

**A** NNUAL

**O** PERATING

**P** LAN

# Kansas River Projects

**1958 Operations**

**1959 Outlook**

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

**February 1959**

UNITED STATES DEPARTMENT OF THE INTERIOR  
Fred A. Seaton, Secretary

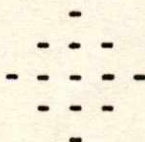
BUREAU OF RECLAMATION  
Wilbur A. Dexheimer, Commissioner

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

ANNUAL OPERATING PLAN

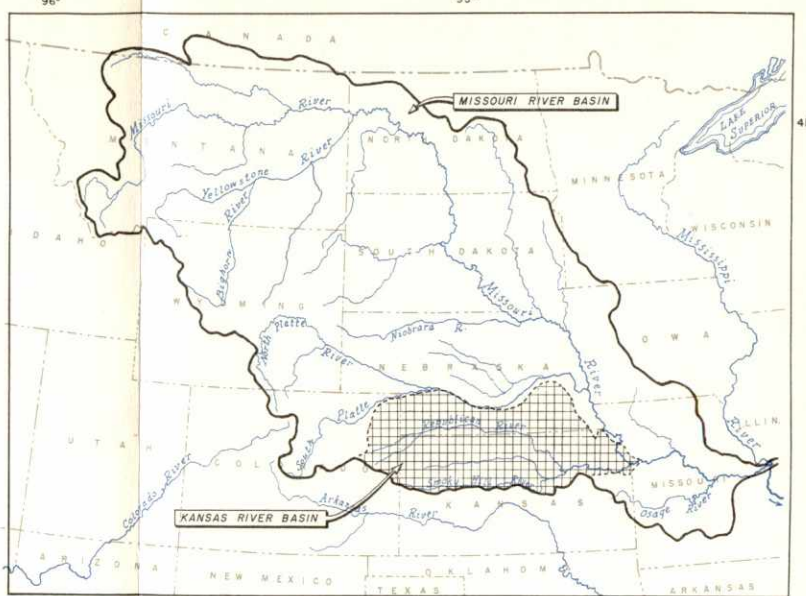
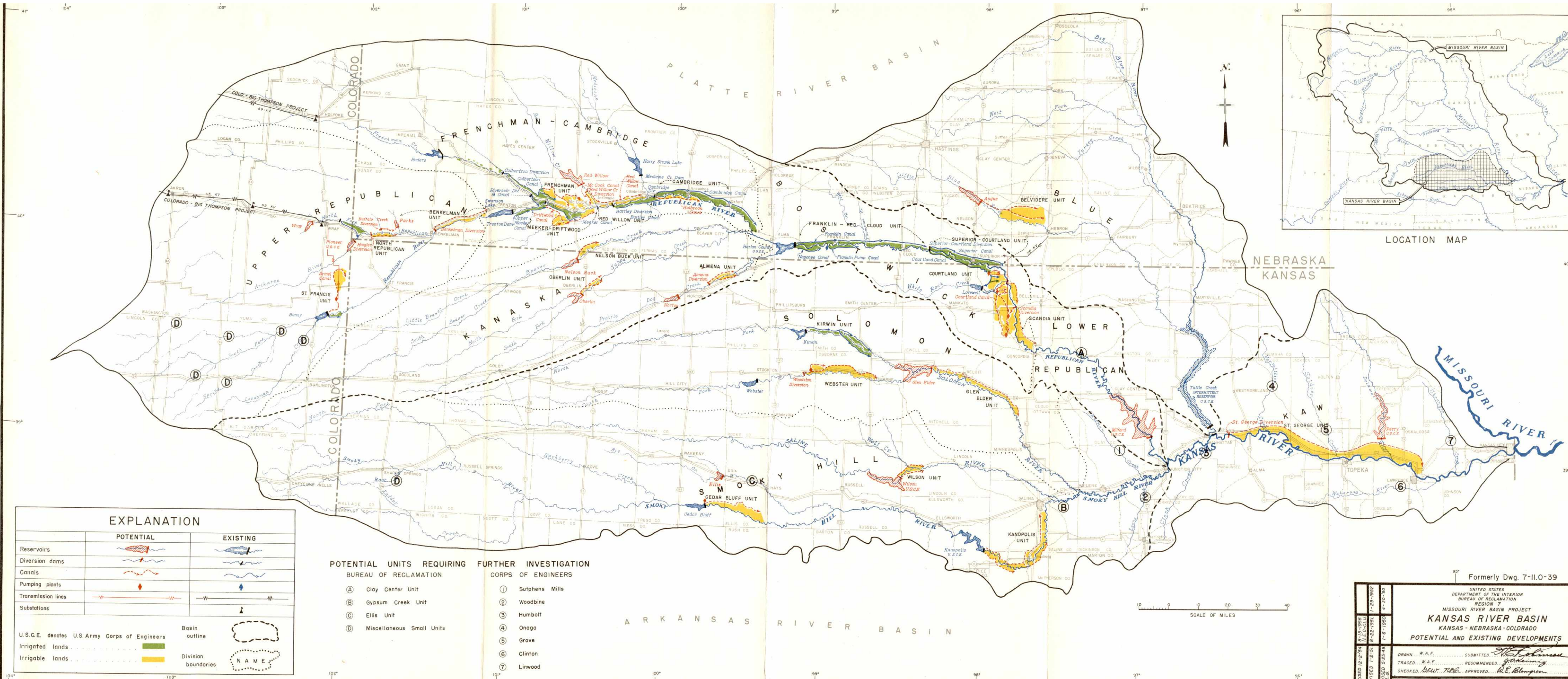
KANSAS RIVER PROJECTS

1958 OPERATIONS  
1959 OUTLOOK



February 1959





### EXPLANATION

	POTENTIAL	EXISTING
Reservoirs		
Diversion dams		
Canals		
Pumping plants		
Transmission lines		
Substations		
U.S.C.E. denotes U.S. Army Corps of Engineers	Basin outline	
Irrigated lands		
Irrigable lands		
	Division boundaries	
	NAME	

### POTENTIAL UNITS REQUIRING FURTHER INVESTIGATION

BUREAU OF RECLAMATION      CORPS OF ENGINEERS

- |                               |                    |
|-------------------------------|--------------------|
| (A) Clay Center Unit          | (1) Sutphens Mills |
| (B) Gypsum Creek Unit         | (2) Woodbine       |
| (C) Ellis Unit                | (3) Humbolt        |
| (D) Miscellaneous Small Units | (4) Onaga          |
|                               | (5) Grove          |
|                               | (6) Clinton        |
|                               | (7) Linwood        |

REVISIONS	1-29-1932	2-29-1932	3-29-1932	4-29-1932	5-29-1932	6-29-1932	7-29-1932	8-29-1932	9-29-1932	10-29-1932	11-29-1932	12-29-1932	1-29-1933	2-29-1933	3-29-1933	4-29-1933	5-29-1933	6-29-1933	7-29-1933	8-29-1933	9-29-1933	10-29-1933	11-29-1933	12-29-1933	1-29-1934	2-29-1934	3-29-1934	4-29-1934	5-29-1934	6-29-1934	7-29-1934	8-29-1934	9-29-1934	10-29-1934	11-29-1934	12-29-1934	1-29-1935	2-29-1935	3-29-1935	4-29-1935	5-29-1935	6-29-1935	7-29-1935	8-29-1935	9-29-1935	10-29-1935	11-29-1935	12-29-1935	1-29-1936	2-29-1936	3-29-1936	4-29-1936	5-29-1936	6-29-1936	7-29-1936	8-29-1936	9-29-1936	10-29-1936	11-29-1936	12-29-1936	1-29-1937	2-29-1937	3-29-1937	4-29-1937	5-29-1937	6-29-1937	7-29-1937	8-29-1937	9-29-1937	10-29-1937	11-29-1937	12-29-1937	1-29-1938	2-29-1938	3-29-1938	4-29-1938	5-29-1938	6-29-1938	7-29-1938	8-29-1938	9-29-1938	10-29-1938	11-29-1938	12-29-1938	1-29-1939	2-29-1939	3-29-1939	4-29-1939	5-29-1939	6-29-1939	7-29-1939	8-29-1939	9-29-1939	10-29-1939	11-29-1939	12-29-1939	1-29-1940	2-29-1940	3-29-1940	4-29-1940	5-29-1940	6-29-1940	7-29-1940	8-29-1940	9-29-1940	10-29-1940	11-29-1940	12-29-1940	1-29-1941	2-29-1941	3-29-1941	4-29-1941	5-29-1941	6-29-1941	7-29-1941	8-29-1941	9-29-1941	10-29-1941	11-29-1941	12-29-1941	1-29-1942	2-29-1942	3-29-1942	4-29-1942	5-29-1942	6-29-1942	7-29-1942	8-29-1942	9-29-1942	10-29-1942	11-29-1942	12-29-1942	1-29-1943	2-29-1943	3-29-1943	4-29-1943	5-29-1943	6-29-1943	7-29-1943	8-29-1943	9-29-1943	10-29-1943	11-29-1943	12-29-1943	1-29-1944	2-29-1944	3-29-1944	4-29-1944	5-29-1944	6-29-1944	7-29-1944	8-29-1944	9-29-1944	10-29-1944	11-29-1944	12-29-1944	1-29-1945	2-29-1945	3-29-1945	4-29-1945	5-29-1945	6-29-1945	7-29-1945	8-29-1945	9-29-1945	10-29-1945	11-29-1945	12-29-1945	1-29-1946	2-29-1946	3-29-1946	4-29-1946	5-29-1946	6-29-1946	7-29-1946	8-29-1946	9-29-1946	10-29-1946	11-29-1946	12-29-1946	1-29-1947	2-29-1947	3-29-1947	4-29-1947	5-29-1947	6-29-1947	7-29-1947	8-29-1947	9-29-1947	10-29-1947	11-29-1947	12-29-1947	1-29-1948	2-29-1948	3-29-1948	4-29-1948	5-29-1948	6-29-1948	7-29-1948	8-29-1948	9-29-1948	10-29-1948	11-29-1948	12-29-1948	1-29-1949	2-29-1949	3-29-1949	4-29-1949	5-29-1949	6-29-1949	7-29-1949	8-29-1949	9-29-1949	10-29-1949	11-29-1949	12-29-1949	1-29-1950	2-29-1950	3-29-1950	4-29-1950	5-29-1950	6-29-1950	7-29-1950	8-29-1950	9-29-1950	10-29-1950	11-29-1950	12-29-1950	1-29-1951	2-29-1951	3-29-1951	4-29-1951	5-29-1951	6-29-1951	7-29-1951	8-29-1951	9-29-1951	10-29-1951	11-29-1951	12-29-1951	1-29-1952	2-29-1952	3-29-1952	4-29-1952	5-29-1952	6-29-1952	7-29-1952	8-29-1952	9-29-1952	10-29-1952	11-29-1952	12-29-1952	1-29-1953	2-29-1953	3-29-1953	4-29-1953	5-29-1953	6-29-1953	7-29-1953	8-29-1953	9-29-1953	10-29-1953	11-29-1953	12-29-1953	1-29-1954	2-29-1954	3-29-1954	4-29-1954	5-29-1954	6-29-1954	7-29-1954	8-29-1954	9-29-1954	10-29-1954	11-29-1954	12-29-1954	1-29-1955	2-29-1955	3-29-1955	4-29-1955	5-29-1955	6-29-1955	7-29-1955	8-29-1955	9-29-1955	10-29-1955	11-29-1955	12-29-1955	1-29-1956	2-29-1956	3-29-1956	4-29-1956	5-29-1956	6-29-1956	7-29-1956	8-29-1956	9-29-1956	10-29-1956	11-29-1956	12-29-1956	1-29-1957	2-29-1957	3-29-1957	4-29-1957	5-29-1957	6-29-1957	7-29-1957	8-29-1957	9-29-1957	10-29-1957	11-29-1957	12-29-1957	1-29-1958	2-29-1958	3-29-1958	4-29-1958	5-29-1958	6-29-1958	7-29-1958	8-29-1958	9-29-1958	10-29-1958	11-29-1958	12-29-1958	1-29-1959	2-29-1959	3-29-1959	4-29-1959	5-29-1959	6-29-1959	7-29-1959	8-29-1959	9-29-1959	10-29-1959	11-29-1959	12-29-1959	1-29-1960	2-29-1960	3-29-1960	4-29-1960	5-29-1960	6-29-1960	7-29-1960	8-29-1960	9-29-1960	10-29-1960	11-29-1960	12-29-1960	1-29-1961	2-29-1961	3-29-1961	4-29-1961	5-29-1961	6-29-1961	7-29-1961	8-29-1961	9-29-1961	10-29-1961	11-29-1961	12-29-1961	1-29-1962	2-29-1962	3-29-1962	4-29-1962	5-29-1962	6-29-1962	7-29-1962	8-29-1962	9-29-1962	10-29-1962	11-29-1962	12-29-1962	1-29-1963	2-29-1963	3-29-1963	4-29-1963	5-29-1963	6-29-1963	7-29-1963	8-29-1963	9-29-1963	10-29-1963	11-29-1963	12-29-1963	1-29-1964	2-29-1964	3-29-1964	4-29-1964	5-29-1964	6-29-1964	7-29-1964	8-29-1964	9-29-1964	10-29-1964	11-29-1964	12-29-1964	1-29-1965	2-29-1965	3-29-1965	4-29-1965	5-29-1965	6-29-1965	7-29-1965	8-29-1965	9-29-1965	10-29-1965	11-29-1965	12-29-1965	1-29-1966	2-29-1966	3-29-1966	4-29-1966	5-29-1966	6-29-1966	7-29-1966	8-29-1966	9-29-1966	10-29-1966	11-29-1966	12-29-1966	1-29-1967	2-29-1967	3-29-1967	4-29-1967	5-29-1967	6-29-1967	7-29-1967	8-29-1967	9-29-1967	10-29-1967	11-29-1967	12-29-1967	1-29-1968	2-29-1968	3-29-1968	4-29-1968	5-29-1968	6-29-1968	7-29-1968	8-29-1968	9-29-1968	10-29-1968	11-29-1968	12-29-1968	1-29-1969	2-29-1969	3-29-1969	4-29-1969	5-29-1969	6-29-1969	7-29-1969	8-29-1969	9-29-1969	10-29-1969	11-29-1969	12-29-1969	1-29-1970	2-29-1970	3-29-1970	4-29-1970	5-29-1970	6-29-1970	7-29-1970	8-29-1970	9-29-1970	10-29-1970	11-29-1970	12-29-1970	1-29-1971	2-29-1971	3-29-1971	4-29-1971	5-29-1971	6-29-1971	7-29-1971	8-29-1971	9-29-1971	10-29-1971	11-29-1971	12-29-1971	1-29-1972	2-29-1972	3-29-1972	4-29-1972	5-29-1972	6-29-1972	7-29-1972	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## SYNOPSIS

### Annual Operating Plan - Kansas River Projects 1958 Operations 1959 Outlook

This is the sixth Annual Operating Plan for irrigation units in the Kansas River Projects area. The report is basically concerned with the Federally constructed irrigation facilities in the Republican, Solomon, and Smoky Hill River Drainage areas. The primary purpose is to describe the irrigation operations and responsibilities of the Bureau of Reclamation. The operational data regarding Harlan County Reservoir, constructed and operated by the Corps of Engineers, has been prepared with the cooperation of the Corps.

Chapter I introduces the report with a brief description of the irrigation units in the Kansas River Projects area. The 1958 operations are summarized in Chapter II. The plan of operation for 1959 is presented in Chapter III.

#### 1958 OPERATIONS

During 1958, the water supply was more than adequate to irrigate 60,247 acres under Kansas River Projects' units. Precipitation varied from 82 per cent of normal at Harry Strunk Lake to 139 per cent at Bonny Reservoir. The inflows to Bonny, Harlan County, Lovewell, Kirwin Reservoirs and Harry Strunk Lake were below normal while Swanson Lake, Enders, Webster and Cedar Bluff Reservoirs were above normal. Controlled spills occurred at all the reservoirs except Kirwin, which did not spill.

#### 1959 OUTLOOK

The prospects for 1959 are excellent with more than enough carry-over storage water to meet the requirements of 87,248 acres that are expected to be irrigated. If dry weather should prevail, supplemental water may be used on approximately 7,500 acres of land under private irrigation systems.



KANSAS RIVER PROJECTS  
1958 OPERATIONS  
1959 OUTLOOK

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# ANNUAL OPERATING PLAN - KANSAS RIVER PROJECTS

## 1958 OPERATIONS - 1959 OUTLOOK

### CHAPTER I - INTRODUCTION

#### PURPOSE OF REPORT

The purpose of this Annual Operating Plan is to advise water users, cooperating agencies, and other interests of the results of irrigation operations during 1958 and the plan of irrigation operations for 1959. This report does not include operations for flood control which are the responsibility of the Corps of Engineers.

#### LOCATION AND MAJOR FEATURES

The Kansas River Projects consist of the irrigation units of the Kansas River Basin, which are a part of the Missouri River Basin Project. This includes multiple-purpose reservoirs which provide storage for irrigation, flood control, municipal water supply, recreational purposes, stream pollution abatement, and other uses. These dams and reservoirs, constructed and operated by the Bureau of Reclamation or Corps of Engineers, serve the irrigation systems for these units. The canals and diversion dams have been constructed or rehabilitated by the Bureau of Reclamation and, for the most part, are operated by Irrigation Districts.

Ten reservoirs, nine canal systems, and three diversion dams are in operation, one diversion dam, three canal systems are under construction and one diversion dam and canal system are being rehabilitated. Two of the reservoirs, Harlan County and Kanopolis are operated by the Corps of Engineers. At the present time, Kanopolis is not being used to serve an irrigation unit and was not included in the scope of this report. Storage allocations for the included reservoirs are shown in Table 1 on page 12. The reservoirs and main irrigation canals are schematically shown in Exhibit 1, page 18.

#### IRRIGATION DISTRICTS

Eight Irrigation Districts in the Kansas River Projects area have contracted with the Bureau of Reclamation for construction of irrigation facilities. These are the Frenchman Valley, H&RW, Frenchman-Cambridge, and Nebraska-Bostwick Irrigation Districts in the State of Nebraska; and Kansas-Bostwick, Kirwin, Webster and Almena Irrigation Districts in the State of Kansas. Contracts with Cedar Bluff Irrigation District and the City of Russell, Kansas, are being negotiated.



## Frenchman Valley

Enders Reservoir and Culbertson Canal will be used to serve approximately 9,600 acres. The Bureau of Reclamation is rehabilitating the diversion dam and the main canal and water was delivered for the first time under the repayment contract in 1958.

## H&RW (initials for Hitchcock and Red Willow)

The Bureau of Reclamation is presently enlarging and extending the Culbertson Canal to serve 11,500 acres in the H&RW Irrigation District as well as the 9,400 acres now being irrigated in the Frenchman Valley Irrigation District. Present construction schedules provide for completion by December 1961.

## Frenchman-Cambridge

This unit is designed to receive storage water from three reservoirs. At the present time, Swanson Lake and Harry Strunk Lake are complete, and are serving this unit. Red Willow Reservoir will be constructed when funds are available.

The Cambridge, Bartley, and Meeker-Driftwood Canals are now in operation. The Meeker-Driftwood Canal will be completed by June, 1959, and will provide water for the lands that include those formerly irrigated by the Meeker Canal. The McCook and Red Willow Canals will be constructed when a water supply is available from Red Willow Reservoir. When all facilities in the Frenchman-Cambridge Irrigation District are completed, water will be available for approximately 42,400 acres.

## Nebraska-Bostwick

The primary source of storage water for the Nebraska-Bostwick Irrigation District is Harlan County Reservoir. The Franklin, Naponee, Franklin Pump, Superior and Courtland Canals have been constructed to serve 24,240 acres.

## Kansas-Bostwick

Storage water for this district will be provided primarily by Harlan County and Lovewell Reservoirs. The inflow to Lovewell Reservoir from White Rock Creek is insufficient to meet irrigation demands for the lower Courtland Canal. This storage is supplemented by flows of the Republican River and from Harlan County Reservoir. The additional water is delivered to Lovewell Reservoir by means of the Upper Courtland Canal. Approximately 15,000 acres will be served by that portion of the Courtland Canal in Kansas above Lovewell, and about 34,000 acres by Courtland Canal below Lovewell Reservoir. At the present time, service is available to 31,600 acres of the total 49,300 acres planned above and below Lovewell Reservoir.



## Kirwin

Of the 11,500 acres planned for this district, service is available to 11,372 acres. Kirwin Reservoir is used to supply water to the District.

## Webster

The Woodston Diversion Dam is nearing completion and construction has been started on the Osborne Canal. Eventually there will be irrigation service available to 8,500 acres. Water for this district will be stored in Webster Reservoir. There will be no irrigation in 1959.

## Almena

The repayment contract between the Bureau of Reclamation and the Almena Irrigation District has been negotiated. Construction of the Norton Dam, Almena Diversion Dam, and Almena Canal will be started when funds are appropriated.

### MUNICIPAL WATER

The City of Russell, Kansas, temporarily contracted for storage water from Cedar Bluff Reservoir in 1958 as they had in the preceding four years. The Bureau of Reclamation and the City of Russell are now negotiating a long-term contract.

A long-term contract has been negotiated with the City of Norton, Kansas for municipal water supply which will be furnished from Norton Reservoir when constructed.



## CHAPTER II - SUMMARY OF 1958 OPERATIONS

### PRECIPITATION

Precipitation varied greatly over the Kansas River Projects area, but for the most part was above normal from February through August 1958. Precipitation was above normal in the upper Republican, lower Republican, lower White Rock Creek, the South Fork of the Solomon, and the Smoky Hill Drainage areas. Precipitation was normal or below in the Republican River Drainage Area from Harlan County Reservoir to Swanson Lake, in the White Rock Creek drainage area above Lovewell Reservoir, and in the North Fork of the Solomon drainage above Kirwin Reservoir. See table 2 on page 13.

### INFLOW

Inflow into Swanson Lake, Enders, Webster, and Cedar Bluff Reservoirs was above normal and below normal at Harry Strunk Lake, Bonny, Harlan County, Lovewell and Kirwin Reservoirs. The total annual reservoir inflows of 1958 are graphically compared to the previous years of record in exhibits 24 through 32 (pages 41 to 49). Table 3 on page 14 shows the 1958 inflows compared to normal.

### RESERVOIR OPERATIONS - 1958

There were no irrigation shortages, and controlled spills occurred at all of the reservoirs except Kirwin, Table 4 on page 15 shows the 1958 reservoir operations with monthly inflows, outflows and reservoir contents. These operations are plotted on Exhibits 2 through 10 (pages 19 to 27) to compare 1958 with the previous years of operation.

Minimum downstream flow requirements were met by normal return flows and flood spills and no special reservoir operations were necessary.

Although the irrigation storage pools in most reservoirs were filled at various times during the year, the flood control pools were used only slightly and ample flood protection was provided at all times. Controlled spills were made under the direction of the Corps of Engineers.

#### Bonny Reservoir

Controlled spills were made during April and September. The reservoir level was maintained between one and two feet below the top of the irrigation pool from May through August. In September, the reservoir was lowered an additional foot to reduce the necessity for winter-time releases. Natural flow releases were made to Hale Ditch as required. There was no demand for supplemental water.



### Swanson Lake

Controlled spills were made from January through September. The reservoir level for the rest of the year was maintained approximately one-half foot below the top of the irrigation pool. Releases for irrigation were made for Meeker-Driftwood Canal. Bartley Canal requirements were met with reservoir spills.

### Enders Reservoir

The reservoir level was maintained at approximately the top of the irrigation pool from January through April. Controlled spills were made in May, July and August. Natural flows were released for senior water rights during June, part of August, and September. Minor releases were made during August and September for Warren Act contract users.

### Harry Strunk Lake

Storage in Harry Strunk Lake was more than adequate to meet the requirements of the Cambridge Canal and of a few storage users who had Warren Act contracts. The reservoir spilled from April to the early part of August with the maximum reservoir level being less than two feet into the flood pool.

### Harlan County Reservoir

The reservoir level was about one foot below to two feet above the top of the irrigation pool from January through most of August. The pool level was maintained from one and one-half to two and one-half feet below the top of the irrigation pool for the rest of the year to permit minor repairs on the dam and spillway. The storage was more than adequate to fulfill all demands of the Naponee, Franklin, Franklin Pump, Superior and Courtland Canals and Lovewell Reservoir.

### Lovewell Reservoir

The reservoir level was about five feet below the top of the irrigation pool from January to April. During May approximately 13,600 A. F. of flood releases from Harlan County Reservoir were diverted into Lovewell Reservoir through the Upper Courtland Canal to fill the irrigation pool. Inflows from White Rock Creek raised the reservoir level to a maximum of three feet above the top of the irrigation pool during July, August and early September. Releases were made during September to lower the reservoir level by about three feet. Releases were made to Courtland Canal below Lovewell from June through September for the first season of operation.



## Kirwin Reservoir

Although Kirwin Reservoir did not spill in 1958, the storage was more than adequate to meet the demands of the Kirwin Canal. The carry-over storage for 1959 is excellent.

## Webster Reservoir

There were no irrigation demands below Webster Reservoir. To permit construction of the Woodston Diversion Dam, it has been necessary to schedule flood releases to coincide with construction activities. Because of this, the reservoir level was from one to five and one-half feet above the top of the irrigation pool during the last half of the year.

## Cedar Bluff Reservoir

Controlled spills occurred from January through October. Those flood releases were more than adequate to meet the municipal water supply requirements of the City of Russell, Kansas.

### CANAL OPERATIONS

There was 133,206 acre-feet of water diverted into twelve Bureau of Reclamation constructed, rehabilitated or operated canals to serve 60,247 acres of land, 47,397 acres were in Nebraska and 12,850 acres in Kansas.

There was 227 acre-feet of supplemental storage water released for use on 3,350 acres under pump irrigation in Nebraska. Hale Ditch received 2,066 acre-feet of natural flow for use on 575 acres of land.

Table 5, pages 16 and 17, show the monthly diversions and acres irrigated for each canal. Exhibits 11 through 23 (pages 28 to 40) compare 1958 operations to previous year's records.

### OTHER USES

During 1958 water levels of all reservoirs were maintained at fairly constant elevations. This made the lakes very attractive for fishery, waterfowl, and public recreation use. Records indicate 1,249,238 people visited the eight Bureau constructed reservoirs now in operation. These visitors included 207,774 people boating and water skiing, 302,590 fishermen, 143,477 picnickers, 45,932 campers, 40,995 swimmers, 39,670 hunters, and 468,800 sightseers. Recreation uses of the reservoirs have increased greatly each year for the past five years.



## CHAPTER III - ANNUAL OPERATING PLAN FOR 1959

### WATER SUPPLY - 1959

The water supply outlook for 1959 is excellent. The irrigation pools in all reservoirs will be full by the start of the 1959 irrigation season, and even under extremely dry conditions, no shortages are expected.

The total water supply of each reservoir available to meet any demands is the carry-over storage from the previous year plus the 1959 inflow. While the carry-over storage is readily known, the forecast of reservoir inflows in an area where the major source of water is flood runoff is nearly impossible. For forecasting purposes, values of annual inflows that will be statistically equaled or exceeded 10, 50, and 90 per cent of the time were selected from the probability curve to be "Reasonable Maximum," "Most Probable," and "Reasonable Minimum" inflow conditions. The estimates of the annual inflow for 1959 selected by the above procedure are shown in Table 3 on page 14 and are compared graphically with historical inflow records on Exhibits 24 through 32 (pages 41 to 49).

### RESERVOIR OPERATIONS - 1959

The normal storage limitations at all of the reservoirs for irrigation and municipal purposes will be the top of the irrigation storage pool, as shown in Table 1 on page 12. State laws regulating the use of water will also affect the amount and time of storing stream-flows.

It is anticipated that minimum downstream flow requirements will be met by normal return flow and flood spills from reservoirs.

Each fall after the demand period, the storage in all reservoirs is evaluated and when it is apparent that a reservoir will spill before the start of the next irrigation season, controlled releases will be made and only that portion of the inflow required to fill the irrigation storage pool by the first of May will be stored. This method is not used for Bonny Reservoir as it is undesirable to make releases during winter months.

Exhibits 2 through 10 (pages 19 to 27) show the probable effects on each reservoir for 1959 under "Most probable," "Reasonable Minimum," and "Reasonable Maximum" inflow conditions.

#### Bonny Reservoir

The carry-over storage will more than meet any requirements of Hale Ditch for supplemental storage during 1959. Controlled spills will occur under any inflow condition. Releases to lower the reservoir



level in advance of anticipated inflow which would more than fill the irrigation storage pool are also considered as controlled spills. As the Hale Ditch outlet pipe is exposed, it is not desirable to make continuous releases during freezing weather. This makes it necessary to have the reservoir level three to four feet below the top of the irrigation pool each fall. To reduce the large drawdown required each September, the reservoir level will be lowered to two feet below the top of the irrigation pool during April, and maintained there throughout the summer months. This will make only a one or two-foot drawdown necessary in September. This plan of operation will be revised as required for flood inflow or extremely dry weather.

#### Swanson Lake

Irrigation releases from this reservoir will be used primarily for lands under Meeker-Driftwood and Bartley Canals.

The Meeker-Driftwood Canal, which will be completed by June, 1959, will serve the land that was formerly irrigated by the Meeker Canal. Water records for Meeker Canal for 1959 will be included in the Meeker-Driftwood Canal diversions. The carry-over storage and available inflow should be more than adequate to meet the irrigation demands for 1959. Surplus storage will be available as supplemental water for Warren Act contract sales. Swanson Lake will spill under all expected inflow conditions.

#### Enders Reservoir

The storage in Enders Reservoir will be more than adequate to meet any irrigation requirements. Surplus storage will be available for Warren Act contractors on Frenchman or Stinking Water Creeks. Spills will occur under all inflow conditions.

#### Harry Strunk Lake

Harry Strunk Lake will be spilling at the start of the 1959 irrigation season. Irrigation releases will be made for Cambridge Canal. Surplus storage will again be available for sale to private irrigators in the Medicine Creek watershed.

#### Harlan County Reservoir

This reservoir will spill this spring under any expected inflow conditions. Irrigation releases will be made for Franklin, Naponee, Franklin Pump, Superior and Courtland Canals in Nebraska and Courtland Canal and Lovewell Reservoir, as required, in Kansas. The carry-over storage in Lovewell Reservoir is such that no releases will be required



from Harlan County Reservoir before the start of the 1959 irrigation season. Under dry conditions, a storage transfer may be necessary during May and September but under the "Most Probable" or "Reasonable Maximum" inflow conditions no storage transfers are expected.

If conditions permit, the transfers of storage from Harlan County Reservoir to Lovewell Reservoir will normally be made during the first and last month of the irrigation season, but unusual conditions may occasionally require transfer operations during the non-irrigation season. The transfers of storage will be held to a minimum during winter months as the maintenance costs are higher and the irrigation districts are normally preparing their canals for the next year's operation while the canals are dry.

### Lovewell Reservoir

Lovewell Reservoir was planned for regulation of Courtland Canal as well as the storage of natural flows on White Rock Creek. The demands on Courtland Canal below Lovewell Reservoir will be met with water stored from White Rock Creek flows and water diverted from the Republican River through the Upper Courtland Canal. When the flows in the Republican River and White Rock Creek are inadequate to meet the demand, special releases from Harlan County Reservoir will be made to transfer storage to Lovewell Reservoir. During periods of low water supply in Harlan County and Lovewell Reservoirs, all flow not needed by Superior and Courtland Canals or downstream water rights will be diverted into Lovewell Reservoir. Under severe drouth conditions, diversions could continue through all of the non-irrigation season months except January and February.

During the winter months, it is desirable that the reservoir level at Lovewell Dam be at an elevation of approximately 1578 feet or above to reduce the possibilities of erosion to the upstream face of the dam. If conditions permit, any drawdown of Harlan County required for this purpose will be done in September. If water is available either as pickup in the Republican River or as surplus storage in Harlan County Reservoir, the irrigation pool of Lovewell Reservoir will be filled during the first month of irrigation operations. This will usually be May.

### Kirwin Reservoir

Kirwin Will spill under all but the "Reasonable Minimum" inflow conditions. The project area in the Kirwin Irrigation District is large for the expected available water supply and successful operation of the unit may at times be dependent upon several years of carryover reservoir storage. The present carry-over storage is more than adequate to meet the demands for 1959 under Kirwin Canal. No plans have been made to make supplemental water available.



## Webster Reservoir

Construction of Woodston Diversion Dam is expected to be completed by spring of 1959. To permit this construction, it was necessary to carry over approximately 15,000 acre-feet of storage in the flood pool and it is planned to evacuate this flood storage upon completion of the diversion dam. No water demands on Bureau of Reclamation constructed facilities are expected until the late summer of 1961. Surplus storage water will be available as supplemental water under Warren Act contracts.

## Cedar Bluff Reservoir

Cedar Bluff Reservoir will spill under all but the "Reasonable Minimum" inflow conditions in 1959. The carry-over storage is more than sufficient to meet the municipal requirements of the City of Russell, Kansas, and the Fish Hatchery demands. Surplus storage will be available to supplement natural flow water rights. It is expected that the Fish Hatchery now under construction, below Cedar Bluff Reservoir, will be in operation by July of 1959.

## CANAL OPERATIONS

As many as 87,248 acres under the Kansas River Projects irrigation units may be irrigated in 1959. Of this, 62,623 acres are in Nebraska and 24,625 in Kansas. The irrigable acres and probable canal diversions for 1959 under "Most Probable," "Reasonable Driest Year," and "Reasonable Wettest Year" are shown graphically in Exhibits 11 through 23 (pages 28 to 40). The canal requirements are based on probability curves that were used for water supply studies. The irrigable acres for 1958 are listed on Table 5 (pages 16 and 17).

The canal operations for 1959 are discussed under the Irrigation District in which they will be operated.

### Frenchman Valley Irrigation District

The Irrigation District will operate the diversion dam and Culbertson Canal but these facilities will be maintained by the Bureau of Reclamation. The irrigation district will irrigate 9,400 acres.

### H&RW Irrigation District

There will be no irrigation in this District during 1959. The present construction schedule indicates December 1961 for completion.



#### Frenchman-Cambridge Irrigation District

The Irrigation District will operate and maintain Bartley and Cambridge Canal systems. The Bureau of Reclamation will operate and maintain the Meeker-Driftwood Canal system. The Meeker-Driftwood Canal will be transferred to the Irrigation District in 1960. As many as 30,600 acres may be irrigated under the three canals during 1959.

#### Nebraska-Bostwick Irrigation District

Franklin, Naponee, Franklin Pump, Superior Canals will be operated and maintained by the Irrigation District. The Kansas-Bostwick Irrigation District will operate the Courtland Canal and the Nebraska-Bostwick Irrigation District will operate and maintain the Courtland Lateral system in Nebraska. The Bureau of Reclamation will operate and maintain the Superior-Courtland Diversion Dam and will maintain the main Courtland Canal. All of the operation and maintenance performed by the Government will be transferred to the Irrigation Districts in 1960.

Service is available to 22,623 acres for the 1959 irrigation season.

#### Kansas-Bostwick Irrigation District

This District will operate the Courtland Canal system above and below Lovewell Reservoir. The Bureau of Reclamation will maintain the main canal and the District will maintain the lateral distribution system. The entire system will be operated and maintained by the District in 1960.

Service has been completed to serve 31,603 acres of which 18,659 acres are expected to be irrigated.

#### Kirwin Irrigation District

The Bureau of Reclamation will operate and maintain Kirwin Canal in 1959. This system will be transferred to the Irrigation District in 1960. Service has been completed to serve the entire District of 11,372 irrigable acres of which 5,966 are expected to be irrigated in 1959.

#### Webster Irrigation District

The Osborne Canal is under construction and will not be operated during 1959.

#### Almena Irrigation District

No construction has been started in the Almena system.



TABLE 1

## RESERVOIR DATA - KANSAS RIVER PROJECTS

RESERVOIR	STORAGE ALLOCATIONS		FLOOD CONTROL	CONDITIONS EXPECTED BY MAY 1, 1959
	DEAD <u>1/</u>	IRRIGATION <u>1/</u>		
Bonny				
Elevation (Ft.)	3635.5	3672.0	3710.0	3670.0
Total Acre Feet	1,420	41,340	170,160	37,390
Net Acre Feet	1,420	39,920	128,820	35,970
Swanson Lake				
Elevation (Ft.)	2710.0	2752.0	2773.0	2752.0
Total Acre Feet	4,100	120,160	253,950	120,160
Net Acre Feet	4,100	116,060	133,790	116,060
Enders				
Elevation (Ft.)	3080.0	3112.3	3127.0	3112.3
Total Acre Feet	8,470	44,480	74,520	44,480
Net Acre Feet	8,470	36,010	30,040	36,010
Harry Strunk				
Elevation (Ft.)	2335.0	2366.1	2386.2	2366.1
Total Acre Feet	5,370	39,230	90,920	39,230
Net Acre Feet	5,370	33,860	51,690	33,860
Harlan County				
Elevation (Ft.)	1920.0 <u>2/</u>	1946.0	1973.5	1946.0
Total Acre Feet	97,200 <u>4/</u>	350,120	850,000	350,120
Net Acre Feet	97,200 <u>4/</u>	252,920	499,880	252,920
Lovewell				
Elevation (Ft.)	1561.0 <u>3/</u>	1582.6	1595.3	1582.6
Total Acre Feet	4,360	41,690	92,150	41,690
Net Acre Feet	4,360	37,330	50,460	36,640
Kirwin				
Elevation (Ft.)	1693.0	1728.4	1757.3	1728.4
Total Acre Feet	6,380	95,180	314,550	95,180
Net Acre Feet	6,380	88,800	219,370	88,800
Webster				
Elevation (Ft.)	1855.5	1889.6	1923.7	1889.6
Total Acre Feet	2,180	67,100	260,740	67,100
Net Acre Feet	2,180	64,920	193,640	64,920
Cedar Bluff				
Elevation (Ft.)	2090.0	2144.0	2166.0	2144.0
Total Acre Feet	8,260	185,090	376,950	185,090
Net Acre Feet	8,260	176,830	191,860	176,830
Total Storage (A.F.)	137,740	984,390	2,483,940	980,440
Total Net Acre Feet	137,740	846,650	1,499,550	842,010

1/ Includes space for sediment storage.2/ Elevation of outlet to Franklin Canal.3/ Elevation of spillway floor to canal is 1562.07 (5,050 A.F.).4/ 95,900 A. F. of this could physically be released to the river.



# PRECIPITATION DATA

Bonny Dam					Trenton Dam					Enders Dam					Medicine Creek Dam					Lovewell Dam				
Month	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1956	1957	1958
Jan.	0.35	0.15	0.37	0.07	0.13	0.44	0.27	0.23	0.08	0.17	0.42	0.45	0.43	0.08	0.14	0.40	0.73	0.28	0.21	0.06	0.60	0.22	0.20	0.21
Feb.	0.41	0.17	0.09	Trace	0.48	0.52	0.24	0.11	0.15	0.77	0.46	0.08	0.54	0.26	0.47	0.64	0.53	0.22	0.19	1.50	0.85	0.34	0.24	1.47
Mar.	0.91	0.15	0.37	1.37	1.55	1.21	0.17	0.06	0.64	1.41	1.06	0.19	0.21	0.88	1.76	0.99	0.12	0.12	1.05	1.43	1.26	0.07	3.12	2.68
Apr.	1.59	0.65	0.10	2.82	1.41	1.94	1.35	0.52	1.72	1.94	1.94	1.71	0.70	2.80	2.13	2.31	0.76	1.23	2.08	1.87	2.21	1.47	2.93	2.08
May	2.40	3.03	1.17	5.07	5.90	3.20	3.23	0.90	5.40	4.94	3.38	3.80	1.77	6.29	2.65	3.22	1.86	1.49	7.23	3.27	3.60	1.65	4.65	2.95
June	2.57	2.35	0.65	3.69	3.79	3.19	2.06	2.77	3.67	2.21	3.36	1.65	7.97	3.66	3.63	3.52	3.89	1.99	4.32	3.17	4.82	7.38	5.51	3.50
July	2.32	0.24	3.69	2.64	3.70	2.61	0.22	1.55	2.71	2.75	2.19	0.54	3.38	3.93	9.08	2.79	0.77	1.19	2.27	3.29	2.81	5.50	0.77	7.99
Aug.	2.27	0.92	3.11	2.66	2.58	2.50	1.23	1.43	2.28	2.47	2.23	1.49	2.84	1.39	2.20	2.61	1.39	2.28	1.22	0.85	2.68	2.85	3.56	3.20
Sept.	1.28	0.79	Trace	0.23	0.89	1.68	2.13	0.17	0.49	1.77	1.79	2.73	0.05	0.49	1.35	2.02	2.79	0.10	3.07	0.66	2.69	0.15	1.40	8.02
Oct.	0.74	0.05	0.50	1.35	0.66	0.87	0.11	0.34	1.23	0.30	0.80	0.23	0.99	2.04	0.48	1.12	0.17	1.17	3.32	0.17	1.45	1.21	1.50	0.54
Nov.	0.41	0.04	0.96	0.26	0.23	0.68	Trace	0.52	0.52	0.16	0.54	0.32	2.14	0.49	0.07	0.84	0.18	0.19	0.31	0.76	1.03	0.35	0.65	0.68
Dec.	0.39	0.11	0.13	0.24	0.44	0.45	0.17	0.19	0.10	0.58	0.45	0.31	0.16	0.42	0.88	0.57	0.55	0.31	0.14	0.14	0.77	0.03	0.55	0.10
Total	15.64	9.65	11.14	20.40	21.76	19.29	11.18	8.79	18.99	19.47	18.62	13.50	21.18	22.73	24.84	21.03	13.75	10.57	25.10	17.17	24.77	21.22	25.08	33.42

Harlan County Dam					Kirwin Dam					Cedar Bluff Dam					Kanopolis Dam					Webster Dam				
Month	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1955	1956	1957	1958	Norm.	1956	1957	1958
Jan.	0.41	0.36	0.26	0.10	0.22	0.47	0.48	0.31	0.18	0.25	0.48	0.33	0.45	0.04	0.07	0.77	1.19	0.59	Trace	0.28	0.40	0.57	0.16	0.49
Feb.	0.58	0.30	0.10	0.15	1.46	0.70	0.75	0.39	0.13	1.16	0.62	0.45	0.57	0.04	0.26	1.08	1.22	0.40	0.90	0.89	0.78	0.53	0.16	0.73
Mar.	0.95	0.17	0.37	1.30	1.82	1.18	0.19	0.09	2.21	2.97	1.26	0.17	Trace	2.82	3.28	1.71	0.22	0.07	3.08	3.02	1.00	0.09	2.43	3.72
Apr.	2.27	0.24	0.98	3.22	2.76	2.40	0.73	0.72	3.57	1.12	2.11	2.72	0.61	2.23	2.06	2.65	3.69	1.16	3.60	1.33	2.20	0.31	2.80	1.00
May	3.21	3.11	1.27	5.78	3.04	2.90	2.88	0.92	6.26	2.27	3.62	5.23	2.29	4.25	4.29	4.02	1.35	3.00	8.78	3.23	2.90	1.24	5.47	3.77
June	3.66	6.55	2.99	7.91	1.29	3.75	3.42	3.96	6.41	1.87	3.92	3.18	0.65	7.11	1.84	4.01	3.03	1.78	6.87	3.38	3.70	5.04	11.74	1.48
July	2.86	0.81	1.22	0.77	5.76	2.87	2.24	3.35	2.76	5.68	2.33	1.93	3.09	2.16	8.51	3.31	3.81	1.76	1.52	4.88	2.70	3.38	4.90	7.26
Aug.	2.48	0.65	3.13	2.92	4.29	2.85	0.93	2.24	2.23	3.56	2.43	0.78	1.05	2.18	3.70	3.45	0.86	2.48	1.17	2.04	2.75	2.71	2.65	3.41
Sept.	2.19	4.18	1.21	1.68	1.47	2.27	4.50	0.35	1.38	1.35	2.06	2.95	0.12	5.07	2.14	3.02	5.65	0.02	4.13	4.71	2.50	0.17	1.81	1.63
Oct.	1.03	0.11	0.94	1.63	0.03	1.26	0.30	0.92	3.10	0.11	1.16	0.17	1.34	1.41	0.09	2.29	1.45	4.25	3.40	0.09	1.40	1.09	1.33	0.67
Nov.	0.77	0.09	0.05	0.40	0.65	0.84	Trace	0.14	0.67	0.47	0.86	Trace	Trace	1.08	0.43	1.30	0.17	0.79	1.17	0.79	0.99	Trace	0.81	0.56
Dec.	0.49	0.28	0.15	0.22	0.03	0.56	0.58	0.02	0.07	0.13	0.55	0.15	0.05	Trace	0.10	0.90	0.08	0.27	0.82	0.17	0.70	0.12	0.10	0.46
Total	20.90	16.85	12.67	26.08	22.82	22.06	17.00	13.14	28.97	20.94	21.40	18.06	10.22	28.39	26.77	28.51	22.72	16.57	35.44	24.81	22.02	15.25	34.36	25.18



TABLE 3

## INFLOW INTO RESERVOIRS - 1958 RECORDS, 1959 ESTIMATES

1	2	3	4	5	6	7	8
	1,000 Acre-Feet (Except Column 4)						
	1958 Records		Average		1959 Estimates 2/		
<u>Reservoir</u>	<u>Actual</u>	<u>Adjusted</u>	<u>Percent of Average</u>	<u>for Period of Record</u>	<u>Reasonable Minimum</u>	<u>Most Probable</u>	<u>Reasonable Maximum</u>
Bonny	29.0		88%	32.8	18.5	26.2	42.0
Swanson Lake	161.3	161.6 1/	118%	137.1	68.0	119.0	205.0
Enders	54.3		109%	49.8	42.8	49.3	57.2
Harry Strunk Lake	46.3		84%	55.0	33.0	51.7	82.0
Harlan County	354.9	422.1 1/	86%	492.4	260.0	455.6	780.0
Lovewell	28.4 3/	10.8 4/	38% 4/	28.3	3.4	17.9	64.0
Kirwin	29.3		53%	55.7	17.0	38.1	115.0
Webster	65.4		126%	52.0	12.5	33.9	98.0
Cedar Bluff	76.9		119%	64.8	12.4	36.9	138.0

1/ Actual records plus upstream depletions caused by reservoirs and canals in Missouri Basin Projects.

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

3/ Includes total of White Rock Creek and inflow from Courtland Canal.

4/ Natural inflow from White Rock Creek.



TABLE 4  
RESERVOIR OPERATIONS - 1958  
(1000 Acre-Feet)

Reservoir	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Bonny-Inflow	2.0	1.9	2.5	2.3	5.1	2.4	3.5	1.8	1.2	1.7	2.1	2.5	29.0
Outflow	0.4	0.4	0.4	7.1	7.7	4.0	2.7	1.7	2.0	0.7	0.4	0.4	27.9
Content End of Mo.	40.5	42.0	44.5	40.1	39.1	38.4	38.6	37.7	35.3	37.4	37.4	39.1	
Swanson-Inflow	9.2	7.8	16.3	20.4	24.6	10.7	15.0	29.5	9.8	4.7	5.7	7.6	161.3
Outflow	3.7	13.3	15.6	20.4	15.4	19.9	7.4	18.3	13.9	1.7	4.6	8.9	143.1
Content End of Mo.	125.2	121.4	120.4	119.5	131.0	118.1	121.7	125.7	117.3	118.3	119.6	118.3	
Enders-Inflow	5.0	4.4	5.2	4.4	5.2	3.9	6.4	3.5	3.8	4.1	3.7	4.7	54.3
Outflow	3.5	4.3	4.8	4.7	3.5	4.8	4.1	5.8	5.4	4.1	3.1	3.7	51.8
Content End of Mo.	44.3	44.0	44.5	44.0	45.4	43.6	46.9	43.5	41.1	40.5	41.2	42.1	
Harry Strunk-Inflow	3.6	3.3	5.0	4.6	4.3	3.6	7.4	3.0	3.1	2.3	2.8	3.3	46.3
Outflow	3.2	4.1	4.3	4.8	4.2	3.4	4.9	8.4	1.5	1.5	1.5	1.9	43.7
Content End of Mo.	38.6	38.0	39.0	39.2	39.7	39.6	41.2	35.3	35.8	36.0	37.4	38.8	
Harlan Co.-Inflow	16.0	29.0	45.3	52.9	52.6	32.1	47.7	24.5	12.5	9.6	12.7	20.0	354.9
Outflow	11.1	15.6	42.2	78.9	40.3	41.9	28.6	54.4	14.9	18.1	8.4	18.8	373.2
Content End of Mo.	354.1	368.5	371.2	350.9	363.4	347.8	366.7	333.4	325.8	312.4	316.8	318.1	
Lovewell-River Inf. 1/	0	0.1	0.2	0.6	0.3	0.2	5.2	2.3	1.8	0	0.1	0	10.8
Canal Inf. 2/	0	0	0	0	13.6	1.4	.9	.9	.3	.5	0	0	17.6
Total Inflow	0	0.1	0.2	0.6	13.9	1.6	6.1	3.2	2.1	0.5	0.1	0	28.4
Outflow	0	0	0	0	0	1.1	1.0	3.6	13.4	0	0	0	19.1
Content at End of Mo.	27.9	28.1	28.4	29.6	41.9	41.3	47.2	45.9	41.5	40.7	40.3	39.0	
Kirwin-Inflow	1.0	1.6	2.8	2.8	4.3	2.2	6.5	5.8	2.0	0	0	0.3	29.3
Outflow	0	0	0	0	.6	4.0	4.1	4.9	1.6	0	0	0	15.2
Content End of Mo.	83.7	84.9	87.9	90.7	93.4	89.0	91.4	90.4	88.3	86.5	85.6	85.9	
Webster-Inflow	1.6	1.3	3.5	6.9	8.3	4.8	16.7	14.3	4.7	0.2	1.5	1.6	65.4
Outflow	0	9.1	11.2	5.7	6.2	2.4	5.3	3.1	2.6	2.6	2.6	2.2	53.0
Content at End of Mo.	71.7	63.7	56.8	58.5	61.7	62.4	75.7	87.3	87.5	83.7	82.2	81.6	
Cedar Bluff-Inflow	.8	.8	3.6	6.9	20.6	4.4	31.4	7.5	.5	.2	.2	0	76.9
Outflow	1.1	.7	1.7	11.6	17.8	16.0	22.1	17.3	1.6	.1	0	0	90.0
Content End of Mo.	188.9	188.9	193.8	193.1	202.0	188.5	202.7	192.0	186.8	184.4	183.0	182.7	

1/ Inflow from White Rock Creek.

2/ Diversions by Courtland Canal from Republican River into Lovewell Reservoir.

Note: Inflow and outflow data are tentative records at inflow and outflow gaging stations. These monthly flow records do not take into account evaporation losses, bank storage losses of reservoir, reservoir gain from bank storage recovery, and pickup below inflow gages. These losses and gains are reflected in reservoir storage values.



TABLE 5, page 1  
ACRES IRRIGATED AND CANAL DIVERSIONS  
KANSAS RIVER PROJECTS

Irrigation Facility	Planned	<u>Acres Irrigated</u>			<u>Acre-feet Diverted in 1958</u>						Total	
		<u>1/ 1959</u>	<u>2/ 1958</u>	<u>3/</u>	April	May	June	July	Aug.	Sept.		Oct.
<u>IN NEBRASKA</u>												
<u>Frenchman Valley Irrigation District</u>												
Culbertson Canal <u>4/</u>	9,600	9,400	9400		0	1777	4306	6238	7208	6801	0	26,330
<u>Frenchman-Cambridge Irrigation District</u>												
Meeker-Driftwood Can. <u>5/</u>	16,440	15,676	<u>7/ 1895</u>		0	188	1728	1864	3209	1724	0	8713
Meeker Canal <u>5/</u>	—	—	2855		0	476	880	2130	3118	2323	631	9558
Bartley Canal <u>4/</u>	7,000	6,592	5300		0	395	577	1999	4104	1065	413	8553
Cambridge Canal <u>4/</u>	15,600	15,508	12800		0	1059	2065	5722	8858	2176	500	20380
Total-French.Cambr.	39,040	37,776	22,850		0	2118	5250	11715	19289	7288	1544	47204
<u>Bostwick Irrigation District in Nebraska</u>												
Franklin Canal <u>4/</u>	11510	11,313	8359		0	107	2531	3487	5294	2360	28	13807
Naponee Canal <u>4/</u>	1640	1,533	930		0	0	0	119	288	0	0	407
Franklin Pump Canal <u>4/</u>	2120	2,123	1391		0	0	0	186	672	0	0	858
Superior Canal <u>4/</u>	6320	5,833	3978		0	234	2065	1539	4308	270	0	8416
Courtland Canal <u>6/</u>	2650	1,821	489		617	-127	794	291	192	28	-175	1620
Total-Nebr.Bostwick	24240	22,623	15147		617	214	5390	5622	10754	2658	-147	25108
<u>Kansas River Projects in Nebraska</u>												
Total for U.S.B.R. Units	72880	69,799	47397		617	4109	14946	23575	37251	16747	1397	98642
Warren Act-Nebraska (Non-Project lands)	—	—	3350		0	0	0	0	206	21	0	226

1/ Planned acreage  
2/ Irrigable acres with service available as  
 January 1, 1959  
3/ Acres determined from crop census.  
4/ Operated by Irrigation District

5/ Operated by Bureau of Reclamation  
6/ Main canal operated by Bureau of Reclamation  
 Laterals operated by Irrigation District.  
7/ 8,500 acres will be irrigated in 1959



TABLE 5, page 2  
ACRES IRRIGATED AND CANAL DIVERSIONS  
KANSAS RIVER PROJECTS

Irrigation Facility	Acres Irrigated				Acre-feet Diverted in 1958							Total
	Planned	<u>1/</u> 1959	<u>2/</u> 1958	<u>3/</u>	April	May	June	July	Aug.	Sept.	Oct.	
<u>IN KANSAS</u>												
<u>Kansas-Bostwick Irrigation No. 2</u>												
Courtland Canal in Kansas:												
Above Lovewell Res.	<u>4/</u>	15,270	9,839	5845	220	946	2324	1960	6962	1628	-313	13,727
Below Lovewell Res.	<u>5/</u>	31,030	21,764	<u>8/ 2878</u>	0	0	0	1035	819	3432	401	5,687
Total, Kansas-Bostwick		46,300	31,603	8723	220	946	2324	2995	7781	5060	88	19,414
<u>Kirwin Irrigation District No. 1</u>												
Kirwin Canal	<u>6/</u>	11,500	11,372	<u>9/ 4127</u>	0	591	3999	4064	4919	1577	0	15,150
<u>Kansas River Projects in Kansas</u>												
Total for U.S.B.R. Units		57,800	42,975	12850	220	1537	6323	7059	12,700	6637	88	34,564
<u>IN COLORADO 7/</u>												
Hale Ditch (Privately-owned system below Bonny Res.)			575		0	12	144	619	569	436	286	2,066
<u>TOTALS FOR KANSAS RIVER PROJECTS</u>												
TOTAL U.S.B.R. UNITS UNDER REPAYMENT CONTRACT		130,680	112,774	60,247	837	5646	21269	30634	49,951	23384	1485	133,206

1/ Planned acreage on January 1, 1959

2/ Irrigable acres with service available on January 1, 1959

3/ Acres as determined by crop census

4/ Main canal operated by Bureau of Reclamation, laterals operated by Irrigation District  
Flow past the Nebraska-Kansas State Line less delivery to Lovewell Reservoir

5/ Operated by Bureau of Reclamation. Measured at canal outlet from Lovewell Reservoir

6/ Operated by Bureau of Reclamation

7/ There are no USBR irrigation systems in Colorado under Kansas River Projects

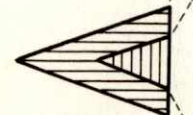
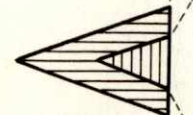
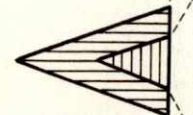
8/ 8,820 acres will be irrigated in 1959.

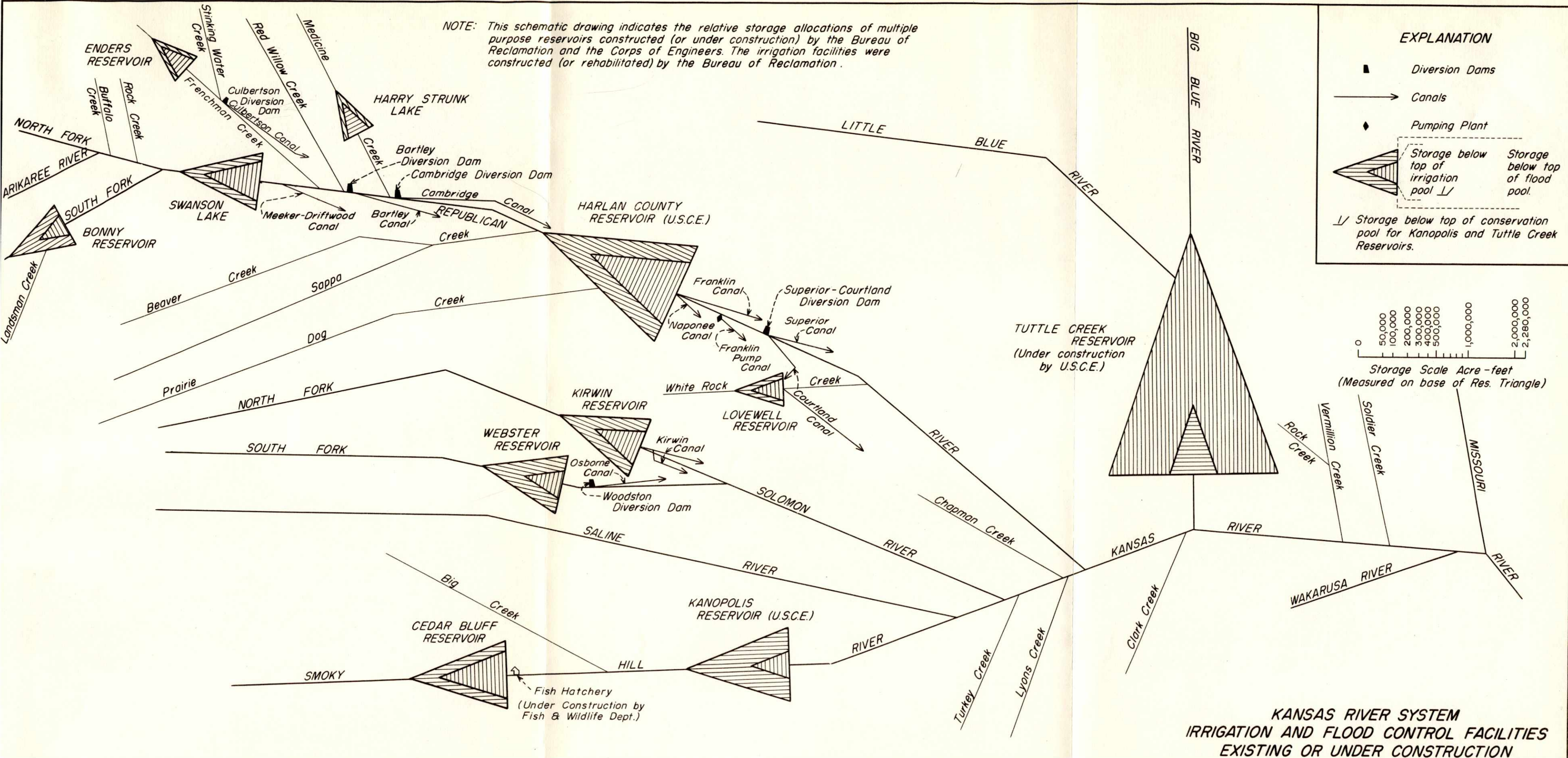
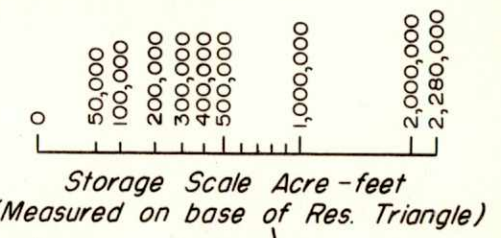
9/ 5,966 acres will be irrigated in 1959.



NOTE: This schematic drawing indicates the relative storage allocations of multiple purpose reservoirs constructed (or under construction) by the Bureau of Reclamation and the Corps of Engineers. The irrigation facilities were constructed (or rehabilitated) by the Bureau of Reclamation.

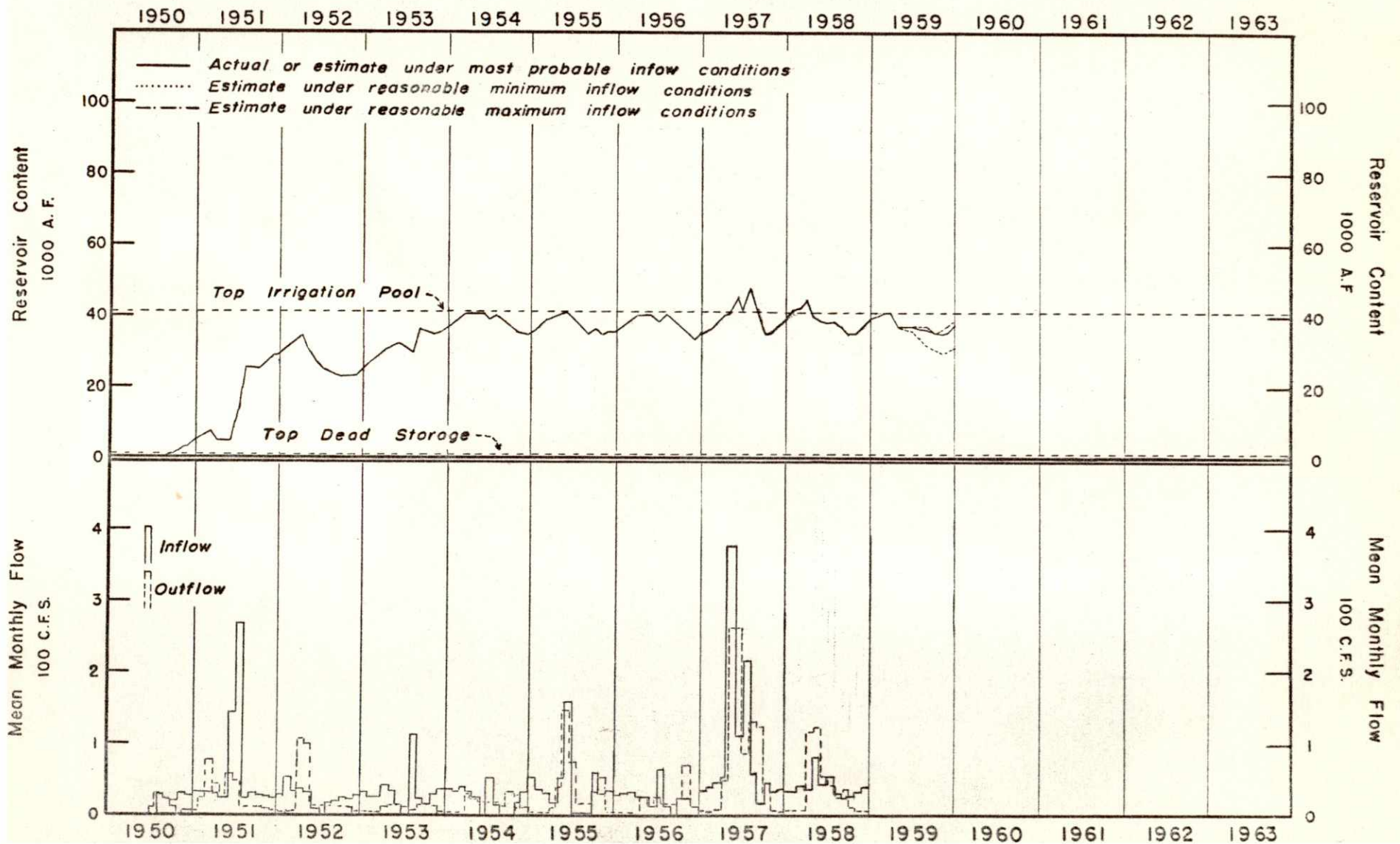
**EXPLANATION**

- Diversion Dams
- Canals
- ◆ Pumping Plant
- Storage below top of irrigation pool  /
- Storage below top of flood pool .
-  / Storage below top of conservation pool for Kanopolis and Tuttle Creek Reservoirs.



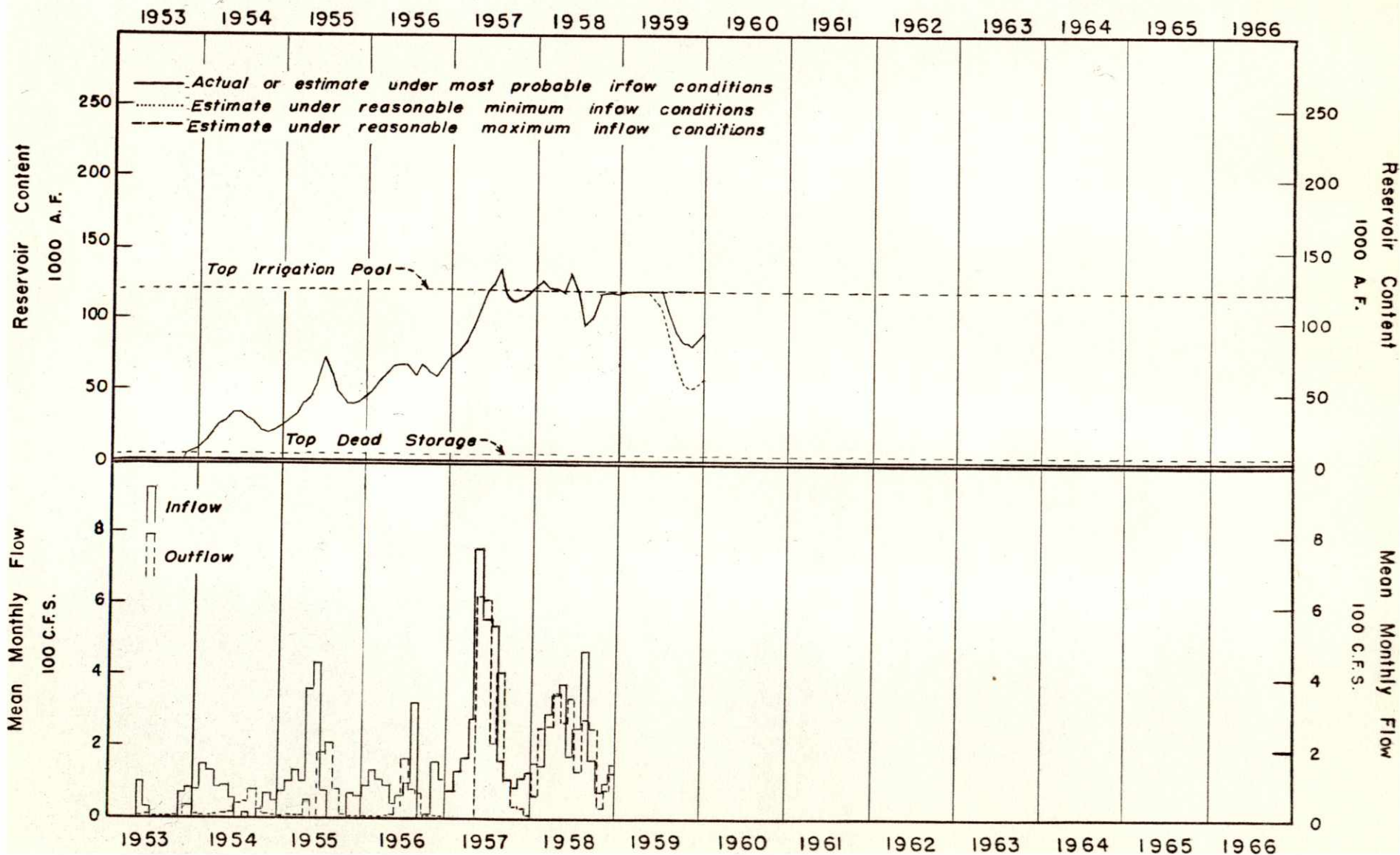


# BONNY RESERVOIR OPERATION HYDROGRAPHS



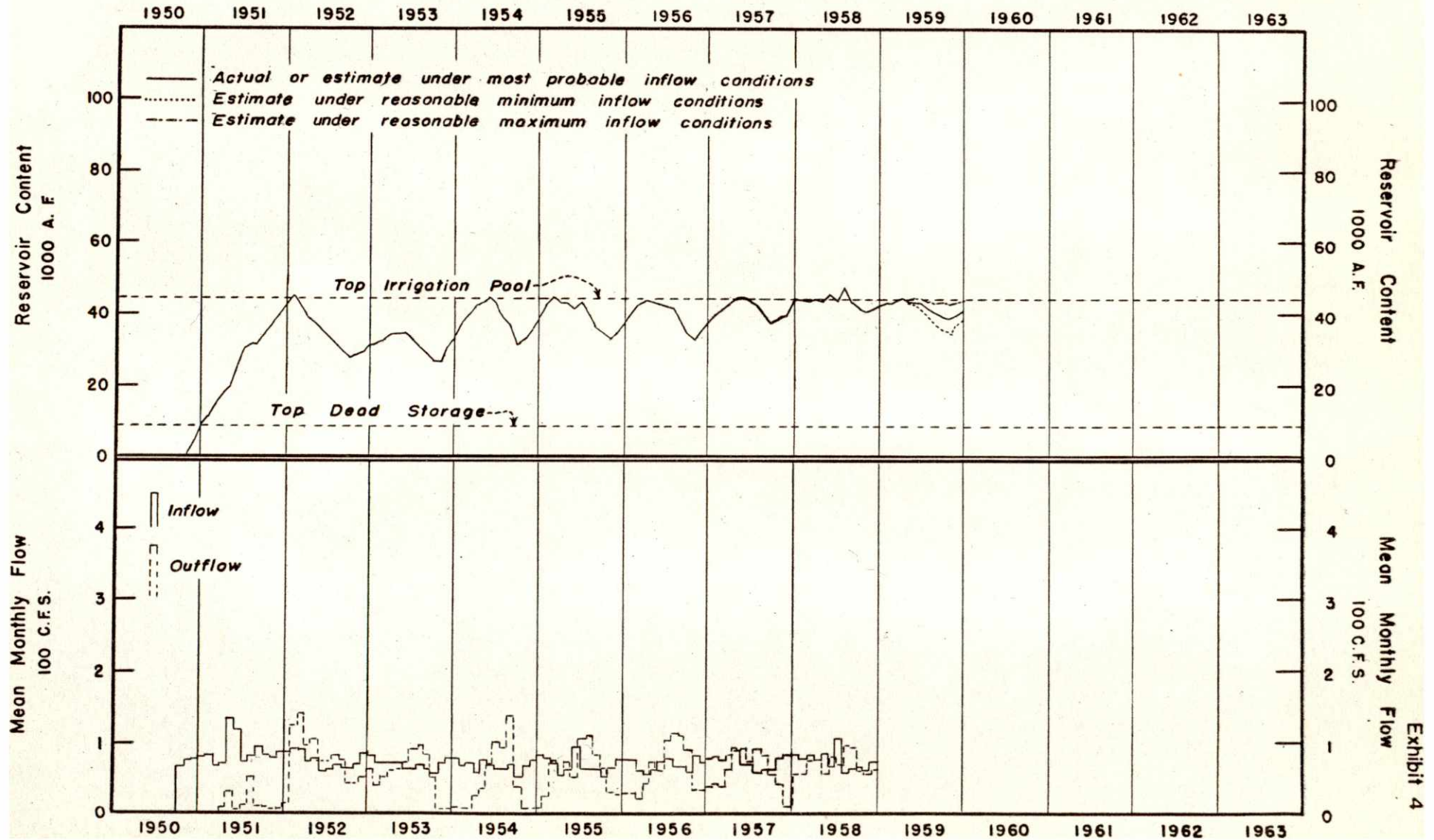


# SWANSON LAKE OPERATION HYDROGRAPHS



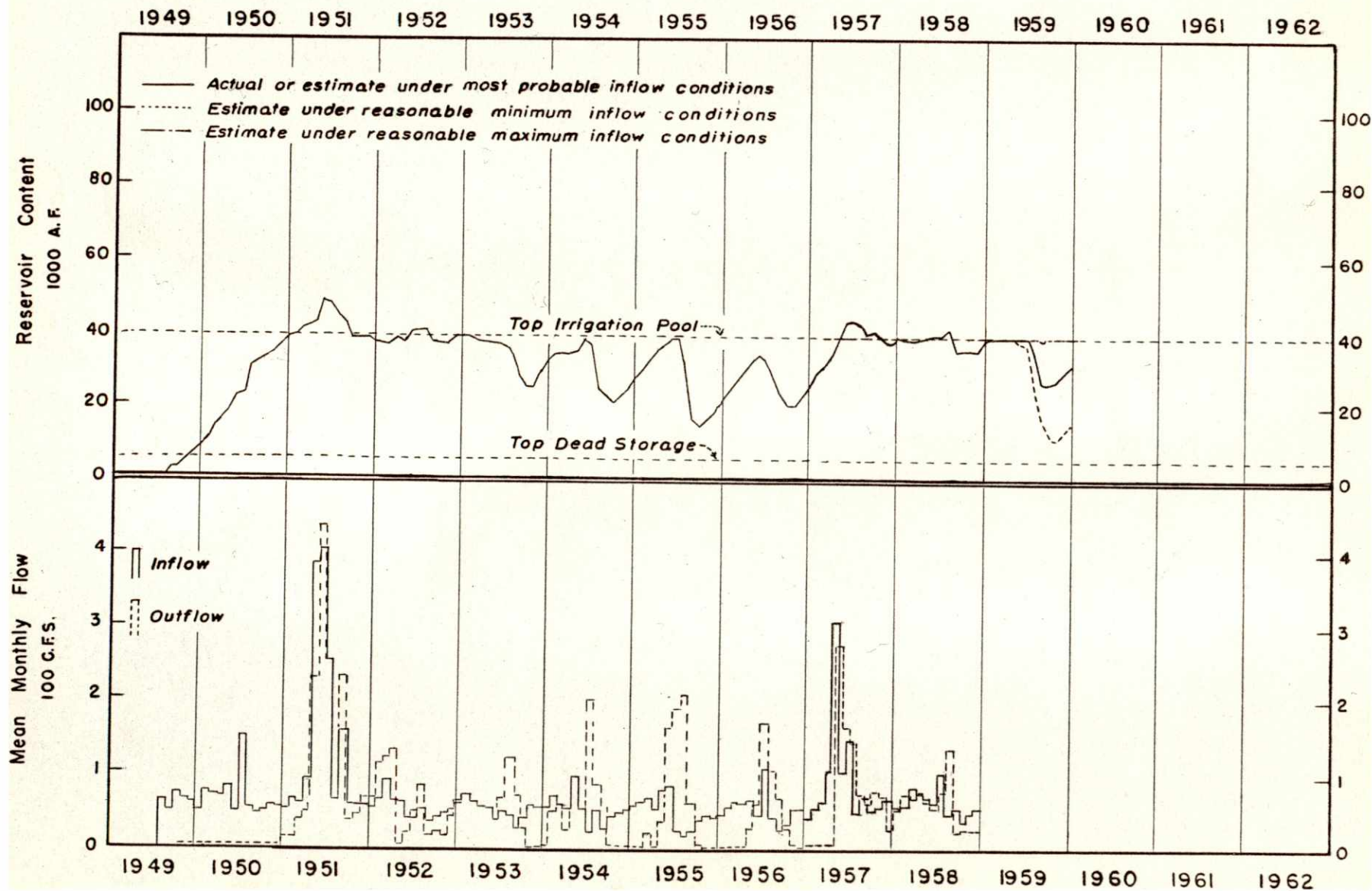


# ENDERS RESERVOIR OPERATION HYDROGRAPHS





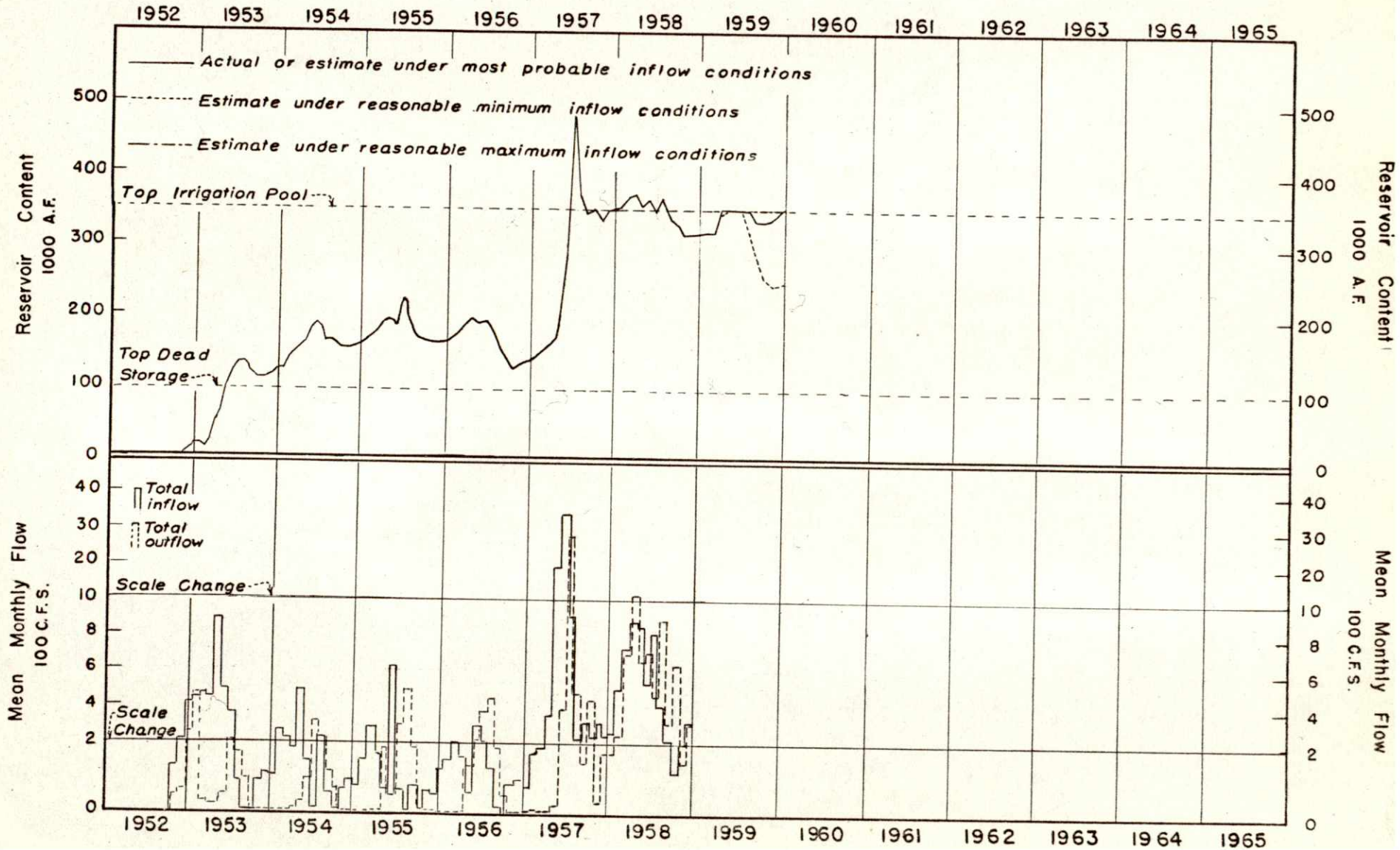
# HARRY STRUNK LAKE OPERATION HYDROGRAPHS





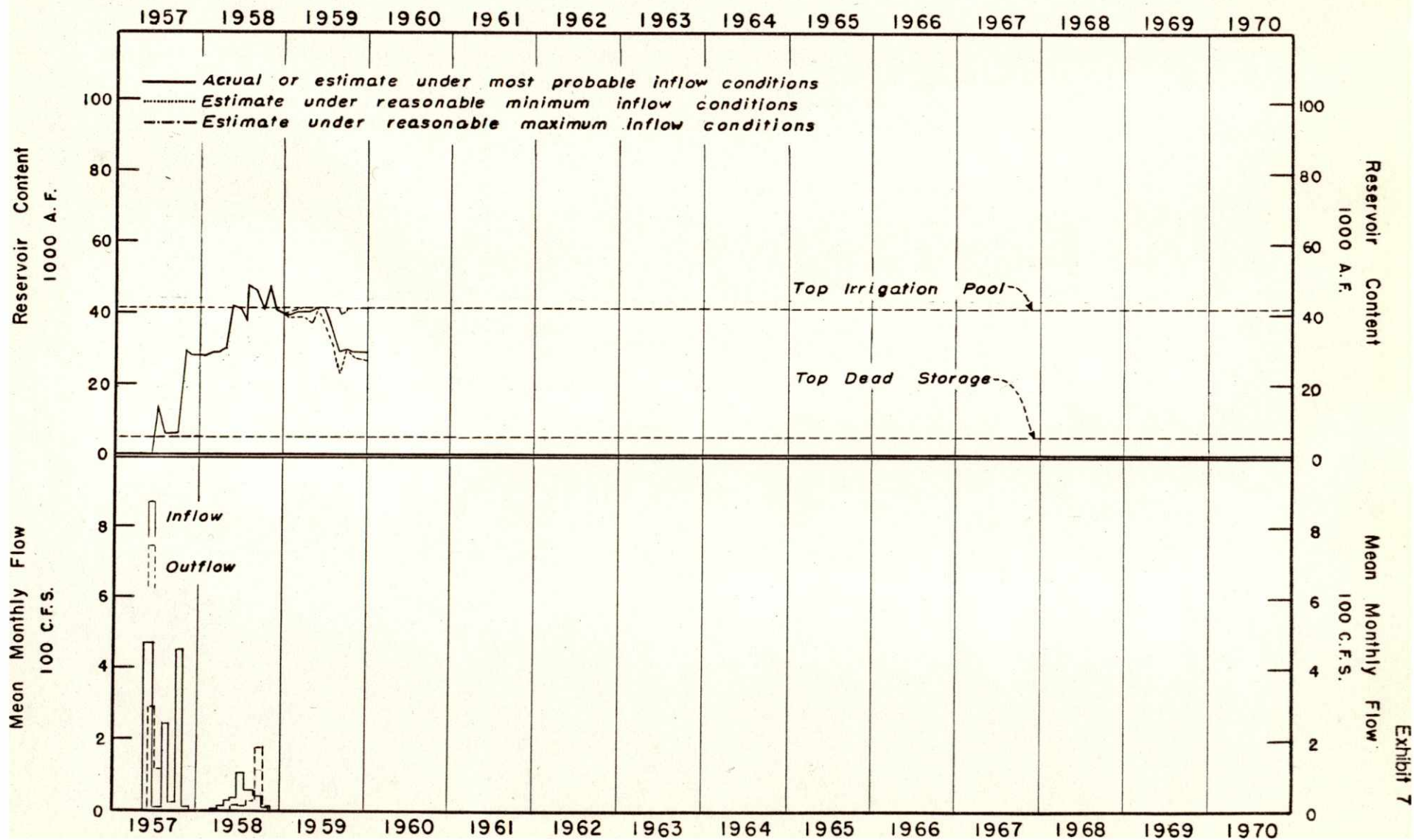
# HARLAN COUNTY RESERVOIR OPERATION HYDROGRAPHS

23



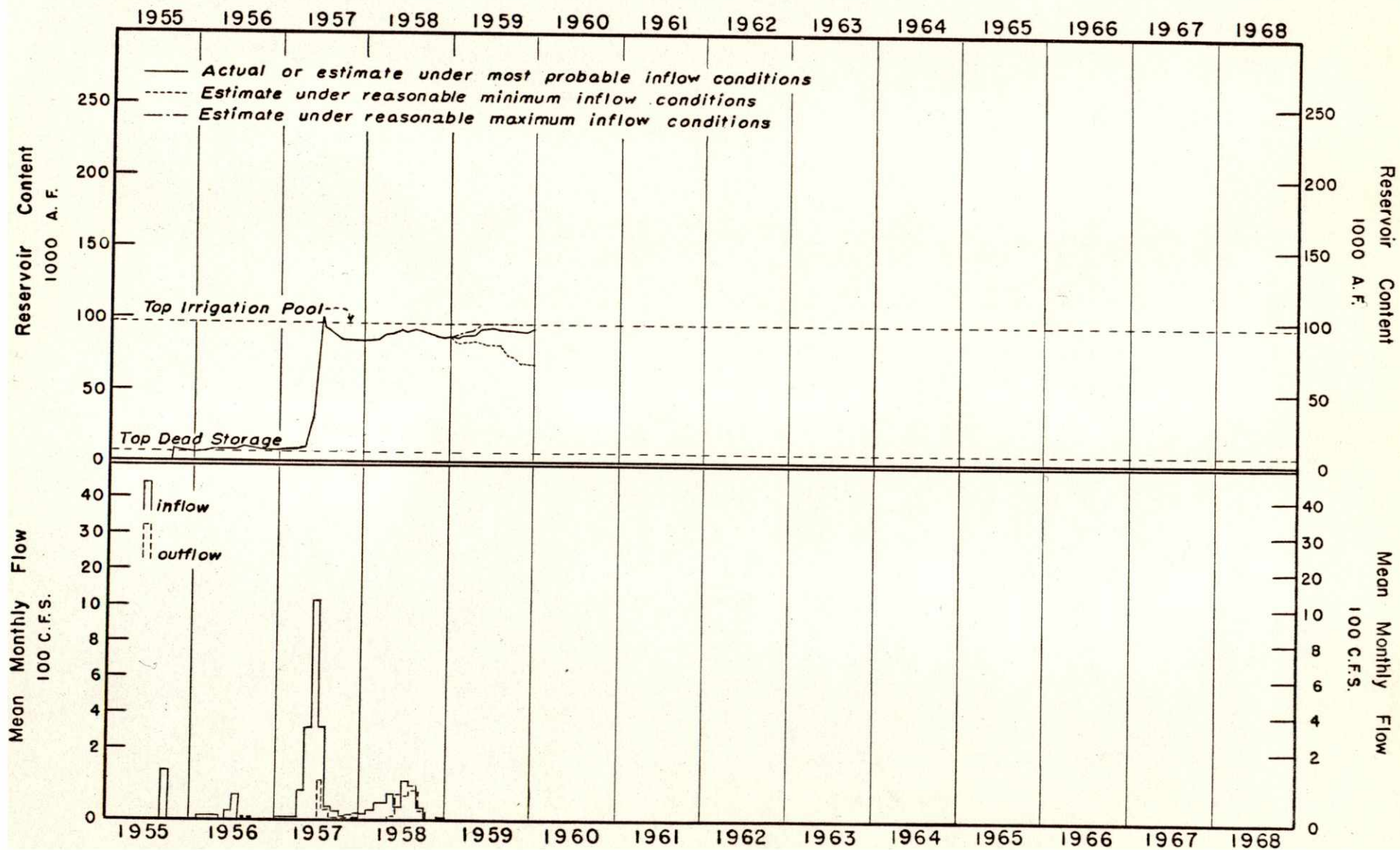


# LOVEWELL RESERVOIR OPERATION HYDROGRAPHS



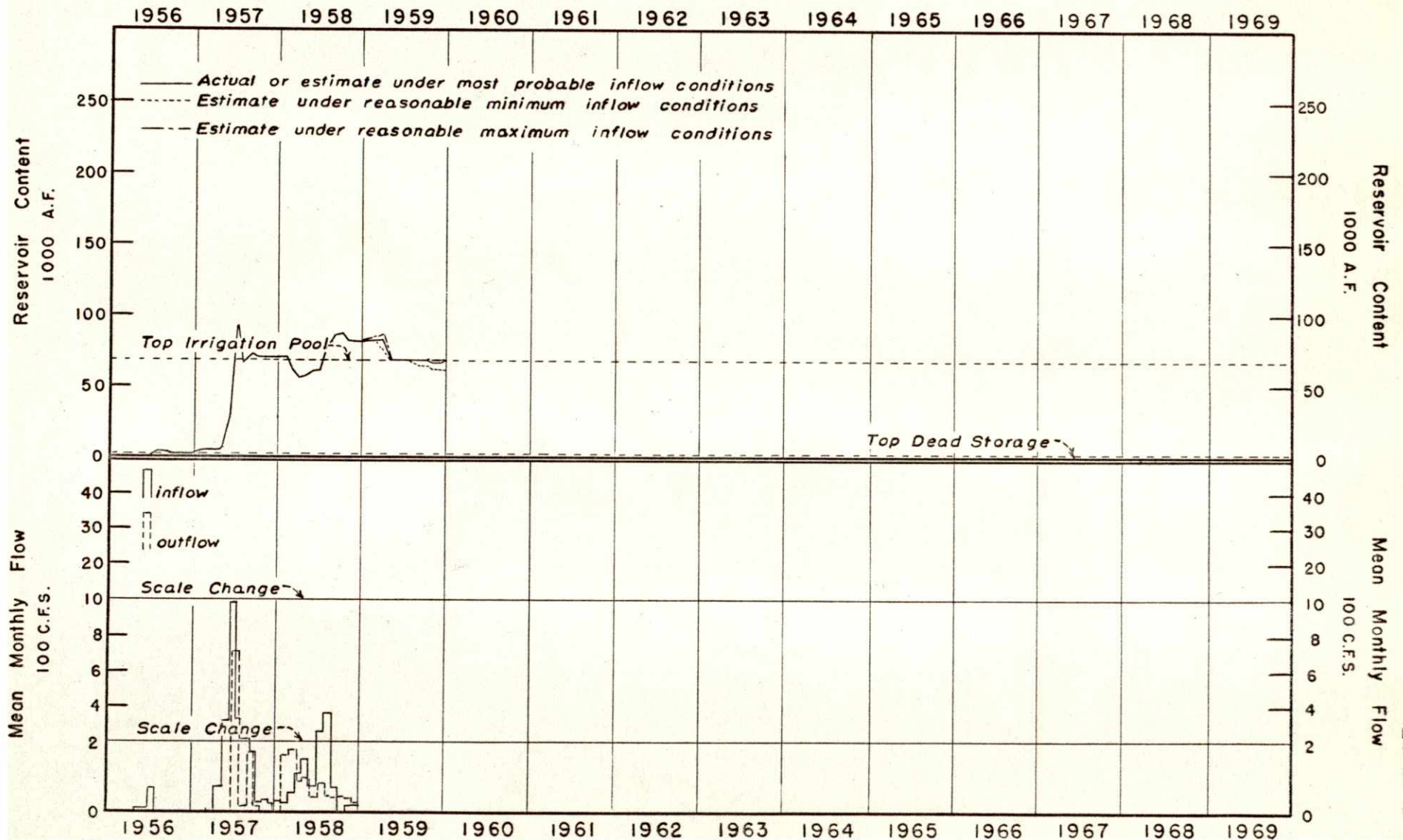


# KIRWIN RESERVOIR OPERATION HYDROGRAPHS



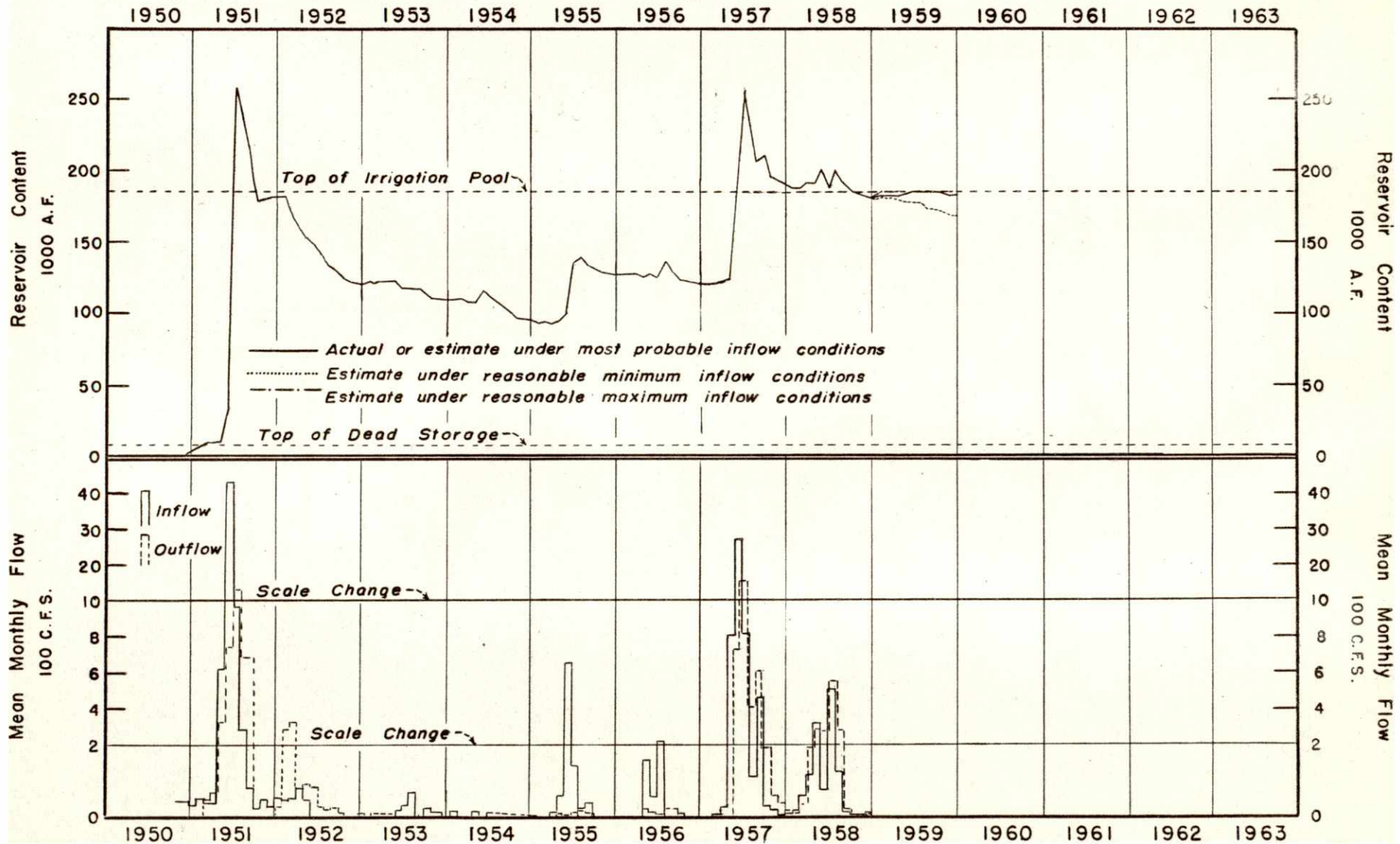


# WEBSTER RESERVOIR OPERATION HYDROGRAPHS





# CEDAR BLUFF RESERVOIR OPERATION HYDROGRAPHS





ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

Exhibit 11

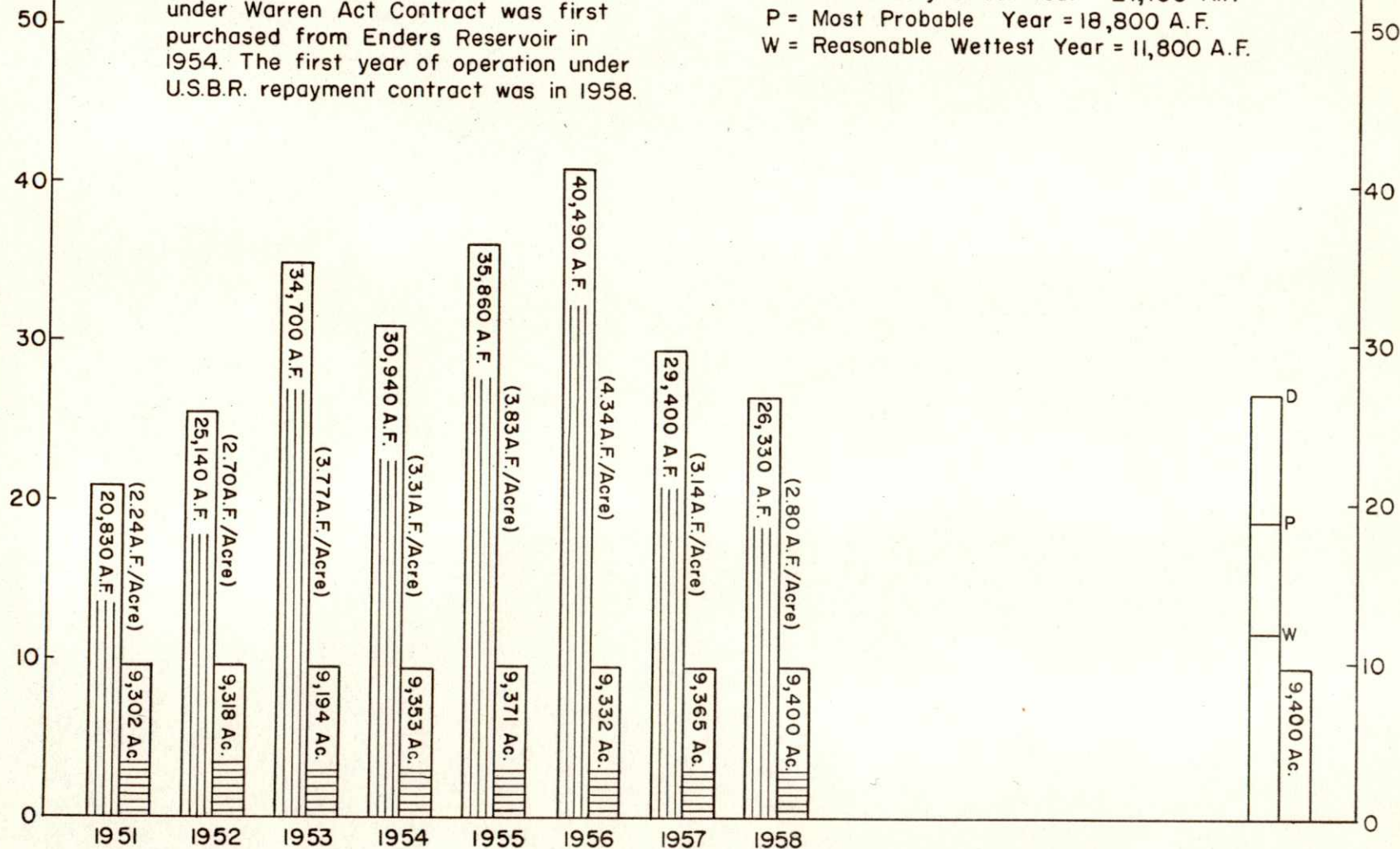
NOTE: Culbertson Canal has been in operation since the 1890's. Supplemental water under Warren Act Contract was first purchased from Enders Reservoir in 1954. The first year of operation under U.S.B.R. repayment contract was in 1958.

ESTIMATED REQUIREMENTS FOR NEXT YEAR

D = Reasonably Driest Year = 27,100 A.F.

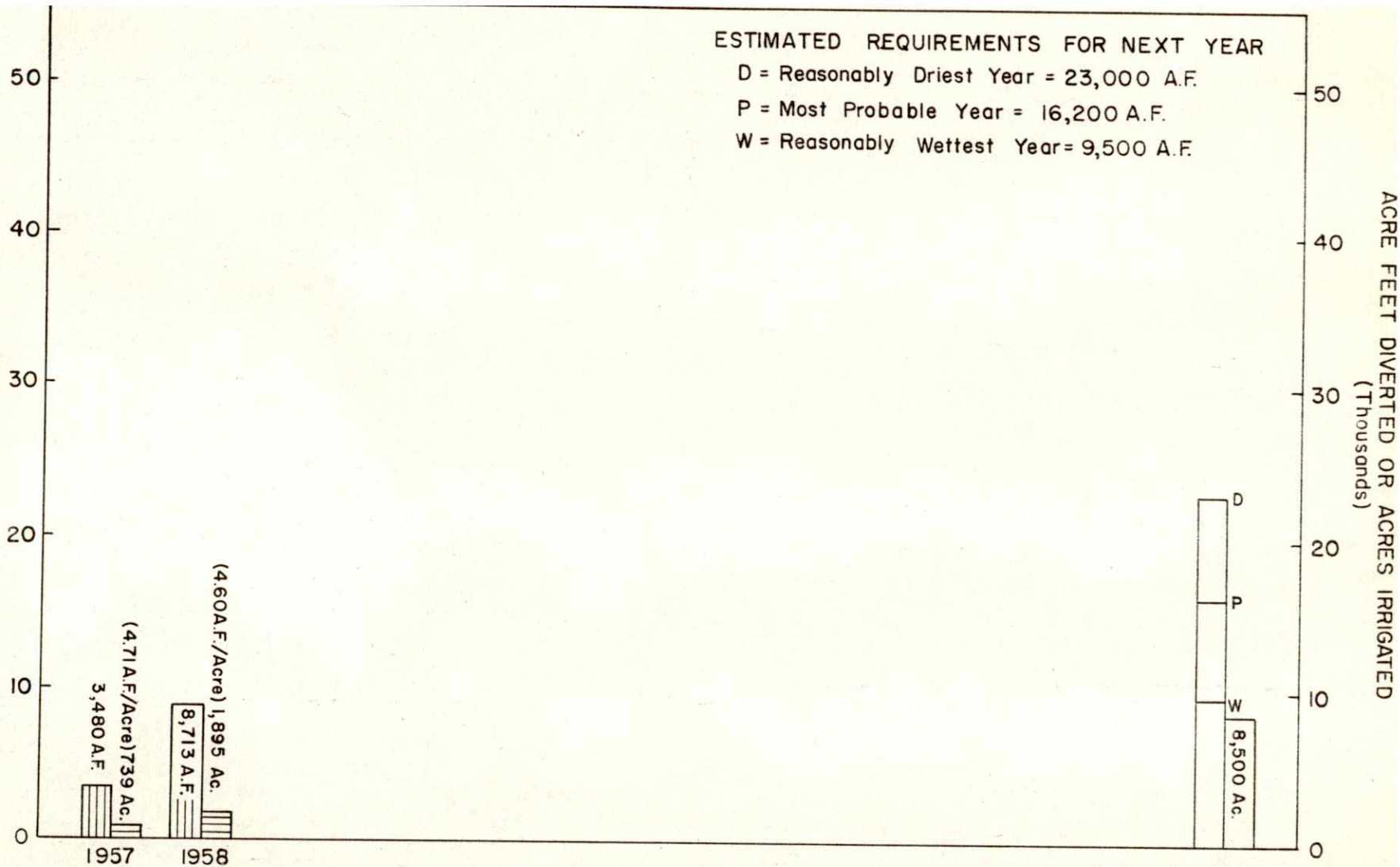
P = Most Probable Year = 18,800 A.F.

W = Reasonable Wettest Year = 11,800 A.F.



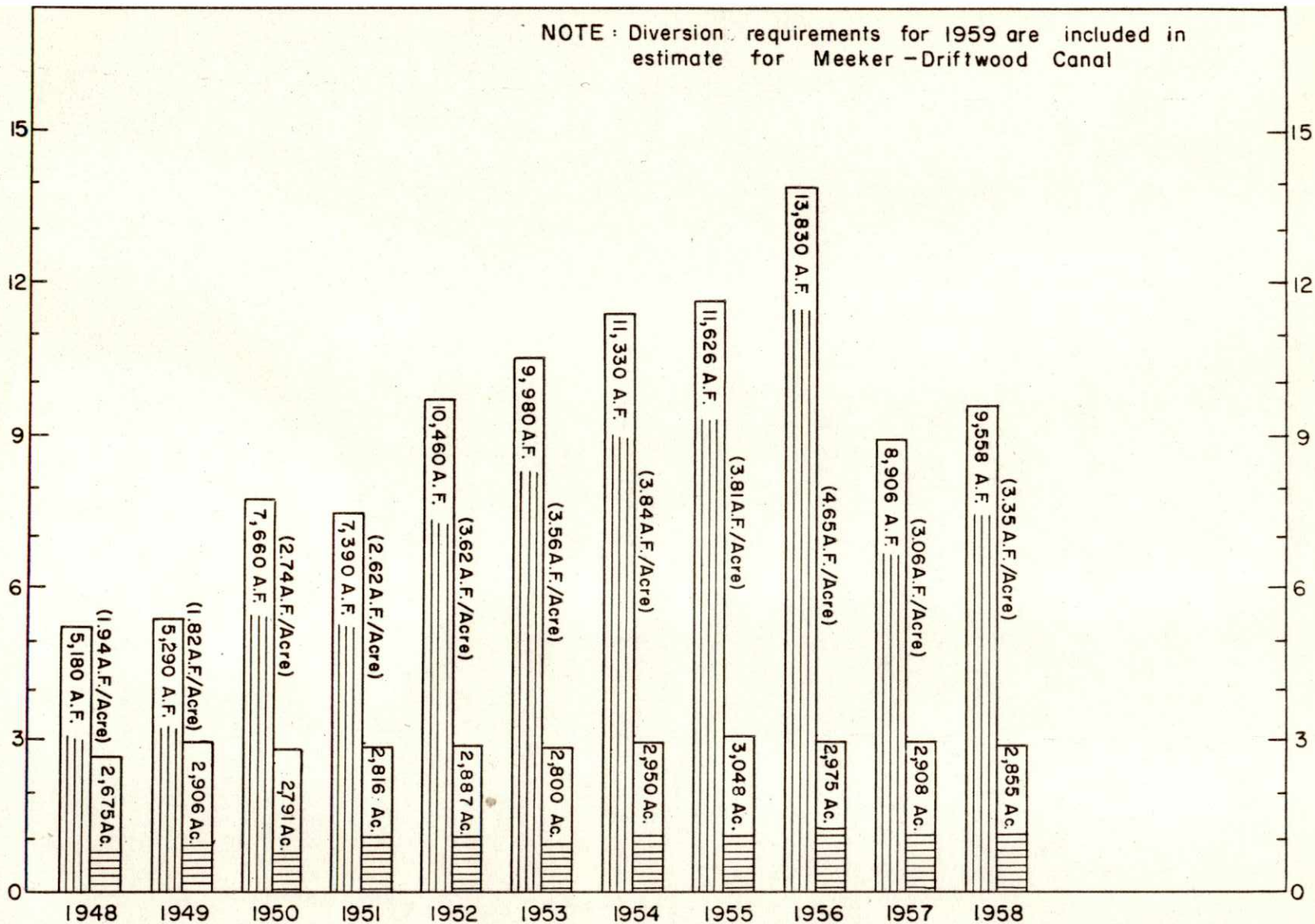
CULBERTSON CANAL DIVERSIONS AND ACRES IRRIGATED



ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

MEEKER-DRIFTWOOD CANAL DIVERSIONS AND ACRES IRRIGATED



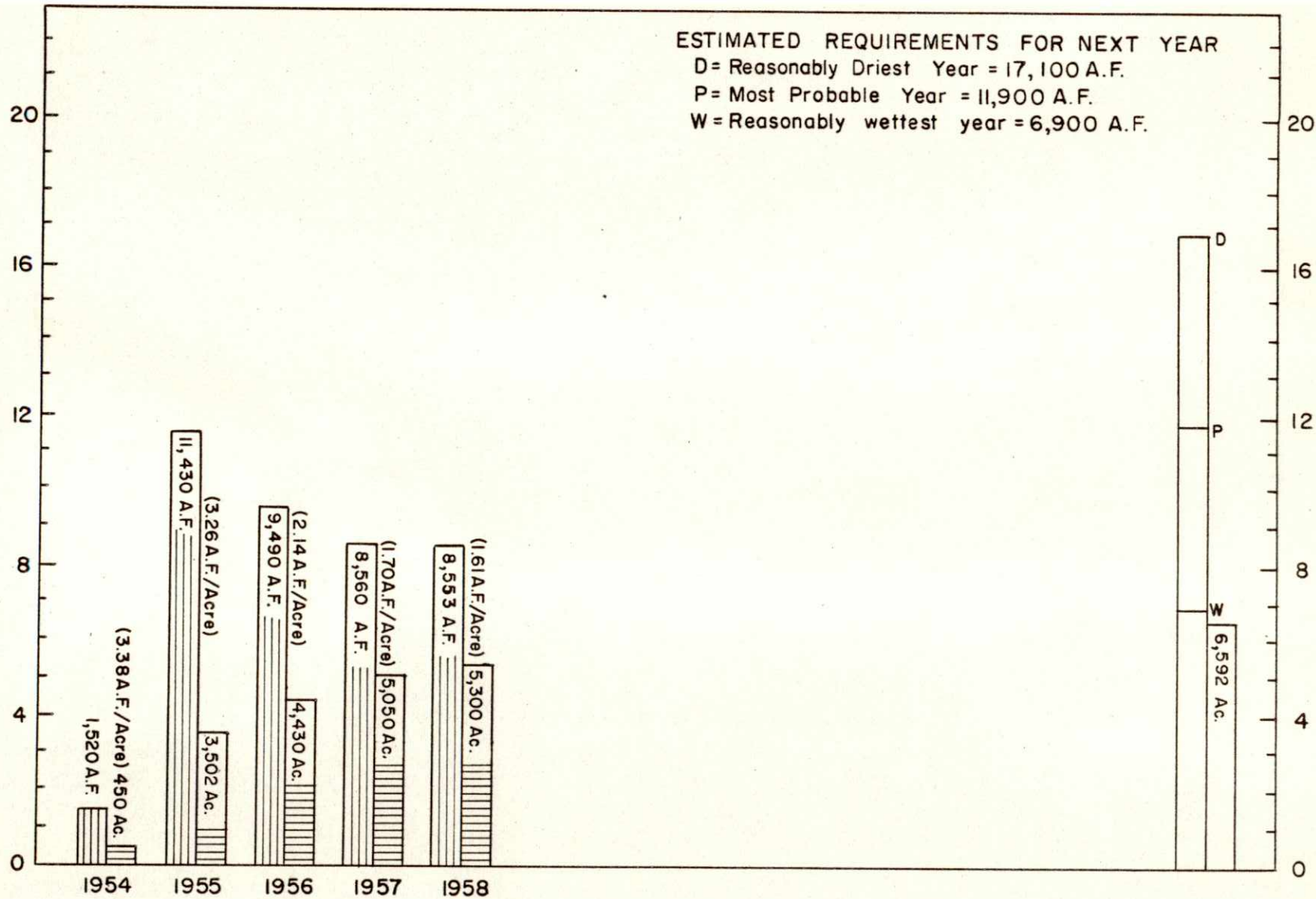
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

MEEKER CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)  
30



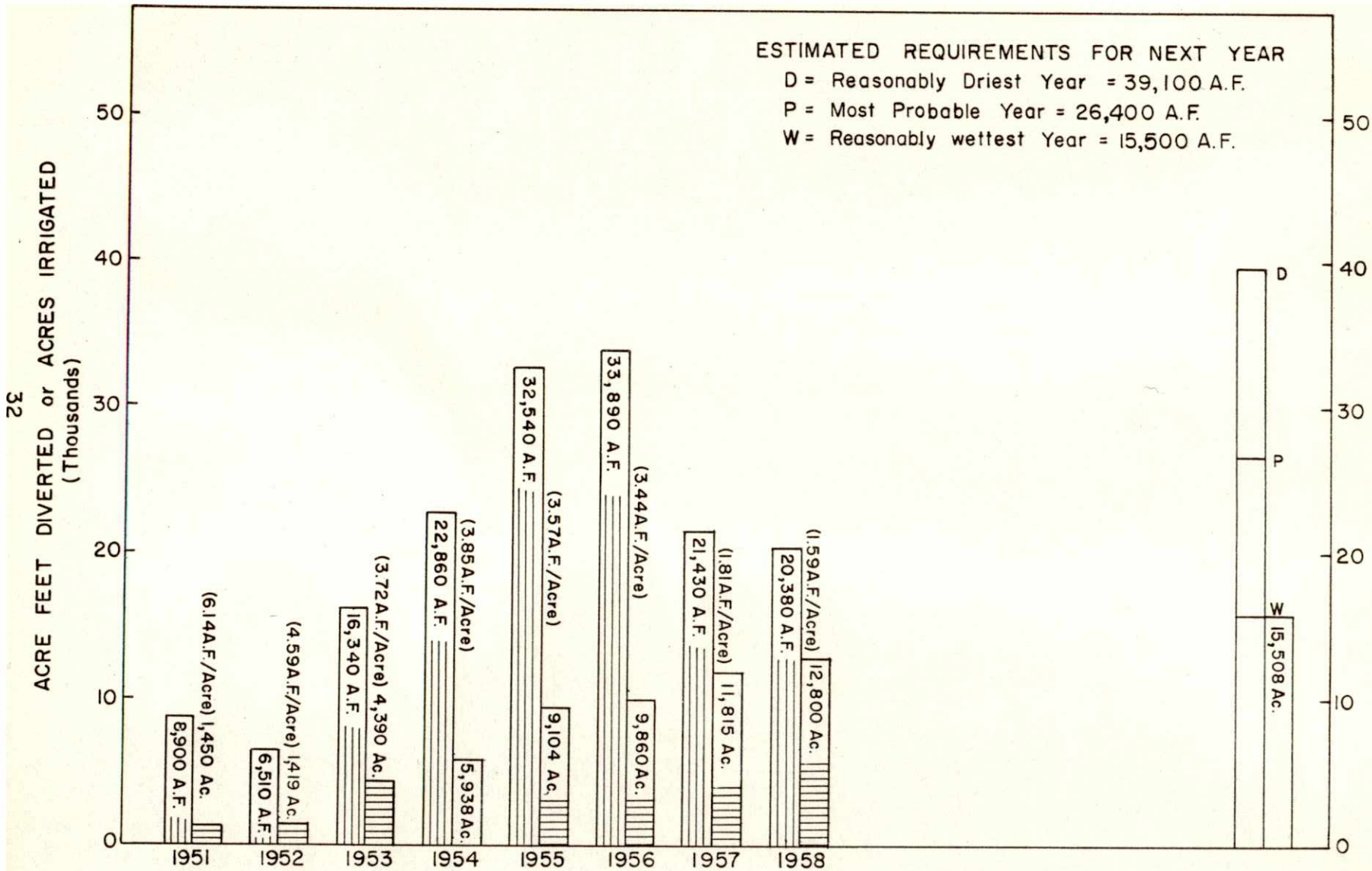
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



BARTLEY CANAL DIVERSION AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

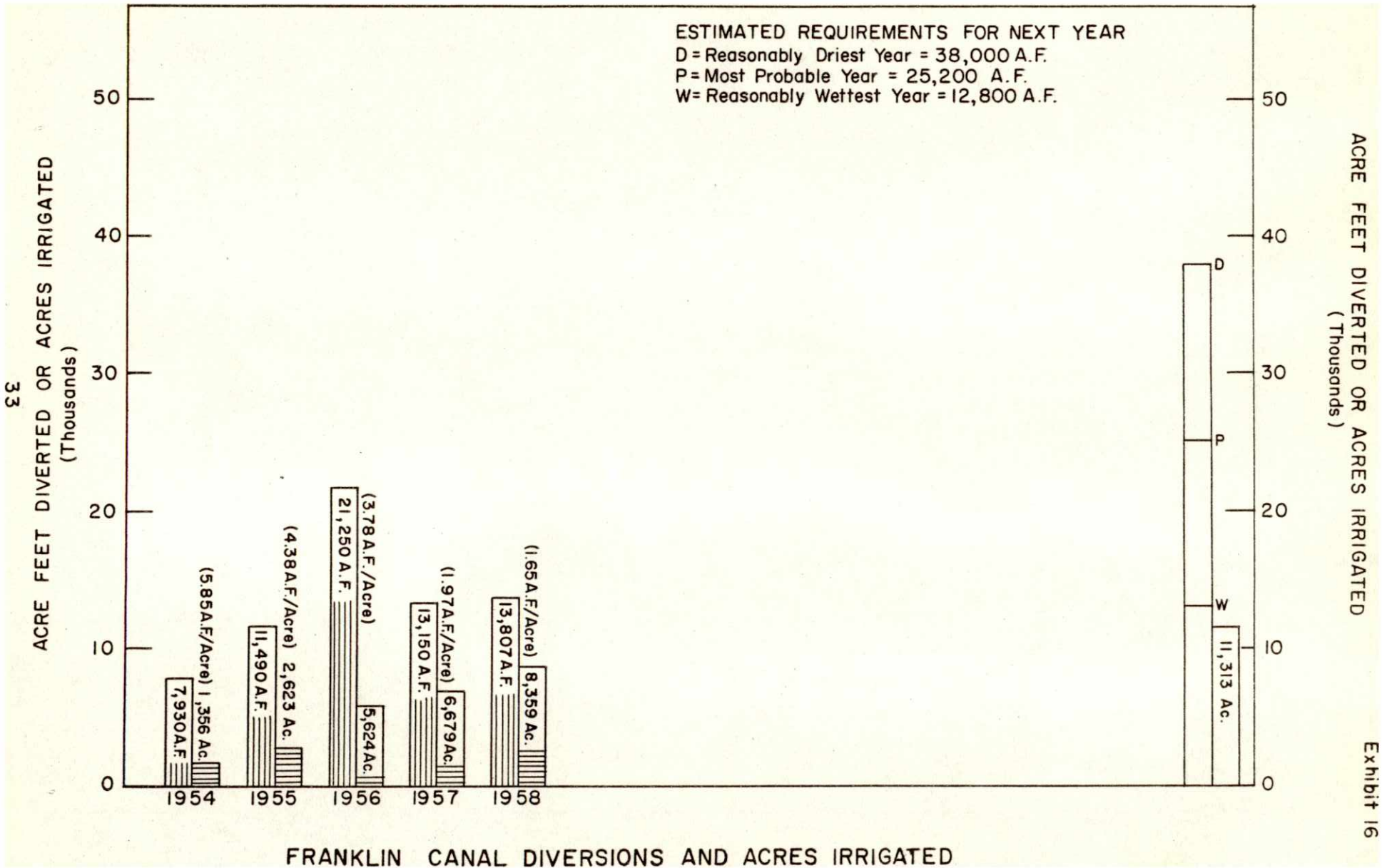




CAMBRIDGE CANAL DIVERSIONS AND ACRES IRRIGATED

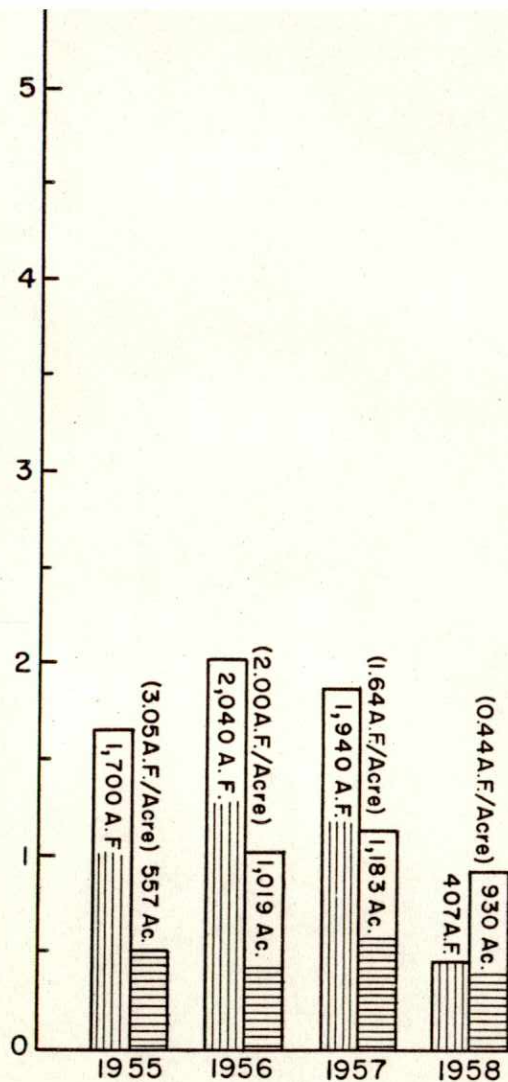
ACRE FEET DIVERTED or ACRES IRRIGATED  
(Thousands)







ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



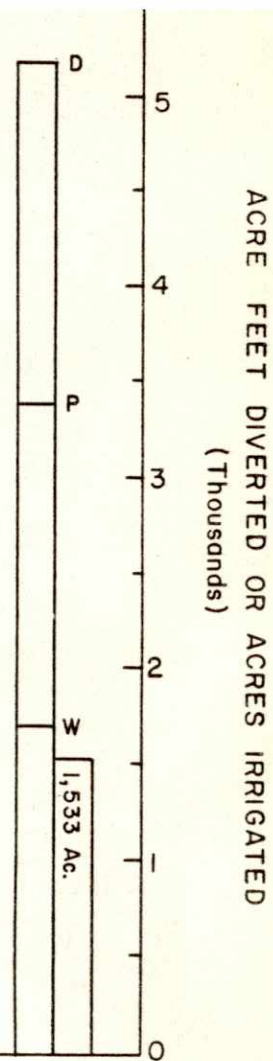
NAPONEE CANAL DIVERSIONS AND ACRES IRRIGATED

# ESTIMATED REQUIREMENTS FOR NEXT YEAR

D = Reasonably Driest Year = 5,200 A.F.

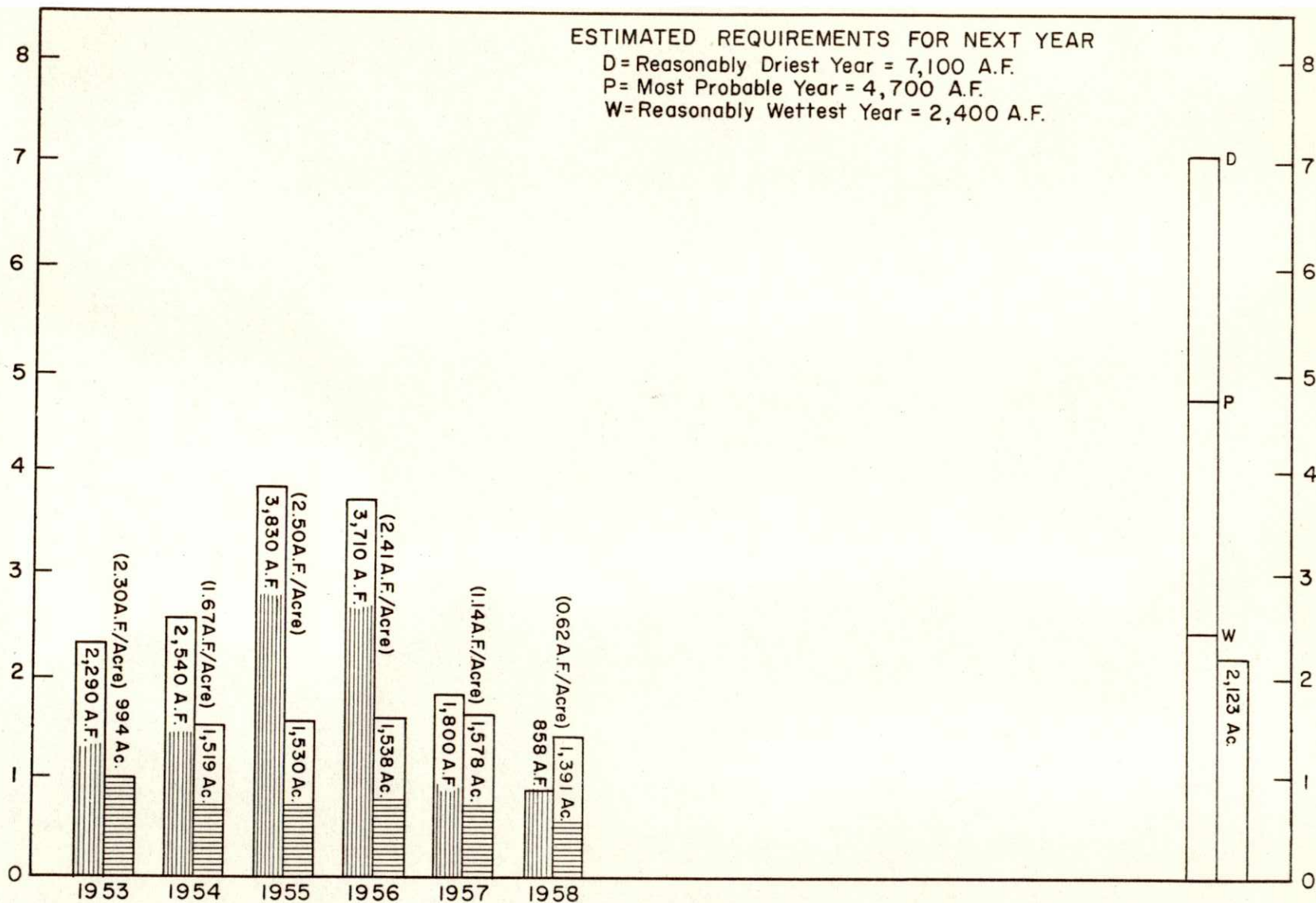
P = Most Probable Year = 3,400 A.F.

W = Reasonably Wettest Year = 1,700 A.F.





ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

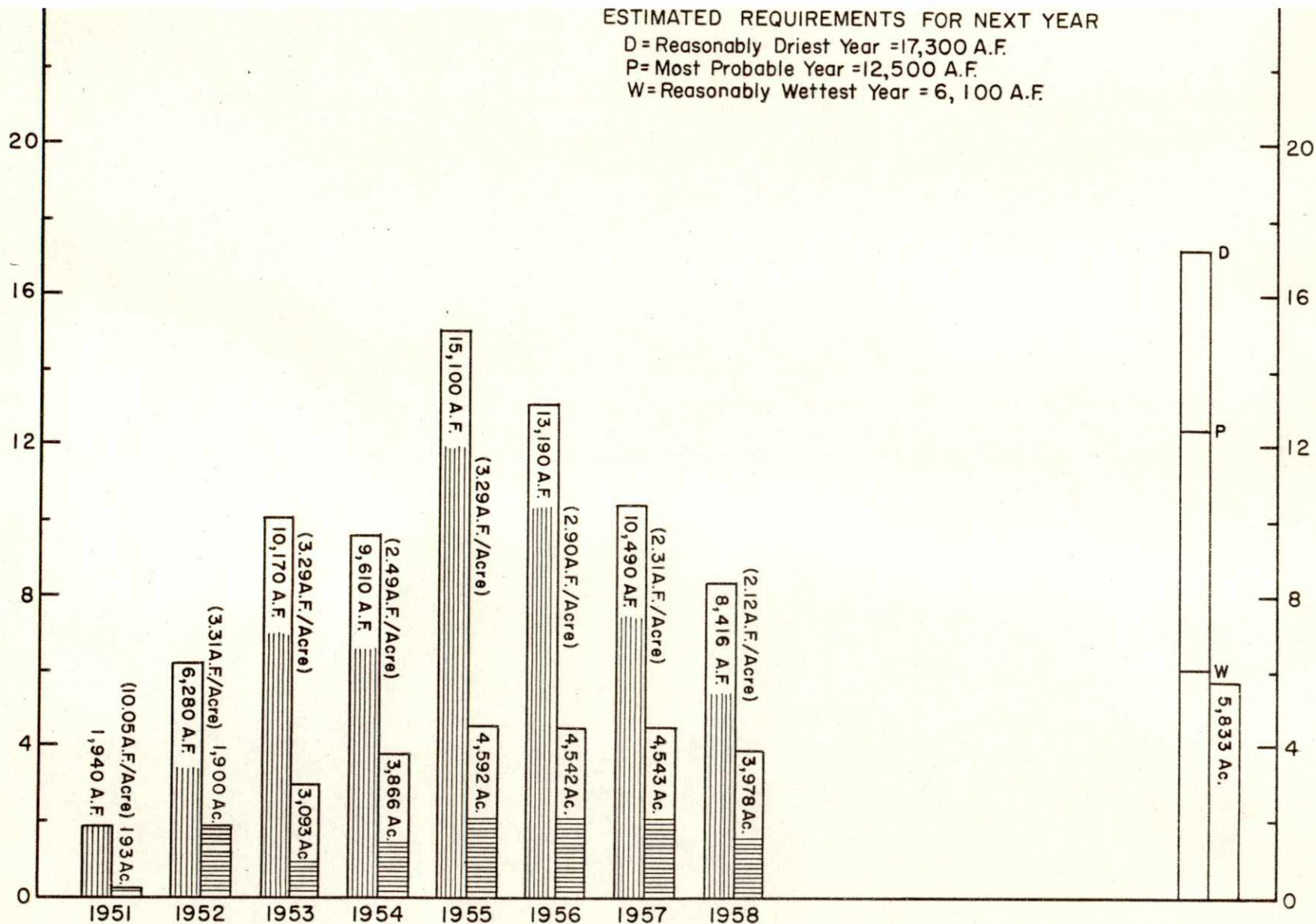


FRANKLIN PUMP CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



ACER FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

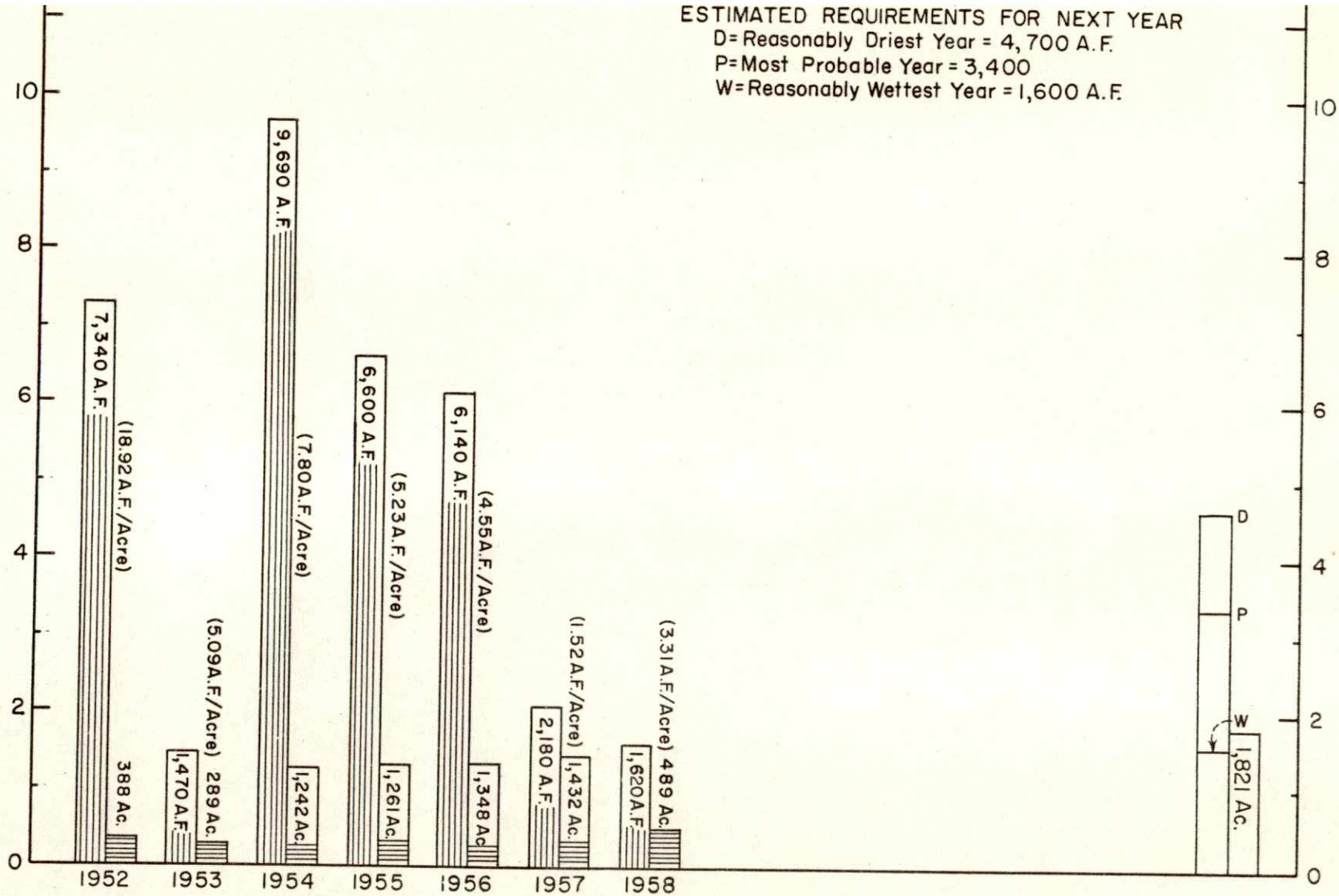


SUPERIOR CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



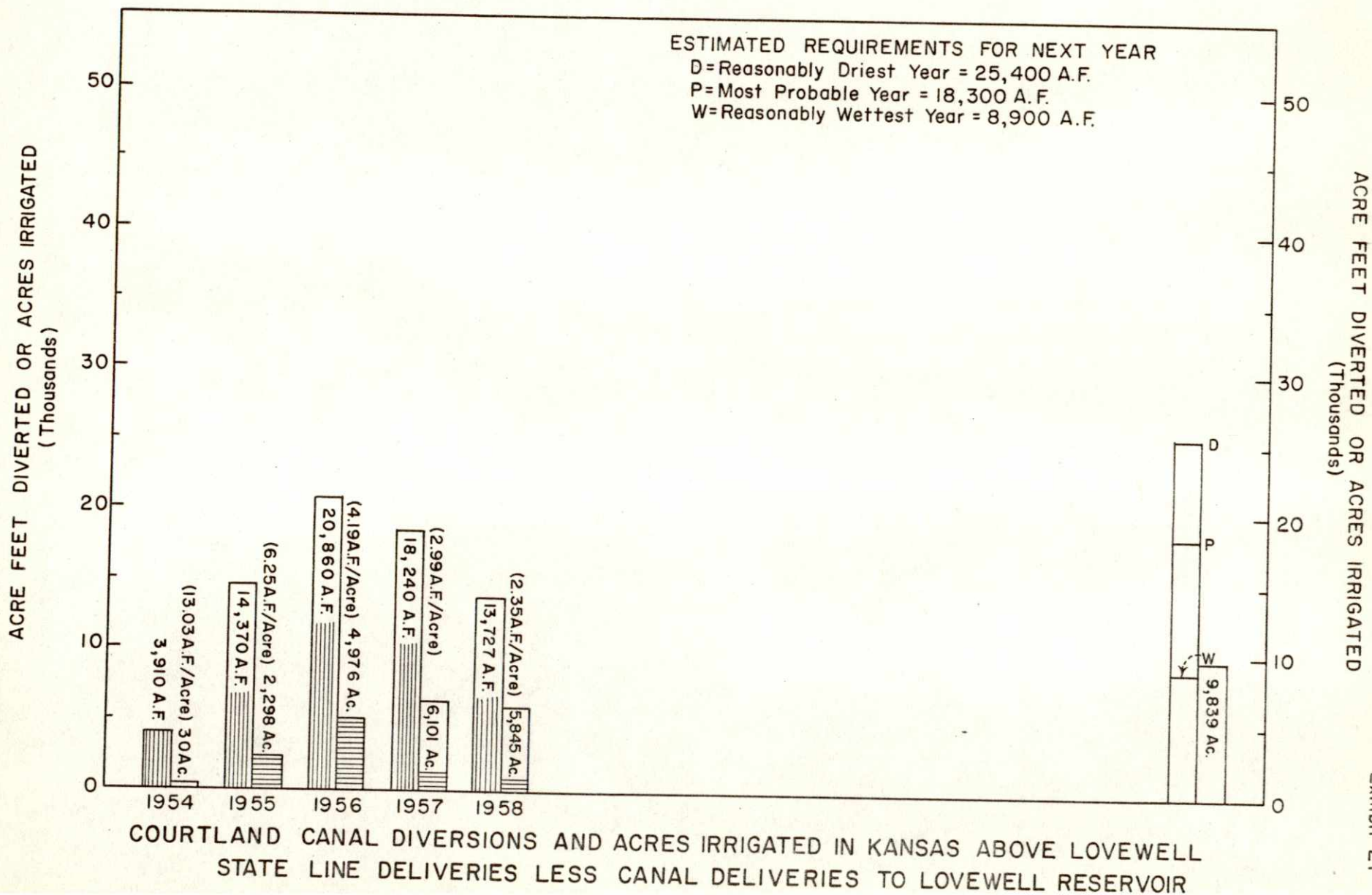
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



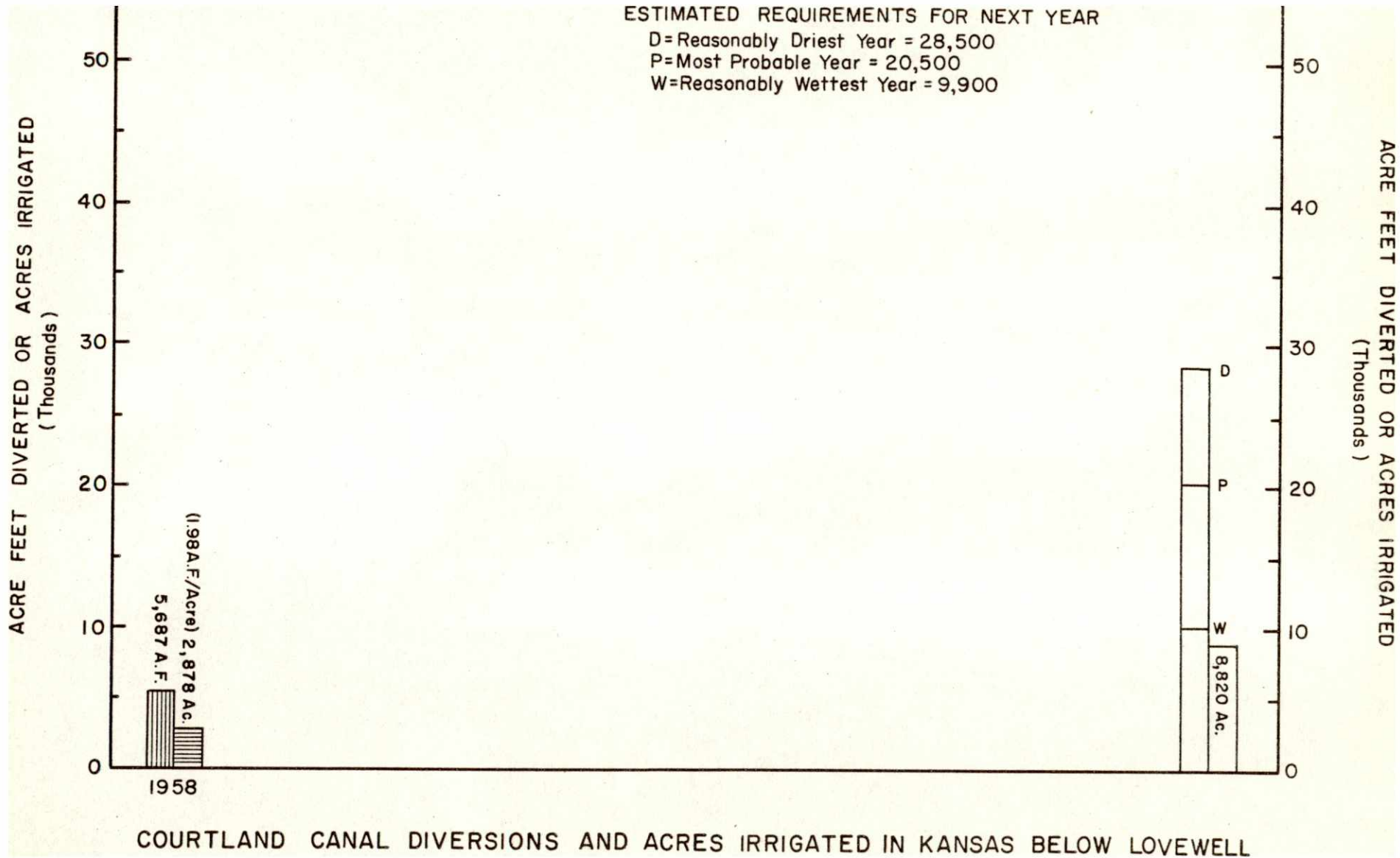
COURTLAND CANAL DIVERSIONS AND ACRES IRRIGATED IN NEBRASKA  
TOTAL DIVERSIONS LESS FLOW AT NEBR.-KAN. STATE LINE

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



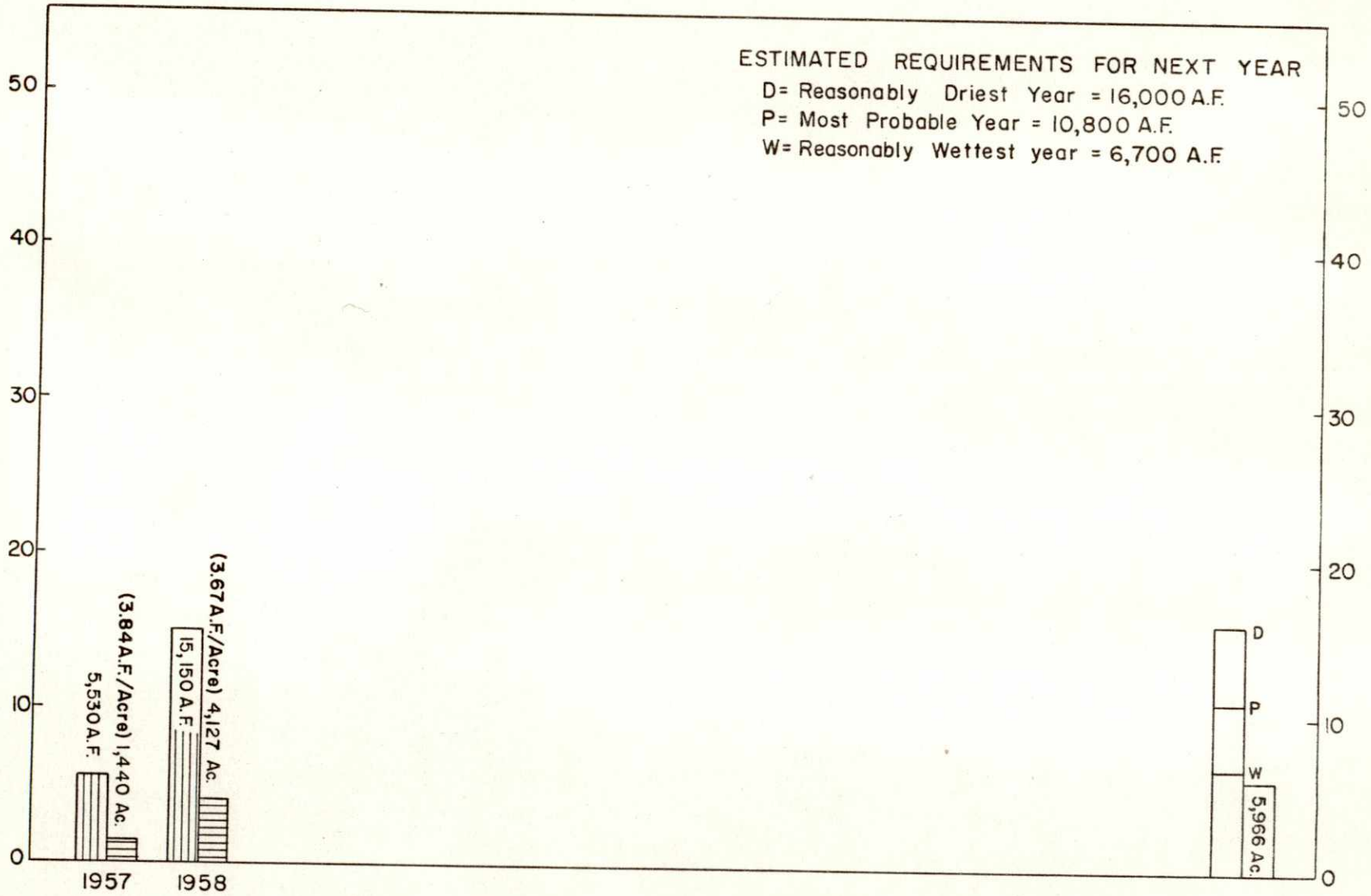






ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

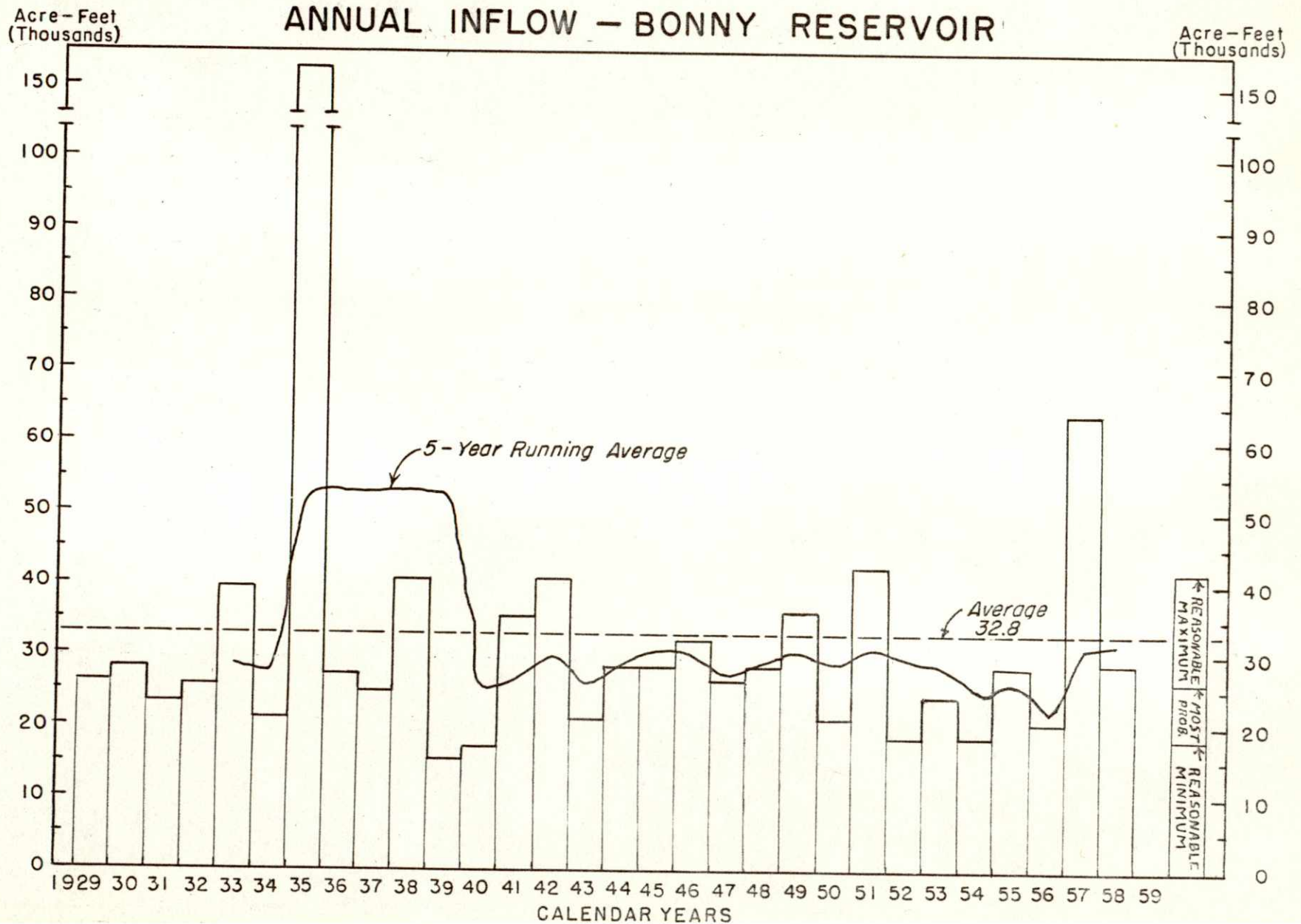
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KIRWIN CANAL DIVERSION AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

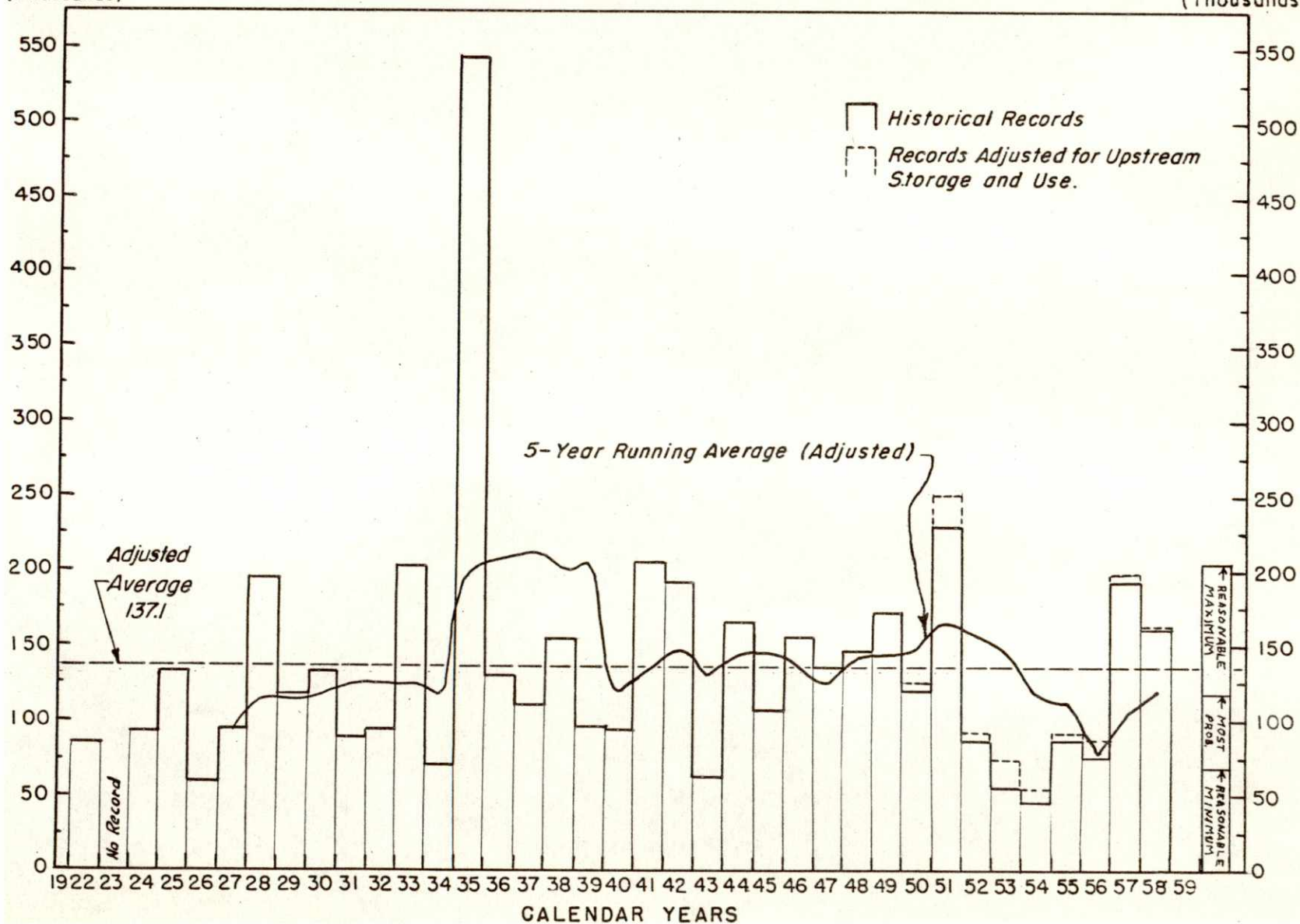




Acre—Feet  
(Thousands)

## ANNUAL INFLOW—SWANSON LAKE

Acre—Feet  
(Thousands)

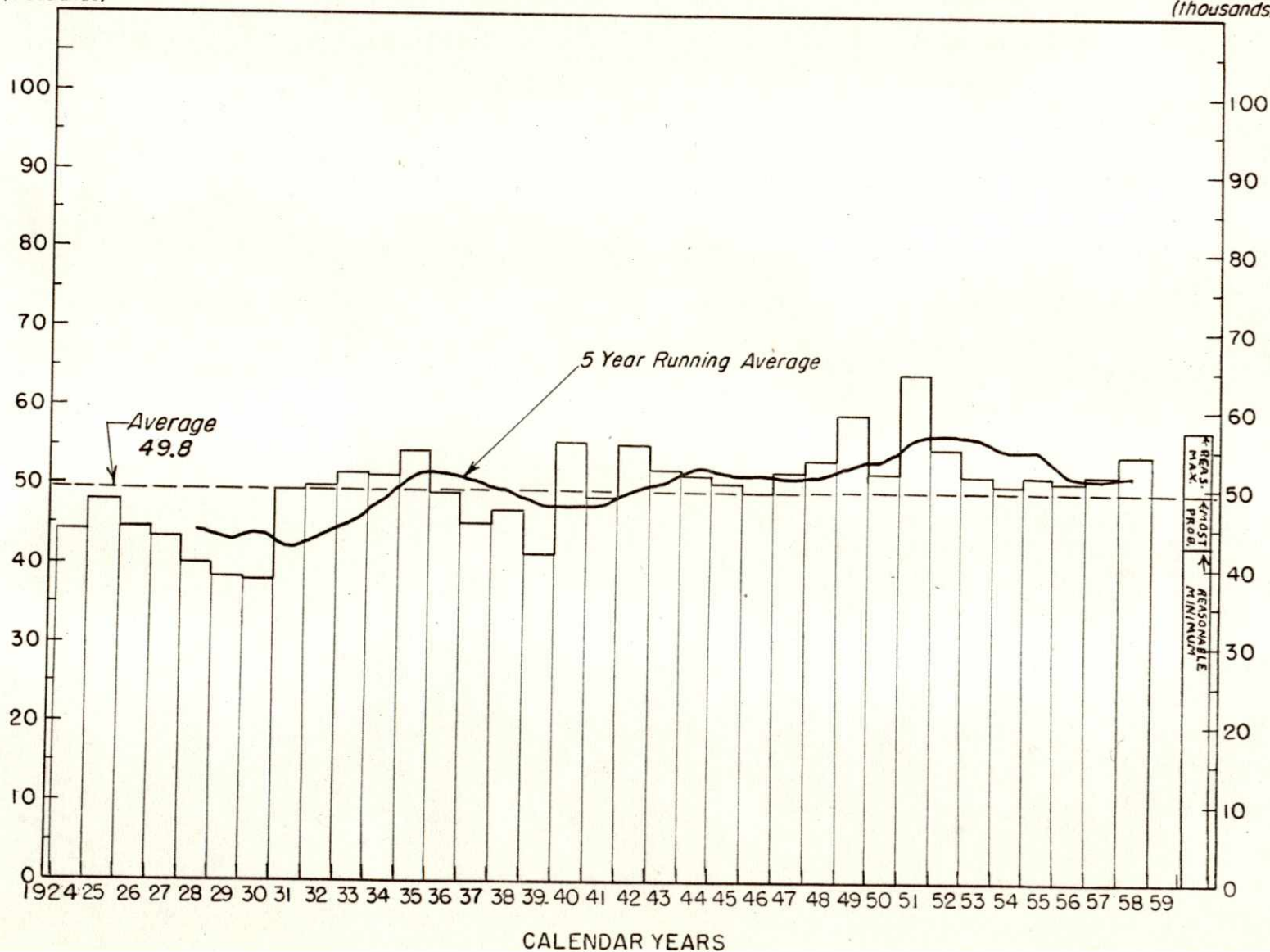




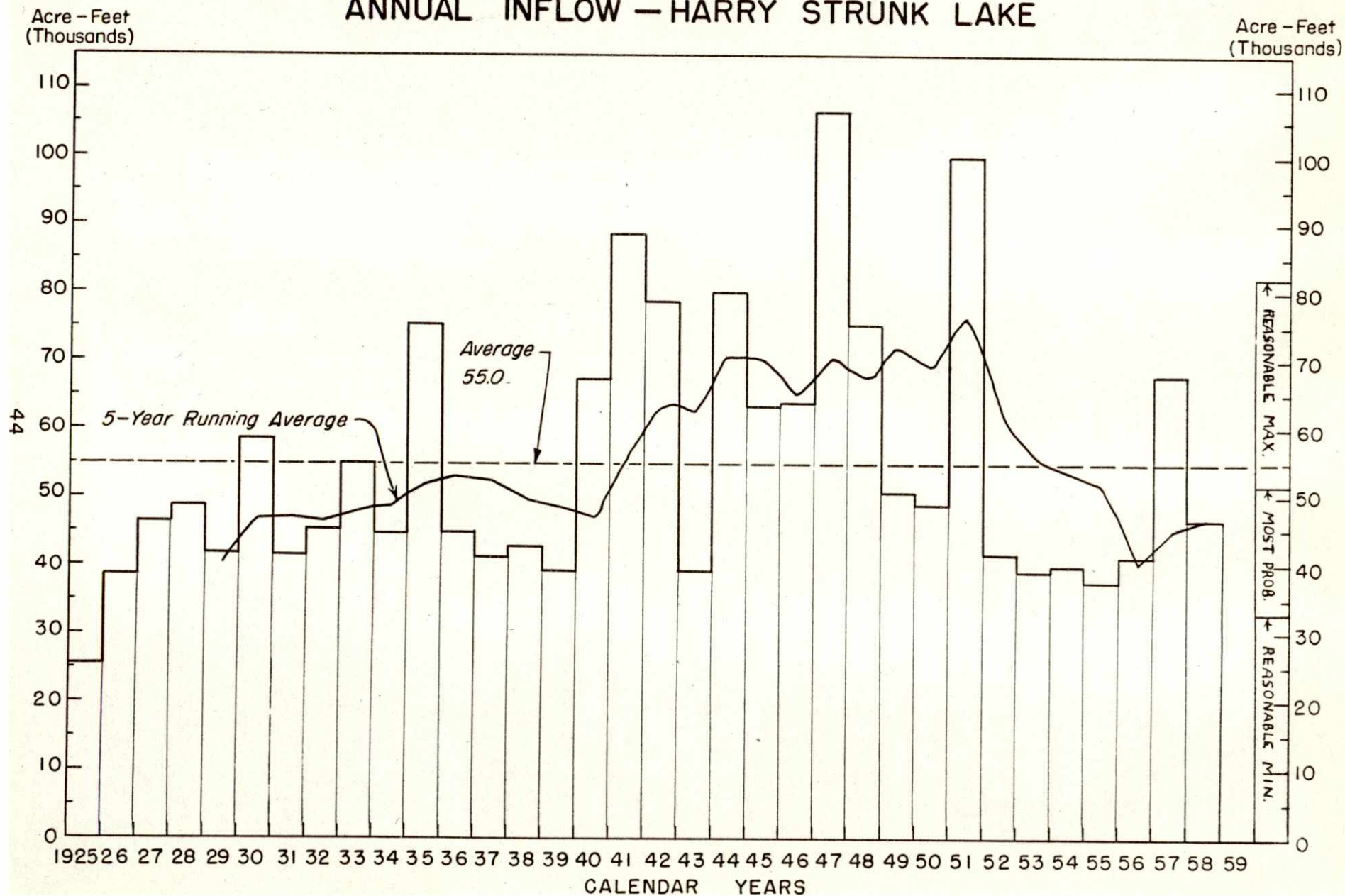
# ANNUAL INFLOW - ENDERS RESERVOIR

Acre-Feet  
(thousands)

Acre-Feet  
(thousands)



# ANNUAL INFLOW — HARRY STRUNK LAKE

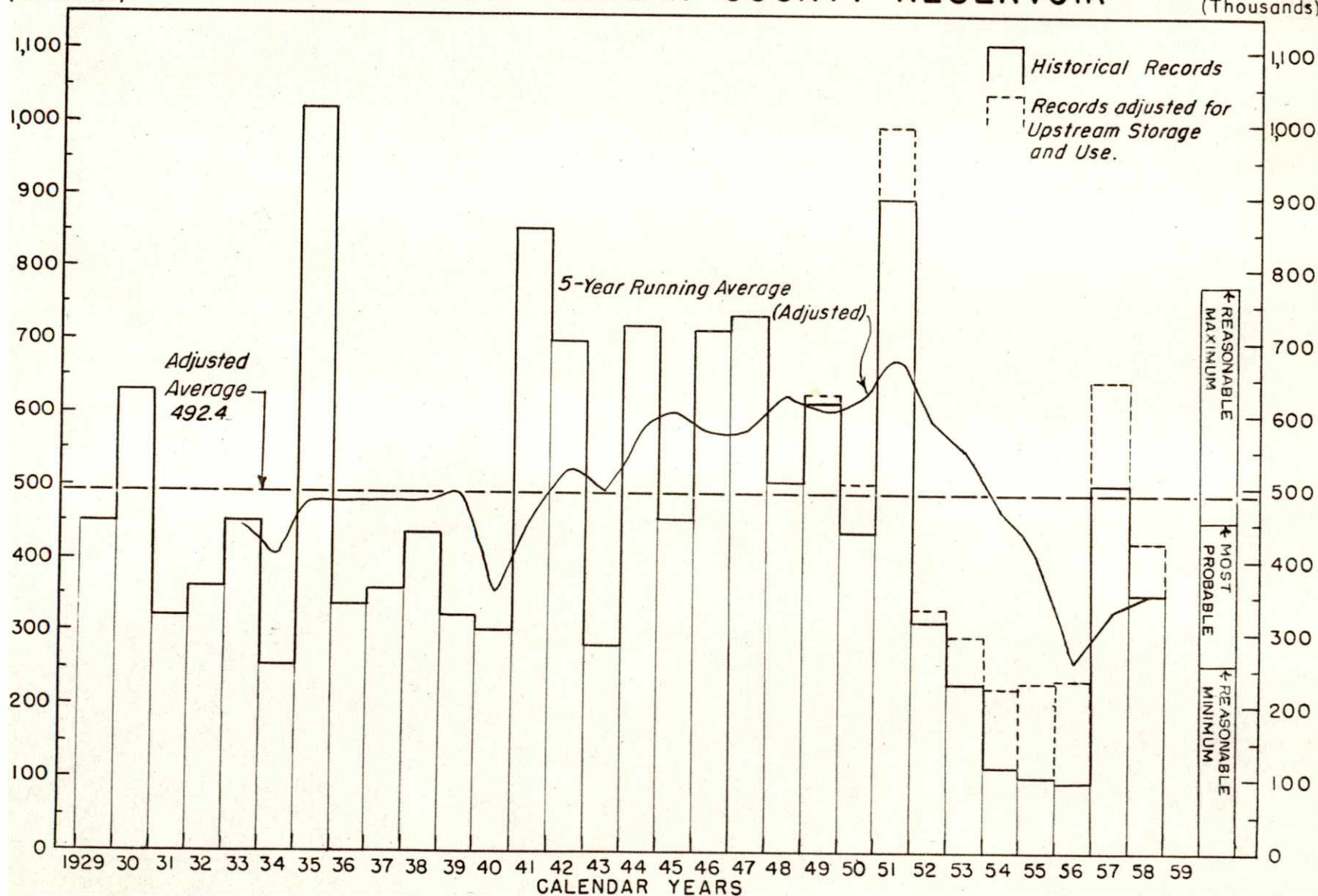




Acre—Feet  
(Thousands)

# ANNUAL INFLOW—HARLAN COUNTY RESERVOIR

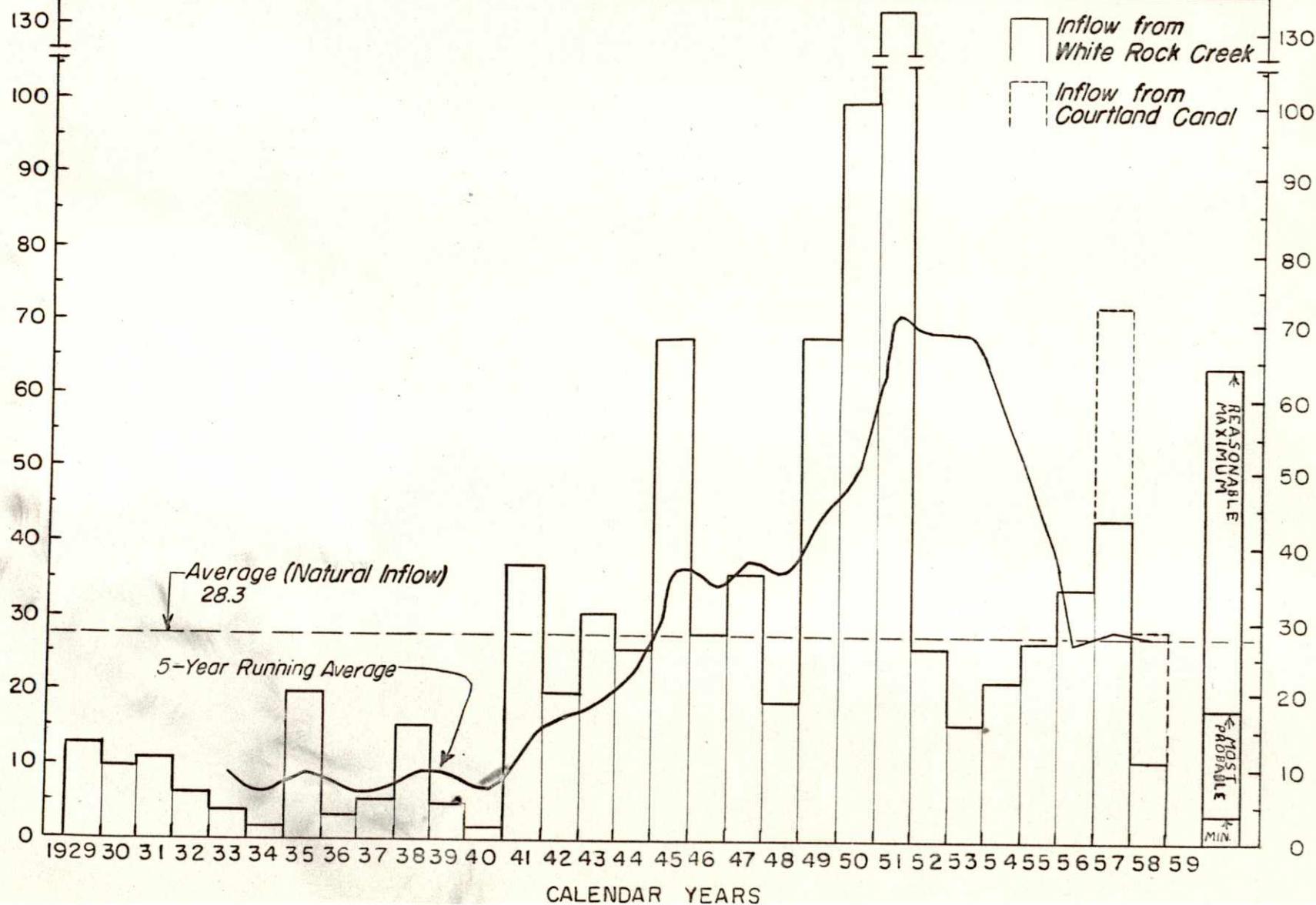
Acre—Feet  
(Thousands)



Acre-Feet  
(Thousands)

# ANNUAL INFLOW - LOVEWELL RESERVOIR (WHITE ROCK CREEK)

Acre-Feet  
(Thousands)

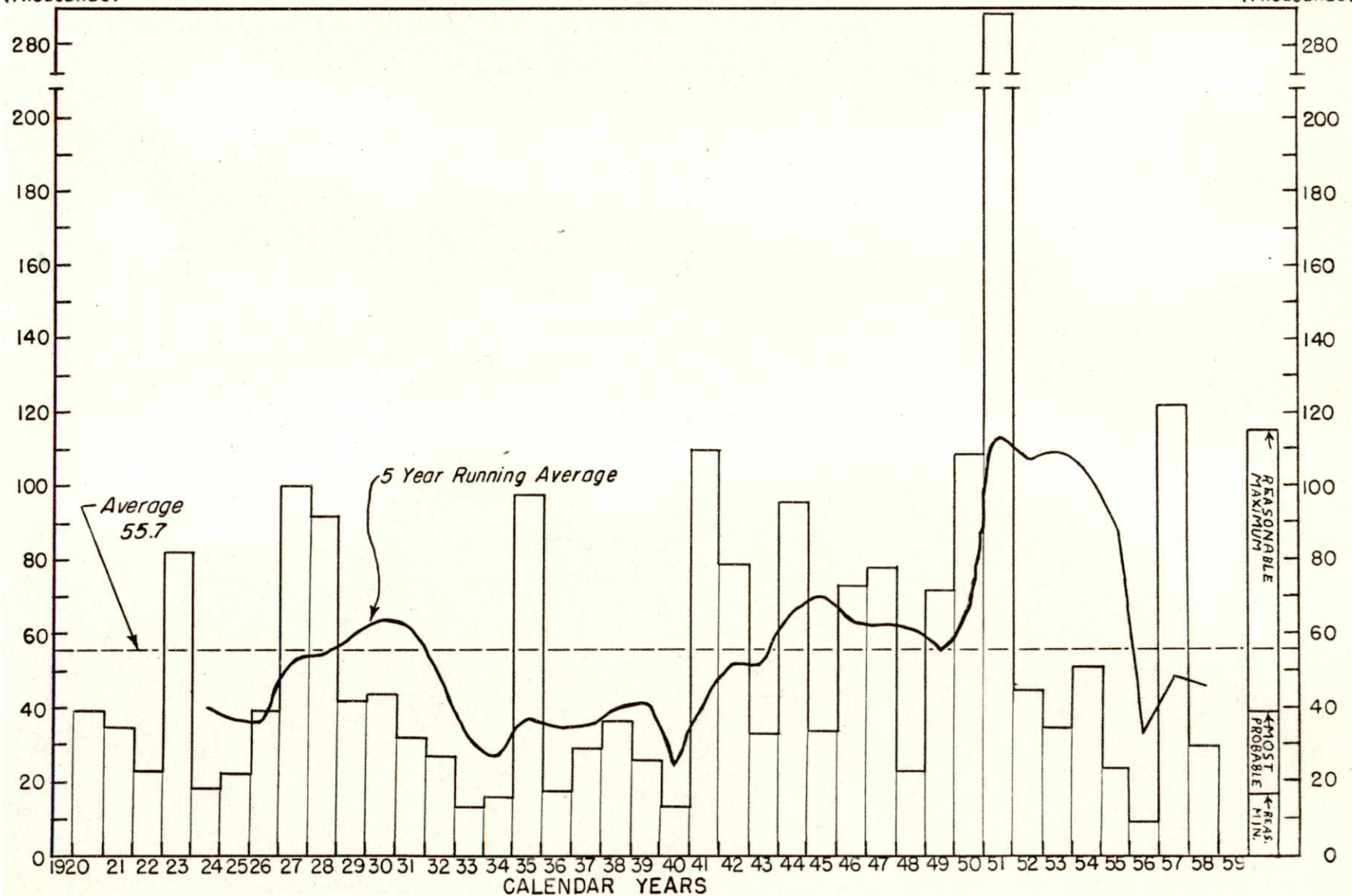




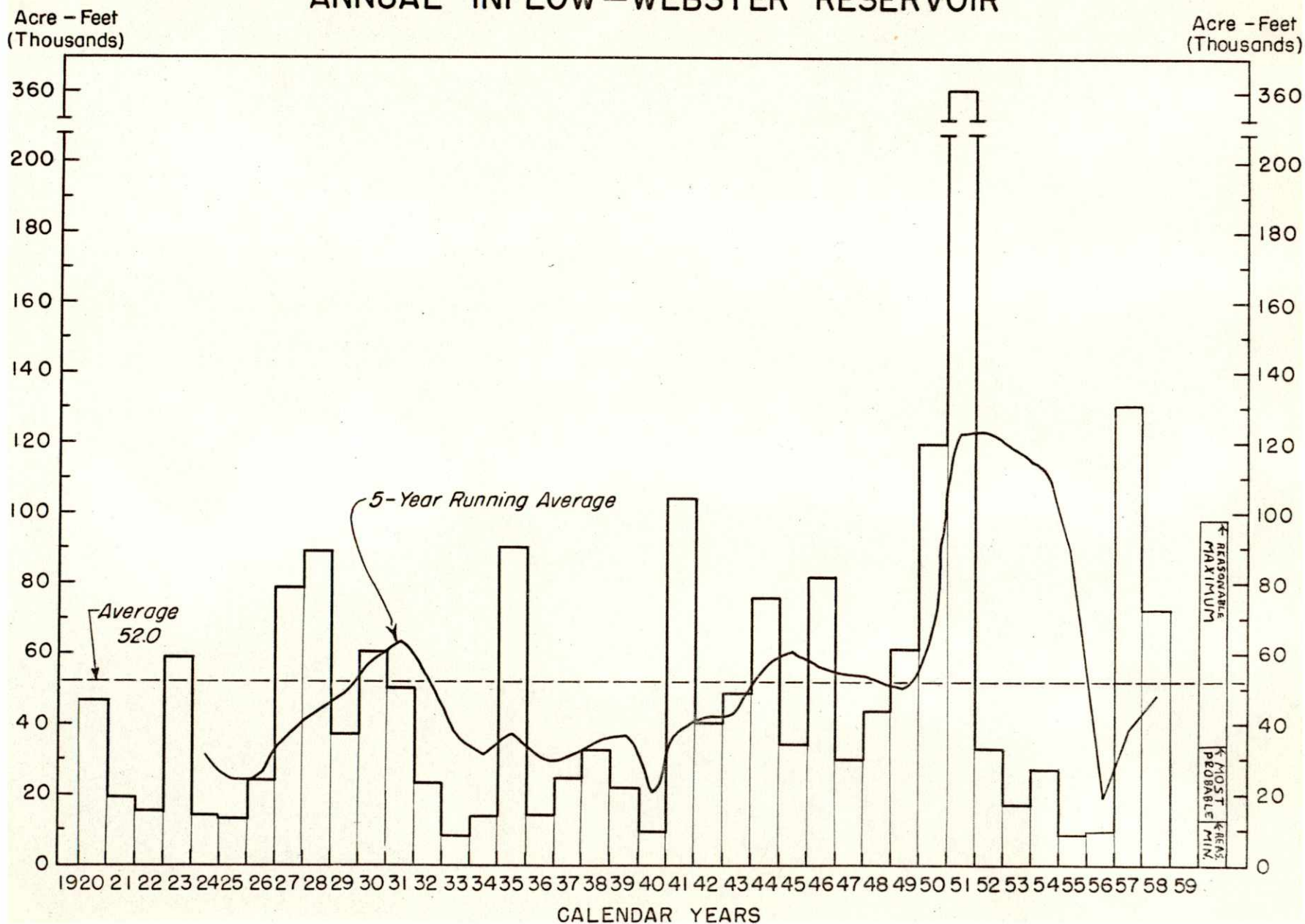
Acre Feet  
(Thousands)

## ANNUAL INFLOW-KIRWIN RESERVOIR

Acre Feet  
(Thousands)



# ANNUAL INFLOW—WEBSTER RESERVOIR





# ANNUAL INFLOW-CEDAR BLUFF RESERVOIR

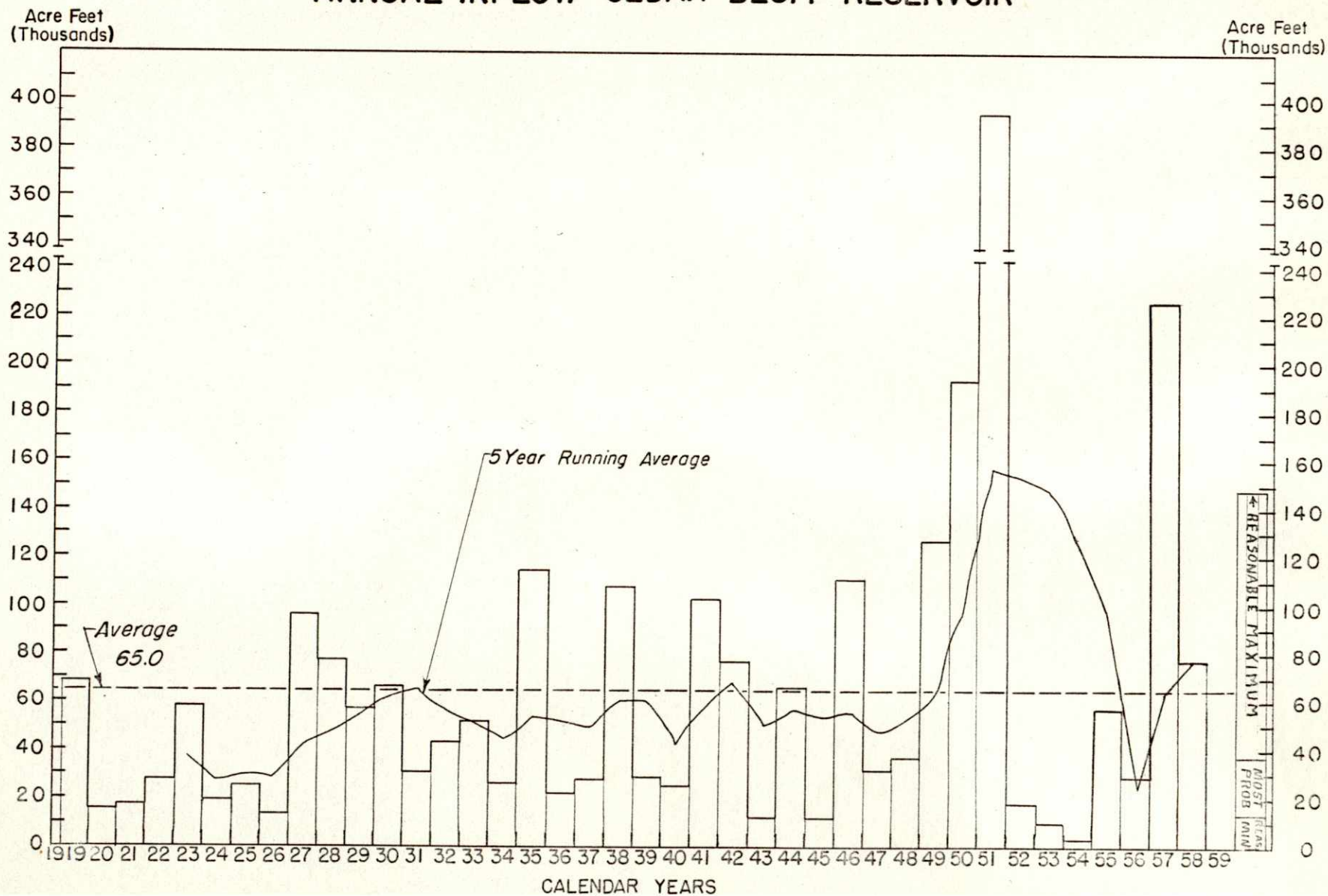


TABLE 5, page 1  
ACRES IRRIGATED AND CANAL DIVERSIONS  
KANSAS RIVER PROJECTS

Irrigation Facility	Planned	<u>Acres Irrigated</u>			<u>Acre-feet Diverted in 1958</u>						Total	
		<u>1/ 1959</u>	<u>2/ 1958</u>	<u>3/</u>	April	May	June	July	Aug.	Sept.		Oct.
<u>IN NEBRASKA</u>												
<u>Frenchman Valley Irrigation District</u>												
Culbertson Canal <u>4/</u>	9,600	9,400	9400		0	1777	4306	6238	7208	6801	0	26,330
<u>Frenchman-Cambridge Irrigation District</u>												
Meeker-Driftwood Can. <u>5/</u>	16,440	15,676	<u>7/ 1895</u>		0	188	1728	1864	3209	1724	0	8713
Meeker Canal <u>5/</u>	—	—	2855		0	476	880	2130	3118	2323	631	9558
Bartley Canal <u>4/</u>	7,000	6,592	5300		0	395	577	1999	4104	1065	413	8553
Cambridge Canal <u>4/</u>	15,600	15,508	12800		0	1059	2065	5722	8858	2176	500	20380
Total-French.Cambr.	39,040	37,776	22,850		0	2118	5250	11715	19289	7288	1544	47204
<u>Bostwick Irrigation District in Nebraska</u>												
Franklin Canal <u>4/</u>	11510	11,313	8359		0	107	2531	3487	5294	2360	28	13807
Naponee Canal <u>4/</u>	1640	1,533	930		0	0	0	119	288	0	0	407
Franklin Pump Canal <u>4/</u>	2120	2,123	1391		0	0	0	186	672	0	0	858
Superior Canal <u>4/</u>	6320	5,833	3978		0	234	2065	1539	4308	270	0	8416
Courtland Canal <u>6/</u>	2650	1,821	489		617	-127	794	291	192	28	-175	1620
Total-Nebr.Bostwick	24240	22,623	15147		617	214	5390	5622	10754	2658	-147	25108
<u>Kansas River Projects in Nebraska</u>												
Total for U.S.B.R. Units	72880	69,799	47397		617	4109	14946	23575	37251	16747	1397	98642
Warren Act-Nebraska (Non-Project lands)	—	—	3350		0	0	0	0	206	21	0	226

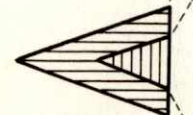
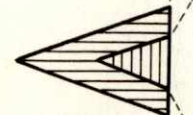
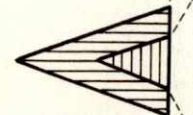
1/ Planned acreage  
2/ Irrigable acres with service available as January 1, 1959  
3/ Acres determined from crop census.  
4/ Operated by Irrigation District

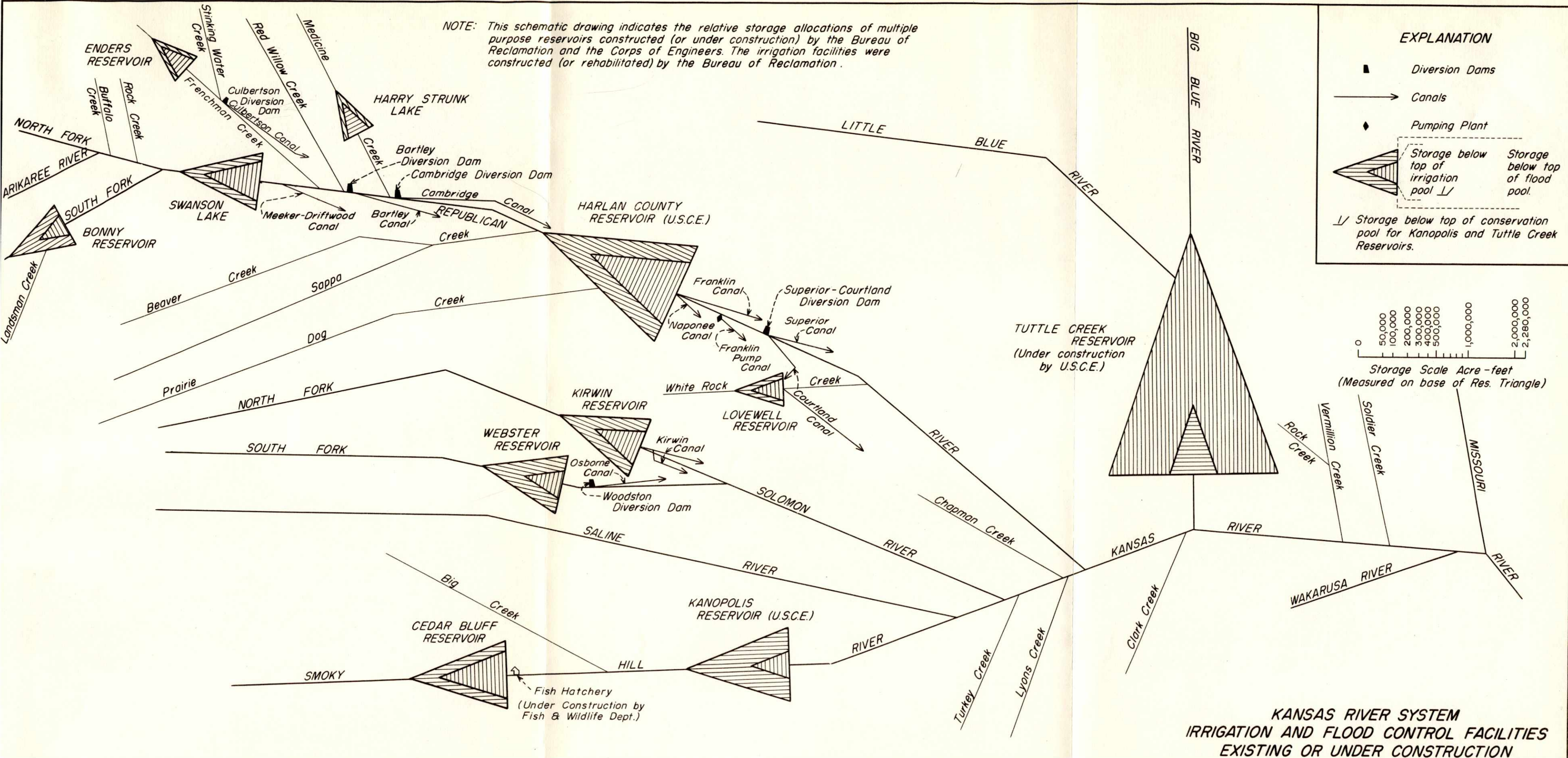
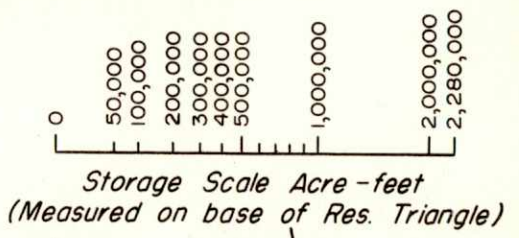
5/ Operated by Bureau of Reclamation  
6/ Main canal operated by Bureau of Reclamation  
 Laterals operated by Irrigation District.  
7/ 8,500 acres will be irrigated in 1959



NOTE: This schematic drawing indicates the relative storage allocations of multiple purpose reservoirs constructed (or under construction) by the Bureau of Reclamation and the Corps of Engineers. The irrigation facilities were constructed (or rehabilitated) by the Bureau of Reclamation.

**EXPLANATION**

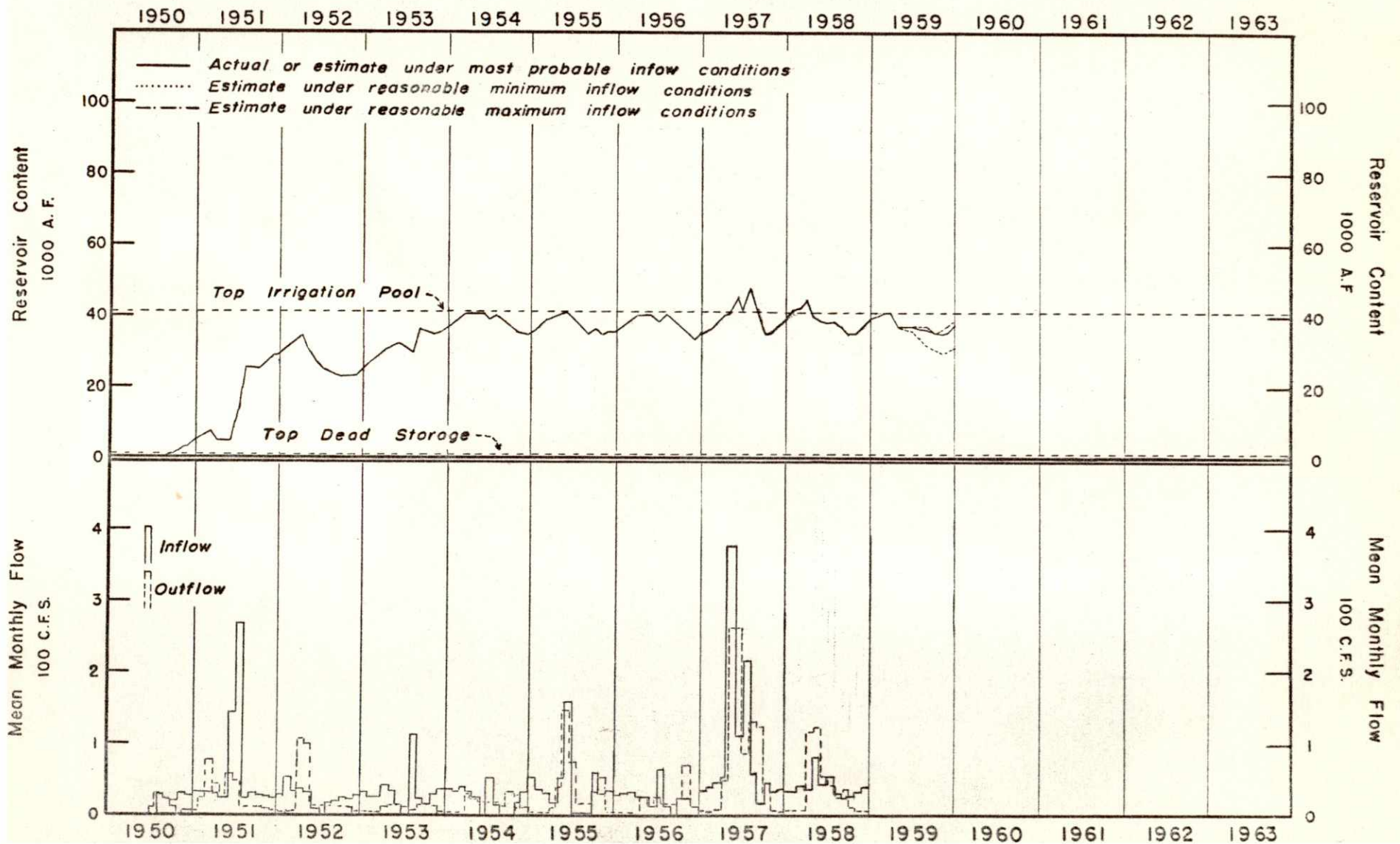
- Diversion Dams
- Canals
- ◆ Pumping Plant
- Storage below top of irrigation pool  /
- Storage below top of flood pool .
-  / Storage below top of conservation pool for Kanopolis and Tuttle Creek Reservoirs.



**KANSAS RIVER SYSTEM  
IRRIGATION AND FLOOD CONTROL FACILITIES  
EXISTING OR UNDER CONSTRUCTION**

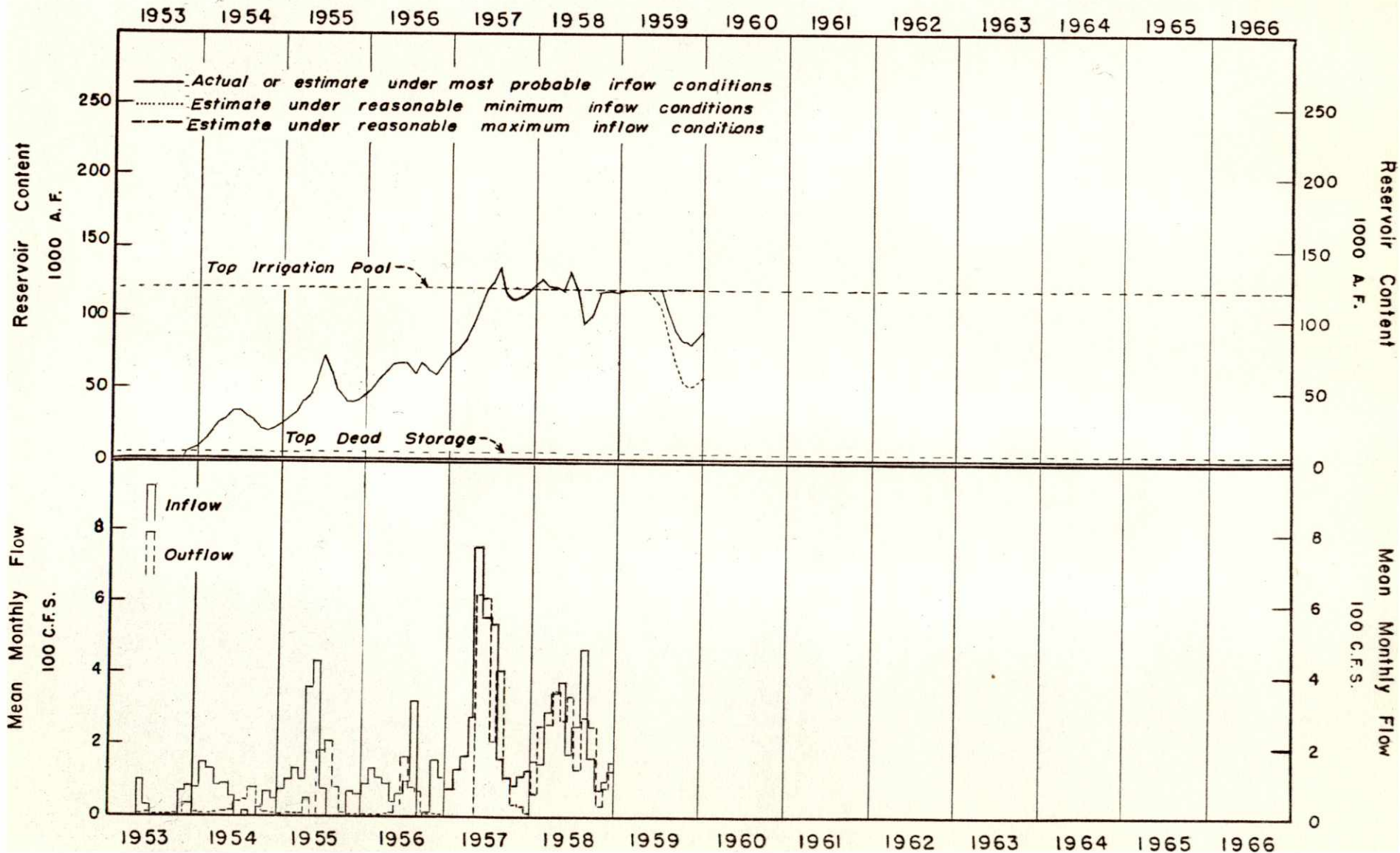


# BONNY RESERVOIR OPERATION HYDROGRAPHS

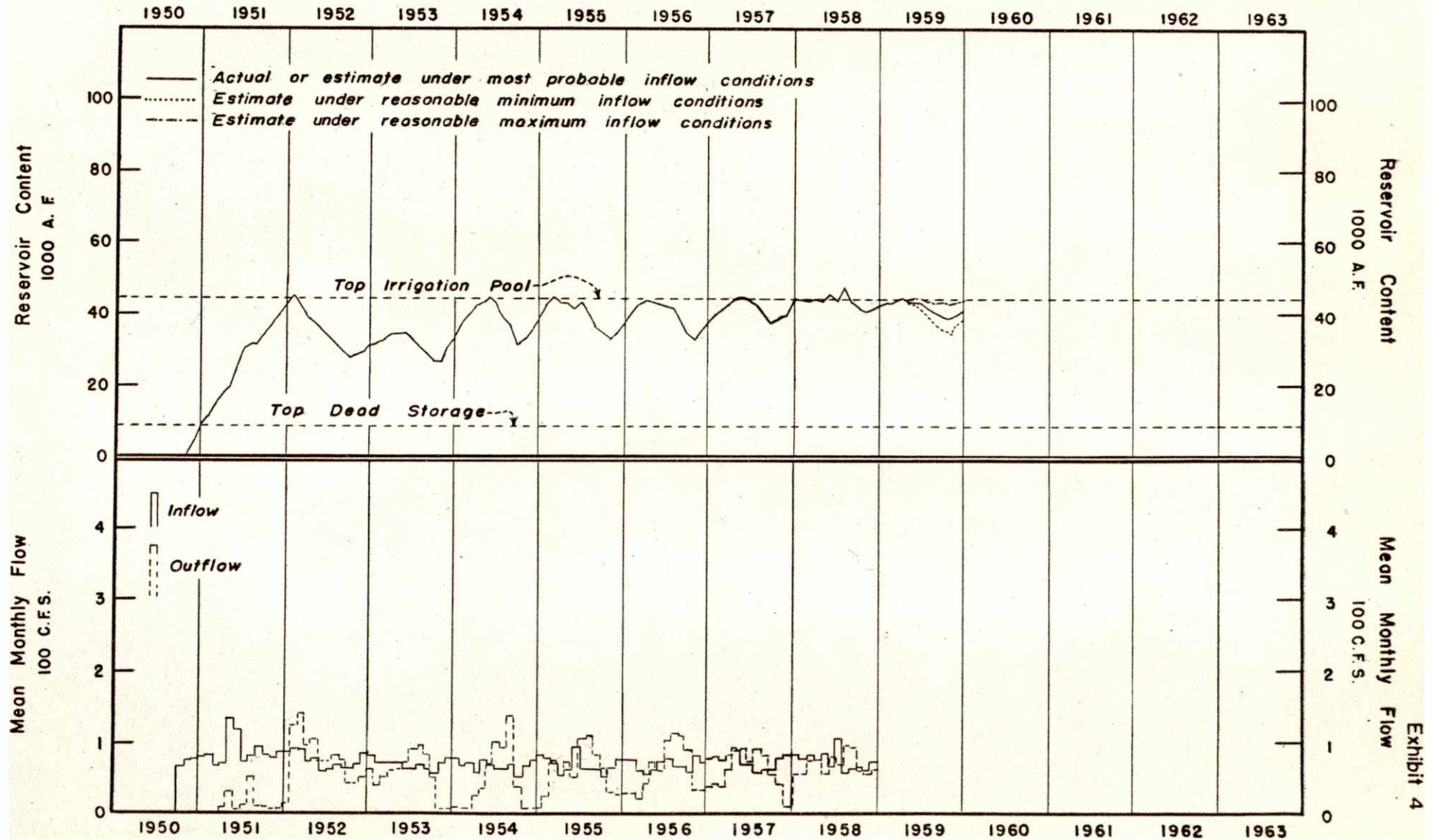




# SWANSON LAKE OPERATION HYDROGRAPHS

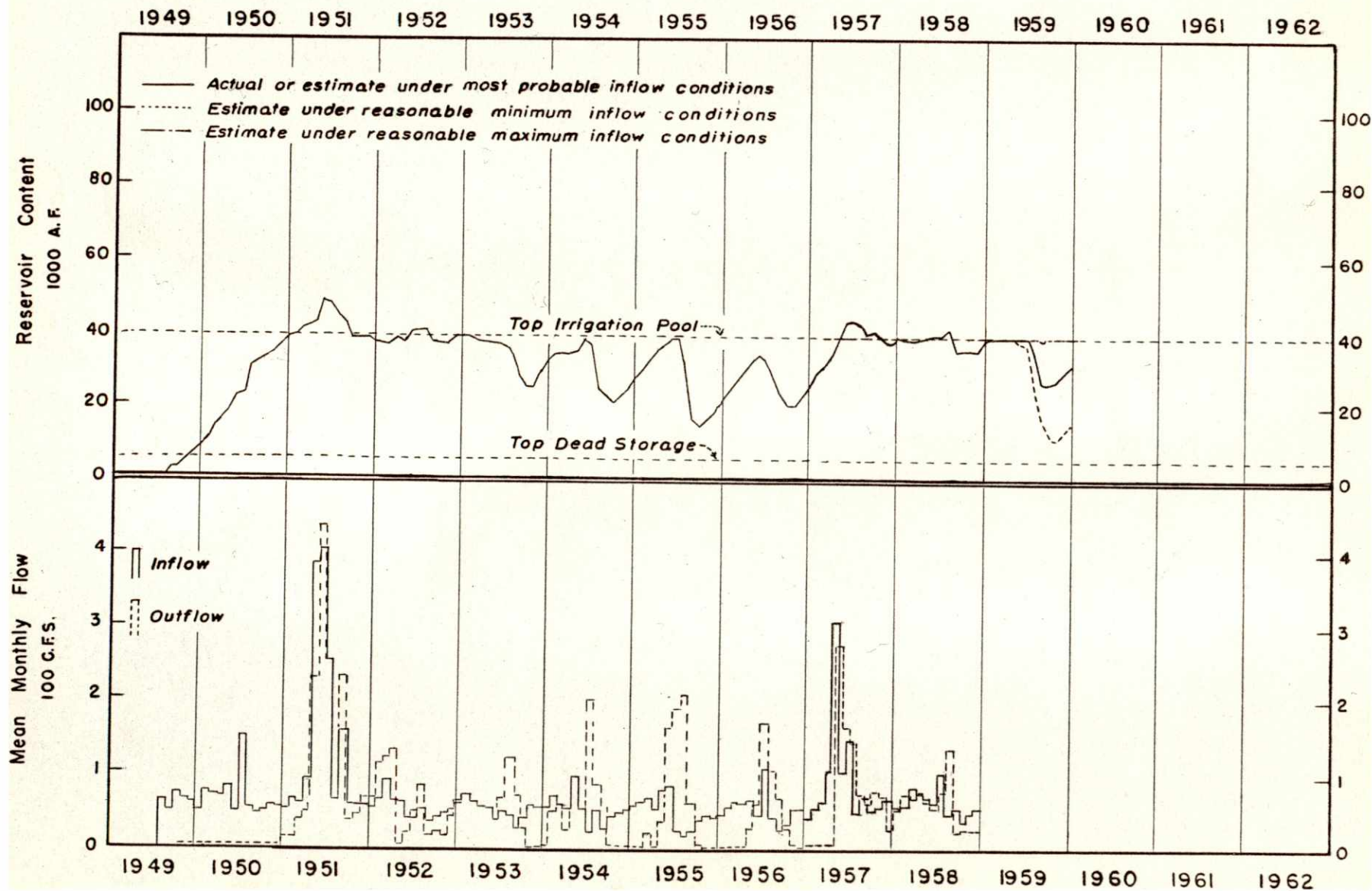


# ENDERS RESERVOIR OPERATION HYDROGRAPHS



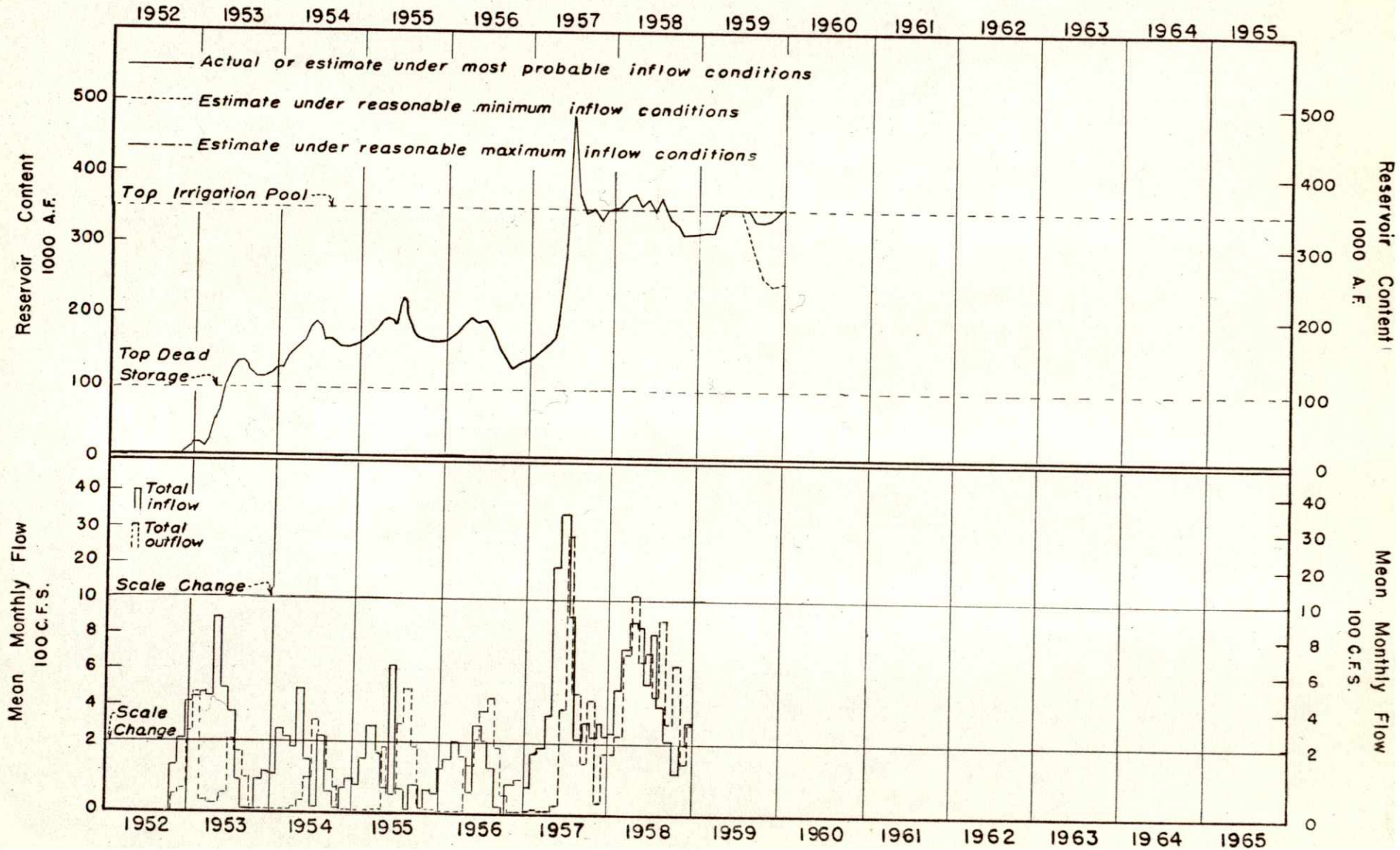


# HARRY STRUNK LAKE OPERATION HYDROGRAPHS



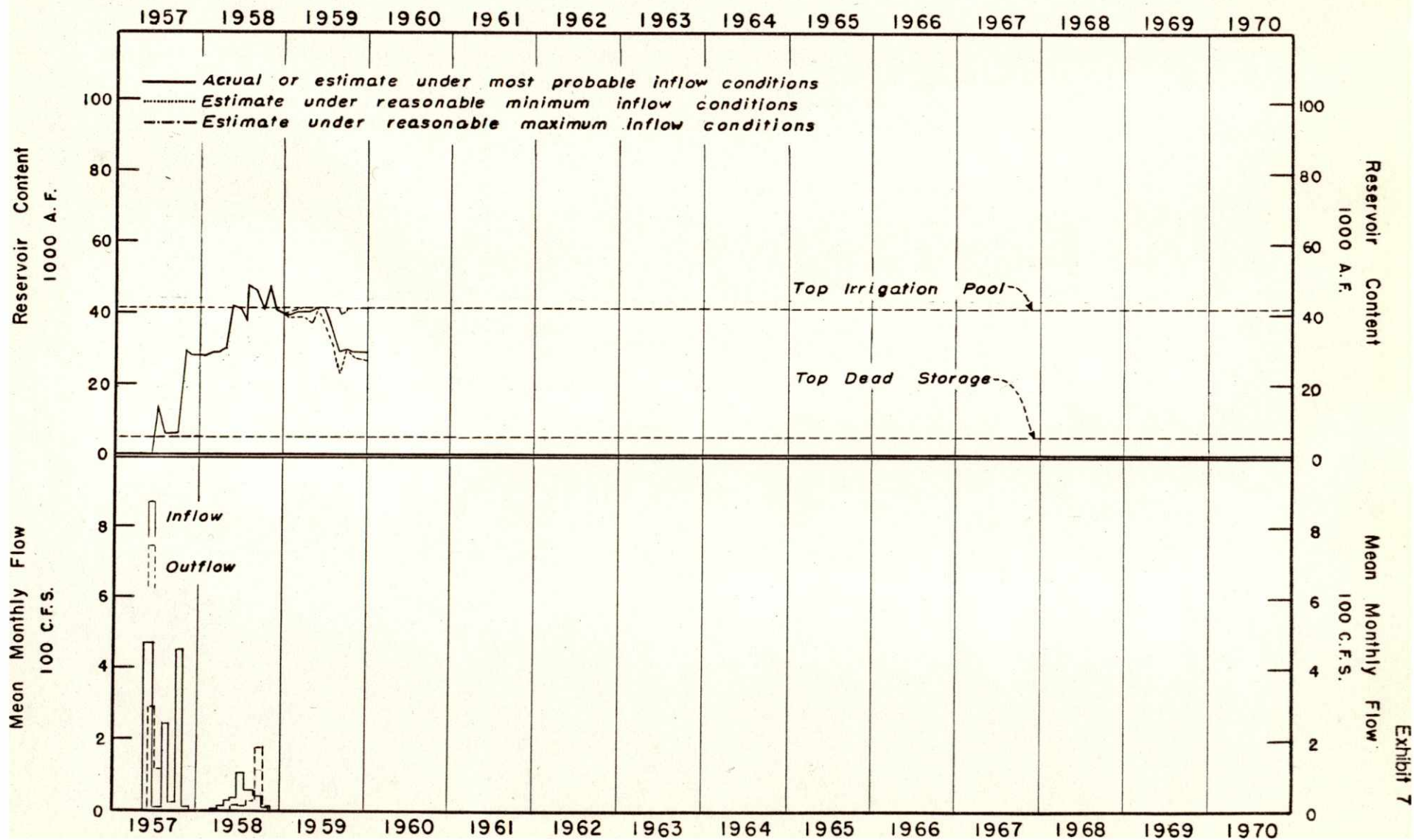
# HARLAN COUNTY RESERVOIR OPERATION HYDROGRAPHS

23

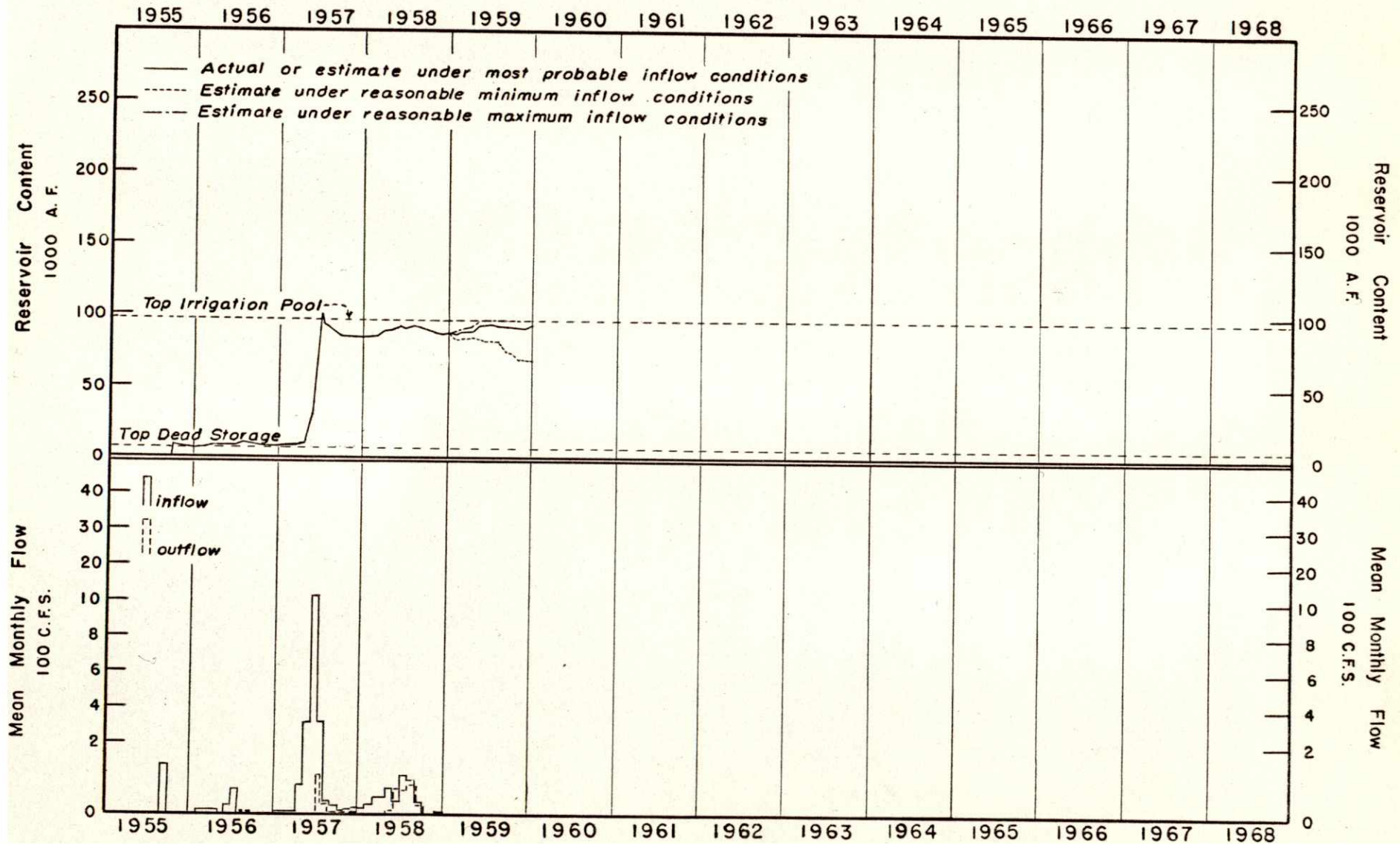




# LOVEWELL RESERVOIR OPERATION HYDROGRAPHS

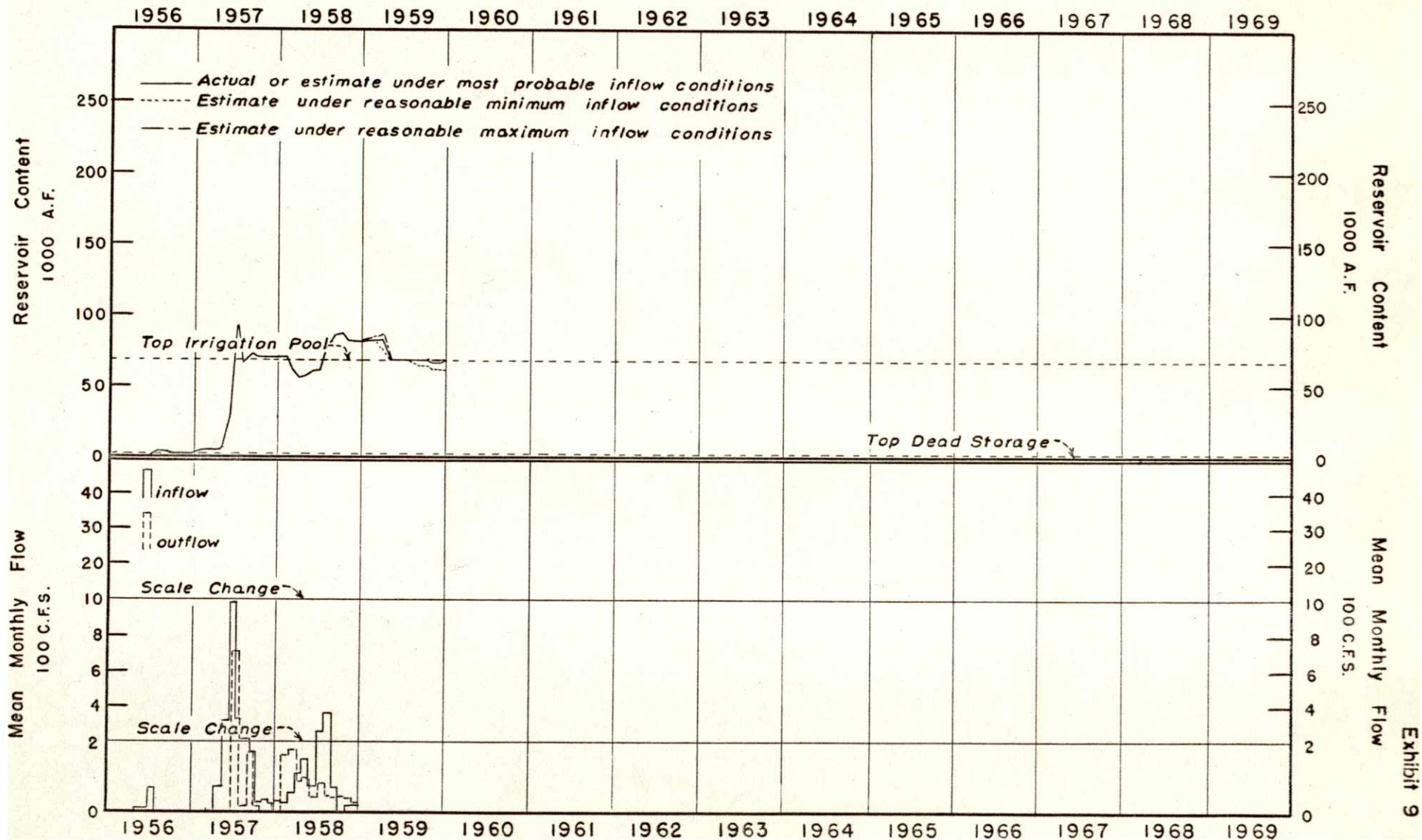


# KIRWIN RESERVOIR OPERATION HYDROGRAPHS

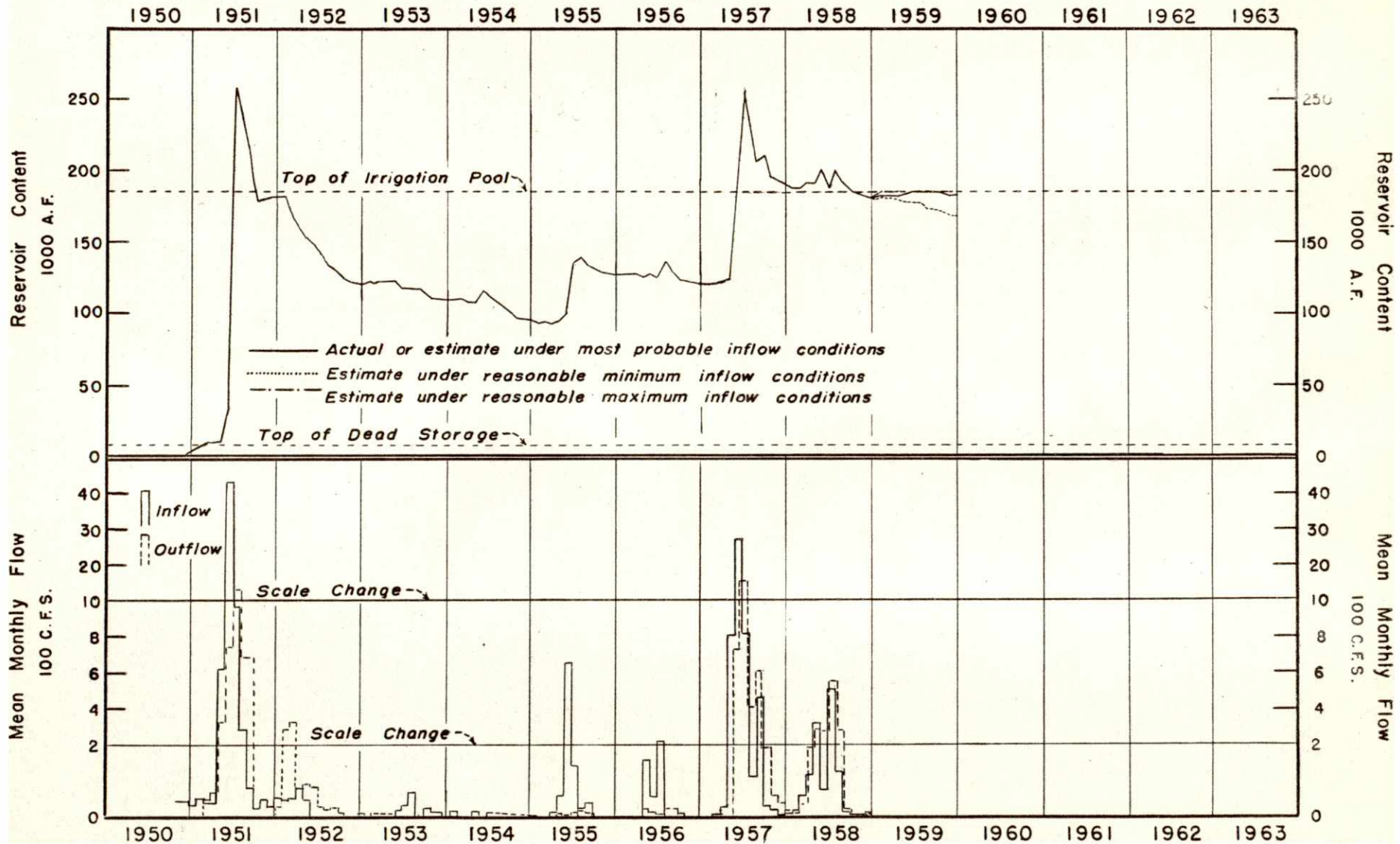




# WEBSTER RESERVOIR OPERATION HYDROGRAPHS



# CEDAR BLUFF RESERVOIR OPERATION HYDROGRAPHS





ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

Exhibit 11

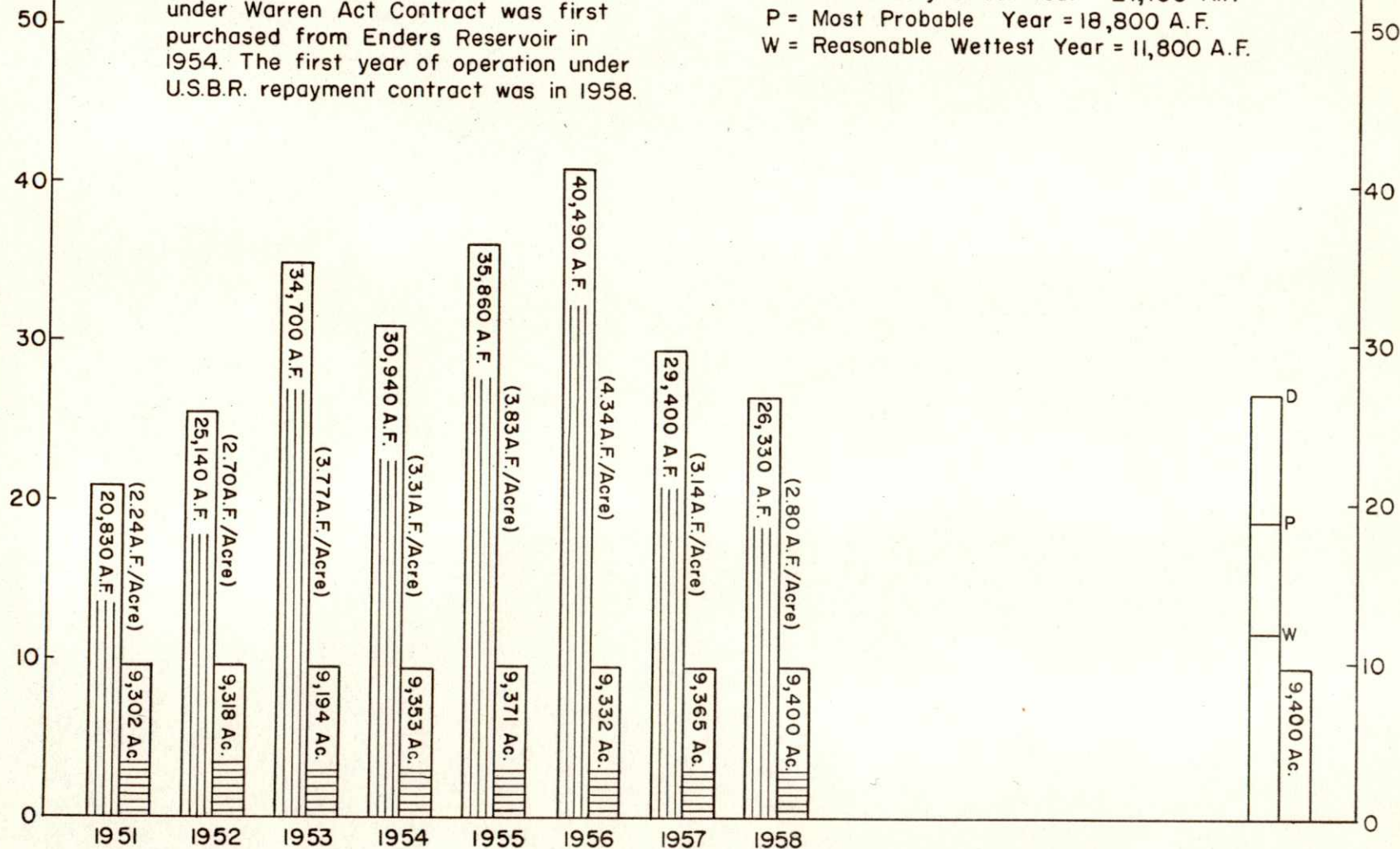
NOTE: Culbertson Canal has been in operation since the 1890's. Supplemental water under Warren Act Contract was first purchased from Enders Reservoir in 1954. The first year of operation under U.S.B.R. repayment contract was in 1958.

ESTIMATED REQUIREMENTS FOR NEXT YEAR

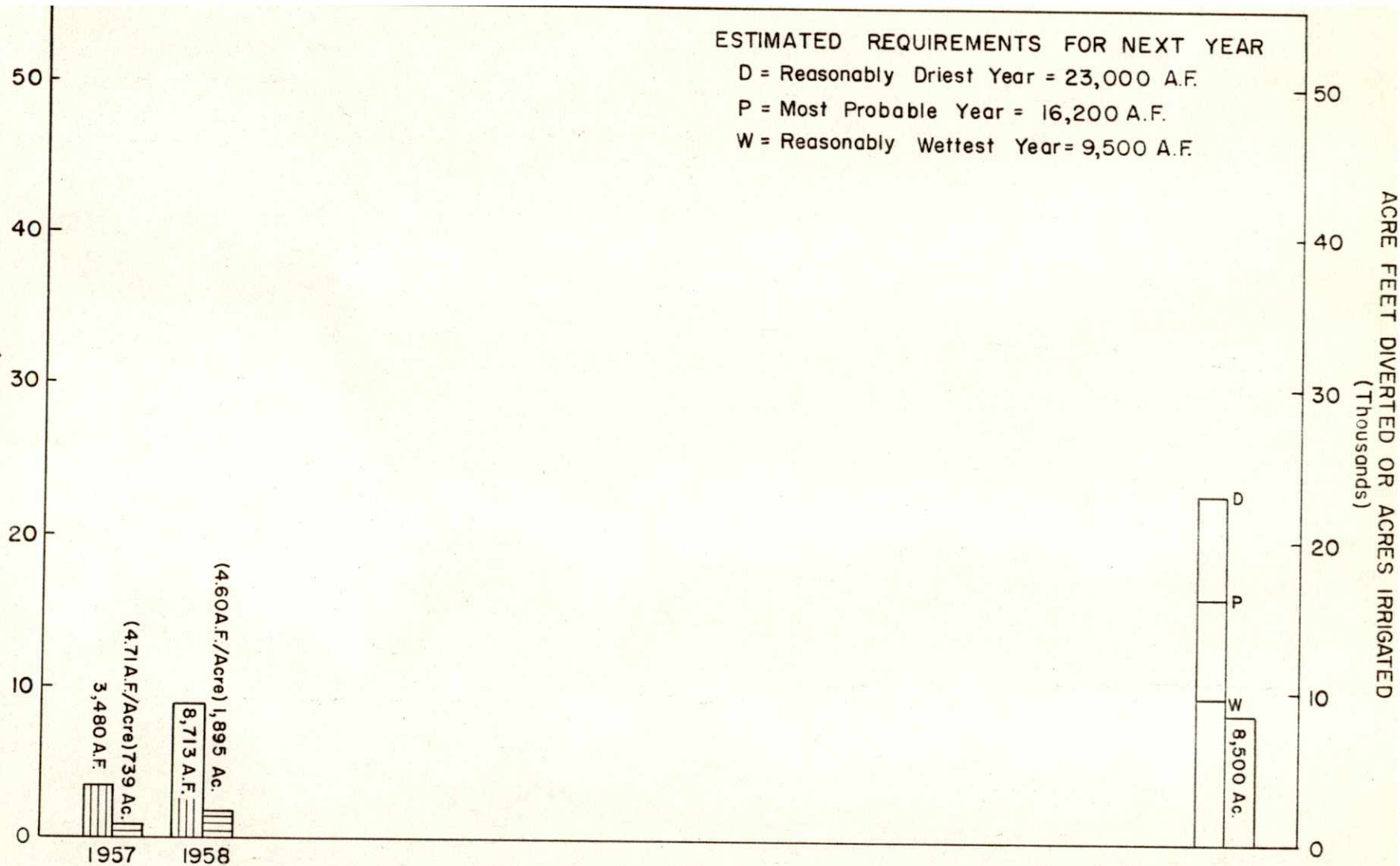
D = Reasonably Driest Year = 27,100 A.F.

P = Most Probable Year = 18,800 A.F.

W = Reasonable Wettest Year = 11,800 A.F.

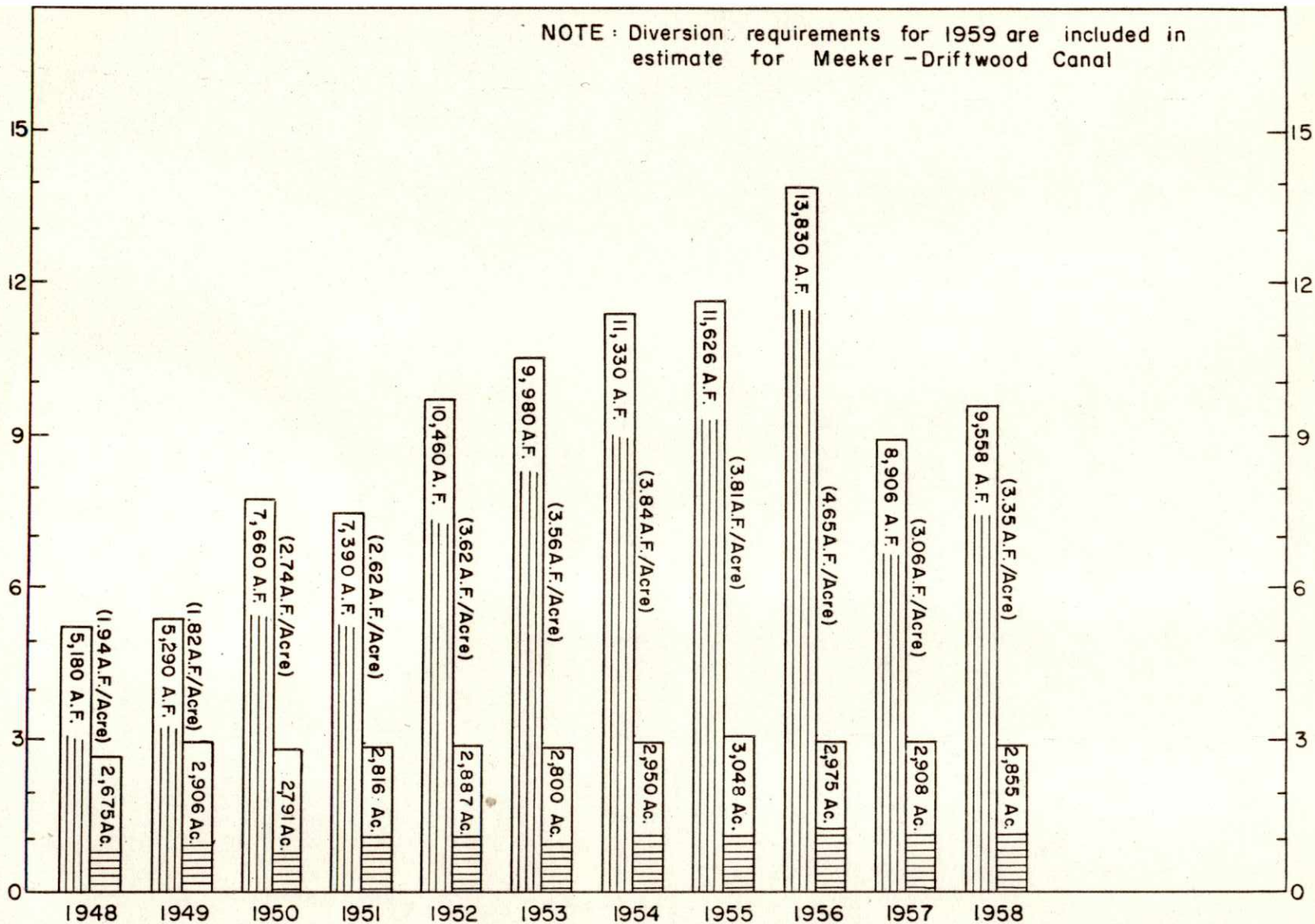


CULBERTSON CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

MEEKER-DRIFTWOOD CANAL DIVERSIONS AND ACRES IRRIGATED

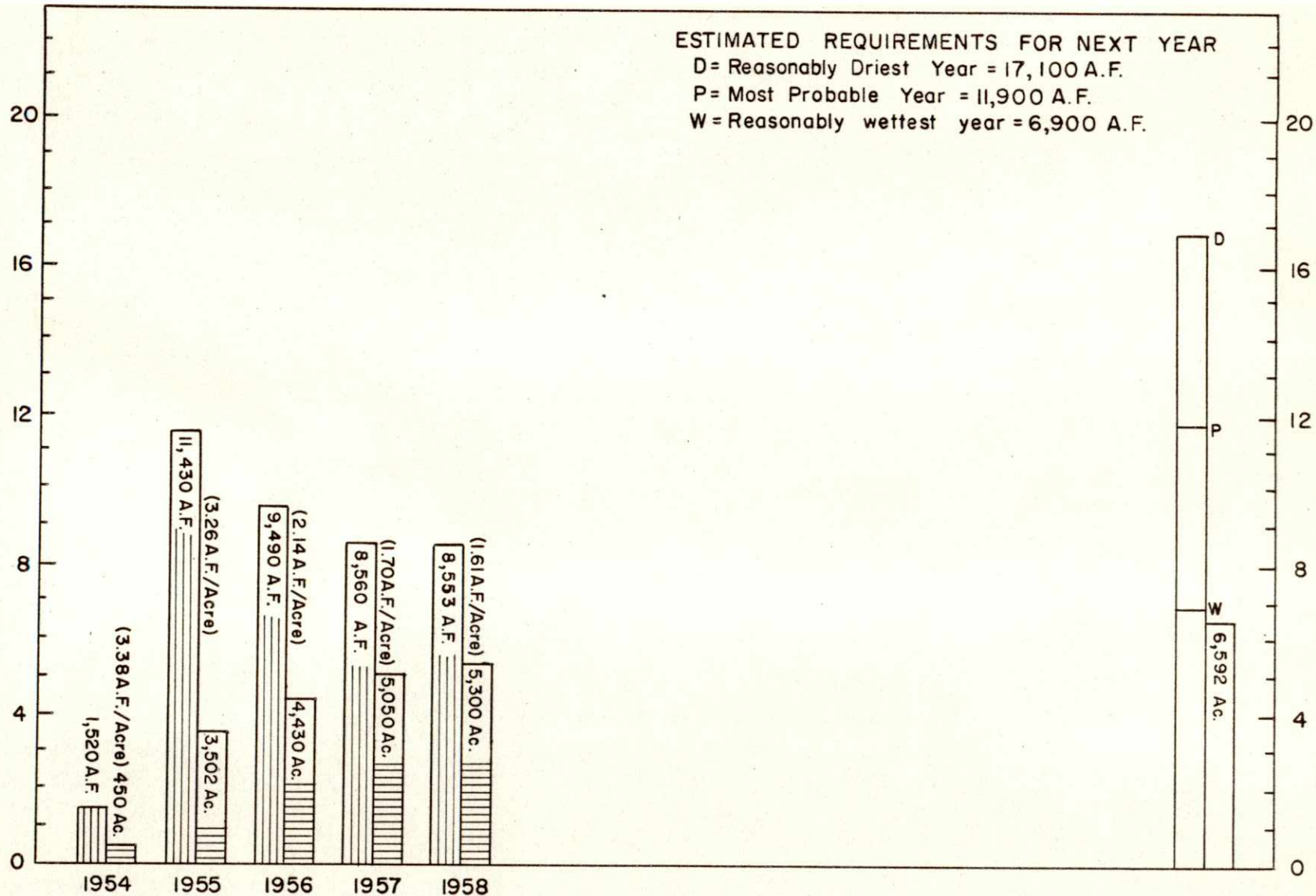


ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

MEEKER CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)  
30

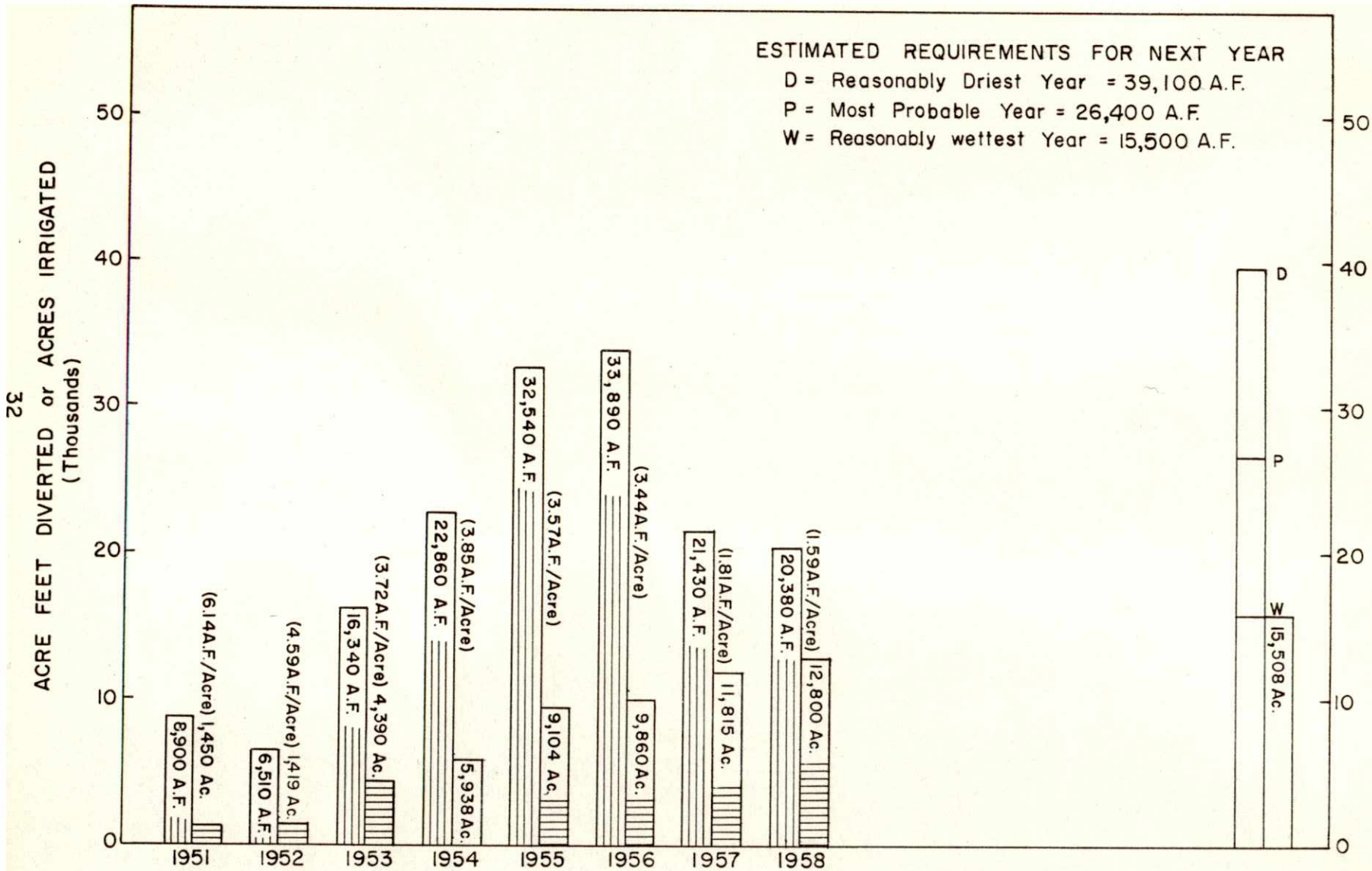
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



BARTLEY CANAL DIVERSION AND ACRES IRRIGATED

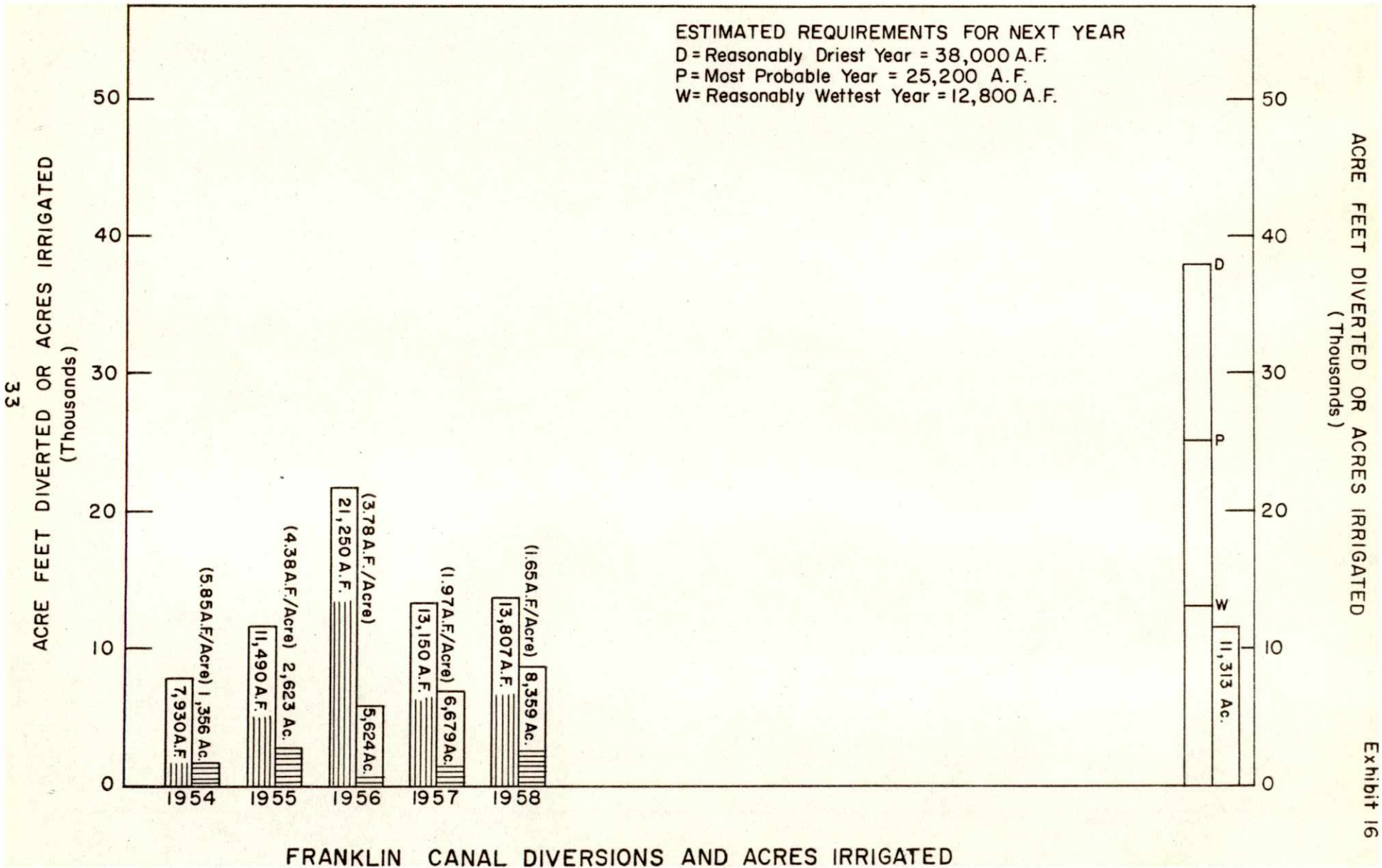
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)





CAMBRIDGE CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED or ACRES IRRIGATED  
(Thousands)





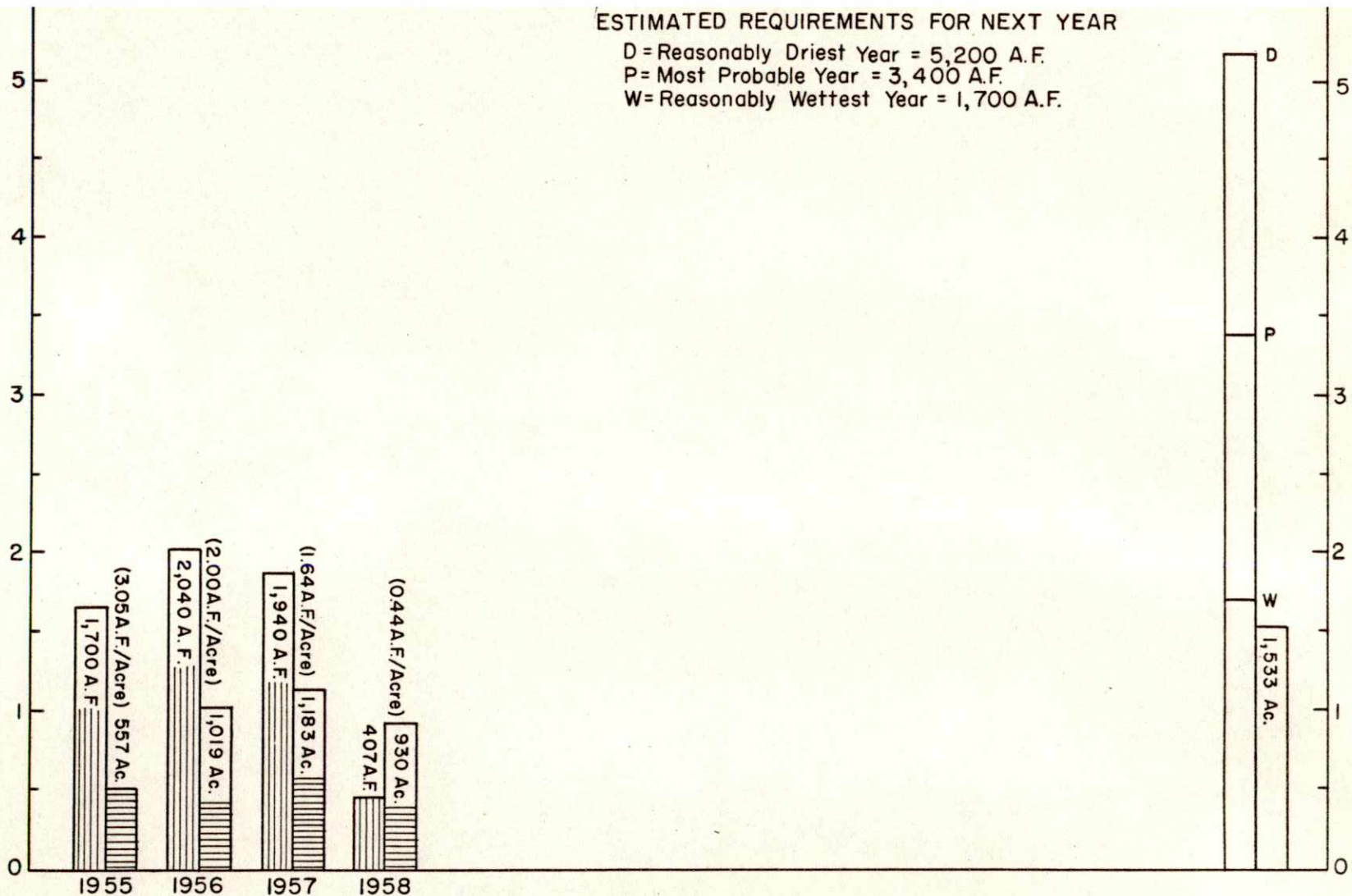
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

## ESTIMATED REQUIREMENTS FOR NEXT YEAR

D = Reasonably Driest Year = 5,200 A.F.

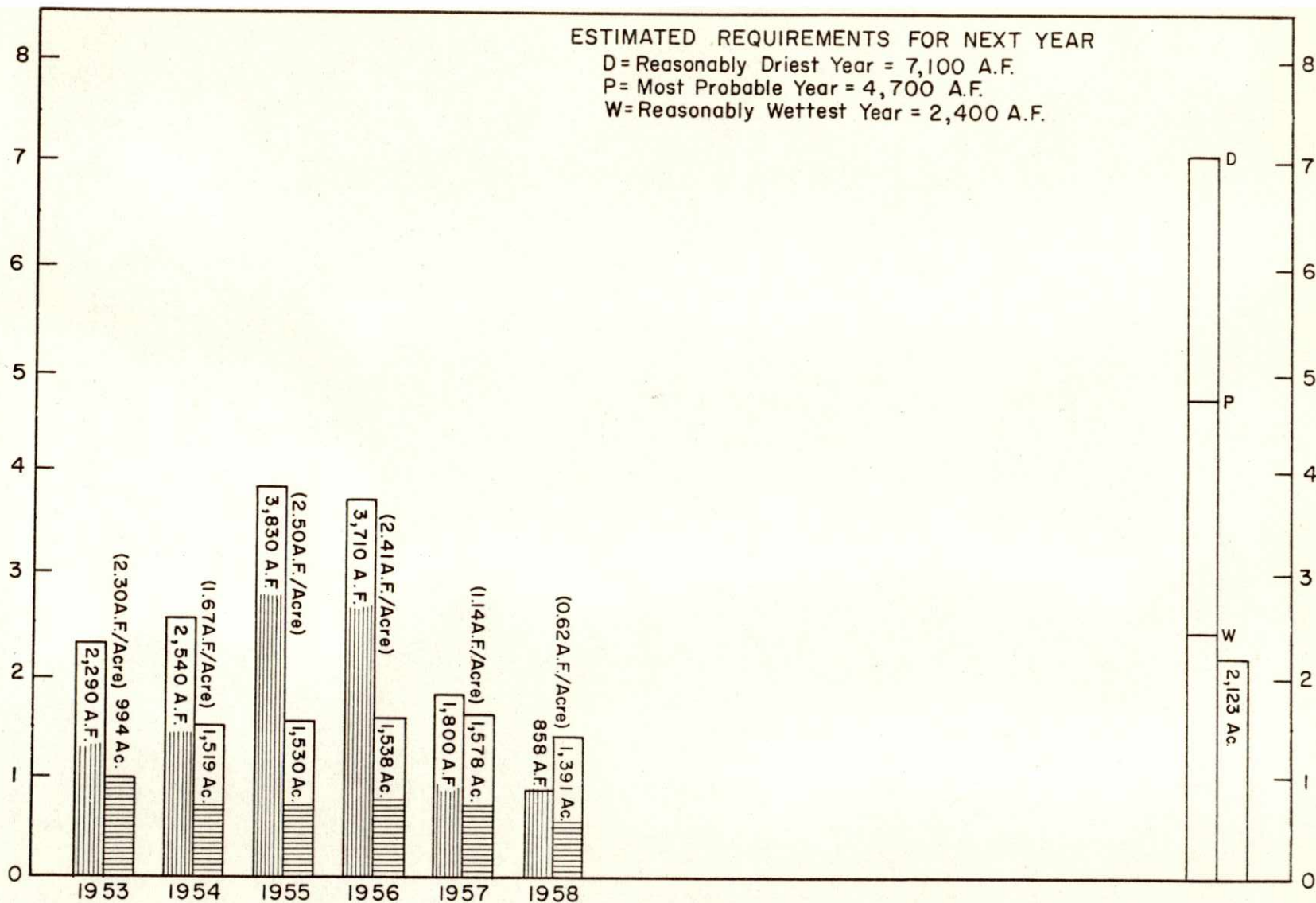
P = Most Probable Year = 3,400 A.F.

W = Reasonably Wettest Year = 1,700 A.F.

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

NAPONEE CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

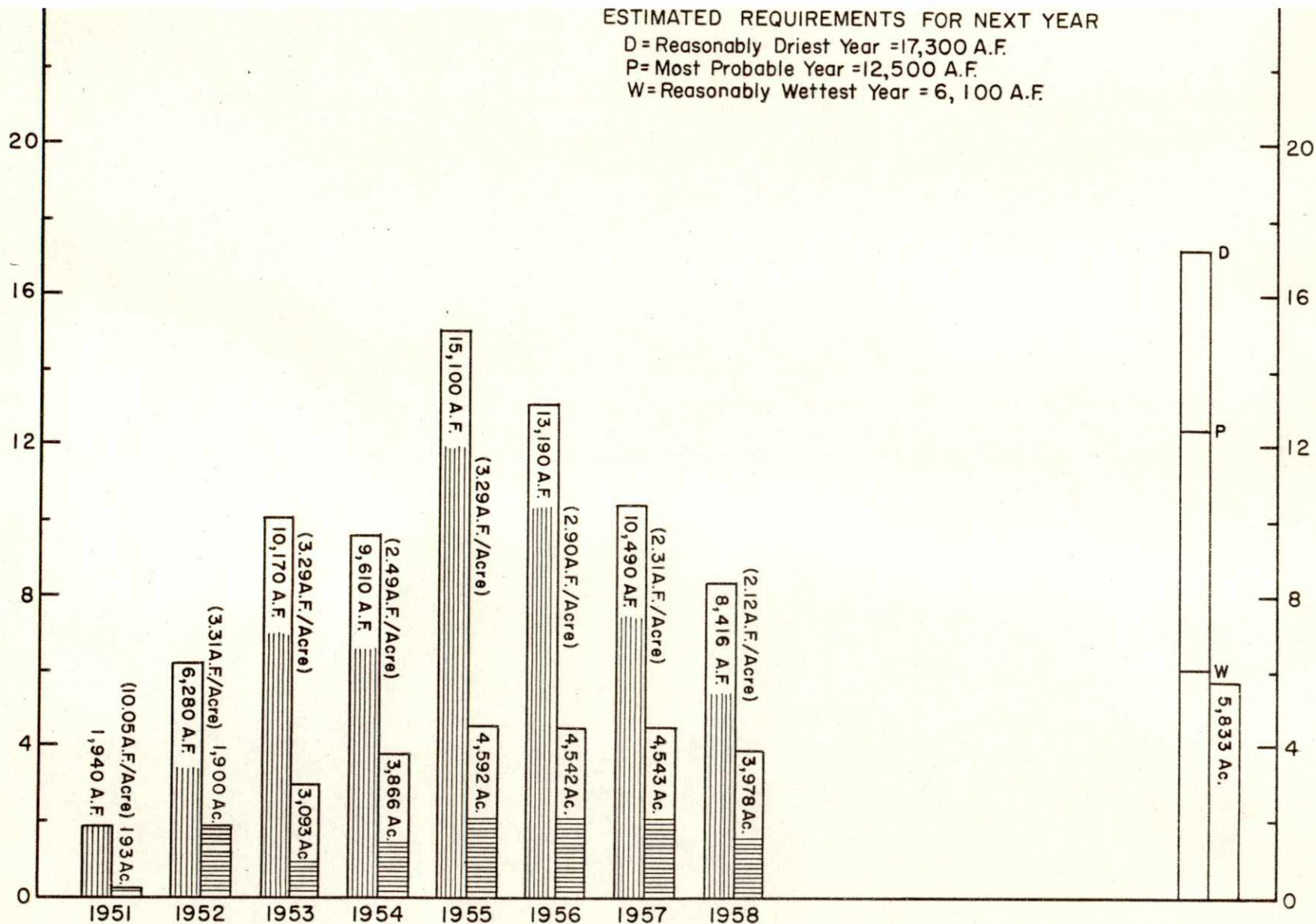


FRANKLIN PUMP CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



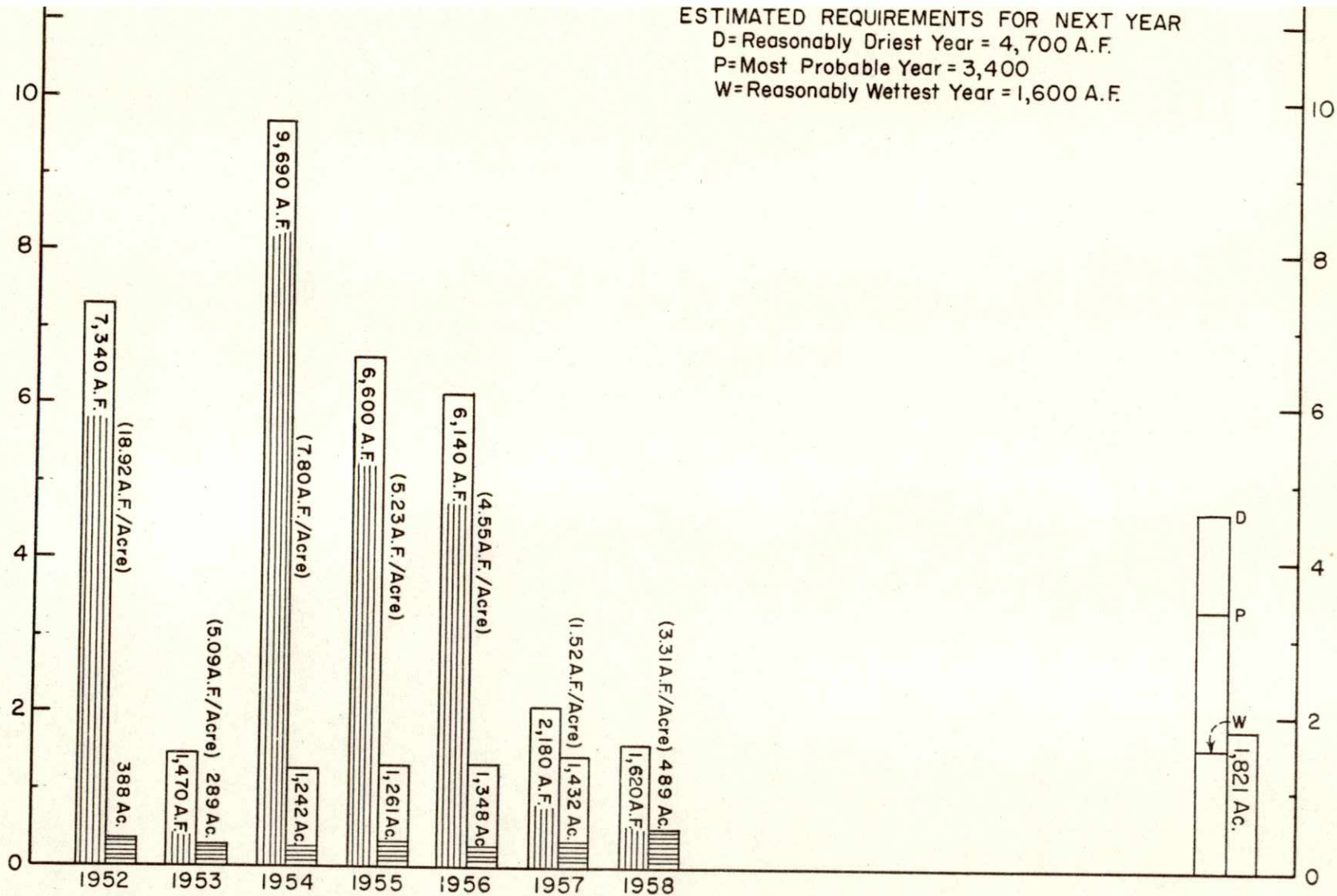
ACER FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)



SUPERIOR CANAL DIVERSIONS AND ACRES IRRIGATED

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

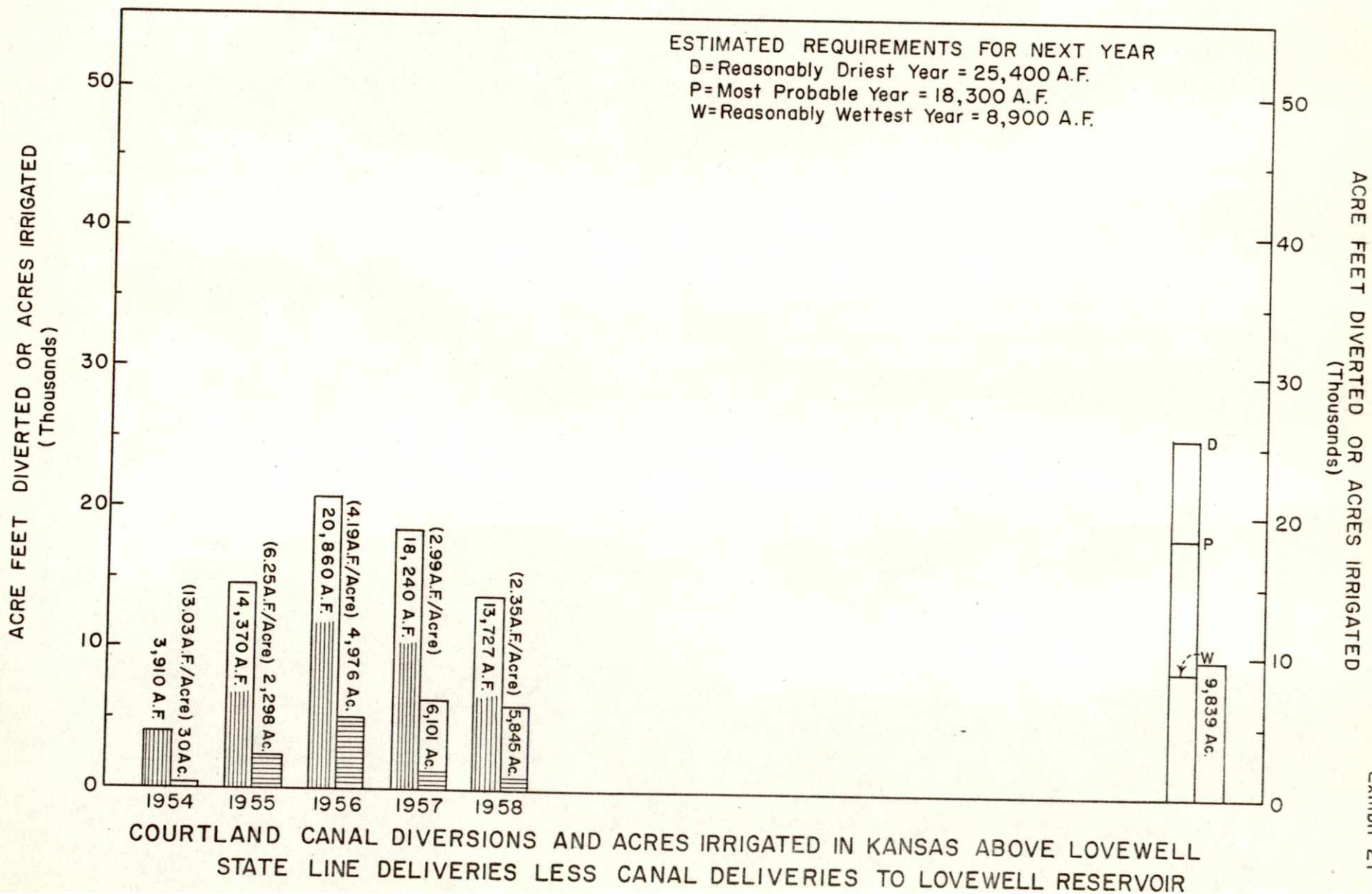
ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

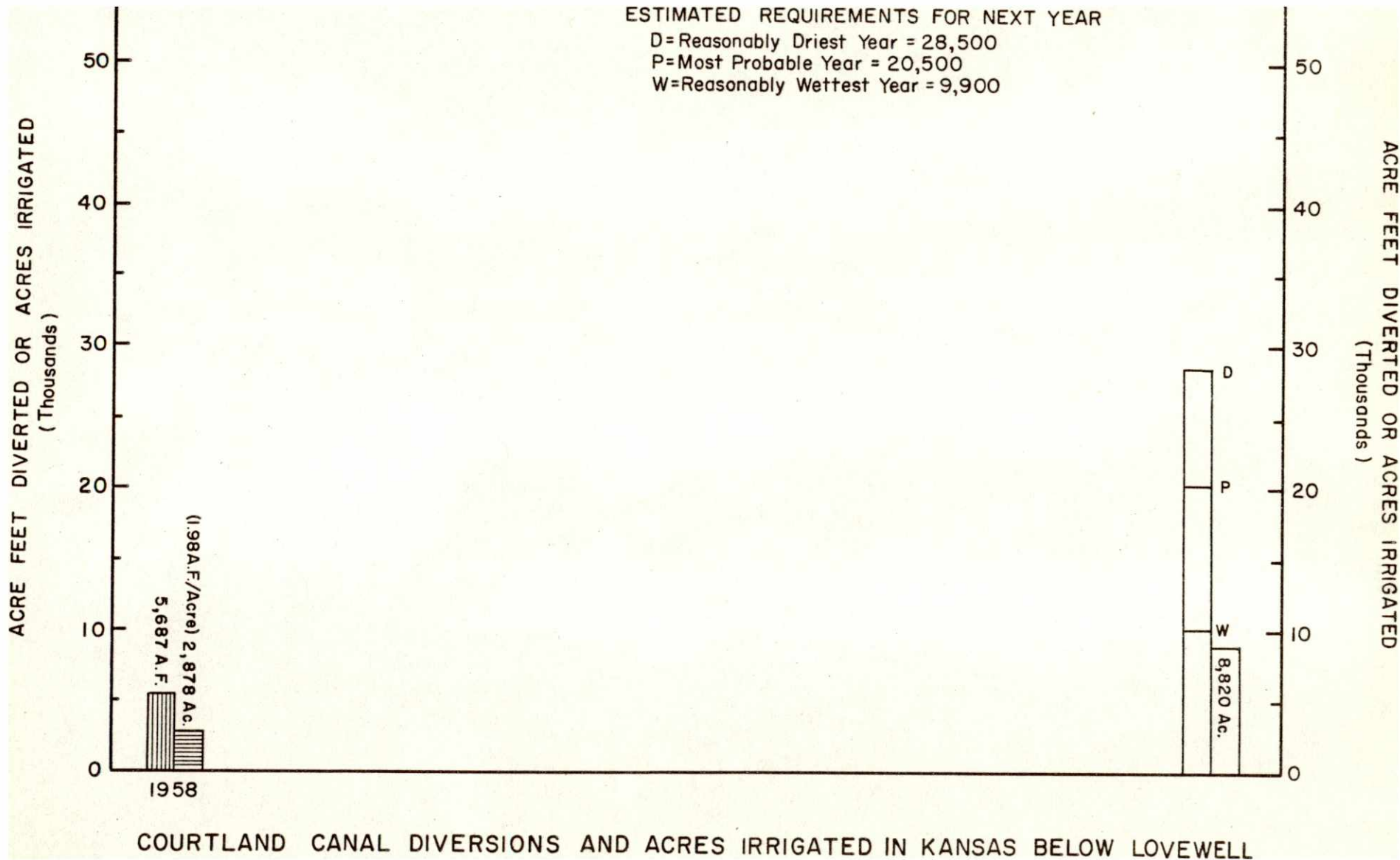


COURTLAND CANAL DIVERSIONS AND ACRES IRRIGATED IN NEBRASKA  
 TOTAL DIVERSIONS LESS FLOW AT NEBR.-KAN. STATE LINE

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)









ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

40

50  
40  
30  
20  
10  
0

1957

5,530 A.F.

(3,84 A.F./Acre) 1,440 Ac.

1958

15,150 A.F.

(3,67 A.F./Acre) 4,127 Ac.

ESTIMATED REQUIREMENTS FOR NEXT YEAR

D= Reasonably Driest Year = 16,000 A.F.

P= Most Probable Year = 10,800 A.F.

W= Reasonably Wettest year = 6,700 A.F.

ACRE FEET DIVERTED OR ACRES IRRIGATED  
(Thousands)

50  
40  
30  
20  
10  
0

D

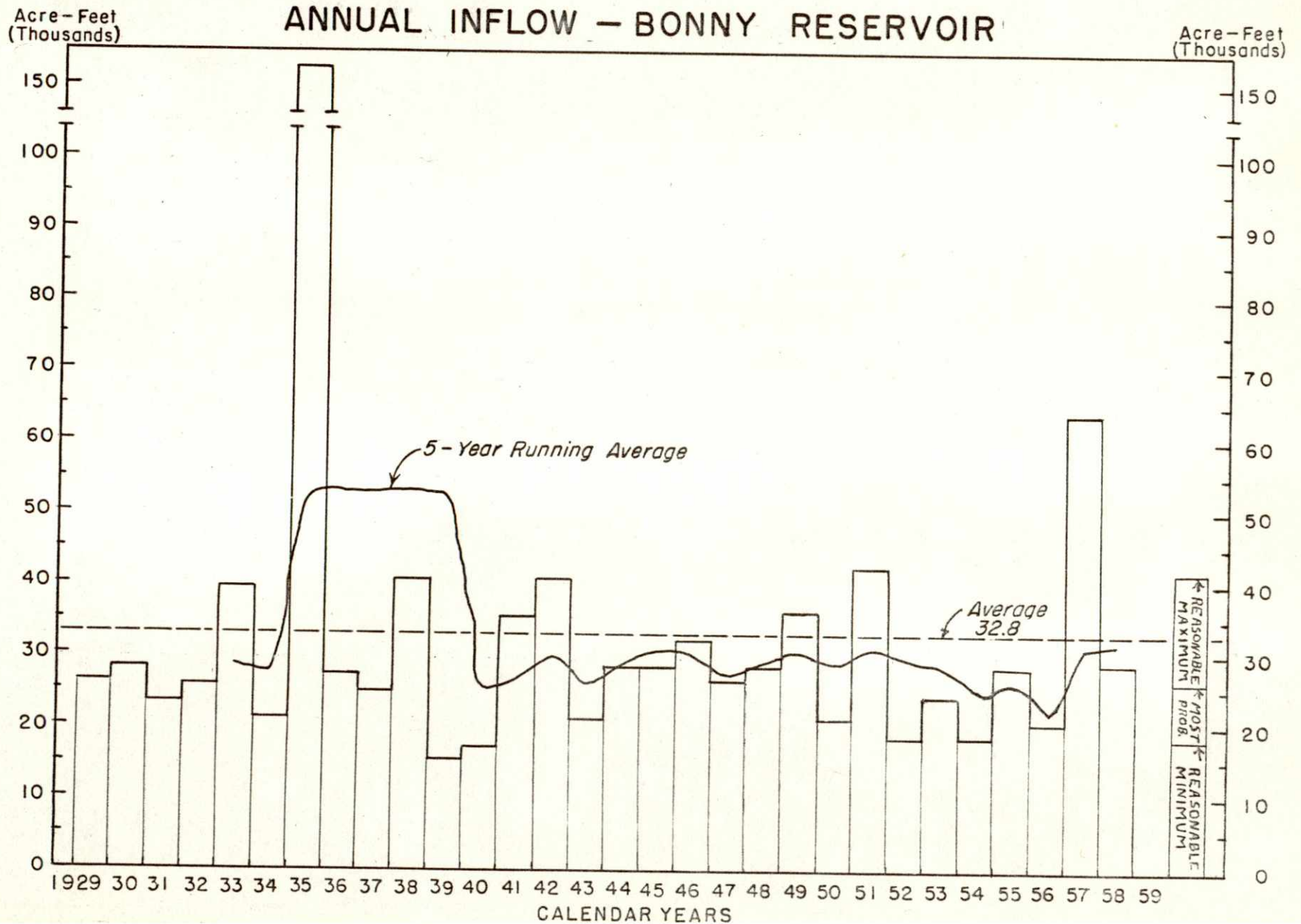
P

W

5,966 Ac.

KIRWIN CANAL DIVERSION AND ACRES IRRIGATED

Exhibit 23

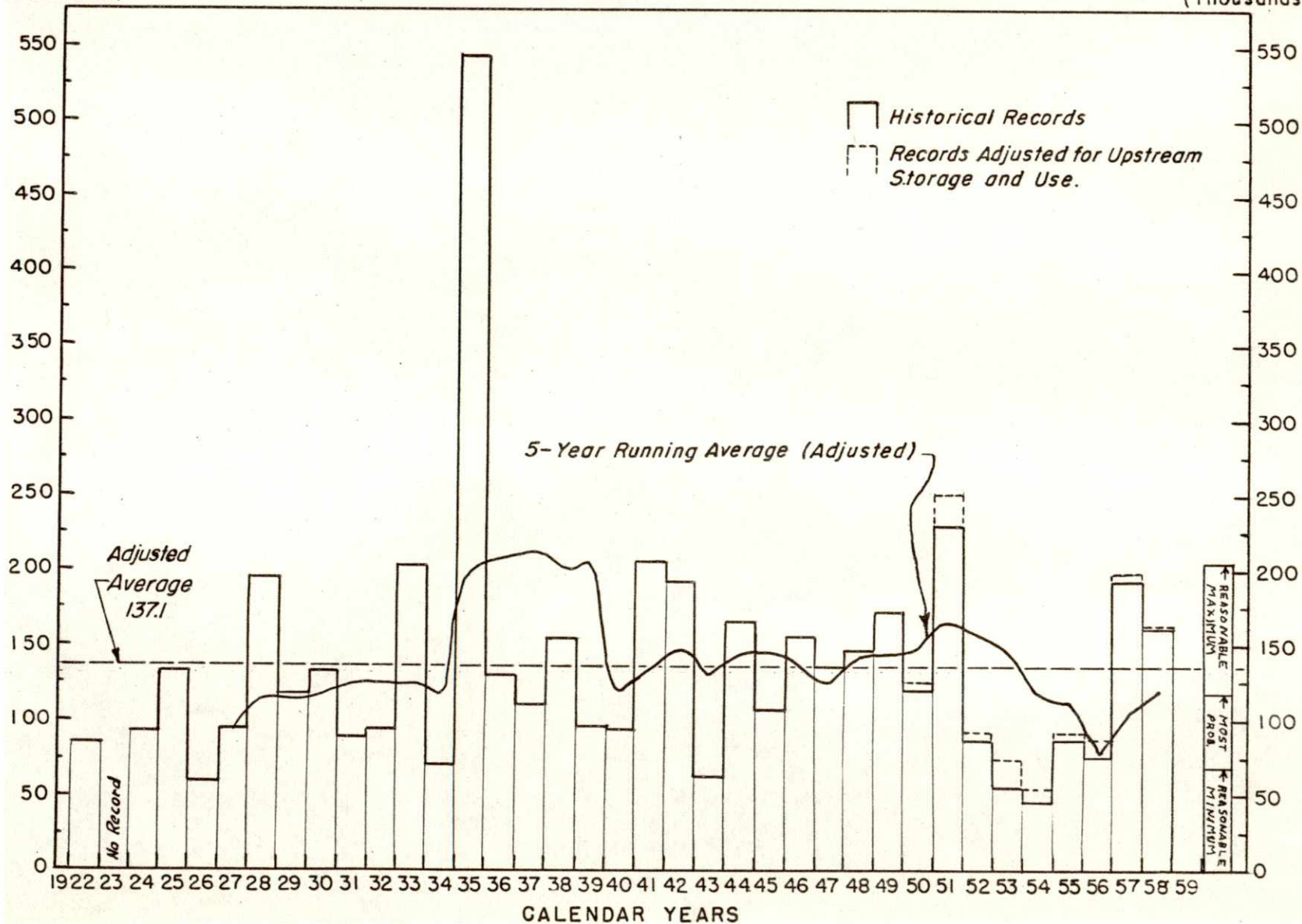




Acre—Feet  
(Thousands)

## ANNUAL INFLOW—SWANSON LAKE

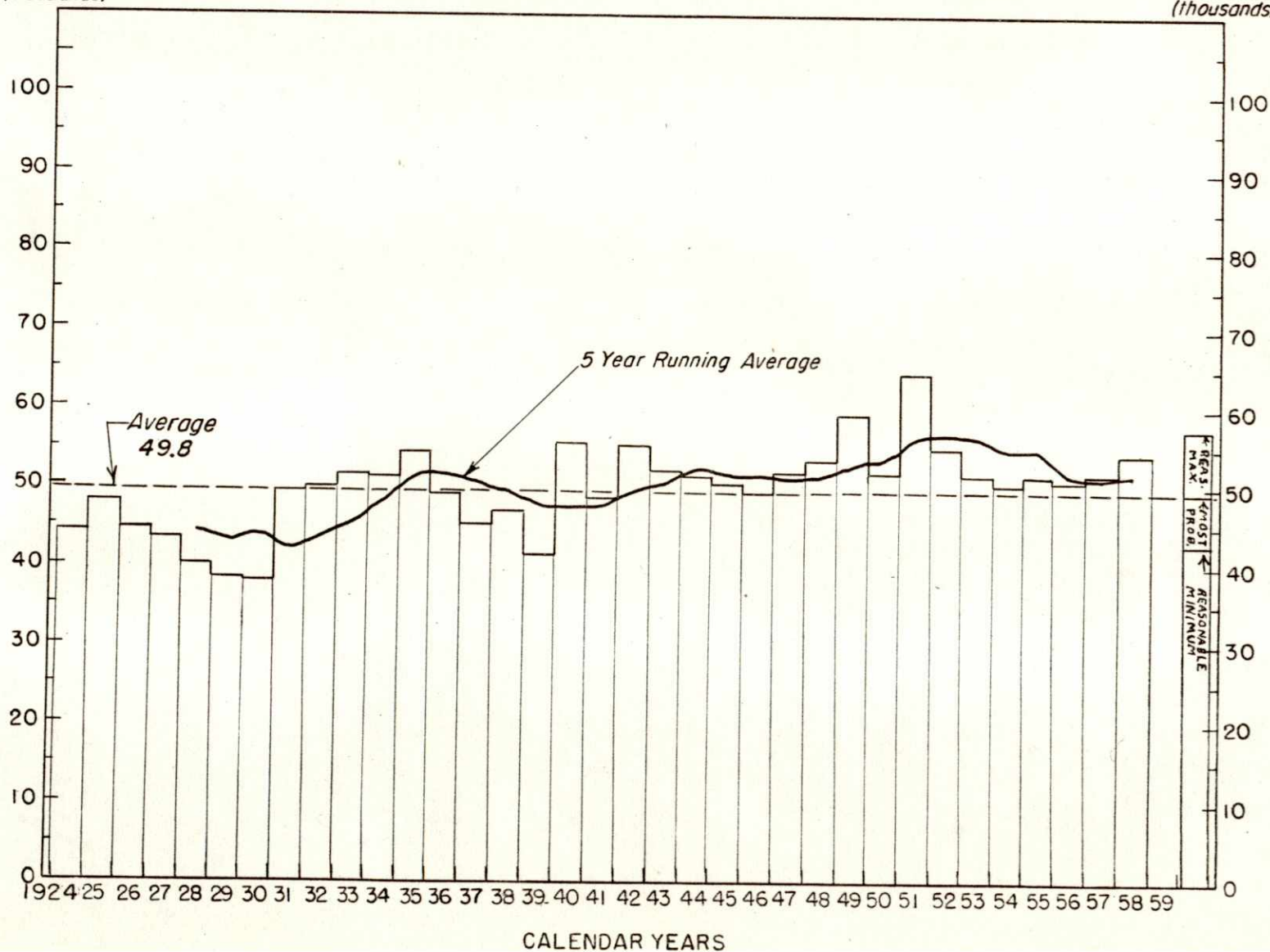
Acre—Feet  
(Thousands)



# ANNUAL INFLOW - ENDERS RESERVOIR

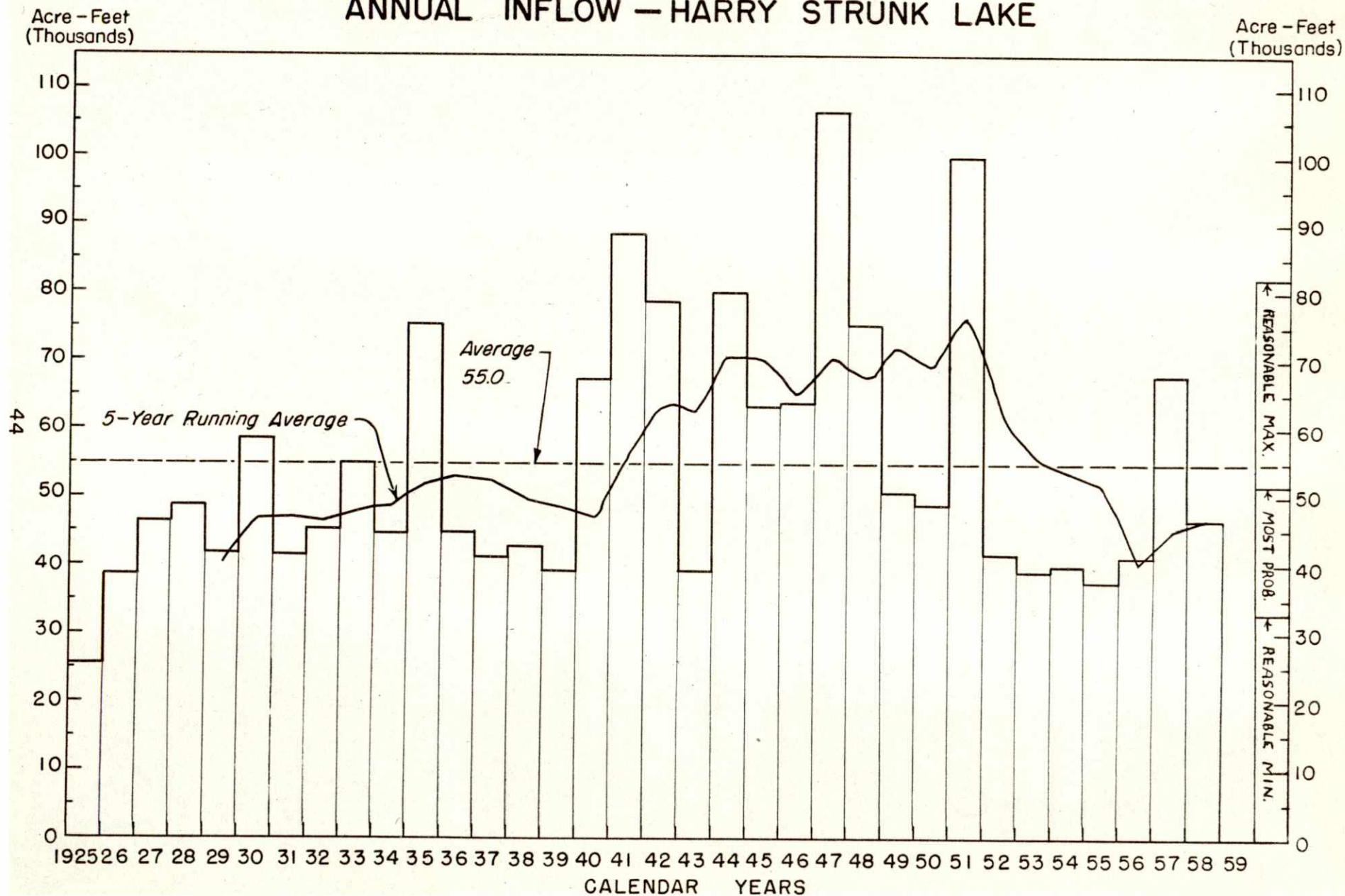
Acre-Feet  
(thousands)

Acre-Feet  
(thousands)





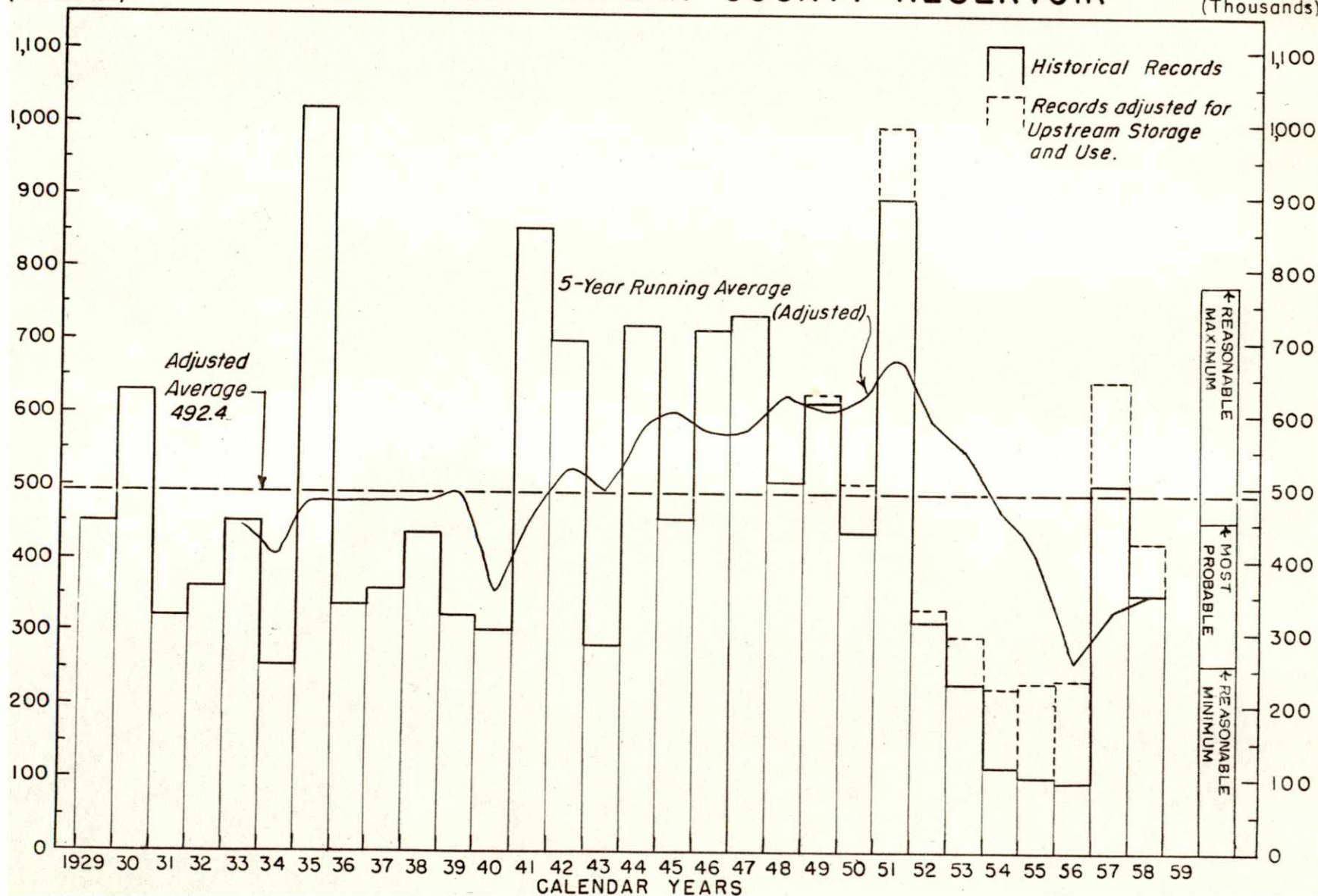
# ANNUAL INFLOW — HARRY STRUNK LAKE



Acre—Feet  
(Thousands)

# ANNUAL INFLOW—HARLAN COUNTY RESERVOIR

Acre—Feet  
(Thousands)

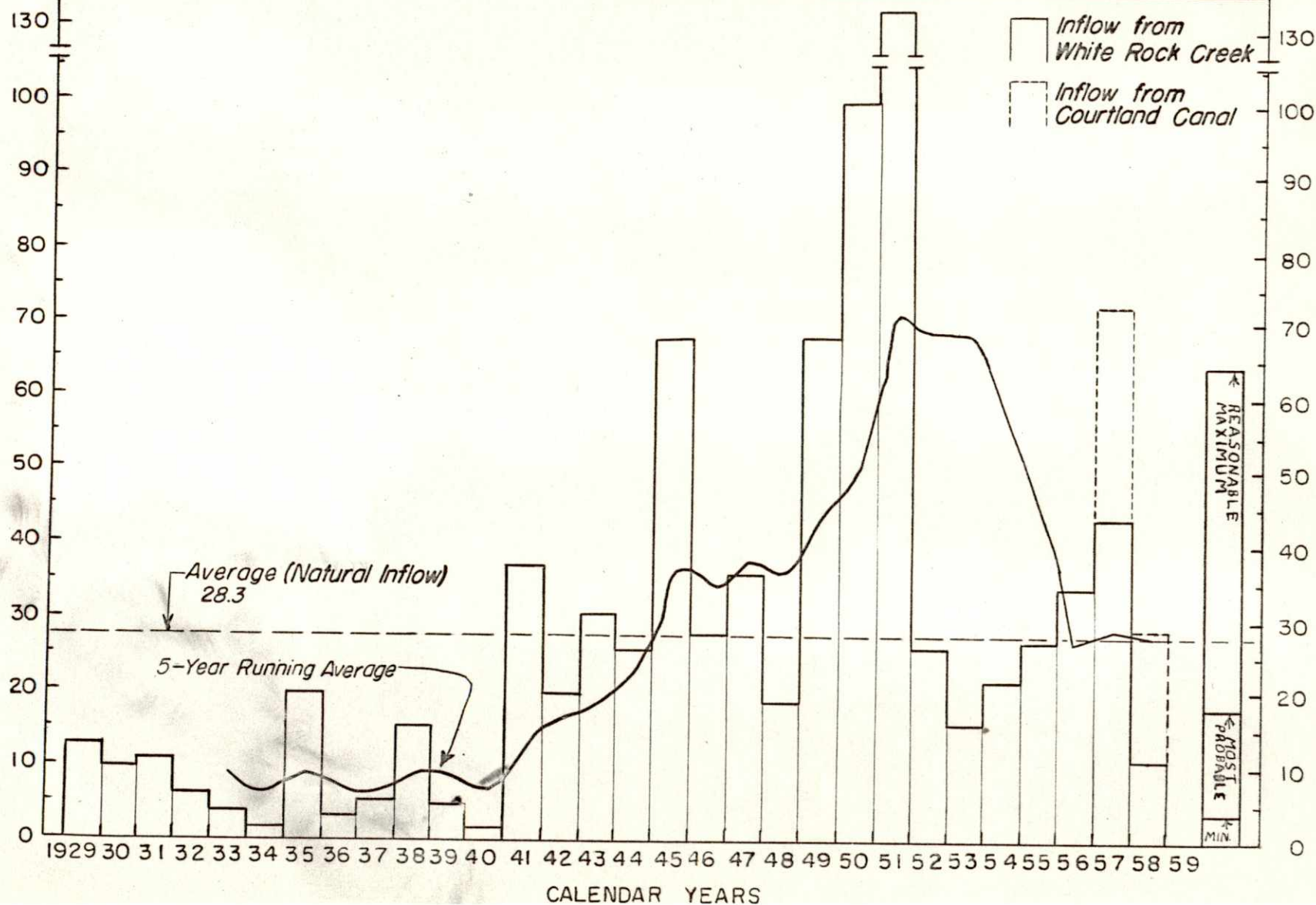




Acre-Feet  
(Thousands)

# ANNUAL INFLOW - LOVEWELL RESERVOIR (WHITE ROCK CREEK)

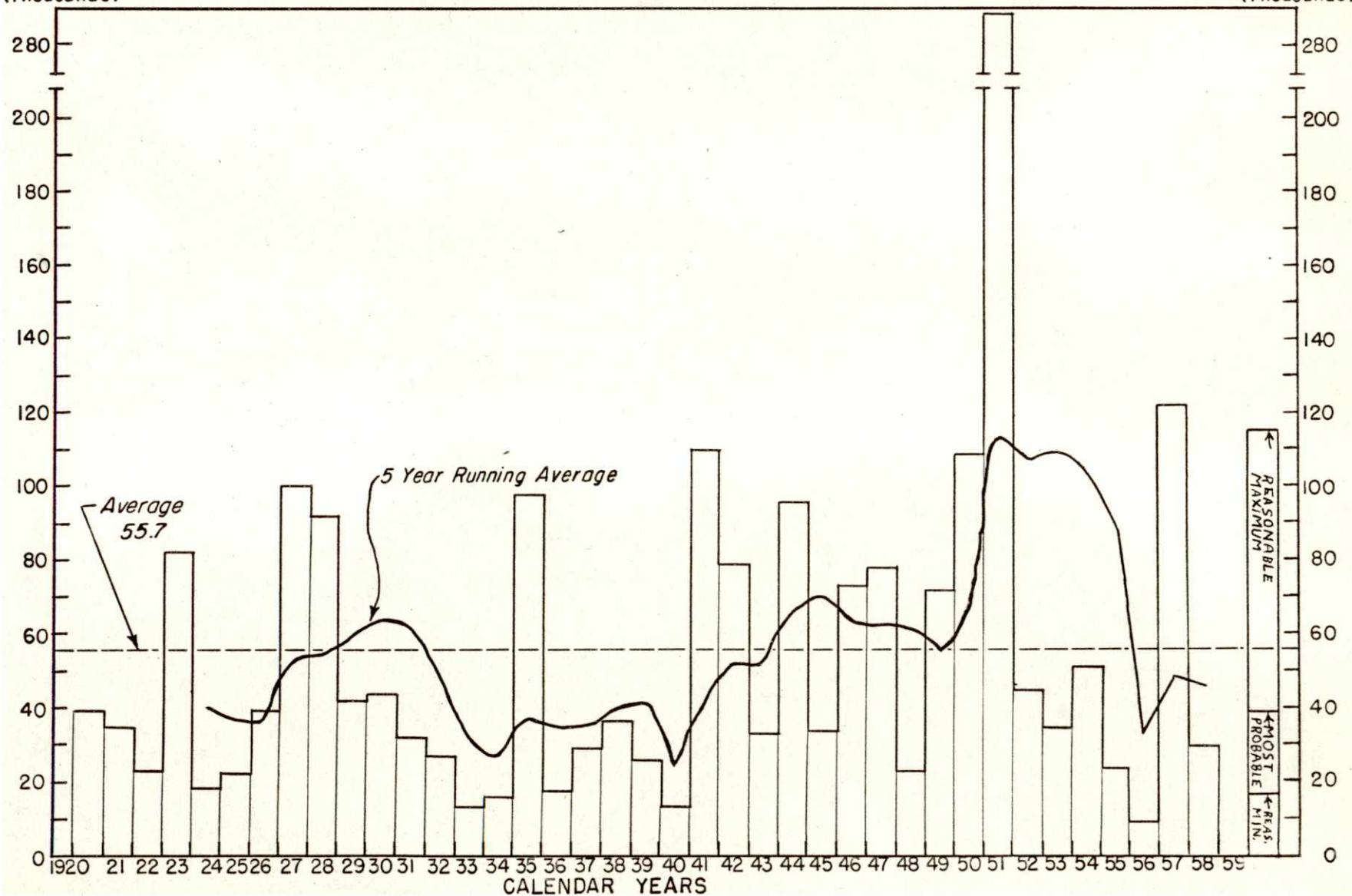
Acre-Feet  
(Thousands)



Acre Feet  
(Thousands)

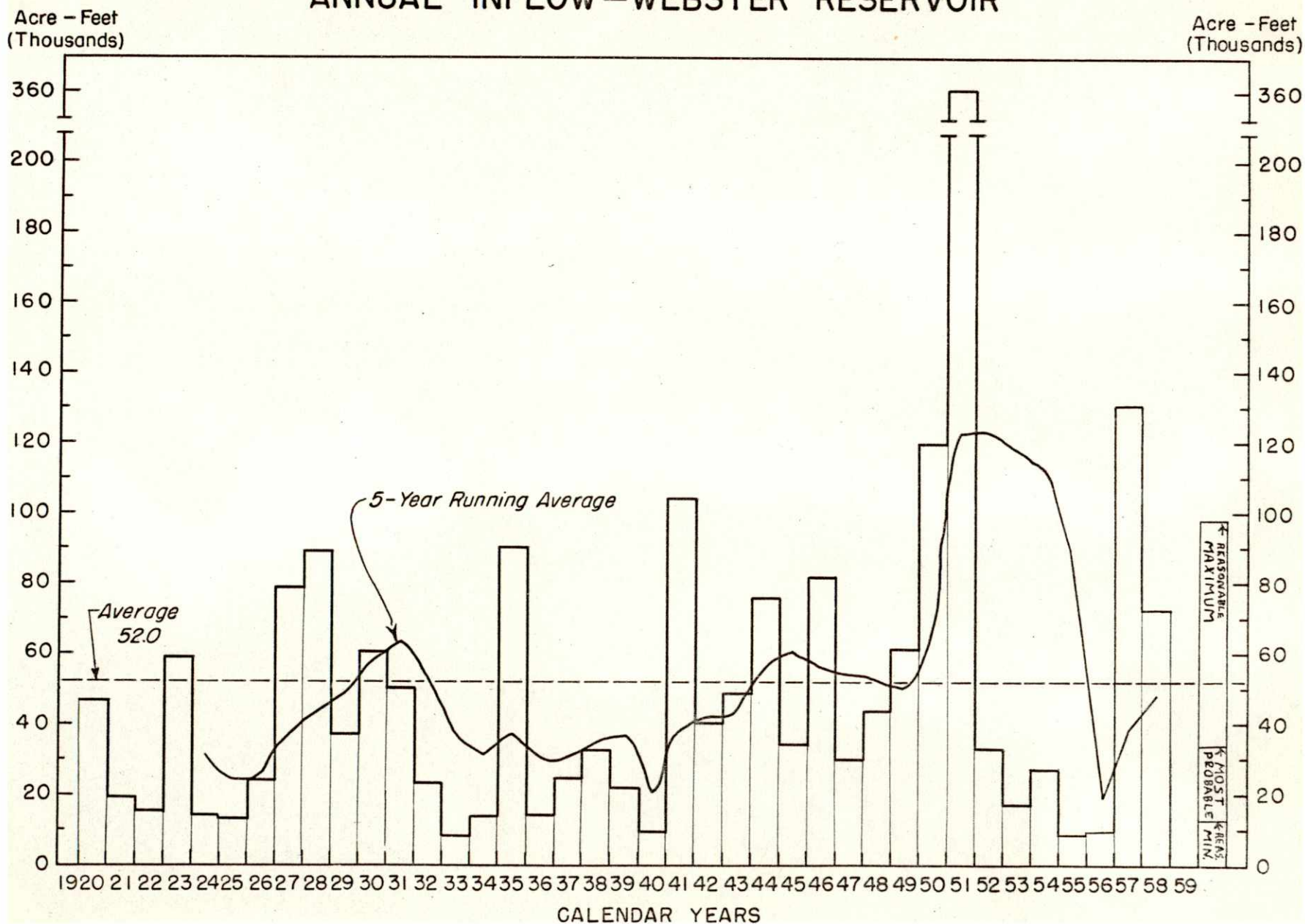
## ANNUAL INFLOW-KIRWIN RESERVOIR

Acre Feet  
(Thousands)





# ANNUAL INFLOW—WEBSTER RESERVOIR



# ANNUAL INFLOW-CEDAR BLUFF RESERVOIR

