ERRATA

Due to a rearrangement of the tabulation of reservoirs in the Rio Grande and Coastal Basins on page A-15 of the Appendix, Table 4 on page 17 is hereby corrected to read by respective columns, as follows:

Rio Grande	6	21,320	6,655,020	2,284,480	8,960,820
Coastal	6	0	102,920	0	102,920

Iron Bridge Dam and Lake Tawakoni--a multipurpose conservation storage reservoir on the Sabine River in Rains, Van Zandt, and Hunt Counties, Texas. (Photograph courtesy of the Sabine River Authority of Texas.)

TEXAS WATER COMMISSION

BULLETIN 6404

CONSERVATION STORAGE RESERVOIRS
IN TEXAS

Some Aspects and Chronology of
Surface-Water Resources Development

By

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FOREWORD

This report was prepared to provide information for students and others interested in but not familiar with the development of surface-water resources in Texas by the construction of conservation storage reservoirs. The definition of every bit of data and the explanation of every consideration of natural and man-made conditions involved with each reservoir and with all reservoirs as a group in Texas were not attempted. The pertinent data for each reservoir and the comparisons presented are the best and most accurate that could be obtained as of October 1, 1963, and within the qualifications stated are reliable for use as may be desired by advanced students, by other agencies, and by consulting hydrologists and engineers. These data and the information provided are in answer to the most frequent requests of this Agency concerning water-resources development by conservation storage reservoirs. A further purpose of this report is to correct some apparent misunderstandings of the role of reservoirs in supplying water for beneficial uses and their ability to provide a portion of their capacity as a water supply during extended drought. A brief discussion on the purposes for which reservoirs are constructed has been included to assist in answering numerous questions on this subject.

Although every reasonable effort has been made to prevent the occurrence of errors in the tabulations in this report, the potentiality of error and significant omission in a compilation of this extent is recognized. Information of the discovery of any error or omission considered significant by the finder is herewith requested for inclusion in errata as may be necessary and desirable.

TEXAS WATER COMMISSION
John J. Vandertulip
John J. Vandertulip
Chief Engineer

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CONSERVATION STORAGE RESERVOIRS

IN TEXAS

Some Aspects and Chronology of

Surface-Water Resources Development

INTRODUCTION

Some of the many aspects and considerations involved with the development and use of open surface storage reservoirs in Texas for conservation of our water resources to provide dependable supplies of water of adequate quality for beneficial purposes are described in this report. A few natural lakes, and the larger reservoirs created on streams by the construction of dams and at off-channel sites by the construction of embankments to serve man's needs, are chronicled herein. These large lakes and reservoirs are the ones with 5000 acre-feet or more capacity each. An acre-foot in volume is equal to a depth of 1 foot on an acre and equal to 325,851 US gallons. There are several hundred thousands of surface storage reservoirs in Texas, ranging in size from a fractional acre-foot to several million acre-feet in capacity, which are depended on to store and supply water as needed for beneficial uses. Most of these are small reservoirs, commonly referred to as farm ponds and stock tanks, used for domestic and livestock purposes on farms and ranches. These small reservoirs are important to the user and are significant to the State, but the magnitude of their number plus the many other reservoirs ranging in capacity up to 5000 acre-feet precludes their inclusion in this report. The term major reservoir is used generally herein to refer to reservoirs with a storage capacity in excess of 5000 acre-feet. The few exceptions to this definition are noted.

The design and development of conservation storage reservoirs for water supply, and flood-control reservoirs for regulation of floodwaters and downstream protection, encompass the evaluation of many aspects of natural phenomena and consideration of local, areal and other economies. Some of these are explained to a limited degree in the section titled "General Discussion".

Comparative data describing the rate of development, the uses, and some significant relationships concerning reservoirs are contained under the heading "Development of Reservoirs in Texas." Data are included as of January 1 and on October 1, 1963.

Appended to this report is a tabulation of conservation storage reservoirs in Texas with capacity of 5000 acre-feet or more each on October 1, 1963, together with pertinent data and explanations of the related terms as necessary. The reservoirs tabulated are shown in geographical location on the included map.

ACKNOWLEDGEMENTS

The pertinent data on reservoirs tabulated in this report have been compiled from information furnished the Texas Water Commission by Federal agencies, State agencies and municipalities, industries, consulting engineering firms, private consultants in engineering and hydrology, and individuals. The cooperation and assistance of these many sources of information are gratefully acknowledged with particular thanks to personnel in the United States Department of Interior Bureau of Reclamation Area Planning Office and Geological Survey Surface Water District Office in Austin; the Department of Defense, United States Army Corps of Engineers District Offices in Fort Worth, New Orleans, and Tulsa; the Federal Power Commission Regional Office in Fort Worth; the United States Department of Agriculture Soil Conservation Service Offices in Temple and Fort Worth; the Department of State International Boundary and Water Commission, United States Section Offices in El Paso and Laredo; the Texas State Soil Conservation Board in Temple; and the Texas Parks and Wildlife Department in Austin.

PERSONNEL

This report was prepared in Engineering Services, Texas Water Commission, under the general supervision of John J. Vandertulip, Chief Engineer, by Louis L. McDaniels, Research Program Coordinator in the Planning Division, Manton A. Nations, Director. A large part of this work was done by the author in the Surface Water Division (now the Surface Water and Permits Division), Seth D. Breeding, Director. I. G. Janca and Fred A. Godfrey of that Division are especially acknowledged for their assistance in researching basic records in the Commission files and in revising and updating the tabulation of reservoir data. Other personnel, past and present, of this Agency have assisted materially in the compilation and verification of these data.

GENERAL DISCUSSION

Nature Provides

Water--Abundant Yet Scarce

Water, an element essential to the existence of plant and animal life, has existed in the form of moisture vapors, liquids, and solids in the air about, on, and below the surface of Earth since at least the first accounting of time by man, and will doubtlessly continue to exist in total quantities far greater than needed to supply the largest conceivable total water requirements in the future. Even with this abundance, the history of man from the earliest times and his findings by study of prehistoric evidence document the uneven distribution of water and an indefinitely large number of incidents of extreme shortages and excesses in the amounts of water occurring naturally from place to place on Earth. These conditions, known as droughts and floods, have been disastrous in varying degrees to plant and animal life and all civilizations.

Natural Reservoirs

Nature has provided reservoirs for storage of water in its various forms, of which some are helpful and others are restrictive to the development of man and his environment. Natural reservoirs for water in liquid form are provided by the oceans, by surface lakes and other water bodies, and by underground formations. In a solid form, water is stored naturally in the polar icecaps, in glaciers, and in seasonal ice formations and snow deposits on ground and water surfaces at high altitudes and in the various climatic zones varying with seasonal influence. Natural reservoirs for water in the form of moisture vapors are provided by clouds and the air surrounding Earth.

Changes With Time

Some of Earth's water is moving from one natural reservoir to another almost continuously. Water evaporates from the oceans, surface lakes and other water bodies, and from ground and plant surfaces to enter the atmosphere as moisture vapors. Clouds are formed from the moisture vapors, and precipitation from these clouds returns moisture toward Earth as rain, snow, hail, sleet, and mist. A part of this precipitation evaporates in the air while falling to reform as clouds or to disperse as atmospheric vapors. The remainder falls to Earth where some goes into storage again in the liquids and solids reservoirs, some is intercepted by plants, and some is retained in upper soils as moisture to support plant growth from which a part is transpired as vapor into the air. Precipitation goes into storage as a liquid in the oceans and other water bodies again by falling directly thereon, and by flow from streams carrying runoff from land surfaces, and into storage in ground-water reservoirs by infiltration through permeable soils and rocks. Some of the water infiltrating to ground-water reservoirs is returned directly by seepage through soils and by springflow to streams and surface reservoirs for eventual storage in inland lakes and the oceans. Some of the water held in solids storage as ice and snow may be retained for centuries while some is released by seasonal thaws each year or more often to be held in storage in surface lakes and other water bodies, or to flow in streams to other lakes or the oceans, or to infiltrate to ground-water reservoirs, or to evaporate into the atmosphere. The intermingling and interchanging of water in its various forms is a process that has been named the hydrologic cycle.

Man Develops

Water Available and Usable

The variations within the hydrologic cycle with respect to time, place, and magnitude of the occurrence and interchange in water forms has caused man to further develop and to synthesize some of natures reservoirs to prevent where possible the disasters resulting from droughts and floods.

The activity of man has been restricted by and dependent on the availability and extent of a water supply of potable quality. Although the oceans and some other water bodies have contained great volumes of water, man has been restricted in their use because of the large amounts of dissolved minerals. The spread of civilization has generally been to areas where water of acceptable quality was readily available from lakes, streams, springs, and wells; and the degree of habitation has been controlled by the amounts of water available for development as dependable supplies in each area. To develop water resources to supply the water requirements of community development where the time distribution of the water yielded by a source was such that shortages and excesses occurred with respect to needs, man dug reservoirs in the ground and constructed dikes to form surface reservoirs for the storage of waters transported from other areas, and to intercept and impound floodwaters for domestic, livestock, and irrigational uses. Such development has been documented by historians studying the early civilizations in the Mediterranean area and eastward through India. Early in the area now comprising the United States, storage capacities of natural lakes were increased by altering discharge channels, and dams were built on relatively small streams to supply water for power to operate sawmills and gristmills, and to supply water for navigation on streams and canals. Later, but preceding the development of large reservoirs for municipal water supply, some reservoirs were constructed in areas east of the Mississippi River for flood control and in areas west of the Mississippi River for irrigation.

Purposes of Use and Development

During the 20th century, many reservoirs have been constructed in the United States with the trend in design progressing from: single-purpose reservoirs to provide flood control or to supply water for municipalities, industries, irrigation, mining, hydroelectric power, navigation, recreation, quality-of-water regulation, recharge of ground-water reservoirs, or other uses; to multipurpose reservoirs combining two or more of these uses. Particularly in Texas, this development of single-purpose and multipurpose reservoirs has been accelerating in recent years. A tabulation showing purpose of use and other pertinent data for major reservoirs in Texas having conservation storage capacity of 5000 acre-feet or more each is attached to this report as an Appendix.

Man Learns From Nature

In his study of how nature provides water in varying amounts at various places and times, man has observed that some water going into storage in the form of ice and snow during the cold months is later released by melting to flow in streams to areas of need during dry, hot months; and some water going into storage in ground-water reservoirs during wet seasons is discharged at a more-or-less uniform rate directly into lakes, streams, and other water bodies to supply many needs during dry seasons. Emulating nature, man has constructed conservation storage reservoirs on streams and near streams for the purposes of intercepting, capturing, and storing water during times when streamflows are adequate or excessive. From these conservation storage reservoirs, water is released or diverted for use as needed. Dry-period flows of streams are generally too small to supply needs dependably for water directly so reservoirs are needed to hold flood flows in storage for later use. Thus, man has patterned after nature a system of conservation to improve on the dependability of nature's distribution and provision of water to serve his progress.

Conservation Storage

The term "conservation storage" as applied to water-supply reservoirs means the volume capacity of the space available in a reservoir to store water for subsequent release or withdrawal to serve the needs for man's various beneficial uses.

All of the water captured and conserved in storage in surface reservoirs is not available for beneficial uses. Nature takes its toll by forcing water in such conservation storage to reenter the hydrologic cycle through the processes of evaporation from the water surface, evapotranspiration from the vegetation and ground adjacent to the water, and seepage or infiltration from the reservoir into permeable soils. The capability of conservation storage reservoirs to supply specific amounts of water annually is dependent on combinations of natural and man-made conditions. Significant conditions affecting the satisfactory development of individual reservoirs vary from place to place geographically and include a number of physical factors and considerations. Among these are: the variations in climates and soils; the phases of interchange in the hydrologic cycle; the volumes of water occurring as inflow to the reservoirs; the recurrence frequency, duration, and severity of extremes in water shortages and excesses; the shape and topographic orientation of the reservoir and the geometry of its basin; the capacity of the reservoir; the size and physical characteristics and cultural development of the area drained to the reservoir; and the distribution pattern of the annual withdrawal of specific amounts of water from the reservoir.

Critical Periods and Firm Yields

For a reservoir of any particular size located at a site where known or assumed streamflow would not have supplied specific requirements for water throughout an historical period, there would have been a period of time during which the reservoir would have provided the least amount of water without shortages throughout the entire time period and with the reservoir emptied at the end of the period. This period of time is called the "critical period" for the reservoir. Beginning with a full conservation storage content in a particular reservoir, the amount of water that could have been supplied throughout the critical period under the stated conditions is called the "firm yield." The firm yield can be expressed in another sense as the maximum amount of water that can be supplied continuously by the reservoir under conditions of the driest and most severe drought period known to have occurred at the site. It is therefore apparent that the contribution of a reservoir to a system supplying a specific water requirement is dependent on the content in conservation storage at the beginning of the critical period and the amount of inflow to and losses from the reservoir during the period The amount of water so provided as the firm yield is generally less than the sum of the beginning content of the reservoir and the volume of streamflow from the area drained during the critical period. This relationship is caused partly by natural depletions of water in conservation storage, which result from net loss of water by evaporation from the reservoir surface, and in some cases from losses by leakage, by seepage or infiltration, and by evapotranspiration from adjacent ground and vegetation.

The performances of reservoirs in supplying water requirements under historical critical conditions usually provide the bases for forecasting yields of reservoirs in the future. However, data of the degree of severity of historically critical droughts in a specific area may be inadequate to provide the assurance desired in planning conservation storage reservoirs to serve expected future water needs. Severe droughts have occurred in many parts of Texas in varying intensities at the same time and at different times. Yet a drought more severe, more extensive, or more prolonged than any known in an area may begin at any time. This is a probability for consideration any time the content of a water-supply conservation storage reservoir is less than full, as the first instance of natural reduction of the content in storage may signify the beginning of such a drought. For these reasons, particular criteria are commonly chosen and called "design drought criteria" for specific reservoir sites.

Dependable Yield and Safe Yield

As the relationships of the sequences and combinations of the historical conditions affecting the firm-yield capabilities of reservoirs have remote probability of recurring in the same order in the future, and as the utmost severity of such future relationships in comparison with historical relationships is not known, design-drought criteria for water-supply reservoirs are used by some engineers and hydrologists to estimate a "dependable yield" or a "safe yield." In these criteria, hypothetical reserve contents are retained in conservation storage at the end of the historical critical periods, or other relationships of severe conditions are assumed, to provide a safety factor against the occurrence of a drought more severe than any previously experienced in the area. The firm yield as previously defined will be larger for a given reservoir than the dependable or safe yield that assumes a safety factor. Some investigators have used the terms "dependable yield" and "safe yield" with variations in definition from that stated above. In some cases, dependable yield has been expressed as a specific amount annually for a certain period of years with an expectancy of a lesser annual amount being available once during the period on the average, and safe yield has occasionally been used synonymously with firm yield. Studies by Water Commission personnel employ the definition of firm yield given herein.

Yields Reduced by Sedimentation

The firm yield and the dependable yield of a reservoir will be reduced each year the reservoir is in operation as the initial conservation storage capacity is depleted by sedimentation. Sediments consisting of silt, clay, sand, rock, and other materials are transported in suspension and by movement along streambeds by water flowing into reservoirs. The degree of sedimentation of reservoirs varies from place to place geographically, and is related to various watershed characteristics in combination with reservoir operational procedures and practices. As the capacity of a reservoir is reduced by sedimentation in time, less water can be held in conservation storage to augment inflow during critical periods to provide for a water-supply requirement. The locations of the sediments deposited in the reservoir alters the area-capacity relationships, and may have significant effect on reservoir yields. Under a given set of hydrologic and operational conditions, the area-capacity relationships of a reservoir are indicative of its efficiency. Deep and narrow reservoir basins provide storage capacities having less water-surface area exposed to evaporation than are provided in shallow and wide basins for comparable capacities.

Sedimentation Surveys

As the volume of water lost through evaporation from a reservoir varies directly with area, changes in area-capacity relationships from initial conditions are necessary to evaluate the effect sedimentation may have on firm yield or on dependable yield. To determine the changes in these relationships, sedimentation surveys of reservoirs are made. In these surveys, the general practice is to determine the elevation of the basin bottom along sections across the reservoir. These cross sections are called "sedimentation ranges" and are surveyed at predetermined locations to afford comparison with data obtained by prior surveys. These data provide a basis for computing the volume of sediment periodically trapped in the reservoir and the resulting loss of storage capacity. From the area-capacity relationships revised on the basis of these surveys, periodic reevaluation of the adequacy of the reservoir can be made. Also, these data, expressed as rates of sedimentation in time, are useful in the design of reservoirs in similar areas.

Water-Shortage Tolerance

Some uses of water supplied from reservoirs are more tolerant of water shortages than others. In some cases, shortages can be tolerated from a given reservoir because of supplementary supplies available from other sources. These sources may be ground-water wells maintained on a standby basis, or other surface streams from which diversions may be made during emergencies, or other reservoirs that are a part of the system supplying the same area. During periods of water shortages, the conservative use of water for domestic purposes and the rationing of water for nonessential municipal uses have stretched diminishing reserves to the time of natural replenishment. Shortages of water used for some industrial purposes can be tolerated by curtailment of certain processes, by reuse of water within acceptable limits of quality, by emergency installation of water reclaiming facilities, or by utilization of auxiliaries that are undesirable under other than emergency conditions. For some industrial uses, decreases in available water causes reductions in production or suspension of some processes, and the complete stoppage of industries intolerant of water shortages. Agricultural production dependent on reservoirs to supply water for irrigation may be tolerant of shortages through the decrease in frequency and amount of water applied to croplands. However, severe or extended reduction of irrigation may cause large crop losses. Hydroelectric-power generation efficiencies decrease as water in storage decreases to low levels, causing diminishing hydraulic heads for the development of hydrostatic pressure. These pressures are developed by the weight of the column of water that varies with height above the turbines. As these water pressures decrease, the degrees of water shortages tolerable are in relation to the economic capacities of the generating industries and the customers dependent thereon. Other purposes for which water from surface reservoirs is used can tolerate temporary shortages, but extended shortages may produce severe results. Sanitation and public health is dependent on ample supplies of water of good quality. Fish and wildlife are limited in the degree of shortage tolerance. Water-related recreation areas and investments in such recreational facilities suffer severe economic losses during extended periods of water shortages.

The deterioration of water quality is a less tolerable effect of shortages in water supplies for some uses than is the shortage of water by itself. Diminishing inflows to reservoirs during droughts are generally characterized by increases in concentration of chemicals in solution that may be of natural or man-made origin. The quality of water in storage in reservoirs deteriorates as the flows from saline springs, seeps, and the return flows of water used by man become an increasingly larger percentage of the total inflow. This deterioration of quality of water in storage is further affected by concentration of chemicals caused by evaporation from water surfaces.

Capacity-Yield Relationships--East to West

Sometimes a general public sense of well-being falsely accrues from knowledge of the large amount of conservation storage space provided by the many reservoirs existing and under construction, because of misconceptions and lack of understanding of the meaning of reservoir conservation storage capacities and contents in different parts of Texas. In humid East Texas, a reservoir may provide a firm yield equal to or larger than its conservation storage capacity. In subhumid Central Texas, a reservoir may provide a firm yield equal to only one-fifth or less of its conservation storage capacity. In semiarid and arid West Texas, a reservoir may provide a firm yield varying within a range equal to one-tenth to one-thirtieth or less of its conservation storage capacity. These comparisons are made on the basis of analyses of historical reservoir performances and hypothetical operational studies of reservoirs in the future under conditions of known changes and reasonable assumptions of expected changes in the conditions affecting surface reservoirs. Therefore, compilations of reservoir capacities and contents are relatively indicative of the available water supply only, and are necessarily evaluated through detailed study to provide reliable estimates of the true water-supply potential.

Location and Capacity Determinations

In some cases, the capacity of a conservation storage reservoir is determined on the basis of design-drought criteria and an existing need for water, while in other cases the capacity is determined on the basis of design-drought criteria and prognostications of future water requirements.

Once a water requirement is determined, hypothetical reservoir operations using the design-drought criteria applicable to an area may be made to determine the size of reservoir sufficient to supply the water requirement. Or, such reservoir studies may be made for particularly favorable or essential sites to determine the capacity-yield relationships throughout the range in reservoir sizes physically afforded by the topography and supportable by the available water resources in order to evaluate the best development or the potential maximum development possible. Such capacity-yield studies are generally projected into the future to evaluate the effect that probable changes in the development and use of water and land resources in the drainage area above a reservoir in time may have on reservoir yields. The results of these studies are further tempered at times in the interest of the public welfare by the use of reasonable hypothetical drought conditions more severe than historical conditions.

The size as finally determined for a conservation storage reservoir will provide storage space for the expected sedimentation during a particular period of time and the storage space required to provide the design yield. The storage space allocated to sedimentation may be based on time periods of any length, but the most frequently used periods are for 50 and 100 years. Thus, a conservation storage reservoir may be designed to provide a firm yield of a specific amount of water under conditions assuming the recurrence of certain drought criteria 50 years after the date of completion.

Allocation of Storage

Generally, the space in a reservoir basin is divided into dead storage, inactive storage, conservation storage, and flood-control storage spaces. The dead storage space is below the level at which water begins to flow through the lowest outlet provided in the dam forming the reservoir. This level may be at or above the invert of the lowest outlet. Water cannot be released or diverted from the dead storage space by use of existing facilities in a dam. The inactive storage space is reserved for the design sedimentation in the reservoir above the lowest outlet or dead storage level. The conservation storage capacity designed to provide a particular yield is included in the space above the lowest outlet. In many instances the inactive sediment-storage space and the design conservation storage space are combined as one, under which criteria the initial conservation storage capacity decreases in time. The "active" or "usable" conservation capacity as used herein is the combined space above the lowest outlet of a reservoir allocated for these purposes.

The active or usable conservation storage capacity of a reservoir in reality varies with time because a greater capacity is usable at the beginning of operation than exists after sedimentation begins. Therefore, it is desirable to know the potential performance of a reservoir under drought conditions at any time from the date deliberate impoundment begins, because the fact has been established by experience that nature does not delay droughts until reservoirs are filled with water. Knowledge of usable contents of reservoirs is essential at all times. Even the content in dead storage may be used under emergency conditions by placement of pumps or by modification and extension of diversion intakes.

Temporary use of space in a reservoir basin above the design maximum operating level or the crest of the uncontrolled spillway may be incorporated in the conservation storage reservoir design as surcharge storage space for floodwaters. Surcharge storage provides retardation and detention of floodflows and thereby effects partial flood regulation in that the flood discharges below a dam may be reduced by the temporary regulation by the reservoir. Surcharge storage in a conservation storage reservoir can be very effective in diminishing the magnitude of peak discharges downstream.

Flood-control storage space is often incorporated with conservation storage space to provide multipurpose reservoirs for water supply and for the protection of downstream developments from flood damage. In these designs, the flood-control space in reality provides the storage capacity that will contain the design controlled flood without having an uncontrolled spillage or forced release of water from the reservoir. This could be called controlled-flood storage space, and the surcharge storage space could be called flood-control storage space. Flood-control storage space is defined here as the space in a reservoir within which floodwaters can be captured and held and as soon as possible released. Surcharge storage space differs from flood-control space as it cannot be regulated. Each affects a reduction in floods, but with each, downstream floods may occur, but with reduced frequency.

Multipurpose Use

The operation of multipurpose reservoirs is planned to provide the most benefits within a practical balance of the needs for water and the priority of uses served. The development of hydroelectric-power facilities in upriver reservoirs serving downstream needs for municipal, industrial, irrigational, navigational, and other uses exemplifies such operations. Such reservoirs may provide water for direct diversions by local users and release water for downstream users through the power facilities, which is a nonconsumptive and nondeteriorating use. In some reservoirs seasonal use of part of the flood-control storage space is permissible. This affords more efficient use of available waters during seasons having a low expectancy of floods, particularly in the operation of a number of reservoirs as a coordinated river-system development.

DEVELOPMENT OF RESERVOIRS IN TEXAS

Discussion of the development of major reservoirs in Texas is generally restricted in this report to the existing reservoirs listed in the Appendix. The included tables showing storage capacities are based on the most recent data as contained in the Appendix and are presented to illustrate relative comparisons in magnitude of change in water storage potential with time.

An Historic Example: Lake McDonald and Austin Dam

A few small reservoirs were developed in Texas for irrigation and power purposes prior to 1900; however, the development at the site of Lake Austin is the only early conservation storage reservoir specifically acknowledged herein. Experience at this site exemplifies some of the problems in early designs caused by the lack of basic hydrologic data.

The completion of Austin Dam in 1893 on the Colorado River at Austin created Lake McDonald as a water supply for municipal use and hydroelectric-power generation. It was perhaps the most ill-fated reservoir development in Texas, even to this date. At that time, this was the largest masonry overflow-type dam in the world across a flowing stream. Lake McDonald had an initial conservation storage capacity of 49,300 acre-feet. When the dam was breached by the flood of April 7, 1900, the conservation storage capacity had been reduced by sedimentation to about half the original capacity. Reconstruction of the dam began in 1911, and water was impounded in 1913 to the level of the altered spillway crest, 9 feet lower than the original. Installation of spillway crest gates and gate piers was completed in May 1915 to create a reservoir storage capacity of 32,000 acre-feet. Subsequently, the dam became inoperative for hydroelectric-power purposes as the floods of September 1915 and April 1918 carried away some of the spillway gates, and the flood of June 1935 carried away most of the remaining gates and gate piers. By August 1924, sedimentation had reduced the capacity of the second reservoir to 2900 acre-feet. The depletions of storage capacity by sediment were large in proportion to the original capacities of the reservoirs at this site, and demonstrate the inadequate storage capacity provided with respect to the large area drained. Reconstruction of the dam beginning in 1937 was completed in 1939, and the reservoir created was filled that year to the conservation storage capacity of 21,000 acre-feet. The hydroelectric power plant began operation March 31, 1940. The present dam and reservoir were named Tom Miller Dam and Lake Austin. The area drained directly to Lake Austin was greatly reduced in 1937 and in 1940, respectively, when Buchanan Reservoir and Lake Travis began operation upstream. The sediment trapping and flood protection provided by these reservoirs assure a longer and less hazardous life for the present Lake Austin.

Rate of Development, 1910 to October 1, 1963

The rate of development of major reservoirs from 1910 for beneficial purposes in Texas is illustrated in Figure 1 and Table 1, which contain data showing the number, the total conservation storage capacity, and the total storage capacity of existing major reservoirs at the end of 5-year periods to 1960, at the end of 1962, and on October 1, 1963. (Lake Austin at Austin is not included prior to 1935 because of inoperative condition.)

Current Status

Existing and Potential Uses

In addition to the 117 reservoirs existing on October 1, 1963, for which storage capacities are shown in Table 1, 17 reservoirs were under construction and 1 reservoir was in active preconstruction-planning stages. Of the existing reservoirs, 54 were developed for single-purpose uses and 63 were developed for multipurpose uses. The number of reservoirs existing, under construction, and in active preconstruction planning stages and the principal purposes of use or development as of October 1, 1963, are shown in Table 2.

The enlargement of Lake Waco on the Bosque River is being accomplished with a separate dam that will create a reservoir submerging the existing Lake Waco. The construction of Amistad Dam on the Rio Grande will create a reservoir submerging Lake Walk and Devils Lake on the Devils River, which are used for hydroelectric power.

Hydroelectric-Power Capacities

Table 3 shows the reservoir or lake name and the installed hydroelectric-power generating capacity at major reservoirs by rivers on October 1, 1963. The most extensive hydroelectric-power development in a single river system in Texas is on the Colorado River.

Potential Storage Capacities by River Basins

About 97 percent of the total capacity of all conservation storage reservoirs in Texas is contained in the major reservoirs listed in the Appendix. Of

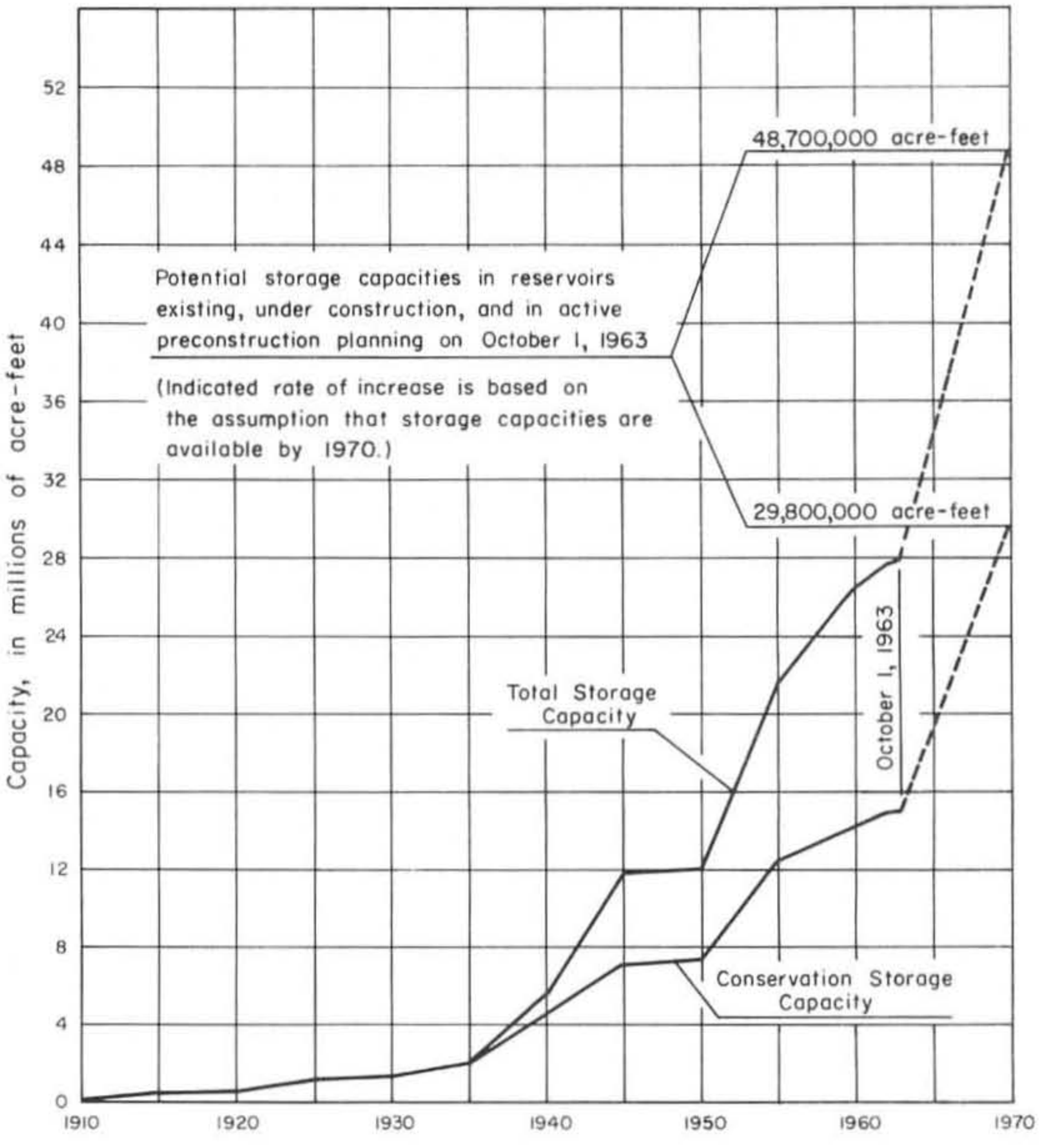

Figure 1

Conservation and Total Storage Capacities of Major Reservoirs in Texas, 1910 to October 1, 1963

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Table 1.--Number and storage capacities of major reservoirs in Texas, at indicated times, 1910 to October 1, 1963

End of year	Number of reservoirs	Storage capacity, in acre-feet	
		Conservation	Total
1910	3	26,000	29,000
1915	9	532,000	535,000
1920	10	538,000	542,000
1925	18	1,092,000	1,112,000
1930	31	1,363,000	1,386,000
1935	35*	1,992,000*	2,016,000*
1940	46	4,600,000	5,471,000
1945	51	7,091,000	11,762,000
1950	63	7,399,000	12,081,000
1955	86†	12,414,000‡	21,617,000
1960	102†	14,255,000	26,562,000
1962	115	14,918,000	27,694,000
Oct. 1, 1963	117	15,008,000	27,937,000

* Lake Austin embankment on Peyton Creek in Matagorda County was destroyed by storm in August 1932, and storage capacity of 12,630 acre-feet is deleted from totals beginning in 1935.

† Number does not include new dams submerging Garza Dam and Lake Dallas, Mathis Dam and old Lake Corpus Christi, and the dam on Salt Creek forming part of Graham Lake. Operation of Garza-Little Elm Reservoir began November 1954; Lake Dallas was inundated and Garza Dam was breached in 1957. Old Lake Corpus Christi was inundated by new Lake Corpus Christi formed by Wesley E. Seale Dam in 1958. Graham Lake was formed by the completion of a dam on Salt Creek and a canal connecting the reservoir so created with enlarged Lake Eddleman on Flint Creek to constitute one operating reservoir in 1958.

‡ Includes 400,000 acre-feet of winter conservation storage capacity authorized in International Falcon Reservoir.

Table 2.--Number and principal purposes of use of major reservoirs existing, under construction, and in active preconstruction planning in Texas, October 1, 1963

Use	Number of reservoirs			
	Existing	Under construction	In active preconstruction planning	Total
Domestic	1	-	-	1
Municipal	13	2	-	15
Industrial	12	1	-	13
Irrigation	9	-	-	9
Mining	1	-	-	1
Power	8	-	-	8†
Recreation	9	-	-	9
Fish and Wildlife	1	1	-	2
Multipurpose*	63	13	1	77†
Total, all uses	117	17	1	135‡

* Includes combinations of the single uses shown plus navigation and flood control.

† Two power reservoirs and one multipurpose reservoir will be inundated by the completion of two reservoirs under construction.

‡ Upon completion of construction of the reservoirs listed and the inundation acknowledged, there will be a total of 132 major reservoirs operating wholly in Texas and on border streams.

Table 3.--Installed electricity-generating capacities at major reservoirs in Texas, October 1, 1963

Reservoir or lake	River	Installed electricity-generating capacity, in kilowatts
Texoma	Red	70,000*
Possum Kingdom	Brazos	22,500†
Whitney	Brazos	30,000
Buchanan	Colorado	33,750
Inks	Colorado	12,500
Granite Shoals	Colorado	45,000
Marble Falls	Colorado	30,000
Travis	Colorado	67,500
Austin	Colorado	13,500
Dunlap	Guadalupe	3,600
McQueeney	Guadalupe	2,800
H-4	Guadalupe	2,400
Red Bluff	Pecos	2,300
Devils	Devils	1,800
Walk	Devils	1,350
International Falcon	Rio Grande	31,500‡

* Power facilities are provided for three additional 35,000-kilowatt units.

† Power facilities are provided for an additional 11,250-kilowatt unit.

‡ This is capacity of plant on United States side of river. Mexico has equal capacity.

the 135 major reservoirs listed, four are on border streams, one under construction is an enlargement that will submerge another, and one under construction on a border stream will submerge two others wholly within Texas when completed and filled; this will leave 132 major reservoirs in Texas and on border streams. The completion of Proctor Reservoir on the Leon River and transfer of flood-control storage to it will allow reallocation of storage space in Belton Reservoir. The conservation storage space in Belton Reservoir will be increased from 210,320 to 457,320 acre-feet, and the flood-control storage space will be reduced from 887,000 to 640,000 acre-feet. The enlargement of Lake Waco on the Bosque River will provide an increase in conservation storage capacity from 22,030 to 157,700 acre-feet, and initially will provide flood-control storage capacity of 574,600 acre-feet.

The potential total storage capacities of major reservoirs in Texas are shown by river basins in Table 4. The tabulation was made using conservation storage capacities at normal maximum operating levels of reservoirs having undesignated storage space--Toledo Bend, Palestine, Dam B, and Granite Shoals--and the physical capacity of Lake Corpus Christi, the winter conservation storage capacity authorized in International Falcon Reservoir, and maximum conservation storage capacities of other reservoirs except the seasonal storage increase allowed in Lake O' the Pines for recreational uses. In Table 4, the total storage capacity column only includes 248,250 acre-feet of combined usable but undesignated storage capacities above normal maximum conservation storage levels in Toledo Bend Reservoir (under construction), Lake Palestine, Dam B Reservoir, and Granite Shoals Lake, and 16,800 acre-feet of storage capacity in Lake Cisco restricted from use by a court injunction held by the Missouri-Kansas-Texas Railroad Company. Other reservoir storage capacities excluded from Table 4 are the combined surcharge storage capacities of 854,000 acre-feet provided in the Trinity River Basin above Fort Worth by Bridgeport, Eagle Mountain, and Benbrook Reservoirs, and 76,720 acre-feet provided in the middle Colorado River Basin above Coleman and Brady by Hords Creek and Brady Reservoirs, respectively, which afford partial flood regulation. These surcharge storage spaces are below the uncontrolled emergency spillway crest and above the controlled storage level in each reservoir.

Storage Shared on Border Streams

Texas does not have use of all the conservation storage capacities shown in Table 4 and the Appendix tabulation, as four of the major reservoirs existing and being developed are on border streams. Conservation storage in Toledo Bend Reservoir will be divided equally between Texas and Louisiana in accordance with provisions of the Sabine River Compact. Conservation storage in Lake Texoma has not been divided between Texas and Oklahoma although a compact between the States of Arkansas, Louisiana, Oklahoma, and Texas on the Red River is being negotiated at this time. Conservation storage capacities of International Falcon Reservoir and Amistad Reservoir have been divided between the United States and Mexico by treaty that grants Texas the use of 58.6 percent and 56.2 percent of the capacity of each reservoir, respectively. Although 58,000 acre-feet of the 175,000 acre-feet of conservation storage capacity of Caddo Lake is in Texas, the use of the total storage capacity has not been divided at this time between Texas and Louisiana. Using the divisions of storage capacities as described and an assumed equal division of Lake Texoma storage capacities, the potential conservation storage capacity and total storage capacity of major reservoirs available for use in Texas when the projects listed in the Appendix are completed

Table 4.--Potential reservoir storage capacities in Texas, by river basins, as provided by the status of major reservoirs on October 1, 1963 (shown in the Appendix)

Basin	Number of reservoirs	Storage capacities, in acre-feet			
		Dead	Conservation	Flood control	Total
Canadian River	2	43,100	833,000	544,000	1,420,100
Red River	14	1,110,000	2,457,720	2,694,000	6,261,720
Sulphur River	2	0	152,500	2,509,000	2,661,500
Cypress Creek	4	3,060	461,640	587,200	1,051,900
Sabine River	9	9,130	5,535,910	0	5,729,040
Neches River	8	10,080	3,155,440	1,586,900	4,810,690
Trinity River	22	21,560	2,869,100	1,358,280	4,248,940
San Jacinto River	3	7,300	536,720	0*	544,020
Brazos River	30	13,650	2,970,010	3,902,000	6,902,460
Colorado River	18	95,800	3,080,170	1,485,200	4,667,870
Guadalupe River	4	4,290	399,510	354,700	758,500
San Antonio River	2	0	280,500	0†	280,500
Nueces River	2	140	309,550	0	309,690
Rio Grande	9	21,320	6,714,360	2,284,480	9,020,160
Coastal	3	0	43,580	0	43,580
Total	132	1,339,430	29,799,710	17,305,760	48,710,670

* Barker and Addicks Reservoirs in the upper Buffalo Bayou watershed provide 204,800 and 204,460 acre-feet of flood-control storage capacity, respectively, but have no conservation storage capacity.

† Olmos Reservoir in the upper San Antonio River watershed provides 15,500 acre-feet of flood-control storage capacity with no conservation storage.

could be 23,900,000 and 39,800,000 acre-feet, respectively. The difference between these figures and the totals shown in Table 4 are the established and assumed share of storage in reservoirs divided with adjacent states and Mexico.

Large Reservoirs

Total Capacities Exceeding 100,000 Acre-feet

Texas will have 44 major conservation storage reservoirs wholly within the State and on border streams with a total capacity of 100,000 acre-feet or more each when the reservoirs under construction and in active preconstruction planning on October 1, 1963, are completed. These reservoirs are listed in descending order of magnitude of capacity in Table 5, with the surface area shown in acres and to the nearest square mile at the water level conforming with the capacity of each.

Conservation Capacities Exceeding 100,000 Acre-feet

Not all major reservoirs in Texas with total storage capacity of 100,000 acre-feet or more each have conservation storage capacity in that amount. According to the tabulation in the Appendix showing the status of reservoirs on October 1, 1963, Texas will have 39 major reservoirs with conservation storage capacity of 100,000 acre-feet or more when the indicated construction projects are completed. These reservoirs are listed in descending order of magnitude of conservation storage capacity in Table 6, with the surface area shown in acres and to the nearest square mile at the normal maximum operating level (top of conservation storage space).

Surface Areas and Storage Relationships

Table 7 contains a tabulation of reservoirs in Texas with 100,000 acre-feet or more capacity each at the normal maximum conservation storage level, listed in descending order of magnitude of the surface area at that level. Two ratios expressing particular relationships are included in Table 7 and discussed herein as an acknowledgement of existing interest in water resources development by students and others who may desire to compare the relative merits of different reservoirs. This requires some reconsideration of parts of the preceding "General Discussion."

In the earlier discussion on the natural losses of water from reservoirs and the depletion of conservation storage capacities by sedimentation, the shape and size of a reservoir basin and its area-capacity relationships were identified as part of many conditions having an effect on its efficiency and water-yield characteristics. The degree of effect of the area-capacity relationships of reservoirs can be evaluated roughly by a ratio termed the "average depth," which is obtained by dividing the storage capacity by the surface area at the corresponding water level. The reservoirs having the largest average depth generally have the best area-capacity relationships, which are conducive to the least loss of water in a particular geographic area. Large ratios generally indicate favorable depths and efficient geometry of reservoir basins, and small ratios generally indicate unfavorable depths and geometry. The deeper the reservoir in relation to surface area, the better the storage efficiency is with

Table 5.--Conservation storage reservoirs in Texas having 100,000 acre-feet or more total capacity on October 1, 1963

(Listed in descending order of magnitude--surface area is at full capacity)

Magnitude	Name	Total capacity, in acre-feet	Surface area		Remarks
			Acres	Square miles	
1	Lake Texoma	5,530,300	144,100	225	No current division
2	Amistad Reservoir	5,325,000	84,000	131	Texas share, 56.2 percent*
3	Toledo Bend Reservoir	4,661,000	186,500	291	Divided 50-50*
4	McGee Bend Reservoir	4,478,800	150,730	236	(*)
5	International Falcon Reservoir	3,280,700	98,960	155	Texas share, 58.6 percent
6	Texarkana Reservoir	2,654,300	119,700	187	
7	Whitney Reservoir	2,017,500	49,710	78	
8	Lake Travis	1,950,000	29,000	45	
9	Sanford Reservoir	1,408,000	21,630	33	(*)
10	Belton Reservoir	1,097,600	23,620	37	
11	Garza-Little Elm Reservoir	1,002,900	39,900	62	
12	Buchanan Reservoir	992,000	23,200	36	
13	Lake Tawakoni	936,200	36,700	57	
14	Lake O' the Pines	842,100	38,200	60	
15	Canyon Reservoir	740,900	12,890	20	(*)
16	Lake Waco	732,300	19,440	30	Enlargement*
17	Possum Kingdom Reservoir	724,700	19,800	31	
18	Cedar Creek Reservoir	678,900	34,000	53	(*)
19	Stillhouse Hollow Reservoir	630,400	11,830	18	(*)
20	Twin Buttes Reservoir	600,000	22,700	35	
21	Somerville Reservoir	507,500	24,400	38	(*)
22	Forney Reservoir	490,000	22,740	36	(*)
23	Lake Kemp	461,800	20,620	32	
24	Grapevine Reservoir	435,500	12,740	20	
25	Lavon Reservoir	423,400	20,050	31	
26	San Angelo Reservoir	396,400	12,700	20	
27	Honea Reservoir	380,400	17,600	28	(†)
28	Proctor Reservoir	374,200	14,010	22	(*)
29	Hubbard Creek Reservoir	320,000	15,250	24	
30	Red Bluff Reservoir	310,000	11,700	18	
31	Lake Corpus Christi	302,100	22,050	34	Currently operated at lower capacity
32	Bridgeport Reservoir	270,900	10,400	16	
33	Medina Lake	254,000	5,575	9	
34	Navarro Mills Reservoir	212,200	11,700	18	(*)
35	Lake J. B. Thomas	203,600	7,820	12	
36	Eagle Mountain Reservoir	182,700	8,500	13	
37	Caddo Lake	175,000	32,700	51	No current division
38	Benbrook Reservoir	164,800	5,820	9	
39	Lake Houston	158,200	12,500	20	
40	Granite Shoals Lake	145,200	6,400	10	
41	Brownwood Reservoir	143,400	7,300	11	
42	Bardwell Reservoir	140,000	6,040	9	
43	Dam B Reservoir	124,700	16,830	26	
44	Lake Kickapoo	106,000	6,200	10	

* Under construction.

† In active preconstruction planning.

Table 6.--Reservoirs in Texas having 100,000 acre-feet or more capacity at conservation storage level on October 1, 1963

(Listed in descending order of magnitude--surface area is at normal maximum operating level)

Magnitude	Name	Capacity, in acre-feet	Surface area		Remarks
			Acres	Square miles	
1	Toledo Bend Reservoir	4,477,000	181,600	283	Divided 50-50*
2	Amistad Reservoir	3,550,000	67,000	105	Texas share, 56.2 percent*
3	McGee Bend Reservoir	2,891,900	114,550	179	(*)
4	Lake Texoma	2,836,300	91,200	142	No current division
5	International Falcon Reservoir	2,711,220[1]	87,700	137	Texas share, 58.6 percent [1] Winter capacity
6	Lake Travis	1,172,000	18,930	30	
7	Buchanan Reservoir	992,000	23,200	36	
8	Lake Tawakoni	936,200	36,700	57	
9	Sanford Reservoir	864,000	16,500	26	(*)
10	Possum Kingdom Reservoir	724,700	19,800	31	
11	Cedar Creek Reservoir	678,900	34,000	53	(*)
12	Forney Reservoir	490,000	22,740	36	(*)
13	Garza-Little Elm Reservoir	482,000	22,970	36	
14	Lake Kemp	461,800	20,620	32	
15	Belton Reservoir	457,600[2]	12,300	19	[2] After Proctor is completed
16	Whitney Reservoir	387,000	15,800	25	
17	Canyon Reservoir	386,200	8,240	13	(*)
18	Honea Reservoir	380,400	17,600	27	(†)
19	Hubbard Creek Reservoir	320,000	15,250	24	
20	Red Bluff Reservoir	310,000	11,700	18	
21	Bridgeport Reservoir	270,900	10,400	16	
22	Lake O' the Pines	254,900	18,680	29	
23	Medina Lake	254,000	5,575	9	
24	Stillhouse Hollow Reservoir	235,700	6,430	10	(*)
25	Lake J. B. Thomas	203,600	7,820	12	
26	Grapevine Reservoir	188,500	7,380	12	
27	Lake Corpus Christi	185,900[3]	15,500	24	[3] Current operation
28	Eagle Mountain Reservoir	182,700	8,500	13	
29	Caddo Lake	175,000	32,700	51	No current division
30	Twin Buttes Reservoir	170,000	8,440	13	
31	Somerville Reservoir	160,100	11,460	18	(*)
32	Lake Houston	158,200	12,500	20	
33	Lake Waco	157,700	7,260	11	Enlargement*
34	Texarkana Reservoir	145,300	20,000	31	
35	Brownwood Reservoir	143,400	7,300	11	
36	Lavon Reservoir	143,600	11,080	17	
37	Granite Shoals Lake	138,500	6,200	10	
38	San Angelo Reservoir	119,200	5,440	8	
39	Lake Kickapoo	106,000	6,200	10	

* Under construction.

† In active preconstruction planning.

Table 7.--Surface area, average depth, and capacity per square mile of uncontrolled drainage area, of reservoirs in Texas having 100,000 acre-feet or more storage capacity at normal maximum operating level on October 1, 1963

(Listed in descending order of magnitude of surface area.)

Magnitude	Name	Surface area, in acres	Average depth, in feet	Acre-feet capacity per square mile of drainage area
1	Toledo Bend Reservoir*	181,600	25	745
2	McGee Bend Reservoir*	114,550	25	899
3	Lake Texoma	91,200	31	121
4	International Falcon Reservoir‡	87,700	32	134
5	Amistad Reservoir*	67,000	53	505
6	Lake Tawakoni	36,700	26	1,238
7	Cedar Creek Reservoir*	34,000	20	684
8	Caddo Lake	32,700	5	98
9	Buchanan Reservoir	23,200	43	88
10	Garza-Little Elm Reservoir	22,970	21	319
11	Forney Reservoir*	22,740	22	1,628
12	Lake Kemp	20,620	22	221
13	Texarkana Reservoir	20,000	7	42
14	Possum Kingdom Reservoir	19,800	37	72
15	Lake Travis	18,930	62	649
16	Lake O' the Pines	18,680	14	318
17	Honea Reservoir†	17,600	22	855
18	Sanford Reservoir*	16,500	52	96
19	Whitney Reservoir	15,800	24	109
20	Lake Corpus Christi	15,500	12	13
21	Hubbard Creek Reservoir	15,250	21	295
22	Lake Houston	12,500	13	56
23	Belton Reservoir§	12,300	37	201
24	Red Bluff Reservoir	11,700	26	117
25	Somerville Reservoir	11,460	14	158
26	Lavon Reservoir	11,080	13	187
27	Bridgeport Reservoir	10,400	26	244
28	Eagle Mountain Reservoir	8,500	21	241
29	Twin Buttes Reservoir	8,440	20	67
30	Canyon Reservoir*	8,240	47	272
31	Lake J. B. Thomas	7,820	26	218
32	Grapevine Reservoir	7,380	26	280
33	Brownwood Reservoir	7,300	20	96
34	Lake Waco Enlargement*	7,260	22	97
35	Stillhouse Hollow Reservoir*	6,430	37	179
36	Granite Shoals Lake	6,200	22	28
37	Lake Kickapoo	6,200	17	385
38	Medina Lake	5,575	46	400
39	San Angelo Reservoir	5,440	22	86

* Under construction.

† In active preconstruction planning.

‡ Winter capacity.

§ After Proctor Reservoir is completed.

respect to evaporation loss. However, these ratios do not indicate the relative efficiency between reservoirs when comparisons are made in different and unrelated climatic areas. In humid areas, relatively shallow impoundments with large surface areas of water might be exposed to the air without incurring a loss through evaporation in a volume equal to a loss from relatively deep impoundments exposing smaller surface areas of water in arid areas. The point being made is that a number of conditions must be considered in making rough comparisons and evaluations of relative characteristics of reservoirs.

The ratio of the storage capacity of a reservoir to the size of its drainage area below upstream reservoirs serving as sediment traps provides a basis for interesting comparisons of reservoir development. This ratio, obtained by dividing the storage capacity by the described drainage area, is an indicator of the relative degree of development of reservoir capacity with respect to sediment storage requirements that might be needed to assure the long life of a project--the larger the ratio, the longer the life. However, this ratio cannot be used solely to evaluate an adequate sediment reserve capacity. The volume and rate of sediment production in a river basin generally varies between watersheds and by reaches of the streams because of variations in soils, land use, topography, climatic and flooding characteristics, and frequency of storm rainfalls. Also, only a part of a large drainage area above a reservoir might contribute sediment to a downstream site. The capacity to drainage area ratio of 13:1 for Lake Corpus Christi--the smallest listed in Table 7--appears inadequate, but sedimentation surveys by the U. S. Soil Conservation Service have shown that the average annual net erosion to this reservoir site in the past has been less than 0.1 acre-foot per square mile of drainage area and less than 1500 acre-feet of sedimentation yearly. This indicates that the entire drainage area is not contributing sediment to Lake Corpus Christi. Conversely, some of the higher ratios are not conclusive. For instance, the drainage area above the Forney Reservoir Site and below Lavon Reservoir is small in comparison to the planned capacity that provides a ratio of 1628:1. If the total drainage area above the Forney Site is considered, the ratio decreases to 458:1. Neither ratio is wholly realistic because Lavon Reservoir will pass sediment to the Forney Site at times, and will provide complete trapping at times, depending on reservoir operation and content, the frequency and magnitude of storm rainfall, flood inflows, and duration of floodwater retention in storage. The sedimentation experienced in Lake Austin prior to the construction of upstream reservoirs, which effectively decreased the area drained directly thereto, was in agreement with indications of its storage capacity to drainage area ratio of less than 2:1. The Medina Lake ratio of 400:1 is a reduction from the 1913 ratio of 432:1, which was caused by sedimentation of about 7 percent of the original storage capacity. A long life can be expected for Medina Lake on the basis of this small loss of storage capacity.

The capacity to drainage area ratios can be used to indicate roughly the degree of development of the streamflow from watersheds in different climatic areas. In this sense, large ratios for reservoirs in humid areas indicate that large quantities of water per square mile of drainage area might be developed by the reservoir--the opposite would be indicated for small ratios in arid areas; however, these relations are dependent on inflow and other considerations also. In a river-system development of multipurpose reservoirs, as the Lower Colorado River Authority has on the Colorado River at and above Austin, a better index of development might be obtained by combining the capacities of the reservoirs and relating the total capacity to the drainage area. In Table 7 the capacity to drainage area ratios for Buchanan (88), Granite Shoals (28), and Travis (649) represent considerable variance in development. But if the capacities of these reservoirs are combined with the capacities of Inks Lake, Marble Falls Reservoir, and Lake Austin, the resulting ratio is about 130:1; by excluding Buchanan Reservoir and its drainage area from the total the ratio is about 200:1. This discussion of Table 7 is intended to demonstrate some comparisons of the reservoirs listed that might be interesting to some, and to show how the degree of development of reservoirs and watersheds can be evaluated roughly by "rule-of-thumb" ratios if the principal elements are known and properly considered; without such knowledge and consideration the figures can be misconstrued.

Comparable Status
January 1 and October 1, 1963

Information about the status of major-reservoir development and about conservation and related storage capacities in Texas by calendar years is desirable for making comparisons with other statistical and historical data. The tables in this circular are compiled to September 30, 1963, which date marks the ending of the 1963 water year. The water year is a hydrologically significant period beginning on October 1 and extending for 12 months to September 30 of the following year. The records of streamflow and reservoir content collected in Texas by the U. S. Geological Survey in cooperation with the Texas Water Commission and other State and Federal agencies are currently published annually on a water year basis. Table 8 contains comparable figures for January 1, 1963 and October 1, 1963. Table 9 shows the change in status of reservoirs listed in the Appendix, between January 1 and October 1, 1963: these figures provide summations of reservoir data for use through calendar year 1962.

A tabulation of pertinent data for major conservation storage reservoirs in Texas on October 1, 1963, as used in the compilations herein, an explanation of the kind of data tabulated, and a map showing the geographical location of each reservoir listed are contained in the Appendix.

Table 8.--Comparable data on major conservation storage reservoirs in Texas, January 1 and October 1, 1963

Date	Total number				Storage capacity, in acre-feet			
	E[a]	UC[b]	APC[c]	Pot[d]	Dead	Conservation	Flood control	Total
January 1, 1963	115	-	-	-	1,269,100	14,917,650	11,426,630[e]	27,694,430
Do.	-	13	-	-	63,730	9,084,100	6,041,000	15,188,830
Do.	-	-	3	-	4,100	5,343,300	-	5,531,400
Do.	-	-	-	128	1,311,360	29,671,620	17,220,630	48,494,230[f]
Texas share only	-	-	-	128	-	23,756,320	-	39,590,980
October 1, 1963	117	-	-	-	1,272,820	15,007,660	11,575,530[e]	27,937,060
Do.	-	17	-	-	67,330	14,085,080	5,977,230	20,313,640
Do.	-	-	1	-	-	380,400	-	380,400
Do.	-	-	-	132	1,339,430	29,799,710	17,305,760	48,710,670[f]
Texas share only	-	-	-	132	-	23,884,410	-	39,807,420

[a] Existing.

[b] Under construction.

[c] In active preconstruction planning.

[d] Potential.

[e] Does not include reservoirs having flood-control storage capacity only--Olmos (15,500 acre-feet) in San Antonio, and Barker (204,800 acre-feet) and Addicks (204,460 acre-feet) near Houston.

[f] Existing Lake Waco, Devils Lake, and Lake Walk will be inundated by Waco Enlargment and Amistad Reservoir.

Note.--The potential storage capacities are adjusted for reassignment and use of existing storage space not in use for conservation purposes on October 1, 1963.

Table 9.--Change in status of major conservation storage reservoirs in Texas during the period January 1 to October 1, 1963

Construction completed	Construction began		
Brady	Toledo Bend*	Bardwell	Cleburne
Navarro Mills	Forney*	Palo Pinto Creek	Bastrop

* In active preconstruction planning stages on January 1, 1963.

APPENDIX

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS

Existing, Under Construction, and in Active
Preconstruction Planning Stages
on October 1, 1963

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS

Explanation of Reservoirs Included in and Omitted from Tabulation

The reservoirs listed in this compilation (page A-8) have been developed for single-purpose and multipurpose uses. Only reservoirs having usable conservation storage capacities of 5000 acre-feet or more are tabulated and designated as MAJOR. This arbitrary criterion for inclusion of a reservoir as major in this compilation is established because the pertinent data available across the State for beneficially used conservation storage reservoirs above a particular capacity can best and most reliably be authenticated for the ones above the stated limit. The tabulation accounts for about 97 percent of the total capacity of all water-supply reservoirs in Texas, thereby affording the most accurate and practical statewide accounting of conservation storage capacities and contents of reservoirs from time to time.

A few reservoirs and natural lakes in Texas not included in this compilation may have usable conservation storage capacities of 5000 acre-feet or more, but sufficient data are not developed to reliably qualify their capacities and related data. One such natural lake, Lake Austin on Peyton Creek in Matagorda County, that was altered by raised embankments has been deleted from the listing because of damage to embankments by hurricane storms causing an undetermined volume loss of storage capacity. Mud Creek Reservoir in the Neches River Basin, previously listed in compilations as "under construction," has been deleted from the current listing because of discontinuance of preliminary construction activity. The figures of capacity and surface area for the reservoirs included are the best and most recent data obtained by the Texas Water Commission; however, these data are not inviolable with respect to currently existing relationships because some of the reservoirs have not been resurveyed in recent years to determine the amount of storage capacity depleted by sedimentation. Even with resurveys, the data are not precise but are the best afforded by the methods and degree of detail of surveys considered as practical within the economical limitations at the time.

Reservoirs developed for flood control or floodwater retention and for floodwater retardation or detention without at least 5000 acre-feet of conservation storage capacity in Texas are not included in this compilation. Largest among these are Olmos Reservoir in San Antonio and Barker and Addicks Reservoirs near Houston. Olmos Reservoir, completed in 1926, is a flood-control reservoir having a controllable capacity of 15,500 acre-feet with no conservation storage on Olmos Creek, a main tributary to the San Antonio River. Barker Reservoir on Buffalo Bayou near Houston is a flood-control structure having a controllable capacity of 204,800 acre-feet with no conservation storage. The reservoir was first used for flood protection for Houston in 1945, and Barker Dam was completed in February 1946. Addicks Reservoir on South Mayde Creek, a tributary to Buffalo Bayou downstream from Barker Dam, is a flood-control structure having a controllable capacity of 204,460 acre-feet with no conservation storage. Addicks Dam was completed during the fall of 1948. The United States Department of Agriculture Soil Conservation Service had completed the development of 763 floodwater-retarding structures on tributary streams in Texas on October 1, 1963. The total drainage area above these structures is 3171 square miles, the total storage capacity below the lowest uncontrolled outlet is 102,680 acre-feet, and the total floodwater-retarding capacity is 807,790 acre-feet. Nine of these structures have detention capacities of more than 5000 acre-feet each. The conservation storage capacities of the reservoirs formed by these structures are generally less than 200 acre-feet each except in instances where Permits to appropriate waters so impounded have been issued by the Texas Water Commission to individuals or municipalities for municipal, irrigational, recreational, or other uses. In such instances, conservation storage capacities have been increased by arrangement with the Soil Conservation Service.

Scattered across Texas are hundreds of water-supply reservoirs having less than 5000 acre-feet of conservation storage capacity each, and hundreds of thousands of small natural lakes, farm ponds, and livestock tanks providing water for beneficial uses in many instances that are not included in this report.

Explanation of Pertinent Data Contained in the Tabulation of Reservoirs

Some of the pertinent data for reservoirs most often requested of the Texas Water Commission are contained in the tabulation of reservoirs in a particular order and under specific headings. The order of listing, the headings, and some related examples are described, defined, and explained sequentially as used therein.

Order of listing. The reservoirs in this compilation are tabulated in sequence in standard stream order, beginning with the most upstream development and progressing downstream in each river basin by geographic order from east to west except the small coastal basins that are listed from east to west following the Rio Grande Basin.

Name. The name of each reservoir is given as officially reported to the Water Commission and as contained in records of reservoir content published by the U. S. Geological Survey in cooperation with this and other State and Federal agencies. The name of a reservoir as used locally and during construction is often changed when construction is completed or when the development is formally dedicated. In many instances the reservoir and dam creating it have different names that are used interchangeably by various parties. Locally used names are included with the principal name of reservoirs in some cases.

Year operation began. The date shown is the year during which deliberate impoundment of water began for beneficial purposes, and does not necessarily coincide with dates of completion of the reservoir and dam.

Stream. The name of the stream on which the impounding dam is located is given in accordance with topographic maps and most local designations. Some reservoirs are "perched" within the flood plain or drainage area near a stream from which water is diverted into storage for later use. These reservoirs are identified as "off-channel" and the stream named is the principal source of water.

Location. Reservoir locations are given as airline distances to the nearest mile on the eight compass points in relation to a town or city nearby. The county name is the one in which the reference town or city is located and is not necessarily a county wherein all or part of the dam and reservoir are located. The distance is measured from the center of the reference town or city to the dam at the midpoint of the stream. The locations by compass points are accurate within 22-1/2 degrees.

Owner or operator. The name of the owner or responsible agency operating each reservoir for beneficial purposes as of October 1963 is given. The Federal Government constructed, owns, and operates all or part of some reservoirs through acknowledged agencies including the Corps of Engineers, U. S. Army; the Bureau of Reclamation, Department of Interior; the Forest Service and Soil Conservation Service, Department of Agriculture; and the International Boundary and Water Commission, United States Section, Department of State. In many of these structures, State municipalities have purchased conservation storage capacities that are operated in conjunction with the Federal agencies. These dual interests are shown where more than two participate and space permits.

Use. The use of each reservoir is shown in accordance with purposes for which the Water Commission Permits for impoundment and appropriation of public waters were issued and for the principal Federal interests. The order of use shown is in accord with statutory priorities as defined under the "Wagstaff" Act of 1931 in Article 7471 in reference to Article 7467 of Vernon's Revised Civil Statutes of Texas. The abbreviations of these uses are defined at the end of the tabulation of pertinent data. As most reservoirs provide some sort of recreational use, such use is shown herein only in accord with specific Permits.

Drainage area. The total drainage area within the basin or watershed divide above each dam is shown in square miles--1 square mile is equal to 640 acres. This figure includes contributing and noncontributing areas. So-called noncontributing drainage areas may occasionally or may never contribute runoff directly to streams within the drainage basin. Runoff within most of such areas generally infiltrates highly permeable soils and rocks, drains into natural surface depressions and playa lakes, and does not flow directly into stream systems draining to the Gulf of Mexico except under rare instances of extreme high flooding. In some parts of Texas and adjacent states and Mexico, closed basins exist within general stream-basin divides from which no surface runoff to the draining stream system occurs. The total drainage-area figures provide data for determining the intervening areas between successive reservoirs on a stream and in a river system.

Surface area. The surface areas shown are the areas, in acres, of the water surfaces at the levels corresponding to the top of conservation storage space and top of flood-control storage space as designated by footnotes.

Surface elevation. Surface elevations are heights of water surfaces above mean sea level which correspond to designated and footnoted storage capacities.

Storage capacity. The storage capacity is the volume of water that can be contained within the reservoir. When appropriate, the capacity of each reservoir is divided into four categories: dead storage, conservation storage, flood-control storage, and total storage capacities.

Dead storage capacity. The dead storage capacity is the volume below the lowest outlet level of the dam from which space water cannot be released by gravity flow. Dead storage capacity is not wholly realistic in reservoirs having withdrawal facilities with intakes below the lowest outlet level of the dam, in which cases such capacity is usable conservation storage capacity. In a few reservoirs where such use is known to be possible, dead storage as defined herein is not shown. This is particularly applicable to off-channel reservoirs and to reservoirs used for supplying cooling water to thermal-electric power plants in addition to other uses as at Striker Creek Reservoir, East Lake, and Lake Bastrop.

Conservation storage capacity. The conservation storage capacity is the volume between the lowest outlet and the normal maximum operating level from which water can be released or withdrawn for beneficial uses. This capacity is also referred to as "usable conservation storage capacity" and is not the same as "design capacity". The normal maximum operating level is generally the spillway crest if the reservoir does not have flood-control storage space, and is an authorized storage level in accord with design and permitted use of reservoirs having flood-control storage space.

Flood-control storage capacity. The flood-control storage capacity is the volume below the lowest uncontrolled spillway crest or top of gates of a dam allocated to store floodwaters, which can be released at a controlled rate as rapidly as channel capacities permit without causing damage downstream. Also under flood control in the tabulation, surcharge capacity is shown in parentheses for reservoirs having uncontrolled service spillways and uncontrolled emergency spillways between which levels floodwater detention or retarding capacities are provided. Such reservoirs include Bridgeport and Eagle Mountain Reservoirs above Fort Worth, which have service spillways with several gated bays and one open bay each, and Benbrook Reservoir with a 100-foot notch in the 500-foot concrete spillway 14 feet lower than the main portion.

Total storage capacity. The total storage capacity is the maximum volume provided by the lowest uncontrolled feature of the reservoir dam, which may be the emergency spillway crest, the service spillway crest, the invert of inlet to the outlet works, top of gates, or top of dam below which storage can be controlled and above which uncontrolled spillage occurs.

Significance of figures. Some agencies active in water-resources investigations and development in Texas may use figures differing from the ones compiled herein for the same reservoirs. Such differences may result from rounding-off figures, use of design capacities instead of existing capacities, variations in definitions, and use of different nomenclature. Otherwise, these figures as tabulated are in agreement with figures used by other agencies. This compilation contains figures to the following refinement: distance, to the nearest mile; drainage area, to the nearest square mile; surface area, to the nearest 10 acres if more than 10,000 and to the nearest acre if less; capacity for most reservoirs, to the nearest 100 acre-feet if more than 1,000,000 and to the nearest 10 acre-feet if less. The capacities are shown for the storage spaces below the lowest outlet level, between the lowest outlet level and top of conservation storage level, and between the top of conservation storage level and uncontrolled spillway crest or top of gates as appropriate. This is done to provide a simple basis for determining the usable content of reservoirs at any time with respect to each one's ability to provide waters for withdrawal and release downstream, particularly during periods of drought. In time, storage capacities will be reduced by sedimentation and new surveys will be required to provide figures of more current accuracy to determine the available water in storage for beneficial uses. Other agencies may use design data that may include sediment-reserve storage space, inactive storage space for fish and wildlife and other considerations, power-head storage, and conservation storage space for water supply within the same space shown as conservation storage capacity in these tables. Also, conservation capacities may be shown by other agencies in accordance with intake levels of pumping plants used for withdrawal of water, below which levels capacities are often designated as inactive although releases can be made therefrom.

Availability of Records of Reservoir Content

Each month the Texas Water Commission prepares and distributes a report on "Water Conditions" for the preceding month, describing conditions of streamflow and rainfall across the State and containing data on water levels in selected observation wells and content of 39 major conservation storage reservoirs in Texas, with comparable data for the preceding month and the previous year. The total capacity of these 39 reservoirs is 25,500,000 acre-feet and the usable conservation storage capacity is 12,800,000 acre-feet as compared with the total capacity of 27,900,000 acre-feet and the usable conservation storage capacity of 15,000,000 acre-feet afforded by the 117 major conservation storage reservoirs existing in Texas on October 1, 1963.

Records of daily water levels and content of many of the reservoirs listed are collected and published in annual water-supply papers by the U. S. Geological Survey in cooperation with the Texas Water Commission and other State and Federal agencies. Unpublished data for these and other reservoirs are available in the files of the Water Commission. The published data are available for public use at offices of the Water Commission and the Geological Survey in Austin; at Geological Survey subdistrict field offices in Wichita Falls, Houston, Fort Worth, San Angelo and San Antonio; and at most public, university, college, and water-related agency libraries across the State.

(The map following the tabulation of reservoirs shows the locations and names of the reservoirs listed. The outline of each reservoir is plotted to scale and represents the water level at top of the conservation storage space.)

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
CANADIAN RIVER BASIN												
Rita Blanca, Lake	1939	Rita Blanca Creek	3 mi S of Dalhart, Hartley County	City of Dalhart	R	1,062	524	3860.0		12,100		12,100
Sanford Reservoir (Meredith, Lake)	*	Canadian River	10 mi NW of Borger, Hutchinson County	Canadian River Municipal Water Authority, Bureau of Reclamation	M,I, FC	20,220	16,500c 21,630s	2936.5c 2965.0s	43,100	820,900	544,000	1,408,000
RED RIVER BASIN												
Buffalo Lake	1938	Tierra Blanca Creek	2 mi S of Umbarger, Randall County	U.S. Fish and Wild Life Service	R	2,075	1,900	3642.5		18,150		18,150
Bivins Lake (Amarillo City Lake)	1926	Palo Duro Creek	8 mi NW of Canyon, Randall County	City of Amarillo	M	982	379	3634.7		5,120		5,120
Baylor Creek Reservoir	1949	Baylor Creek	10 mi NW of Childress, Childress County	City of Childress	M	40	610	2010.0		9,220		9,220
Kemp, Lake	1922	Wichita River	6 mi N of Maybelle, Baylor County	City of Wichita Falls, A/	M,I, Ir	2,086	20,620	1153.0		461,800		461,800
Diversion Lake	1924	Wichita River	14 mi W of Holliday, Archer County	City of Wichita Falls, A/	M,Ir	-	3,420	1051.5		40,000		40,000
Santa Rosa Lake	1929	Beaver Creek	15 mi S of Vernon, Wilbarger County	W. T. Waggoner Estate	Mi	336	1,500	1150e		11,570		11,570
Wichita, Lake	1901	Holliday Creek	6 mi SW of Wichita Falls, Wichita County	City of Wichita Falls	M,Ir	143	2,200	980.5	3,000	11,000		14,000
Kickapoo, Lake	1946	North Fork Little Wichita River	10 mi NW of Archer City, Archer County	City of Wichita Falls	M	275	6,200	1045.0		106,000		106,000
Farmers Creek Reservoir (Nocona, Lake)	1960	Farmers Creek	8 mi NE of Nocona, Montague County	North Montague County Water Supply District	M,I, Mi	94	1,470	827.0	1,000	24,400		25,400
Texoma, Lake	1943	Red River	5 mi N of Denison, Grayson County	Corps of Engineers	M,I, P,FC	39,719	91,200c 144,100s	617.0c 640.0s	1,106,000	1,730,300	2,694,000	5,530,300 1/
Randall, Lake	1909	Shawnee Creek	4 mi NW of Denison, Grayson County	City of Denison	M	11	172	640.0		5,400		5,400
Brushy Creek Reservoir	1961	Brushy Creek (Red River off-channel)	3 mi N of Savoy, Fannin County	Texas Power & Light Company	I	8	1,180	610.0		16,800		16,800
Coffee Mill, Lake	1938	Coffee Mill Creek	12 mi NW of Honey Grove, Fannin County	U.S. Forest Service	R	39	704	496.0		8,000		8,000
Crook, Lake	1923	Pine Creek	5 mi N of Paris, Lamar County	City of Paris	M	52	1,226	476.0		9,960		9,960
SULPHUR RIVER BASIN												
River Crest Reservoir	1953	Sulphur River Off-channel	7 mi SE of Bogata, Red River County	Texas Power & Light Company	I	-	560	328.0		7,200		7,200

A/ Wichita County Water Control and Improvement District No. 2.

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
SULPHUR RIVER BASIN--Continued												
Texarkana Reservoir	1956	Sulphur River	11 mi SW of Texarkana, Bowie County	Corps of Engineers	M,FC	3,443	20,000c 119,700s	220.0c 259.5s		145,300	2,509,000	2,654,300
CYPRESS CREEK BASIN												
Ellison Creek Reservoir	1943	Ellison Creek	8 mi S of Daingerfield, Morris County	Lone Star Steel Company	I	37	1,516	258.1	200	24,500		24,700
Johnson Creek Reservoir	1961	Johnson Creek	13 mi NW of Jefferson, Marion County	Southwestern Electric Power Company	I	11	650	280.0		10,100		10,100
Lake O' the Pines	1957	Cypress Creek	8 mi W of Jefferson, Marion County	Corps of Engineers, Northeast Texas Mun. Water District	M,FC	850	18,680c 19,780r 38,200s	228.5c 230.0r 249.5s	2,860	252,040 280,840r	587,200 558,400r	842,100
Caddo Lake	1914	Cypress Creek	29 mi NE of Marshall, Harrison County	Corps of Engineers	M, Nav	2,639T	32,700 11,000T	168.5		175,000 58,000T		175,000 58,000T
SABINE RIVER BASIN												
Tawakoni, Lake	1960	Sabine River	9 mi NE of Wills Point, Van Zandt County	Sabine River Authority	M,I, Ir	756	36,700	437.5		936,200		936,200
Holbrook, Lake	1962	Keys Creek	4 mi NW of Mineola, Wood County	Wood County	R	15	653	372.0	200	7,790		7,990
Quitman, Lake	1962	Dry Creek	4 mi N of Quitman, Wood County	Wood County	R	31	814	395.0		7,440		7,440
Hawkins, Lake	1962	Little Sandy Creek	3 mi NW of Hawkins, Wood County	Wood County	R	30	716	342.0	300	10,040		10,340
Winnsboro, Lake	1962	Big Sandy Creek	6 mi SW of Winnsboro, Wood County	Wood County	R	31	720	417.0		6,580		6,580
Gladewater, Lake	1952	Glade Creek	In NW Gladewater, Gregg and Upshur Counties	City of Gladewater	M	35	800	300.0		6,950		6,950
Cherokee, Lake	1948	Cherokee Bayou	12 mi SE of Longview, Gregg County	Cherokee Water Co. City of Longview	M,I, R	158	3,987	280.0	4,510	42,190		46,700
Murvaul Lake	1957	Murvaul Bayou	10 mi SW of Carthage, Panola County	Panola County Fresh Water Supply District No.1	M,I	115	3,820	265.3	20	45,820		45,840
Toledo Bend Reservoir	*	Sabine River	14 mi NE of Burkeville, Newton County	Sabine River Authority	M,I, Ir,P	7,178	181,600n 80,000Tn 186,500m	172.0n 173.0m	4,100	4,472,900n 4,382,300p 4,655,900m		4,661,000[2]
NECHES RIVER BASIN												
Flat Creek Reservoir	1962	Flat Creek	8 mi E of Athens, Henderson County	Athens Municipal Water Authority	M	22	1,520	440.0	5,850	26,990		32,840
Palestine, Lake (Blackburn Crossing)	1962	Neches River	4 mi E of Frankston, Anderson County	Upper Neches River Municipal Water Authority	M,I	839	4,000n 6,800m	317.0n 322.0m	550	29,950n 57,000n		57,550

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
				NECHES RIVER BASIN--Continued								
Jacksonville, Lake (Gum Creek)	1957	Gum Creek	5 mi SW of Jacksonville, Cherokee County	City of Jacksonville	M,R	40	1,320	422.0		30,500		30,500
Striker Creek Reservoir	1957	Striker Creek	18 mi SW of Henderson, Rusk County	Angelina-Nacogdoches Counties WCID No. 1	M,I	182	2,400	292.0		26,700		26,700
Tyler, Lake	1949	Prairie Creek	12 mi SE of Tyler, Smith County	City of Tyler	M,I	45	2,450	375.5	4,400	39,000		43,400
Kurth, Lake	1960	Angelina River Off-channel	8 mi N of Lufkin, Angelina County	Southland Paper Mills, Inc.	I	4	800	197.5		16,200		16,200
McGee Bend Reservoir (Rayburn, Lake)	*	Angelina River	11 mi NW of Jasper, Jasper County	Corps of Engineers, LNVA	M,I,Ir, P,FC	3,449	114,550c 150,730e	164.0c 176.0e		2,891,900 2,848,700p	1,586,900	4,478,800
Dam B Reservoir	1951	Neches River	1 mi N of Town Bluff, Tyler County	Corps of Engineers, Lower Neches Valley Authority (LNVA)	M,I, Ir	7,573	13,700n 16,830m	83.0n 85.0m		94,200n 124,700m		124,700
				TRINITY RIVER BASIN								
Bridgeport Reservoir	1932	West Fork Trinity River	4 mi W of Bridgeport, Wise County	Tarrant County WCID No. 1	M,I, Ir	1,111	10,400c (18,200)	826.2c (853.1)		270,900	(395,000)	270,900
Amon G. Carter, Lake	1956	Big Sandy Creek	6 mi S of Bowie, Montague County	City of Bowie	M,I	100	1,540	920.0		20,050		20,050
Eagle Mountain Reservoir	1934	West Fork Trinity River	14 mi NW of Fort Worth, Tarrant County	Tarrant County WCID No. 1	M,I Ir	1,970	8,500c (19,000)	649.1c (676.0)	150	182,550	(365,200)	182,700
Worth, Lake	1914	West Fork Trinity River	In Fort Worth, Tarrant County	City of Fort Worth	M	2,064	3,267	594.3		33,660		33,660
Weatherford Lake	1957	Clear Fork Trinity River	7 mi E of Weatherford, Parker County	City of Weatherford	M,I	109	1,280	896.0	600	19,000		19,600
Benbrook Reservoir	1952	Clear Fork Trinity River	10 mi SW of Fort Worth, Tarrant County	Corps of Engineers	Nav, FC	429	3,770c 5,820e (7,630)	694.0c 710.0e (724.0)	10	88,240	76,550 (93,800)	164,800
Arlington, Lake	1957	Village Creek	7 mi W of Arlington, Tarrant County	City of Arlington	M,I	143	2,275	550.0	180	45,530		45,710
Mountain Creek Lake	1937	Mountain Creek	4 mi SE of Grand Prairie, Dallas County	Dallas Power & Light Company	I	295	2,940	458.0		27,000		27,000
Garza-Little Elm Reservoir	1954	Elm Fork Trinity River	2 mi NE of Lewisville, Denton County	Corps of Engineers, Dallas and others	M,I, FC	1,660	22,970c 38,900e	515.0c 532.0e	240	481,760	520,900	1,002,900
Grapevine Reservoir	1952	Denton Creek	2 mi NE of Grapevine, Tarrant County	Corps of Engineers, Dallas and others	M,I,Nav, R,FC	695	7,380c 12,740e	535.0c 560.0e	830	187,670	247,000	435,500
North Lake	1957	South Fork Grapevine Creek	2 mi SE of Coppell, Dallas County	Dallas Power & Light Company	I	3	820	510.0		17,000		17,000
White Rock Lake	1911	White Rock Creek	In NE Dallas, Dallas County	City of Dallas	R	100	1,095	458.1		12,300		12,300
Lavon Reservoir	1953	East Fork Trinity River	2 mi W of Lavon, Collin County	Corps of Engineers, North Texas Municipal Water District	M,I, FC	770	11,080c 20,050e	472.0c 490.0e	14,330	129,270	279,800	423,400

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
TRINITY RIVER BASIN--Continued												
Forney Reservoir	*	East Fork Trinity River	4 mi N of Forney, Kaufman County	City of Dallas	M	1,071	22,740	435.5		490,000		490,000
Trinidad Lake	1925	Trinity River Off-channel	2 mi S of Trinidad, Henderson County	Texas Power & Light Company	I	-	753	285.0		7,800		7,800
Terrell Reservoir	1955	Muddy Cedar Creek	5 mi E of Terrell, Kaufman County	City of Terrell	M	14	885	503.0		8,300		8,300
Cedar Creek Reservoir	*	Cedar Creek	3 mi NE of Trinidad, Henderson County	Tarrant County WCID No. 1	M,I	1,007	34,000	322.0		678,900		678,900
Navarro Mills Reservoir	1963	Richland Creek	16 mi SW of Corsicana, Navarro County	Corps of Engineers, Trinity River Auth.	M,FC	320	5,070c 11,700s	424.5c 443.0s	2,400	60,900	148,900	212,200
Waxahachie, Lake	1956	South Prong Waxahachie Creek	4 mi S of Waxahachie, Ellis County	Ellis County WCID No. 1	M,I	30	645	531.5	1,500	12,000		13,500
Bardwell Reservoir	*	Waxahachie Creek	3 mi SE of Bardwell, Ellis County	Corps of Engineers, Trinity River Auth.	M,FC	176	3,570c 6,040s	421.0c 439.0s	1,320	53,550	85,130	140,000
Halbert, Lake	1921 1950	Elm Creek	4 mi SE of Corsicana, Navarro County	City of Corsicana	M	12	650	368.0		7,420		7,420
Anahuac Lake	1953	Turtle Bay	In Anahuac, Chambers County	Chambers-Liberty Counties Navigation District	Ir	199	5,300	5.0		35,300		35,300
SAN JACINTO RIVER BASIN												
Honea Reservoir	**	West Fork San Jacinto River	7 mi NW of Conroe, Montgomery County	San Jacinto River Authority	M,I, Mi	445	17,600	201.0		380,400		380,400
Houston, Lake	1954	San Jacinto River	4 mi N of Sheldon, Harris County	City of Houston	M,I, Ir,Mi,R	2,828	12,500	43.8	7,300	150,900		158,200
Sheldon Reservoir	1943	Carpenters Bayou	2 mi SW of Sheldon, Harris County	Texas Parks and Wildlife Department	FW	9	1,200	50.5		5,420		5,420
BRAZOS RIVER BASIN												
Buffalo Springs, Lake	1960	North Fork Double Mountain Fork Brazos River	9 mi SE of Lubbock, Lubbock County	Lubbock County WCID No. 1	M,I, R	6,000e	225	3011.8		5,360		5,360
White River Reservoir	*	White River	16 mi SE of Crosbyton, Crosby County	White River Municipal Water District	M,I, Mi	172	1,808	2369.0	200	38,000		38,200
Sweetwater, Lake	1930	Bitter and Cottonwood Creeks	5 mi SE of Sweetwater, Nolan County	City of Sweetwater	M,I	104	630	2116.5		11,900		11,900
Abilene, Lake	1921	Elm Creek	6 mi NW of Tuscola, Taylor County	City of Abilene	M	102	641	2018.8		9,790		9,790
Kirby Lake	1928	Cedar Creek	5 mi S of Abilene, Taylor County	City of Abilene	M,Ir	44	740	1785.0		7,620		7,620
Fort Phantom Hill Reservoir	1938	Elm Creek	5 mi S of Nugent, Jones County	City of Abilene	M,I	478	4,246	1635.9		74,310		74,310

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH

October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
				BRAZOS RIVER BASIN--Continued								
Stamford, Lake	1953	Paint Creek	10 mi SE of Haskell, Haskell County	City of Stamford	M,I	360	5,125	1416.8	430	59,570		60,000
Cisco, Lake	1925	Sandy Creek	4 mi N of Cisco, Eastland County	City of Cisco	M	26	445l 1,050s	1496.0l 1520.0s		8,800l		25,600
Hubbard Creek Reservoir	1962	Hubbard Creek	6 mi NW of Breckenridge, Stephens County	West Central Texas Municipal Water District	M,I, Mi	1,107	15,250	1183.0		320,000		320,000
Daniel, Lake	1948	Gonzales Creek	7 mi S of Breckenridge, Stephens County	City of Breckenridge	M,I	115	950	1278.0	400	9,600		10,000
Graham Lake	1929 1958	Flint and Salt Creeks	2 mi NW of Graham Young County	City of Graham	M,I	212	2,550	1075.0		52,500		52,500
Possum Kingdom Reservoir	1941	Brazos River	11 mi SW of Graford, Palo Pinto County	Brazos River Authority	M,I, Ir,Mi P,R	22,550	19,800	1000.1	240	724,460 698,900p		724,700
Palo Pinto Creek Reservoir	*	Palo Pinto Creek	15 mi SW of Mineral Wells, Palo Pinto County	Palo Pinto County Municipal Water District No. 1	M,I	471	2,275	863.0	1,900	32,350		34,250
Mineral Wells, Lake	1921 1943	Rock Creek	4 mi E of Mineral Wells, Palo Pinto County	City of Mineral Wells	M,I	63	646	863.0		8,420		8,420
Cleburne Reservoir	*	Nolands River	6 mi S of Cleburne, Johnson County	City of Cleburne	M	92	1,545	733.5		25,600		25,600
Whitney Reservoir	1951	Brazos River	7 mi SW of Whitney Hill County	Corps of Engineers	P,FC	26,170	15,800c 49,710s	520.0c 571.0s	5,140	381,860 343,500p	1,630,500	2,017,500
Waco, Lake	1929	Bosque River	2 mi W of Waco, McLennan County	City of Waco	M,I	1,649	2,742	430.0		22,030		22,030[3/]
Waco Reservoir Enlargement	*	Bosque River	2 mi W of Waco, McLennan County	Corps of Engineers	M,I, FC	1,652	7,260c 19,440s	455.0c 500.0s		157,700	574,600	732,300[3/]
Lake Creek Reservoir	1952	Manos Creek (Brazos River off-channel)	4 mi SW of Riesel, McLennan County	Texas Power & Light Company	I	14	550	405.0	300	8,100		8,400
Leon Reservoir	1954	Leon River	7 mi S of Ranger, Eastland County	Eastland County Water Supply District	M,I	252	1,590	1375.0	870	26,420		27,290
Proctor Reservoir	*	Leon River	9 mi NE of Comanche, Comanche County	Corps of Engineers, Brazos River Auth.	M,I, Ir,FC	1,265	4,610c 14,010s	1162.0c 1197.0s	70	59,330	314,800	374,200
Belton Reservoir	1954	Leon River	4 mi NW of Belton, Bell County	Corps of Engineers Brazos River Authority	M,I, Ir,FC	3,560	7,400c 12,300x 23,620s	569.0c 594.0x 631.0s	280	210,320 457,320x	887,000 640,000x	1,097,600
Stillhouse Hollow Reservoir	*	Lampasas River	5 mi SW of Belton, Bell County	Corps of Engineers Brazos River Authority	M,I, Ir,FC	1,318	6,430c 11,830s	622.0c 666.0s	780	234,920	394,700	630,400
Alcoa Lake	1953	Sandy Creek (Little River off-channel)	7 mi SW of Rockdale, Milam County	Aluminum Company of America	I	9	703	464.0		10,500		10,500
Somerville Reservoir	*	Yegua Creek	2 mi S of Somerville, Burleson County	Corps of Engineers Brazos River Authority	M,I, Ir,FC	1,006	11,460c 24,400s	238.0c 258.0s	220	159,880	347,400	507,500
Mexia, Lake	1961	Navasota River	7 mi SW of Mexia, Limestone County	Bistone Municipal Water District	M,I	198	1,200	448.3	1,000	9,000		10,000

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
				BRAZOS RIVER BASIN--Continued								
Camp Creek Lake	1948	Camp Creek	13 mi E of Franklin, Robertson County	Camp Creek Water Company	R	40	750	310.0	270	8,280		8,550
Smithers Lake	1957	Dry Creek	10 mi SE of Richmond, Fort Bend County	Houston Lighting & Power Company	I	24	2,140	66.0		18,000		18,000
Harris Reservoir, William	1947	Brazos River & Oyster Creek Off-channel	8 mi NW of Angleton, Brazos County	Dow Chemical Company	M,I	-	1,663	43.0	900	11,100		12,000
Eagle Nest and Manor Lake	1949	Unnamed Tributary to Varner's Creek	5 mi N of West Columbia, Brazoria County	T. M. Smith, et al	Ir	32	4,305	32.5		18,000		18,000
Brazoria Reservoir	1954	Brazos River Off-channel	1 mi NE of Brazoria, Brazoria County	Dow Chemical Company	M,I	-	1,865	32.5	650	21,320		21,970
				COLORADO RIVER BASIN								
Thomas, Lake J. B.	1952	Colorado River	15 mi SW of Snyder, Scurry County	Colorado River Municipal Water District	M,I Mi,R	3,524	7,820	2258.0	1,300	202,300		203,600
Colorado City, Lake	1949	Morgan Creek	6 mi SW of Colorado City, Mitchell County	Texas Electric Service Company	M,I	322	1,655	2070.1	200	30,800		31,000
Champion Creek Reservoir	1958	Champion Creek	7 mi S of Colorado City, Mitchell County	Texas Electric Service Company	M,I	203	1,560	2083.0	880	41,620		42,500
Oak Creek Reservoir	1953	Oak Creek	5 mi SE of Blackwell Coke County	City of Sweetwater	M,I	244	2,375	2000.0	100	39,260		39,360
Twin Buttes Reservoir	1962	Middle and South Concho Rivers	8 mi SW of San Angelo, Tom Green County	San Angelo Water Supply Corp., Bureau of Reclamation	M,I, Ir,FC	3,724	8,440c 22,700s	1940.2c 1969.1s	5,100	164,900	430,000	600,000
Nasworthy, Lake	1930 1948	South Concho River	6 mi SW of San Angelo, Tom Green County	City of San Angelo	M,I, Ir	3,833	1,596	1872.2		12,390		12,390
San Angelo Reservoir	1952	North Concho River	3 mi NW of San Angelo, Tom Green County	Upper Colorado River Authority, Corps of Engineers	M,Ir, Mi,R, FC	1,488	5,440c 12,700s	1908.0 1938.5		119,200	277,200	396,400
Hords Creek Reservoir	1948	Hords Creek	5 mi NW of Valera, Coleman County	Corps of Engineers, City of Coleman	M,FC	48	510 (1,260)	1900.0 (1920.0)		8,640	(16,670)	8,640
Brownwood Reservoir	1932	Pecan Bayou	8 mi N of Brownwood, Brown County	Brown County WID No. 1	M,I, Ir	1,535	7,300	1424.6		143,400		143,400
Brady Reservoir	1963	Brady Creek	3 mi W of Brady, McCulloch County	City of Brady & Soil Conservation Service	M,I	508	2,020 (4,464)	1743.0c (1762.4)	1,320	29,110	(60,050)	30,430
Buchanan Reservoir	1937	Colorado River	11 mi W of Burnet, Burnet County	Lower Colorado River Authority	M,I, Ir,Mi, P	31,250	23,200	1020.5	36,800	955,200p		992,000
Inks Lake	1938	Colorado River	10 mi W of Burnet, Burnet County	Lower Colorado River Authority	P	31,290	830	888.0		17,000		17,000
Granite Shoals Lake	1951	Colorado River	4 mi SW of Marble Falls, Burnet County	Lower Colorado River Authority	P	36,290	6,200n 6,400m	825.0n 826.0m	21,200	117,300n 124,000m		145,200

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
COLORADO RIVER BASIN--Continued												
Marble Falls Lake	1951	Colorado River	In Marble Falls, Burnet County	Lower Colorado River Authority	P	36,325	780	738.0		8,760		8,760
Travis, Lake	1940	Colorado River	13 mi NW of Austin, Travis County	Lower Colorado River Authority	M,I, Ir,Mi, P,FC	38,130	18,930c 29,000s	581.1c 714.1s	27,900	1,144,100 1,117,200p	778,000	1,950,000
Austin, Lake	1939	Colorado River	In Austin, Travis County	Lower Colorado River Authority	M,I, P	38,240	1,830	492.8	1,000	20,000		21,000
Bastrop, Lake	*	Spicer Creek (Colorado River off-channel)	3 mi NE of Bastrop, Bastrop County	Lower Colorado River Authority	I	9	906	450.0		16,590		16,590
Eagle Lake	Natural	Colorado River Off-channel	At Eagle Lake Colorado County	Lakeside Irrigation Company	Ir	20	1,200	170.0		9,600		9,600
GUADALUPE RIVER BASIN												
Canyon Reservoir	*	Guadalupe River	12 mi NW of New Braunfels, Comal County	Guadalupe-Blanco River Authority, Corps of Engineers	M, FC	1,418	8,240c 12,890s	909.0c 943.0s	640	385,560	354,700	740,900
Dunlap, Lake	1928	Guadalupe River	9 mi NW of Seguin, Guadalupe County	Texas Power Corporation	P	1,653	406	575.0	2,350	3,550		5,900
McQueeney, Lake	1928	Guadalupe River	5 mi W of Seguin, Guadalupe County	Texas Power Corporation	P	1,684	396	528.0		5,000		5,000
H-4 Reservoir	1931	Guadalupe River	4 mi SE Belmont, Gonzales County	Texas Hydro-Electric Corporation	P	2,038	800	331.0	1,300	5,400		6,700
SAN ANTONIO RIVER BASIN												
Medina Lake	1913	Medina River	8 mi NW of Rio Medina, Medina County	Bexar-Medina-Atascosa Counties WID No. 1	Ir	634	5,575	1064.5		254,000		254,000
East Lake (Victor Braunig Lake)	1962	Arroyo Seco (San Antonio R. off-channel)	15 mi SE of San Antonio, Bexar County	City of San Antonio	I	9	1,350	507.0		26,500		26,500
NUECES RIVER BASIN												
Upper Nueces Reservoir	1947	Nueces River	6 mi N of Crystal City, Zavala County	Zavala-Dimmit Counties WID No. 1	Ir	2,160e	316	598.0		7,590		7,590
Corpus Christi, Lake	1958	Nueces River	4 mi SW of Mathis, San Patricio County	Lower Nueces River Water Supply District	M,I, Ir,Mi, R	16,656	15,500 22,050z	88.0 94.0z	140	185,760 301,960z		185,900 302,100z
RIO GRANDE BASIN												
San Estaban Lake	1911	Alamito Creek	10 mi S of Marfa, Presidio County	Mrs. Pearle M. Robinson	Ir	-	762	4461.0		18,770		18,770
Red Bluff Reservoir	1936	Pecos River	5 mi N of Orla, Reeves County	Red Bluff Water Power Control District	Ir,P	20,720	11,700	2841.7	3,000	307,000		310,000
Balmorhea, Lake	1917	Sandia Creek (Toyah Creek off-channel)	3 mi SE of Balmorhea, Reeves County	Reeves County WID No. 1	Ir	22	573	3187.0	500	5,850		6,350

MAJOR CONSERVATION STORAGE RESERVOIRS IN TEXAS WITH CAPACITY OF 5000 ACRE-FEET OR MORE EACH
October 1, 1963

Name	Year Operation Began	Stream	Location	Owner or Operator	Use	Drainage Area (Sq Mi)	Surface Area (Acres)	Surface Elevation (Feet)	Storage Capacity, in Acre-Feet			
									Dead	Conservation	Flood Control	Total
				RIO GRANDE BASIN—Continued								
Devils Lake	1928	Devils River	16 mi N of Del Rio, Val Verde County	Central Power & Light Company	P	4,053	406	1042.3		9,200		9,200
Walk, Lake	1929	Devils River	11 mi NW of Del Rio, Val Verde County	Central Power & Light Company	P	4,104	380	1001.0		5,400		5.400
Amistad Reservoir	*	Rio Grande	12 mi NW of Del Rio, Val Verde County	International Boundary and Water Commission	M,I, Ir,P, FC	126,423 82,690U	67,000c 43,200T 84,000s	1117.0c 1140.4s	15,000	3,535,000 1,986,700T	1,775,000	5,325,000 2,992,600T
Casa Blanca Lake	1949	Chacon Creek	3 mi NE of Laredo, Webb County	Webb County	M	117	1,656	446.5		20,000		20,000
International Falcon Reservoir	1953	Rio Grande	3 mi W of Falcon Heights, Starr County	International Boundary and Water Commission	M,I, Ir,P, FC	164,482 87,760U	78,340c 36,000T 87,700w 98,960s	296.4c 301.2w 306.7s	2,820	2,368,400 1,387,900T 2,768,400w 1,620,000Tw	909,480 509,480w	3,280,700 1,922,500T
				COASTAL BASINS								
Big Hill Reservoir	⁄	Big Hill Bayou Off-channel	At Port Acres, Jefferson County	Texas Parks and Wildlife Department	FW	-	7,284	6.0		32,000		32,000
Highlands Reservoir	1943	Goose Creek (San Jacinto R. off-channel)	2 mi E of Highlands, Harris County	San Jacinto River Authority	M,I	-	1,407	48.0		5,580		5,580
Tranquitas Reservoir	-	Tranquitas Creek	5 mi NW of Kingsville, Kleberg County	King Ranch	D	-	400	100e		6,000		6,000
Monte Alto Reservoir (Willacy Reservoir)	1939	Rio Grande Off-channel	4 mi N of Monte Alto, Hidalgo County	Hidalgo and Willacy Counties WCID No. 1	Ir	-	2,371	56.5		25,000		25,000
Valley Acres Reservoir	1951	Rio Grande Off-channel	7 mi N of Mercedes, Hidalgo County	Valley Acres Water District	Ir	-	906	62.0		7,840		7,840
Loma Alta Reservoir	1962	Rio Grande Off-channel	8 mi NE of Brownsville, Cameron County	Brownsville Navigation District	M,I	-	2,490	17.5		25,500		25,500

* Under construction. ** Active preconstruction planning.
⁄ Partially completed multiple-stage construction.
c At top of conservation storage space.
e Estimated
i Water level and storage limited by injunction obtained by Missouri-Kansas-Texas Railroad Co.
m Maximum usable conservation capacity.
n At normal maximum operating level.
p Conservation content which can be released through powerplant.
r Normal maxima May-September.
s At top of flood-control storage space.
w Normal winter-operating maxima.
x These amounts will result from reassignment of flood-control storage capacity when Proctor Reservoir is completed.
z Additional storage capacity available when needed. The dam has two gated spillways, one of which is fixed open at present.
T In Texas or Texas share.

U In the United States.
() At spillway crest providing partial control above controlled outlet.
1/ Water shared between Texas and Oklahoma.
2/ Water divided equally between Texas and Louisiana.
3/ Capacity of existing Lake Waco combined with Lake Waco Enlargement and considered as one reservoir.

Note.--Conservation capacities shown are amounts between lowest outlet and top of conservation storage space# The principal and/or permitted use of impounded waters is indicated by the following symbols:
D, domestic; M, municipal; I, industrial; Ir, irrigation; Mi, mining; P, hydroelectric power; Nav, navigation; R, recreation; FC, flood control; FW, fish and wildlife.
Abbreviations used under the column headed OWNER or OPERATOR are as follows: WCID, water control and improvement district; WID, water improvement district. Elevations are above mean sea level.

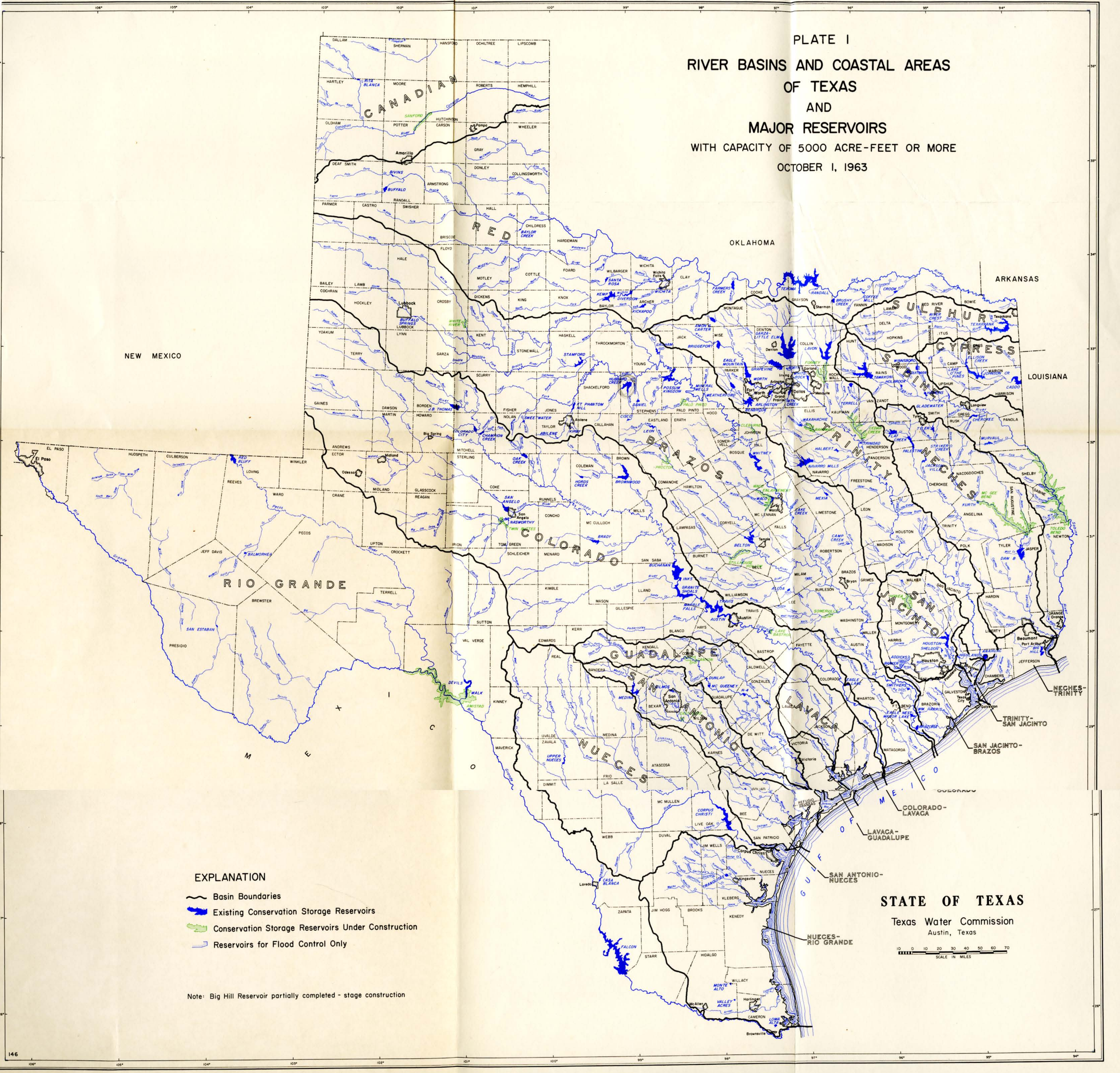
\# Except in Striker Creek Reservoir, East Lake and Lake Bastrop.

PLATE I

RIVER BASINS AND COASTAL AREAS OF TEXAS AND MAJOR RESERVOIRS

WITH CAPACITY OF 5000 ACRE-FEET OR MORE

OCTOBER 1, 1963



Note: Big Hill Reservoir partially completed - stage construction

STATE OF TEXAS

Texas Water Commission
Austin, Texas