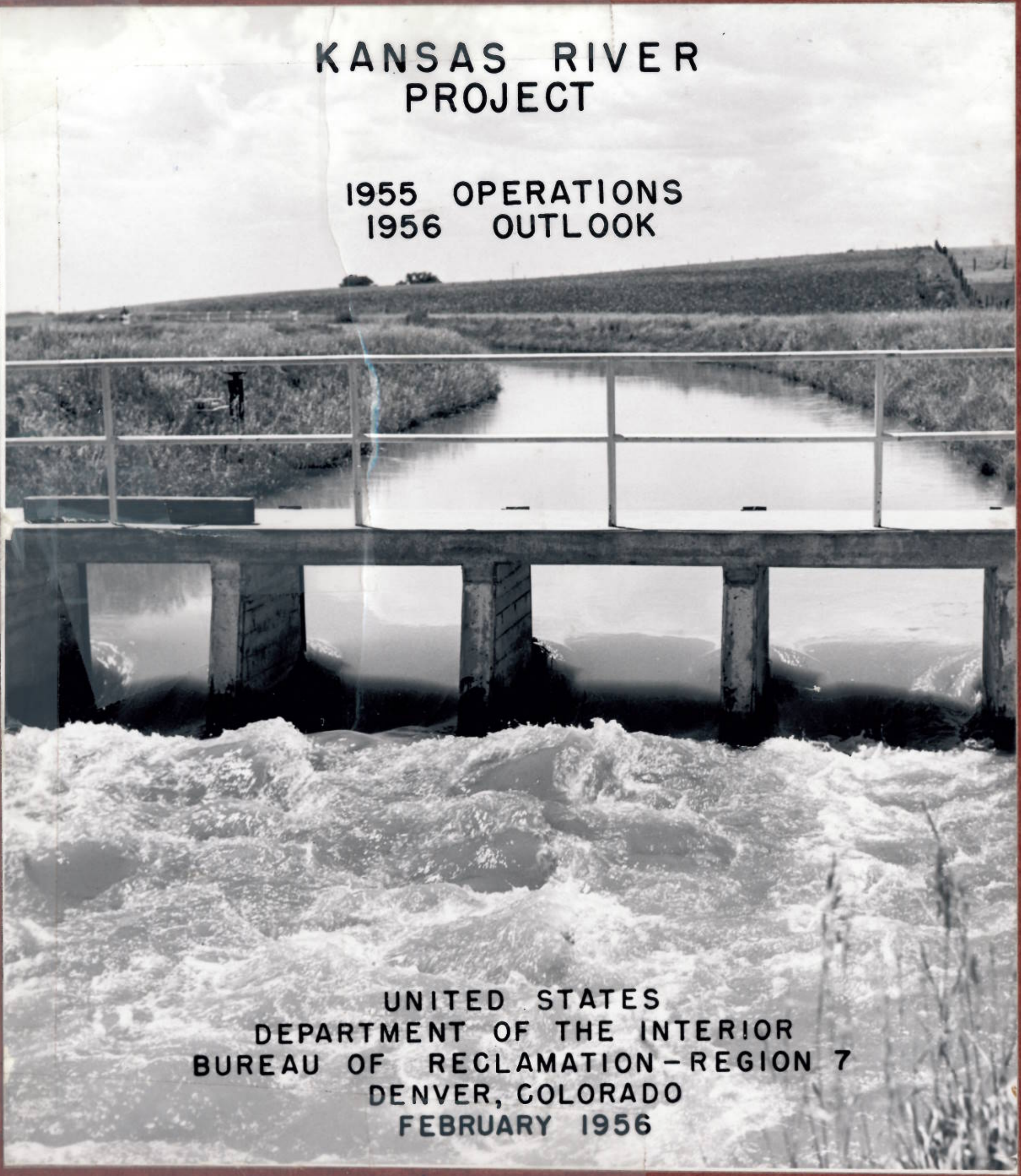


KANSAS RIVER PROJECT

1955 OPERATIONS
1956 OUTLOOK

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION – REGION 7
DENVER, COLORADO
FEBRUARY 1956

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

BUREAU OF RECLAMATION
Wilbur A. Dexheimer, Commissioner

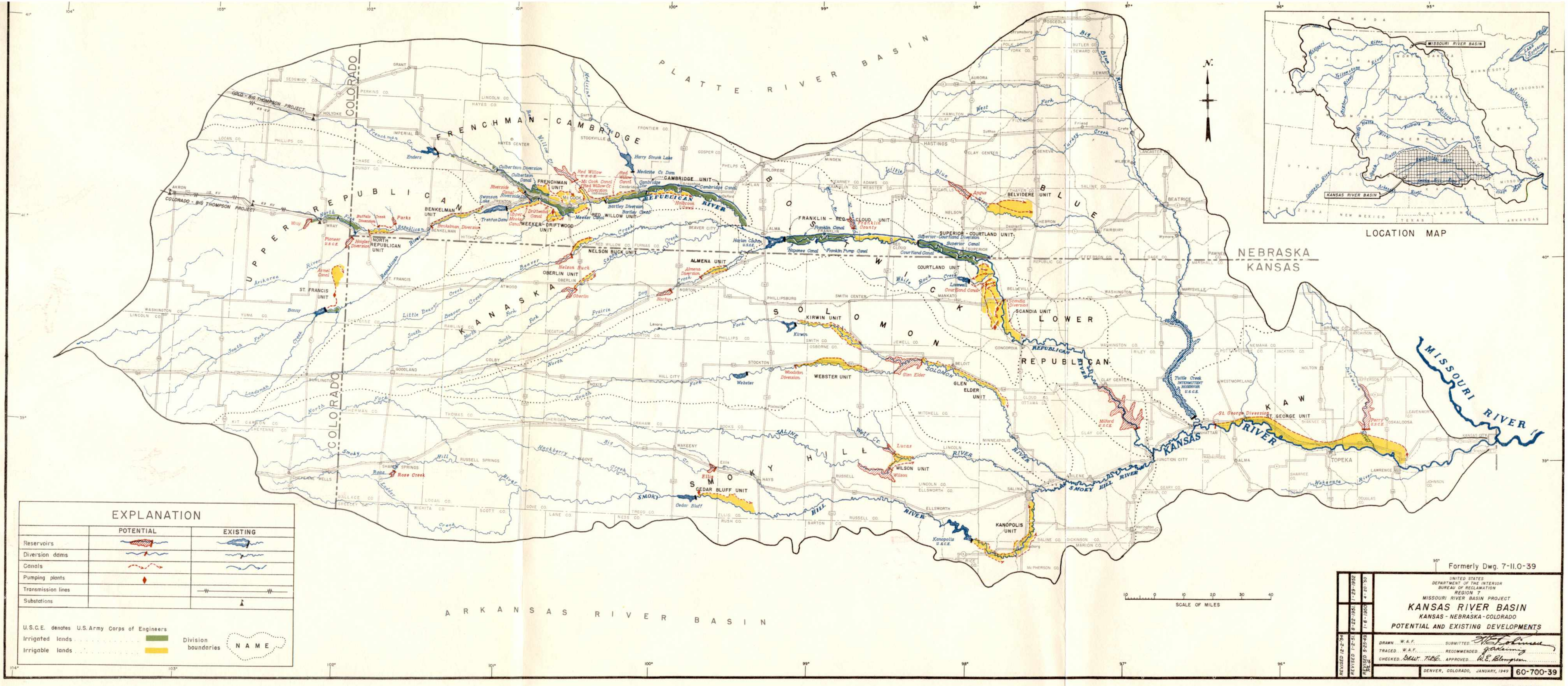
Region 7 - Denver, Colorado
Rudolph J. Walter, Jr., Regional Director

KANSAS RIVER PROJECT

1955 Operations
1956 Outlook

* * *

February 1956



Formerly Dwg. 7-11.0-39

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGION 7
MISSOURI RIVER BASIN PROJECT

KANSAS RIVER BASIN

KANSAS - NEBRASKA - COLORADO

POTENTIAL AND EXISTING DEVELOPMENTS

DRAWN W. A. F. SUBMITTED
TRACED W. A. F. RECOMMENDED J. A. Keimig
CHECKED Gew. NEC APPROVED W. E. Blomgren

REVISED 12-2-'54
REVISED 1-2-51. 8-22-1951. 1-29-1952
REVISED 5-25-49 1-6-1950 4-20-'50 PLG.

DENVER, COLORADO, JANUARY, 1949

60-700-39

GPO 835445

SYNOPSIS

Kansas River Project

1955 Operations

1956 Outlook

This is the third Annual Operating Plan for the Kansas River Units. The scope of the report is limited to irrigation and to other functions that are the responsibility of the Bureau of Reclamation. It does not include operational data on flood control that is the responsibility of the Corps of Engineers.

The report concerns primarily only those Federally constructed irrigation facilities in the Republican, Solomon, and Smoky Hill River drainage areas which were in operation during 1955 or are expected to be in operation during 1956. One part of the report is historical and gives the results of actual operations for the 1955 calendar year. Another part presents operational extimates for 1956. The operational data pertaining to Harlan County Reservoir, which was constructed and is operated by the Corps of Engineers, has been prepared with the cooperation of the Corps.

During 1955 irrigation water was delivered to approximately 29,000 acres under Bureau-operated irrigated systems, and supplemental water was delivered to about 15,000 acres under privately operated irrigation systems. Practically all of the acreages served were in the Republican River Basin. The inflow at all reservoirs, except Enders, was below average but there was an adequate water supply to meet all irrigation requirements. This was the fourth consecutive year in which the inflow to all reservoirs, except Enders, was below average. Reservoirs in operation during 1955 were Bonny, Swanson, Enders, Harry Strunk, Harlan County (operated by the Corps of Engineers), Kirwin, and Cedar Bluff. Kirwin Reservoir was placed in operation during September 1955.

It is anticipated that during 1956 approximately 37,300 acres will be irrigated under Bureau-operated irrigation systems. If it is a dry year, as much as 17,000 acres under privately operated irrigation systems may obtain supplemental water. Most of these areas will be in the Republican River Basin. No shortages of irrigatio water are expected, even for the most probable dry year. In addition to the seven reservoirs operated in 1955, one or two additional reservoirs are planned to be placed in operation in 1956. Closure at Webster Dam may be made about May 1, 1956, and closure at Lovewell Dam is expected the latter part of 1956 or the early part of 1957. Actual closure dates will depend upon the rate of construction and weather conditions.

KANSAS RIVER PROJECT

1955 OPERATIONS

1956 OUTLOOK

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CHAPTER I

INTRODUCTION

The Federally constructed reservoirs for the units of the Kansas River Project are operated in accordance with the general pattern of operating arrangements for multiple-purpose reservoirs throughout the Missouri River Basin. These arrangements, developed jointly by the Bureau of Reclamation and Corps of Engineers, provide that the Corps of Engineers will be primarily responsible for flood control operation, and the Bureau of Reclamation will be primarily responsible for irrigation. It is also agreed that whichever agency constructs and maintains a dam and reservoir will be primarily responsible for functional operation of the reservoir for purposes other than irrigation and flood control.

Purpose of Report

The purpose of this report is to advise the administrative staff, the water users, state officials, Corps of Engineers, and other interested agencies and persons of the annual operating plan for the Kansas River Units. It is hoped that this annual operating plan will provide a basis for cooperation and understanding among all concerned with operation of reservoirs in the Kansas River Units. This report is intended to deal only with the water supply and its uses for the various collateral purposes.

Included in the report are a review of 1955 operations and the plan of operation for 1956. The report deals primarily with reservoirs operated by the Bureau of Reclamation, reservoirs operated by the Corps of Engineers which are now used to supply irrigation water, and irrigation systems which receive irrigation water from these reservoirs.

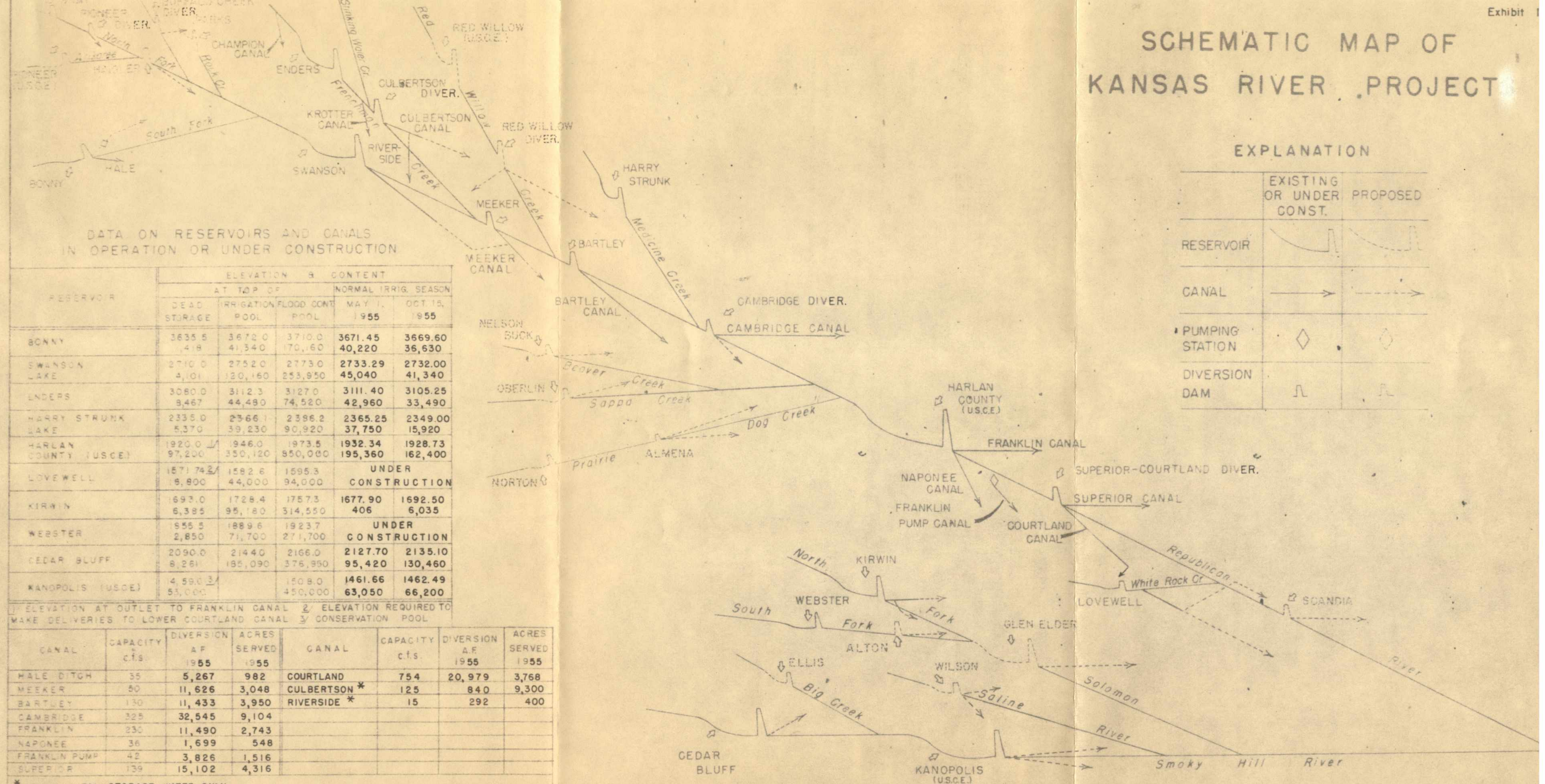
Location and Major Features

The Kansas River Units includes Federally constructed facilities in the Kansas River Basin for which the Bureau of Reclamatio is responsible for operation or from which irrigation water is supplied to irrigation systems. Existing and proposed irrigation and flood control facilities are shown on the location map of the Kansas River Basin (Frontispiece). A schematic map of the major features is presented in Exhibit 1 (page 2). All of the reservoirs (existing or proposed) are on tributaries of the Kansas River System, which drains approximately 60,000 square miles of the Great Plains Region of Colorado, Nebraska, and Kansas.

There are now eight reservoirs in operation. Six of these reservoirs, Bonny, Swanson Lake, Enders, Harry Strunk Lake, Kirwin and Cedar Bluff are operated by the Bureau of Reclamation. Two reservoirs, Harlan County and Kanopolis, are operated by the Corps of Engineers, however, Harlan County is the only one of these two

Exhibit

SCHEMATIC MAP OF KANSAS RIVER PROJECT



DATA ON RESERVOIRS AND CANALS IN OPERATION OR UNDER CONSTRUCTION

RESERVOIR	ELEVATION & CONTENT				
	AT TOP OF			NORMAL IRRIG. SEASON	
	DEAD STORAGE	IRRIGATION POOL	FLOOD CONT. POOL	MAY 1, 1955	OCT. 15, 1955
BONNY	3635.5 418	3672.0 41,340	3710.0 170,160	3671.45 40,220	3669.60 36,630
SWANSON LAKE	2710.0 4,101	2752.0 120,160	2773.0 253,950	2733.29 45,040	2732.00 41,340
ENDERS	3080.0 8,467	3112.3 44,480	3127.0 74,520	3111.40 42,960	3105.25 33,490
HARRY STRUNK LAKE	2335.0 5,370	2366.1 39,230	2386.2 90,920	2365.25 37,750	2349.00 15,920
HARLAN COUNTY (USCE)	1920.0 1/ 97,200	1946.0 350,120	1973.5 850,000	1932.34 195,360	1928.73 162,400
LOVEWELL	1571.74 2/ 16,800	1582.6 44,000	1595.3 94,000	UNDER CONSTRUCTION	
KIRWIN	1693.0 6,385	1728.4 95,180	1757.3 314,550	1677.90 406	1692.50 6,035
WEBSTER	1855.5 2,850	1889.6 71,700	1923.7 271,700	UNDER CONSTRUCTION	
CEDAR BLUFF	2090.0 8,261	2144.0 185,090	2166.0 376,950	2127.70 95,420	2135.10 130,460
KANOPOLIS (USCE)	1459.0 3/ 53,000		1508.0 450,000	1461.66 63,050	1462.49 66,200

1/ ELEVATION AT OUTLET TO FRANKLIN CANAL 2/ ELEVATION REQUIRED TO MAKE DELIVERIES TO LOWER COURTLAND CANAL 3/ CONSERVATION POOL

CANAL	CAPACITY c.f.s.	DIVERSION A.F. 1955	ACRES SERVED 1955	CANAL	CAPACITY c.f.s.	DIVERSION A.F. 1955	ACRES SERVED 1955
HALE DITCH	35	5,267	982	COURTLAND	754	20,979	3,768
MEEKER	50	11,626	3,048	CULBERTSON *	125	840	9,300
BARTLEY	130	11,433	3,950	RIVERSIDE *	15	292	400
CAMBRIDGE	325	32,545	9,104				
FRANKLIN	230	11,490	2,743				
NAPONEE	36	1,699	548				
FRANKLIN PUMP	42	3,826	1,516				
SUPERIOR	139	15,102	4,316				

*SUPPLEMENTAL STORAGE WATER ONLY

which is now used to supply irrigation water. Reservoirs which will be formed by two dams now under construction, Webster and Lovewell, will be operated by the Bureau of Reclamation. The storage allocations for these reservoirs are shown in Exhibit 1 (page 2).

The location map (Frontispiece) divides the areas of the Kansas River Basin into divisions. Facilities in the divisions with which the Bureau of Reclamation was concerned in 1955, or will be concerned with in 1956, are described under the following discussions of each division.

Upper Republican Division

Bonny Reservoir, on the South Fork of the Republican River near Hale, Colorado, is the only reservoir that has been constructed in this division. It provides the natural flow and supplemental water to the privately owned and operated Hale Ditch. About 745 acres received supplemental water in 1954. It is expected that eventually a total of 6,750 acres will be served from Bonny Reservoir.

Frenchman-Cambridge Division

Three reservoirs are in operation in the Frenchman-Cambridge Division. Swanson Lake, on the Republican River near Trenton, Nebraska, has supplied supplemental water to about 400 acres under the Riverside Canal (non-government operated). Supplemental water charged to the Riverside Canal on Frenchman Creek, is to replace natural flow belonging to the Meeker Canal, on the Republican River, but taken out of priority by irrigators under the Riverside Canal. Storage water was also supplied to the Meeker Canal which is operated by the Bureau of Reclamation, and to about 630 acres of pump rights on Red Willow Creek which took water out of priority of Bartley Canal. Approximately 3,950 acres were served under the Bartley Canal. Although some releases to Bartley Canal came from Enders, the normal operating procedure, until Red Willow Dam is constructed, will be to serve all of the Bartley Canal from Swanson Lake. Bartley Canal completed in 1954 by the Bureau of Reclamation has been constructed to serve a total of 6,503 acres. The diversion point for the Meeker Canal will by moved from its present location below the mouth of Frenchman Creek to a diversion point at Trenton Dam (Swanson Lake) as soon as the Meeker-Driftwood Canal system, now under construction, is completed. The completion date is expected about May 1959. The acreage to be served by this canal (including about 3,000 acres under the present Meeker Canal) will be about 16,440 acres.

Enders Reservoir, on Frenchman Creek near Enders, Nebraska, has supplied supplemental water to approximately 9,300 acres under the Culbertson Canal. This canal is privately owned and operated. Also supplemental water has been supplied to about 3,160 acres under private pumps on Frenchman Creek and on Stinking Water Creek. Supplemental water charged to users on Stinking Water Creek is to replace natural flow claimed by the Culbertson Canal on Frenchman Creek, but taken out of priority by irrigators on Stinking Water Creek. Releases can also be made from Enders Reservoir to serve Meeker Canal and Bartley Canal; however, during normal operations, releases for these canals will come from Swanson Lake. The over-all plan of development, using Enders Reservoir, calls for a total of 22,910 acres to be served by renovated and extended Culbertson and Riverside Canals and by private pumps.

Harry Strunk Lake, on Medicine Creek about nine miles upstream from Cambridge, Nebraska, was used to serve 9,104 acres under the Cambridge Canal and approximately 725 acres under private pumps. Cambridge Canal, completed in 1954 by the Bureau of Reclamation, was planned to serve a total of 15,076 acres.

Bostwick Division

Most of the Bostwick Division will be served storage water from Harlan County Reservoir, on the Republican River near Republican City, Nebraska. Harlan County Dam was constructed by the Corps of Engineers and the Reservoir is operated by them.

Two canals, Franklin and Naponee, divert directly out of the Reservoir. Franklin Canal, was used to irrigate 2,743 acres in 1955. It is scheduled for completion about April 1956. It is planned that 11,987 acres will eventually be served under the canal. Naponee Canal was completed by the Bureau of Reclamation in 1954 to serve a total of 1,544 acres. The canal was used for the first time for irrigation purposes in 1955 to serve 548 acres.

Franklin Pump Canal has a pump diversion about 21 miles below Harlan County Dam. The canal is planned to serve 2,070 acres, however, only 1,516 acres were irrigated in 1955.

The Superior-Courtland Diversion Dam, constructed by the Bureau fo Reclamation, is on the Republican River about sixty river miles below Harlan County Dam. This serves as a diversion point for two canals, Superior and Courtland. The Superior Canal has been completed by the Bureau of Reclamation and is designed to serve 6,069 acres. The maximum acreage served to date was 4,316 acres in 1955. The Courtland Canal in Nebraska has been completed to serve 2,573 acres, but only 1,383 acres were irrigated in 1955. That portion in Kansas between the state line and White Rock Creek (Lovewell Reservoir) will not be completed until May 1956; however, part of the canal system was used to irrigate 2,385 acres in Kansas in 1955.

Lowewell Dam, on White Rock Creek near Lovewell, Kansas, is now under construction by the Bureau of Reclamation. The dam is scheduled for completion about April 1957. That portion of the Courtland Canal extending south of Lovewell Reservoir is scheduled for completion about December 1957. Approximately 49,000 acres are planned to be irrigated under the Courtland Canal in Kansas.

Solomon Division

Kirwin Dam, on the North Fork of the Solomon River at Kirwin, Kansas, was completed by the Bureau of Reclamation in October 1955. The canal system now under construction is scheduled for completion in April 1958. The system is planned to serve 10,000 acres.

Webster Dam, on the South Fork of the Solomon River at Webster Kansas, is under construction and is scheduled for completion in May 1956. No construction has been started on the irrigation system to be served from the reservoir.

Smoky Hill Division

Cedar Bluff Reservoir is on the Smoky Hill River about 15 miles southeast of Ellis, Kansas. No construction has been started on the irrigation system to be served from the reservoir. However, in the past water has been released for municipal use by the city of Russell, Kansas. The city pumps are located about 44 river miles below Cedar Bluff Dam. Also very small amounts of releases have been pumped at a point about six miles below the dam for use on an irrigation development farm.

Coordination of Operations

The planning of irrigation systems in the Kansas River Projects has been carried on with the general objective that a basin type of operation would be needed after completion of all of the irrigation systems. The Bureau of Reclamation's plan of development for a basin plan of operation provides that storage reservoirs will be used to equalize the water supply so that shortages will be reduced to a minimum and the water will be equally shared, insofar as possible, by all lands having storage contracts for water. In order to provide maximum benefits throughout the Kansas River Basin the water supply studies for the various irrigation projects made the maximum use of sectional gains. Requirements not met by sectional gains were then met by reservoir releases.

The use of water by the various irrigation systems of the Kansas River Units is based on the concept that the Federal Government will control the stored water in the reservoirs, built or to be built by the Government, to the extent that such storage water can be administered to supplement natural flow so that all areas proposed for development will share the available water supply. The repayment contracts of the various irrigation districts are worded to accomplish this objective.

The operations of multi-purpose reservoirs in which both the Bureau of Reclamation and the Corps of Engineers have an interest are governed by reservoir operating agreements between the two agencies. These agreements set up operating criteria to be used under various operating conditions. The primary purposes of these multiple-purpose reservoirs are irrigation and flood control. Insofar as is practical and consistent with state irrigation laws, efforts are made to operate the reservoirs in such a manner as to satisfy requirements for stream pollution abatement, fish and wildlife interest and recreational interest.

An exchange of information by radio and telephone during routine and emergency conditions, among the Corps of Engineers, the Geological Survey, the Weather Bureau, State Water Commissioners, and the Bureau of Reclamation is of considerable importance in coordinating the operation of the various irrigation systems of the Kansas River Basin which are included in the Kansas River Units.

The Corps of Engineers exchange daily information with the Bureau of Reclamation on existing weather conditions and reservoir operations. During emergencies constant contact is maintained between critical control points.

The Geological Survey operates the stream-gaging stations to measure inflow and outflow of the reservoirs in the Kansas River Project area.

The Weather Bureau supplies routine weather forecasts and special forecasts of runoff that may affect irrigation operations. The use of radar in spotting the location of severe storms and estimating runoff from them has greatly speeded up the channeling of such information to the Kansas River Project Office in McCook, Nebraska. The radar stations at North Platte, Nebraska and at Goodland, Kansas have been quite helpful in this.

State Water Commissioners are a necessity in keeping all irrigation operators within the limits of state laws.

Development of Annual Operating Plan

In order to obtain maximum utilization of the water supply in a complicated multiple-purpose system of development, it is necessary to plan the operations which can be expected by budgeting an anticipated water demand against an anticipated water supply. During the early stages of development in the Kansas River Project the plan of development may not be so complicated or difficult; however, each year of added development will tend to increase the necessity for a plan of operation.

Water rights to natural flow senior to irrigation projects planned by the Bureau of Reclamation already complicates, to a certain extent, existing operations. Also non-government operated projects with water rights junior to Bureau sponsored projects have during the past four years requested to buy supplemental storage water. In order to determine if surplus water will be available next year for these junior rights, it is necessary to make operational studies based on anticipated conditions.

CHAPTER II

SUMMARY OF 1955 OPERATIONS

The year 1955 was one of the driest on record at reservoirs in the Kansas River Project area and in some cases was even drier than 1954. Inflow at Webster Reservoir was the lowest on record. Inflow at all of the other reservoirs, except Enders Reservoir, was below normal for the fourth consecutive year. (See Table 1, page 8, and Exhibits 2 and 3, pages 9 and 10.)

The precipitation at the dams during the 1955 irrigation season, May through October, ranged from 62 percent of normal at Trenton Dam (Swanson Lake) to 96 percent of normal at Harlan County Dam. The inflow for the same six months' period ranged from 15 percent of normal at Webster Reservoir to 107 percent of normal at Cedar Bluff Reservoir. See Table 2, hydrologic data for 1955 irrigation season (May through October), page 11.

Irrigation under Bureau-operated Units was limited in 1955 to areas in the Republican River Basin. No shortages of irrigation water were experienced. Table 3 (pages 12 - 14) lists the monthly diversion by the various canals and Exhibits 4 and 5 (pages 15 and 16) show the cumulative monthly diversions during 1955. A total of about 29,000 acres was irrigated under Bureau-operated Units during 1955 and approximately 15,000 acres of land not under Bureau-operated projects received supplemental water.

Table 4 (pages 17-19) shows the monthly inflow, outflow and reservoir content at each of the reservoirs. The amount of storage releases indicated in Table 4 was computed on a daily basis by determining the amount which the mean daily outflow exceeded the mean daily inflow. These daily values were added to give monthly totals. Stream flow records at inflow and outflow gages were used in these computations. A graph indicating reservoir content at each reservoir is shown in Exhibits 6 and 7 (pages 20 and 21). Total annual inflows at all reservoirs during the entire periods of record are shown in Exhibits 8 through 15 (pages 35 - 42).

Exhibit 1 (page 2) is a schematic drawing of the Units in the Kansas River Project area. This exhibit also contains a table listing important operational data including reservoir contents at the start and end of the 1955 irrigation season.

Upper Republican Division

At Bonny Reservoir natural flow rights were observed and supplemental water was supplied to the Hale Ditch during 1955. A total of 5,267 acre-feet was released for 982 acres. Part of the acreage was on land above the canal and was served by sprinklers.

TABLE 1

INFLOW INTO RESERVOIRS - 1955 RECORDS, 1956 ESTIMATES

	1000 Acre-Feet				
	1955 Records		1956 Estimates 2/		
Reservoir	Actual	Adjusted 1/	Reasonable Minimum	Most Probable	Reasonable Maximum
Bonny	28.5		18.5	26.2	42.0
Swanson Lake	87.9	91.5	68.0	119.0	205.0
Enders	51.3		42.8	49.3	57.2
Harry Strunk Lake	37.4		33.0	51.7	82.0
Harlan County	100.2	203.4	260.0	455.6	780.0
Kirwin	23.1 3/		17.0	38.1	115.0
Webster	8.7 4/		12.5	33.9	98.0
Cedar Bluff	56.7		12.4	36.9	138.0

1/ Adjusted by adding upstream depletions caused by reservoirs and canals in Missouri River Basin Projects.

2/ Values determined from inflow frequency curve. A value of 90% on curve = reasonable minimum conditions, 50% = most probable conditions, and 10% = reasonable maximum conditions.

3/ Storage commenced on September 19, 1955.

4/ No storage during 1955. Expect storage to commence about May 1, 1956.

Exhibit 2

INFLOW TO RESERVOIRS

(UPPER REPUBLICAN AND FRENCHMAN-CAMBRIDGE DIVISIONS)

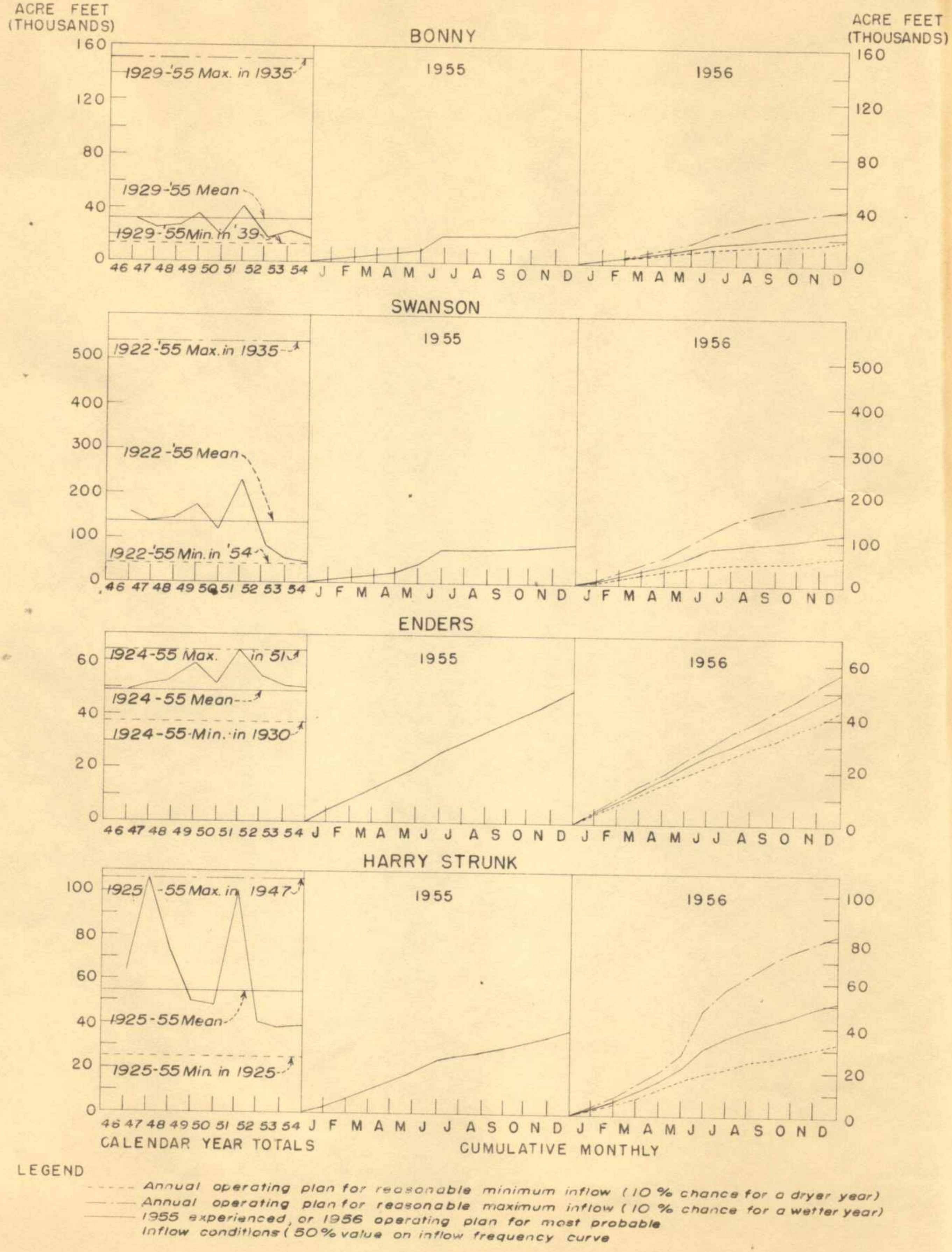
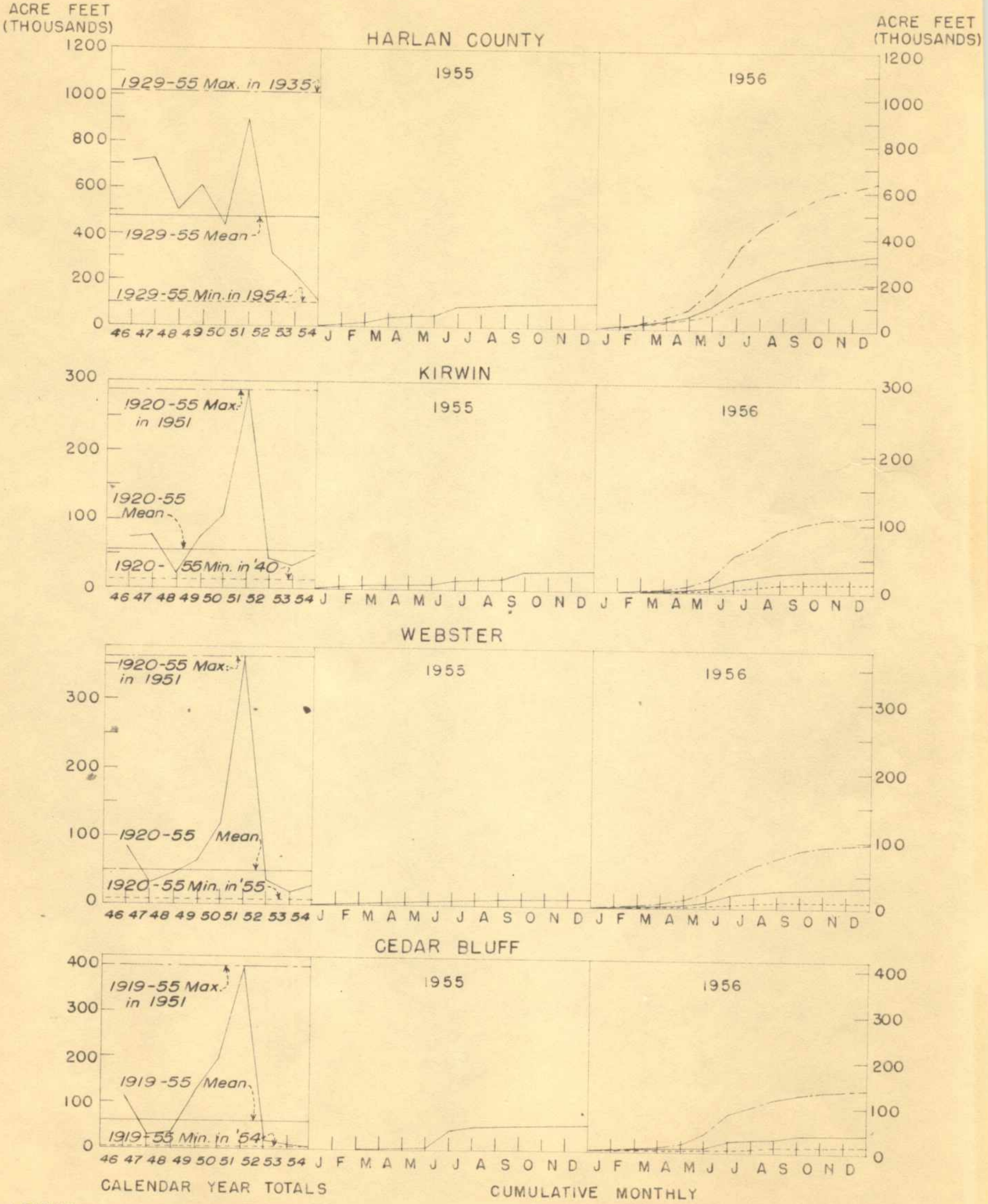


Exhibit 3

INFLOW TO RESERVOIRS

(BOSTWICK, SOLOMON, AND SMOKY HILL DIVISIONS)



LEGEND

Annual operating plan for reasonable minimum inflow (10% chance for a dryer year).
Annual operating plan for reasonable maximum inflow (10% chance for a wetter year).
1955 experienced, or 1956 operating plan for most probable inflow conditions (50% value on inflow frequency curve).

TABLE 2

HYDROLOGIC DATA FOR 1955 IRRIGATION SEASON (MAY THROUGH OCTOBER)

PRECIPITATION (PERCENT OF NORMAL) 1/

	Reservoir							
MONTH	Bonny (Burlington, Colorado)	Swanson (Culbertson, Nebraska)	Enders (Imperial, Nebraska)	H. Strunk (Cambridge, Nebraska)	Harlan Co. (Alma, Nebraska)	Kirwin (Phillipsburg, Kansas)	Webster (Stockton, Kansas)	Cedar Bluff (Wakeeney, Kansas)
May	126	110	121	58	103	107	106	170
June	84	60	46	111	186	115	67	83
July	9	8	20	28	28	25	65	66
August	36	48	59	53	22	23	94	29
September	58	132	166	138	194	167	127	121
October	112	10	18	15	8	16	9	13
Period May to October	66	62	70	71	96	82	83	88

1/ The records at the reservoirs compared to normals of indicated nearby stations.

INFLOW (PERCENT OF NORMAL)

MONTH	Bonny	Swanson	Enders	H. Strunk	Harlan Co.	Kirwin	Webster	Cedar Bluff
May	59	114	89	82	53	7	2	51
June	198	125	123	50	53	44	11	204
July	21	4	111	33	3	27	0	106
August	18	1	111	35	0	11	0	18
September	0	0	103	43	14	177 8.5	100	48
October	237	38	87	71	0	10	11	8
Period May to October	95	72	104	53	32	42	15	107

TABLE 3

CANAL DIVERSIONS AND ACRES IRRIGATED - 1955
(ABOVE HARLAN COUNTY RESERVOIR)

Canal	Month	Total Diversions (A.F.)	Supplemental Storage (A.F.)
Hale Ditch 1/	Apr.	271	0
	May	966	0
(982 Ac. Total)	June	879	0
	July	972	105
(745 Ac. Supplemental Storage)	Aug.	728	401
	Sept.	653	308
	Oct.	518	0
	Nov.	280	0
	Total	5,267	814
Private Pumps and Canals 3/	May	-	162
	June	-	0
	July	-	372
(14,214 Ac. Supplemental Storage)	Aug.	-	1,756
	Sept.	-	284
	Total		2,574
Meeker Canal	May	1,934	8
(3,048 Ac. Total)	June	1,180	0
	July	2,715	208
(882 Ac. Supplemental Storage)	Aug.	2,997	299
	Sept.	2,122	67
	Oct.	678	0
	Total	11,626	582
Bartley Canal	May	1,105	
	June	539	
(3,950 Ac.)	July	3,533	
	Aug.	4,693	
	Sept.	1,311	
	Oct.	252	
	Total	11,433	
Cambridge Canal	Apr.	147	
	May	3,646	
	June	1,928	
(9,104 Ac.)	July	10,058	
	Aug.	11,996	
	Sept.	4,181	
	Oct.	589	
	Total	32,545	

1/ Hale Ditch diverts water directly out of Bonny Reservoir.

2/ Supplemental storage delivered under Warren Act Contracts to non-government-operated irrigation systems and to Meeker Canal to supplemental natural flow rights.

3/ Includes Culbertson Canal, Riverside Canal, and pump irrigators.

TABLE 3 (Cont.)

CANAL DIVERSIONS AND ACRES IRRIGATED - 1955
(BELOW HARLAN COUNTY RESERVOIR)

Canal	Month	Total Diversions (A.F.)	Supplemental Storage (A.F.)
Franklin Canal	May	1,426	
	June	946	
(2,743 Ac.)	July	3,098	
	Aug.	4,534	
	Sept.	1,486	
	Total	11,490	
Naponee Canal	May	202	
	June	29	
(548 Ac.)	July	441	
	Aug.	728	
	Sept.	299	
	Total	1,699	
Franklin Pump Canal	May	470	
	June	0	
(1,516 Ac.)	July	827	
	Aug.	1,987	
	Sept.	542	
	Total	3,826	
Superior Canal	Apr.	135	
	May	2,485	
(4,316 Ac.)	June	619	
	July	3,816	
	Aug.	6,339	
	Sept.	1,656	
	Oct.	50	
	Total	15,100	
Private Pump	May	-	21
	June	-	0
(70 Ac. Supplemental Storage)	July	-	0
	Aug.	-	33
	Sept.	-	10
	Total	-	64

TABLE 3 (Cont.)

CANAL DIVERSIONS AND ACRES IRRIGATED - 1955
(BELOW HARLAN COUNTY RESERVOIR)

Canal	Month	Diversions (A.F.) Total	Nebr. 1/	Kans.
Courtland Canal	May	2,729	1,821	908
	June	2,376	740	1,636
(3,768 Ac. Total)	July	4,423	1,635	2,788
(1,383 Ac.-Nebr.)	Aug.	8,357	1,963	6,394
(2,385 Ac.-Kans.)	Sept.	3,094	446	2,648
	Total	20,979	6,605	14,376

(Below Cedar Bluff Reservoir)

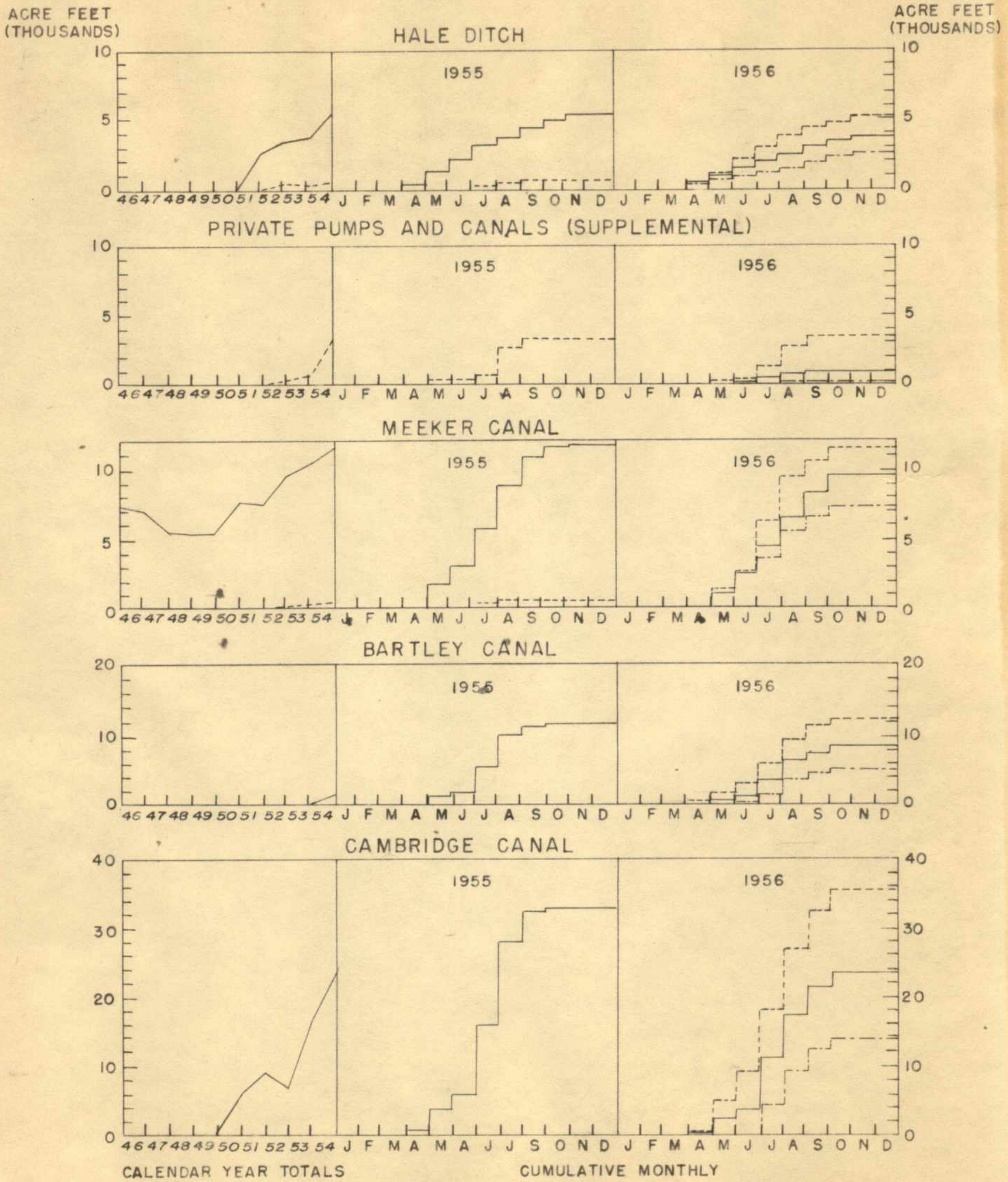
Kutina Development Farm	Month	Diversions (A.F.)
Pump Diversion	May	11.1
	June	2.0
(76.1 Ac.)	July	45.1
	Aug.	82.3
	Sept.	23.1
	Total	163.6

1/ Total diversion less flow passing Nebraska-Kansas state line.

Exhibit 4

IRRIGATION DIVERSIONS

(UPPER REPUBLICAN AND FRENCHMAN-CAMBRIDGE DIVISIONS)



LEGEND -------- *Supplemental storage deliveries prior to 1956, or 1956 operating plan under reasonable minimum inflow conditions.*

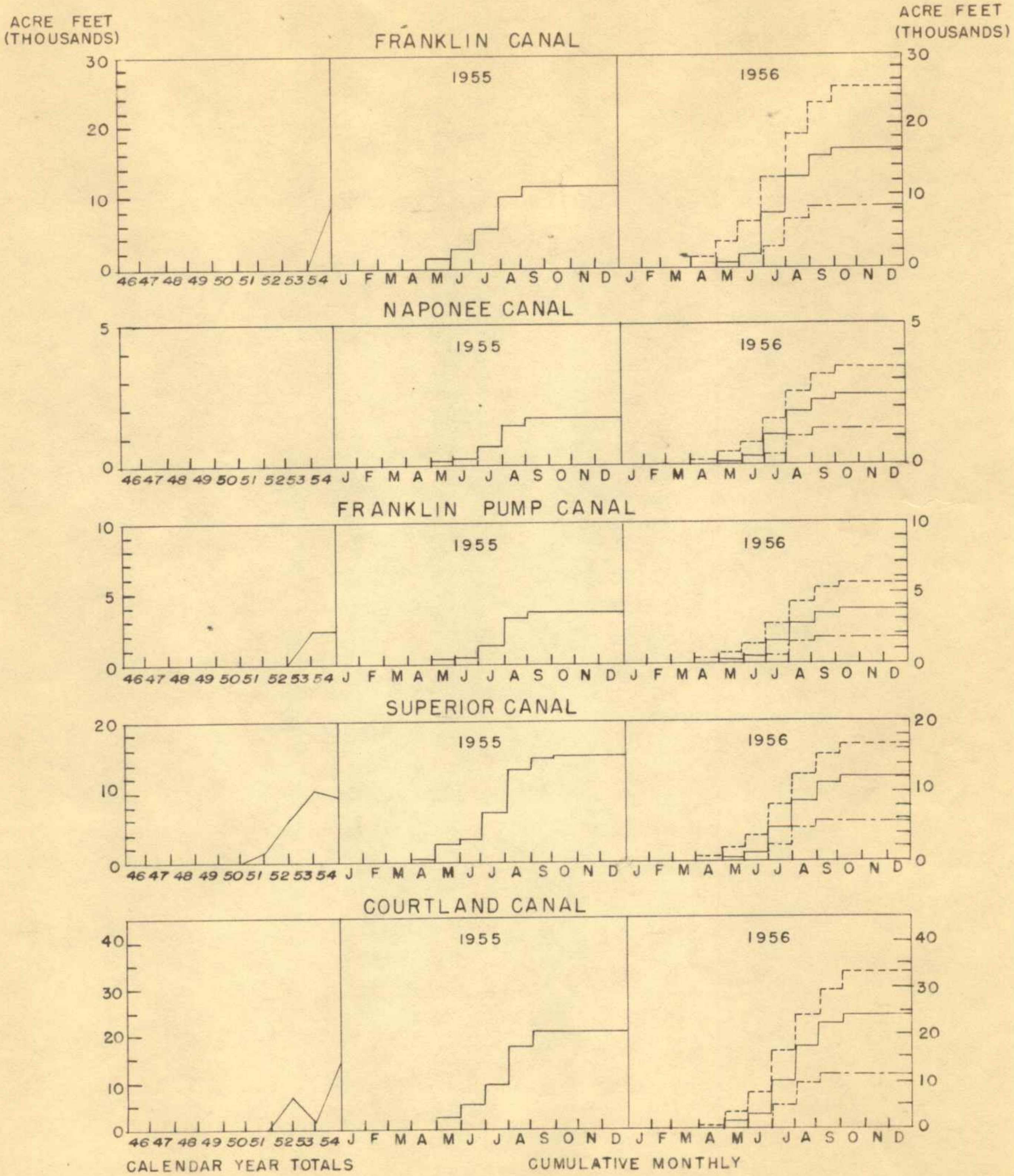
—.— *Annual operating plan under reasonable maximum inflow conditions.*

——— *1955 experienced, or 1956 operating plan under most probable inflow conditions.*

Exhibit 5

IRRIGATION DIVERSIONS

(BOSTWICK DIVISION)



LEGEND

----- *Annual operating plan under reasonable minimum inflow conditions.*

—.— *Annual operating plan under reasonable maximum inflow conditions.*

——— *1955 experienced, or 1956 operating plan under most probable inflow conditions.*

TABLE 4

RESERVOIR OPERATIONS DURING 1955

1000 Acre-feet

					Use of Storage Releases (Approx.)		
Reservoir	Month	Res. Inflow	Res. Outflow	Res. Cont. at End of Mo.	Div. for Irrig.	Other Uses	Total
	Dec. (1954)	-	-	35.6	-	-	-
Bonny	Jan. (1955)	2.1	0.4	37.4	0	0	0
	Feb.	2.1	0.4	38.6	0	0	0
	Mar.	1.8	0.4	39.8	0	0	0
	Apr.	1.1	0.7	40.2	0	0.3	0.3
	May	3.4	2.4	41.4	0	0.8	0.8
	June	9.5	8.7	44.3	0	5.5	5.5
	July	0.5	4.8	38.4	0.1	4.2	4.3
	Aug.	0.4	1.1	36.3	0.4	0.6	1.0
	Sept.	0	1.0	34.6	0.3	0.7	1.0
	Oct.	3.8	2.2	36.3	0	0.9	0.9
	Nov.	1.8	3.1	34.6	0	1.5	1.5
	Dec.	2.0	0.8	35.8	0	0	0
	Total	28.5	26.0		0.8	14.5	15.3
Swanson	Dec. (1954)	-	-	25.7	-	-	-
Lake	Jan. (1955)	4.6	0.5	29.2	0	0	0
	Feb.	5.8	0.5	34.1	0	0	0
	Mar.	8.2	0.5	40.9	0	0	0
	Apr.	6.2	0.5	45.0	0	0	0
	May	22.4	3.2	56.1	1.0	1.3	2.3
	June	26.0	0.5	73.9	0	0	0
	July	4.6	11.4	62.5	4.1	5.3	9.4
	Aug.	0.4	13.1	48.2	5.9	6.9	12.8
	Sept.	0	4.9	42.0	1.6	3.3	4.9
	Oct.	0.9	0.6	40.7	0	0	0
	Nov.	4.5	0.3	43.1	0	0	0
	Dec.	4.3	0.3	46.6	0	0	0
	Total	87.9	36.3		12.6	16.8	29.4
	Dec. (1954)	-	-	38.8	-	-	-
Enders	Jan. (1955)	5.1	0.6	42.4	0	0	0
	Feb.	4.4	1.5	44.6	0	0	0
	Mar.	4.4	4.9	43.5	0	0.4	0.4
	Apr.	3.4	3.6	43.0	0	0.1	0.1
	May	3.9	4.7	41.6	0.2	0.6	0.8
	June	5.8	3.0	43.5	0	0	0
	July	4.0	6.7	39.8	0.4	2.1	2.5
	Aug.	4.0	7.0	36.0	1.8	0.6	2.4
	Sept.	3.9	5.1	34.3	0.5	0.4	0.9
	Oct.	3.4	4.2	33.1	0	0.6	0.6
	Nov.	4.1	1.8	34.7	0	0	
	Dec.	4.9	1.8	37.5	0	0	
	Total	51.3 1/	44.9		2.9	4.8	7.7

1/ Includes only the flow passing the Imperial Gaging Station.

TABLE 4 (Cont.)

RESERVOIR OPERATIONS DURING 1955

1000 Acre-feet

					Use of Storage Releases		
						(Approx.)	
Reservoir	Month	Res. Inflow	Res. Outflow	Res. Cont. at End of Mo.	Div. for Irrig.	Other Uses	Total
	Dec. (1954)	-	-	28.2	-	-	-
Harry Strunk Lake	Jan. (1955)	3.6	0.4	30.9	0	0	0
	Feb.	3.6	0.3	33.6	0	0	0
	Mar.	4.3	1.5	35.6	0	0.2	0.2
	Apr.	3.4	0.3	37.7	0	0	0
	May	4.9	2.6	38.9	0.7	0	0.7
	June	5.1	10.0	38.5	0.5	6.2	6.7
	July	1.7	11.8	28.4	9.2	1.0	10.2
	Aug.	1.3	12.8	17.2	10.9	0.7	11.6
	Sept.	1.5	3.8	15.1	2.7	0	2.7
	Oct.	2.5	0.6	16.8	0	0	0
	Nov.	2.7	0.4	19.2	0	0	0
	Dec.	2.8	0.3	21.9	0	0	0
	Total	37.4	44.8		24.0	8.1	32.1
	Dec. (1954)	-	-	160.0	-	-	-
Harlan County	Jan. (1955)	4.8	0.6	163.9	0	0	0
	Feb.	8.3	0.7	172.6	0	0	0
	Mar.	17.8	0.8	189.1	0	0	0
	Apr.	10.2	1.0	195.1	0	0	0
	May	4.4	10.5	186.6	6.0	1.8	7.8
	June	37.2	3.2	221.8	0	0	0
	July	4.3	18.5	202.0	12.2	2.8	15.0
	Aug.	0.3	30.1	168.9	21.2	8.7	29.9
	Sept.	4.8	10.4	163.8	5.7	3.9	9.6
	Oct.	0.5	0.6	160.6	0.1	0.3	0.4
	Nov.	4.1	0.5	161.0	0	0	0
	Dec.	3.5	0.5	163.3	0	0	0
	Total	100.2	77.4		45.2	17.5	62.7

TABLE 4 (Cont.)

RESERVOIR OPERATIONS DURING 1955

1000 Acre-feet

					Use of Storage Releases (Approx.)		
Reservoir	Month	Res. Inflow	Res. Outflow	Res. Cont. at End of Mo.	Div. for Irrig.	Other Uses	Total
Kirwin	Sept. 18	-	-	0.3	-	-	-
	Sept. 19-30	8.5	0.1	6.3 1/	0	0.1	0.1
	Oct.	0.3	0	6.2	0	0	0
	Nov.	0.1	0	6.0	0	0	0
	Dec.	0.1	0	6.0	0	0	0
	Total	9.0	0.1		0	0.1	0.1
	Dec. (1954)	-	-	96.3	-	-	-
Cedar Bluff	Jan. (1955)	0	0.2	94.8	0	0.2	0.2
	Feb.	0	0	94.6	0	0	0
	Mar.	0	0	94.2	0	0	0
	Apr.	0.8	0	95.4	0	0	0
	May	3.7	0.4	100.5	0.2	0.1	0.3
	June	39.3	0.2	136.2	0	0	0
	July	8.7	0.8	139.3	0.2	0	0.2
	Aug.	1.6	1.6	134.3	0.6	0.2	0.8
	Sept.	2.2	1.0	131.5	0.8	0.2	1.0
	Oct.	0.3	0	129.4	0	0	0
	Nov.	0.1	0	127.8	0	0	0
	Dec.	0	0	127.0	0	0	0
	Total	56.7	4.2		1.8	0.7	2.5

1/ Storage was commenced on September 19, 1955. Previous storage amounts were caused by ponding during construction and bypass of inflow.

Exhibit 6

RESERVOIR STORAGE

(UPPER REPUBLICAN AND FRENCHMAN-CAMBRIDGE DIVISIONS)

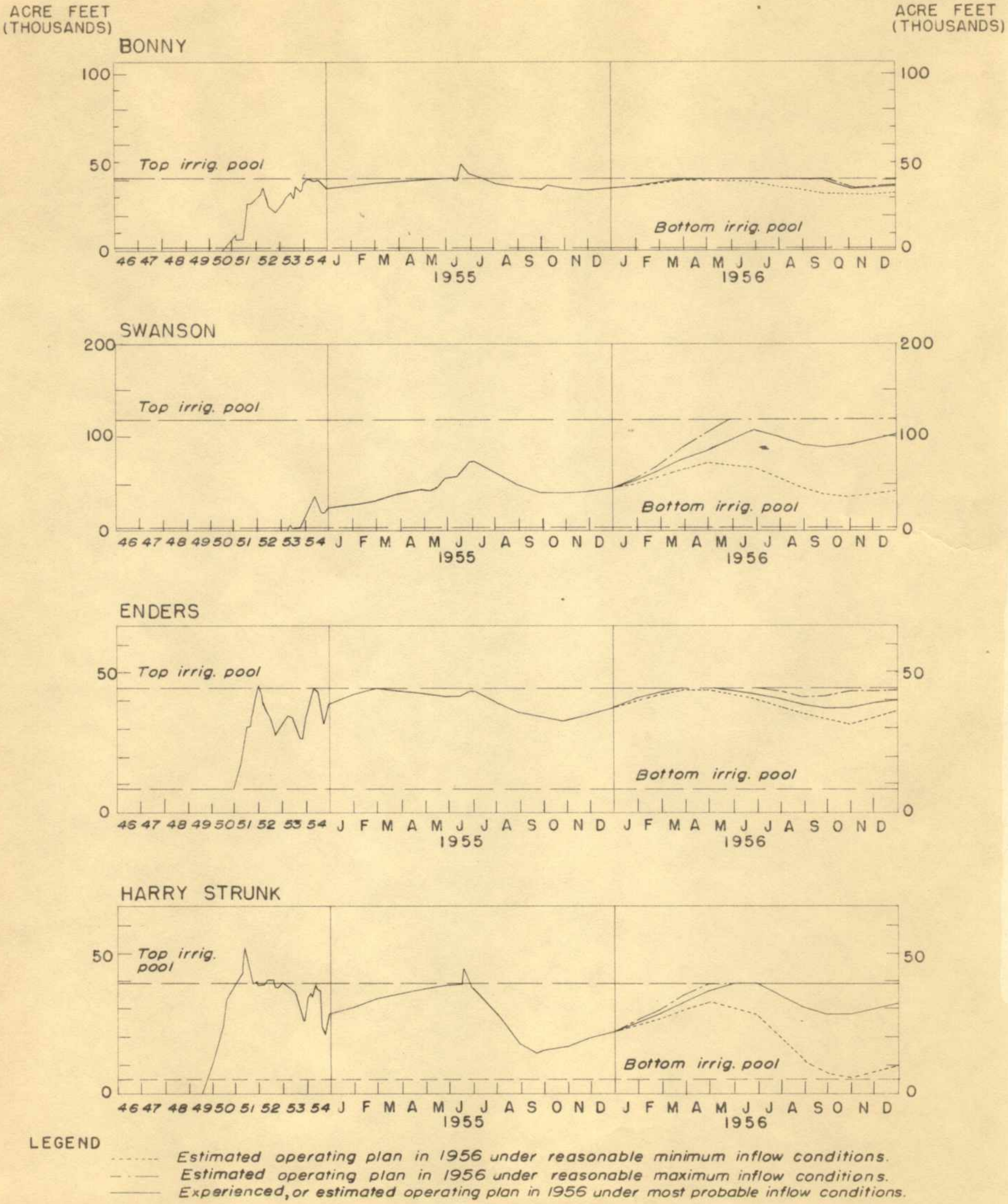
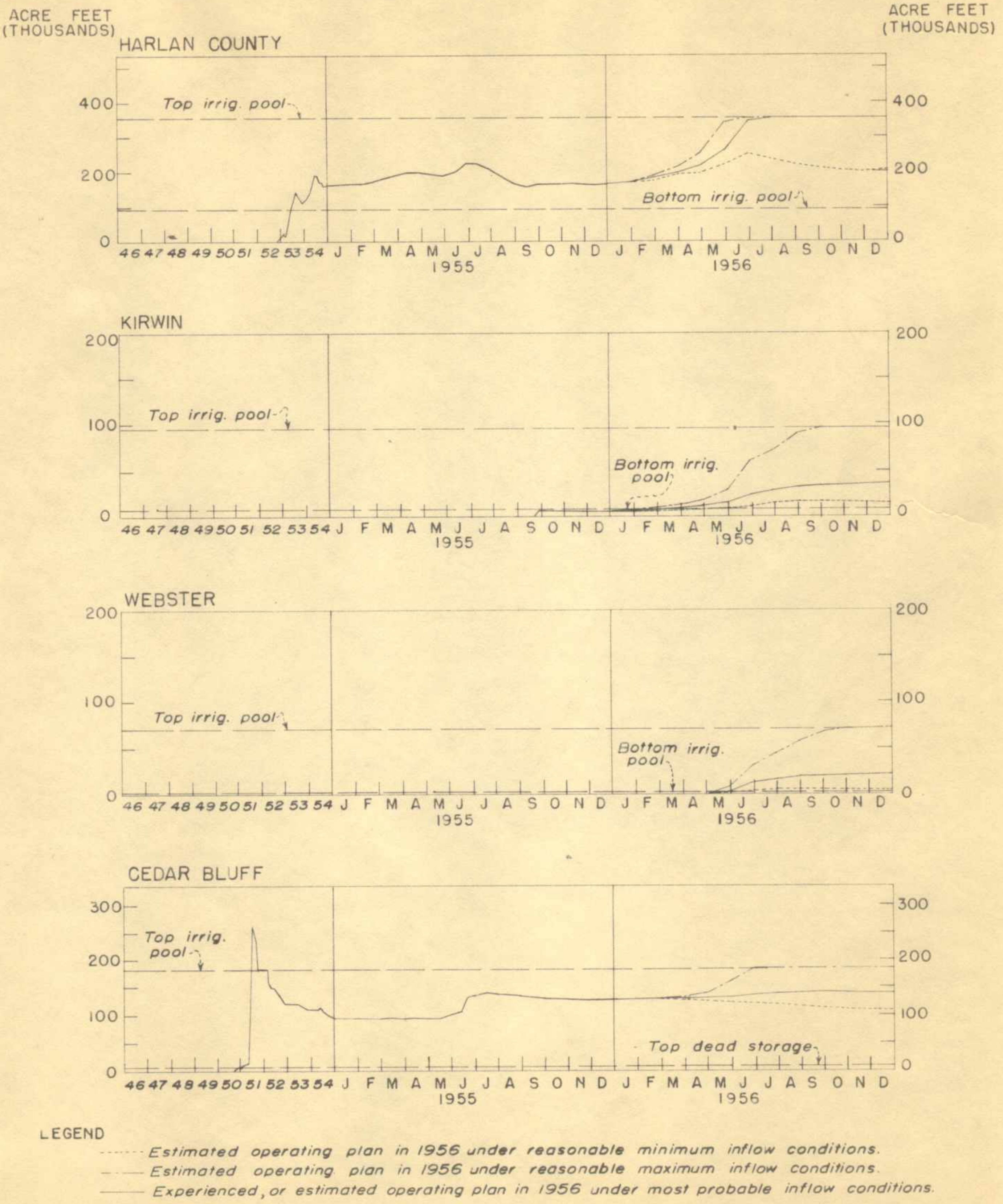


Exhibit 7

RESERVOIR STORAGE

(BOSTWICK, SOLOMON, AND SMOKY HILL DIVISIONS)



The total diversion included 814 acre-feet of supplemental water to 740 acres under Warren Act Contracts. The reservoir started the calendar year with 35,600 acre-feet of storage and ended the year with 35,800 acre-feet of storage.

The minimum flow in the river below Bonny Dam was approximately six second-feet and was due to seepage past the dam when the river outlet was closed. Controlled spills occurred during June and July. During October, November, and December releases were made to the river in order to lower the reservoir level from elevation 3669.45 feet to elevation 3668.50 feet. It is desirable that the elevation of the water level of Bonny Reservoir at the beginning of the winter months be 3 to 4 feet below spilling (elevation 3672.0) in order to keep from having the reservoir spill during the winter months. During very cold weather there is considerable danger of causing freezing damage to the Hale Ditch outlet pipe when releases are made to the river, and spills through the gated orifice are likely to cause ice formation in the gated area and on the spillway.

The inflow into Bonny Reservoir in 1955 was 28,500 acre-feet. The average for 27 years of record is 32,300 acre-feet.

Frenchman-Cambridge Division

Swanson Lake commenced the 1955 calendar year with a storage of 25,700 acre-feet and ended the year with a content of 46,600 acre-feet. Reservoir releases were made to provide supplemental water to the Riverside Canal, the Meeker Canal and pump users on Red Willow Creek. Releases were also made for the Bartley Canal. The total historical inflow in 1954 was 87,900 acre-feet compared with a 33-year average of 135,100 acre-feet. The historical inflow, adjusted by adding upstream uses in 1954, was 91,500 acre-feet compared with a 33-year adjusted average of 136,900 acre-feet.

Riverside Canal, which is non-Bureau operated, used 292 acre-feet of supplemental water under Warren Act Contracts on 400 acres.

Meeker Canal, operated by the Bureau, diverted a total of 11,626 acre-feet of natural flow and storage water to serve 3,048 acres. Supplemental storage amounting to 582 acre-feet was used on 882 acres.

Bartley Canal diverted a total of 11,433 acre-feet to irrigate 3,950 acres.

Enders Reservoir started the 1955 calendar year with a total storage of 38,800 acre-feet and ended the year with 37,500 acre-feet. During much of the irrigation season most of the inflow was claimed by senior water rights and was not stored. Supplemental storage releases under Warren Act Contracts were made for the Culbertson Canal and various pump irrigators in Frenchman Creek and Stinking Water Creek. Some releases also were made for the Bartley Canal in order to reduce the demand on Swanson Lake. The total inflow at the Imperial gaging station was 51,300 acre-feet compared with a 32-year average of 49,700 acre-feet.

A total of 840 acre-feet of supplemental water was delivered to approximately 9,300 acres under the Culbertson Canal, which is not operated by the Bureau.

Various pump irrigators used a total of 1,017 acre-feet of storage water on 3,159 acres.

On January 1, 1955, the storage in Harry Strunk Lake amounted to 28,200 acre-feet. At the end of the year the storage was 21,900 acre-feet. Releases were made to the Cambridge Canal and for senior water rights. Also a small amount of supplemental water was delivered under Warren Act Contracts. Controlled spills occurred during parts of June and July. The total inflow for the year was 37,400 acre-feet compared with a 31-year average of 55,000 acre-feet.

A total of 32,545 acre-feet was diverted by the Cambridge Canal to serve 9,104 acres.

Supplemental storage amounting to 226 acre-feet was delivered from Harry Strunk Lake to 726 acres under pump irrigation.

Bostwick Division

On January 1, 1955, Harlan County Reservoir had a total storage content of 160,000 acre-feet. At the end of the year the content was 163,300 acre-feet. Reservoir releases were made to irrigate lands under the Franklin, Franklin Pump, Superior, and Courtland Canals. The total historical inflow during 1955 was 100,200 acre-feet compared with a 27-year average of 477,800 acre-feet. The historical inflow adjusted by adding upstream uses in 1955 amounted to 203,400 acre-feet compared with an adjusted average of 494,100 acre-feet.

A total of 11,490 acre-feet was diverted by the Franklin Canal to serve 2,743 acres and to season the canal.

The Naponee Canal was used for the first year to divert 1,699 acre-feet to irrigate 548 acres.

The Franklin Pump Canal diverted 3,826 acre-feet to irrigate 1,516 acres.

The Superior Canal diverted 15,100 acre-feet to serve 4,316 acres.

Courtland Canal diverted 20,979 acre-feet to serve a total of 3,768 acres and season the canal. Of the total diversions 6,605 acre-feet were used in Nebraska to serve 1,380 acres. The remainder of 14,376 acre-feet were used in Kansas to serve 2,385 acres and to season new canals.

During the summer months, approximately 40 second-feet were by-passed at the Superior-Courtland Diversion Dam to provide minimum flows recommended for stream sanitation. This recommendation appears in the "Statement of Operational Objectives for Harlan County Reservoir" agreed upon by the various cooperating states and agencies. During much of the summer of 1955 it was necessary to make storage releases from Harlan County Reservoir in order to provide the recommende amount of by-pass.

Solomon Division

Kirwin Reservoir started storing in September 1955. The reservoir content at the end of 1955 was 6,000 acre-feet. In 1955 the total flow at Kirwin Dam was 23,100 acre-feet compared with a 36-year average of 55,200 acre-feet. There was no storage in Webster Reservoir. The flow at Webster Dam was the lowest on record with a total annual flow of 8,700 acre-feet. The 36-year average is 51,000 acre-feet.

Smoky Hill Division

Cedar Bluff Reservoir started the 1955 calendar year with a content of 96,300 acre-feet and ended the year with a content of 127,000 acre-feet. The inflow of 56,700 acre-feet was caused largely by an inflow of 39,300 acre-feet in June. The 31-year average inflow is 61,500 acre-feet. No construction has started on the proposed irrigation system to be served from Cedar Bluff Reservoir. Releases during 1955 were limited to those required for stockwater downstream, an irrigation development farm, and municipal water for the city of Russell, Kansas.

The irrigation development farm, served by a pump, diverted 164 acre-feet in 1954 to irrigate 76 acres.

During the months of May, July, August, and September a total of about 1,760 acre-feet of storage water was released from the reservoir, in excess of that required for minimum stockwater requirements for the city of Russell municipal water supply pumps on the Smoky Hill River at Pfeifer, Kansas.

CHAPTER III

ANNUAL OPERATING PLAN FOR 1956

The Plan of Operation for 1956 will be similar to the Operation of 1955. The irrigation of land will be limited primarily to the Republican River Basin because no canal systems have been completed in other river basins.

Water Supply

The water supply outlook for 1956 is excellent for all requirements due to the fact that the construction of reservoir dams has taken place at a more rapid pace than the construction of canal systems. Consequently, sufficient storage water is available to meet the estimated requirements of the most probable dry year. It is impossible to forecast the exact inflows into the various reservoirs; however, an approach has been made to set up a method of estimating the flow on the basis of frequency analysis of historical flows. The water supply studies in the Republican River Basin has been based upon the period 1929 to 1947 and figures of flow, either estimated or actual, are available for all of the critical points. For some of the other tributaries of the Kansas River, longer records have been used as a basis of water supply. Where records were short, they were extended to the desired period of study by correlation procedures. Commencing with these discharge tables from the water supply studies, plus any additional records that were available, individual tables of discharge have been built up for each gaging station to include the entire record of flow for each station. These tables were used for determining the probability of flow at each gaging station. The tables also provide a basis for comparing the yearly flow with the computed normal for each station. Annual totals of these inflow records are plotted in Exhibits 8 through 15 (Pages 35 through 42).

It appears that any estimation of stream flows in the Kansas River Project area will be dependent primarily upon the frequency analysis, due to the fact that the water supply is primarily dependent upon runoff from rainstorms. Most of the streams have some base flow from ground water, but only in the cases of Medicine Creek and Frenchman Creek is the ground water supply a significant portion of the water supply. Snow melt is not an important item because the tributaries do not drain mountain areas. After the projects have been in operation for several years, return flows will become an important item, but up to the present time, no appreciable amounts of return flows have been developed from Bureau constructed units.

The frequency method of analysis was used to estimate reservoir inflow for reasonable minimum, most probable, and reasonable maximum inflow conditions. Frequency curves were drawn and shown as Exhibits 16 through 20 (Pages 43 - 47). The discharge occurrences for 10, 50, and 90 per cent of the time were used to represent reasonable minimum, most probable, and reasonable maximum inflow conditions, respectively. These computed values are shown in Table I (Page 8).

A detailed description of the records and correlations used in compiling historical inflows of the various reservoirs was given in last year's "Annual Operating Plan."

Estimated Water Requirements

Irrigation Requirements

Use of river water for irrigation purposes during 1956 will be confined primarily to the Republican River Basin. It is anticipated that about 37,300 acres will be irrigated in the Republican River Basin under Bureau operated canals. In addition, it is expected that in a dry year about 17,000 acres of land under private canals and stream pumps may be irrigated with supplemental storage water.

The irrigation requirements for 1956 have been estimated for reasonable minimum, most probable, and reasonable maximum inflow conditions. The diversion requirement tables as used in the various Definite Plan Reports were used as the basis for determining the diversion rates for the various conditions. The diversion rates thus obtained were then corrected for canal loss rates obtained from actual experience and for water required for seasoning the canal, and then these adjusted diversion rates were applied to the acreage expected to be irrigated. Estimated irrigation requirements for 1956 are shown in Table 5 (Pages 27 - 28).

Fishery Requirements

At Bonny Reservoir, Swanson Lake, Enders Reservoir, Harry Strunk Lake, Harlan County Reservoir, and Cedar Bluff Reservoir, there will be adequate storage for fishery needs in the reservoirs. The interests responsible for fishing and recreation at the various reservoirs are kept informed of any major changes in the storage of water in order that the maximum benefits may be obtained for these two purposes. Below the reservoirs the benefits for fish are incident to releases made for stock water or other purposes.

Public Health Requirements

The "Statement of Operational Objectives for Harlan County Reservoir" agreed upon June 27, 1952, at Lincoln, Nebraska, by the various cooperating states and agencies sets desired minimum flows

ESTIMATED CANAL DIVERSIONS AND ACRES TO BE IRRIGATED - 1956
(UNITS IN 1000 ACRE-FEET)

Reasonable Minimum Inflow Conditions	Hale D. (Suppl. to 1,000 Ac.)	Pvt. Irrig. F-C Div. (Suppl. to 14,230 ac.) 1/	Meeker C. (Suppl. to 1,000 Ac.)	Bartley Canal (4,300 Ac.)	Cambridge Canal (10,000 Ac.)
Apr.	0	0	0	0.6	0.8
May	0	0.1	0	1.3	4.2
June	0.1	0.1	0	1.2	4.2
July	0.3	0.7	.4	3.0	9.0
Aug.	0.3	1.4	.2	3.4	8.8
Sept.	0.2	0.5	0	1.9	5.5
Oct.	0	0	0	1.0	2.9
Total	0.9	2.8	0.6	12.4	35.4
Most Probable Conditions					
Apr.	0	0	0	0	0.3
May	0	0	0	0.7	2.1
June	0.1	0.1	0	0.5	1.4
July	0.2	0.2	.2	2.5	7.4
Aug.	0.2	0.2	.1	2.5	6.3
Sept.	0	0.1	0	1.5	4.2
Oct.	0	0	0	0.9	2.1
Total	0.5	0.6	0.3	8.6	23.8
Reasonable Maximum Inflow Conditions					
Apr.	0	0	0	0	0
May	0	0	0	0	0
June	0	0	0	0.1	0
July	0.1	0	0	1.6	4.5
Aug.	0.1	0.1	0	2.0	4.9
Sept.	0	0	0	0.8	3.2
Oct.	0	0	0	0.6	1.4
Total	0.2	0.1	0	5.1	14.0

1/ Est. 1,320 Acres for Median Year and 100 Acres for Wet Year

Sheet 2 of 2

TABLE 5 (Cont.)
ESTIMATED CANAL DIVERSIONS AND ACRES TO BE IRRIGATED - 1956
(UNITS IN 1000 ACRE-FEET)

Reasonable Minimum Inflow Conditions	Franklin Canal (5,962 Ac.)	Naponee Canal (1,058 Ac.)	Franklin Pump Canal (1,745 Ac.)	Superior Canal (4,695 Ac.)	Courtland Canal (6,449 Ac.)	Kutina Develop. Farm (76 Ac.)
Apr.	1.4	0.2	0.3	0.9	0.6	0
May	2.3	0.3	0.5	1.1	3.0	.01
June	2.5	0.3	0.6	1.9	3.9	.02
July	6.6	0.9	1.5	4.3	8.8	.04
Aug.	6.0	0.9	1.4	4.1	8.1	.07
Sept.	4.2	0.6	1.0	2.8	5.5	.02
Oct.	2.1	0.3	0.5	1.6	3.3	.02
Total	25.1	3.5	5.8	16.7	33.2	.18
Most Probable Conditions						
Apr.	0	0	0	0	0	0
May	0.3	0.1	0.1	0.4	1.2	0
June	1.5	0.2	0.3	0.9	1.8	.01
July	5.5	0.8	1.3	3.6	7.0	.03
Aug.	5.3	0.8	1.2	3.8	7.5	.04
Sept.	3.0	0.4	0.7	2.4	4.8	.01
Oct.	1.1	0.2	0.3	0.9	1.8	.01
Total	16.7	2.5	3.9	12.0	24.1	.10
Reasonable Maximum Inflow Conditions						
Apr.	0	0	0	0	0	0
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	2.8	0.4	0.6	2.5	5.0	.02
Aug.	3.9	0.6	0.9	2.4	4.8	.03

to be maintained because of public health requirements at various points downstream from Harlan County Dam. The recommended minimum flows at Superior, Nebraska, which is the closest named point below the Superior-Courtland Diversion Dam are as follows:

	Dec.-Feb.	Mar.	Apr.	May	June-Sept.	Oct.	Nov.
Minimum requirement in second feet	8	10	16	24	40	18	12

During 1955 releases were made from Harlan County Reservoir to provide minimum flows recommended for stream sanitation. There were times when much of this was storage water. A considerable amount of storage water released for this purpose was used by pump irrigators below Harlan County Dam. In the drainage area above Harlan County Dam, the policy has been established to have pump irrigation and privately operated canal systems pay for storage water deliveries when there was a surplus supply of storage water. This is consistent with the existing policy of placing similar charges against irrigation districts that have repayment contracts with the Federal government. Because of the technicalities of Nebraska State Law, the practice of bypassing the stream sanitation requirements of the Superior-Courtland Diversion Dam has made it impossible so far to have closing orders placed on irrigators with rights junior to the Nebraska-Bostwick Irrigation District, or to charge them for deliveries of storage water. There were twenty-two such rights with recorded filings as of January 4, 1954, but the number has increased since that date. Under the present arrangements, sufficient releases must be made from Harlan County Reservoir to satisfy those rights junior to the Bostwick irrigation District in addition to the bypass requirement for stream sanitation.

Flood Control Requirements

The Corps of Engineers is responsible for flood control operations in the Kansas River Project area. They have indicated that storage allocated to flood control will be operated to control the flow downstream to effect the maximum practicable reduction in flood damages on the streams below the dams and on the Kansas and Missouri Rivers. Storage will be kept at or below the bottom of the flood control pools in all reservoirs, except during impoundment and release of flood inflows.

Operating Limitations

During the summer months of 1956, there will be no operating limitations at any of the reservoirs at which irrigation water will be stored except that the maximum storage for this purpose will be limited to the top of the various irrigation pools. Storage at Bonny is limited to about 3 or 4 feet below the top of the irrigation pool in the fall months in order to keep the reservoir from spilling during winter months.

When it is apparent that a reservoir will spill before the start of the irrigation season, it is planned that continuous release will be made during winter months at a rate to have the reservoir full in the following April. This will avoid extremes in reservoir releases and also keep the water level lower during winter months when the high winds can cause wave action damage to riprap.

Reservoir Operating Criteria

The adopted policy provides that all appropriate facilities be operated for maximum flood control, fish and wildlife, recreation and pollution abatement after irrigation requirements are satisfied. A minimum release of approximately 3 to 10 second-feet will be made at all times for livestock water downstream except when seepage below a reservoir is sufficient to meet this requirement. Usually releases in excess of this cannot be made if such a policy conflicts with irrigation requirements. The operating criteria in 1956 for the various reservoirs will be as follows:

Bonny Reservoir, Store all available inflow that can be stored in the irrigation pool. Stored water may be released under terms of Warren Act Contracts to irrigators under the Hale Ditch. During the month of October, it will be necessary to see that the water level is at least three or four feet below the top of the irrigation pool and it may be necessary to make releases to the river to achieve this. It is not desirable to have spills pass through the gated spillway orifice during winter months, because of the possibility of ice freezing in the orifice and on the spillway. During winter months there is danger of the water freezing in the Hale Ditch pipe when releases are made to the river, because water backs into this pipe when releases are made through the river outlet works. During that part of the year when there is no danger of water freezing in the Hale Ditch pipe, spills can be passed through the outlet works, or the gated spillway.

Swanson Lake. All available water will be stored in the irrigation pool. Releases will be made to serve land under the Bartley Canal and to provide storage water under Warren Act Contracts to lands under the Meeker Canal, Riverside Canal, and pump irrigation on Red Willow Creek

Enders Reservoir. All available inflow will be stored in the irrigatio pool. Storage water may be released under terms of Warren Act Contracts to the Culbertson Canal and to private pump irrigators on Frenchman Creek and Stinking Water Creek. Controlled spills will be passed through the outlet works in order to avoid spilling water over the spillway.

Harry Strunk Lake. All available inflows will be stored until needed to supply demands on the Cambridge Canal. Storage water may be sold under Warren Act Contracts to private pump irrigators. Controlled spil will be passed through the outlet works in order to avoid spills over the spillway.

Harlan County Reservoir. All inflow not required for releases will be stored. Water will be supplied to the Franklin Canal, Naponee Canal, Franklin Pump Canal, Superior Canal, and Courtland Canal. Also releases for public health requirements will be made as described under the topic "Public Health Requirements," previously discussed in this report.

Kirwin Reservoir. All available inflow, except that which is required to be by-passed in the administration of Kansas State water laws, will stored. A maximum by-pass of about five second-feet is expected to satisfy most requirements. When pickup below the dam is not sufficient to meet requirements, the inflow which can be claimed by senior water rights is usually less than five second-feet.

Webster Reservoir. Closure will be made about May 1, 1956, (depending upon rate of construction and weather conditions) and all available inflow will be stored, consistent with state administration of water rights, except a maximum by-pass of five second-feet for stockwater.

Cedar Bluff Reservoir. All inflow available under state law will be stored. Releases may be made for the irrigation demonstration farm abou six miles downstream. Storage water may also be released under terms of a special contract to the municipal water supply pumps of the City of Russell, Kansas.

1956 Operation Plan

It is expected that about 32,400 acres of land in Nebraska will be irrigated under canals operated by the Bureau of Reclamation in 1956. During a dry year, it is estimated that as much as 14,200 acres of land with private irrigation rights would receive supplemental storage water under Warren Act Contracts in Nebraska. About 1,000 acres of land in Colorado will be irrigated by the privately operated Hale Ditch of which 800 acres may use supplement storage water. Approximately 5,000 acres under the Courtland Canal and 76 acres of land at an irrigation development farm below Cedar Bluff Dam will be served in Kansas. A listing of the approximate acreages to be served next year and the estimated irrigation requirements for canal or pump diversions during a dry, normal or wet year are shown in Table 5 (Pages 27-28) and Exhibits 4 and 5 (Pages 15-16). Operation tables estimating reservoir operations for 1956 under reasonable minimum inflow conditions, most probable inflow conditions, and reasonable maximum inflow conditions are shown in Tables 6 through 13 (Pages 48-63) and Exhibits 2 and 3 (Pages 9-10).

Upper Republican Division

On January 1, 1956, Bonny Reservoir had a total content of 35,800 acre-feet. It is expected that the irrigation pool will be full before the beginning of the 1956 irrigation season. Water claimed under natural flow rights will be delivered to the Hale Ditch. Storage water will be more than adequate to meet requirements of the Hale Ditch under Warren Act Contracts. No Federally constructed irrigation canals will be served during 1956. It is anticipated that if 1956 inflow is equal to that of a median year (most probable inflow conditions), the reservoir content at the end of the calendar year will be 37,600 acre-feet. Bonny Reservoir can be expected to spill, in 1956, under both the most probable inflow conditions and reasonable maximum inflow conditions.

Frenchman-Cambridge Division

Swanson Lake started the 1956 Calendar Year with a total content of 46,600 acre-feet. The Bartley Canal will be used to irrigate about 4,300 acres of the Red Willow Unit in 1956. Inflows into Swanson Lake which are claimed under natural flow rights by the Meeker Canal will be by-passed downstream. Also, lands under the Meeker Canal and the Riverside Canal may receive supplemental storage from Swanson Lake under Warren Act Contracts. If the 1956 inflow is equal to that of a median year, the content of Swanson Lake at the end of the year will be 103,700 acre-feet. Swanson Lake will spill in 1956 under reasonable maximum inflow conditions.

On January 1, 1956, the total content of Enders Reservoir was 37,500 acre-feet. The irrigation pool will be filled before the beginning of the 1956 irrigation season. No canals operated by the Bureau of Reclamation will be served from Enders Reservoir during 1956, except for Meeker and Bartley Canals if the demand on Swanson Lake becomes exceptionally heavy. Supplemental storage water may be sold under Warren Act Contracts to private irrigators. If the inflow into Enders Reservoir during 1956 is equal to that of a median year, the content at the end of the year will be approximately 39,900 acre-feet. Enders Reservoir will spill in 1956 under probable and reasonable maximum inflow conditions.

Harry Strunk Lake started the 1956 Calendar Year with a total content of 21,900 acre-feet. The irrigation pool will be filled before the beginning of the 1956 irrigation season except under reasonable minimum inflow conditions. It will be used in 1956 to serve 10,000 acres under the Cambridge Canal. Supplemental storage water may be sold under Warren Act Contracts to pump irrigators. If 1956 inflow conditions are equal to that of a median year, the content of Harry Strunk Lake at the end of the year will be about 31,900 acre-feet. The Reservoir will spill in 1956 under most probable and reasonable maximum inflow conditions.

Bostwick Division

Releases from Harlan County for public health requirements downstream will be made according to schedules previously discussed in this report. The reservoir will be used in 1956 to irrigate about 15,000 acres in Nebraska and 4,900 acres in Kansas. Approximate acreages to be served during 1956 under each canal in the Bostwick Division are as follows:

Canal	Acres to Be Irrigated
Franklin	5,962
Naponee	1,058
Franklin Pump	1,745
Superior	4,695
Courtland (Nebraska)	1,526
Courtland (Kansas)	4,923
	19,909

The acreage indicated in the previous tabulation under the Courtland (Kansas) Canal includes 776 acres under the North Canal and 2,062 acres under the Ridge Canal. These are actually large laterals of the main Courtland Canal.

On January 1, 1956, the total content of Harlan County Reservoir was 163,300 acre-feet. If the inflow into Harlan County Reservoir is equal to that of a most probable year, the content at the end of the year is estimated to be 350,100. Harlan County Reservoir will spill in 1956 under most probable and reasonable maximum inflow conditions.

Solomon Division

Storage in Kirwin Reservoir at the end of the 1955 Calendar Year was 6,000 acre-feet. No releases above 5 second-feet will be required, except for senior water rights. If 1956 is a median year, it is expected that the reservoir content at the end of the calendar year will be about 34,800 acre-feet. Kirwin Reservoir will spill in 1956 under reasonable maximum inflow conditions. No irrigation is planned this year for federally constructed irrigation works.

It is planned that closure at Webster Dam will be made in May of 1956; however, the actual closure date will depend upon construction progress and weather conditions. No releases above 5 second-feet will be required except for senior water rights to be satisfied under administration of state water laws.

Smoky Hill Division

The total storage in Cedar Bluff Reservoir at the beginning of the 1956 Calendar Year was 127,000 acre-feet. No Bureau-operated canals will be served; however, about 76 acres of land in an irrigation demonstration farm will receive water from the reservoir. Storage water may be delivered to pump sites downstream for the City of Russell Kansas. If the 1956 inflow is equal to that of a most probable year, t content of Cedar Bluff Reservoir at the end of the year will be approximately 141,900 acre-feet.

ANNUAL* INFLOW — BONNY RESERVOIR

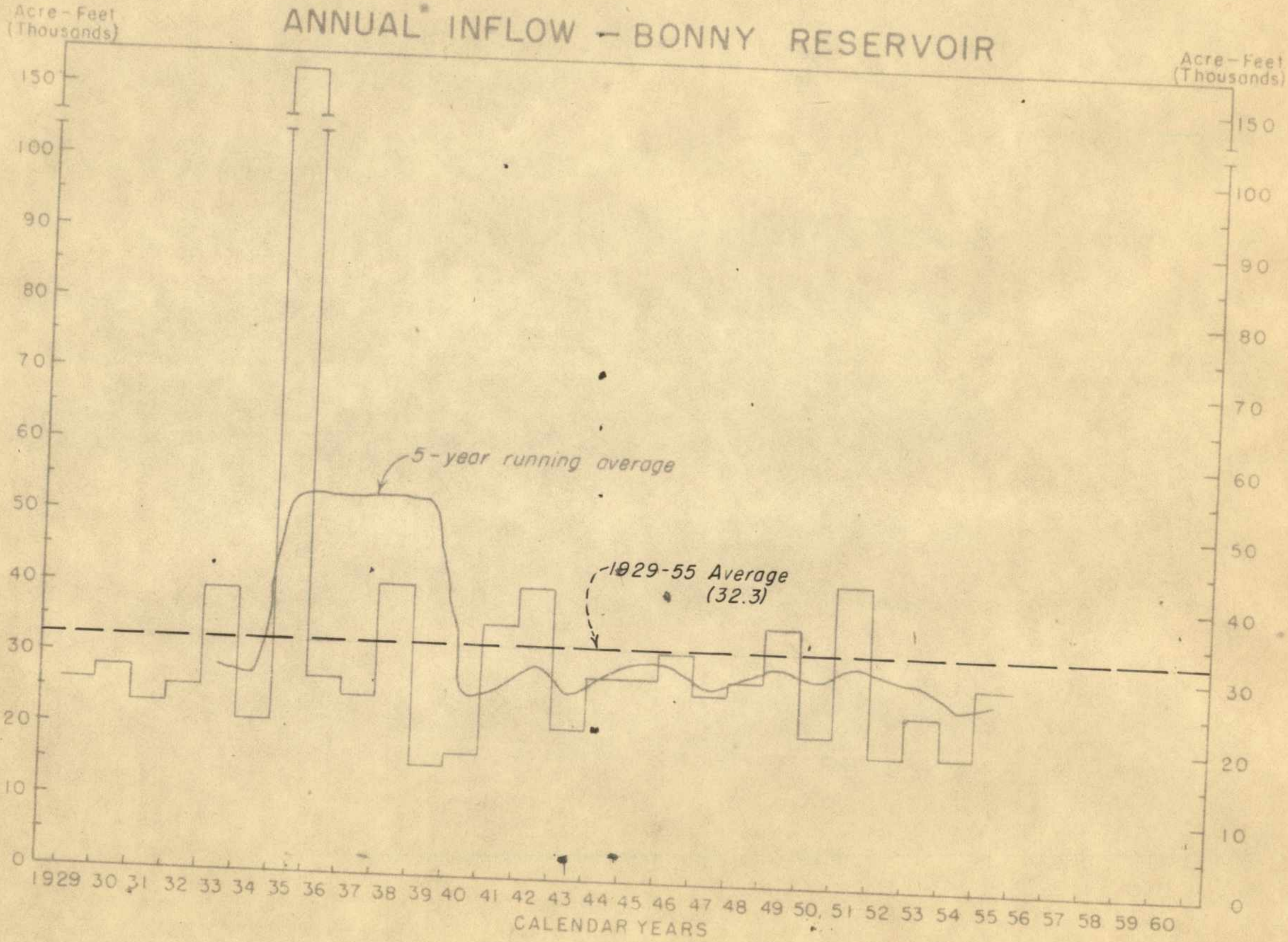


Exhibit 8

ANNUAL INFLOW—SWANSON LAKE

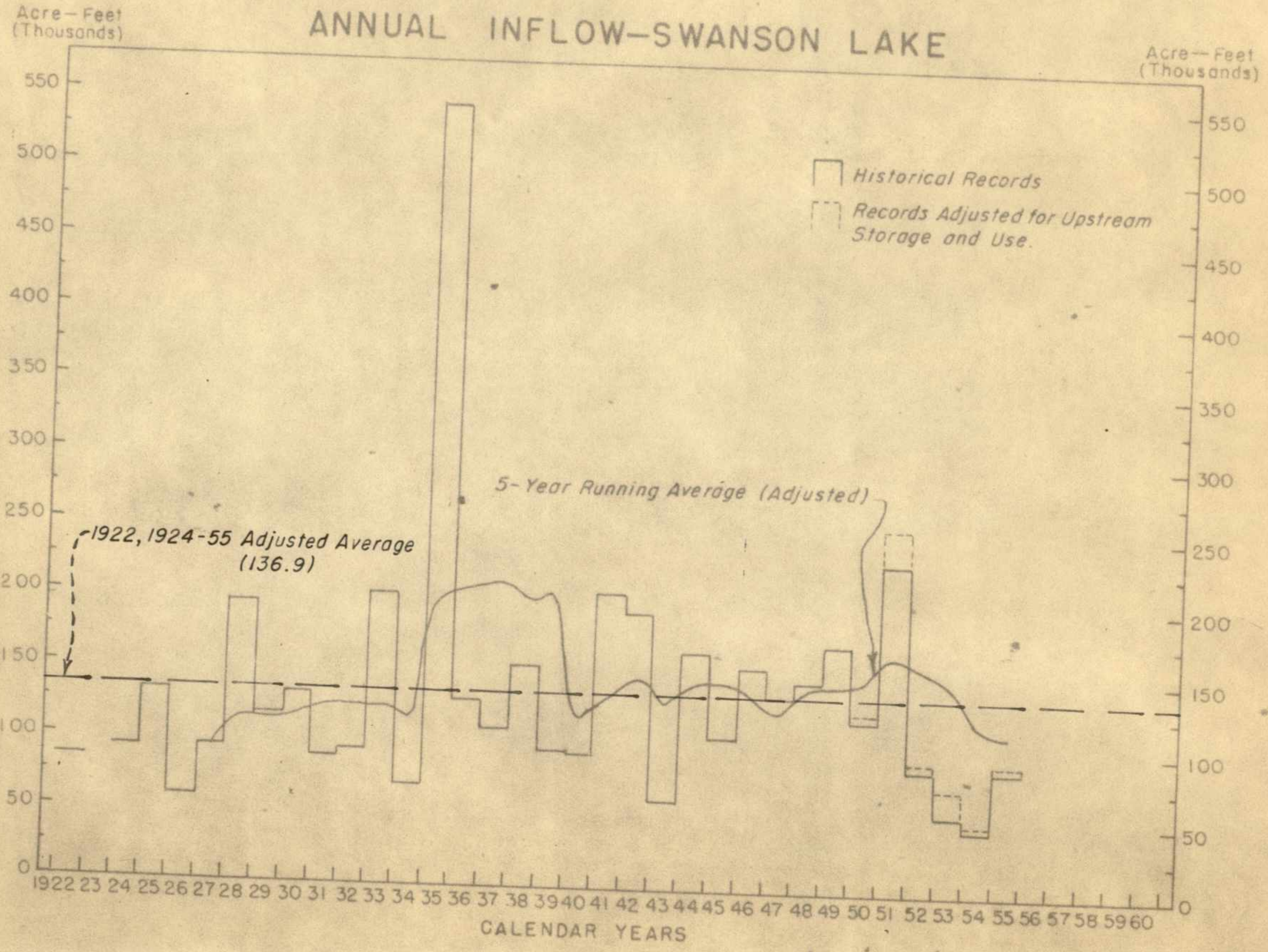


Exhibit 9

ANNUAL INFLOW- ENDERS RESERVOIR

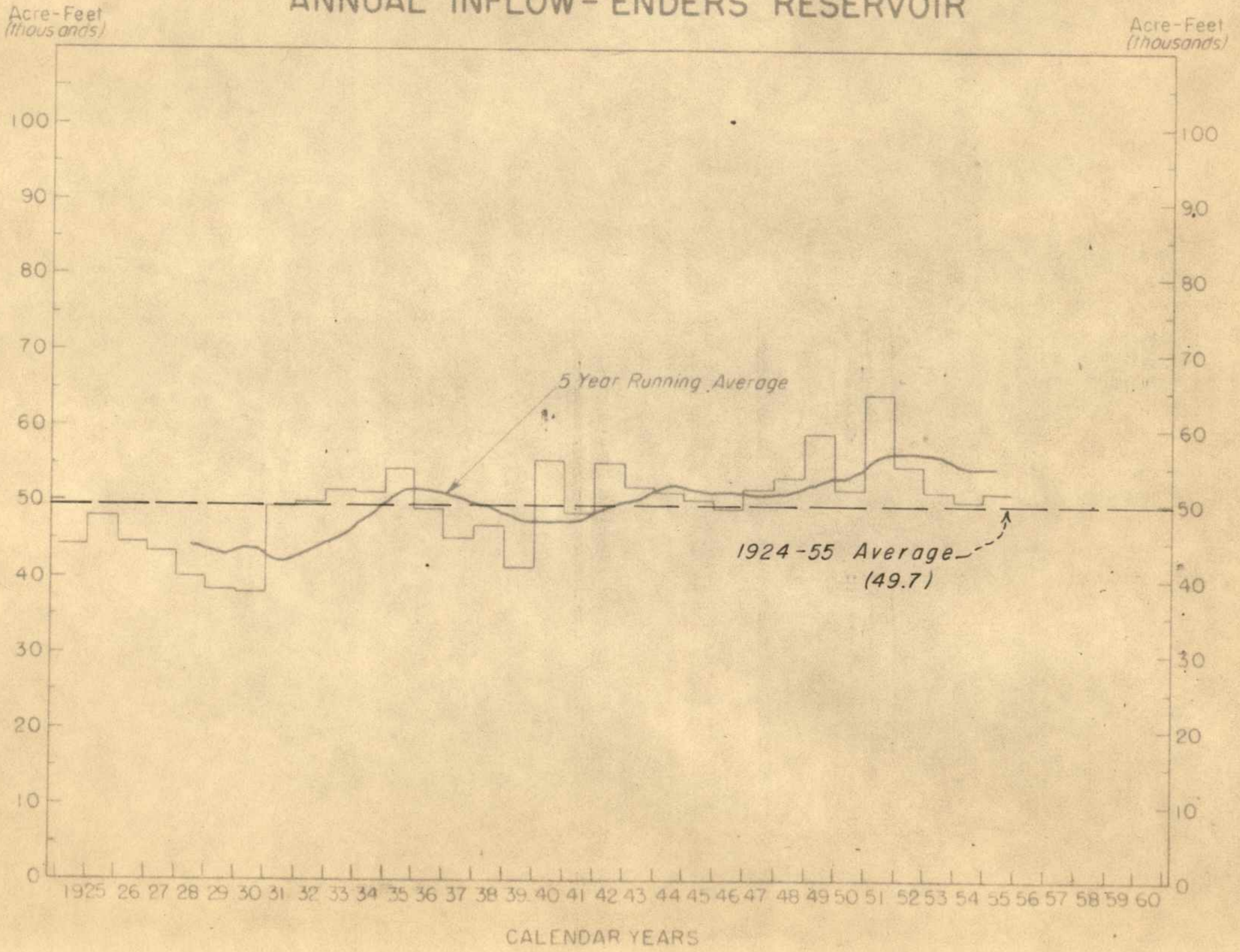
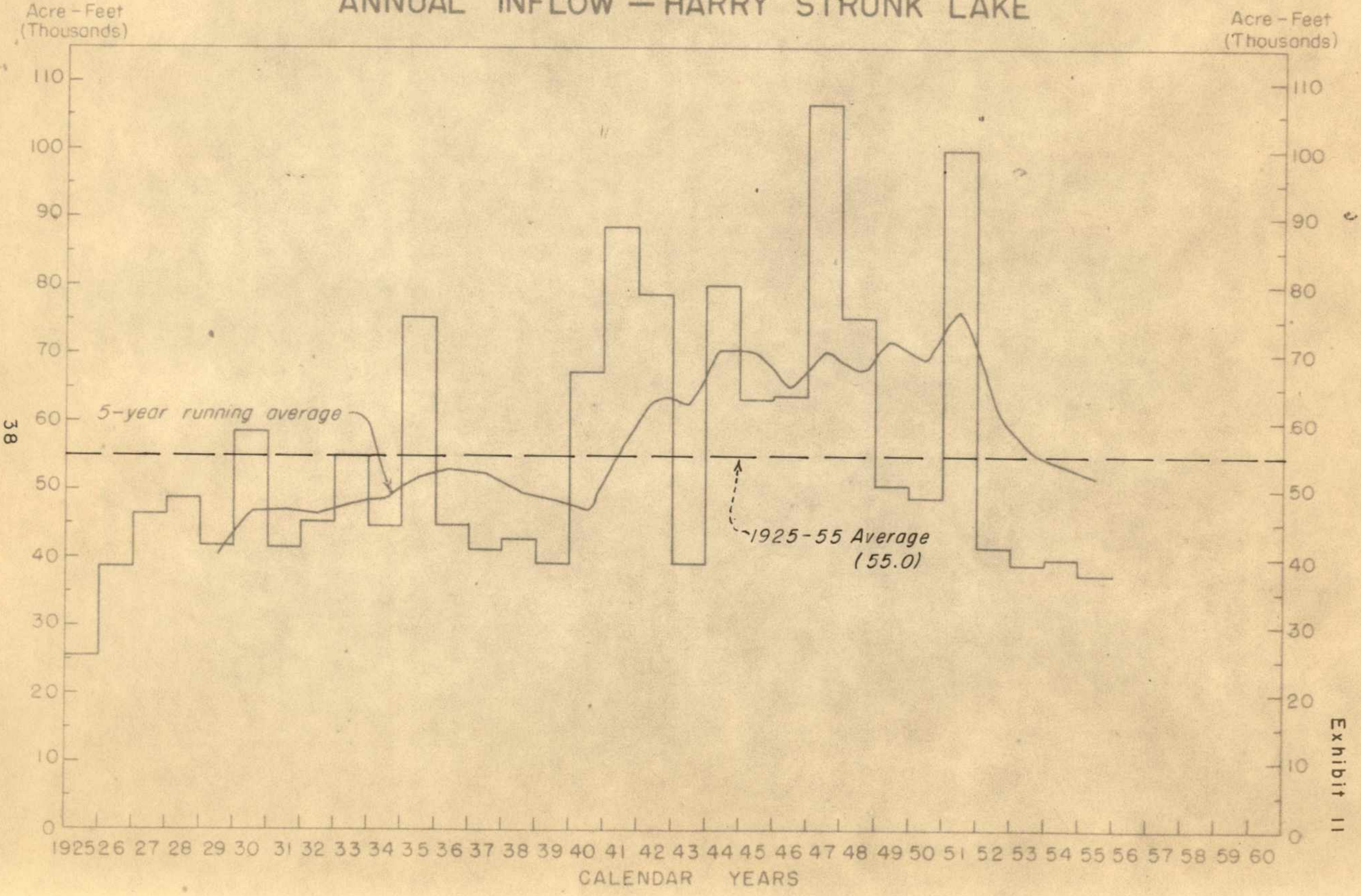


Exhibit 10

ANNUAL INFLOW — HARRY STRUNK LAKE



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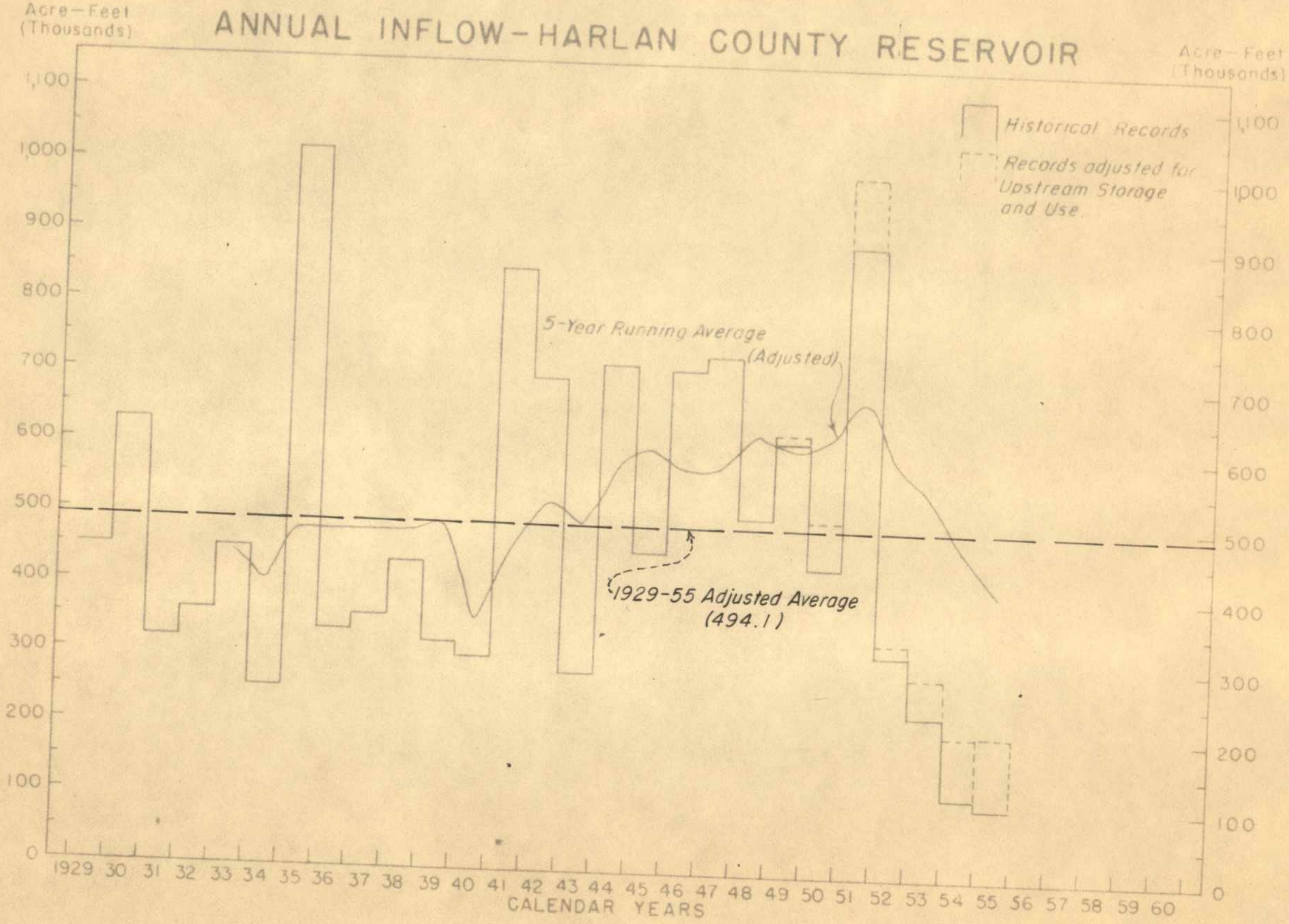
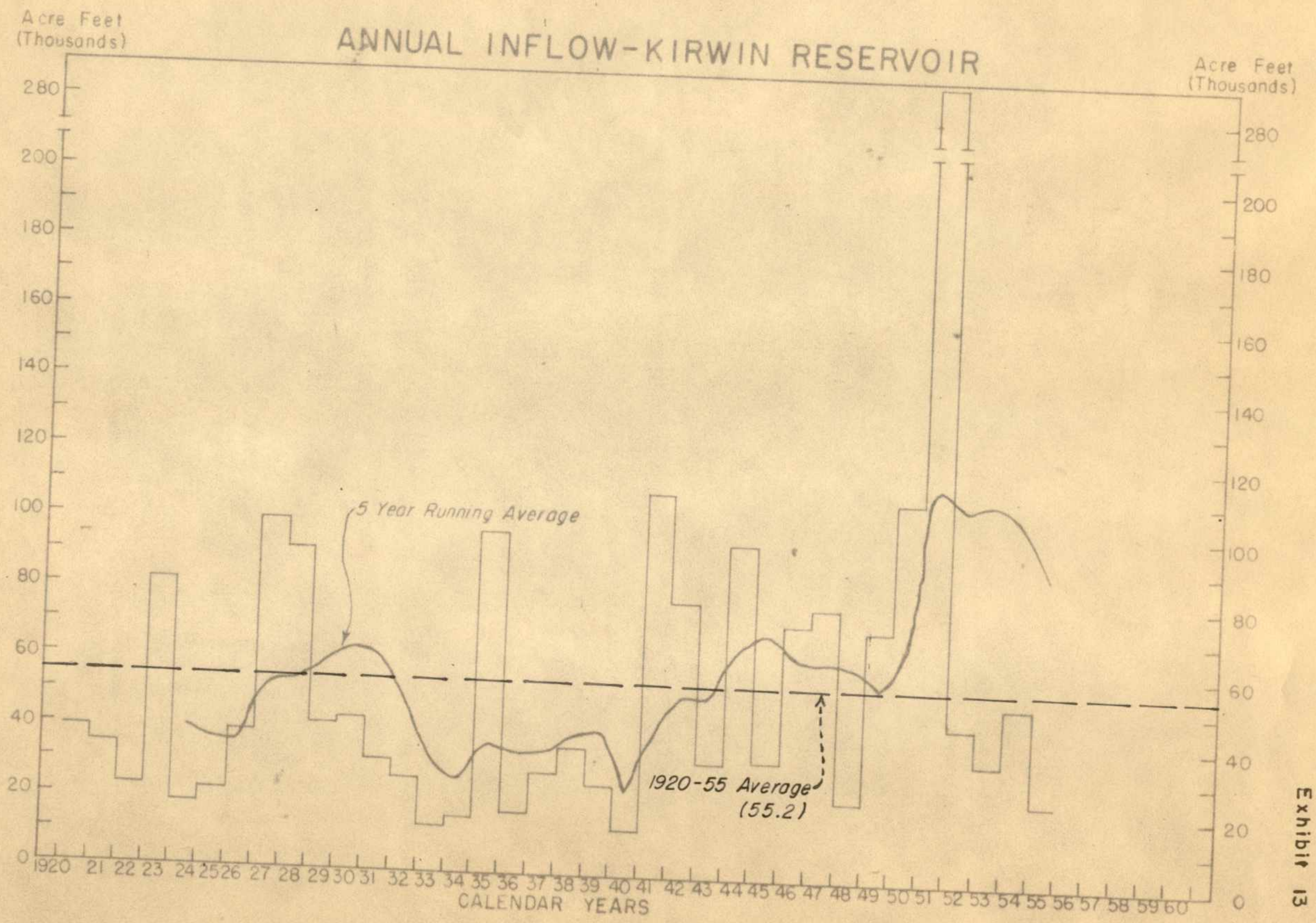


ANNUAL INFLOW-HARLAN COUNTY RESERVOIR

Exhibit 12


ANNUAL INFLOW-KIRWIN RESERVOIR
Acre Feet
(Thousands)
Acre Feet
(Thousands)
280
200
180
160
140
120
100
80
60
40
20
0
5 Year Running Average
1920-55 Average
(55.2)
1920
21
22
23
24
25
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CALENDAR YEARS

Exhibit 13

ANNUAL INFLOW—WEBSTER RESERVOIR

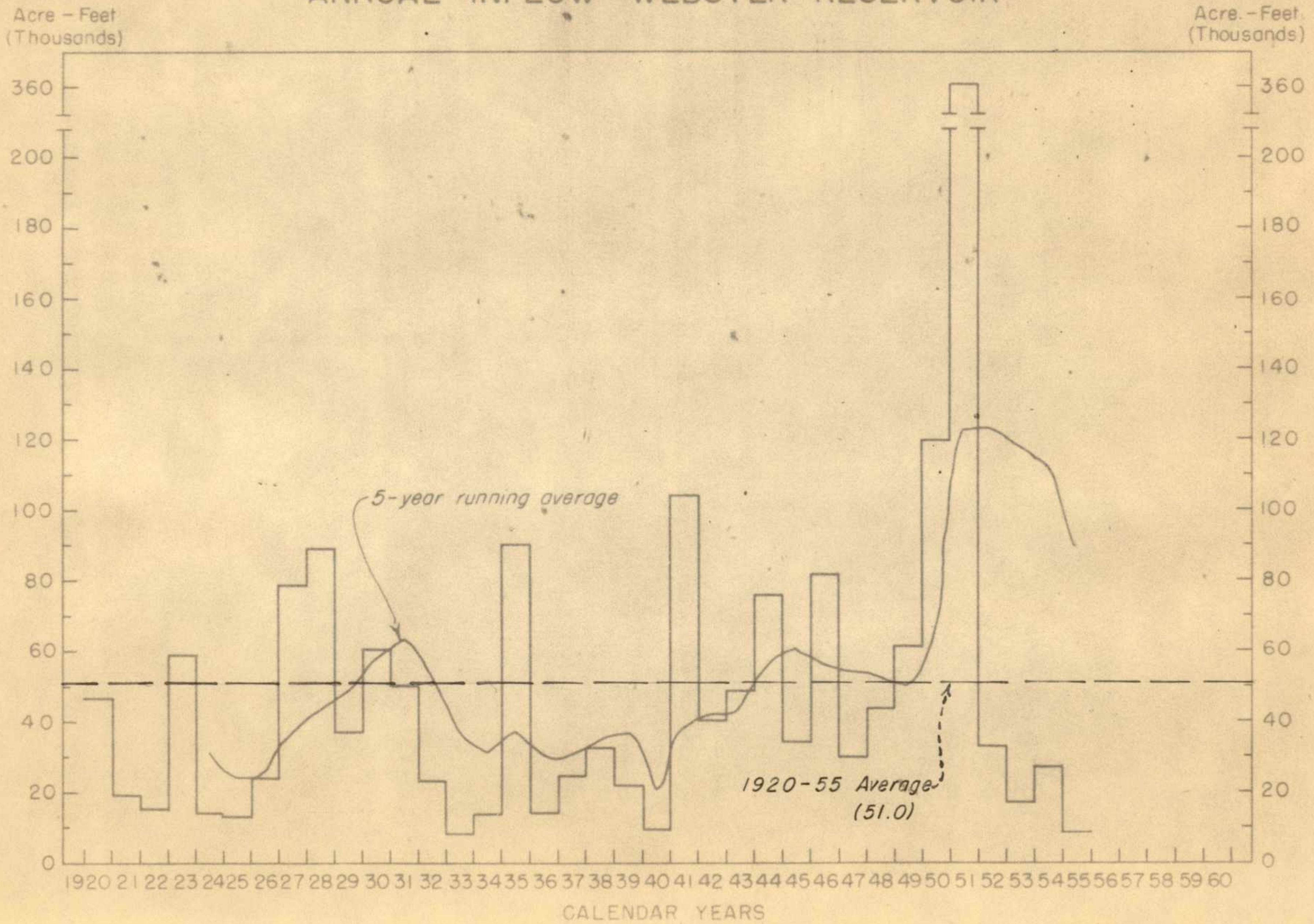


Exhibit 14

ANNUAL INFLOW—CEDAR BLUFF RESERVOIR

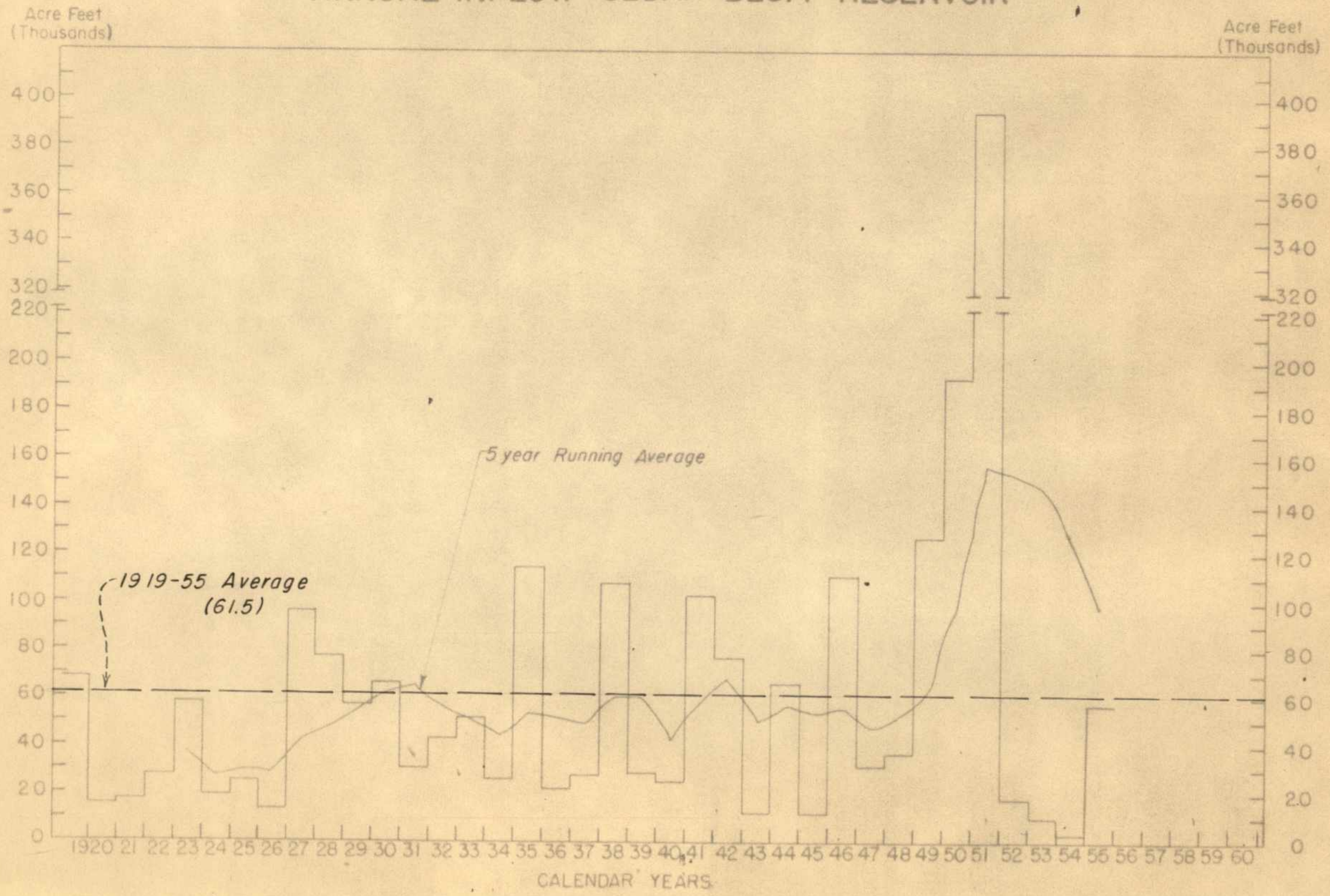
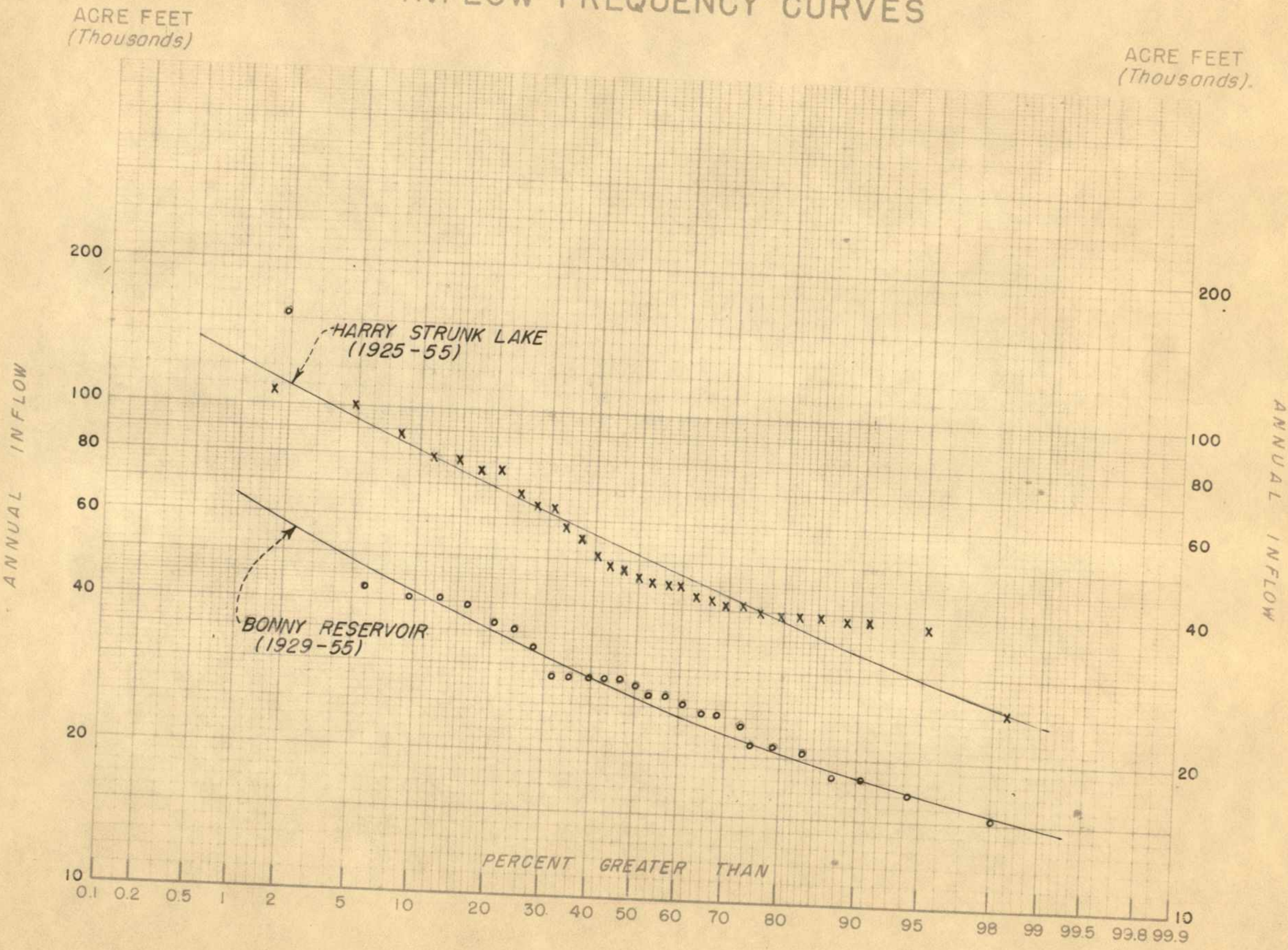


Exhibit 15

INFLOW FREQUENCY CURVES



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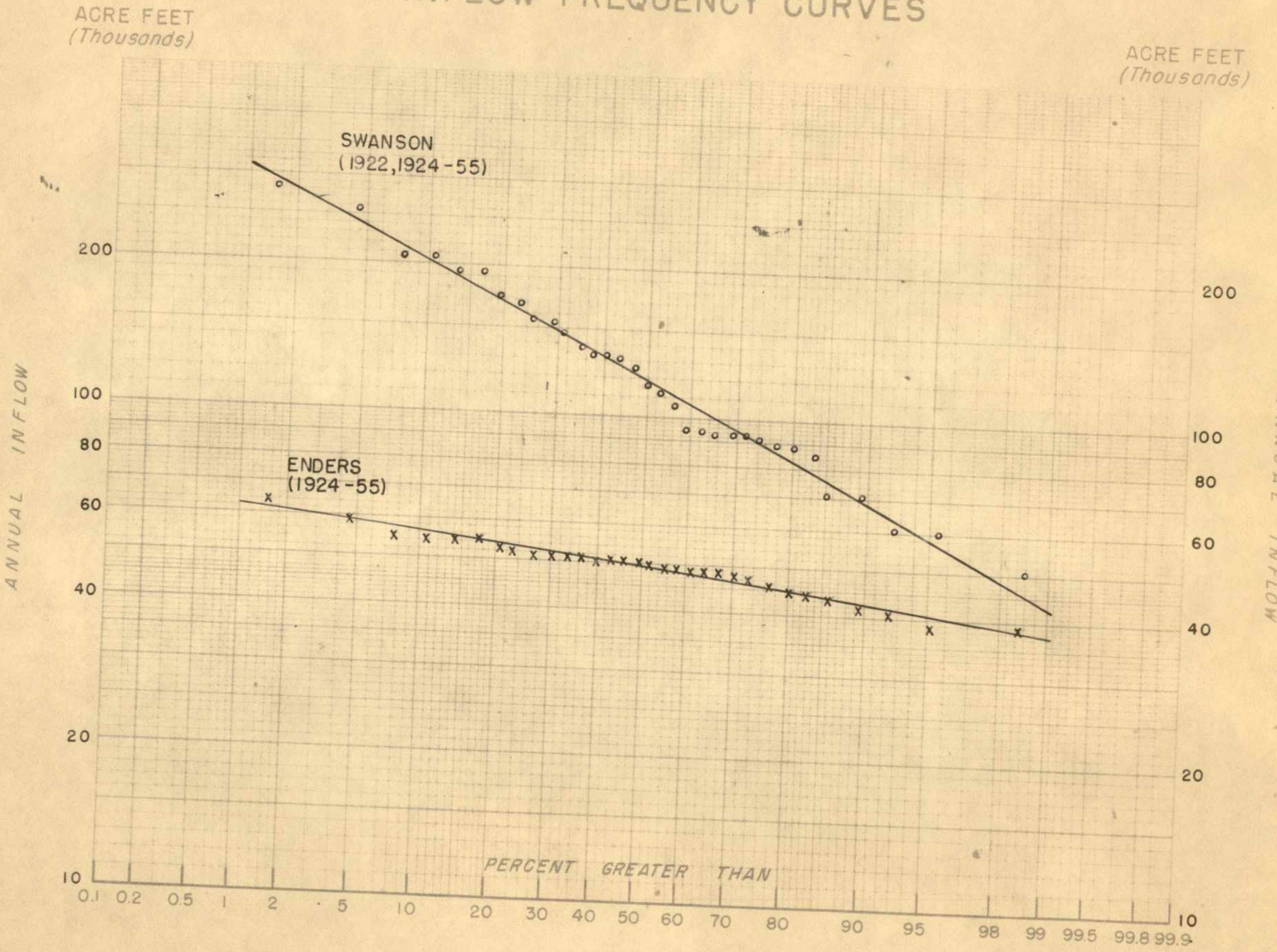
INFLOW FREQUENCY CURVES



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INFLOW FREQUENCY CURVES

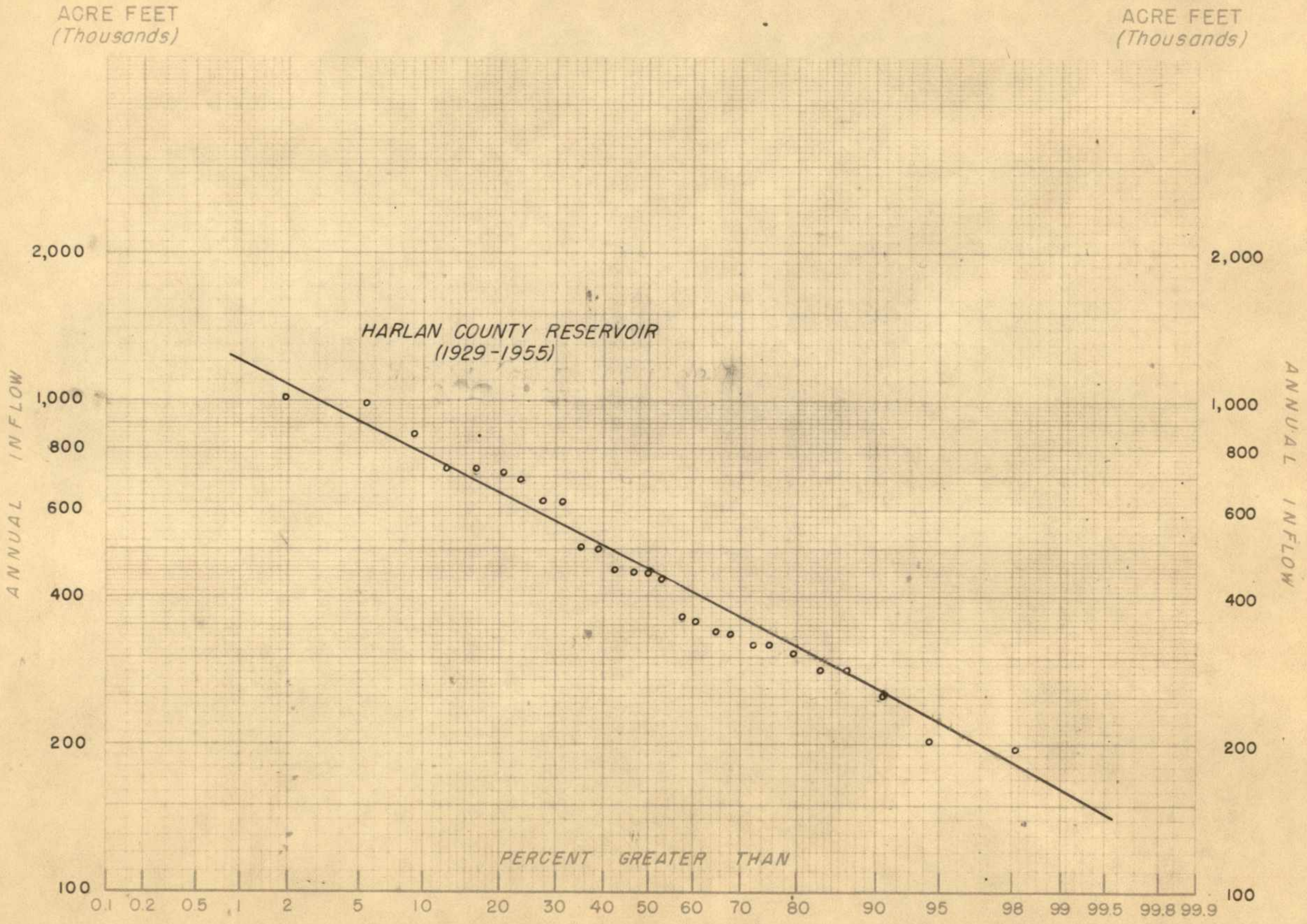

Exhibit 18

INFLOW FREQUENCY CURVES

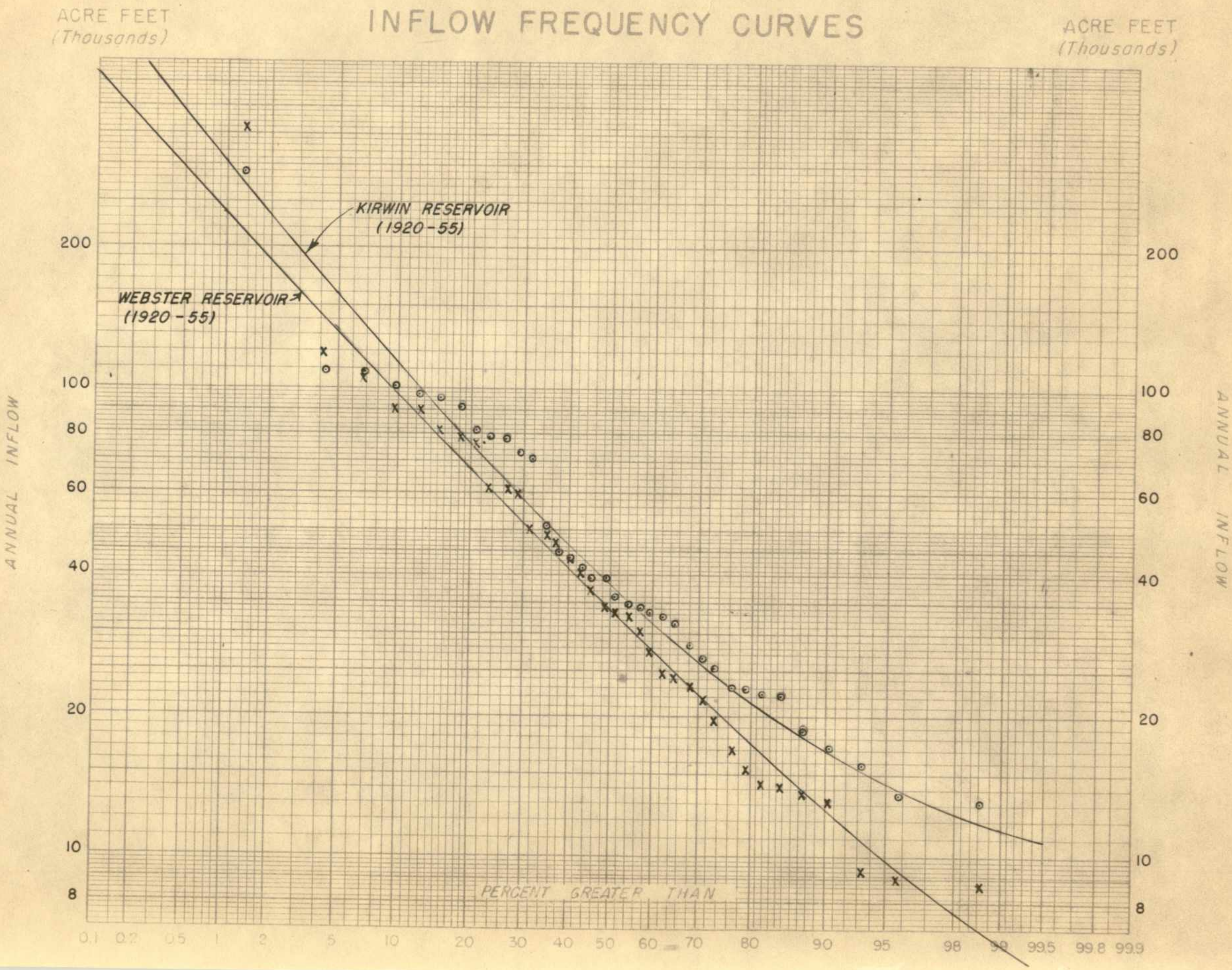

Exhibit 19

INFLOW FREQUENCY CURVES

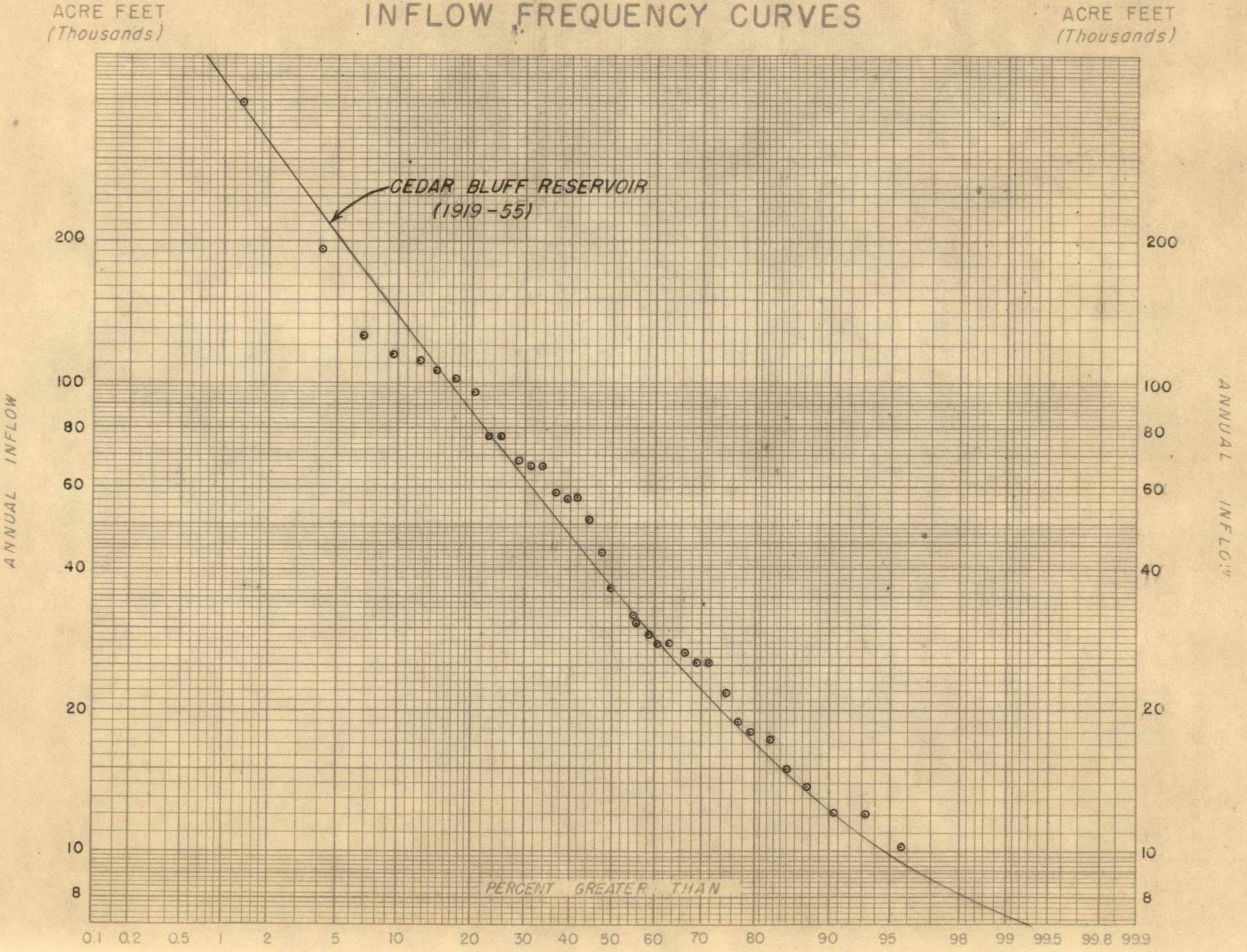

Exhibit 20

TABLE 6

BONNY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9	10	11
		Values in 1000 Acre-feet Unless Indicated Otherwise								
Type of Year	Mo.	Historical Inflow	Net Evaporation In.		Rel. to Hale Ditch	Rel. to River	Total Rel. Req.	Res. Change	Res. Cont. at End of Mo.	Res Spil
Reasonable Minimum Conditions	Dec. (55)	-	-	-	-	-	-	-	35.8	-
	Jan. (56)	2.1	1.45	.2	0	.6	.6	+1.3	37.1	-
	Feb.	2.1	1.55	.2	0	.6	.6	+1.3	38.4	
	Mar.	2.4	2.45	.4	0	.6	.6	+1.4	39.8	
	Apr.	2.0	4.30	.7	.3	.6	.9	+0.4	40.2	
	May	2.0	5.35	.9	.9	.6	1.5	-0.4	39.8	
	June	1.8	6.95	1.1	.9	.6	1.5	-0.8	39.0	
	July	0.7	8.30	1.4	.9	.6	1.5	-2.2	36.8	
	Aug.	0.5	7.00	1.1	.8	.6	1.4	-2.0	34.8	
	Sept.	0.4	5.20	.8	.6	.6	1.2	-1.6	33.2	
	Oct.	1.1	5.05	.8	.5	.6	1.1	-0.8	32.4	
	Nov.	1.6	3.05	.4	.3	.6	.9	+0.3	32.7	
	Dec.	1.8	1.85	.3	0	.6	.6	+0.9	33.6	
	Total	18.5	52.50	8.3	5.2	7.2	12.4	-2.2		
Most Probable Conditions	Dec. (55)	-	-	-	-	-	-	-	35.8	
	Jan. (56)	2.3	1.20	.2	0	.6	.6	+1.5	37.3	
	Feb.	2.3	1.40	.2	0	.6	.6	+1.5	38.8	
	Mar.	2.9	1.85	.3	0	.6	.6	+2.0	40.8	
	Apr.	2.4	2.80	.5	.4	.6	1.0	+0.5	41.3	0.4
	May	3.0	3.00	.5	.6	.6	1.2	0	41.3	1.3
	June	3.0	4.60	.8	.6	.6	1.2	0	41.3	1.0
	July	1.2	6.25	1.0	.4	.6	1.0	-0.8	40.5	-
	Aug.	1.8	6.10	1.0	.4	.6	1.0	-0.2	40.3	-
	Sept.	1.5	4.30	.7	.6	.6	1.2	-0.4	39.9	
	Oct.	1.7	4.55	.7	.6	4.8	5.4	-4.4	35.5	
	Nov.	1.9	2.80	.4	.2	.6	.8	+0.7	36.2	
	Dec.	2.2	1.55	.2	0	.6	.6	+1.4	37.6	
	Total	26.2	40.40	6.5	3.8	11.4	15.2	+1.8		2.7
Reasonable Maximum Conditions	Dec. (55)	-	-	-	-	-	-	-	35.8	
	Jan. (56)	2.8	.90	.1	0	.6	.6	+2.1	37.9	
	Feb.	2.9	1.25	.2	0	.6	.6	+2.1	40.0	
	Mar.	3.5	1.35	.2	0	.6	.6	+1.3	41.3	1.4
	Apr.	3.6	2.40	.4	.3	.6	.9	0	41.3	2.3
	May	4.8	2.05	.3	.5	.6	1.1	0	41.3	3.4
	June	5.9	2.50	.4	.2	.6	.8	0	41.3	4.7
	July	3.9	5.05	.8	.2	.6	.8	0	41.3	2.3
	Aug.	5.0	4.00	.7	.4	.6	1.0	0	41.3	3.3
	Sept.	2.4	3.20	.5	.4	.6	1.0	0	41.3	0.9
	Oct.	2.3	3.40	.5	.3	7.3	7.6	-5.8	35.5	
	Nov.	2.4	2.60	.4	.3	.6	.9	+1.1	36.6	
	Dec.	2.5	1.30	.2	0	.6	.6	+1.7	38.3	
	Total	42.0	30.00	4.7	2.6	13.9	16.5	+2.5		18.3

Note: At end of October elevation should not be higher than approximately three feet below top of irrigation pool and content should not exceed approximately 35,500 A. F.

TABLE 6

BONNY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1 As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions, and 10% = reasonable maximum conditions.

Col. 2 Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distribute on a monthly basis.

Col. 5: Col. 4 values used to determine reservoir evaporation loss for month.

Col. 6: Natural flow claimed by Hale Ditch + supplemental storage used under Warren Act Contracts.

Col. 7: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 8: Col. 7 + 8.

Col. 9: Col. 3 - (Col. 5 + 8)

Col. 10: Content at end of previous month + Col. 9.

Col. 11: Values from Col. 9 that would cause reservoir content to exceed total storage at top of irrigation pool (41,300 A.F.)

TABLE 7

SWANSON LAKE OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9	10	11
		Values in 1000 Acre-Feet Unless Indicated Otherwise								
Type of Year	Mo.	Undepleted Inflow	Corr. for Upstr. Depl.	Depleted Inflow	Net Evaporation In.		Total Rel. Req.	Res. Change	Res. Cont. at End of Mo.	Res Spil
Reasonable Minimum Conditions	Dec. (55)	-	-	-	-	-	-	-	46.6	
	Jan. (56)	7.6	-1.5	6.1	1.05	.3	.3	+5.5	52.1	
	Feb.	9.7	-1.5	8.2	1.20	.3	.3	+7.6	59.7	
	Mar.	10.7	-1.8	8.9	1.95	.6	.3	+8.0	67.7	
	Apr.	8.3	-1.1	7.2	3.85	1.2	.3	+5.7	73.4	
	May	7.5	-0.5	7.0	4.10	1.4	7.7	-2.1	71.3	
	June	6.8	-0.4	6.4	5.20	1.7	7.4	-2.7	68.6	
	July	1.9	+0.5	2.4	7.70	2.3	10.6	-10.5	58.1	
	Aug.	1.8	+0.6	2.4	6.90	1.9	10.8	-10.3	47.8	
	Sept.	0.4	+0.6	1.0	5.25	1.3	8.4	-8.7	39.1	
	Oct.	2.2	0	2.2	4.60	1.1	4.3	-3.2	35.9	
	Nov.	5.3	-0.7	4.6	2.70	.6	.3	+3.7	39.6	
	Dec.	5.8	-1.2	4.6	1.30	.3	.3	+4.0	43.6	
	Total	68.0	-7.0	61.0	45.80	13.0	51.0	-3.0		
Most Probable Conditions	Dec. (55)	-	-	-	-	-	-	-	46.6	
	Jan. (56)	10.0	-1.7	8.3	.75	.2	.3	+7.8	54.4	
	Feb.	12.3	-1.7	10.6	1.00	.3	.3	+10.0	64.4	
	Mar.	14.4	-2.3	12.1	1.40	.4	.3	+11.4	75.8	
	Apr.	11.9	-1.0	10.9	2.40	.8	.3	+9.8	85.6	
	May	14.9	-0.5	14.4	2.10	.8	3.9	+9.7	95.3	
	June	19.5	-0.9	18.6	3.70	1.4	3.8	+13.4	108.7	
	July	5.3	-0.4	4.9	6.10	2.4	9.9	-7.4	101.3	
	Aug.	5.9	-1.0	4.9	5.70	2.1	9.8	-7.0	94.3	
	Sept.	5.1	-0.3	4.8	3.40	1.3	7.5	-4.0	90.3	
	Oct.	4.2	+3.7	7.9	4.30	1.6	3.9	+2.4	92.7	
	Nov.	7.3	-1.1	6.2	2.10	.8	.3	+5.1	97.8	
	Dec.	8.2	-1.6	6.6	1.10	.4	.3	+5.9	103.7	
	Total	119.0	-8.8	110.2	84.05	12.5	40.6	+57.1		
Reasonable Maximum Conditions	Dec. (55)	-	-	-	-	-	-	-	46.6	
	Jan. (56)	13.9	-2.2	11.7	.55	.2	.3	+11.2	57.8	
	Feb.	16.4	-2.3	14.1	.60	.2	.3	+13.6	71.4	
	Mar.	20.4	-1.5	18.9	.60	.2	.3	+18.4	89.8	
	Apr.	16.8	-0.4	16.4	.60	.2	.3	+15.9	105.7	
	May	24.6	-0.3	24.3	.80	.3	.3	+14.5	120.2	9.2
	June	27.5	-0.4	27.1	1.90	.8	.3	0	120.2	26.0
	July	27.9	-0.9	27.0	4.00	1.7	8.8	0	120.2	16.5
	Aug.	15.5	-0.8	14.7	5.00	2.1	9.2	0	120.2	3.4
	Sept.	11.1	-0.5	10.6	2.40	1.0	7.4	0	120.2	2.2
	Oct.	9.6	+5.3	14.9	3.80	1.6	.3	0	120.2	13.0
	Nov.	10.1	-1.5	8.6	1.60	.6	.3	0	120.2	7.7
	Dec.	11.2	-1.9	9.3	.65	.3	.3	0	120.2	8.7
	Total	205.0	-7.4	197.6	22.50	9.2	28.1	+73.6		86.7

TABLE 7

SWANSON LAKE - RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions, and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records corrected for upstream storage, and storage water used by irrigation systems not operated by Bureau of Reclamation. Annual total taken from curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Estimated 1955 depletions or releases resulting from upstream flood control and irrigation works built after 1947.

Col. 5: Col. 3 - Col. 4.

Col. 6: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 7: Col. 6 value used to determine reservoir evaporation loss for month.

Col. 8: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 9: Col. 5 - (Col. 7 + 8)

Col. 10: Content at end of previous month + Col. 9.

Col. 11: Values from Col. 9 which would cause reservoir content to exceed total storage at top of irrigation pool (120,200 A.F.)

TABLE 8

ENDERS RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9
		Values in 1000 Acre-Feet Unless Indicated Otherwise						
Type of Year	Mo.	Historical Inflow	Net Evaporation In.		Total Release Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
Reasonable Minimum Conditions	Dec. (55)	-	-	-	-	-	37.5	
	Jan. (56)	4.3	1.05	.1	1.8	+2.4	39.9	
	Feb.	3.8	1.20	.2	1.8	+1.8	41.7	
	Mar.	3.9	1.95	.3	1.8	+1.8	43.5	
	Apr.	3.5	4.10	.6	2.7	+ .2	43.7	
	May	3.6	4.65	.7	4.6	-1.7	42.0	
	June	3.5	5.25	.7	4.4	-1.6	40.4	
	July	3.1	8.60	1.2	4.7	-2.8	37.6	
	Aug.	3.2	6.85	.8	4.9	-2.5	35.1	
	Sept.	3.2	5.50	.7	4.3	-1.8	33.3	
	Oct.	3.4	4.60	.5	4.3	-1.4	31.9	
	Nov.	3.5	2.65	.3	1.2	+2.0	33.9	
	Dec.	3.8	1.20	.2	1.1	+2.5	36.4	
	Total	42.8	47.60	6.3	37.6	-1.1		
Most Probable Conditions	Dec. (55)	-	-	-	-	-	37.5	
	Jan. (56)	4.8	.75	.1	1.8	+2.9	40.4	
	Feb.	4.3	.95	.1	1.8	+2.4	42.8	
	Mar.	4.4	1.35	.2	1.8	+1.7	44.5	0.7
	Apr.	4.1	2.60	.4	1.8	0	44.5	1.9
	May	4.1	3.00	.4	4.8	-1.1	43.4	
	June	4.2	3.55	.5	4.9	-1.2	42.2	
	July	3.7	5.90	.8	4.7	-1.8	40.4	
	Aug.	3.7	6.50	.9	4.7	-1.9	38.5	
	Sept.	3.7	3.45	.5	4.6	-1.4	37.1	
	Oct.	3.9	4.30	.6	2.7	+ .6	37.7	
	Nov.	4.1	2.30	.3	2.9	+ .9	38.6	
	Dec.	4.3	.90	.1	2.9	+1.3	39.9	
	Total	49.3	35.60	4.9	39.4	+2.4		2.6
Reasonable Maximum Conditions	Dec. (55)	-	-	-	-	-	37.5	
	Jan. (56)	5.1	.55	.1	1.8	+3.2	40.7	
	Feb.	4.7	.30	.1	1.8	+2.8	43.5	
	Mar.	5.1	.95	.1	1.8	+1.0	44.5	2.2
	Apr.	4.6	.80	.1	1.8	0	44.5	2.7
	May	4.8	1.25	.2	3.3	0	44.5	1.3
	June	5.6	2.40	.4	4.8	0	44.5	0.4
	July	4.2	4.35	.6	4.8	-1.2	43.3	
	Aug.	4.2	4.50	.6	4.9	-1.3	42.0	
	Sept.	4.6	2.30	.3	4.8	- .5	41.5	
	Oct.	4.7	3.35	.5	2.7	+1.5	43.0	
	Nov.	4.7	1.90	.3	4.5	- .1	42.9	
	Dec.	4.9	.65	.1	4.4	+ .4	43.3	
	Total	57.2	23.30	3.4	41.4	+5.8		6.6

TABLE 8

ENDERS RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 5: Col. 4 value used to determine reservoir evaporation loss for month.

Col. 6: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 7: Col. 3 - (Col. 5 + 6)

Col. 8: Content at end of previous month + Col. 7.

Col. 9: Values from Col. 7 that would cause reservoir content to exceed total storage at top of irrigation pool (44,500 A.F.)

TABLE 9

HARRY STRUNK LAKE-RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9
		Values in 1000 Acre-Feet Unless Indicated Otherwise						
Type of Year	Mo.	Historical Inflow	Net Evaporation		Total Release Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
			In.					
Reasonable Minimum Conditions	Dec. (55)	-	-	-	-	-	21.9	-
	Jan. (56)	2.8	.76	.1	.3	+2.4	24.3	-
	Feb.	3.0	.89	.1	.3	+2.6	26.9	
	Mar.	3.6	1.87	.2	.3	+3.1	30.0	
	Apr.	3.5	4.23	.5	.7	+2.3	32.3	
	May	3.2	4.07	.5	4.2	-1.5	30.8	
	June	3.1	5.02	.6	5.2	-2.7	28.1	
	July	2.6	8.41	.8	10.1	-8.3	19.8	
	Aug.	2.5	7.42	.5	9.9	-7.9	11.9	
	Sept.	1.7	4.64	.2	6.6	-5.1	6.8	
	Oct.	2.2	4.52	.2	3.1	-1.1	5.7	
	Nov.	2.3	2.57	.1	.3	+1.9	7.6	
	Dec.	2.5	1.10	.1	.3	+2.1	9.7	
	Total	33.0	45.50	3.9	41.3	-12.2		
Most Probable Conditions	Dec. (55)	-	-	-	-	-	21.9	
	Jan. (56)	3.6	.50	.1	.3	+3.2	25.1	
	Feb.	3.9	.75	.1	.3	+3.5	28.6	
	Mar.	4.2	1.40	.2	.3	+3.7	32.3	
	Apr.	4.8	2.29	.3	.3	+4.2	36.5	
	May	5.4	2.41	.4	2.1	+2.7	39.2	.2
	June	8.4	3.67	.5	2.4	0	39.2	5.5
	July	5.2	5.35	.8	8.5	-4.1	35.1	
	Aug.	3.5	5.33	.7	7.4	-4.6	30.5	
	Sept.	3.0	3.71	.4	5.2	-2.6	27.9	
	Oct.	3.1	4.14	.5	2.1	+ .5	28.4	
	Nov.	3.2	2.00	.3	1.4	+1.5	29.9	
	Dec.	3.4	.81	.1	1.3	+2.0	31.9	
	Total	51.7	32.36	4.4	31.6	+10.0		5.7
Reasonable Maximum Conditions	Dec. (55)	-	-	-	-	-	21.9	
	Jan. (56)	4.3	.25	.1	.3	+3.9	25.8	
	Feb.	4.3	.40	.1	.3	+3.9	29.7	
	Mar.	5.6	.49	.1	.3	+5.2	34.9	
	Apr.	6.0	.63	.1	.3	+4.3	39.2	1.3
	May	7.7	.42	.1	.3	0	39.2	7.3
	June	19.9	.98	.2	.3	0	39.2	19.4
	July	9.5	5.13	.8	5.5	0	39.2	3.2
	Aug.	5.7	4.19	.6	5.9	-0.8	38.4	
	Sept.	6.8	2.33	.3	4.9	+ .8	39.2	0.8
	Oct.	4.4	3.66	.4	1.6	0	39.2	2.4
	Nov.	3.8	.46	.1	4.3	-0.6	38.6	
	Dec.	4.0	.34	.1	4.3	-0.4	38.2	
	Total	82.0	19.30	3.0	28.3	+16.3		34.4

TABLE 9

HARRY STRUNK LAKE-RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 5: Col. 4 value used to determine reservoir evaporation loss for month.

Col. 6: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 7: Col. 3 - (Col. 5 + 6)

Col. 8: Content at end of previous month + Col. 7.

Col. 9: Values from Col. 7 that would cause reservoir content to exceed total storage at top of irrigation pool (39,200 A.F.)

TABLE 10

HARLAN COUNTY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9	10	11
		Values in 1000 Acre-Feet Unless Indicated Otherwise								
Type of Year	Mo.	Undepleted Inflow	Corr. for Upstr. Depl.	Depleted Inflow	Net Evaporation In.		Total Rel. Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
Reasonable Minimum Conditions	Dec.(55)								163.3	
	Jan.(56)	18.2	-12.3	5.9	.90	.6	.6	+4.7	168.0	
	Feb.	23.6	-14.1	9.5	.78	.6	.6	+8.3	176.3	
	Mar.	31.9	-15.8	16.1	1.74	1.3	.6	+14.2	190.5	
	Apr.	26.0	-13.0	13.0	4.70	3.7	4.4	+4.9	195.4	
	May	35.4	-3.4	32.0	4.38	3.6	7.7	+20.7	216.1	
	June	52.8	-1.9	50.9	6.60	5.8	11.7	+33.4	249.5	
	July	18.3	+4.6	22.9	9.71	8.6	29.1	-14.8	234.7	
	Aug.	13.8	+4.3	18.1	8.41	7.3	27.8	-17.0	217.7	
	Sept.	7.3	+6.1	13.4	5.56	4.6	19.3	-10.5	207.2	
	Oct.	5.1	0	5.1	4.52	3.7	10.0	-8.6	198.6	
	Nov.	11.9	-9.3	2.6	2.58	2.1	.6	-0.1	198.5	
	Dec.	15.7	-10.4	5.3	1.12	0.9	.6	+3.8	202.3	
	Total	260.0	-65.2	194.8	51.00	42.8	113.0	+39.0		
Most Probable Conditions	Dec.(55)		-	-	-	-	-	-	163.3	
	Jan.(56)	23.1	-16.0	7.1	.65	.5	.6	+6.0	169.3	
	Feb.	31.3	-18.1	13.2	.61	.5	.6	+12.1	181.4	
	Mar.	37.6	-19.9	17.7	1.13	.9	.6	+16.2	197.6	
	Apr.	39.2	-16.8	22.4	1.31	1.1	.6	+20.7	218.3	
	May	61.7	-16.2	45.5	3.27	3.0	.6	+41.9	260.2	
	June	106.7	-17.5	89.2	5.46	5.6	.6	+83.0	343.2	
	July	44.6	-1.4	43.2	7.70	8.4	18.2	+6.9	350.1	9.7
	Aug.	28.8	-0.3	28.5	6.01	6.6	21.4	0	350.1	.5
	Sept.	24.4	-0.3	24.1	4.47	5.1	14.6	0	350.1	4.4
	Oct.	17.0	-5.5	11.5	3.43	3.9	4.5	0	350.1	3.1
	Nov.	19.2	-10.0	9.2	1.55	1.7	.6	0	350.1	6.9
	Dec.	22.0	-11.4	10.6	.71	.8	.6	0	350.1	9.2
	Total	455.6	-133.4	322.2	36.30	38.1	63.5	+186.8		33.8
Reasonable Maximum Conditions	Dec.(55)		-	-	-	-	-	-	163.3	-
	Jan.(56)	28.2	-20.9	7.3	0	0	.6	+6.7	170.0	
	Feb.	40.4	-23.0	17.4	.28	.2	.6	+16.6	186.6	
	Mar.	56.8	-26.5	30.3	.70	.6	.6	+29.1	215.7	
	Apr.	58.4	-21.0	37.4	.21	.2	.6	+36.6	252.3	
	May	103.0	-15.4	87.6	1.78	1.7	.6	+85.3	337.6	
	June	179.6	-1.9	177.7	1.58	1.8	.6	+12.5	350.1	162.8
	July	85.4	-8.9	76.5	6.53	7.2	4.1	0	350.1	65.2
	Aug.	63.6	-9.0	54.6	3.43	3.9	11.0	0	350.1	39.7
	Sept.	74.3	-6.4	67.9	3.84	4.2	2.7	0	350.1	61.0
	Oct.	31.8	-0.7	31.1	2.28	2.6	.6	0	350.1	27.9
	Nov.	28.4	-1.8	26.6	1.03	1.2	.6	0	350.1	24.8
	Dec.	30.1	-2.4	27.7	.40	.4	.6	0	350.1	26.7
	Total	780.0	-137.9	642.1	22.00	24.0	23.2	+186.8		408.1

TABLE 10

HARLAN COUNTY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable year, and 10% = reasonable maximum condition.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: The undepleted inflow columns are historical records correct for upstream storage, new diversions for irrigation by canals constructed after 1947, and storage water used by irrigation systems not operated by Bureau of Reclamation. Annual total taken from curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Estimated 1956 depletions or releases resulting from upstrea flood control and irrigation works built after 1947.

Col. 5: Col. 3 - Col. 4.

Col. 6: Net evaporation as determined from frequency curve distribut on a monthly basis.

Col. 7: Col. 6 value used to determine reservoir evaporation loss for month.

Col. 8: Irrigation and other requirements. When spills appear probable, it is very likely that these values will vary from those indicated.

Col. 9: Col. 5 - (Col. 7 + 8)

Col. 10: Content at end of previous month + Col. 9.

Col. 11: Values from Col. 9 which would cause reservoir content to exceed total storage at top of irrigation pool (350,100 A.F.

TABLE 11

KIRWIN RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9
		Values in 1000 Acre-Feet Unless Indicated Otherwise						
Type of Year	Mo.	Historical Inflow	Net Evaporation In.		Total Release Req.	Res. Change	Res. Cont. at End of Mo.	Res Spil
Reasonable Minimum Inflow Conditions	Dec. (55)	--	--	--	--	--	6.0	--
	Jan. (56)	0.1	.91	0.1	0.3	-0.3	5.7	
	Feb.	0.8	1.04	0.1	0.3	+0.4	6.1	
	Mar.	1.4	1.79	0.1	0.3	+1.0	7.1	
	Apr.	1.5	4.60	0.3	0.3	+0.9	8.0	
	May	2.4	4.77	0.4	0.3	+1.7	9.7	
	June	4.2	6.32	0.6	0.3	+3.3	13.0	
	July	2.7	8.80	0.9	0.3	+1.5	14.5	
	Aug.	1.9	7.74	0.8	0.3	+0.8	15.3	
	Sept.	1.1	5.66	0.6	0.3	+0.2	15.5	
	Oct.	0.2	4.61	0.5	0.3	-0.6	14.9	
	Nov.	0.4	2.54	0.3	0.3	-0.2	14.7	
	Dec.	0.3	1.22	0.1	0.3	-0.1	14.6	
	Total	17.0	50.00	4.8	3.6	+8.6		
Most Probable Inflow Conditions	Dec. (55)	--	--	--	--	--	6.0	--
	Jan. (56)	0.9	.73	0.1	0.3	+0.5	6.5	
	Feb.	1.8	.77	0.1	0.3	+1.4	7.9	
	Mar.	2.0	1.04	0.1	0.3	+1.6	9.5	
	Apr.	2.6	1.89	0.2	0.3	+2.1	11.6	
	May	4.2	3.60	0.4	0.3	+3.5	15.1	
	June	10.2	4.65	0.7	0.3	+9.2	24.3	
	July	5.8	6.33	1.1	0.3	+4.4	28.7	
	Aug.	4.4	5.56	1.0	0.3	+3.1	31.8	
	Sept.	2.5	4.25	0.8	0.3	+1.4	33.2	
	Oct.	1.5	3.59	0.7	0.3	+0.5	33.7	
	Nov.	1.2	1.85	0.3	0.3	+0.6	34.3	
	Dec.	1.0	.74	0.2	0.3	+0.5	34.8	
	Total	38.1	35.00	5.7	3.6	+28.8		
Reasonable Maximum Inflow Conditions	Dec. (55)	--	--	--	--	--	6.0	--
	Jan. (56)	2.0	.45	0.0	0.3	+1.7	7.7	
	Feb.	2.6	.50	0.1	0.3	+2.2	9.9	
	Mar.	2.9	.56	0.1	0.3	+2.5	12.4	
	Apr.	5.2	.53	0.1	0.3	+4.8	17.2	
	May	11.6	1.68	0.3	0.3	+11.0	28.2	
	June	32.7	1.66	0.5	0.3	+31.9	60.1	
	July	14.4	5.47	2.0	0.3	+12.1	72.2	
	Aug.	19.8	4.67	1.9	0.3	+17.6	89.8	
	Sept.	12.7	2.75	1.1	0.3	+5.4	95.2	
	Oct.	5.1	2.27	0.9	0.3	0.0	95.2	5.9
	Nov.	3.7	1.02	0.4	0.3	0.0	95.2	3.9
	Dec.	2.3	.54	0.3	0.3	0.0	95.2	3.0
	Total	115.0	22.10	7.7	3.6	+89.2		1.7 14.5

TABLE 11

KIRWIN RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 5: Col. 4 value used to determine reservoir evaporation loss for month.

Col. 6: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 7: Col. 3 - (Col. 5 + 6)

Col. 8: Content at end of previous month + Col. 7.

Col. 9: Values from Col. 7 that would cause reservoir content to exceed total storage at top of irrigation pool (71,700 A.F.)

TABLE 12

WEBSTER RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9
		Values in 1000 Acre-Feet Unless Indicated Otherwise						
Type of Year	Mo.	Historical Inflow	Net Evaporation In.		Total Release Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
Reasonable Minimum Inflow Conditions	Dec. (55)	--	--	--	--	--	0	--
	Jan. (56)	0.1	.96	0	0.1	0	0	
	Feb.	0.8	1.11	0	0.8	0	0	
	Mar.	1.2	2.08	0	1.2	0	0	
	Apr.	1.5	4.92	0	1.5	0	0	
	May	1.7	4.75	.1	.3	+1.3	1.3	
	June	3.6	7.50	.2	.3	+3.1	4.4	
	July	1.7	9.04	.5	.3	+0.9	5.3	
	Aug.	0.8	8.08	.5	.3	0	5.3	
	Sept.	0.9	6.70	.4	.3	+0.2	5.5	
	Oct.	0	4.71	.3	.3	-0.6	4.9	
	Nov.	0.1	2.45	.1	.3	-0.3	4.6	
	Dec.	0.1	1.20	.1	.3	-0.3	4.3	
	Total	12.5	53.50	2.2	6.0	+4.3		
Most Probable Inflow Conditions	Dec. (55)	--	--	--	--	--	0	--
	Jan. (56)	0.7	.67	0	0.7	0	0	
	Feb.	1.6	.81	0	1.6	0	0	
	Mar.	1.9	1.48	0	1.9	0	0	
	Apr.	2.8	2.72	0	2.8	0	0	
	May	4.3	3.13	.1	.3	+3.9	3.9	
	June	10.3	4.40	.4	.3	+9.6	13.5	
	July	4.4	7.02	.8	.3	+3.3	16.8	
	Aug.	3.2	5.72	.7	.3	+2.2	19.0	
	Sept.	2.3	4.69	.6	.3	+1.4	20.4	
	Oct.	0.8	3.37	.5	.3	0	20.4	
	Nov.	0.9	1.61	.2	.3	+0.4	20.8	
	Dec.	0.7	.78	.1	.3	+0.3	21.1	
	Total	33.9	36.40	3.4	9.4	+21.1		
Reasonable Maximum Inflow Conditions	Dec. (55)	--	--	--	--	--	0	--
	Jan. (56)	2.1	.53	0	2.1	0	0	
	Feb.	2.4	.48	0	2.4	0	0	
	Mar.	3.7	.70	0	3.7	0	0	
	Apr.	6.3	1.00	0	6.3	0	0	
	May	10.1	1.74	.1	.3	+9.7	9.7	
	June	22.9	.72	.1	.3	+22.5	32.2	
	July	14.2	5.63	1.1	.3	+12.8	45.0	
	Aug.	14.5	4.03	1.0	.3	+13.2	58.2	
	Sept.	11.9	3.75	1.0	.3	+10.6	68.8	
	Oct.	4.4	2.83	.8	.3	+2.9	71.7	0.4
	Nov.	3.5	.99	.3	.3	0	71.7	2.9
	Dec.	2.0	.60	.1	.3	0	71.7	1.6
	Total	98.0	23.00	4.5	16.9	+71.7		4.9

Note: Expect storage to commence about May 1, 1956, but depends upon rate of construction progress.

TABLE 12

WEBSTER RESERVOIR OPERATION STUDY ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditions, and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 5: Col. 4 value used to determine reservoir evaporation loss for month.

Col. 6: Irrigation and other requirements. When spills appear probable, it is very likely these values will vary from those indicated.

Col. 7: Col. 3 - (Col. 5 + 6)

Col. 8: Content at end of previous month + Col. 7.

Col. 9: Values from Col. 7 that would cause reservoir content to exceed total storage at top of irrigation pool (95,000 A.F.)

TABLE 13

CEDAR BLUFF RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

1	2	3	4	5	6	7	8	9
		Values in 1000 Acre-Feet Unless Indicated Otherwise						
Type of Year	Mo.	Historical Inflow	Net Evaporation In.		Total Release Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
Reasonable Minimum Inflow Conditions	Dec. (55)	--	--	--	--	--	127.0	--
	Jan. (56)	0.3	1.22	0.5	.3	-.5	126.5	
	Feb.	0.6	1.31	0.5	.3	-.2	126.3	
	Mar.	0.8	2.34	1.0	.3	-.5	125.8	
	Apr.	0.7	4.84	2.1	.3	-1.7	124.1	
	May	1.4	4.81	2.0	.4	-1.0	123.1	
	June	2.6	7.75	3.1	.4	-.9	122.2	
	July	2.5	9.15	4.0	.5	-2.0	120.2	
	Aug.	1.4	8.24	3.2	.7	-2.5	117.7	
	Sept.	0.9	6.69	2.8	.6	-2.5	115.2	
	Oct.	0.4	4.94	1.9	.3	-1.8	113.4	
	Nov.	0.4	2.76	1.0	.3	-0.9	112.5	
	Dec.	0.4	1.45	0.6	.3	-0.5	112.0	
	Total	12.4	55.50	22.7	4.7	-15.0		
Most Probable Inflow Conditions	Dec. (55)	--	--	--	--	--	127.0	
	Jan. (56)	0.8	1.06	0.4	.3	+0.1	127.1	
	Feb.	1.1	1.10	0.5	.3	+0.3	127.4	
	Mar.	1.1	1.57	0.6	.3	+0.2	127.6	
	Apr.	2.1	3.26	1.4	.3	+0.4	128.0	
	May	3.8	3.09	1.4	.3	+2.1	130.1	
	June	10.1	4.66	2.0	.3	+7.8	137.9	
	July	5.9	7.68	3.6	.3	+2.0	139.9	
	Aug.	4.5	5.73	2.7	.4	+1.4	141.3	
	Sept.	4.0	4.64	2.2	.4	+1.4	142.7	
	Oct.	1.5	3.74	1.8	.4	-0.7	142.0	
	Nov.	1.2	2.13	1.0	.3	-0.1	141.9	
	Dec.	0.8	1.09	0.5	.3	0.0	141.9	
	Total	36.9	39.75	18.1	3.9	+14.9		
Reasonable Maximum Inflow Conditions	Dec. (55)	--	--	--	--	--	127.0	
	Jan. (56)	2.1	.89	0.4	.3	+1.4	128.4	
	Feb.	2.3	.78	0.3	.3	+1.7	130.1	
	Mar.	3.1	1.05	0.5	.3	+2.3	132.4	
	Apr.	7.5	2.12	0.9	.3	+6.3	138.7	
	May	22.8	1.86	0.8	.3	+21.7	160.4	
	June	43.9	.80	0.4	.3	+24.7	185.1	18.5
	July	15.7	6.07	3.1	.3	0.0	185.1	12.3
	Aug.	17.6	3.98	2.4	.3	0.0	185.1	14.9
	Sept.	11.8	3.97	2.4	.3	0.0	185.1	9.1
	Oct.	6.5	2.63	1.6	.3	0.0	185.1	4.6
	Nov.	2.6	1.52	0.9	.3	0.0	185.1	1.4
	Dec.	2.1	.83	0.5	.3	0.0	185.1	1.3
	Total	138.0	26.50	14.2	3.6	+58.1		62.1

TABLE 13

CEDAR BLUFF RESERVOIR OPERATION STUDY
ESTIMATES FOR 1956

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = reasonable minimum conditions, 50% = most probable conditio and 10% = reasonable maximum conditions.

Col. 2: Months for a calendar year in order to include a complete irrigation season.

Col. 3: Historical records determined from frequency curve (noted for Col. 1) and distributed on a monthly basis.

Col. 4: Net evaporation, as determined from frequency curve, distributed on a monthly basis.

Col. 5: Col. 4 value used to determine reservoir evaporation loss for month.

Col. 6: Irrigation and other requirements. When spills appear probable, it is likely these values will vary from those indicated.

Col. 7: Col. 3 - (Col. 5 + 6)

Col. 8: Content at end of previous month + Col. 7.

Col. 9: Values from Col. 7 that would cause reservoir content to exceed total storage at top of irrigation pool (185,100 A.F