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ANNUAL OPERATING PLAN
KANSAS RIVER PROJECTS

1954 OPERATIONS
1955 PLAN OF OPERATION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION—REGION 7
DENVER, COLORADO
FEBRUARY 1955

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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

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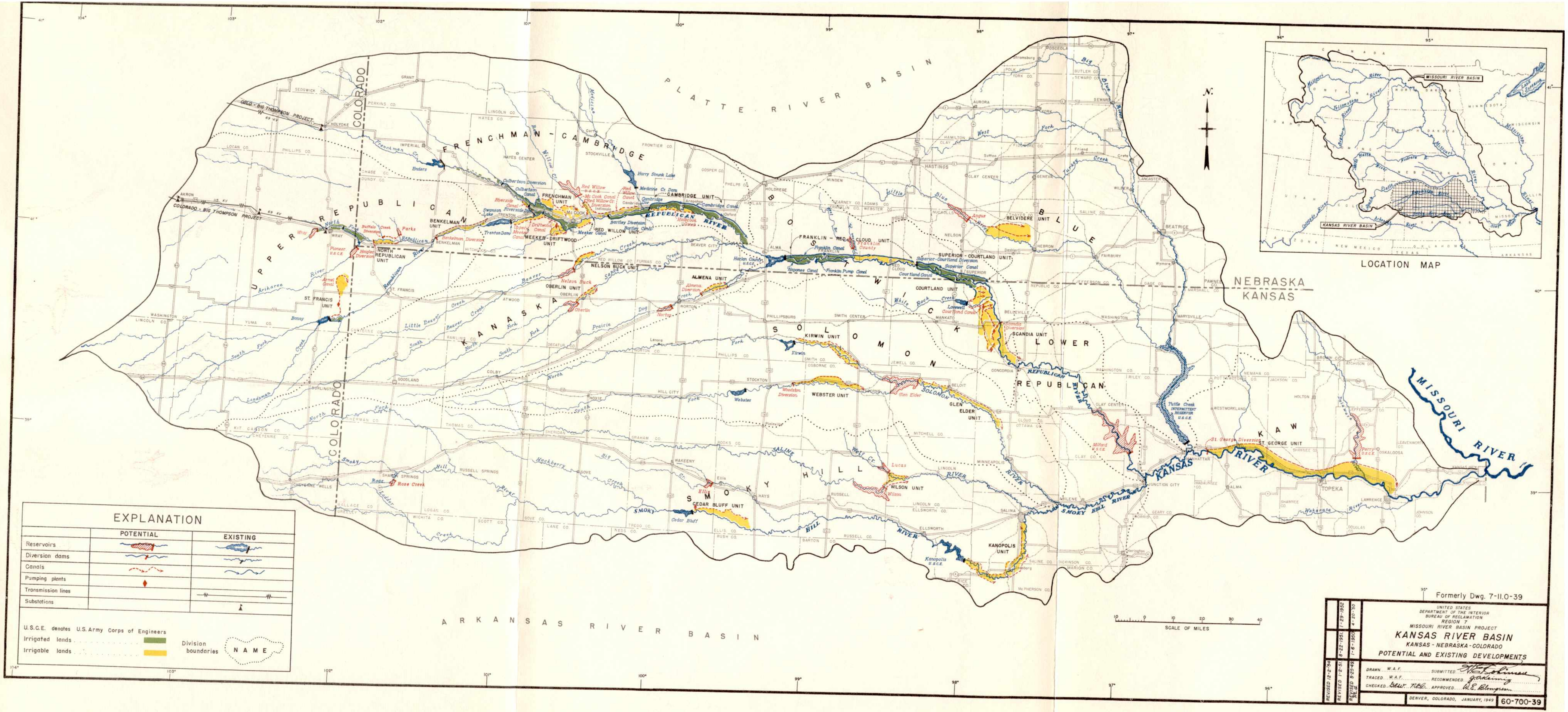

PLATTE RIVER BASIN
ARKANSAS RIVER BASIN
NEBRASKA
KANSAS
COLORADO
MISSOURI RIVER
UPPER REPUBLICAN
FRENCHMAN-CAMBRIDGE
BOSTWICK
LOWER REPUBLICAN
KANASKA
SOLOMON
SMOKY HILL
KAW
BLUE
REPUBLICAN RIVER
KANSAS RIVER
SMOKY HILL RIVER
SALINE RIVER
CAMBRIDGE UNIT
FRENCHMAN UNIT
BENKELMAN UNIT
NORTH REPUBLICAN UNIT
ST. FRANCIS UNIT
NELSON BUCK UNIT
OBERLIN UNIT
ALMENA UNIT
FRANKLIN - RED CLOUD UNIT
SUPERIOR - COURTLAND UNIT
COURTLAND UNIT
SCANDIA UNIT
BELVIDERE UNIT
KIRWIN UNIT
WEBSTER UNIT
GLEN ELDER UNIT
WILSON UNIT
CEDAR BLUFF UNIT
KANOPOLIS UNIT
ST GEORGE UNIT
TOPEKA
LOCATION MAP
MISSOURI RIVER BASIN
KANSAS RIVER BASIN
N.
SCALE OF MILES
EXPLANATION
POTENTIAL
EXISTING
Reservoirs
Diversion dams
Canals
Pumping plants
Transmission lines
Substations
U.S.C.E. denotes U.S. Army Corps of Engineers
Irrigated lands
Irrigable lands
Division boundaries
NAME
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.
TRACED W.A.F.
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
DENVER, COLORADO, JANUARY, 1949
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SYNOPSIS

Annual Operating Plan - Kansas River Projects

1954 Operations

1955 Plan of Operation

This is the second "Annual Operating Plan" for the Kansas River Projects. The first such plan issued in March 1954 was entitled a report on the "Republican River and Smoky Hill River Basins". The scope of the report is limited to irrigation and such collateral purposes as are within the functions and responsibilities of the Bureau of Reclamation. It does not pertain to the operation of such facilities for flood control, because such operation is the responsibility of the Corps of Engineers.

The "Annual Operating Plan" concerns primarily only those Federally constructed irrigation facilities in the Republican, Solomon, and Smoky Hill River drainage areas which were in operation during 1954, or are expected to be in operation during 1955. The operational data in this report pertaining to Harlan County Reservoir, which was constructed and is operated by the Corps of Engineers, has been prepared in cooperation with the Corps.

During 1954, irrigation water was delivered to approximately 17,950 acres of Bureau operated irrigation systems, and 15,670 acres of privately operated irrigation systems received supplemental water. Practically all of the acreages served were in the Republican River Basin. Although this was one of the driest years of record, there was an adequate water supply to meet all irrigation requirements. Reservoirs in operation during 1954 were Bonny, Swanson, Enders, Harry Strunk, Harlan County (operated by the Corps of Engineers), and Cedar Bluff.

It is anticipated that during 1955 approximately 23,740 acres may receive irrigation water under Bureau operated irrigation systems. If it is a dry year, 17,600 acres under privately operated irrigation systems may obtain supplemental water. Most of these areas will be in

the Republican River Basin. No shortages of irrigation water are expected, even for a dry year. In addition to the six reservoirs noted above, two reservoirs in the Solomon River Basin will be placed in operation during 1955. Closure is expected at Kirwin Dam during February and at Webster Dam during November.

KANSAS RIVER PROJECTS

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CHAPTER I

INTRODUCTION

The Federally constructed reservoirs of the Kansas River Projects 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 Projects. 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 Projects. 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 1954 operations and the plan of operation for 1955. 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 Projects includes Federally constructed facilities in the Kansas River Basin for which the Bureau of Reclamation 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. 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 seven reservoirs in operation. Five of these reservoirs, Bonny, Swanson Lake, Enders, Harry Strunk Lake, 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 which is now used to supply irrigation water. Reservoirs which will be formed by three dams now under construction, Kirwin, Webster, and Lovewell, will be operated by the Bureau of Reclamation. The storage allocations for these reservoirs are shown in Exhibit 1.

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 1954, or will be concerned with in 1955, 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 supplemental water to the privately owned and operated Hale Ditch. About 1,540 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 450 acres under the Riverside Canal (non-government operated). Supplemental water charged to the Riverside Canal on Frenchman-Creek, is to replace natural flow claimed by the Meeker Canal, on the Republican River, but taken out of priority by irrigators under the Riverside Canal. Supplemental water was also supplied to the Meeker Canal which is operated by the Bureau of Reclamation. Also, approximately 450 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. It is planned that eventually the diversion point for the Meeker Canal will be moved from its present location below the mouth of Frenchman Creek to a diversion point at Trenton Dam (Swanson Lake), and 16,440 acres will be served by the Meeker-Driftwood Canal.

Enders Reservoir, on Frenchman Creek near Enders, Nebraska, has supplied supplemental water to approximately 9,350 acres under the Culbertson Canal and 1,030 acres under the Krotter Canal. Both of these canals are privately owned and operated. Also supplemental water has been supplied to about 3,025 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 operation, 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, has been used to serve 6,410 acres under the Cambridge Canal and approximately 720 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, now under construction by the Bureau of Reclamation, is scheduled for completion in April 1956. It is expected that 11,987 acres will eventually be served under the canal. A total of 1,356 acres were irrigated under the upper portion of the canal in 1954. Naponee Canal was completed by the Bureau of Reclamation in 1954 to serve a total of 1,544 acres. The canal will be used for the first time for irrigation purposes in 1955.

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 1,519 acres were irrigated in 1954.

The Superior-Courtland Diversion Dam, constructed by the Bureau of 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 3,865 acres in 1954. The Courtland Canal in Nebraska has been completed to serve 2,573 acres, but only 1,292 acres were irrigated in 1954. 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 (about 25 miles) will be available for use in 1955.

Lovewell 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 is under construction by the Bureau of Reclamation and is scheduled for completion in July 1955; however, the work is progressing ahead of schedule. No construction has been started on the irrigation system to be served from the reservoir.

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 shared alike, 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 Projects 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; however, insofar as is practical efforts are also made to operate the reservoirs in such a manner as to satisfy requirements for stream pollution abatement, fish and wildlife interests, and other recreational interests.

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 Projects.

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 Projects 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 three 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 1954 OPERATIONS

The year 1954 was one of the driest on record at reservoirs in the Kansas River Projects area and in most cases was even drier than 1953. Inflows at Swanson Lake, Harlan County Reservoir, and Cedar Bluff Reservoir were the lowest on record. Inflow at all of the other reservoirs, except Enders Reservoir, was far below normal and close to the driest years of record. (See Table 1 and Exhibits 2 and 3).

Irrigation under Bureau operated projects was limited in 1954 to areas in the Republican River Basin. No shortages of irrigation water were experienced. Table 2 lists the monthly diversion by the various canals and Exhibits 4 and 5 show the cumulative monthly diversions during 1954. A total of about 17,950 acres was irrigated under Bureau operated projects during 1954 and approximately 15,670 acres of land not under Bureau operated projects received supplemental water.

Table 3 shows the monthly inflow, outflow and reservoir content at each of the reservoirs. The amount of storage releases indicated in Table 3 was computed on a daily basis by determing 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 Exhibit 6. Total annual inflows at all reservoirs during the entire periods of record are shown in Exhibits 7 through 14.

Exhibit 1 is a schematic drawing of the projects in the Kansas River Projects area. This exhibit also contains a table listing important operational data including reservoir contents at the start and end of the 1954 irrigation season.

Upper Republican Division

At Bonny Reservoir natural flow rights were observed and supplemental water was supplied to the Hale Ditch during 1954. A total of 5,493 acre-feet was released for 1,541 acres. About half of the acreage was on land above the canal and was served by sprinklers. The total diversion included 642 acre-feet of supplemental water to 1,100 acres under Warren Act Contracts. The reservoir started the calendar year with 37,500 acre-feet of storage and ended the year with 35,600 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 the period March through June. During October and November releases were made to the river in order to lower the reservoir level from elevation 3669.30 feet to elevation 3668.60 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 1954 was 18,700 acre-feet. The average for 26 years of record is 32,500 acre-feet.

Frenchman-Cambridge Division

Swanson Lake commenced the 1954 calendar year with a storage of 9,700 acre-feet and ended the year with a content of 25,700 acre-feet. Reservoir releases were made to provide supplemental water to the Riverside Canal and the Meeker Canal. Releases were also made for the Bartley Canal. The total historical inflow in 1954 was 46,000 acre-feet compared with a 32-year average of 136,600 acre-feet. The historical inflow, adjusted by adding upstream uses in 1954, was 51,600 acre-feet compared with a 32-year adjusted average of 138,400 acre-feet.

Riverside Canal, which is non-Bureau operated, used 201 acre-feet of supplemental water under Warren Act Contracts on 451 acres.

Meeker Canal, operated by the Bureau, diverted a total of 11,375 acre-feet of natural flow and storage water to serve 3,051 acres. Supplemental storage amounting to 488 acre-feet was used on 800 acres.

Bartley Canal diverted water for the first time in 1954. Only 13.5 miles of the total 19 miles of Bartley Canal received water and this was not started until late August. A total of 1,525 acre-feet was used to irrigate 450 acres and prime the canal.

Enders Reservoir started the 1954 calendar year with a total storage of 34,000 acre-feet and ended the year with 38,800 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, Krotter 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 50,300 acre-feet compared with a 31-year average of 49,600 acre-feet.

A total of 1,260 acre-feet of supplemental water was delivered to approximately 9,353 acres under the Culbertson Canal, which is not operated by the Bureau.

Another non-Bureau operated system, Krotter Canal, used 290 acre-feet of supplemental water on 1,028 acres.

Various pump irrigators used a total of 850 acre-feet of storage water on 3,024 acres.

On January 1, 1954, the storage in Harry Strunk Lake amounted to 32,300 acre-feet. At the end of the year the storage was 28,200 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 the period January through May. The total inflow for the year was 39,900 acre-feet compared with a 30-year average of 55,600 acre-feet.

During the period July 8-20 the entire natural flow of approximately 30 second-feet was by-passed at Cambridge Diversion Dam, on orders of the State Water Commission, to satisfy a one second-foot water right on the Republican River about 45 miles below the diversion dam. At the end of that period a newly constructed wasteway on the Cambridge Canal was available and was used to make deliveries to the one second-foot water right senior to that of the Cambridge Canal. The rate at which the by-passed natural flow progressed downstream indicated that if the 30-second foot by-pass was made continuously during an extremely dry period the natural flow was not sufficient to get to a point 45 miles below the diversion dam.

A total of 22,859 acre-feet was diverted by the Cambridge Canal to serve 6,410 acres and to season the last 19 miles of newly constructed canal.

Supplemental storage amounting to 231 acre-feet was delivered from Harry Strunk Lake to 717 acres under pump irrigation.

Bostwick Division

During 1954 the lowest inflow on record occurred at Harlan County Reservoir. On January 1, 1954 Harlan County Reservoir had a total storage content of 122,300 acre-feet. At the end of the year the content was 160,000 acre-feet. Reservoir releases were made to irrigate lands under the Franklin, Franklin South Side Pump, Superior, and Courtland Canals. The total historical inflow during 1954 was 116,400 acre-feet compared with a 26-year average of 492,300 acre-feet. The historical inflow adjusted by adding upstream uses in 1954 amounted to 200,700 acre-feet compared with an adjusted average of 505,100 acre-feet.

Diversions were made for the first time in 1954 to about 14 miles of the Franklin Canal. A total of 7,930 acre-feet was diverted to serve 1,356 acres and to season the canal.

The Franklin Pump Canal diverted 2,540 acre-feet to irrigate 1,519 acres.

The Superior Canal diverted 9,612 acre-feet to serve 3,865 acres.

Courtland Canal diverted 13,601 acre-feet to serve a total of 1,292 acres and season the canal. About 16 miles of the canal were used in Nebraska and 8 miles were seasoned in Kansas. Of the total acreage, only 30 acres were in Kansas.

During the summer months, approximately 40 second-feet were by-passed at the Superior-Courtland Diversion Dam to provide minimum flows recommended for stream pollution abatement. 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 1954 it was necessary to make storage releases from Harlan County Reservoir in order to provide the recommended amount of by-pass.

Solomon Division

No storage occurred in Kirwin or Webster Reservoirs during 1954; however, Kirwin Reservoir will start storing in February 1955 and it is expected that storage will start at Webster Reservoir in November 1955.

In 1954 the flow at Kirwin Dam was 46,500 acre-feet compared with a 35-year average of 55,800 acre-feet. The flow at Webster Dam was 24,200 acre-feet compared with a 35-year average of 52,100 acre feet.

Smoky Hill Division

Cedar Bluff Reservoir started the 1954 calendar year with a content of 110,000 acre-feet and ended the year with a content of 95,200 acre-feet. The inflow of 3,200 acre-feet was the lowest on record. The 36-year average inflow is 61,600 acre-feet. No construction has started on the proposed irrigation system to be served from Cedar Bluff Reservoir. Releases during 1954 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 176 acre-feet in 1954 to irrigate 76 acres.

During the months of July through October a total of about 2,200 acre-feet 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 1955

The Plan of Operation for 1955 will be similar to the Operation of 1954 and will not bear much resemblance to the basin type of operation which will be required with complete development in the Kansas River Projects area. The irrigation of land will be limited primarily to the Republican River Basin except for the possible operation of development and research farms served by pumps because no canals have yet been constructed in other river basins.

Water Supply

The water supply outlook for 1955 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 more than meet the maximum requirements during this season. 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 have 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, 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.

It appears that any estimation of stream flows in the Kansas River Projects 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 major 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 projects.

The frequency method of analysis was used to estimate reservoir inflow for dry, normal and west conditions. Frequency curves were drawn and shown as Exhibits 15 through 19. The discharge occurrences for 10, 50, and 90 per cent of the time were used to represent wet, normal and dry conditions, respectively. These computed values are shown in Table 1.

The basic data used for the frequency analysis were as follows:

Bonny Reservoir. Twenty-six years, of which 15 years are direct measurement and 11 are built up by correlations. January 1929 - August 1937, is based on the built-up records at Hale adjusted to the dam site. These records are built up on a correlation of South Fork Republican River at Hale versus Republican River at Max.

September 1937 - March 1940, is based on the Hale station records filled out by correlation with South Fork Republican near Benkleman.

April 1940 - September 1947, is based on Hale records adjusted to the dam site.

October 1947 - March 1950, is based on South Fork Republican River at Colorado-Kansas Line, adjusted to the dam site.

April 1950 - December 1954, is the sum of records of South Fork Republican River near Idalia and Landsman Creek near Hale.

Swanson Lake. Thirty-two years, of which 31 are direct measurement and one is built up by correlation.

January 1922 - December 1922 and January 1924 - November 1946, are based on records of Republican River at Culbertson adjusted to the dam site. During this period, records for Culbertson for April and October 1929, and January through September 1930, were estimated by correlation with Republican River at Max.

December 1946 - July 1950, records at Trenton were used.

August 1950 - December 1954, records at Stratton were used. Starting with July 1950, the historical records have been corrected for upstream depletions.

Enders Reservoir. Thirty-one years, 21 of which are measured records and 10 are built up by correlation.

January 1924 - December 1930, records at Imperial were used.

January 1931 - November 1940, inflow considered to be 69 per cent of the flow at the Hamlet station of Frenchman Creek.

December 1940 - December 1954, records at Imperial were used.

Harry Strunk Lake. Thirty years, 24 years based on measurement and six years based on correlation.

January 1925 - September 1931, January 1937 - September 1943, and October 1944 - July 1949, based on Medicine Creek records at Cambridge, adjusted to Harry Strunk Lake.

October 1931 - December 1936, based on correlation between Medicine Creek at Cambridge and Frenchman Creek at Culbertson.

October 1943 - September 1944, based on correlation between Cambridge and Red Willow Creek near Red Willow.

August 1949 - December 1954, is the sum of records of Medicine Creek and Mitchell Creek above Harry Strunk Lake.

Harlan County Reservoir. Twenty-six years, all based on measurement.

January 1929 - September 1947, is based on Bloomington records adjusted to the reservoir location.

October 1947 - December 1954, is considered to be the sum of records of Republican River at Orleans, Sappa Creek near Stamford, and Prairie Dog Creek near Woodruff. Starting with August 1949 historical records have been corrected for upstream depletions.

Kirwin Reservoir. Thirty-five years of which 22 years are records and 13 years based on correlations. January 1920 - June 1925, September 1928 - June 1932, and January 1942 to December 1954 are records.

July 1925 - August 1928 based on correlation with Solomon at Niles.

September 1928 - June 1932 are records.
July 1932 - December 1941 based on correlation with Solomon at Beloit.

January 1942 - December 1954 are records.

Webster Reservoir. Thirty-five years of which 10 years are records and 25 based on correlations.

February 1945 - June 1945; October 1945 - December 1954 are records.

January 1920 - June 1925; September 1928 - June 1932; July 1942 - January 1945 and July 1945 - September 1945 are correlated with South Fork Solomon at Alton.

July 1925 - August 1928 correlated with Solomon at Niles.

July 1932 - June 1942 correlated with Solomon at Beloit.

Cedar Bluff Reservoir. Thirty-six years, of which 13 are records and 23 are based upon correlations with records at other stations.

January 1919 - December 1941, based on Smoky Hill River near Ellis extended by correlation with Ellsworth Station and adjusted to the dam site. (Ellsworth correlated with Mentor for July 1925 - July 1928).

January 1942 - January 1950, based on records at Ellis adjusted to dam site.

February 1950 - April 1951, are records at Ransom station.

May, June, July 1951, are from USGS Water Supply Pager #1139, records of streamflow at the Ransom gaging station.

August 1951 - December 1954, are records at the Arnold gaging station.

Estimated Water Requirements

Irrigation Requirements

Use of river water for irrigation purposes during 1955 will be confined to the Republican River Basin except for the development farm which is irrigated by pump diversion from the stream below the Cedar Bluff Reservoir. It is expected that about 23,740 acres will be irrigated in the Republican River Basin under Bureau operated canals. In addition, it is expected that in a dry year about 17,600 acres of lands under private canals and stream pumps may be irrigated with supplemental storage water.

The irrigation requirements for 1955 have been estimated for dry, normal and wet conditions. The diversion requirement tables as used in the Bostwick Division and Frenchman-Cambridge Division 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 1955 are shown in Table 4.

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 incidental 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 to be maintained because of public health requirements at various points downstream from Harlan County Dam. The recommended minimum flows in second feet are as follows:

	Dec.-Feb.	Mar.	Apr.	May	June-Sept.	Oct.	Nov.
Franklin, Nebraska	2	2	3	5	8	4	2
Red Cloud, Nebraska	4	5	8	12	20	9	6
Superior, Nebraska	8	10	16	24	40	18	12
Scandia, Kansas	6	8	12	18	30	14	9
Concordia, Kansas	9	12	19	28	47	21	14
Clay Center, Kansas	7	8	13	20	33	15	10
Junction City, Kansas	8	10	16	24	40	18	20

During 1954, releases were made from Harlan County Reservoir to provide minimum flows recommended for stream pollution abatement. There were times when much of the release for this purpose was storage water which had been filed upon for irrigation purposes. It is expected that within the next few years the use of storage water from Harlan County Reservoir for stream pollution abatement will probably have to be discontinued. The storage use filings for all reservoirs in the Frenchman-Cambridge and Bostwick Division of Nebraska were made in such a manner that all irrigation districts under Federally constructed developments in the Frenchman-Cambridge and Bostwick Division (including lands in Nebraska and Kansas) will, insofar as possible, share equitably the available water supply with respect to irrigation requirements during periods of shortages. Therefore, the practice of wasting irrigation storage water for pollution abatement or recreational purposes conflicts with the interests of irrigation in the Frenchman-Cambridge and Bostwick Division, and this should be a matter of concern to the irrigation districts affected.

Flood Control Requirements

The Corps of Engineers is responsible for flood control operations in the Kansas River Projects 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 1955, 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. During winter months it is sometimes necessary to keep from storing when riprap on a dam is being repaired. There is a possibility that this may be necessary at Harry Strunk in the fall of 1955. Unless riprap damage occurs, this will not be necessary at any of the other dams. 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 high winds can cause wave action and 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. The operating criteria in 1955 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. Also, during winter months there is danager 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 danager 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 new lands under the Bartley Canal and to provide storage water under Warren Act Contracts to lands under the Meeker Canal and Riverside Canal.

Enders Reservoir. All available inflow will be stored in the irrigation pool. Storage water may be released under terms of Warren Act Contracts to the Culbertson and Krotter Canals 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. Store all available inflow and supply water to the Cambridge Canal. Also water may be sold under Warren Act Contracts to private pump irrigators downstream. Controlled spills 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. Store all available inflow starting in February 1955, unless critical flood conditions interfere with construction in which case flood water will be by-passed, through the river outlet works if possible. A maximum by-pass of about five second-feet is expected to satisfy all requirements immediately below the dam; however, this release will be increased if necessary to satisfy senior water rights.

Webster Reservoir. Make closure in November 1955 and store all available inflow except a maximum by-pass of five second-feet for stockwater.

Cedar Bluff Reservoir. Store all available inflow. Releases may be made for the irrigation demonstration farm about six miles downstream. Water may also be released under terms of a special contract to the municipal water supply pumps of the City of Russell, Kansas.

1955 Operation Plan by Division

It is planned that 23,810 acres of land in Nebraska will be irrigated under canals operated by the Bureau of Reclamation in 1955. During a dry year, it is estimated that as much as 16,500 acres of land with private irrigation rights would receive supplemental storage water in Nebraska. About 1,540 acres of land in Colorado will be irrigated by the privately operated Hale Ditch of which 1,100 acres may use supplemental storage water. Approximately 76 acres of land at an irrigation development far 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 4 and Exhibits 2 and 3. Operation tables estimating reservoir operations if 1955 is a dry, median, or wet year are shown in Tables 7 through 12 and Exhibit 14.

Upper Republican Division

On January 1, 1955, Bonny Reservoir had a total content of 35,690 acre-feet. It is expected that the irrigation pool will be full before the beginning of the 1955 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 developments will be served during 1955. It is anticipated that if 1955 inflow is equal to that of a median year, the reservoir content at the end of the calendar year will be 37,800 acre-feet. Bonny Reservoir can be expected to spill, if 1955 is a wet or median year.

Frenchman-Cambridge Division

Swanson Lake started the 1955 Calendar Year with a total content of 24,740 acre-feet. It will be possible to use all of the Bartley Canal to irrigate 2,300 acres of the Red Willow Unit in 1955. 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 1955 inflow is equal to that of a median year, the content of Swanson Lake at the end of the year will be 112,300 acre-feet. Swanson Lake will spill if 1955 is a wet year.

On January 1, 1955, the total content of Enders Reservoir was 38,930 acre-feet. The irrigation pool will be filled before the beginning of the 1955 irrigation season. No canals operated by the Bureau of Reclamation will be served from Enders Reservoir during 1955, 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 1955 is equal to that of a median year, the content at the end of the year will be approximately 38,700 acre-feet. Enders Reservoir will spill in 1955 even under dry conditions.

Harry Strunk Lake started the 1955 Calendar Year with a total content of 28,230 acre-feet. The irrigation pool will be filled before the beginning of the 1955 irrigation season. It will be used in 1955 to serve 7,850 acres under all of the Cambridge Main Canal and Laterals. Supplemental storage water may be sold under Warren Act Contracts to pump irrigators. If 1955 conditions are equal to that of a median year, the content of Harry Strunk Lake at the end of the year will be about 33,300 acre-feet. The reservoir will spill if 1955 is a wet or a median year.

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 1955 to irrigate about 10,535 acres of land. All of this will be in Nebraska, except for 925 acres in Kansas under the Courtland Canal. The miles of each canal to be used and approximate acreages to be served during 1955 are listed as follows:

Canal	Miles of Main Canal	Acres Irrigated
Franklin	27	2,465
Naponee	8	345
Franklin Pump	5	1,500
Superior	30	4,000
Courtland (Nebraska)	16	1,300
Courtland (Kansas)	25	925
	111	10,535

On January 1, 1955, the total content of Harlan County Reservoir was 160,330 acre-feet. If the inflow into Harlan County Reservoir is equal to that of a median year, the content at the end of the year is estimated to be 350,100. Harlan County Reservoir will spill if 1955 is a wet or a median year.

Solomon Division

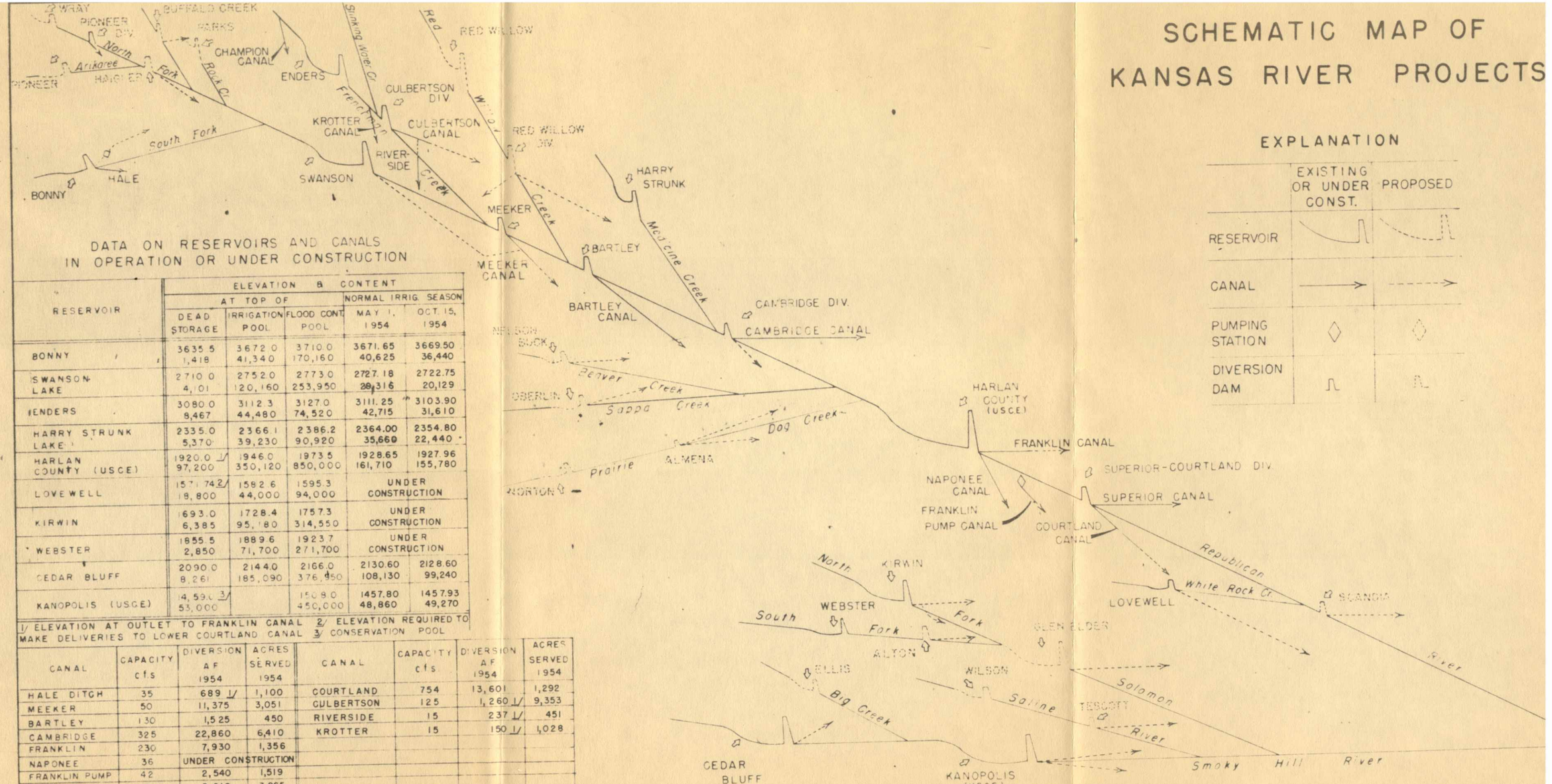
Storage will commence at Kirwin Reservoir in February 1955. Except for a possible flood emergency, interfering with construction operations, no release above 5 second-feet will be required, except for senior water rights. If 1955 is a median year, it is expected that the reservoir content at the end of the calendar year will be about 28,500 acre-feet. Kirwin Reservoir will spill if 1955 is a wet year.

It is expected that closure at Webster Dam will not be made until November of 1955; therefore, storage at the end of the year will be negligible.

Smoky Hill Division

The total storage in Cedar Bluff Reservoir at the beginning of the 1955 Calendar Year was 95,000 acre-feet. No Bureau operated canals will be served; however, about 76 acres of land in an irrigation demonostration farm will receive water from the reservoir. Storage water may be delivered to pump sites downstream for the City of Russell, Kansas If the 1955 inflow is equal to that of a median year, the content of Cedar Bluff Reservoir at the end of the year will be approximately 115,700 acre-feet.

SCHEMATIC MAP OF KANSAS RIVER PROJECTS



EXPLANATION

	EXISTING OR UNDER CONST.	PROPOSED
RESERVOIR		
CANAL	→	⇢
PUMPING STATION	◇	◇
DIVERSION DAM	⎍	⎍

DATA ON RESERVOIRS AND CANALS IN OPERATION OR UNDER CONSTRUCTION

RESERVOIR	ELEVATION & CONTENT AT TOP OF DEAD STORAGE	AT TOP OF IRRIGATION POOL	AT TOP OF FLOOD CONT POOL	NORMAL IRRIG. SEASON MAY 1, 1954	NORMAL IRRIG. SEASON OCT. 15, 1954
BONNY	3635.5 1,418	3672.0 41,340	3710.0 170,160	3671.65 40,625	3669.50 36,440
SWANSON LAKE	2710.0 4,101	2752.0 120,160	2773.0 253,950	2727.18 28,316	2722.75 20,129
ENDERS	3080.0 8,467	3112.3 44,480	3127.0 74,520	3111.25 42,715	3103.90 31,610
HARRY STRUNK LAKE	2335.0 5,370	2366.1 39,230	2386.2 90,920	2364.00 35,660	2354.80 22,440
HARLAN COUNTY (USCE)	1920.0 1/ 97,200	1946.0 350,120	1973.5 850,000	1928.65 161,710	1927.96 155,780
LOVEWELL	1571.7 2/ 18,800	1582.6 44,000	1595.3 94,000	UNDER CONSTRUCTION	
KIRWIN	1693.0 6,385	1728.4 95,180	1757.3 314,550	UNDER CONSTRUCTION	
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	2130.60 108,130	2128.60 99,240
KANOPOLIS (USCE)	1459.0 3/ 53,000		1508.0 450,000	1457.80 48,860	1457.93 49,270

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

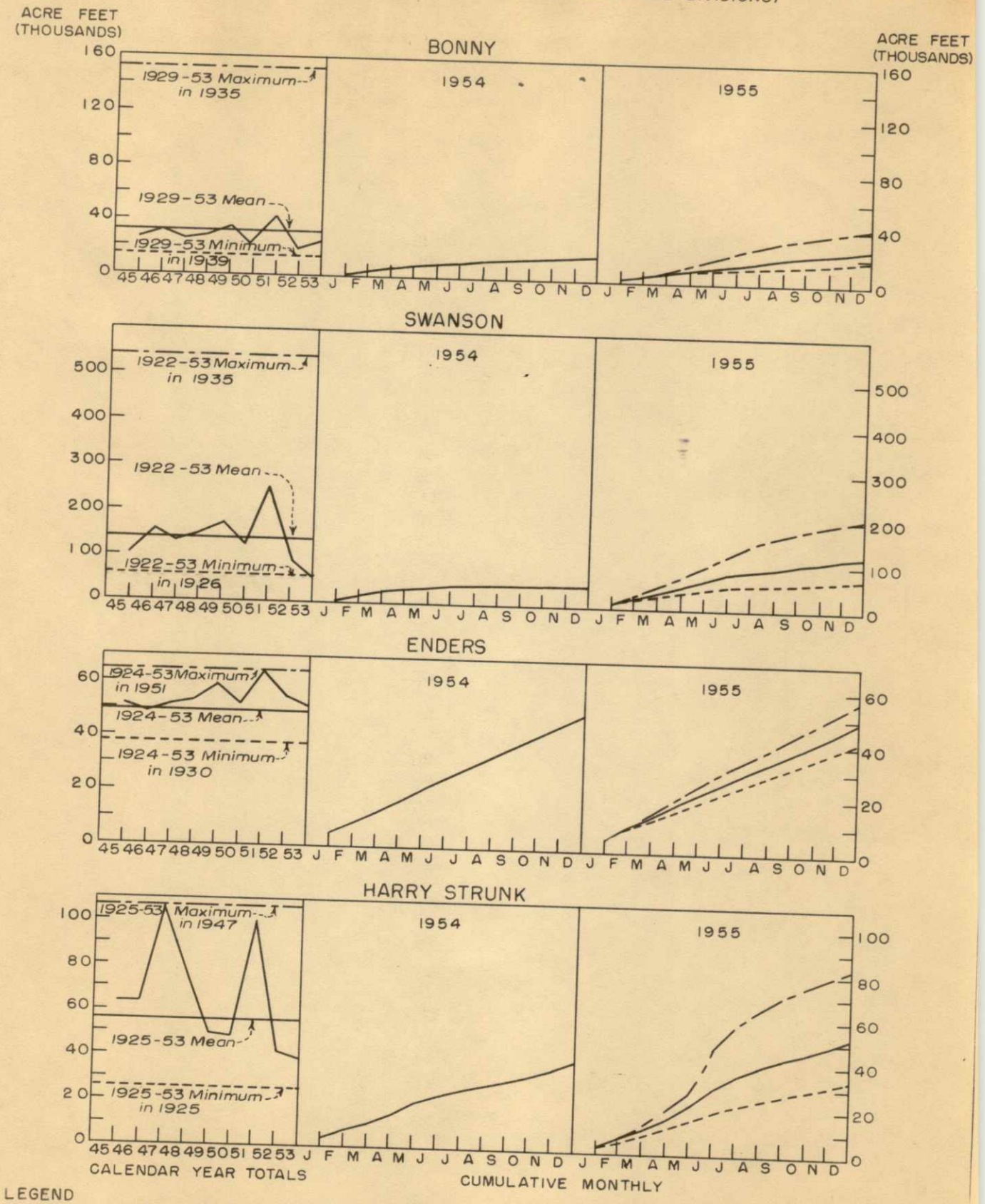
CANAL	CAPACITY c.f.s.	DIVERSION A.F. 1954	ACRES SERVED 1954	CANAL	CAPACITY c.f.s.	DIVERSION A.F. 1954	ACRES SERVED 1954
HALE DITCH	35	689 1/	1,100	COURTLAND	754	13,601	1,292
MEEKER	50	11,375	3,051	CULBERTSON	125	1,260 1/	9,353
BARTLEY	130	1,525	450	RIVERSIDE	15	237 1/	451
CAMBRIDGE	325	22,860	6,410	KROTTER	15	150 1/	4,028
FRANKLIN	230	7,930	1,356				
NAPONEE	36	UNDER CONSTRUCTION					
FRANKLIN PUMP	42	2,540	1,519				
SUPERIOR	139	9,612	3,865				

1/ SUPPLEMENTAL STORAGE WATER ONLY

INFLOW TO RESERVOIRS

Exhibit 2

(UPPER REPUBLICAN AND FRENCHMAN-CAMBRIDGE DIVISIONS)



LEGEND

-----Annual operating plan for reasonable minimun inflow (10% chance for dry year)

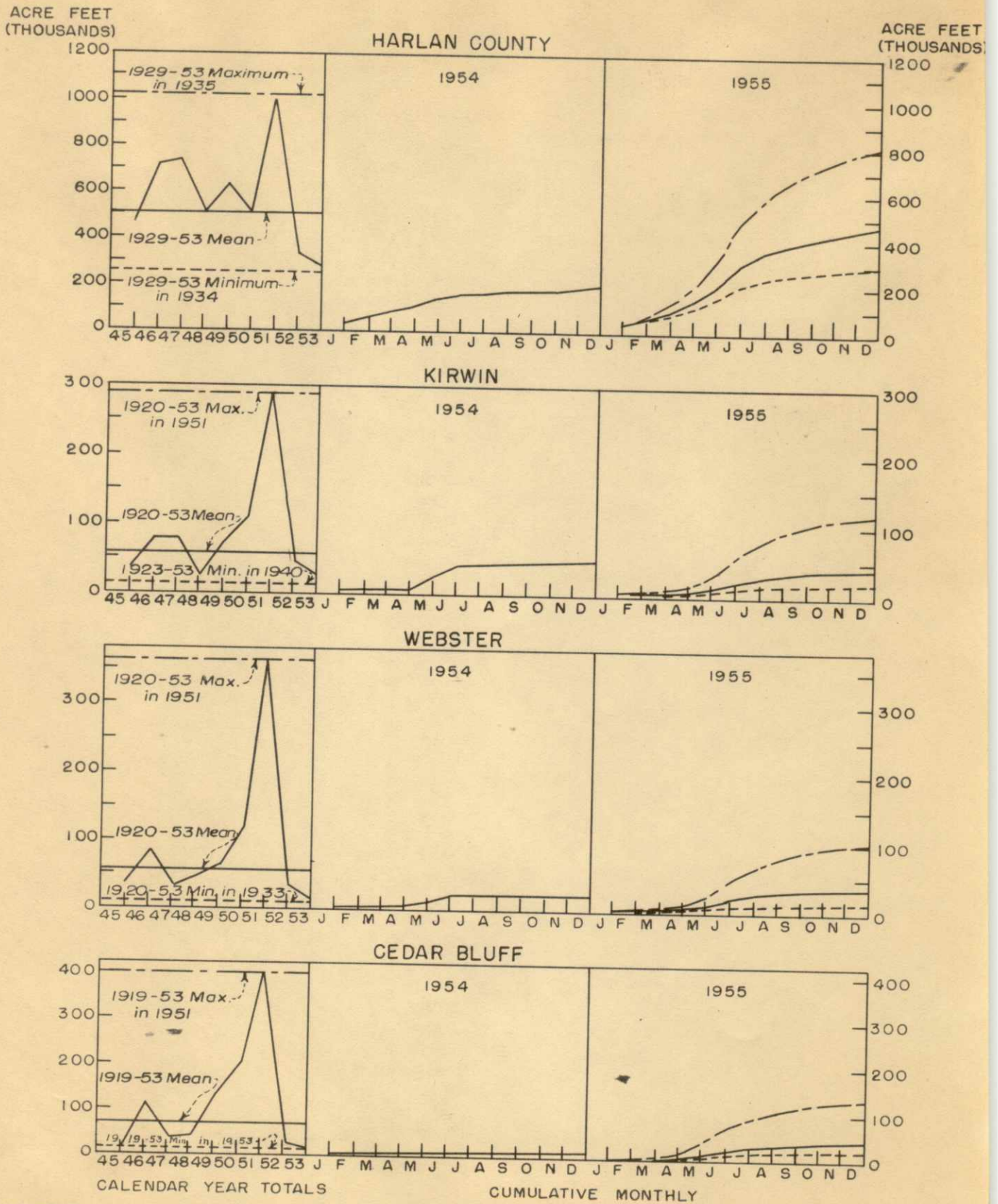
— — —Annual operating plan for reasonable maximum inflow (10% chance for wet year)

———1954 experienced, or 1955 operating plan for median year.

Exhibit 3

INFLOW TO RESERVOIRS

(BOSTWICK, SOLOMON, AND SMOKY HILL DIVISIONS)



LEGEND

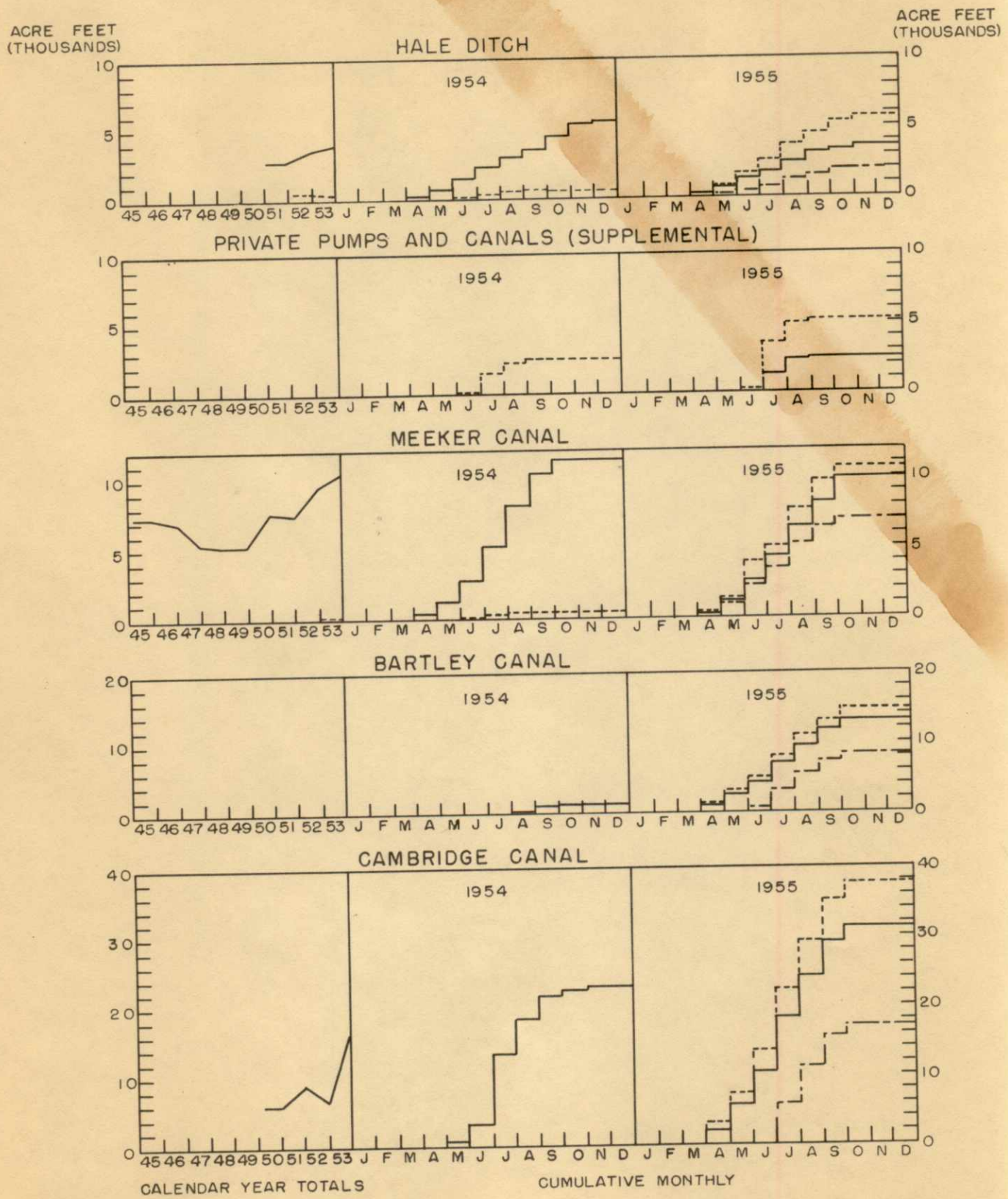
----- *Annual operating plan for reasonable minimun inflow (10 % chance for dry year)*

—·— *Annual operating plan for reasonable maximum inflow (10 % chance for wet year)*

——— *1954 experienced, or 1955 operating plan for median year.*

IRRIGATION DIVERSIONS

(UPPER REPUBLICAN AND FRENCHMAN-CAMBRIDGE DIVISIONS)



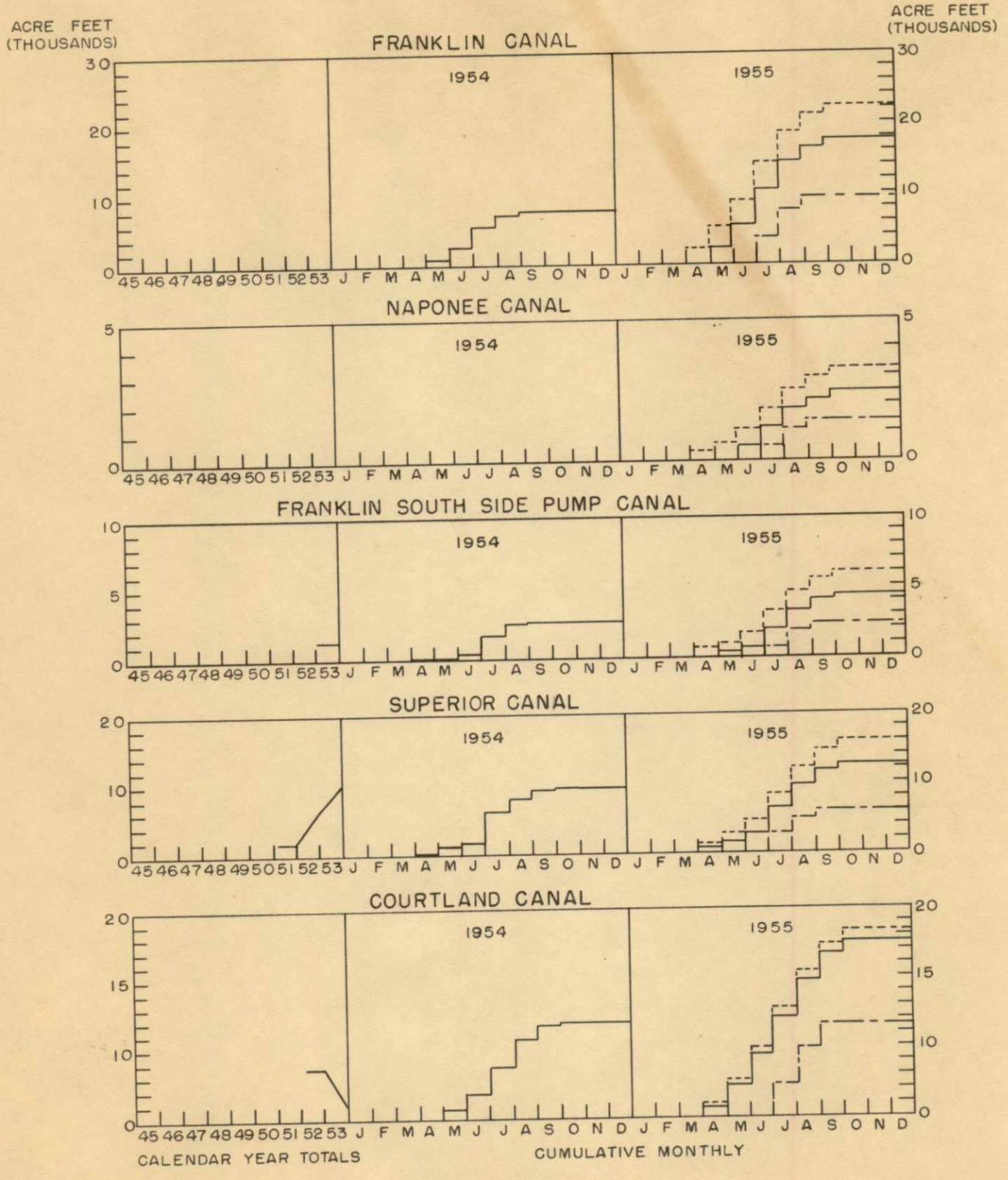
LEGEND

------ *Supplemental storage deliveries prior to 1955, or 1955 operating plan for dry year.*

—·— *Annual operating plan for wet year.*

——+—— *1954 experienced, or 1955 operating plan for median year.*

IRRIGATION DIVERSIONS
(BOSTWICK DIVISION)



LEGEND

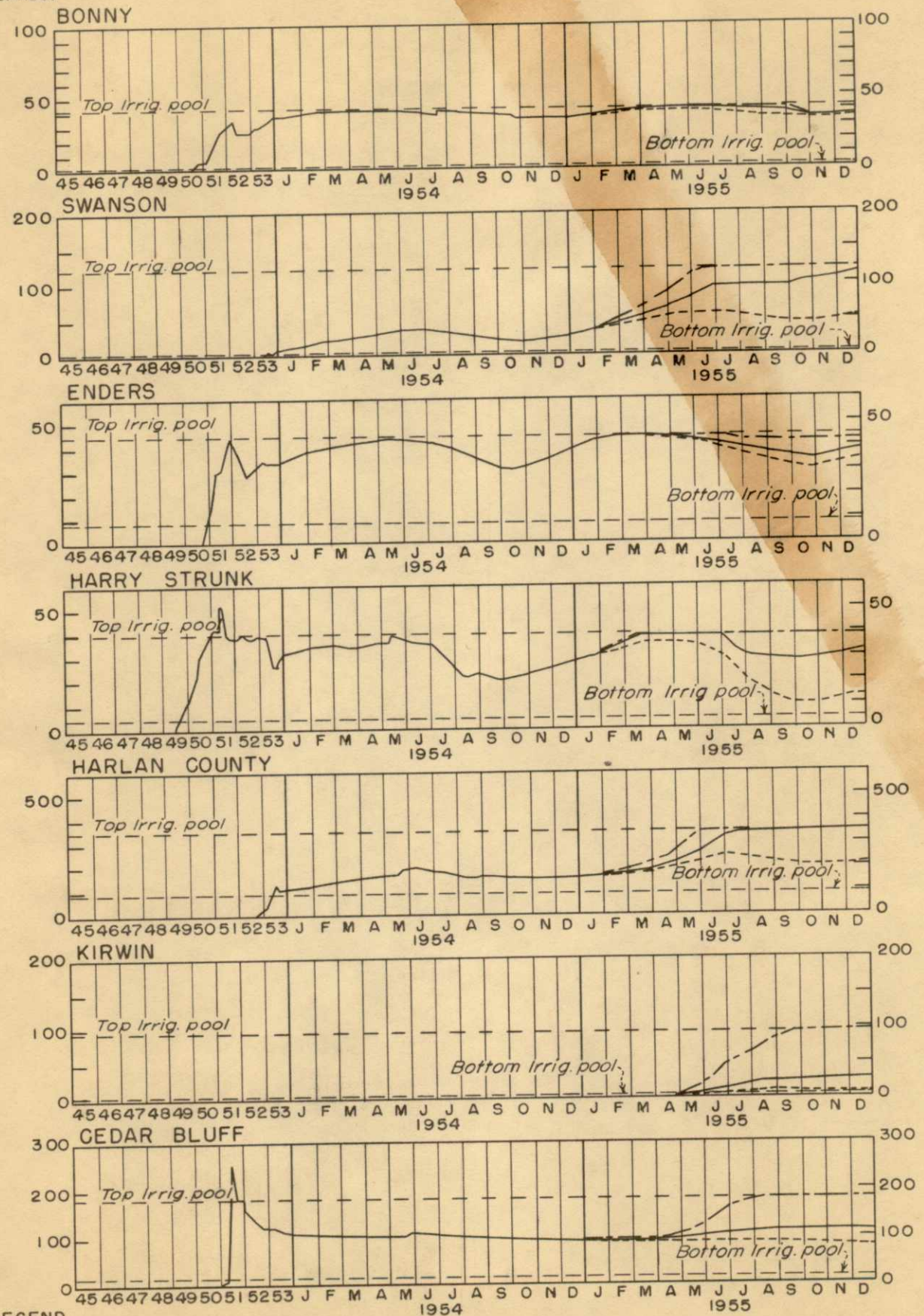
_____ *Annual operating plan for dry year.*
_ _ _ *Annual operating plan for wet year.*
_____ *1954 experienced, or 1955 operating plan for median year.*

Exhibit 6

RESERVOIR STORAGE

ACRE FEET (THOUSANDS)

ACRE FEET (THOUSANDS)



LEGEND

------ Estimated operating plan if 1955, is a dry year.

— — — Estimated operating plan if 1955, is a wet year.

_____ Experienced, or estimated operating plan if 1955, is a median year.

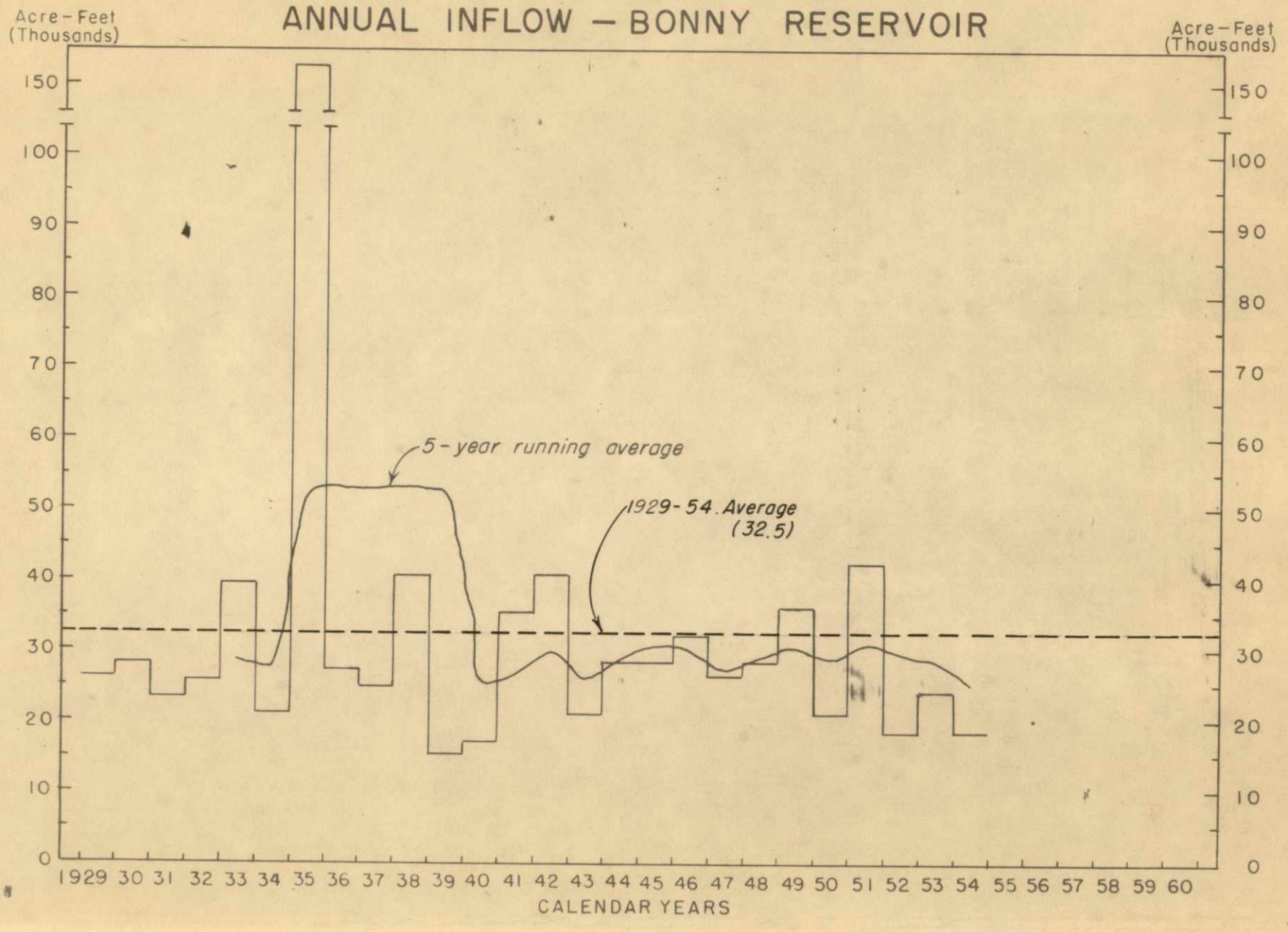

ANNUAL INFLOW — BONNY RESERVOIR
Acre-Feet (Thousands)
Acre-Feet (Thousands)
150
100
90
80
70
60
50
40
30
20
10
0
5-year running average
1929-54 Average (32.5)
1929 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CALENDAR YEARS

Exhibit 7

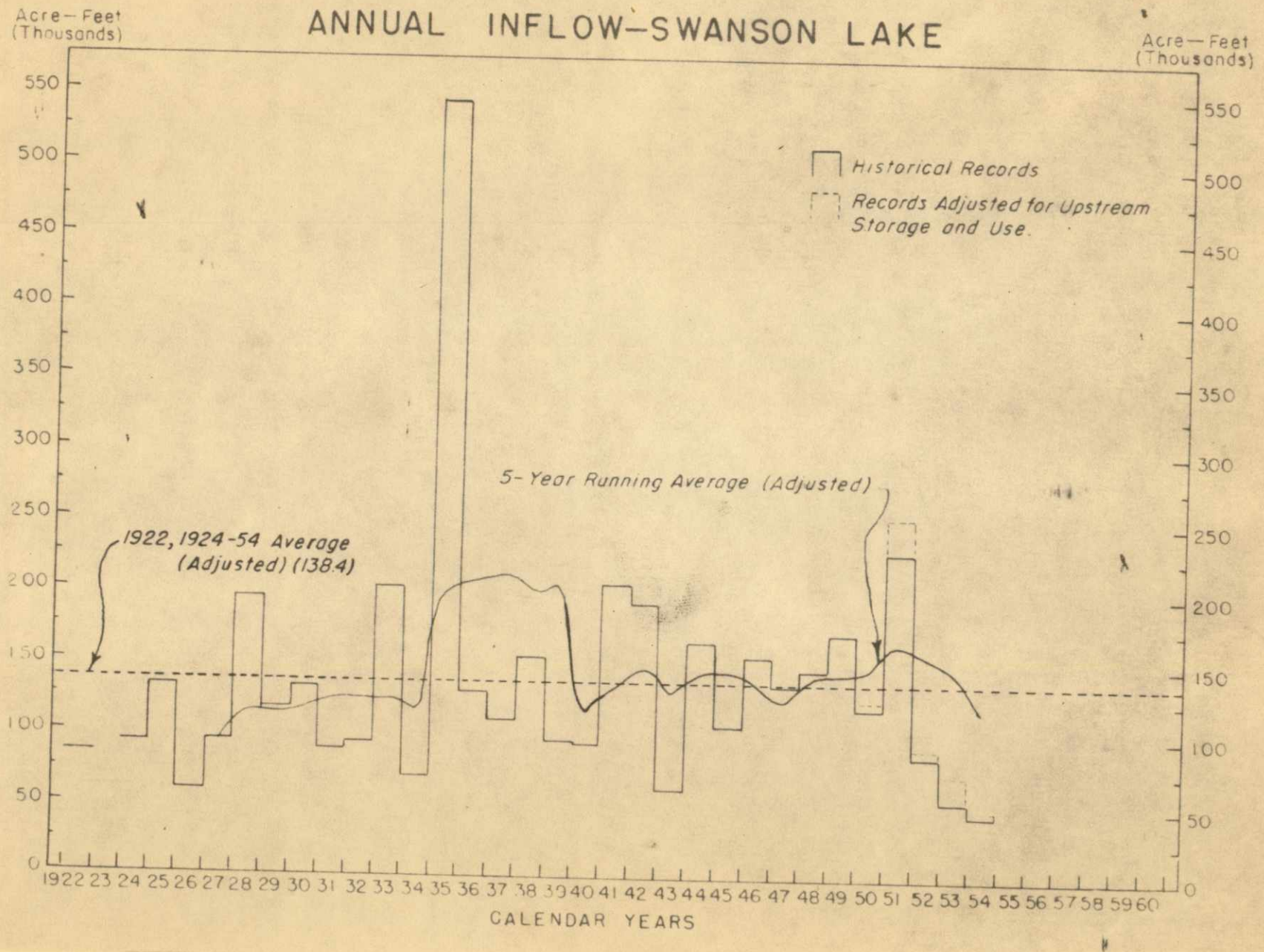

ANNUAL INFLOW—SWANSON LAKE
Acre—Feet (Thousands)
Acre—Feet (Thousands)
Historical Records
Records Adjusted for Upstream Storage and Use.
5-Year Running Average (Adjusted)
1922, 1924-54 Average (Adjusted) (138.4)
550
500
450
400
350
300
250
200
150
100
50
0
1922 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CALENDAR YEARS

Exhibit 8

ANNUAL INFLOW - ENDERS RESERVOIR

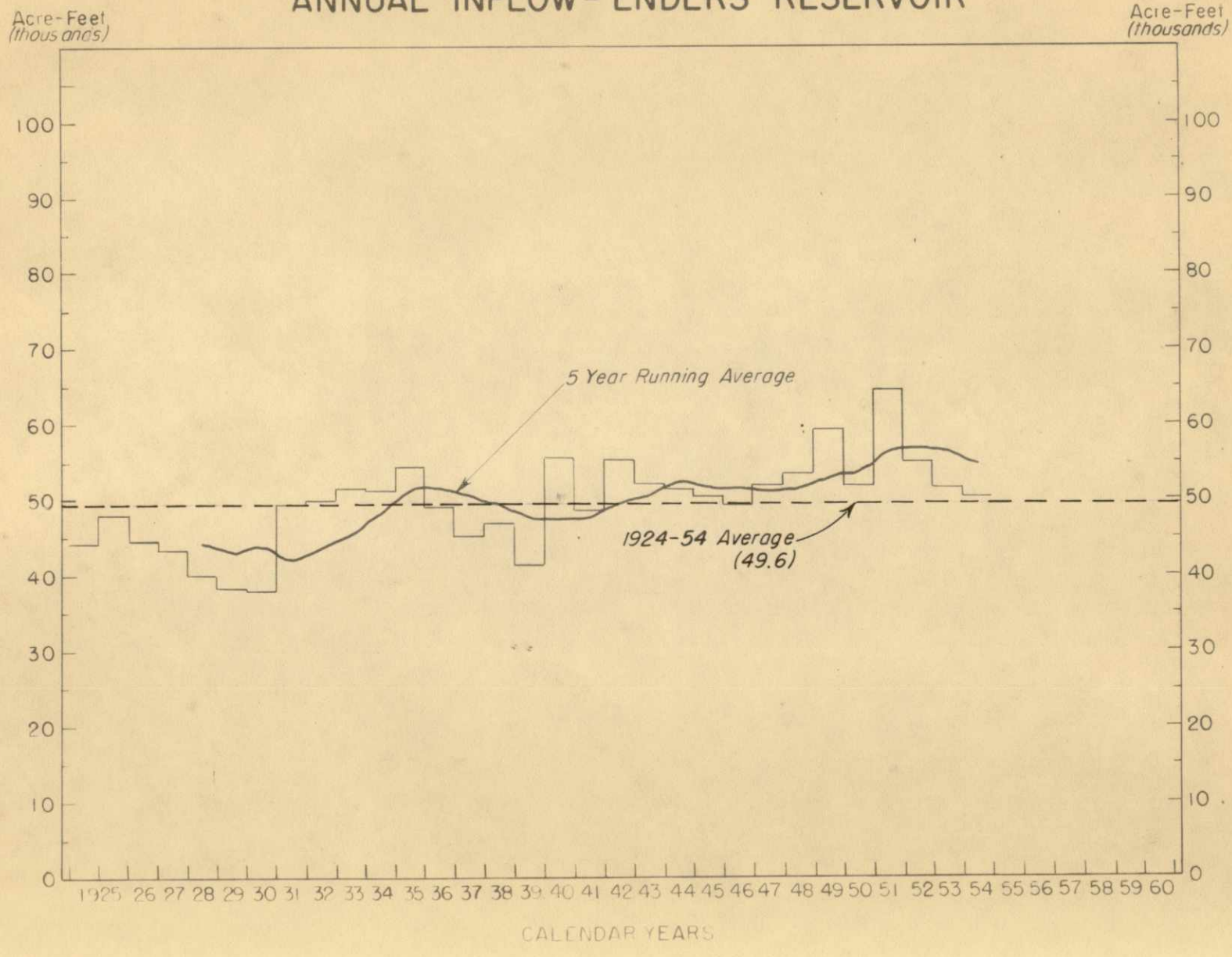


Exhibit 9

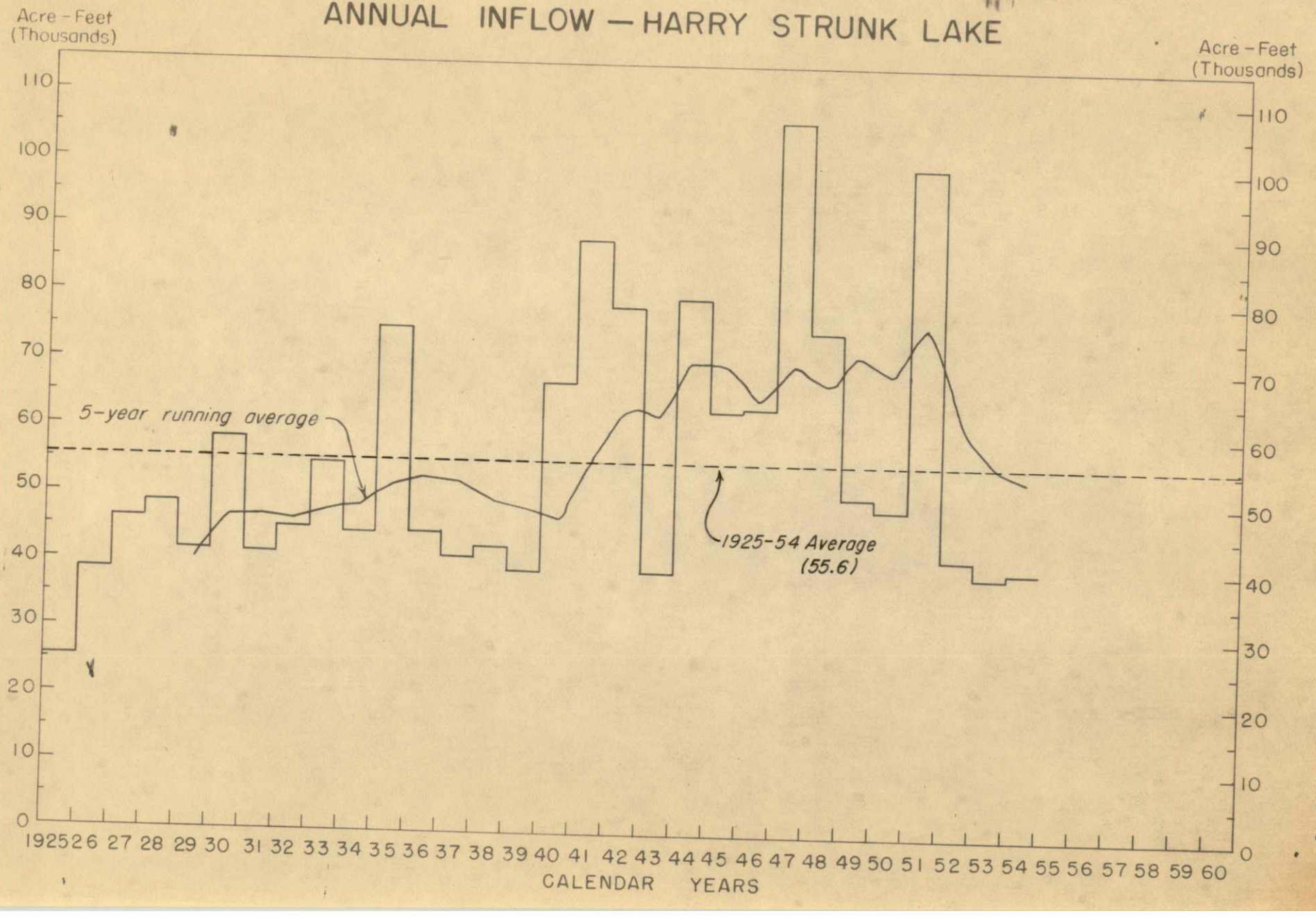

ANNUAL INFLOW — HARRY STRUNK LAKE
Acre - Feet (Thousands)
Acre - Feet (Thousands)
110
100
90
80
70
60
50
40
30
20
10
0
5-year running average
1925-54 Average (55.6)
1925 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CALENDAR YEARS

Exhibit 10

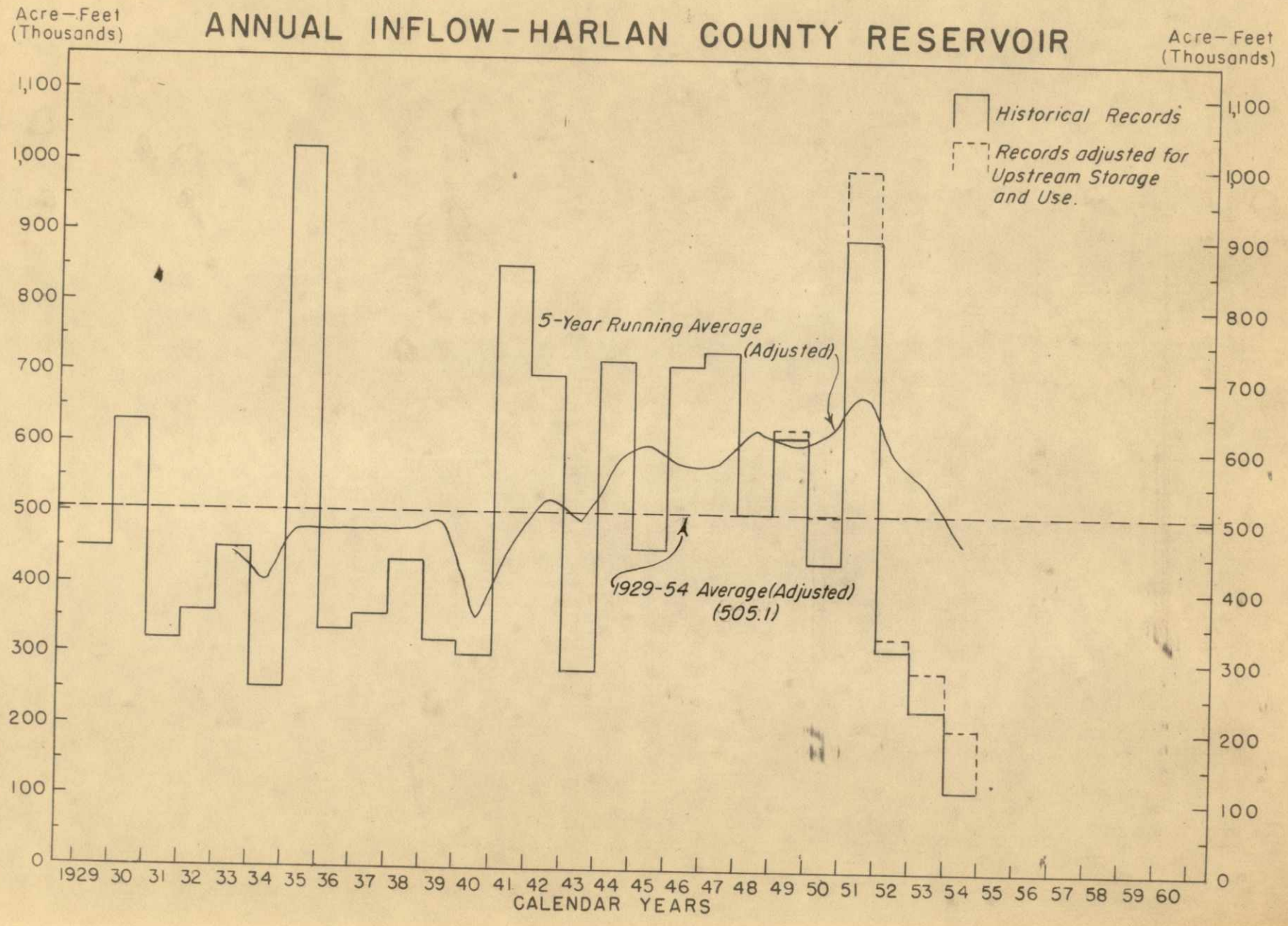

ANNUAL INFLOW - HARLAN COUNTY RESERVOIR
Acre-Feet (Thousands)
Acre-Feet (Thousands)
1,100
1,000
900
800
700
600
500
400
300
200
100
0
Historical Records
Records adjusted for Upstream Storage and Use.
5-Year Running Average (Adjusted)
1929-54 Average (Adjusted) (505.1)
1929 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CALENDAR YEARS

Exhibit 11

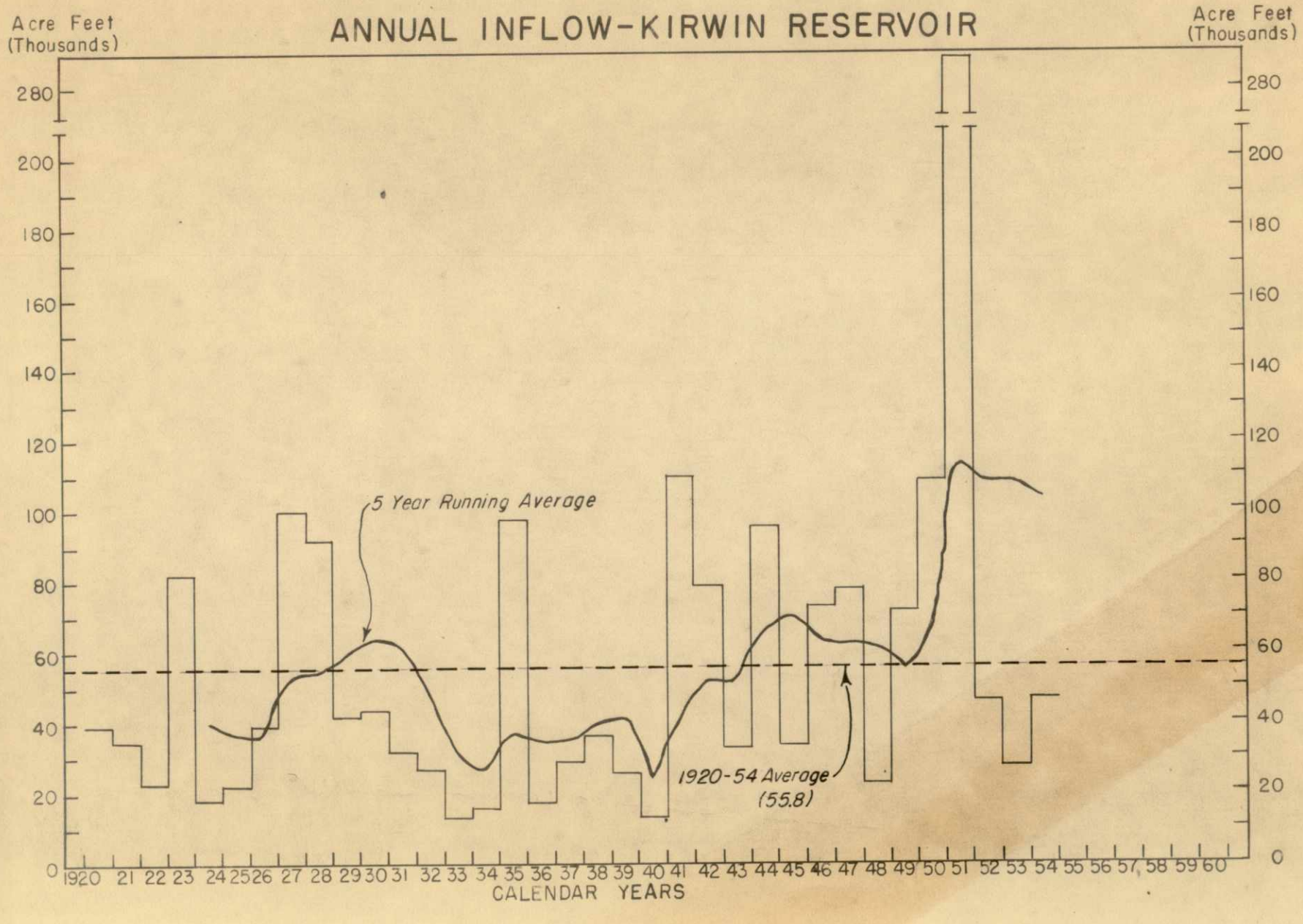

ANNUAL INFLOW-KIRWIN RESERVOIR
Acre Feet (Thousands)
Acre Feet (Thousands)
280
200
180
160
140
120
100
80
60
40
20
0
5 Year Running Average
1920-54 Average (55.8)
1920 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
CALENDAR YEARS

Exhibit 12

ANNUAL INFLOW—WEBSTER RESERVOIR

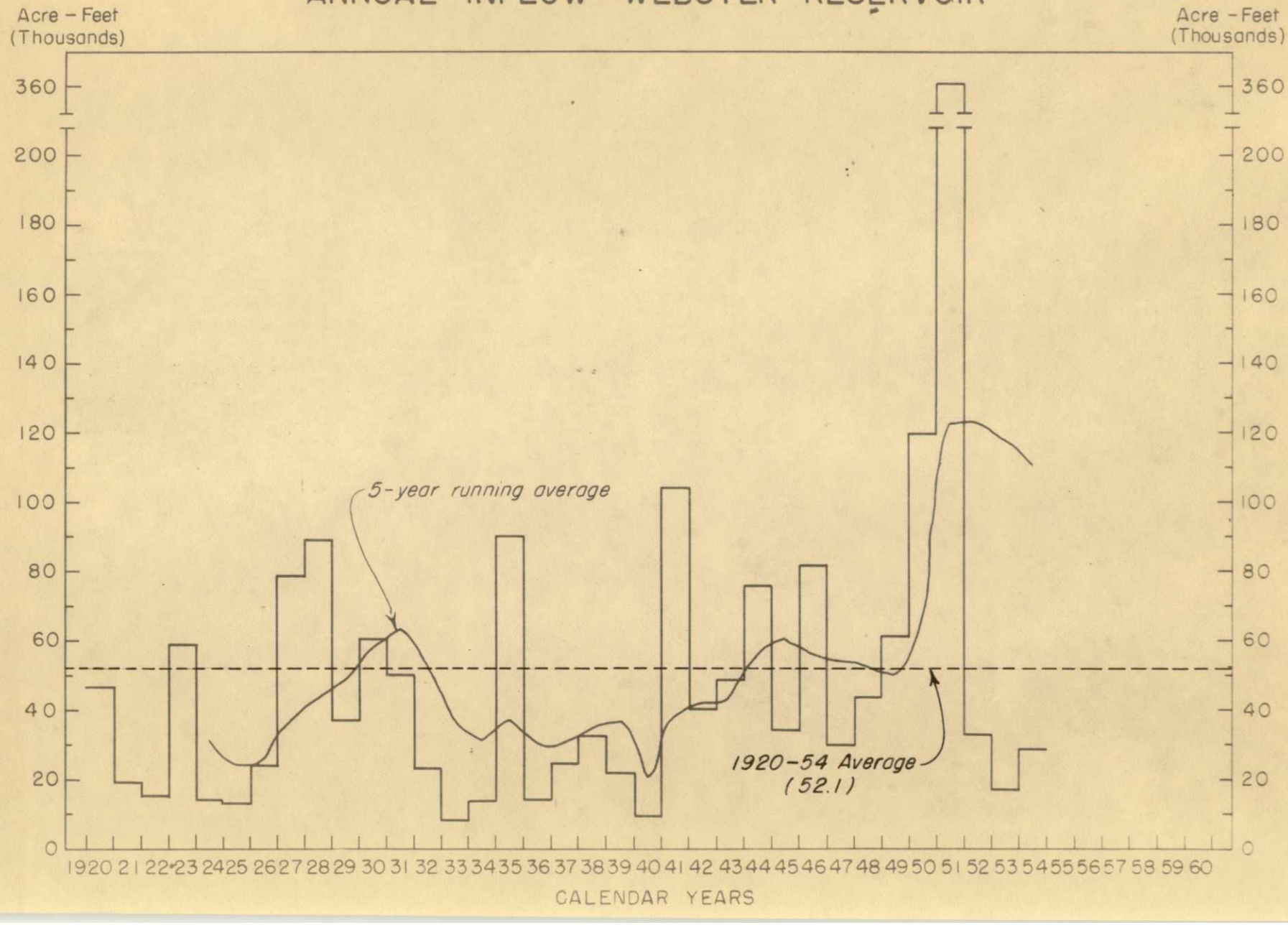


Exhibit 13

ANNUAL INFLOW- CEDAR BLUFF RESERVOIR

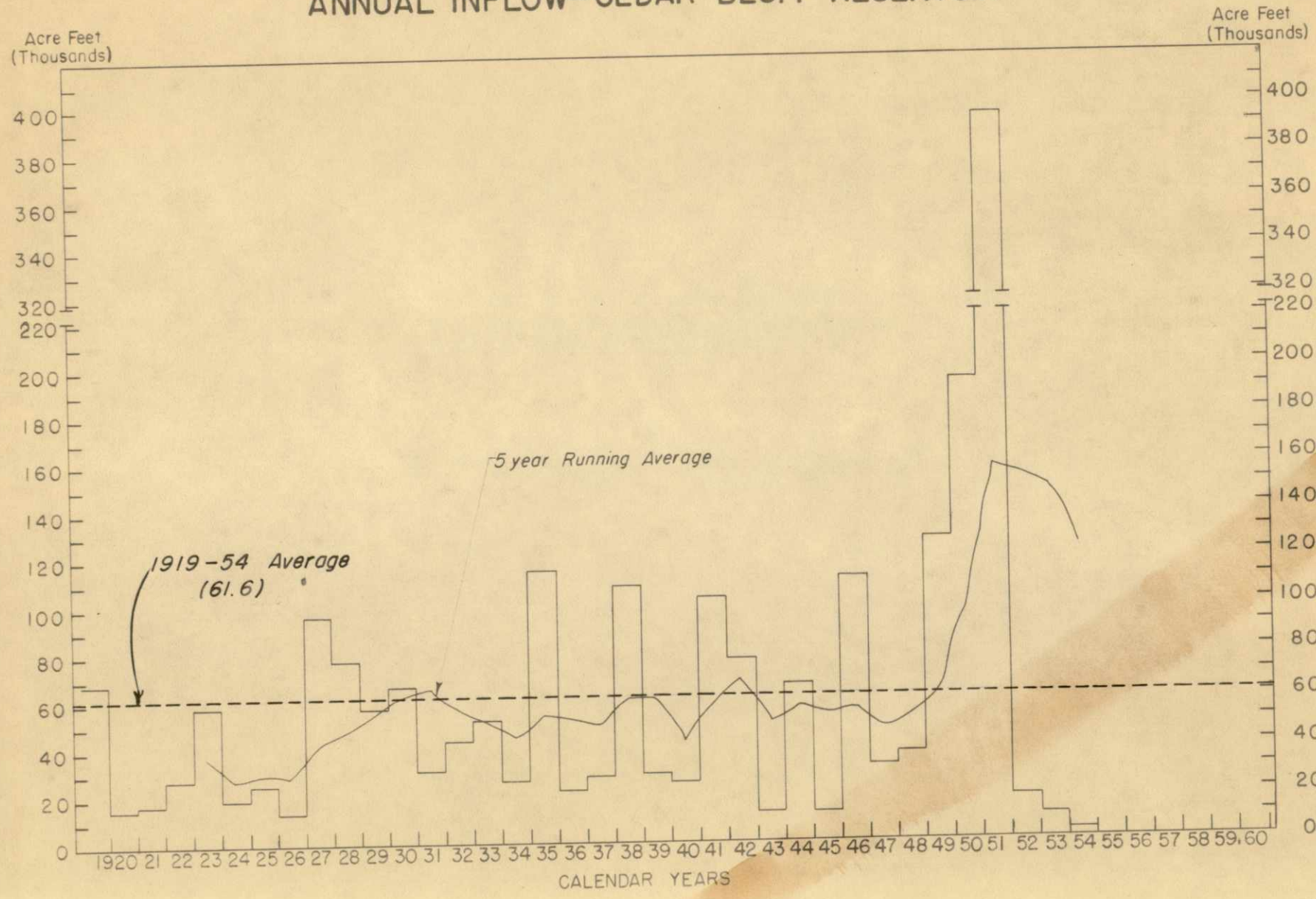


Exhibit 14

INFLOW FREQUENCY CURVES

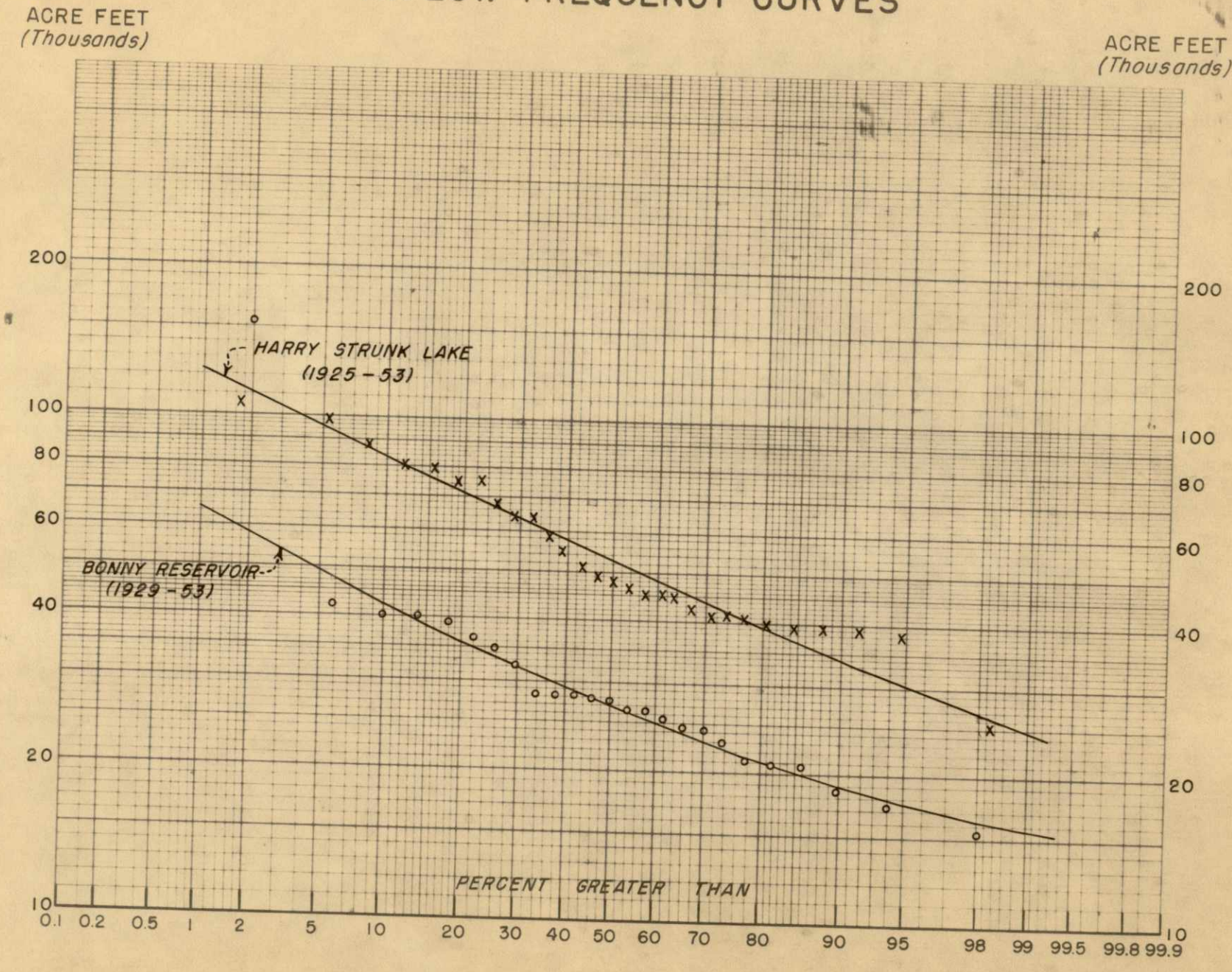


Exhibit 15

INFLOW FREQUENCY CURVES

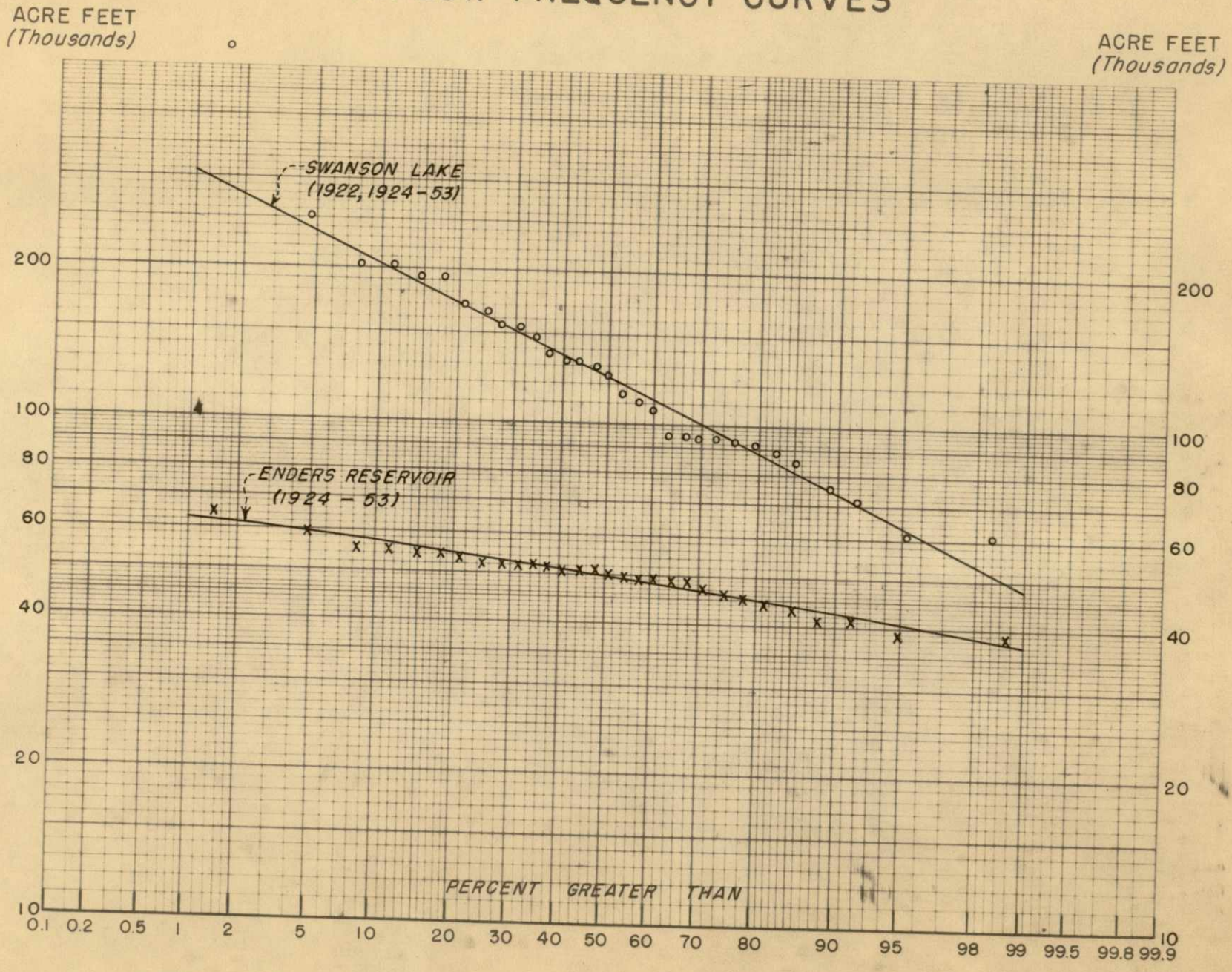


Exhibit 16

INFLOW FREQUENCY CURVE

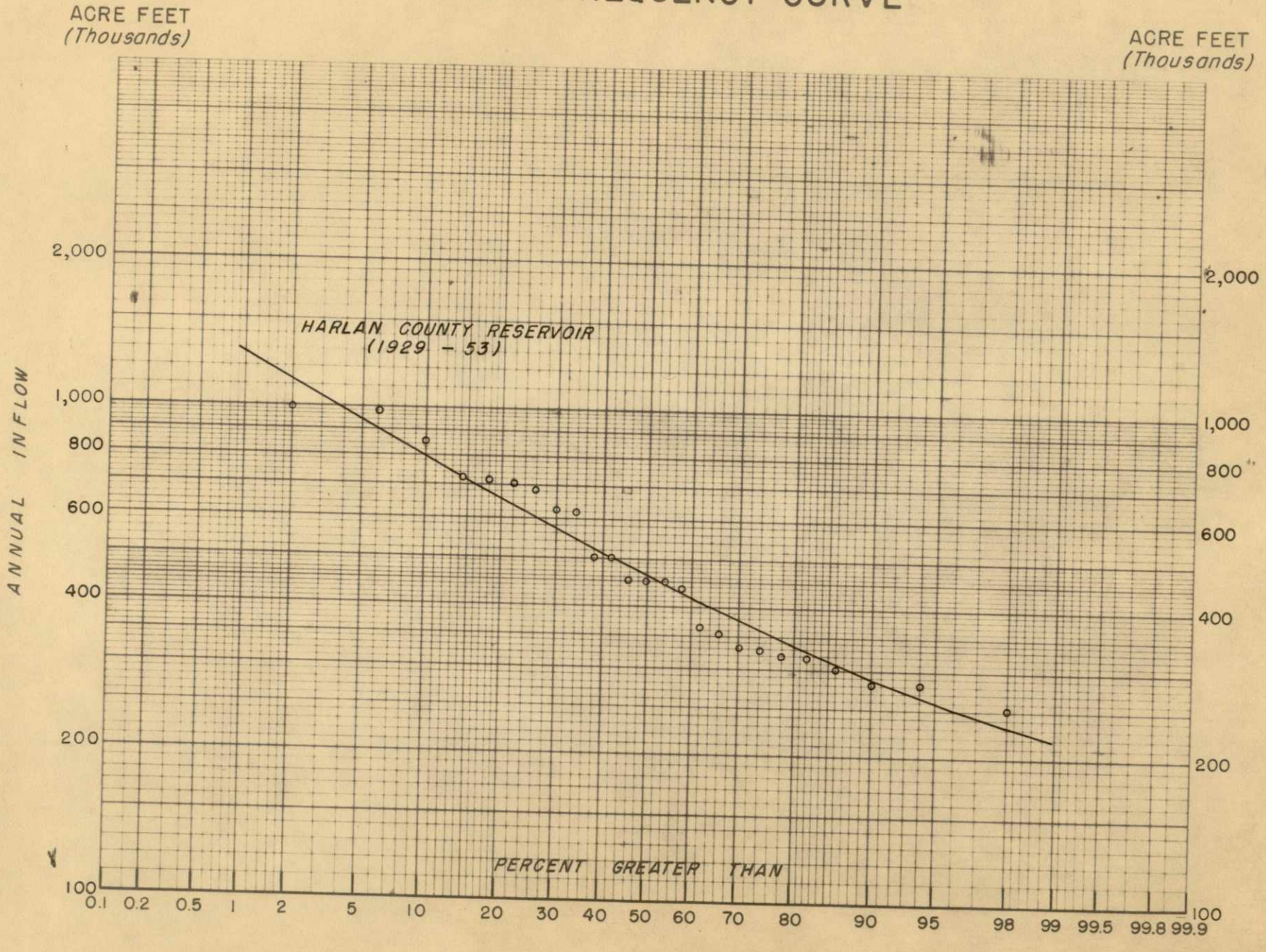


Exhibit 17

INFLOW FREQUENCY CURVES

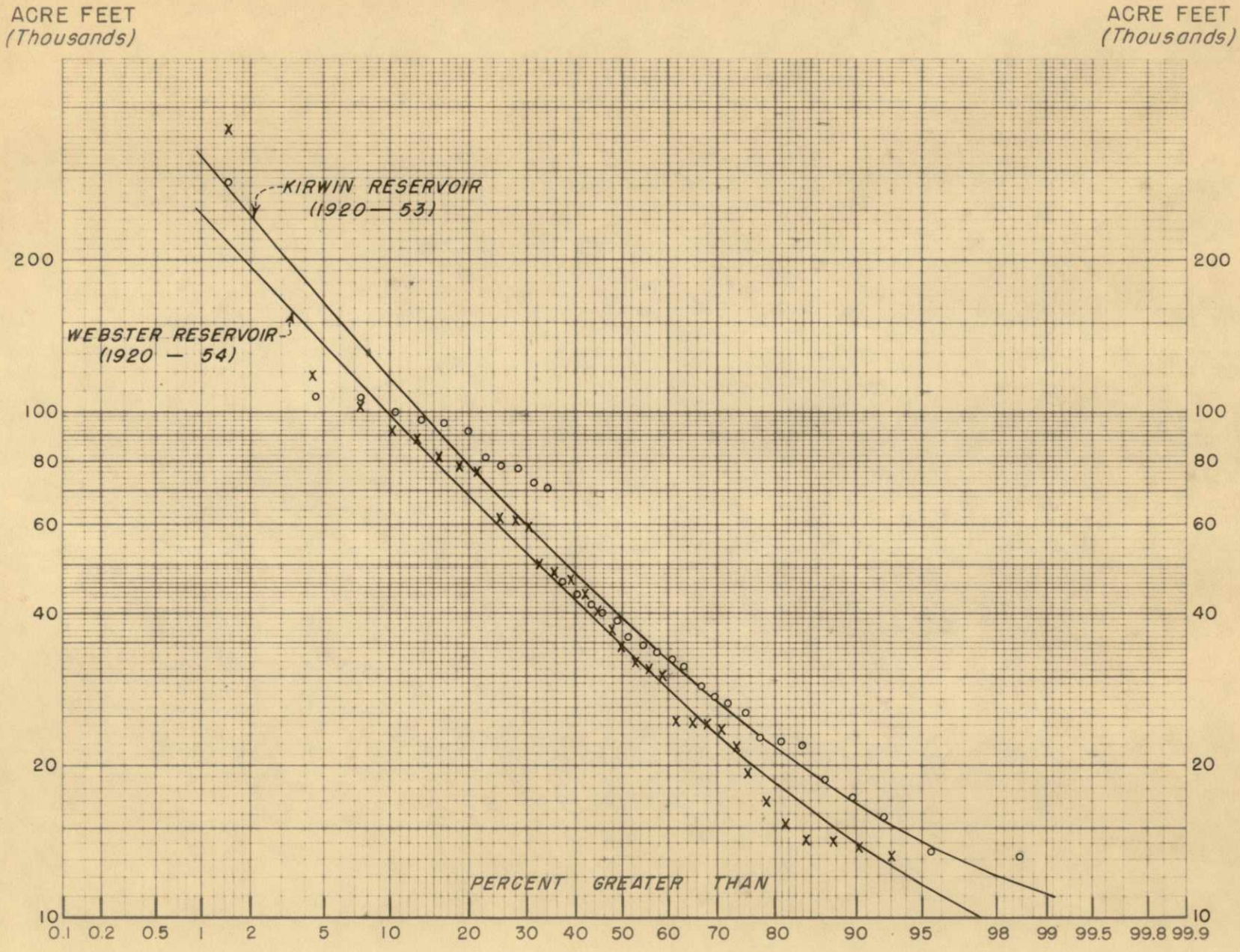


Exhibit 18

INFLOW FREQUENCY CURVE

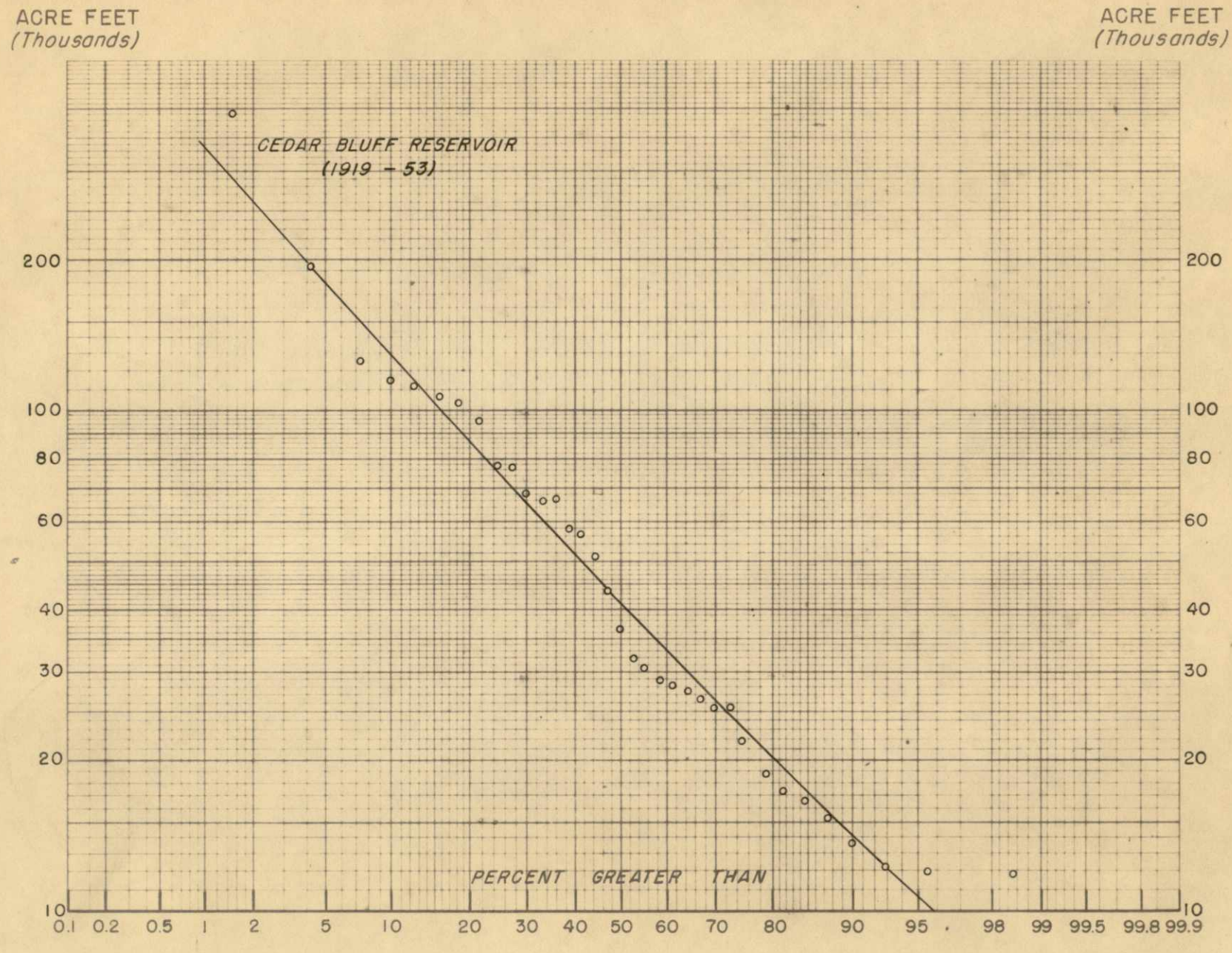


Exhibit 19

TABLE 1

INFLOW INTO RESERVOIRS - 1954 RECORDS, 1955 ESTIMATES

Reservoir	1000 Acre-feet				
	1954 Records		1955 Estimates 2/		
	Actual	Adjusted 1/	Dry Yr.	Median Yr.	Wet Yr.
Bonny	18.7		19.0	27.0	42.0
Swanson Lake	46.0	51.6	73.0	123.0	205.0
Enders	50.3		42.5	49.5	57.2
Harry Strunk Lake	39.9		34.0	52.8	83.0
Harlan County	116.4	200.7	290.0	465.0	800.0
Kirwin	46.5 3/		16.7	38.6	116.0
Webster	24.2 4/		14.0	34.3	100.0
Cedar Bluff	3.2		14.0	41.0	130.0

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 = dry year, 50% = median year, and 10% = wet year.

3/ No storage during 1954. Expect storage to commence about February 15, 1955.

4/ No storage during 1954. Expect storage to commence about October 1, 1955.

TABLE 2

CANAL DIVERSIONS AND ACRES IRRIGATED - 1954
(ABOVE HARLAN COUNTY RESERVOIR)

Canal	Month	Total Diversions (A.F.)	Supplemental Storage (A.F.) 2/
Hale Ditch 1/	Apr.	102	0
	May	643	0
(1,541 Ac. Total)	June	734	40
	July	780	369
(1,100 Ac. Supplemental Storage)	Aug.	742	126
	Sept.	494	107
	Oct.	875	0
	Nov.	873	0
	Dec.	250	0
	Total	5,493	642
Private Pumps and Canals 3/	June	-	7
	July	-	1,547
	Aug.	-	806
(14,573 Ac. Supplemental Storage)	Sept.	-	212
	Total		2,572
Meeker Canal	Apr.	420	0
	May	746	0
(3,051 Ac. Total)	June	1,777	26
	July	2,233	322
(800 Ac. Supplemental Storage)	Aug.	2,912	140
	Sept.	2,313	0
	Oct.	974	0
	Total	11,375	488
Bartley Canal	Aug.	40	
	Sept.	1,255	
(450 Ac.)	Oct.	230	
	Total	1,525	
Cambridge Canal	May	756	
	June	2,563	
(6,410 Ac.)	July	10,026	
	Aug.	5,167	
	Sept.	3,064	
	Oct.	956	
	Nov.	327	
	Total	22,859	

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, Krotter Canal, Riverside Canal, and pump irrigators.

TABLE 2 (Cont.)

CANAL DIVERSIONS AND ACRES IRRIGATED - 1954
(BELOW HARLAN COUNTY RESERVOIR)

Canal	Month	Total Diversions (A.F.)
Franklin Canal	May	910
	June	1,652
(1,356 Ac.)	July	2,856
	Aug.	1,837
	Sept.	675
	Total	7,930
Franklin Pump Canal	Apr.	9
	May	0
	June	157
(1,519 Ac.)	July	1,523
	Aug.	752
	Sept.	99
	Total	2,540
Superior Canal	Apr.	141
	May	1,133
(3,865 Ac.)	June	274
	July	4,504
	Aug.	1,972
	Sept.	1,390
	Oct.	198
	Total	9,612
Courtland Canal	May	1,073
	June	2,319
(1,292 Ac.)	July	4,082
	Aug.	3,775
	Sept.	2,253
	Oct.	99
	Total	13,601

(BELOW CEDAR BLUFF RESERVOIR)

Kutina Development Farm	Month	Total Diversions (A.F.)
Pump Diversion	May	9.1
	June	17.3
	July	45.3
(76.1 Ac.)	Aug.	68.0
	Sept.	16.0
	Oct.	0
	Nov.	20.3
	Total	176.0

TABLE 3

RESERVOIR OPERATIONS DURING 1954

Reservoir	Month	1000 Acre-feet					
		Res. Inflow	Res. Outflow	Res. Cont. at End of Mo.	Use of Storage Releases (Approx.) Div. for Irrig.	Other Use	Total
Bonny	Jan.	2.2	0.4	39.1	0	0	0
	Feb.	2.0	0.4	40.1	0	0	0
	Mar.	2.8	0.6	41.3	0	0	0
	Apr.	2.0	2.0	40.6	0	.3	.3
	May	1.7	1.3	40.8	0	.1	.1
	June	0.2	1.1	39.0	0	.9	.9
	July	3.5	1.2	40.1	.4	.4	.8
	Aug.	1.0	1.1	38.4	.1	.5	.6
	Sept.	0	0.9	36.8	.1	.8	.9
	Oct.	0.3	2.1	35.3	0	1.9	1.9
	Nov.	1.2	1.7	34.8	0	.6	.6
	Dec.	1.8	0.7	35.6	0	0	0
	Total	18.7	13.5		.6	5.5	6.1
Swanson Lake	Jan.	5.3	0.7	13.3	0	0	0
	Feb.	8.2	0.3	20.8	0	0	0
	Mar.	8.1	0.5	26.5	0	0	0
	Apr.	5.2	0.5	29.2	0	0	0
	May	5.9	0.9	34.1	0	0	0
	June	3.3	1.0	34.8	.2	.3	.5
	July	0	2.6	30.5	1.2	1.4	2.6
	Aug.	1.0	2.9	27.2	.8	1.9	2.7
	Sept.	0	4.9	21.3	.8	4.1	4.9
	Oct.	1.5	1.7	20.0	.2	.6	.8
	Nov.	3.8	0.6	22.2	0	0	0
	Dec.	3.7	0.3	25.7	0	0	0
	Total	46.0	16.9		3.2	8.3	11.5
Enders	Jan.	4.9	0.6	37.2	0	0	0
	Feb.	3.9	0.5	39.8	0	0	0
	Mar.	4.4	0.6	42.2	0	0	0
	Apr.	3.6	1.8	42.9	0	.1	.1
	May	4.8	2.4	44.1	0	.1	.1
	June	4.2	4.5	42.6	0	.8	.8
	July	4.0	6.4	38.9	1.3	1.0	2.3
	Aug.	4.1	5.9	36.4	.7	1.1	1.8
	Sept.	4.2	8.2	31.7	.8	3.4	4.2
	Oct.	3.3	2.6	32.7	.2	.5	.7
	Nov.	4.1	0.5	35.4	0	0	0
	Dec.	4.8	0.6	38.8	0	0	0
	Total	50.3 1/	34.6		3.0	7.0	10.0

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

TABLE 3 (Cont.)

RESERVOIR OPERATIONS DURING 1954

Reservoir	Month	1000 Acre-feet					
		Res. Inflow	Res. Outflow	Res. Cont. at End of Mo.	Use of Storage Releases (Approx.) Div. for Irrig.	Other Use	Total
Harry Strunk Lake	Jan.	3.6	0.4	34.4	0	0	0
	Feb.	4.0	2.9	35.0	0	0	0
	Mar.	3.7	3.8	34.4	0	0.1	0.1
	Apr.	3.4	1.6	35.6	0	0	0
	May	6.1	3.5	38.1	0	1.0	1.0
	June	3.2	3.5	36.6	0.5	0.6	1.1
	July	1.6	12.5	25.7	9.6	1.3	10.9
	Aug.	3.4	5.5	23.8	3.4	0.1	3.5
	Sept.	1.7	3.5	21.5	1.8	0	1.8
	Oct.	2.8	0.5	23.4	0	0	0
	Nov.	3.0	0.3	25.7	0	0	0
	Dec.	3.4	0.4	28.2	0	0	0
	Total	39.9	38.4		15.3	3.1	18.4
Harlan County	Jan.	6.4	0.4	127.5	0	0	0
	Feb.	15.2	0.5	143.8	0	0	0
	Mar.	13.8	0.5	153.6	0	0	0
	Apr.	10.7	0.8	162.1	0	0	0
	May	30.7	2.2	189.3	0	0	0
	June	8.8	5.9	188.4	1.5	1.5	3.0
	July	1.2	20.0	163.1	12.9	5.8	18.7
	Aug.	14.3	12.4	163.6	6.3	2.5	8.8
	Sept.	3.5	6.7	156.7	3.6	1.4	5.0
	Oct.	1.7	1.0	155.2	.3	.4	.7
	Nov.	4.4	0.5	156.0	0	0	0
	Dec.	5.7	0.6	160.0	0	0	0
	Total	116.4	51.5		24.6	11.6	36.2
Cedar Bluff	Jan.	0.4	0.2	109.5	0	0	0
	Feb.	1.2	0.2	110.4	0	0	0
	Mar.	0.3	0.3	108.8	0	0	0
	Apr.	0.3	0.2	108.6	0	0	0
	May	0.7	0.3	115.2	0	0	0
	June	0.1	0.3	112.3	0	.1	.1
	July	0	1.0	107.9	0	1.0	1.0
	Aug.	0	1.1	104.1	0	1.1	1.1
	Sept.	0.1	0.8	100.5	0	.7	.7
	Oct.	0.1	0.7	98.0	0	.6	.6
	Nov.	0	0.3	96.5	0	.3	.3
	Dec.	0	0.3	95.2	0	.3	.3
	Total	3.2	5.7		0	4.1	4.1

TABLE 4

ESTIMATED CANAL DIVERSIONS AND ACRES TO BE IRRIGATED - 1955
(UNITS IN 1000 ACRE-FEET)

Dry Yr.	Hale D. (Suppl. to 1,100 Ac.)	Pvt. Irrig. F-C Div. (Suppl. to 16,500 Ac.) 1/	Meeker C. (Suppl. to 1,000 Ac.)	Bartley Canal (2,300 Ac.)	Cambridge Canal (7,850 Ac.)
Apr.	0	0	0	1.5	3.3
May	0	0	0	1.8	4.0
June	0	.1	0	2.1	6.4
July	.2	3.5	.4	2.9	8.5
Aug.	.6	2.4	.2	3.1	7.4
Sept.	.2	.2	0	2.4	5.6
Oct.	0	0	0	1.2	2.6
Total	1.0	6.2	0.6	15.0	37.8
Median Yr.					
Apr.	0	0	0	1.1	2.2
May	0	0	0	1.5	3.7
June	0	0	0	1.8	4.8
July	0	1.4	.2	2.7	7.7
Aug.	0	1.0	.1	2.7	6.0
Sept.	0	.1	0	2.2	4.8
Oct.	0	0	0	1.1	2.2
Total	0	2.5	.3	13.1	31.4
Wet Yr.					
Apr.	0	0	0	0	0
May	0	0	0	0	0
June	0	0	0	.9	0
July	0	0	0	2.3	6.0
Aug.	0	0	0	2.4	5.2
Sept.	0	0	0	1.9	4.3
Oct.	0	0	0	1.0	1.8
Total	0	0	0	8.5	17.3

1/ Est. 1,300 Acres for Median Year

TABLE 4 (Cont.)

ESTIMATED CANAL DIVERSIONS AND ACRES TO BE IRRIGATED - 1955
(UNITS IN 1000 ACRE-FEET)

Dry Yr.	Franklin Canal (2,465 Ac.)	Naponee Canal (345 Ac.)	Franklin Pump Canal (1,500 Ac.)	Superior Canal (4,000 Ac.)	Courtland Canal (2,225 Ac.)	Kutina Develop. Farm (76 Ac.)
Apr.	2.7	.3	.6	1.1	1.9	0
May	2.5	.3	.4	1.4	3.3	.01
June	3.8	.5	.7	2.2	4.7	.02
July	5.2	.7	1.5	3.9	5.5	.04
Aug.	4.5	.7	1.4	3.5	5.4	.07
Sept.	2.4	.4	.9	2.5	3.9	.02
Oct.	1.2	.3	.5	1.3	2.1	.02
Total	22.3	3.2	6.0	15.9	26.8	.18
Median Yr.						
Apr.	0	0	0	.6	1.6	0
May	2.1	0	.2	.9	3.1	0
June	3.5	.5	.5	1.4	4.3	.01
July	4.8	.7	1.3	3.4	5.2	.03
Aug.	4.2	.6	1.3	3.3	5.3	.04
Sept.	2.0	.3	.7	2.2	3.8	.01
Oct.	.9	.3	.3	.8	1.8	.01
Total	17.5	2.4	4.3	12.6	25.1	.10
Wet Yr.						
Apr.	0	0	0	0	0	0
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	3.9	.5	.7	2.6	4.9	.02
Aug.	3.8	.6	1.0	2.3	4.8	.03
Sept.	1.6	.3	.5	1.1	3.3	.01
Oct.	0	0	0	0	0	0
Total	9.3	1.4	2.2	6.0	13.0	.06

TABLE 5

BONNY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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. Spill
									35.6	
Dry	Jan.	2.0	1.45	.2	0	.5	.5	+1.3	36.9	
	Feb.	2.1	1.55	.3	0	.5	.5	+1.3	38.2	
	Mar.	2.4	2.45	.4	0	.5	.5	+1.5	39.7	
	Apr.	2.1	4.30	.7	.1	.5	.6	+ .8	40.5	
	May	2.0	5.35	.9	.7	.5	1.2	- .1	40.4	
	June	1.9	6.95	1.1	.9	.5	1.4	- .6	39.8	
	July	0.8	8.30	1.4	1.0	.5	1.5	-2.1	37.7	
	Aug.	0.5	7.00	1.1	1.1	.5	1.6	-2.2	35.5	
	Sept.	0.5	5.20	.8	.7	.5	1.2	-1.5	34.0	
	Oct.	1.1	5.05	.8	.6	.5	1.1	- .8	33.2	
	Nov.	1.6	3.05	.5	.6	.5	1.1	0	33.2	
	Dec.	2.0	1.85	.3	0	.5	.5	+1.2	34.4	
	Total	19.0	52.50	8.5	5.7	6.0	11.7	-1.2		
									35.6	
Median	Jan.	2.3	1.20	.2	0	.5	.5	+1.6	37.2	
	Feb.	2.4	1.40	.2	0	.5	.5	+1.7	38.9	
	Mar.	3.0	1.85	.3	0	.5	.5	+2.2	41.2	
	Apr.	2.5	2.80	.5	.1	.5	.6	+ .2	41.3	1.2
	May	3.0	3.00	.5	.6	.5	1.1	0	41.3	1.4
	June	3.0	4.60	.8	.6	.5	1.1	0	41.3	1.1
	July	1.2	6.25	1.0	.6	.5	1.1	- .9	40.4	
	Aug.	2.1	6.10	1.0	.6	.5	1.1	0	40.4	
	Sept.	1.6	4.30	.7	.6	.5	1.1	- .2	40.2	
	Oct.	1.7	4.55	.7	.3	5.4	5.7	-4.7	35.5	
	Nov.	2.0	2.80	.4	.3	.5	.8	+ .8	36.3	
	Dec.	2.2	1.55	.2	0	.5	.5	+1.5	37.8	
	Total	27.0	40.40	6.5	3.7	10.9	14.6	+2.2		3.7
									35.6	
Wet	Jan.	2.8	.90	.1	0	.5	.5	+2.2	37.8	
	Feb.	2.9	1.25	.2	0	.5	.5	+2.2	40.0	
	Mar.	3.6	1.35	.2	0	.5	.5	+1.3	41.3	1.6
	Apr.	3.6	2.40	.2	.1	.5	.6	0	41.3	2.8
	May	5.1	2.05	.3	.1	.5	.6	0	41.3	4.2
	June	5.0	2.50	.4	.1	.5	.6	0	41.3	4.0
	July	4.3	5.05	.8	.5	.5	1.0	0	41.3	2.5
	Aug.	5.2	4.00	.7	.5	.5	1.0	0	41.3	3.5
	Sept.	2.5	3.20	.5	.4	.5	.9	0	41.3	1.1
	Oct.	2.1	3.40	.5	.3	7.1	7.4	-5.8	35.5	
	Nov.	2.4	2.60	.4	0	.5	.5	+1.5	37.0	
	Dec.	2.5	1.30	.2	0	.5	.5	+1.8	38.8	
	Total	42.0	30.00	4.5	2.0	12.6	14.6	+3.2		19.7

TABLE 5 (Cont.)

BONNY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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 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: Minimum of 8 c.f.s. (approximately 500 A.F. per month) seepage around dam. Value indicated for October is the amount of release necessary to draw the reservoir level down to an elevation 3 feet below top of irrigation pool. This is necessary in order to keep reservoir from spilling through spillway notch during winter months. Danger of freezing water, and possible damage, in Hale Ditch outlet pipe make it impractical to make releases through river outlet during winter months.

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 6

SWANSON LAKE OPERATION STUDY
ESTIMATES FOR 1955

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	Corr. for Upstr. Depl.	Depleted Inflow	Net Evaporation In.		Total Rel. Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spills
									25.7	
Dry	Jan.	8.1	-1.5	6.6	1.05	.2	.6	+5.8	31.5	
	Feb.	9.7	-1.6	8.1	1.20	.3	.6	+7.2	38.7	
	Mar.	11.0	-1.9	9.1	1.95	.5	.6	+8.0	46.7	
	Apr.	8.8	-1.5	7.3	3.85	1.0	.6	+5.7	52.4	
	May	8.2	- .8	7.4	4.10	1.2	2.8	+3.4	55.8	
	June	7.5	- .5	7.0	5.20	1.5	2.9	+2.6	58.4	
	July	1.9	+ .5	2.4	7.70	2.3	4.9	-4.8	53.6	
	Aug.	2.2	+ .5	2.7	6.90	1.8	4.9	-4.0	49.6	
	Sept.	0.8	+ .5	1.3	5.25	1.4	4.2	-4.3	45.3	
	Oct.	2.8	0	2.8	4.60	1.1	1.5	+0.2	45.5	
	Nov.	5.7	- .5	5.2	2.70	.7	.6	+3.9	49.4	
	Dec.	6.3	-1.5	4.8	1.30	.3	.6	+3.9	53.3	
	Total	73.0	8.3	64.7	45.80	12.3	24.8	+27.6		
									25.7	
Median	Jan.	10.3	-1.8	8.5	.75	.2	.6	+7.7	33.4	
	Feb.	12.8	-1.9	10.9	1.00	.2	.6	+10.1	43.5	
	Mar.	14.9	-2.5	12.4	1.40	.4	.6	+11.4	54.9	
	Apr.	11.9	- .7	11.2	2.40	.7	.6	+9.9	64.8	
	May	14.9	- .5	14.4	2.10	.7	.6	+13.1	77.9	
	June	19.5	- .8	18.7	3.70	1.3	.6	+16.8	94.7	
	July	5.5	- .1	5.4	6.10	2.3	3.3	-0.2	94.5	
	Aug.	6.8	-1.0	5.8	5.70	2.1	3.7	0	94.5	
	Sept.	5.4	- .5	4.9	3.40	1.3	3.7	-0.1	94.4	
	Oct.	4.7	+4.0	8.7	4.30	1.7	0	+7.0	101.4	
	Nov.	7.8	-1.2	6.6	2.10	.9	.6	+5.1	106.5	
	Dec.	8.5	-1.7	6.8	1.10	.4	.6	+5.8	112.3	
	Total	123.0	-8.7	114.3	34.05	12.2	15.5	+86.6		
									25.7	
Wet	Jan.	13.7	-2.3	11.4	.55	.2	.6	+10.6	36.3	
	Feb.	16.4	-2.4	14.0	.60	.2	.6	+13.2	49.5	
	Mar.	20.0	-1.5	18.5	.60	.2	.6	+17.7	67.2	
	Apr.	16.7	- .2	16.5	.60	.3	.6	+15.6	82.8	
	May	23.9	- .3	23.6	.80	.3	.6	+22.7	105.5	
	June	27.5	- .4	27.1	1.90	.7	.6	+14.7	120.2	11.1
	July	29.0	- .8	28.2	4.00	1.7	.6	0	120.2	25.9
	Aug.	15.1	- .7	14.4	5.00	2.1	.6	0	120.2	11.7
	Sept.	11.5	- .5	11.0	2.40	1.0	.6	0	120.2	9.4
	Oct.	9.6	+5.3	14.9	3.80	1.6	.6	0	120.2	12.7
	Nov.	10.5	-1.9	8.6	1.60	.6	.6	0	120.2	7.4
	Dec.	11.1	-2.0	9.1	.65	.3	.6	0	120.2	8.2
	Total	205.0	-7.7	197.3	22.50	9.2	7.2	+94.5		86.4

TABLE 6 (Cont.)

SWANSON LAKE - RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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.

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 7

ENDERS RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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
							38.8	
Dry	Jan.	4.1	1.05	.2	.6	+3.3	42.1	
	Feb.	3.8	1.20	.2	.6	+2.4	44.5	0.6
	Mar.	3.9	1.95	.3	.6	0	44.5	3.0
	Apr.	3.7	4.10	.6	4.6	-1.5	43.0	
	May	3.6	4.65	.6	4.5	-1.5	41.5	
	June	3.4	5.25	.7	4.4	-1.7	39.8	
	July	3.1	8.60	1.2	5.6	-3.7	36.1	
	Aug.	3.1	6.85	.8	4.8	-2.5	33.6	
	Sept.	3.2	5.50	.6	4.3	-1.7	31.9	
	Oct.	3.4	4.60	.5	4.3	-1.4	30.5	
	Nov.	3.4	2.65	.3	1.2	+1.9	32.4	
	Dec.	3.8	1.20	.2	1.2	+2.4	34.8	
	Total	42.5	47.60	6.2	36.7	-4.0		3.6
							38.8	
Median	Jan.	4.8	.75	.1	.6	+4.1	42.9	
	Feb.	4.3	.95	.1	.6	+1.6	44.5	2.0
	Mar.	4.4	1.35	.2	.6	0	44.5	3.6
	Apr.	4.3	2.60	.4	4.8	-0.9	43.6	
	May	4.1	3.00	.4	4.8	-1.1	42.5	
	June	4.2	3.55	.5	4.8	-1.1	41.4	
	July	3.7	5.90	.8	5.1	-2.2	39.2	
	Aug.	3.7	6.50	.9	4.8	-2.0	37.2	
	Sept.	3.6	3.45	.5	4.6	-1.5	35.7	
	Oct.	4.1	4.30	.6	4.8	-1.3	34.4	
	Nov.	4.0	2.30	.3	1.8	+1.9	36.3	
	Dec.	4.3	.90	.1	1.8	+2.4	38.7	
	Total	49.5	35.60	4.9	39.1	-0.1		5.6
							38.8	
Wet	Jan.	5.1	.55	.1	.6	+4.4	43.2	
	Feb.	4.8	.30	.1	.6	+1.3	44.5	2.8
	Mar.	5.1	.95	.1	.6	0	44.5	4.4
	Apr.	4.7	.80	.1	2.4	0	44.5	2.2
	May	4.8	1.25	.2	4.8	-0.2	44.3	
	June	5.4	2.40	.4	4.8	+0.2	44.5	
	July	4.3	4.35	.7	4.8	-1.2	43.3	
	Aug.	4.2	4.50	.7	4.8	-1.3	42.0	
	Sept.	4.6	2.30	.3	4.8	-0.5	41.5	
	Oct.	4.7	3.35	.5	4.0	+0.2	41.7	
	Nov.	4.7	1.90	.2	3.6	+0.9	42.6	
	Dec.	4.8	.65	.1	3.6	+1.1	43.7	
	Total	57.2	23.30	3.5	39.4	+4.9		9.4

TABLE 7 (Cont.)

ENDERS RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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. A minimum of approximately 10 c.f.s. (600 A.F. per month) seepage can be expected around the dam. Values in November and December are approximate continuous releases that could be made and still have the reservoir approximately full in the following April. If a reservoir is expected to spill, it is better to make continuous regulated releases to fill the reservoir gradually throughout the winter than it is to close the outlet for a few months and then suddenly start passing large amounts as soon as the reservoir is full. This also keeps the water level lower during winter months when high winds can cause wave action and damage to riprap.

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 8

HARRY STRUNK LAKE-RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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
							28.2	
Dry	Jan.	2.8	.76	.1	.3	+2.4	30.6	
	Feb.	3.1	.89	.1	.3	+2.7	33.3	
	Mar.	3.7	1.87	.2	.3	+3.2	36.5	
	Apr.	3.5	4.23	.6	3.1	-0.2	36.3	
	May	3.2	4.07	.6	4.3	-1.7	34.6	
	June	3.4	5.02	.6	6.7	-3.9	30.7	
	July	2.6	8.41	.9	10.5	-8.8	21.9	
	Aug.	2.6	7.42	.6	9.2	-7.2	14.7	
	Sept.	2.0	4.64	.3	5.9	-4.2	10.5	
	Oct.	2.2	4.52	.2	2.9	-0.9	9.6	
	Nov.	2.4	2.57	.1	.3	+2.0	11.6	
	Dec.	2.5	1.10	.1	.3	+2.1	13.7	
	Total	34.0	45.50	4.4	44.1	-14.5		
							28.2	
Median	Jan.	3.6	.50	.1	.3	+3.2	31.4	
	Feb.	3.9	.75	.1	.3	+3.5	34.9	
	Mar.	4.2	1.40	.2	.3	+3.7	38.6	
	Apr.	4.7	2.29	.3	1.2	+0.6	39.2	2.6
	May	5.2	2.41	.4	2.4	0	39.2	2.4
	June	8.8	3.57	.5	3.0	0	39.2	5.3
	July	5.9	5.95	.8	8.8	-3.7	35.5	
	Aug.	3.6	5.33	.7	7.1	-4.2	31.3	
	Sept.	3.1	3.51	.4	5.1	-2.4	28.9	
	Oct.	3.1	4.14	.5	2.1	+0.5	29.4	
	Nov.	3.2	2.00	.3	1.2	+1.7	31.1	
	Dec.	3.5	.81	.1	1.2	+2.2	33.3	
	Total	52.8	32.66	4.4	33.0	+5.1		10.3
							28.2	
Wet	Jan.	4.4	.25	.1	.3	+4.0	32.2	
	Feb.	4.3	.40	.1	.3	+3.9	36.1	
	Mar.	5.6	.49	.1	.3	+3.1	39.2	2.1
	Apr.	6.0	.65	.1	.3	0	39.2	5.6
	May	7.8	.42	.1	.3	0	39.2	7.4
	June	20.2	.98	.1	.3	0	39.2	19.8
	July	9.5	5.13	.8	5.2	0	39.2	3.5
	Aug.	5.8	4.19	.3	5.5	0	39.2	
	Sept.	7.1	2.33	.4	3.4	0	39.2	3.3
	Oct.	4.5	3.66	.5	1.0	0	39.2	3.0
	Nov.	3.8	.46	.1	4.0	-0.3	38.9	
	Dec.	4.0	.34	.1	4.0	-0.1	38.8	
	Total	83.0	19.30	2.8	24.9	+10.6		44.7

TABLE 8 (Cont.)

HARRY STRUNK LAKE-RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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. Values in November and December are approximate continuous releases that could be made during winter months and still have reservoir approximately full in the following April. If a reservoir is expected to spill, it is better to fill the reservoir gradually during the winter months than it is to close the outlet for a few months and then suddenly start passing large amounts as soon as the reservoir is full. This also keeps the water level lower during winter months when high winds can cause wave action and damage to riprap.

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 9

HARLAN COUNTY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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	Corr. for Upstr. Depl.	Depleted Inflow	Net Evaporation In.		Total Rel. Req.	Res. Change	Res. Cont. at End of Mo.	Res. Spill
	Dec.(54)								160.0	
Dry	Jan.	18.1	-13.5	4.6	.90	.6	.6	+3.4	163.4	
	Feb.	24.8	-14.5	10.3	.78	.6	.6	+9.1	172.5	
	Mar.	32.4	-14.1	18.3	1.74	1.3	.6	+16.4	188.9	
	Apr.	28.8	-12.5	16.3	4.70	3.5	7.6	+5.2	194.1	
	May	38.2	- 9.2	29.0	4.38	3.6	8.4	+17.0	211.1	
	June	63.5	- 9.0	54.5	6.60	5.5	14.4	+34.6	245.7	
	July	25.4	- 1.9	23.5	9.71	8.2	23.7	-8.4	237.3	
	Aug.	17.2	- 2.0	15.2	8.41	7.7	22.8	-15.3	222.0	
	Sept.	7.7	+ 0.2	7.9	5.56	4.6	15.2	-11.9	210.1	
	Oct.	5.7	- 3.5	2.2	4.52	3.7	7.6	-9.1	201.0	
	Nov.	11.9	- 9.4	2.5	2.58	2.1	.6	-0.2	200.8	
	Dec.	16.3	-10.5	5.8	1.12	1.1	.6	+4.1	204.9	
	Total	290.0	-99.9	190.1	51.00	42.5	102.7	+44.9		
	Dec.(54)								160.0	
Median	Jan.	23.3	-17.2	6.1	.65	.5	.6	+5.0	165.0	
	Feb.	31.4	-17.5	13.9	.61	.5	.6	+12.8	177.8	
	Mar.	37.8	-18.4	19.4	1.13	.9	.6	+17.9	195.7	
	Apr.	40.7	-15.0	25.7	1.31	1.0	.6	+24.1	219.8	
	May	63.1	-19.2	43.9	3.27	3.0	2.5	+38.4	258.2	
	June	106.8	-25.4	81.4	5.46	5.4	2.4	+73.6	331.8	
	July	46.9	-9.9	37.0	7.70	8.2	15.4	+13.4	345.2	
	Aug.	30.4	-8.3	22.1	6.01	6.6	17.5	-2.0	343.2	
	Sept.	24.8	-5.8	19.0	4.47	5.0	12.3	+1.7	344.9	
	Oct.	17.5	-8.3	9.2	3.43	3.8	4.3	+1.1	346.0	
	Nov.	19.3	-11.4	7.9	1.55	1.7	.6	+4.1	350.1	1.5
	Dec.	23.0	-12.7	10.3	.71	.9	.6	0	350.1	8.8
	Total	465.0	-169.1	295.9	36.30	37.5	58.0	+190.1		10.3
	Dec.(54)								160.0	
Wet	Jan.	28.4	-21.7	6.7	0	0	.6	+6.1	166.1	
	Feb.	40.5	-21.2	19.3	.28	.2	.6	+18.7	184.8	
	Mar.	57.5	-22.7	34.8	.70	.6	.6	+33.6	218.4	
	Apr.	59.0	-16.3	42.7	.21	.2	.6	+41.9	260.3	
	May	109.7	-23.4	86.3	1.78	1.8	.6	+83.9	344.2	
	June	184.6	-17.4	167.2	1.58	1.8	.6	+5.9	350.1	158.9
	July	86.3	-11.1	75.2	6.53	7.2	5.4	0	350.1	62.6
	Aug.	64.1	-10.1	54.0	3.43	3.9	10.9	0	350.1	39.2
	Sept.	76.2	-7.9	68.3	3.84	4.2	2.5	0	350.1	61.4
	Oct.	34.2	-0.3	33.9	2.28	2.6	.6	0	350.1	30.7
	Nov.	28.7	-3.4	25.3	1.03	1.2	.6	0	350.1	23.5
	Dec.	30.8	-3.5	27.3	.40	.4	.6	0	350.1	26.3
	Total	800.0	-159.0	641.0	22.00	24.1	24.2	+190.1		402.6

TABLE 9 (Cont.)

HARLAN COUNTY RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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

Col. 3: Historical records corrected 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 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 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 10

KIRWIN RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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
Dry	Jan.	0.1	.91	0	0.1	0	0	
	Feb.	.5	1.04	0	.5	0	0	
	Mar.	1.4	1.79	.1	.3	∕1.0	1.0	
	Apr.	1.4	4.60	.1	.3	∕1.0	2.0	
	May	2.3	4.77	.2	.3	∕1.8	3.8	
	June	3.8	6.32	.3	.3	∕3.2	7.0	
	July	3.3	8.80	.6	.3	∕2.4	9.4	
	Aug.	2.2	7.74	.6	.3	∕1.3	10.7	
	Sept.	0.9	5.66	.5	.3	∕0.1	10.8	
	Oct.	0.1	4.61	.4	.3	-0.6	10.2	
	Nov.	0.4	2.54	.1	.3	0	10.2	
	Dec.	0.3	1.22	.1	.3	-0.1	10.1	
	Total	16.7	50.00	3.0	3.6	∕10.1		
Median	Jan.	0.9	.73	0	0.9	0	0	
	Feb.	1.8	.77	0	1.8	0	0	
	Mar.	2.1	1.04	.1	.3	∕1.7	1.7	
	Apr.	2.6	1.89	.1	.3	∕2.2	3.9	
	May	4.1	3.60	.2	.3	∕3.6	7.5	
	June	10.2	4.65	.5	.3	∕9.4	16.9	
	July	6.3	6.33	.9	.3	∕5.1	22.0	
	Aug.	4.3	5.56	.9	.3	∕3.1	25.1	
	Sept.	2.5	4.25	.7	.3	∕1.5	26.6	
	Oct.	1.6	3.59	.6	.3	∕0.7	27.3	
	Nov.	1.2	1.85	.3	.3	∕0.6	27.9	
	Dec.	1.0	.74	.1	.3	∕0.6	28.5	
	Total	38.6	35.00	4.4	5.7	∕28.5		
Wet	Jan.	2.0	.45	0	2.0	0	0	
	Feb.	2.7	.50	0	2.7	0	0	
	Mar.	2.9	.56	.1	.3	∕2.5	2.5	
	Apr.	5.3	.53	.1	.3	∕4.9	7.4	
	May	10.6	1.68	.2	.3	∕10.1	17.5	
	June	33.4	1.66	.3	.3	∕32.8	50.3	
	July	14.5	5.47	1.7	.3	∕12.5	62.8	
	Aug.	20.4	4.67	1.7	.3	∕18.4	81.2	
	Sept.	12.7	2.75	1.0	.3	∕11.4	92.6	
	Oct.	5.2	2.27	1.0	.3	∕2.4	95.0	1.5
	Nov.	3.9	1.02	.4	.3	0	95.0	3.2
	Dec.	2.4	.54	.2	.3	0	95.0	1.9
	Total	116.0	22.10	6.7	7.7	∕95.0		6.6

TABLE 10 (Cont.)

KIRWIN RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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: Expect storage to commence about Mar. 1, 1955. Release during storage will be approximately 5 second-feet. Records of stream-flow pickup below dam indicate that pickup will be available to satisfy senior water rights.

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 11

WEBSTER RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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
Dry	Jan.	0.2	.96	0	0.2	0	0	
	Feb.	.8	1.11	0	.8	0	0	
	Mar.	1.3	2.08	0	1.3	0	0	
	Apr.	1.6	4.92	0	1.6	0	0	
	May	1.8	4.75	0	1.8	0	0	
	June	4.0	7.50	0	4.0	0	0	
	July	1.8	9.04	0	1.8	0	0	
	Aug.	1.2	8.08	0	1.2	0	0	
	Sept.	.9	6.70	0	.9	0	0	
	Oct.	0	4.71	0	0	0	0	
	Nov.	.2	2.45	0	.2	0	0	
	Dec.	.2	1.20	0	.2	0	0	
	Total	14.0	53.50	0	14.0	0		
Median	Jan.	0.7	.67	0	0.7	0	0	
	Feb.	1.7	.81	0	1.7	0	0	
	Mar.	2.0	1.48	0	2.0	0	0	
	Apr.	2.9	2.72	0	2.9	0	0	
	May	4.4	3.13	0	4.4	0	0	
	June	10.0	4.40	0	10.0	0	0	
	July	4.5	7.02	0	4.5	0	0	
	Aug.	3.3	5.72	0	3.3	0	0	
	Sept.	2.3	4.69	0	2.3	0	0	
	Oct.	.9	3.37	.2	.3	∕ .4	0.4	
	Nov.	.9	1.61	.1	.3	∕ .5	0.9	
	Dec.	.7	.78	.1	.3	∕ .3	1.2	
	Total	34.3	36.40	.4	32.7	∕1.2		
Wet	Jan.	2.1	.53	0	2.1	0	0	
	Feb.	2.3	.48	0	2.3	0	0	
	Mar.	3.8	.70	0	3.8	0	0	
	Apr.	6.3	1.00	0	6.3	0	0	
	May	10.0	1.74	0	10.0	0	0	
	June	22.9	.72	0	22.9	0	0	
	July	14.4	5.63	0	14.4	0	0	
	Aug.	15.5	4.03	0	15.5	0	0	
	Sept.	12.2	3.75	0	12.2	0	0	
	Oct.	4.7	2.83	.3	.3	∕4.1	4.1	
	Nov.	3.7	.99	.1	.3	∕3.3	7.4	
	Dec.	2.1	.60	.1	.3	∕1.7	9.1	
	Total	100.0	23.00	.5	90.4	∕9.1		

TABLE 11 (Cont.)

WEBSTER RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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: Expect storage to commence about October 1, 1955. Release during storage will be about 5 second-feet.

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 12

CEDAR BLUFF RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

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
Dry	Jan.	0.4	1.22	.4	.3	- .3	95.2 94.9	
	Feb.	.6	1.31	.4	.3	- .1	94.8	
	Mar.	.8	2.34	.7	.3	- .2	94.6	
	Apr.	.9	4.84	1.6	.3	-1.0	93.6	
	May	1.6	4.81	1.6	.3	- .3	93.3	
	June	3.2	7.75	2.6	.3	≠ .3	93.6	
	July	2.5	9.15	3.0	1.3	-1.8	91.8	
	Aug.	1.7	8.24	2.7	1.3	-2.3	89.5	
	Sept.	.9	6.69	2.1	1.2	-2.4	87.1	
	Oct.	.4	4.94	1.5	1.2	-2.3	84.8	
	Nov.	.5	2.76	.8	.3	- .6	84.2	
	Dec.	.5	1.45	.4	.3	- .2	84.0	
	Total	14.0	55.50	17.8	7.4	-11.2		
Median	Jan.	0.9	1.06	.3	.3	≠ .3	95.2 95.5	
	Feb.	1.2	1.10	.3	.3	≠ .6	96.1	
	Mar.	1.3	1.57	.5	.3	≠ .5	96.6	
	Apr.	2.6	3.26	1.1	.3	≠1.2	97.8	
	May	4.4	3.09	1.1	.3	≠3.0	100.8	
	June	10.8	4.66	1.7	.3	≠8.8	109.6	
	July	6.1	7.68	3.0	.3	≠2.8	112.4	
	Aug.	5.1	5.73	2.2	1.3	≠1.6	114.0	
	Sept.	4.6	4.64	1.8	1.2	≠1.6	115.6	
	Oct.	1.7	3.74	1.4	.6	- .3	115.3	
	Nov.	1.2	2.13	.9	.3	0	115.3	
	Dec.	1.1	1.09	.4	.3	≠ .4	115.7	
	Total	41.0	39.75	14.7	5.8	≠20.5		
Wet	Jan.	2.0	.89	.1	.3	≠1.6	95.2 96.8	
	Feb.	2.3	.78	.1	.3	≠1.9	98.7	
	Mar.	3.1	1.05	.3	.3	≠2.5	101.2	
	Apr.	7.3	2.12	.8	.3	≠6.2	107.4	
	May	22.7	1.86	.7	.3	≠21.7	129.1	
	June	36.5	.80	.4	.3	≠35.8	164.9	
	July	15.7	6.07	3.6	.3	≠11.8	176.7	
	Aug.	17.6	3.98	2.5	.3	≠ 8.4	185.1	6.4
	Sept.	11.8	3.97	2.5	.3	0	185.1	9.0
	Oct.	6.4	2.63	1.6	.3	0	185.1	4.5
	Nov.	2.5	1.52	.9	.3	0	185.1	1.3
	Dec.	2.1	.83	.5	.3	0	185.1	1.3
	Total	130.0	26.50	14.0	3.6	≠89.9		22.5

TABLE 12 (Cont.)

CEDAR BLUFF RESERVOIR OPERATION STUDY
ESTIMATES FOR 1955

Explanation of Columns

Col. 1: As determined from inflow frequency curve, 90% on curve = dry year, 50% = median year, and 10% = wet year.

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: Releases for senior water rights, irrigation, and municipal water supply. Estimate minimum releases of about 5 second-feet required to keep live stream below dam.

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.)