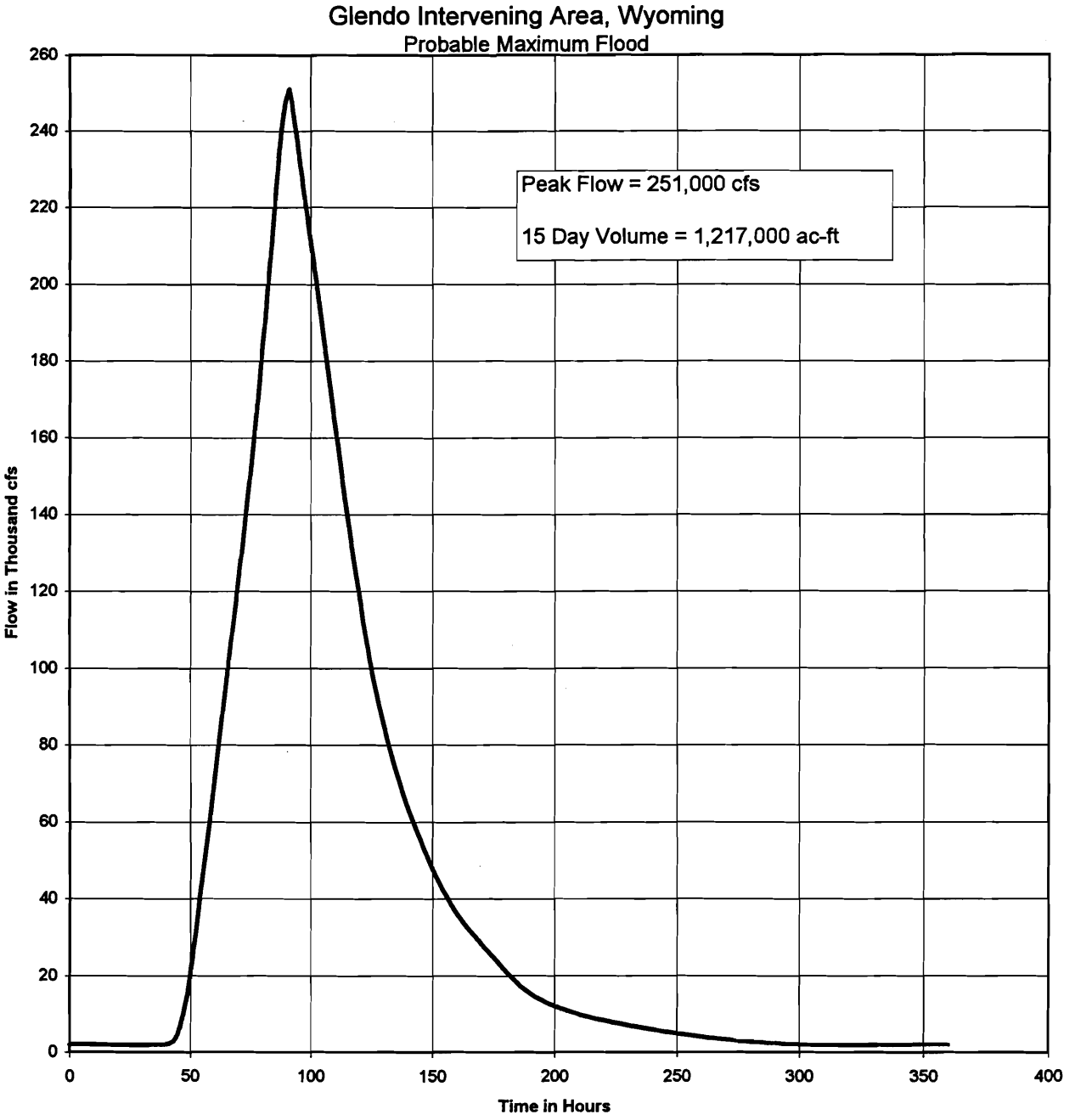


Prepared By: RH
Reviewed By: ADC

Water Control Manual
Glendo Dam and Reservoir, Wyoming

Reservoir Design Flood Routing

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997



Source of Data:
Glendo Standard Operating Procedures
(SOP), Bureau of Reclamation, March 1991

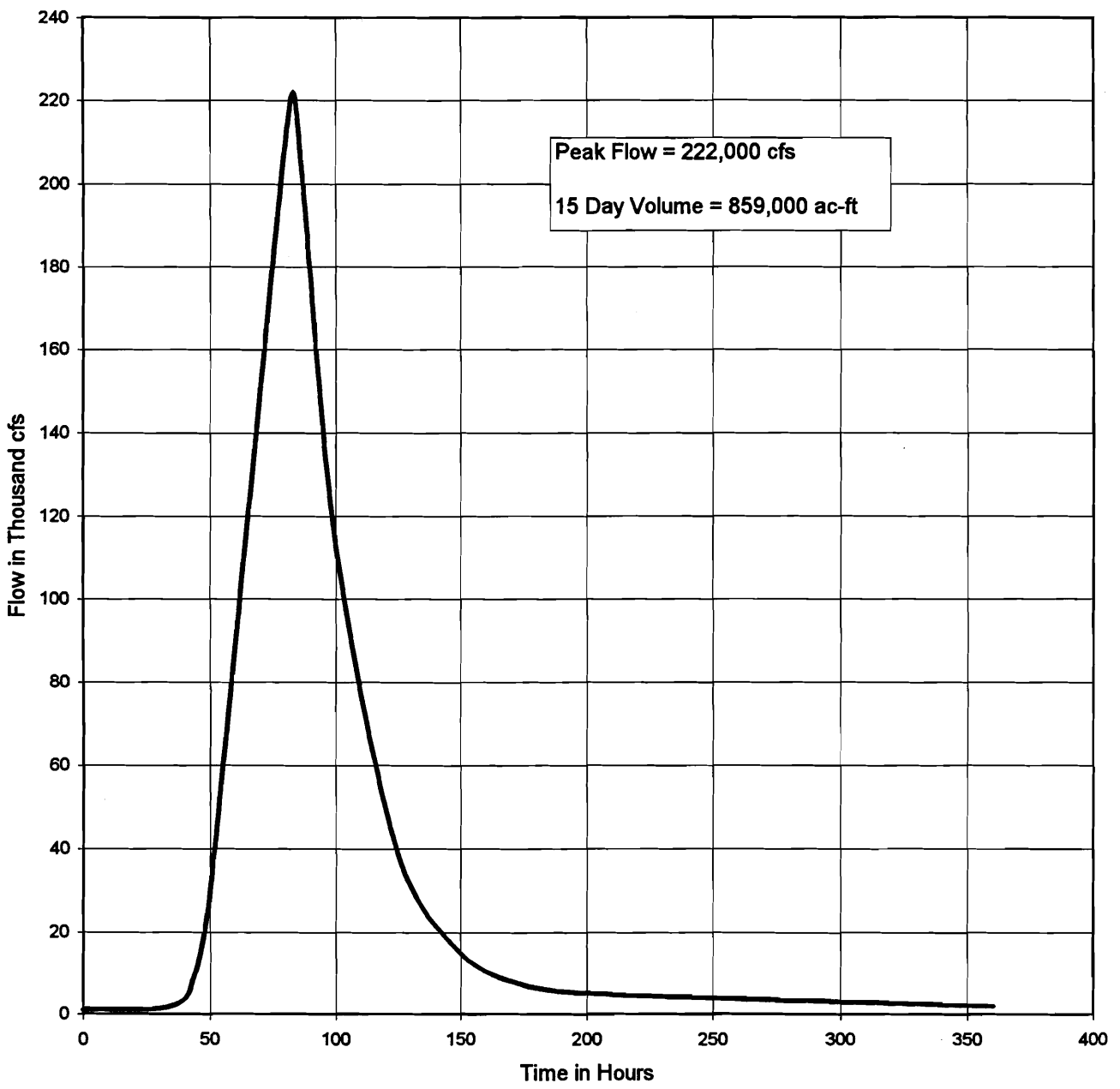
Prepared By: _____
Reviewed By: _____

Water Control Manual
Glendo Dam and Reservoir, Colorado

Probable Maximum Flood

Intervening Area Between Pathfinder Dam and Glendo Dam

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997



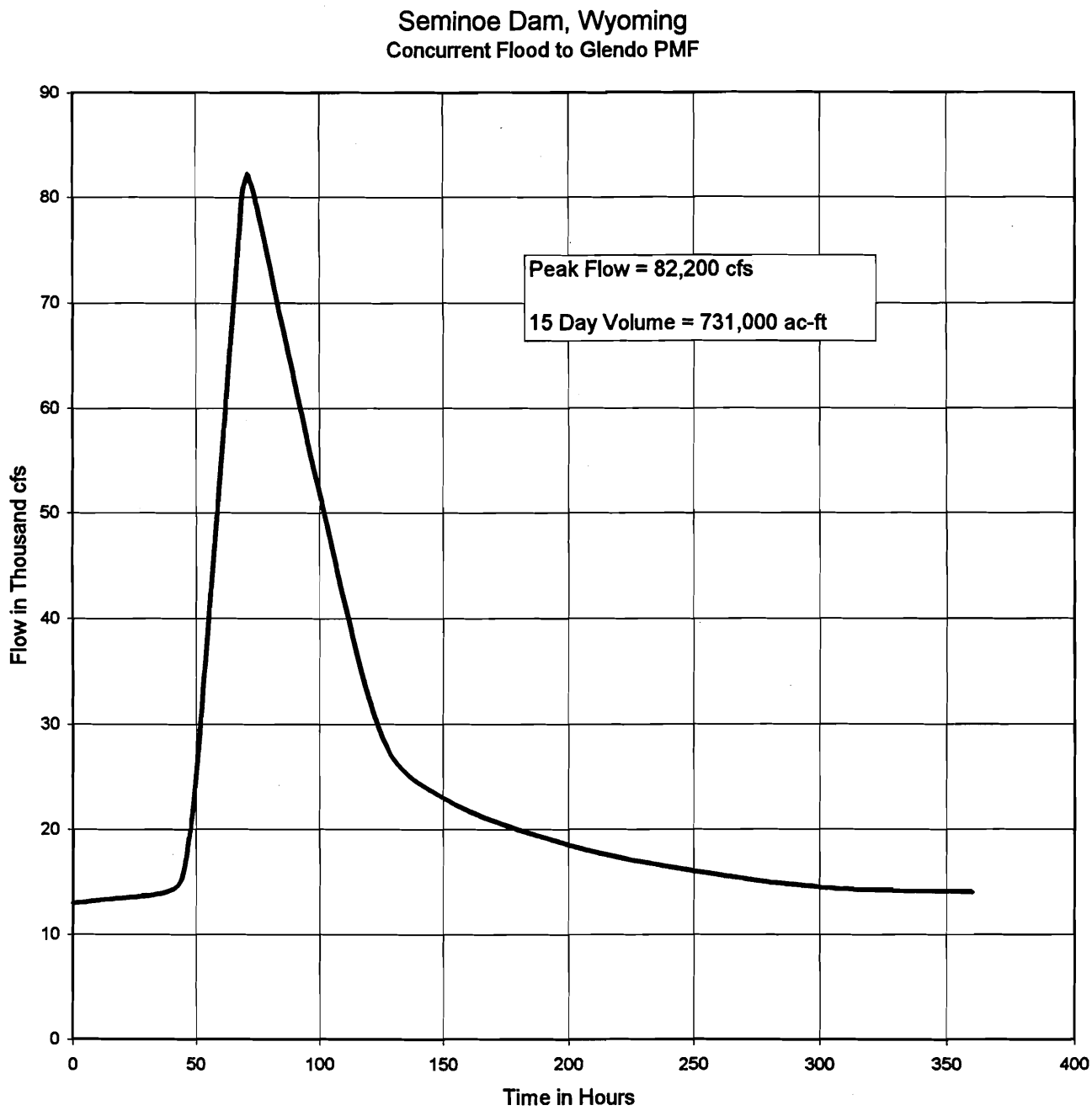
Water Control Manual
Glendo Dam and Reservoir, Colorado

Probable Maximum Flood

Intervening Area Between Pathfinder Dam and Seminoe Dam

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By: RH
Reviewed By: JC



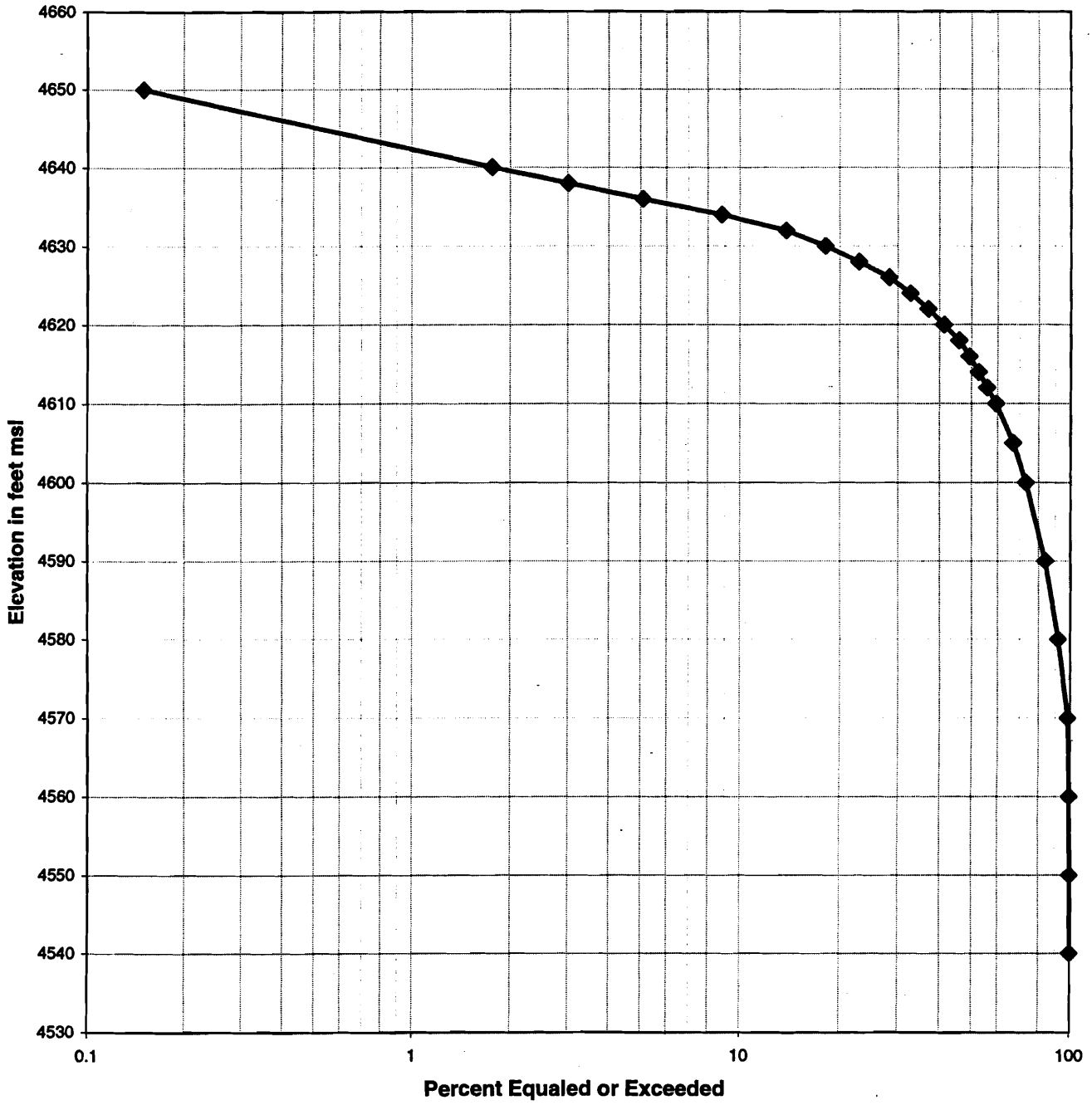
Water Control Manual
Glendo Dam and Reservoir, Colorado

Probable Maximum Flood

Above Seminoe Dam

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By: RH
Reviewed By: WJC



Note:
Curve represents all daily elevations from January 1, 1959 to December 31, 1997.

Water Control Manual
Glendo Dam and Reservoir, Colorado

Pool Elevation Duration Curve

U. S. Army Engineer District, Omaha
Corps of Engineers, Omaha, Nebraska
September 1997

Prepared By:
Reviewed By: