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COLORADO RIVER SYSTEM CONSUMPTIVE USES AND LOSSES REPORT 1976 - 1980

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UNITED STATES DEPARTMENT OF THE INTERIOR
James G. Watt, Secretary

BUREAU OF RECLAMATION
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UPPER COLORADO REGION
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LOWER COLORADO REGION
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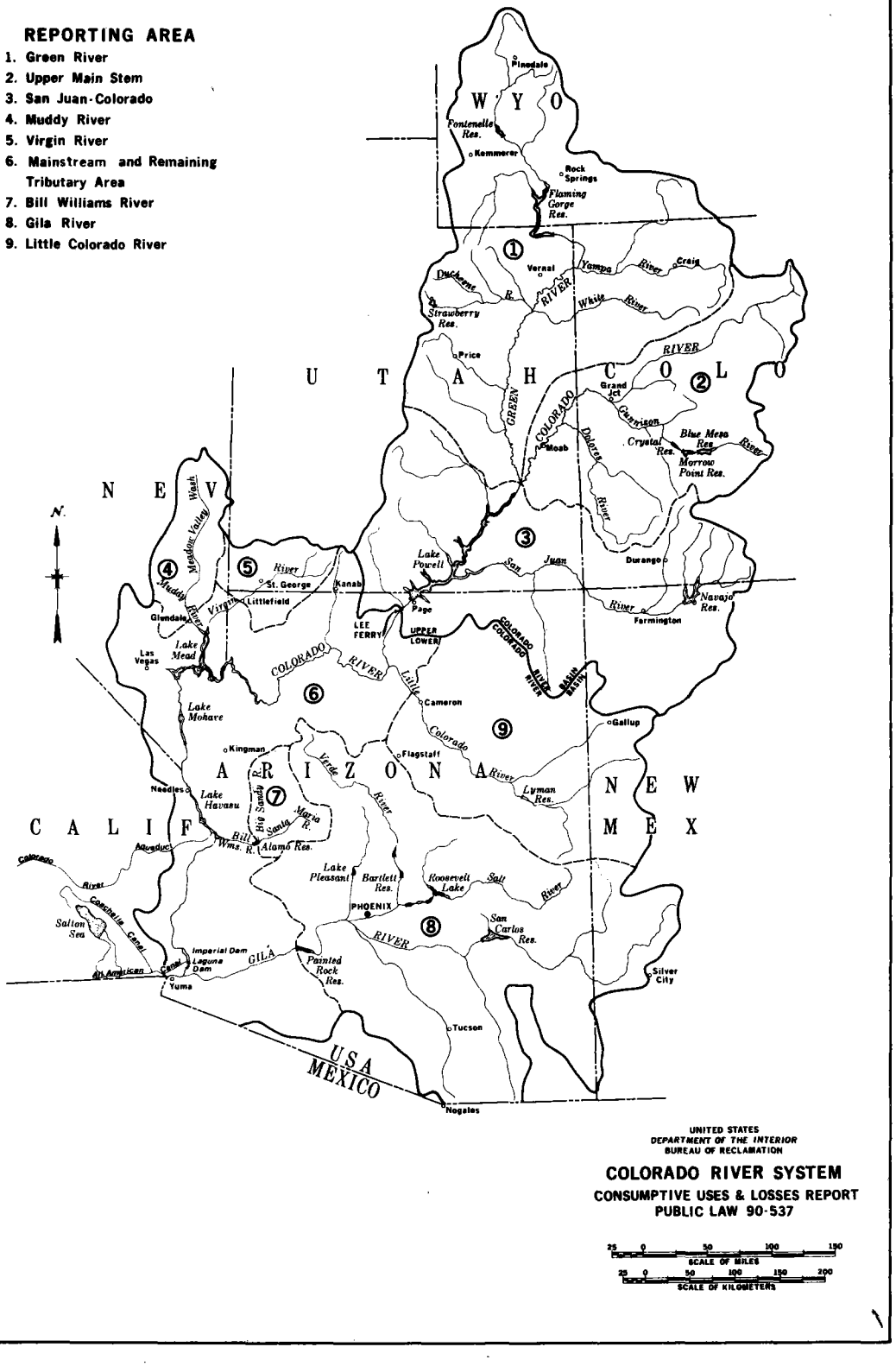
As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

This report was prepared pursuant to the Colorado River Basin Project Act of 1968, Public Law 90-537. The act directs the Secretary of the Interior to "make reports as to the annual consumptive uses and losses of water from the Colorado River System after each successive five-year period, beginning with the five-year period starting October 1, 1970....Such reports shall be prepared in consultation with the States of the lower Basin individually and with the Upper Colorado River Commission and shall be transmitted to the President, the Congress, and to the Governors of each State signatory to the Colorado River Compact."

This report reflects the Department of the Interior's best estimate of actual consumptive uses and losses within the Colorado River Basin. The reliability of the estimate is affected by the availability of data and the current capabilities of data evaluation.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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER SYSTEM
CONSUMPTIVE USES & LOSSES REPORT
PUBLIC LAW 90-537
SCALE OF MILES
SCALE OF KILOMETERS

SUMMARY

This report presents estimates of the consumptive uses and losses from the Colorado River system for each year from 1976 to 1980. It includes a breakdown of the beneficial consumptive use by major types of use, by major tributary streams, and, where possible, by individual States.

The main stem of the Colorado River rises in the Rocky Mountains of Colorado, flows southwesterly about 1,400 miles and terminates in the Gulf of California. Its drainage area of 242,000 square miles in this country represents one-fifteenth of the area the United States. Water is used for irrigation, municipal and industrial purposes, electric power generation, mineral activities, livestock, fish and wildlife, and recreation. Large amounts are exported from the system to adjoining areas. The following table summarizes annual water use from the system by basins and States, including water use supplied by ground water overdraft. Distribution of water use by types of use from the various reporting areas is contained within the body of the report.

SUMMARY

Water Use by States [1/]

1976-1980

(1,000 acre-feet)

State	1976	1977	1978	1979	1980	Average 1976-1980
Arizona	5,033	5,369	5,351	5,409	5,641	5,361
California	4,813	4,837	4,624	4,591	4,680	4,709
Colorado	1,679	1,608	1,937	1,824	1,744	1,758
Nevada	226	227	224	228	233	228
New Mexico	310	239	361	432	457	360
Utah	705	462	746	798	738	690
Wyoming	282	219	333	348	337	304
Other[2/]	1,931	1,832	1,887	2,070	2,063	1,956
Total - Colorado River System	14,979	14,793	15,463	15,700	15,893	15,366
Water Passing to Mexico						
Treaty	1,475	1,554	1,513	1,668	1,707	1,583
Minute 242	205	209	194	171	185	193
Excess Releases	69	68	38	927	4,251	1,071
Total - Water Passing to Mexico	1,749	1,831	1,745	2,766	6,143	2,847
Total - Colorado River System and Water Passing to Mexico	16,728	16,624	17,208	18,466	22,036	18,213

1/ On site consumptive uses and losses; includes water uses satisfied by ground water overdrafts.

2/ Represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin.

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COLORADO RIVER SYSTEM

CONSUMPTIVE USES AND LOSSES REPORT

1976-1980

Introduction

The Colorado River system is composed of portions of seven States - Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. It has a drainage area of about 242,000 square miles and represents about one-fifteenth of the area of the United States. This report incorporates annual estimates of consumptive uses and losses of water from the system from 1976 to 1980. Wherever available, water use reports prepared in accordance with legal requirements concerning the operation of the Colorado River were utilized. Base data needed to estimate onsite consumptive uses were taken largely from existing reports and studies and from ongoing programs. Where current data were not available, estimated values were developed by various techniques and reasoned judgment. In general, methodology followed the techniques normally used within the system for estimating water use. Nothing in this report is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Water Treaty of 1944 with the United Mexican States (Treaty Series 994; 59 Stat. 1219), the decree entered by the Supreme Court of the United States in Arizona v. California, et al. (376 U.S. 340), the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), the Colorado River Storage Project Act, (70 Stat. 105; 43 U.S.C. 620), or the Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501).

Authority

The authority for this report is contained in Public Law 90-537, the Colorado River Basin Project Act of 1968. Title VI, Section 601(b)(1) of the act reads as follows:

> (b) The Secretary is directed to-
> (1) Make reports as to the annual consumptive uses and losses of water from the Colorado River system after each successive five-year period, beginning with the five-year period starting October 1, 1970. Such reports shall include a detailed breakdown of the beneficial consumptive use of water on a State-by-State basis. Specific figures on quantities consumptively used from the major tributary streams flowing into the Colorado River shall also be included on a State-by-State basis. Such reports shall be prepared in consultation with the States of the lower basin individually and with the Upper Colorado River Commission, and shall be transmitted to the President, the Congress, and to the Governors of each State signatory to the Colorado River Compact.

Plan of Study

A proposed plan of study was presented for comment to representatives of the Upper and Lower Basin States and the Upper Colorado River Commission. Comments received principally concerned water accounting procedures. This issue is longstanding and is related to the interpretation and implementation of the legal documentary controlling the operation of the river. In the Upper Basin, the principal comment concerned the use of accurate data bases, particularly irrigated acreage. The Lower Basin comments concerned the lack of credit for unmeasured return flows originating from mainstream diversions and the failure to quantitatively recognize that ground water overdraft in the

Gila River Basin satisfies a major portion of the beneficial consumptive use. To the degree possible, these concerns are addressed within this report.

Study Reporting Areas

The estimated drainage area of the Colorado River System in the United States is about 242,000 square miles. The river originates in the Rocky Mountains of Colorado and Wyoming, flows southwest about 1,400 miles, and terminates in the Gulf of California. The system consists of portions of seven States: Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming. The drainage area was divided into ten sub-basins for the purpose of this report.

The major tributary streams selected as reporting areas in the Upper Colorado River Basin are: Green River (Wyoming, Utah, Colorado); Upper Main Stem (Colorado, Utah); and San Juan-Colorado (Colorado, New Mexico, Utah, Arizona).

Six tributary areas in addition to the mainstream were selected in the Lower Colorado River Basin: Little Colorado River (Arizona, New Mexico); Virgin River (Utah, Arizona); Muddy River (Nevada); Bill Williams River (Arizona); Gila River (Arizona, New Mexico); and remaining areas in Arizona, Nevada and Utah.

The outflow point and drainage area for each is shown in Table C-1. The boundaries of the reporting areas are shown on the frontispiece map. A brief description of each reporting area follows.

Upper Colorado River Basin

Green River, Wyoming-Colorado-Utah: The Green River reporting area comprises about 44,800 square miles in southwestern Wyoming, northwestern Colorado, and northeastern and east-central Utah.

Principal tributaries of the Green River are Blacks Fork, Henry's Fork, Hams Fork, and Big Sandy Creek in southwestern Wyoming; Yampa and White Rivers on the western slope of the Continental Divide in northwestern Colorado; and the Price, Duchesne, and San Rafael Rivers in eastern Utah. These streams are fed by numerous headwater lakes.

The largest towns in the reporting area are Rock Springs and Green River in Wyoming; Vernal and Price in Utah; and Craig, Steamboat Springs, and Meeker in Colorado.

Mineral production is the major industry. Oil and natural gas are of primary importance, as are coal, gilsonite, asphalt, and trona (soda ash). Thermal electric power production is becoming an increasingly important industry.

Agriculture ranks near mineral production in importance to the local economy. Agricultural development is centered around livestock production, primarily beef cattle and sheep. Because of a short growing season, crop production is limited largely to small grain, hay, and pasture. These crops are used as winter livestock feed and complement the vast areas of public grazing lands.

Irrigation consumptive use accounts for about 75 percent of the total water use in the Green River reporting area. Nearly 670,000 acres of land are irrigated in an average year. Large exports of water are made to the Great Basin in Utah.

Upper Main Stem, Colorado-Utah: The Upper Main Stem reporting area is drained by the Colorado River and its tributaries above the mouth of the Green River. Principal tributaries are the Roaring Fork, Gunnison, and the Dolores Rivers. The Upper Main Stem reporting area consists of 26,200 square miles, with about 85 percent of the area in Colorado and the remainder in Utah.

Grand Junction, Montrose, and Glenwood Springs are the principal towns in Colorado. Moab is the only major community in Utah.

Mineral production is the predominant industry. This area is the Nation's chief source of molybdenum and is a major source of vanadium, uranium, lead, zinc, coal, and gilsonite.

In the Upper Main Stem reporting area, as in that of the Green River, agriculture centers around production of livestock which feeds on irrigated lands to complement the large areas of rangeland. There is somewhat more diversification of crops in the Upper Main Stem, however, with some major land areas devoted to corn, beans, potatoes, table vegetables, and fruit. This diversification is made possible by climatic and topographic conditions which create favorable air drainage and minimize frost damage.

Irrigation consumptive use accounts for over half the water use in the Upper Main Stem reporting area. In an average year about 550,000 acres of land are irrigated. A considerable amount (almost one-third of the total basin use) of water is exported to serve agricultural and municipal needs on the eastern slope of the Continental Divide in Colorado.

San Juan-Colorado: The San Juan reporting area is drained by the Colorado River and its tributaries below the mouth of the Green River and above Lee Ferry, Arizona. The largest of the tributary streams is the San Juan River which heads on the western slope of the Continental Divide in southwestern Colorado. Principal tributaries of the San Juan River are the Navajo, Los Pinos, Animas, and La Plata Rivers. The other main tributaries in the basin are the Dirty Devil, Escalante, and Paria Rivers which drain a portion of the eastern slope of the Wasatch Plateau in Utah. The reporting area includes about 38,600 square miles in portions of Utah, New Mexico, Arizona, and Colorado.

The largest towns are Durango and Cortez in Colorado; Monticello and Blanding in Utah; and Farmington in New Mexico. Page, near Glen Canyon Dam, is the only community of significant size in Arizona. Most of the remaining Arizona portion is in the Navajo Indian Reservation.

Mining and agriculture form the economic base for the San Juan-Colorado reporting area. The agricultural development is similar to that of the Upper Main Stem with most of the cropland devoted to livestock feeds but with production of diversified market crops on lands with favorable air drainage. The main market crops are fruit, vegetables, and dry beans. Oil, natural gas, and coal are the most important minerals produced. Thermal elecric power production is increasingly important to the economy of the area.

Irrigation accounts for the largest use of water, nearly 80 percent of the San Juan reporting area use. About 250,000 acres of land are irrigated in an average year.

Lower Colorado River Basin

Mainstream below Lee Ferry, Arizona-California-Nevada: The Colorado River has a length of over 700 miles and a drainage area of 132,300 square miles within the Lower Colorado River system in the United States. The river flows from Lee Ferry to the headwaters of Lake Mead through the spectacular canyons of northern Arizona, including the Grand Canyon. Diversions are made at Lake Mead to the rapidly expanding North Las Vegas-Las Vegas-Henderson-Boulder City area for municipal and industrial purposes. The river below Lake Mead courses through canyons and broad alluvial valleys interspersed with bordering groups of mountains. Lakes Mohave and Havasu provide flood control and regulatory storage below Lake Mead. Lake Havasu also provides a forebay for pumped export to the Metropolitan Water District of Southern

California. Lake Mohave reregulates Hoover Dam releases for power production and for deliveries to Mexico. Lesser structures downstream include Senator Wash, Laguna, Headgate Rock, Palo Verde, Imperial, and Morelos Dams. Senator Wash and Laguna Dams provide very limited amounts of reregulation capacity while the others are used principally for diversion.

Diversions below Lake Mead for agriculture, municipal and industrial, power, export, and other purposes are of the magnitude of 8.5 to 9.5 million acre-feet annually. A portion of these diversions is satisfied from upstream return flows. Yuma and Lake Havasu City in Arizona, and Needles and Blythe in California are the major cities along the mainstream below Lake Mead. Current irrigated lands adjacent to the mainstream are estimated to cover approximately 395,000 acres. There has been a significant annual increase in the diversions for municipal and industrial purposes, particularly from Lake Mead to the metropolitan Las Vegas area in Nevada.

Little Colorado River, Arizona-New Mexico: The Little Colorado River drainage area occupies a large part of northern Arizona and a portion of west-central New Mexico. It originates on the north slopes of the White Mountains about 20 miles above Springerville, Arizona. The river has a mainstream length of about 356 miles and joins the Colorado River on the east boundary of Grand Canyon National Park about 78 miles downstream from Glen Canyon Dam.

A series of saline springs near the mouth produce an estimated 160,000 acre-feet of water annually. The USGS gaging station near Cameron, Arizona, is located on the Navajo Indian Reservation about 45 miles upstream from the mouth. Streamflow is undependable and erratic and is subject to flash floods of considerable magnitude. Flow at the gaging station during the 1976-80 period varied from 69,570 acre-feet in 1977 to 472,700 acre-feet in 1979. Only minor development of the ground water has occurred because of low yields and poor quality. Excessive erosion and sediment deposition plague the area. Agriculture is concentrated along the mainstream in the upper reaches of the river, on Silver Creek, a southern tributary, and on the Zuni River in New Mexico. Current irrigated lands in the basin are estimated to include approximately 58,000 acres. Irrigated acreage in the basin is subject to variation because of frequent water shortages and inadequate storage facilities. Population is predominately rural with a relatively large Indian segment. Principal cities include Flagstaff, Winslow, and Holbrook in Arizona, and Gallup and Zuni Pueblo in New Mexico. Leading industries include tourism, recreation, manufacturing, mining, and forest products.

Virgin River, Arizona-Utah: The Virgin River originates in western Kane County, Utah. It flows southwesterly through the southwest corner of Utah and the northwestern corner of Arizona and empties into the northern extremity of the Overton Arm of Lake Mead in Nevada. The selected outflow point is the long-term USGS gaging station at Littlefield, Arizona, which is about 36 miles upstream from Lake Mead and about 10 miles above the Arizona-Nevada State line. The river is fed chiefly from tributaries heading in the southern high plateaus and mountains in Utah. Several springs contribute water to the river at a relatively uniform rate. The two most significant of these springs are located near LaVerkin, Utah, and Littlefield, Arizona, and both are highly saline. Agricultural and municipal developments in Nevada below the selected outflow point are included in "remaining areas," as shown on the frontispiece map.

The major irrigated areas are located in the LaVerkin-Hurricane-St. George-Santa Clara areas of Washington County, Utah, and in the Littlefield area of Mohave County, Arizona. There are small irrigated areas scattered throughout. Irrigated lands in 1980

were estimated to include approximately 20,000 acres. Ground water has been developed to a limited degree. Population is predominately rural with St. George, Utah, being the principal city in the basin. Zion National Park, located near Springdale, Utah, attracts many visitors each year.

Muddy River, Nevada: The Muddy River, a tributary of the Virgin River prior to the existence of Lake Mead, originates from warm springs in northern Clark County, Nevada, about 10 miles northwest of Glendale. The river flows southeasterly for about 30 miles and terminates at the northwestern extremity of the Overton Arm of Lake Mead near Overton, Nevada. Meadow Valley Wash, the major tributary of Muddy River, originates in northeastern Lincoln County and flows south to join the parent stream at Glendale. The USGS gaging station near Glendale is about 2.4 miles downstream from Meadow Valley Wash. Outflow varies little from year to year. Meadow Valley Wash, although perennial in the vicinity of Caliente, is normally dry in the last 50-mile reach above Glendale. Estimated irrigated lands covered approximately 10,000 acres in 1980. The entire basin is sparsely populated.

Bill Williams River, Arizona: The Bill Williams River is formed by the mergence of the Big Sandy and Santa Maria Rivers about 7.5 miles above Alamo Dam. The river above Alamo Dam drains an area of about 4,700 square miles from small, rough mountain ranges and intervening valleys in parts of Mohave, Yuma, and Yavapai Counties. Alamo Dam and Reservoir, a flood control structure completed in 1968, was built to protect downstream development along the Colorado River. A minimum pool is maintained for recreation and game management purposes. Releases up to a maximum of 2,000 cfs from the allocated conservation pool above the minimum pool are coordinated with releases from mainstream reservoirs. Releases from Alamo Dam and runoff from the intervening area flow westerly and enter at the lower end of Lake Havasu just above Parker Dam. Current irrigated lands are estimated to include approximately 10,000 acres. The limited development in the basin is dominated by copper mining at the unincorporated town of Bagdad. A large portion of the water supply in the basin is obtained from ground water pumpage. Releases from Alamo Dam during the 1976-80 period varied from 17,350 acre-feet in 1977 to 644,500 acre-feet in 1980.

Gila River, Arizona-New Mexico: The Gila River is the largest tributary to the Colorado River in the Lower Colorado River system. The drainage area extends from the Continental Divide in New Mexico to the river's mouth near Yuma, Arizona. Elevations in the basin range from nearly 12,000 feet in the eastern mountains to about 150 feet at the mouth. The selected outflow point for the basin is at Painted Rock Dam, a flood control structure located about 20 miles west of Gila Bend, Arizona. The drainage area above Painted Rock Dam is about 50,900 square miles, of which 5,600 square miles are in New Mexico and 1,100 square miles in Mexico. The dam was constructed to protect agricultural and urban developments downstream.

Nearly three-fourths of the population of the Lower Colorado River system reside in the Gila River Basin in the metropolitan Phoenix and Tucson areas. Industry and recreation play a large part in the economy. About two-thirds of the agricultural development in the Lower Colorado River system is located in the Gila River Basin. This development is concentrated in the central area of Maricopa, Pinal, and Pima Counties and is supported to a large degree by a long-term overdraft of the ground-water resources. Estimated irrigated lands in 1980 include approximately 987,000 acres. Nearly all of the surface water resources in the basin have been developed for decades. Except for major flood

events, such as occurred in 1979 and 1980, inflows to the Colorado River mainstream are negligible. Releases through Painted Rock Dam in water year 1980 totaled 2,385,000 acre-feet with only approximately 1,720,000 acre-feet reaching the Colorado River.

Remaining area in Arizona, Nevada, and Utah: Development away from the Colorado River mainstream is limited by the availability of water and the rugged terrain. In the Boulder City-Las Vegas area there has been a significant increase in the municipal and industrial demand for water. Construction on the second stage of the Southern Nevada Water Project began in 1977 and continued through 1980. Completion of the project will allow Nevada to use its complete entitlement from the Colorado River.

Most of the irrigated lands in this area are located in the lower reach of the Virgin River and Las Vegas Valley in Nevada, on Kanab Creek in Arizona and Utah, and the lower portions of the Gila and Bill Williams Rivers in Arizona. Current irrigated lands are estimated to include approximately 47,000 acres. North Las Vegas, Las Vegas, Henderson, and Boulder City in Nevada, and Kingman and Williams in Arizona are the leading cities.

Terminology

The Colorado River is not only one of the most highly controlled rivers in the world, but is also one of the most institutionally encompassed. A multitude of legal documents, known collectively as the "Law of the River," affect and always dictate its management and operation. Major documents include:

Colorado River Compact - 1922
Boulder Canyon Project Act - 1928
California Limitation Act - 1929
California Seven Party Agreement - 1931
Mexican Water Treaty - 1944
Upper Colorado River Basin Compact - 1948
Colorado River Storage Project Act - 1956
United States Supreme Court Decree in Arizona v. California - 1964
Colorado River Basin Project Act - 1968
Minute 242 of the International Boundary and Water Commission, United States and Mexico - 1973
Colorado River Basin Salinity Control Act - 1974

The Colorado River system is defined in the Colorado River Compact of 1922 as ". . . that portion of the Colorado River and its tributaries within the United States," whereas the Colorado River Basin is defined as ". . . all of the drainage area of the Colorado River system and all other territory within the United States of America to which waters of the Colorado River system shall be beneficially applied." The compact divided the Colorado River Basin into two sub-basins - the "Upper Basin" and the "Lower Basin," with Lee Ferry as the division point on the river. Lee Ferry, located in Arizona, is a point in the mainstream 1 mile below the mouth of the Paria River. For the purpose of this report, the Great Divide Basin, a closed basin in Wyoming, and the White River in Nevada have not been considered as part of the Colorado River system. Diversions from the system to areas outside its drainage area are considered herein as exports and have not been classified as to types of use.

Beneficial consumptive use is normally construed to mean the consumption of water brought about by human endeavors and in this report includes use of water for municipal, industrial, agricultural, power generation, export, recreation, fish and wildlife, and other purposes, along with the associated losses incidental to these uses.

The storage of water and water in transit may also act as losses on the system although normally such water is recoverable in time. Qualitatively, what constitutes beneficial consumptive use is fairly well understood; however, an inability to exactly quantify these uses has led to various differences of opinion. The practical necessity of administering the various water rights, apportionments, etc., of the Colorado River has led to definitions of consumptive use or depletions generally in terms of "how it shall be measured." The Upper Colorado River Basin Compact provides that the Upper Colorado River Commission is to determine the apportionment made to each State by ". . . the inflow-outflow method in terms of manmade depletions of the virgin flow at Lee Ferry . . . ." There is further provision that the measurement method can be changed by unanimous action of the Commission. In contrast, article 1(A) of the decree of the Supreme Court of the United States in Arizona v. California defines, for the purpose of the decree, "Consumptive use means diversions from the stream less such return flows thereto as are available for consumptive use in the United

States or in satisfaction of the Mexican Treaty obligation." Nearly all the water exported from the Upper Colorado River system is measured; however, the remaining beneficial consumptive use, for the most part, must be estimated using theoretical methods and techniques. In the Lower Colorado River system tributaries to the mainstream, similar methods must be employed to determine the amount of water consumptively used.

Reservoir evaporation loss is a consumptive use associated with the beneficial use of water for other purposes. For the purpose of this report, main stem reservoir evaporation is carried as a separate item for the Upper and Lower Basins.

Channel losses within the system are normally construed to be the consumptive use by riparian vegetation along the stream channel (or conveyance route) and the evaporation from the stream's water surface and wetted materials. Seepage from the stream normally appears again downstream or reaches a ground water aquifer where it may be usable again. A decided lack of data and acceptable methodology along with the intermittent flow characteristics of many Southwest streams combine to make a reasonable determination of channel loss difficult. Channel losses have not been estimated for this report within the Upper Basin nor on the tributaries of the Lower Colorado River mainstream. Channel losses on the mainstream below Lee Ferry have been estimated primarily by the inflow-outflow method.

Methodology and Data Adequacy

This report is based almost entirely on data obtained from ongoing programs and current reports. Quantitative measurements of water use were used wherever available, but the majority of the basin water use was theoretically calculated. The following sections describe these calculations for both the Lower Colorado River Mainstream and the Upper and Lower Colorado River Basin tributaries.

Colorado River Basin Tributaries

In the tributary areas of the basin, records of diversions and return flows are not complete enough to allow direct calculation of consumptive water use. Theoretical and indirect methods of estimating consumptive use must then be relied upon. In the New Mexico portion of the Gila River Basin, the annual consumptive use of water is reported by the New Mexico Interstate Stream Commission, pursuant to article VII of the March 9, 1964, decree of the United States Supreme Court in Arizona v. California, et al.

Agriculture: About 85 percent of the consumptive use in the areas tributary to the Colorado River mainstream is for irrigated agriculture. The annual irrigated acreage of most crops grown within each reporting area was estimated from information published in the yearly State Agriculture Statistics. Irrigated pasture and some minor crops not reported by the State statistics were estimated from information in the 1978 National Census of Agriculture with supporting information from the comprehensive framework study and various other local reports. The total irrigated acreage values for the Upper and Lower Basins are shown in tables UC-7 and LC-9, respectively.

Since most of these data were presented on a county basis, it was necessary to separate them into smaller reporting areas for computational purposes. This was accomplished using land inventory maps and relationships developed for the comprehensive framework study.

These sub-basins generally follow tributary stream basin and State boundaries. A representative climatic station was selected for each sub-basin. Using historical records of temperature, precipitation, and frost dates, a consumptive use rate was computed for each major crop in each of the reporting years. For the purpose of this report, the consumptive use rates were computed using the modified Blaney-Criddle evapotranspiration formula in the version described in the Soil Conservation Service Technical Release No. 21, "Irrigation Water Requirements," revised September 1970. Irrigation consumptive rates were determined by subtracting the effective precipitation from the consumptive use rates. Effective precipitation was computed using criteria described in the U.S. Department of Agriculture, Agricultural Research Service, Technical Bulletin No. 1275. The values of irrigation consumptive use rates were applied to the estimates of irrigated acreage to yield the final values of irrigation consumptive use.

An exception to this procedure occurred in the Lower Basin in the "low desert" regions of Arizona and Nevada where the Blaney-Criddle formula was used to estimate the crop consumptive use. This departure was based on the research results of Leonard Erie, et. al. Seasonal crop consumptive use factors ("K") for the lower elevation desert areas were selected from Conservation Research Report Number 29, "Consumptive Use of Water by Major

Crops in the Southwestern United States," issued May 1982 by the United States Department of Agriculture. Effective precipitation was derived from criteria developed for the area by Wayne D. Criddle, former Utah State Engineer.

These theoretical consumptive use calculations were based on the assumption of full water supply during the crop growing season. However, it is estimated that in an average year about 37 percent of the irrigated lands in the Upper Basin receive less than a full supply of water, either due to lack of distribution facilities or junior water rights. The degree to which these lands suffer shortages varies widely from year to year, depending in large part on the magnitude of runoff. For this study, an estimate of the short supply service lands was made for each sub-basin, primarily on the basis of reports and investigations collected for the comprehensive framework study. A stream-flow gaging station was selected within each sub-basin and the magnitude of the recessional portion of the annual hydrograph was used as an index to select the date at which consumptive use calculations should be terminated for the short supply lands.

Comprehensive framework studies of the incidental consumptive use of water associated with irrigation indicated that this use varied between 5 and 28 percent of the irrigation consumptive use depending upon the location of the study area within the Colorado Basin. These percentages were used in the Upper Basin and an average value of 15 percent was used in the Lower Basin to adjust the calculated consumptive use.

The agricultural data is generally adequate for use in this report. With the exception of Utah, each state prepared annual county irrigated acreage estimates of the harvested crops during the reporting period. These statistics are assumed to be reliable. The irrigated pasture values were based largely on the 1978 National Census of Agriculture since the State statistics do not include pastureland. Due to the length of time between reporting dates, this item needs to be considerably strengthened. In this regard, Wyoming and New Mexico have initiated aerial photographic mapping of their State's irrigated acreage to verify the annual statistical sampling. Other areas of agricultural data collection which need to be updated and verified are (1) the consumptive water use of lands which receive less than a full seasonal supply of irrigation water and the areal extent of these lands, and (2) the amount of incidental seepage and phreatophytic losses associated with irrigation.

Reservoir Evaporation: A comprehensive listing was developed of all reservoirs in the Colorado River Basin which included the latitude, elevation, and surface area at total capacity for each reservoir.

Monthly content records were obtained for those reservoirs for which records are available. The average annual water-surface area was determined for each year of the reporting period. For those reservoirs lacking records, a "fullness factor" was estimated on the basis of reservoir use and historical hydrologic conditions. These "fullness factors" were then used to obtain estimates of average annual water-surface area for the unreported reservoirs.

For the majority of the basin, historical evaporation rates were used to determine reservoir evaporation.

In the Upper Basin, regression equations relating gross annual evaporation to elevation, latitude, and climatic subarea were developed for each of the reporting years. In the Lower Basin, evaporation values were calculated for each climatic subarea. Account was taken of precipitation and runoff salvage to determine net evaporation rates. The net evaporation rates were applied to the estimates of average annual water-surface area to yield the values of annual reservoir evaporation.

An exception to this procedure was the determination of evaporation from the main stem reservoirs shown in

table UC-1. Predetermined average evaporation rates were applied to historical surface areas to yield values of evaporation on a monthly basis.

Adequate data exist to allow a reasonably accurate estimate of the basin evaporation. Both an increase in the number of evaporation stations and a better estimate of the surface area of the unmeasured reservoirs would improve the evaporation calculations.

Stockpond Evaporation and Livestock: Stockpond surface areas were estimated from the May 1975 SCS publication, "Livestock Water Use." The subbasin stockpond areas were subdivided by State and basin using the livestock population distribution. The same procedure used to calculate the unmeasured reservoir evaporation was used to estimate the stockpond evaporation.

Livestock population data were taken from annual State Agriculture Statistics and the 1978 Census of Agriculture. Livestock population data included cattle, sheep, horses, hogs, and pigs. Consumption rates for the various livestock were derived from various reports, including the SCS publication, "Livestock Water Use," May 1975.

Stockpond and livestock data are adequate to prepare an estimate of this use. Considering the small amount of water use, any refining effort would be best spent on the irrigation or evaporation categories.

Mineral Resources: Arizona leads the nation in the production of copper and the net water use for its production represents about 90 percent of the total water use for mineral resources in the Lower Basin. The Upper Basin uses water in the production of numerous minerals in addition to energy-related materials such as oil and natural gas.

Estimates of the water consumptively used were based largely on current and previous reports of the Bureau of Mines. These reports include the gross tonnage produced and the water consumed per ton of production.

The Bureau of Mines data should be quite adequate; however, in some cases, important production data was withheld for privacy reasons. In these instances, earlier reports and the comprehensive framework study were used to estimate the water use.

Information regarding the annual use of water by the mineral resource industry was generally inadequate. Information over 10 years old was the best available for certain mineral production and unit water quantity requirements and the accuracy of such information may be in doubt. Much of the data was not listed by county, which caused difficulty in disaggregating the data into tributary areas.

Thermal Electric Power: The net use of water for the production of thermal electric energy from the tributaries of the Colorado River Basin was estimated from records obtained from the various power companies in the Basin. These records were complete and were judged to be accurate.

Municipal and Industrial: The basis for estimating municipal and industrial uses was the urban and rural population within the reporting areas. Preparation of annual population estimates was guided by the 1970 and 1980 censuses, various State and county statistical reviews, and reports which included population estimates for local areas. The yearly population estimates for the Upper and Lower Basins are shown in tables UC-8 and LC-10, respectively. Water withdrawal rates for urban and rural uses in the various reporting areas were derived from available studies in the metropolitan areas, State Water Plan reports, and Bureau of Reclamation technical guidelines. These withdrawals were then converted to depletions using average basin consumptive use factors.

The 1980 population of the Colorado River system, estimated at about 3.8 million, is increasing at an annual

rate of nearly 5 percent. A large portion of the population resides within Maricopa and Pima Counties, Arizona, and in Clark County, Nevada. Sixty percent of the Upper Basin and about 20 percent of the Lower Basin population were classified as rural with a significantly smaller per capita use of water.

Both the urban and rural areas have the mutual problem of providing an adequate current and future water supply for a growing population in a water-short area. As a result of almost continuous studies concerning these problems, adequate production and effluent records are usually available to adequately assess water use.

Exports: Nearly all the transbasin exports from the Colorado Basin were measured and reported by the Geological Survey, or local water commissioners and users. The remainder were estimated on the basis of past records and capacity of facilities. Due to the high degree of measurement, this area of basin consumptive use is considered to be quite accurately determined.

Lower Colorado River Mainstream

The annual consumptive use of water from the Colorado River mainstream by the States and exports from the system were taken from the Bureau annual report entitled "Compilation of Records in Accordance with Article V of the Decree of the United States in Arizona v. California." The estimated Colorado River component of the combined surface and subsurface return flows accruing to Las Vegas Wash and discharging into Lake Mead, as taken from the report, is credited to Nevada's municipal and industrial water uses. Unmeasured subsurface return flows were estimated below Hoover Dam, based partially on preliminary information supplied by the Task Force on Ground-Water Return Flows. All unmeasured subsurface return flows were credited to the irrigation water use taken from the Article V report, and were divided between California and Arizona based on their respective irrigation diversions.

Gross evaporation from Lake Mead is estimated by the USGS and published in its annual Water Resources Data reports. Net evaporation for Lake Mead is estimated by subtracting precipitation at nearby Boulder City, Nevada, from the gross evaporation. Net evaporation from Lakes Mohave and Havasu and Senator Wash Reservoir was derived from available evaporation and precipitation records and operating data.

Annual channel losses were estimated as the inflow or outflow necessary to balance a simplified water budget for the Lee Ferry to Hoover Dam and Hoover Dam to International Boundary reaches. Channel losses include evaporation, seepage, phreatophyte consumptive use, and bank storage.

The accuracy of flow measurements of the Colorado River mainstream for use in determining the channel losses values in table LC-1 is in question. The gage error of an "excellent" USGS flow gage is 5 percent. Actual flow at Lee Ferry, Hoover Dam, or to Mexico may therefore vary approximately 400,000 acre-feet per year from values supplied by the USGS. Such inaccuracies, though a very small percent of total flow, will have dramatic effects on apparent channel loss computations.

The annual land use, water supply, and water use information being gathered for the operation, maintenance, and administration of the Colorado River mainstream below Lee Ferry is believed to be generally adequate in quantity, quality, and extent. These data are under constant review and are being continually upgraded. Studies and programs are in progress to remedy a lack of data on return flows from mainstream diversions.

Beneficial Consumptive Uses and Losses

A summary table of the Colorado River system total annual water uses, 1976-1980, by States and basins is shown on page vi. Tables C-2 through C-6 show on a yearly basis the same information broken down by State, basin, and type of use. Water use within the selected reporting areas is discussed below.

Upper Colorado River Tributaries

Summaries of estimated annual consumptive uses and losses in the Upper Colorado River Basin for each of the reporting years, broken down by State, reporting area, and type of use are shown in tables UC-2 through UC-6. Estimated main stem reservoir evaporation is shown in table UC-1.

Upper Basin consumptive use increased from 2.9 million acre-feet in 1976 to about 3.3 million acre-feet at the end of the reporting period, largely due to water use increases in irrigated acreage, thermal electric power generation, and transbasin exports.

Agricultural uses accounted for about 65 percent of the total Upper Basin consumptive uses and losses. Irrigated acreage increased from 1,430,000 acres in 1976 to 1,480,000 acres in 1980, largely due to the establishment of the Navajo Indian Irrigation Project in New Mexico and an increase in the estimate of the irrigated pasture in Wyoming. Changes in climatic conditions produced additional variation in consumptive use.

Water use for thermal electric power generation doubled during the reporting period as it did during the 1971-1975 period. Increases in production at four recently constructed plants, San Juan, Navajo, Jim Bridger, and Huntington, and the additional construction of the Hunter and Craig plants accounted for the increase.

Transbasin exports, the second largest Upper Basin use, showed great year-by-year variation during the reporting period. Exports were reduced during 1977 due to the Basinwide drought conditions, increased to a record 850,000 acre-feet in 1978, and reduced in 1979 and 1980 apparently due to an abundant water supply on the eastern slope of the Rocky Mountains.

The 1977 drought conditions deserve some mention in this report due to the great impact on irrigated agriculture. A very poor spring runoff resulted in a decrease in the acreage of planted crops. Lands which were supplied by reservoirs having sufficient carryover storage received a fairly consistent water supply during the irrigation season. Lands which did not have sufficient supply had production yields 20 to 40 percent less than in normal years. The estimated 1977 water use for irrigation was 30 percent less than other years, a difference of about 600,000 acre-feet.

Lower Colorado River Mainstream

Table LC-1 shows mainstream reservoir evaporation and channel losses and table LC-3 shows water uses along the lower Colorado River mainstream and flood plain including water passing to Mexico. Water passing to Mexico is made up of deliveries in satisfaction of the Treaty, deliveries made pursuant to Minute No. 242, Gila River flood releases, regulatory waste and anticipatory flood control releases from the mainstream. Table LC-2 summarizes the total water use in the Lower Basin excluding the mainstream evaporation and channel losses. Mainstream reservoirs gained about 3.3 million acre-feet of surface storage during the 5-year reporting period. Water supplies necessary to meet the mainstream water use came principally from the

regulated releases from Lake Powell at Glen Canyon Dam.

Annual reservoir evaporation consumed between 1.0 and 1.2 million acre-feet. Apparent channel losses ranged from 90,000 acre-feet in 1976 and 1977 to 430,000 acre-feet in 1979. Note that apparent channel losses were calculated over the entire Lee Ferry to International Boundary reach instead of only the Davis Dam to International Boundary reach as in the 1971-75 report.

Total mainstream depletions decreased from 1976 to 1980, from 6.1 to 5.8 million acre-feet, with minimum depletions of 5.7 million acre-feet in 1979. This reflects decreases of 140,000 acre-feet for irrigation depletions and 130,000 acre-feet for exports to California from 1976 to 1980. Depletions for irrigation in 1980 were 1.6 million acre-feet and exports to California were 4.2 million acre-feet the same year.

However, municipal and industrial water use, including thermal powerplants in Nevada and Arizona, increased depletions 18 percent from 123,000 acre-feet to 150,000 acre-feet in the 5-year period. Much of this demand is within the rapidly expanding population area of southern Nevada.

Lower Colorado River Tributaries

Tables LC-4 through LC-8 show yearly water uses by tributary area, State, and type of use. Onsite consumptive use in 1976 was estimated to be about 4.1 million acre-feet. By 1980, consumptive use was about 4.8 million acre-feet as a result of a substantial increase in both irrigated acreage and population. Most of the increase in water use, irrigated land, and population has occurred in the Gila River basin.

Significant ground water usage occurs in Arizona, Nevada, and New Mexico. For the purpose of this report, groundwater overdraft has not been taken into account in the computation of tributary consumptive use. Also tributary channel loss and salvage were not evaluated. It should be noted, however, that present ground water overdraft in Arizona has been estimated to be approximately 2.2 million acre-feet per year.

Consumptive use for the irrigation of crops represents between 80 and 85 percent of the total water use in the Lower Colorado tributary areas. Estimated annual consumptive use per area for the Lower Basin during the 5-year period averaged about 3.5 acre-feet per acre, varying from approximately 1 acre-foot per acre in parts of New Mexico to over 4 acre-feet in the western portion of the basin. Estimated crop consumptive use varied considerably from year to year on the basis of climatic conditions, from a low of 3.3 million acre-feet in 1976 to a high of 3.8 million acre-feet in 1980. Irrigated lands amounted to 1,067,000 acres in 1976, decreased to 1,037,000 acres in 1978, and increased to 1,132,000 acres in 1980.

The consumptive use of water for municipal and industrial purposes is estimated to have increased from approximately 444,000 acre-feet in 1976 to approximately 500,000 acre-feet in 1980.

Water supply conditions were characterized by near normal runoff in 1976, exceptionally poor runoff in 1977, and extremely large runoff in 1978, 1979, and 1980. In addition to replenishing storage reservoirs in the basin, the 1978 through 1980 runoff produced an outflow below Painted Rock Dam of as high as 2,385,000 acre-feet during 1980.

TABLE C-1

Drainage Area by States (and Mexico) and Major Tributary Streams

Units = 1,000 Square Miles

Major Tributary Streams and Their Selected Outflow Points	Wyoming	Colorado	Utah	New Mexico	Arizona	Nevada	California	Mexico	Total
Green River at Colorado River Confluence, Utah	17.1	10.6	17.1	-	-	-	-	-	44.8
Upper Main Stem at Green River Confluence, Utah	-	22.2	4.0	-	-	-	-	-	26.2
San Juan-Colorado at Lee Ferry, Arizona	-	5.8	16.2	9.7	6.9	-	-	-	38.6
Little Colorado River near Cameron, Arizona	-	-	-	5.3	21.2	-	-	-	26.5
Virgin River at Littlefield, Arizona	-	-	3.0	-	1.9	0.2	-	-	5.1
Muddy River near Glendale, Nevada	-	-	-	-	-	6.8	-	-	6.8
Bill Williams River below Alamo Dam, Arizona	-	-	-	-	4.7	-	-	-	4.7
Gila River below Painted Rock Dam, Arizona	-	-	-	5.6	44.2	-	-	(1.1)	49.8
Mainstream and Remaining Areas in Lower Basin	-	-	0.6	-	28.3	6.9	3.6	(0.1)	39.4
Colorado River System at Southerly International Boundary	17.1	38.6	40.9	20.6	107.2	13.9	3.6	(1.2)	241.9
Colorado River System above Lee Ferry	17.1	38.6	37.3	9.7	6.9	-	-	-	109.6
Colorado River System below Lee Ferry	-	-	3.6	10.9	100.3	13.9	3.6	(1.2)	132.3

TABLE C-2

Summary of Estimated Water Use by States and Types of Use

1976

(1,000 acre-feet)

State	Estimated Beneficial Consumptive Uses and Losses[1]						
	Reservoir Evaporation	Irrigated Agriculture[2]	Municipal and Industrial[3]	Fish and Wildlife Recreation	Export Outside System	Export Within System	Total
Arizona	222.5	4,338.2	413.7	55.3	0.0	3.1	5,033
California	0	472.4	3.4	0	4,336.9	0	4,813
Colorado	41.5	1,104.1	38.4	0	494.8	0	1,679
Nevada	7.3	93.4	127.6	0.8	0	(-3.1)	226
New Mexico	25.2	160.6	40.1	0	84.4	0	310
Utah	44.0	528.7	22.3	0	110.0	0	705
Wyoming	26.1	207.9	39.0	0	9.2	0	282
Other[4]	1,931.0	0	0	0	1,748.9	0	3,680
Colorado River System Total	2,298	6,905	685	56	6,784	0	16,728

1/ From Tables UC-1, UC-2, LC-1, and LC-2.
2/ Includes livestock water use and stockpond evaporation.
3/ Includes water uses for thermal electric power generation and mineral resources.
4/ Reservoir evaporation represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin. Exports outside system represents water passing to Mexico.

TABLE C-3

Summary of Estimated Water Use by States and Types of Use

1977

(1,000 acre-feet)

State	Estimated Beneficial Consumptive Uses and Losses[1/]						
	Reservoir Evaporation	Irrigated Agriculture[2/]	Municipal and Industrial[3/]	Fish and Wildlife Recreation	Export Outside System	Export Within System	Total
Arizona	171.7	4,733.9	417.9	41.9	0.0	3.4	5,369
California	0	461.6	3.3	0	4,372.1	0	4,837
Colorado	51.4	991.7	41.2	0	523.4	0	1,608
Nevada	6.7	88.4	134.3	0.9	0	(-3.4)	227
New Mexico	23.6	150.3	45.3	0	19.4	0	239
Utah	46.2	311.6	25.1	0	79.5	0	462
Wyoming	27.7	137.3	48.6	0	5.3	0	219
Other[4/]	1,832.0	0	0	0	1,831.4	0	3,663
Colorado River System Total	2,159	6,875	716	43	6,831	0	16,624

1/ From Tables UC-1, UC-3, LC-1, and LC-2.

2/ Includes livestock water use and stockpond evaporation.

3/ Includes water uses for thermal electric power generation and mineral resources.

4/ Reservoir evaporation represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin. Exports outside system represents water passing to Mexico.

TABLE C-4

Summary of Estimated Water Use by States and Types of Use

1978

(1,000 acre-feet)

State	Estimated Beneficial Consumptive Uses and Losses[1/]						
	Reservoir Evaporation	Irrigated Agriculture[2/]	Municipal and Industrial[3/]	Fish and Wildlife Recreation	Export Outside System	Export Within System	Total
Arizona	306.5	4,549.0	446.9	46.4	0.0	2.4	5,351
California	0	475.4	2.9	0	4,146.1	0	4,624
Colorado	62.0	1,196.9	43.1	0	634.8	0	1,937
Nevada	5.7	84.8	135.3	0.9	0	(-2.4)	224
New Mexico	31.5	180.0	43.9	0	105.1	0	361
Utah	50.1	551.9	31.2	0	112.6	0	746
Wyoming	30.2	248.6	46.1	0	8.5	0	333
Other[4/]	1,887.0	0	0	0	1,744.5	0	3,632
Colorado River System Total	2,373	7,287	749	47	6,752	0	17,208

1/ From Tables UC-1, UC-4, LC-1, and LC-2.

2/ Includes livestock water use and stockpond evaporation.

3/ Includes water uses for thermal electric power generation and mineral resources.

4/ Reservoir evaporation represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin. Exports outside system represents water passing to Mexico.

TABLE C-5

Summary of Estimated Water Use by States and Types of Use

1979

(1,000 acre-feet)

State	Estimated Beneficial Consumptive Uses and Losses[1/]						
	Reservoir Evaporation	Irrigated Agriculture[2/]	Municipal and Industrial[3/]	Fish and Wildlife Recreation	Export Outside System	Export Within System	Total
Arizona	413.0	4,477.8	468.3	47.1	0.0	2.6	5,409
California	0	476.4	3.1	0	4,111.8	0	4,591
Colorado	57.6	1,217.2	42.0	0	507.6	0	1,824
Nevada	5.7	80.3	144.2	0.9	0	(-2.6)	228
New Mexico	27.9	193.1	46.3	0	164.2	0	432
Utah	48.2	587.5	35.4	0	126.7	0	798
Wyoming	31.8	257.5	49.0	0	9.7	0	348
Other[4/]	2,070.0	0	0	0	2,766.3	0	4,836
Colorado River System Total	2,654	7,290	788	48	7,686	0	18,466

1/ From Tables UC-1, UC-5, LC-1, and LC-2.
2/ Includes livestock water use and stockpond evaporation.
3/ Includes water uses for thermal electric power generation and mineral resources.
4/ Reservoir evaporation represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin. Exports outside system represents water passing to Mexico.

TABLE C-6

Summary of Estimated Water Use by States and Types of Use

1980

(1,000 acre-feet)

State	Estimated Beneficial Consumptive Uses and Losses[1]						
	Reservoir Evaporation	Irrigated Agriculture[2]	Municipal and Industrial[3]	Fish and Wildlife Recreation	Export Outside System	Export Within System	Total
Arizona	437.4	4,676.1	467.6	56.4	0.0	3.0	5,641
California	0	469.5	2.8	0	4,207.9	0	4,680
Colorado	73.9	1,229.5	45.5	0	395.4	0	1,744
Nevada	6.3	77.1	151.9	1.1	0	(-3.0)	233
New Mexico	37.6	225.3	50.7	0	143.6	0	457
Utah	50.0	542.2	37.1	0	108.9	0	738
Wyoming	31.2	243.0	53.9	0	9.3	0	337
Other[4]	2,063.0	0	0	0	6,142.8	0	8,206
Colorado River System Total	2,699	7,463	809	57	11,008	0	22,036

1/ From Tables UC-1, UC-6, LC-1, and LC-2.
2/ Includes livestock water use and stockpond evaporation.
3/ Includes water uses for thermal electric power generation and mineral resources.
4/ Reservoir evaporation represents mainstem reservoir evaporation in the Upper Basin and mainstream reservoir evaporation and channel losses below Lee Ferry in the Lower Basin. Exports outside system represents water passing to Mexico.

TABLE UC-1

Upper Colorado River Basin

Estimated Mainstem Reservoir Evaporation 1/

1976-1980

(1,000 acre-feet)

Reservoir	Evaporation					
	1976	1977	1978	1979	1980	Average 1976-1980
Flaming Gorge	80	62	57	61	64	65
Blue Mesa	8	5	6	8	8	7
Morrow Point	2	2	2	2	1	2
Lake Powell	541	503	462	519	600	525
Total	631	572	527	590	673	599

1/ Undistributed by States. Evaporation determined using average historical evaporation rates.

TABLE UC-2

Upper Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use

1976

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation & Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other 1/	Municipal and Industrial: Total	Export: Outside System	Export: Within System	Total
Arizona	San Juan-Colo.	3.9	2.7	1.0	3.7	0.0	19.9	2.9	22.8	0.0	0.0	30.4
Colorado	Green River	5.1	101.2	3.1	104.3	4.8	4.9	1.5	11.2	0.0	0.0	120.6
	Upper Main Stem	31.5	839.9	6.9	846.8	11.8	0.8	9.8	22.4	491.8	135.5	1,528.0
	San Juan-Colo.	4.9	149.2	3.8	153.0	2.3	0.0	2.5	4.8	3.0	(-135.5)	30.2
	Total	41.5	1,090.3	13.8	1,104.1	18.9	5.7	13.8	38.4	494.8	0.0	1,678.8
New Mexico	San Juan-Colo.	21.1	141.4	1.2	142.6	3.1	22.9	5.1	31.1	84.4	0.0	279.2
Utah	Green River	32.5	416.5	3.3	419.8	7.4	5.1	3.8	16.3	113.6	0.0	582.2
	Upper Main Stem	0.3	10.4	0.1	10.5	1.4	0.0	0.6	2.0	0.0	0.0	12.8
	San Juan-Colo.	5.1	38.2	2.6	40.8	1.2	0.0	0.9	2.1	(-5.0)	0.0	43.0
	Total	37.9	465.1	6.0	471.1	10.0	5.1	5.3	20.4	108.6	0.0	638.0
Wyoming	Green River	26.1	204.0	3.9	207.9	15.5	20.4	3.1	39.0	9.2	0.0	282.2
Upper Basin	Green River	63.7	721.7	10.3	732.0	27.7	30.4	8.4	66.5	122.8	0.0	985.0
	Upper Main Stem	31.8	850.3	7.0	857.3	13.2	0.8	10.4	24.4	491.8	135.5	1,540.8
	San Juan-Colo.	35.0	331.5	8.6	340.1	6.6	42.8	11.4	60.8	82.4	(-135.5)	382.8
	Total	130.5	1,903.5	25.9	1,929.4	47.5	74.0	30.2	151.7	697.0	0.0	2,908.6

1/ Includes urban, rural, and other industrial uses.

TABLE UC-3

Upper Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use

1977

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation & Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[1/]	Municipal and Industrial: Total	Export: Outside System	Export: Within System	Total
Arizona	San Juan-Colo.	4.2	3.8	1.1	4.9	0.0	21.8	3.1	24.9	0.0	0.0	34.0
Colorado	Green River	6.7	89.3	3.3	92.6	4.8	7.1	1.6	13.5	0.0	0.0	112.8
	Upper Main Stem	39.9	769.7	7.0	776.7	11.9	0.8	10.2	22.9	523.1	61.9	1,424.5
	San Juan-Colo.	4.8	118.6	3.8	122.4	2.3	0.0	2.5	4.8	0.3	(-61.9)	70.4
	Total	51.4	977.6	14.1	991.7	19.0	7.9	14.3	41.2	523.4	0.0	1,607.7
New Mexico	San Juan-Colo.	20.0	131.9	1.1	133.0	3.3	27.6	5.3	36.2	19.4	0.0	208.6
Utah	Green River	35.1	228.0	3.3	231.3	7.5	7.3	4.0	18.8	80.2	0.0	365.4
	Upper Main Stem	0.4	4.0	0.1	4.1	1.5	0.0	0.6	2.1	0.0	0.0	6.6
	San Juan-Colo.	5.3	15.9	2.4	18.3	1.2	0.0	0.9	2.1	(-1.0)	0.0	24.7
	Total	40.8	247.9	5.8	253.7	10.2	7.3	5.5	23.0	79.2	0.0	396.7
Wyoming	Green River	27.7	133.1	4.2	137.3	16.4	28.8	3.4	48.6	5.3	0.0	218.9
Upper Basin	Green River	69.5	450.4	10.8	461.2	28.7	43.2	9.0	80.9	85.5	0.0	697.1
	Upper Main Stem	40.3	773.7	7.1	780.8	13.4	0.8	10.8	25.0	523.1	61.9	1,431.1
	San Juan-Colo.	34.3	270.2	8.4	278.6	6.8	49.4	11.8	68.0	18.7	(-61.9)	337.7
	Total	144.1	1,494.3	26.3	1,520.6	48.9	93.4	31.6	173.9	627.3	0.0	2,465.9

1/ Includes urban, rural, and other industrial uses.

TABLE UC-4

Upper Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use

1978

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation & Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[1/]	Municipal and Industrial: Total	Export: Outside System	Export: Within System	Export: Total
Arizona	San Juan-Colo.	4.3	4.3	1.1	5.4	0.0	19.4	3.8	23.2	0.0	0.0	32.9
Colorado	Green River	7.1	121.3	3.2	124.5	4.8	8.2	1.7	14.7	0.0	0.0	146.3
	Upper Main Stem	47.7	921.1	7.0	928.1	12.0	0.9	10.6	23.5	632.8	115.9	1,748.0
	San Juan-Colo.	7.2	140.0	4.3	144.3	2.3	0.0	2.6	4.9	2.0	(-115.9)	42.5
	Total	62.0	1,182.4	14.5	1,196.9	19.1	9.1	14.9	43.1	634.8	0.0	1,936.8
New Mexico	San Juan-Colo.	26.6	157.1	1.3	158.4	3.4	25.8	5.5	34.7	105.1	0.0	324.8
Utah	Green River	39.3	436.8	3.4	440.2	7.5	11.9	4.2	23.6	108.6	0.0	611.7
	Upper Main Stem	0.4	12.4	0.1	12.5	1.5	0.0	0.6	2.1	0.0	0.0	15.0
	San Juan-Colo.	6.3	44.2	2.7	46.9	1.2	1.2	0.9	3.3	(-4.6)	0.0	51.9
	Total	46.0	493.4	6.2	499.6	10.2	13.1	5.7	29.0	104.0	0.0	678.6
Wyoming	Green River	30.2	244.8	3.8	248.6	17.2	25.2	3.7	46.1	8.5	0.0	333.4
Upper Basin	Green River	76.6	802.9	10.4	813.3	29.5	45.3	9.6	84.4	117.1	0.0	1,091.4
	Upper Main Stem	48.1	933.5	7.1	940.6	13.5	0.9	11.2	25.6	632.8	115.9	1,763.0
	San Juan-Colo.	44.4	345.6	9.4	355.0	6.9	46.4	12.8	66.1	102.5	(-115.9)	452.1
	Total	169.1	2,082.0	26.9	2,108.9	49.9	92.6	33.6	176.1	852.4	0.0	3,306.5

1/ Includes urban, rural, and other industrial uses.

TABLE UC-5

Upper Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use

1979

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation & Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other 1/	Municipal and Industrial: Total	Export: Outside System	Export: Within System	Export: Total
Arizona	San Juan-Colo.	3.7	5.3	0.9	6.2	0.0	20.4	3.6	24.0	0.0	0.0	33.9
Colorado	Green River	7.1	119.9	3.4	123.3	4.9	6.7	1.8	13.4	0.0	0.0	143.8
	Upper Main Stem	45.2	911.9	7.0	918.9	12.1	0.3	11.1	23.5	505.5	124.3	1,617.4
	San Juan-Colo.	5.3	171.2	3.8	175.0	2.4	0.0	2.7	5.1	2.1	(-124.3)	63.2
	Total	57.6	1,203.0	14.2	1,217.2	19.4	7.0	15.6	42.0	507.6	0.0	1,824.4
New Mexico	San Juan-Colo.	23.9	174.8	1.1	175.9	3.6	27.8	5.7	37.1	164.2	0.0	401.1
Utah	Green River	38.0	450.1	3.4	453.5	7.6	12.0	4.4	24.0	127.5	0.0	643.0
	Upper Main Stem	0.3	13.8	0.1	13.9	1.5	0.0	0.7	2.2	0.0	0.0	16.4
	San Juan-Colo.	5.8	56.3	2.6	58.9	1.2	4.8	0.9	6.9	(-5.2)	0.0	66.4
	Total	44.1	520.2	6.1	526.3	10.3	16.8	6.0	33.1	122.3	0.0	725.8
Wyoming	Green River	31.8	253.5	4.0	257.5	18.1	27.0	3.9	49.0	9.7	0.0	348.0
Upper Basin	Green River	76.9	823.5	10.8	834.3	30.6	45.7	10.1	86.4	137.2	0.0	1,134.8
	Upper Main Stem	45.5	925.7	7.1	932.8	13.6	0.3	11.8	25.7	505.5	124.3	1,633.8
	San Juan-Colo.	38.7	407.6	8.4	416.0	7.2	53.0	12.9	73.1	161.1	(-124.3)	564.6
	Total	161.1	2,156.8	26.3	2,183.1	51.4	99.0	34.8	185.2	803.8	0.0	3,333.2

1/ Includes urban, rural, and other industrial uses.

TABLE UC-6

Upper Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use

1980

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation & Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[1/]	Municipal and Industrial: Total	Export: Outside System	Export: Within System	Total
Arizona	San Juan-Colo.	3.7	6.3	1.0	7.3	0.0	22.3	3.6	25.9	0.0	0.0	36.9
Colorado	Green River	8.0	116.3	3.5	119.8	4.9	9.4	1.9	16.2	0.0	0.0	144.0
	Upper Main Stem	58.8	937.2	7.6	944.8	12.2	0.4	11.5	24.1	393.0	129.0	1,549.7
	San Juan-Colo.	7.1	160.2	4.7	164.9	2.4	0.0	2.8	5.2	2.4	(-129.0)	50.6
	Total	73.9	1,213.7	15.8	1,229.5	19.5	9.8	16.2	45.5	395.4	0.0	1,744.3
New Mexico	San Juan-Colo.	33.5	204.8	1.4	206.2	3.7	31.9	5.9	41.5	143.6	0.0	424.8
Utah	Green River	38.8	418.6	3.3	421.9	7.6	13.1	4.6	25.3	109.7	0.0	595.7
	Upper Main Stem	0.4	13.0	0.1	13.1	1.5	0.0	0.7	2.2	0.0	0.0	15.7
	San Juan-Colo.	6.2	52.5	2.5	55.0	1.2	4.7	1.0	6.9	(-5.6)	0.0	62.5
	Total	45.4	484.1	5.9	490.0	10.3	17.8	6.3	34.4	104.1	0.0	673.9
Wyoming	Green River	31.2	239.3	3.7	243.0	19.0	30.7	4.2	53.9	9.3	0.0	337.4
Upper Basin	Green River	78.0	774.2	10.5	784.7	31.5	53.2	10.7	95.4	119.0	0.0	1,077.1
	Upper Main Stem	59.2	950.2	7.7	957.9	13.7	0.4	12.2	26.3	393.0	129.0	1,565.4
	San Juan-Colo.	50.5	423.8	9.6	433.4	7.3	58.9	13.3	79.5	140.4	(-129.0)	574.8
	Total	187.7	2,148.2	27.8	2,176.0	52.5	112.5	36.2	201.2	652.4	0.0	3,217.3

1/ Includes urban, rural, and other industrial uses.

TABLE UC-7

Upper Colorado River Basin

Irrigated Acreage

1976-1980

(1,000 acres)

State	Tributary	Irrigated Acreage 1976	1977	1978	1979	1980
Arizona	San Juan-Colo.	3.6	4.4	5.1	4.7	7.8
Colorado	Green River	105.2	102.2	104.1	103.2	103.5
	Upper Main Stem	546.0	466.5	541.8	546.4	553.0
	San Juan-Colo.	143.0	98.9	125.9	128.0	127.0
	Total	794.2	667.6	771.8	777.6	783.5
New Mexico	San Juan-Colo.	58.1	51.7	67.9	71.9	78.5
Utah	Green River	250.6	140.0	251.7	251.0	251.1
	Upper Main Stem	6.0	2.5	7.0	7.2	7.1
	San Juan-Colo.	28.2	8.4	34.5	34.2	35.5
	Total	284.8	150.9	293.2	292.4	293.7
Wyoming	Green River	285.6	164.8	300.9	308.3	315.9
Upper Basin	Green River	641.4	407.0	656.7	662.5	670.5
	Upper Main Stem	552.0	469.0	548.8	553.6	560.1
	San Juan-Colo.	232.9	163.4	233.4	238.8	248.8
	Total	1,426.3	1,039.4	1,438.9	1,454.9	1,479.4

TABLE UC-8

Upper Colorado River Basin

Population Estimates

1976-1980

(1,000's)

State	Tributary	Estimated Population 1976	1977	1978	1979	1980
Arizona	San Juan-Colo.	31.8	33.3	34.8	36.4	38.1
Colorado	Green River	25.6	27.2	28.9	30.8	32.8
	Upper Main Stem	175.2	182.8	190.9	199.4	208.1
	San Juan-Colo.	42.5	43.7	45.1	46.7	48.1
	Total	243.3	253.7	264.9	276.9	289.0
New Mexico	San Juan-Colo.	83.1	86.7	90.3	94.2	98.3
Utah	Green River	55.1	58.0	60.8	63.9	67.2
	Upper Main Stem	7.7	7.8	8.1	8.3	8.4
	San Juan-Colo.	14.7	15.2	15.5	15.9	16.3
	Total	77.5	81.0	84.4	88.1	91.9
Wyoming	Green River	43.7	47.0	50.8	54.6	58.6
Upper Basin	Green River	124.4	132.2	140.5	149.3	158.6
	Upper Main Stem	182.9	190.6	199.0	207.7	216.5
	San Juan-Colo.	172.1	178.9	185.7	193.2	200.8
	Total	479.4	501.7	525.2	550.2	575.9

TABLE LC-1

Lower Colorado River Basin

Colorado River Mainstream Estimated Reservoir Evaporation and Channel Loss[1/]

1976-1980

(1,000 acre-feet)

	Reservoir Evaporation						Apparent Channel Losses[3/]			Total Reservoir Evaporation and Channel Loss
Water Year	Lake Mead	Lake Mohave	Lake Havasu	Senator Wash Reservoir	Other[2/]	Total	Lee Ferry To Hoover Dam	Hoover Dam to IB	Total	
1976	862	177	128	2	40	1,209	40	50	90	1,300
1977	817	181	138	2	36	1,174	200	(-110)	90	1,260
1978	713	154	120	2	32	1,021	160	180	340	1,360
1979	747	157	113	2	32	1,051	30	400	430	1,480
1980	816	165	126	2	35	1,144	(-40)	290	250	1,390
Average	791	167	125	2	35	1,120	80	160	240	1,360

1/ Undistributed by States.

2/ "Other" impoundments include Palo Verde, Headgate Rock, Imperial, Laguna, and Morelos Diversion Dams.

3/ Losses include channel evaporation, seepage, and phreatophyte consumptive use. Note that gauge error of a USGS "excellent" gage is 5 percent, or approximately 400,000 acre-feet per year for the gages at Lee Ferry, Hoover Dam, and the International Border. Such gage errors may result in the computation of large apparent channel losses.

TABLE LC-2

Lower Colorado River Basin

Estimated Water Use Including Colorado Mainstream by States and Types of Use[1/]

1976-1980

(1,000 acre-feet)

Water Year	State	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evaporation and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Fish, Wildlife, and Recreation	Export: Outside System	Export: Inside System	Total
	Arizona	218.6	4,274.4	60.1	4,334.5	79.7	23.2	288.0	390.9	55.3	0.0	3.1	5,002.4
	Nevada	7.3	91.3	2.1	93.4	3.0	24.9	99.7	127.6	0.8	0.0	(-3.1)	226.0
1976	New Mexico	4.1	14.6	3.4	18.0	0.2	0.0	8.8	9.0	0.0	0.0	0.0	31.1
	Utah	6.1	56.1	1.5	57.6	0.0	0.0	1.9	1.9	0.0	1.4	0.0	67.0
	California	0.0	472.4	0.0	472.4	0.0	0.0	3.4	3.4	0.0	4,336.9	0.0	4,812.7
	Total	236.1	4,908.8	67.1	4,975.9	82.9	48.1	401.8	532.8	56.1	4,338.3	0.0	10,139.2
	Arizona	167.5	4,672.9	56.1	4,729.0	71.9	20.8	300.3	393.0	41.9	0.0	3.4	5,334.8
	Nevada	6.7	86.4	2.0	88.4	4.4	25.6	104.3	134.3	0.9	0.0	(-3.4)	226.9
1977	New Mexico	3.6	14.4	2.9	17.3	0.4	0.0	8.7	9.1	0.0	0.0	0.0	30.0
	Utah	5.4	56.5	1.4	57.9	0.0	0.0	2.1	2.1	0.0	0.3	0.0	65.7
	California	0.0	461.6	0.0	461.6	0.0	0.0	3.3	3.3	0.0	4,372.1	0.0	4,837.0
	Total	183.2	5,291.8	62.4	5,354.2	76.7	46.4	418.7	541.8	42.8	4,372.4	0.0	10,494.4
	Arizona	302.2	4,486.6	57.0	4,543.6	75.4	24.1	324.2	423.7	46.4	0.0	2.4	5,318.3
	Nevada	5.7	83.1	1.7	84.8	4.6	19.1	111.6	135.3	0.9	0.0	(-2.4)	224.3
1978	New Mexico	4.9	17.8	3.8	21.6	0.6	0.0	8.6	9.2	0.0	0.0	0.0	35.7
	Utah	4.1	51.2	1.1	52.3	0.0	0.0	2.2	2.2	0.0	8.6	0.0	67.2
	California	0.0	475.4	0.0	475.4	0.0	0.0	2.9	2.9	0.0	4,146.1	0.0	4,624.4
	Total	316.9	5,114.1	63.6	5,177.7	80.6	43.2	449.5	573.3	47.3	4,154.7	0.0	10,269.9
	Arizona	409.3	4,420.4	51.2	4,471.6	80.2	27.2	336.9	444.3	47.1	0.0	2.6	5,374.9
	Nevada	5.7	78.6	1.7	80.3	3.5	20.7	120.0	144.2	0.9	0.0	(-2.6)	228.5
1979	New Mexico	4.0	13.8	3.4	17.2	0.7	0.0	8.5	9.2	0.0	0.0	0.0	30.4
	Utah	4.1	60.1	1.1	61.2	0.0	0.0	2.3	2.3	0.0	4.4	0.0	72.0
	California	0.0	476.4	0.0	476.4	0.0	0.0	3.1	3.1	0.0	4,111.8	0.0	4,591.3
	Total	423.1	5,049.3	57.4	5,106.7	84.4	47.9	470.8	603.1	48.0	4,116.2	0.0	10,297.1
	Arizona	433.7	4,614.3	54.5	4,668.8	65.6	30.6	345.5	441.7	56.4	0.0	3.0	5,603.6
	Nevada	6.3	75.2	1.9	77.1	3.0	21.8	127.1	151.9	1.1	0.0	(-3.0)	233.4
1980	New Mexico	4.1	15.7	3.4	19.1	0.7	0.0	8.5	9.2	0.0	0.0	0.0	32.4
	Utah	4.6	51.0	1.2	52.2	0.0	0.0	2.7	2.7	0.0	4.8	0.0	64.3
	California	0.0	469.5	0.0	469.5	0.0	0.0	2.8	2.8	0.0	4,207.9	0.0	4,680.2
	Total	448.7	5,225.7	61.0	5,286.7	69.3	52.4	486.6	608.3	57.5	4,212.7	0.0	10,613.9

1/ A portion of the consumptive uses shown herein are satisfied by ground water overdraft.
2/ Includes rural, urban, and other industrial uses.

TABLE LC-3

Lower Colorado River Basin

Colorado River Mainstream Water Use and Exports by States and Mexico[1/]

1976-1980

(1,000 acre-feet)

Water Year	State	Estimated Consumptive Use: Irrigated Agriculture	Municipal and Industrial	Thermal Electric Power	Fish Wildlife & Rec.	Export	Total	Unmeasured Return Flow[2/]	Adjusted Total	Water Passing to Mexico: Treaty	Minute 242[3/]	Excess Releases	Total
1976	Nevada	0.1	90.1	14.7	0.8	0.0	105.7	30.7	75.0	-	-	-	-
	Arizona	1,238.3	11.0	0.6	55.3	0.0	1,305.2	136.9	1,168.3	-	-	-	-
	California	535.5	3.4	0.0	0.0	4,336.9	4,875.8	63.1	4,812.7	-	-	-	-
	Total	1,773.9	104.5	15.3	56.1	4,336.9	6,286.7	230.7	6,056.0	1,474.7	205.6	68.6	1,748.9
1977	Nevada	0.1	89.9	15.1	0.9	0.0	106.0	32.4	73.6	-	-	-	-
	Arizona	1,162.8	12.6	0.8	41.9	0.0	1,218.1	139.7	1,078.4	-	-	-	-
	California	521.9	3.3	0.0	0.0	4,372.1	4,897.3	60.3	4,837.0	-	-	-	-
	Total	1,684.8	105.8	15.9	42.8	4,372.1	6,221.4	232.4	5,989.0	1,553.5	209.4	68.5	1,831.4
1978	Nevada	0.1	93.4	9.6	0.9	0.0	104.0	33.8	70.2	-	-	-	-
	Arizona	1,186.6	13.5	1.0	46.4	0.0	1,247.5	137.6	1,109.9	-	-	-	-
	California	537.8	2.9	0.0	0.0	4,146.1	4,686.8	62.4	4,624.4	-	-	-	-
	Total	1,724.5	109.8	10.6	47.3	4,146.1	6,038.3	233.8	5,804.5	1,513.0	194.2	37.3	1,744.5
1979	Nevada	0.1	105.7	11.0	0.9	0.0	117.7	37.5	80.2	-	-	-	-
	Arizona	1,086.3	11.4	0.9	47.1	0.0	1,145.7	133.8	1,011.9	-	-	-	-
	California	542.6	3.1	0.0	0.0	4,111.8	4,657.5	66.2	4,591.3	-	-	-	-
	Total	1,629.0	120.2	11.9	48.0	4,111.8	5,920.9	237.5	5,683.4	1,668.0	170.6	927.7	2,766.3
1980	Nevada	0.1	122.7	11.7	1.1	0.0	135.6	42.1	93.5	-	-	-	-
	Arizona	1,096.0	12.3	0.8	56.4	0.0	1,165.5	130.7	1,034.8	-	-	-	-
	California	538.8	2.8	0.0	0.0	4,207.9	4,749.5	69.3	4,680.2	-	-	-	-
	Total	1,634.9	137.8	12.5	57.5	4,207.9	6,050.6	242.1	5,808.5	1,706.8	185.0	4,251.0	6,142.8

1/ From the Bureau of Reclamation calendar year reports "Compilation of Records in Accordance with Article V of the Decree of the Supreme Court of the United States in Arizona vs. California dated March 9, 1964." Exports to California and water passing to Mexico are demands on system water and consumption is outside the system.

2/ Estimates of unmeasured return flows are for the Colorado River diversions portions of Las Vegas Wash (Nevada) surface water discharge to Lake Mead, as found in decree accounting. Total unmeasured return flows for Arizona and California are estimated to be 200,000 acre-feet which is proportioned on the basis of irrigated agriculture diversions.

3/ Source: Annual reports by the Bureau of Reclamation, "Operation of the Colorado River Basin and Projected Operations."

TABLE LC-4

Lower Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use[1/]

1976

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evap. and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Export: Outside System	Export: Inside System	Total
Ariz.	Little Colorado	34.8	63.7	11.5	75.2	2.7	4.5	13.1	20.3	0.0	22.4	152.7
	Virgin	0.3	9.7	0.4	10.1	0.0	0.0	0.1	0.1	0.0	0.0	10.5
	Bill Williams	10.1	22.8	1.3	24.1	0.7	0.0	0.6	1.3	0.0	0.0	35.5
	Gila	171.9	2,944.7	35.3	2,980.0	75.2	18.1	256.1	349.4	0.0	(-19.3)	3,482.0
	Remaining Area	1.5	132.1	11.6	143.7	1.1	0.0	7.1	8.2	0.0	0.0	153.4
	Total	218.6	3,173.0	60.1	3,233.1	79.7	22.6	277.0	379.3	0.0	3.1	3,834.1
Nev.	Muddy	7.3	37.8	1.0	38.8	0.5	4.4	0.2	5.1	0.0	0.0	51.2
	Remaining Area	0.0	53.4	1.1	54.5	2.1	5.8	40.5	48.4	0.0	(-3.1)	99.8
	Total	7.3	91.2	2.1	93.3	2.6	10.2	40.7	53.5	0.0	(-3.1)	151.0
N. Mex.	Little Colorado	3.5	5.5	1.8	7.3	0.2	0.0	2.5	2.7	0.0	0.0	13.5
	Gila	0.6	9.1	1.6	10.7	0.0[3/]	0.0	6.3	6.3	0.0	0.0	17.6
	Total	4.1	14.6	3.4	18.0	0.2	0.0	8.8	9.0	0.0	0.0	31.1
Utah	Virgin	5.9	50.5	1.3	51.8	0.0	0.0	1.8	1.8	1.4	0.0	60.9
	Remaining Area	0.2	5.6	0.2	5.8	0.0	0.0	0.1	0.1	0.0	0.0	6.1
	Total	6.1	56.1	1.5	57.6	0.0	0.0	1.9	1.9	1.4	0.0	67.0
Lower Basin	Little Colorado	38.3	69.2	13.3	82.5	2.9	4.5	15.6	23.0	0.0	22.4	166.2
	Virgin	6.2	60.2	1.7	61.9	0.0	0.0	1.9	1.9	1.4	0.0	71.4
	Muddy	7.3	37.8	1.0	38.8	0.5	4.4	0.2	5.1	0.0	0.0	51.2
	Bill Williams	10.1	22.8	1.3	24.1	0.7	0.0	0.6	1.3	0.0	0.0	35.5
	Gila	172.5	2,953.8	36.9	2,990.7	75.2	18.1	262.4	355.7	0.0	(-19.3)	3,499.6
	Remaining Area	1.7	191.1	12.9	204.0	3.2	5.8	47.7	56.7	0.0	(-3.1)	259.3
	Total	236.1	3,334.9	67.1	3,402.0	82.5	32.8	328.4	443.7	1.4	0.0	4,083.2

1/ Excludes Colorado River mainstream and flood plain. A portion of the consumptive uses shown herein are satisfied by ground water overdraft.

2/ Includes rural, urban, and other industrial uses.

3/ This value is included in the "Other" Municipal and Industrial Uses category, as found in the annual report by the New Mexico Interstate Stream Commission as required by the Supreme Court decree in Arizona vs. California.

TABLE LC-5

Lower Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use[1/]

1977

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evap. and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Export: Outside System	Export: Inside System	Total
Ariz.	Little Colorado	25.9	72.9	9.1	82.0	3.1	3.7	13.3	20.1	0.0	10.5	138.5
	Virgin	0.3	12.5	0.3	12.8	0.0	0.0	0.1	0.1	0.0	0.0	13.2
	Bill Williams	9.4	28.2	1.2	29.4	0.9	0.0	0.7	1.6	0.0	0.0	40.4
	Gila	130.7	3,410.1	34.8	3,444.9	66.6	16.3	266.9	349.8	0.0	(-7.1)	3,918.3
	Remaining Area	1.2	126.1	10.7	136.8	1.3	0.0	6.7	8.0	0.0	0.0	146.0
	Total	167.5	3,649.8	56.1	3,705.9	71.9	20.0	287.7	379.6	0.0	3.4	4,256.4
Nev.	Muddy	6.7	39.1	0.9	40.0	0.6	4.4	0.2	5.2	0.0	0.0	51.9
	Remaining Area	0.0	47.2	1.1	48.3	3.3	6.1	47.1	56.5	0.0	(-3.4)	101.4
	Total	6.7	86.3	2.0	88.3	3.9	10.5	47.3	61.7	0.0	(-3.4)	153.3
N. Mex.	Little Colorado	3.0	6.3	1.6	7.9	0.4	0.0	2.5	2.9	0.0	0.0	13.8
	Gila	0.6	8.1	1.3	9.4	0.0[3/]	0.0	6.2	6.2	0.0	0.0	16.2
	Total	3.6	14.4	2.9	17.3	0.4	0.0	8.7	9.1	0.0	0.0	30.0
Utah	Virgin	5.2	50.3	1.2	51.5	0.0	0.0	2.0	2.0	0.3	0.0	59.0
	Remaining Area	0.2	6.2	0.2	6.4	0.0	0.0	0.1	0.1	0.0	0.0	6.7
	Total	5.4	56.5	1.4	57.9	0.0	0.0	2.1	2.1	0.3	0.0	65.7
Lower Basin	Little Colorado	28.9	79.2	10.7	89.9	3.5	3.7	15.8	23.0	0.0	10.5	152.3
	Virgin	5.5	62.8	1.5	64.3	0.0	0.0	2.1	2.1	0.3	0.0	72.2
	Muddy	6.7	39.1	0.9	40.0	0.6	4.4	0.2	5.2	0.0	0.0	51.9
	Bill Williams	9.4	28.2	1.2	29.4	0.9	0.0	0.7	1.6	0.0	0.0	40.4
	Gila	131.3	3,418.2	36.1	3,454.3	66.6	16.3	273.1	356.0	0.0	(-7.1)	3,934.5
	Remaining Area	1.4	179.5	12.0	191.5	4.6	6.1	53.9	64.6	0.0	(-3.4)	254.1
	Total	183.2	3,807.0	62.4	3,869.4	76.2	30.5	345.8	452.5	0.3	0.0	4,505.4

1/ Excludes Colorado River mainstream and flood plain. A portion of the consumptive uses shown herein are satisfied by ground water overdraft.

2/ Includes rural, urban, and other industrial uses.

3/ This value is included in the "Other" Municipal and Industrial Uses category, as found in the annual report by the New Mexico Interstate Stream Commission as required by the Supreme Court decree in Arizona vs. California.

TABLE LC-6

Lower Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use[1/]

1978

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evap. and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Export: Outside System	Export: Inside System	Total
Ariz.	Little Colorado	37.0	79.9	12.5	92.4	3.6	6.5	14.7	24.8	0.0	16.3	170.5
	Virgin	0.3	14.4	0.3	14.7	0.0	0.0	0.1	0.1	0.0	0.0	15.1
	Bill Williams	23.9	29.1	1.3	30.4	2.3	0.0	0.7	3.0	0.0	0.0	57.3
	Gila	239.3	3,175.9	32.5	3,208.4	68.3	16.6	288.8	373.7	0.0	(-13.9)	3,807.5
	Remaining Area	1.7	138.3	10.4	148.7	1.2	0.0	6.4	7.6	0.0	0.0	158.0
	Total	302.2	3,437.6	57.0	3,494.6	75.4	23.1	310.7	409.2	0.0	2.4	4,208.4
Nev.	Muddy	5.7	32.5	0.8	33.3	0.6	4.4	0.2	5.2	0.0	0.0	44.2
	Remaining Area	0.0	50.5	0.9	51.4	3.5	5.1	52.3	60.9	0.0	(-2.4)	109.9
	Total	5.7	83.0	1.7	84.7	4.1	9.5	52.5	66.1	0.0	(-2.4)	154.1
N. Mex.	Little Colorado	4.4	7.9	2.1	10.0	0.6	0.0	2.5	3.1	0.0	0.0	17.5
	Gila	0.5	9.9	1.7	11.6	0.0[3/]	0.0	6.1	6.1	0.0	0.0	18.2
	Total	4.9	17.8	3.8	21.6	0.6	0.0	8.6	9.2	0.0	0.0	35.7
Utah	Virgin	4.0	45.6	1.0	46.6	0.0	0.0	2.1	2.1	8.6	0.0	61.3
	Remaining Area	0.1	5.6	0.1	5.7	0.0	0.0	0.1	0.1	0.0	0.0	5.9
	Total	4.1	51.2	1.1	52.3	0.0	0.0	2.2	2.2	8.6	0.0	67.2
Lower Basin	Little Colorado	41.4	87.8	14.6	102.4	4.2	6.5	17.2	27.9	0.0	16.3	188.0
	Virgin	4.3	60.0	1.3	61.3	0.0	0.0	2.2	2.2	8.6	0.0	76.4
	Muddy	5.7	32.5	0.8	33.3	0.6	4.4	0.2	5.2	0.0	0.0	44.2
	Bill Williams	23.9	29.1	1.3	30.4	2.3	0.0	0.7	3.0	0.0	0.0	57.3
	Gila	239.8	3,185.8	34.2	3,220.0	68.3	16.6	294.9	379.8	0.0	(-13.9)	3,825.7
	Remaining Area	1.8	194.4	11.4	205.8	4.7	5.1	58.8	68.6	0.0	(-2.4)	273.8
	Total	316.9	3,589.6	63.6	3,653.2	80.1	32.6	374.0	486.7	8.6	0.0	4,465.4

1/ Excludes Colorado River mainstream and flood plain. A portion of the consumptive uses shown herein are satisfied by ground water overdraft.

2/ Includes rural, urban, and other industrial uses.

3/ This value is included in the "Other" Municipal and Industrial Uses category, as found in the annual report by the New Mexico Interstate Stream Commission as required by the Supreme Court decree in Arizona vs. California.

TABLE LC-7

Lower Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use[1/]

1979

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evap. and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Export: Outside System	Export: Inside System	Total
Ariz.	Little Colorado	29.8	80.4	10.1	90.5	3.7	8.0	15.3	27.0	0.0	17.4	164.7
	Virgin	0.3	21.2	0.3	21.5	0.0	0.0	0.1	0.1	0.0	0.0	21.9
	Bill Williams	34.8	26.5	1.1	27.6	2.2	0.0	0.8	3.0	0.0	0.0	65.4
	Gila	343.0	3,208.5	29.5	3,238.0	71.9	18.3	299.8	390.0	0.0	(-14.8)	3,956.2
	Remaining Area	1.4	131.3	10.2	141.5	2.4	0.0	9.5	11.9	0.0	0.0	154.8
	Total	409.3	3,467.9	51.2	3,519.1	80.2	26.3	325.5	432.0	0.0	2.6	4,363.0
Nev.	Muddy	5.7	28.2	0.8	29.0	0.0	4.4	0.2	4.6	0.0	0.0	39.3
	Remaining Area	0.0	50.3	0.9	51.2	2.9	5.3	52.2	60.4	0.0	(-2.6)	109.0
	Total	5.7	78.5	1.7	80.2	2.9	9.7	52.4	65.0	0.0	(-2.6)	148.3
N. Mex.	Little Colorado	3.4	7.8	1.8	9.6	0.7	0.0	2.5	3.2	0.0	0.0	16.2
	Gila	0.6	6.0	1.6	7.6	0.0[3/]	0.0	6.0	6.0	0.0	0.0	14.2
	Total	4.0	13.8	3.4	17.2	0.7	0.0	8.5	9.2	0.0	0.0	30.4
Utah	Virgin	4.0	53.7	1.0	54.7	0.0	0.0	2.2	2.2	4.4	0.0	65.3
	Remaining Area	0.1	6.4	0.1	6.5	0.0	0.0	0.1	0.1	0.0	0.0	6.7
	Total	4.1	60.1	1.1	61.2	0.0	0.0	2.3	2.3	4.4	0.0	72.0
Lower Basin	Little Colorado	33.2	88.2	11.9	100.1	4.4	8.0	17.8	30.2	0.0	17.4	180.9
	Virgin	4.3	74.9	1.3	76.2	0.0	0.0	2.3	2.3	4.4	0.0	87.2
	Muddy	5.7	28.2	0.8	29.0	0.0	4.4	0.2	4.6	0.0	0.0	39.3
	Bill Williams	34.8	26.5	1.1	27.6	2.2	0.0	0.8	3.0	0.0	0.0	65.4
	Gila	343.6	3,214.5	31.1	3,245.6	71.9	18.3	305.8	396.0	0.0	(-14.8)	3,970.4
	Remaining Area	1.5	188.0	11.2	199.2	5.3	5.3	61.8	72.4	0.0	(-2.6)	270.5
	Total	423.1	3,620.3	57.4	3,677.7	83.8	36.0	388.7	508.5	4.4	0.0	4,613.7

1/ Excludes Colorado River mainstream and flood plain. A portion of the consumptive uses shown herein are satisfied by ground water overdraft.

2/ Includes rural, urban, and other industrial uses.

3/ This value is included in the "Other" Municipal and Industrial Uses category, as found in the annual report by the New Mexico Interstate Stream Commission as required by the Supreme Court decree in Arizona vs. California.

TABLE LC-8

Lower Colorado River Basin

Estimated Water Use by States, Major Tributaries, and Types of Use[1/]

1980

(1,000 acre-feet)

State	Tributary	Reservoir Evaporation	Agriculture: Irrigation	Agriculture: Stockpond Evap. and Livestock	Agriculture: Total	Municipal and Industrial: Mineral Resources	Municipal and Industrial: Thermal Electric Power	Municipal and Industrial: Other[2/]	Municipal and Industrial: Total	Export: Outside System	Export: Inside System	Total
Ariz.	Little Colorado	29.0	96.0	9.8	105.8	3.3	14.3	15.6	33.2	0.0	18.3	186.3
	Virgin	0.3	17.8	0.3	18.1	0.0	0.0	0.1	0.1	0.0	0.0	18.5
	Bill Williams	37.4	28.5	1.2	29.7	1.8	0.0	0.9	2.7	0.0	0.0	69.8
	Gila	365.7	3,365.9	32.4	3,398.3	58.6	15.5	307.3	381.4	0.0	(-15.3)	4,130.1
	Remaining Area	1.3	140.8	10.8	151.6	1.9	0.0	9.3	11.2	0.0	0.0	164.1
	Total	433.7	3,649.0	54.5	3,703.5	65.6	29.8	333.2	428.6	0.0	3.0	4,568.8
Nev.	Muddy	6.3	23.9	0.9	24.8	0.0	4.4	0.2	4.6	0.0	0.0	35.7
	Remaining Area	0.0	51.2	1.0	52.2	2.5	5.7	46.8	55.0	0.0	(-3.0)	104.2
	Total	6.3	75.1	1.9	77.0	2.5	10.1	47.0	59.6	0.0	(-3.0)	139.9
N. Mex.	Little Colorado	3.4	9.3	1.8	11.1	0.7	0.0	2.5	3.2	0.0	0.0	17.7
	Gila	0.7	6.4	1.6	8.0	0.0[3/]	0.0	6.0	6.0	0.0	0.0	14.7
	Total	4.1	15.7	3.4	19.1	0.7	0.0	8.5	9.2	0.0	0.0	32.4
Utah	Virgin	4.5	45.2	1.1	46.3	0.0	0.0	2.6	2.6	4.8	0.0	58.2
	Remaining Area	0.1	5.8	0.1	5.9	0.0	0.0	0.1	0.1	0.0	0.0	6.1
	Total	4.6	51.0	1.2	52.2	0.0	0.0	2.7	2.7	4.8	0.0	64.3
Lower Basin	Little Colorado	32.4	105.3	11.6	116.9	4.0	14.3	18.1	36.4	0.0	18.3	204.0
	Virgin	4.8	63.0	1.4	64.4	0.0	0.0	2.7	2.7	4.8	0.0	76.7
	Muddy	6.3	23.9	0.9	24.8	0.0	4.4	0.2	4.6	0.0	0.0	35.7
	Bill Williams	37.4	28.5	1.2	29.7	1.8	0.0	0.9	2.7	0.0	0.0	69.8
	Gila	366.4	3,372.3	34.0	3,406.3	58.6	15.5	313.3	387.4	0.0	(-15.3)	4,144.8
	Remaining Area	1.4	197.8	11.9	209.7	4.4	5.7	56.2	66.3	0.0	(-3.0)	274.4
	Total	448.7	3,790.8	61.0	3,851.8	68.8	39.9	391.4	500.1	4.8	0.0	4,805.4

1/ Excludes Colorado River mainstream and flood plain. A portion of the consumptive uses shown herein are satisfied by ground water overdraft.

2/ Includes rural, urban, and other industrial uses.

3/ This value is included in the "Other" Municipal and Industrial Uses category, as found in the annual report by the New Mexico Interstate Stream Commission as required by the Supreme Court decree in Arizona vs. California.

TABLE LC-9

Lower Colorado River Basin

Irrigated Acreage

1976-1980

(1,000 acres)

State	Tributary	Irrigated Acreage[1/] 1976	1977	1978	1979	1980
Arizona	Gila	926.0	924.6	894.9	907.2	982.1
	Little Colorado	38.7	43.7	41.5	40.0	52.9
	Bill Williams	7.2	9.2	9.7	10.2	10.4
	Virgin	1.9	2.6	3.1	4.1	3.1
	Remaining Area	35.2	33.2	34.6	36.0	35.7
	Total	1,009.0	1,013.3	983.8	997.5	1,084.2
Nevada	Muddy	17.3	15.3	13.8	10.4	9.6
	Remaining Area	9.4	8.5	8.7	8.7	8.7
	Total	26.7	23.8	22.5	19.1	18.3
New Mexico	Gila	6.5	5.4	5.7	2.8	4.8
	Little Colorado	4.7	4.4	4.5	4.0	5.3
	Total	11.2	9.8	10.2	6.8	10.1
Utah	Virgin	17.0	16.5	17.5	17.0	17.0
	Remaining Area	2.6	2.6	2.7	2.7	2.7
	Total	19.6	19.1	20.2	19.7	19.7
Lower Basin	Gila	932.5	930.0	900.6	910.0	986.9
	Little Colorado	43.4	48.1	46.0	44.0	58.2
	Bill Williams	7.2	9.2	9.7	10.2	10.4
	Virgin	18.9	19.1	20.6	21.1	20.1
	Muddy	17.3	15.3	13.8	10.4	9.6
	Remaining Area	47.2	44.3	46.0	47.4	47.1
	Total	1,066.5	1,066.0	1,036.7	1,043.1	1,132.3
Colorado Mainstream	Arizona	292.3	269.7	278.3	285.9	286.4
	Nevada	0.1	0.1	0.1	0.1	0.1
	California	111.3	102.8	106.2	109.2	109.3
	Total	403.7	372.6	384.6	395.2	395.8

1/ Irrigated acreage includes all irrigated croplands harvested as well as irrigated pasture. Double-cropping is accounted.

TABLE LC-10

Lower Colorado River Basin

Population Estimates

1976-1980

(1,000's)

State	Tributary	Estimated Population 1976	1977	1978	1979	1980
Arizona	Mainstream Colorado*	128.5	135.4	140.2	147.3	152.9
	Gila	1,955.9	2,037.3	2,194.8	2,279.0	2,336.3
	Little Colorado	128.5	132.6	144.7	149.0	153.4
	Bill Williams	7.7	8.3	8.7	9.2	9.5
	Virgin	0.4	0.4	0.4	0.5	0.5
	Total	2,221.0	2,314.0	2,488.8	2,585.0	2,652.6
California	Mainstream Colorado	21.3	21.4	21.6	21.7	21.9
Nevada	Mainstream Colorado*	361.9	378.9	405.5	436.0	461.8
	Muddy	3.0	3.1	3.3	3.5	3.7
	Total	364.9	382.0	408.8	439.5	465.5
New Mexico	Gila	5.4	5.5	5.7	5.7	5.8
	Little Colorado	45.8	46.7	47.3	46.6	46.0
	Total	51.2	52.2	53.0	52.3	51.8
Utah	Mainstream Colorado*	2.1	2.2	2.3	2.6	3.1
	Virgin	18.0	19.2	20.0	22.6	26.1
	Total	20.1	21.4	22.3	25.2	29.2
Lower Basin	Mainstream Colorado*	513.8	537.9	569.6	607.6	639.7
	Gila	1,961.3	2,042.8	2,200.5	2,284.7	2,342.1
	Little Colorado	174.3	179.3	192.0	195.6	199.4
	Bill Williams	7.7	8.3	8.7	9.2	9.5
	Virgin	18.4	19.6	20.4	23.1	26.6
	Muddy	3.0	3.1	3.3	3.5	3.7
	Total	2,678.5	2,791.0	2,994.5	3,123.7	3,221.0

*Includes Remaining Area population.