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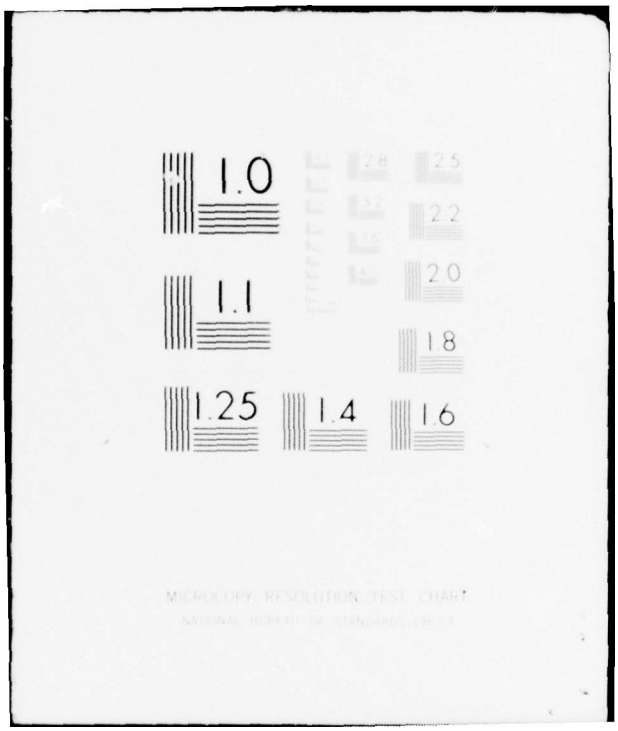
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LOWER COLORADO REGION
Comprehensive Framework Study of Water and Land Resources

SUMMARY REPORT
JUNE 1971

PREPARED BY:

LOWER COLORADO REGION STATE – FEDERAL INTERAGENCY GROUP FOR THE PACIFIC SOUTHWEST INTERAGENCY COMMITTEE

Hoover Dam and Lake Mead exemplify the concept of multipurpose use of stored water including: flood control; power generation; irrigation; recreation; fish and wildlife and other uses

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LOWER COLORADO REGION
COMPREHENSIVE FRAMEWORK STUDY
OF WATER AND RELATED LAND RESOURCES

SUMMARY REPORT

This report of the Lower Colorado Region Framework Study State-Federal Interagency Group was prepared at field-level and presents a framework program for the development and management of the water and related land resources of the Lower Colorado Region. This report is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the Congress for its consideration.

While the comprehensive framework plan presented herein is the result of a coordinated effort by participants from various Federal and State agencies involved in the Study, it does not necessarily reflect the singular viewpoint or policy of any particular agency or state. The type and need for future developments may change appreciably from the framework plan as a result of differing assumptions, methodology, and objectives used in water and land use plans prepared by the State and/or Federal agencies.

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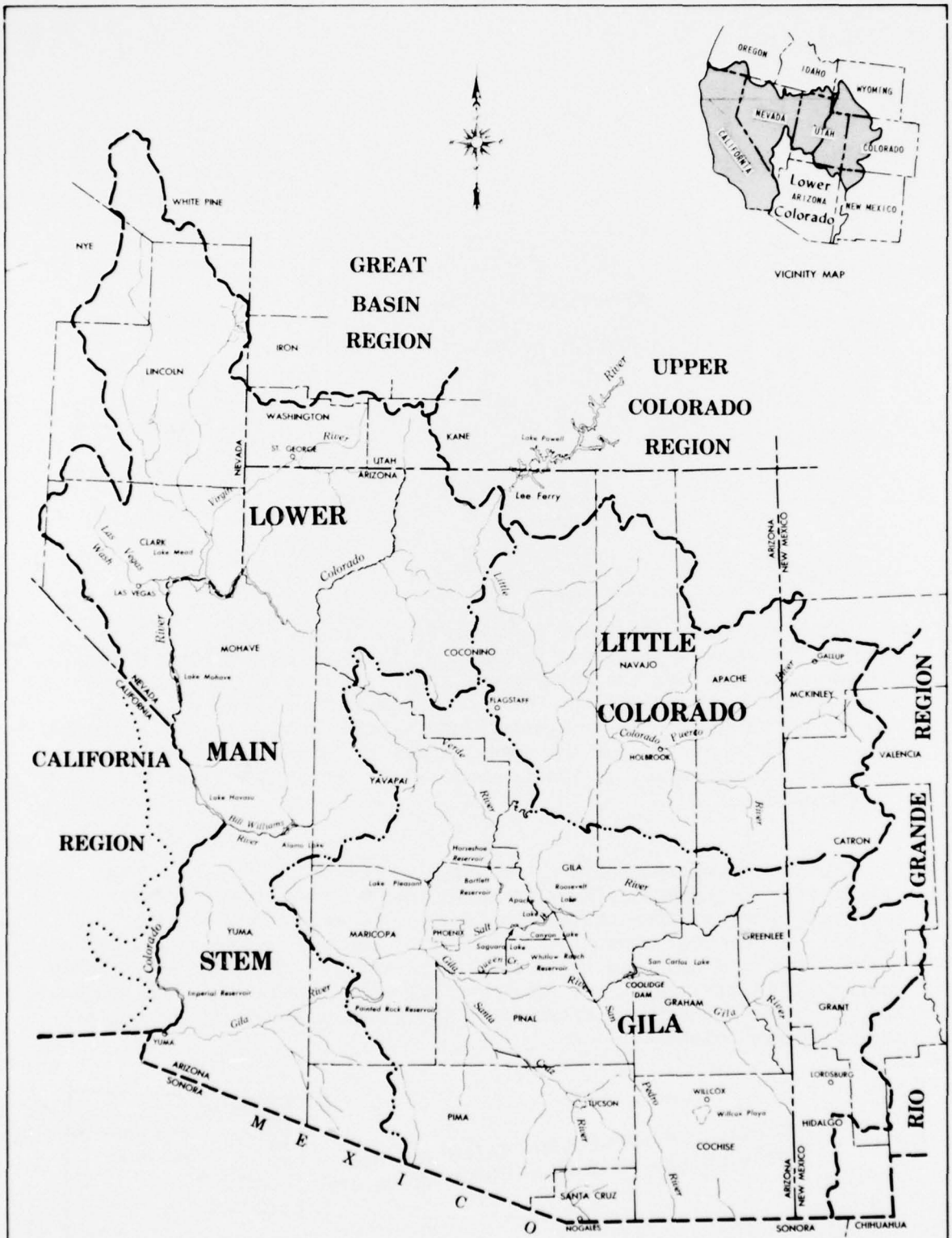

VICINITY MAP
OREGON
IDAHO
WYOMING
NEVADA
UTAH
COLORADO
CALIFORNIA
Lower Colorado
ARIZONA
NEW MEXICO
GREAT BASIN REGION
UPPER COLORADO REGION
LOWER CALIFORNIA REGION
LITTLE COLORADO REGION
GILA
RIO GRANDE
MAIN STEM
WHITE PINE
NYE
LINCOLN
IRON
WASHINGTON
KANE
ST. GEORGE
Virgin River
Lake Powell
Lee Ferry
Colorado River
CLARK
Lake Mead
LAS VEGAS
Las Vegas Wash
MOHAVE
Lake Mohave
COCONINO
FLAGSTAFF
NAVAJO
APACHE
GALLUP
MCKINLEY
HOLBROOK
Little Colorado River
Puerco River
VALENCIA
CATRON
YAVAPAI
Lake Havasu
Bill Williams River
Alamo Lake
Verde River
Horseshoe Reservoir
Bartlett Reservoir
Lake Pleasant
Roosevelt Lake
GREENLEE
YUMA
MARICOPA
PHENOMENAL
Salt River
Saguaro Lake
Canyon Lake
Apache Lake
Whitlow Ranch Reservoir
San Carlos Lake
COOLIDGE DAM
GRAHAM
Gila River
GRANT
Imperial Reservoir
Painted Rock Reservoir
PINAL
Santa Cruz
LORDSBURG
WILLCOX
Willcox Playa
HIDALGO
PIMA
TUCSON
COCHISE
SANTA CRUZ
NOGALES
SONORA
CHIHUAHUA
MEXICO
LEGEND
REGION BOUNDARY
SUBREGION BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
COLORADO RIVER DRAINAGE
COMPREHENSIVE FRAMEWORK STUDY
LOWER COLORADO REGION
SCALE
MILES

SUMMARY REPORT

LOWER COLORADO REGION COMPREHENSIVE FRAMEWORK STUDY

INTRODUCTION

Guidelines for the framework studies state: "The basic objective in the formulation of framework plans is to provide a broad guide to the best use, or combination of uses, of water and related land resources of a region to meet foreseeable short- and long-term needs." Specifically, the study was initiated to:

1. Evaluate the present and future needs of the Lower Colorado Region for water and related land resources through year 2020.

2. Evaluate available resources.

3. Formulate a framework program to meet the future social and economic needs for water and related lands, goods, and services.

4. Preserve natural and cultural values.

5. Protect and enhance the public well-being.

The framework program is of reconnaissance scope, broad in coverage, and flexible in structure. It does not formulate specific development proposals, but serves as a guide and sound basis for a continuous planning process and presents programs for meeting the needs of a particular set of economic projections made for food and fiber demands. Consideration must be given to other programs developed by other groups, agencies, or states which may reflect programs for meeting needs of differing projected economic patterns.

The program presented should be continually reviewed and modified as future changes in economic demands, technology and other factors require. Additional studies will be required to examine and evaluate other courses of action which may be instituted as desirable or necessary.

The Lower Colorado Region is one of four regions in the Pacific Southwest assigned to the Pacific Southwest Inter-Agency Committee by the Water Resources Council for comprehensive framework study. The study is a cooperative effort of primary state and Federal agencies.

U.S. Department of Agriculture

- Economic Research Service
- Forest Service
- Rural Electrification Administration
- Soil Conservation Service

U.S. Department of the Army

- Corps of Engineers

U.S. Department of Commerce

- Business and Defense Services
- Environmental Sciences Service Administration

U.S. Department of Health, Education, and Welfare

U.S. Department of Housing and Urban Development

U.S. Department of the Interior

- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Mines
- Bureau of Outdoor Recreation
- Bureau of Reclamation
- Bureau of Sport Fisheries and Wildlife
- Geological Survey
- National Park Service

U.S. Department of Labor

U.S. Environmental Protection Agency

- Water Quality Office

U.S. Federal Power Commission

U.S. International Boundary and Water Commission

State of Arizona

- Arizona State University
- Arizona Water Commission
- Department of Health
- Flood Control District of Maricopa County
- Game and Fish Department
- Power Authority
- Salt River Project
- State Land Department
- State Parks Board
- University of Arizona

State of California

- Colorado River Board
- Department of Fish and Game
- Department of Water Resources
- Metropolitan Water District of Southern California

State of Nevada

- Colorado River Commission
- Department of Fish and Game
- Division of Water Resources

State of New Mexico

- Department of Game and Fish
- Interstate Stream Commission
- State Planning Office

State of Utah

- Division of Fish and Game
- Division of Health
- Division of Parks and Recreation
- Division of Water Resources
- Geological and Mineralogical Survey

THE REGION

The Lower Colorado Region includes the Colorado River drainage in the United States below Lee Ferry, Arizona, except that occurring in California (see map). In addition, it includes several closed basins in Arizona, Nevada, and New Mexico, and some areas in southern Arizona and New Mexico that drain into Mexico.

The Region occupies 141,137 square miles in the Pacific Southwest area of the United States. Of this total area, 106,982 square miles are in Arizona, 17,310 square miles are in Nevada, 13,355 square miles are in New Mexico, and 3,490 square miles are in Utah. The population is concentrated principally in south central Arizona and southern Nevada. The remainder of the Region's population is located in small, widely scattered communities. Much of the area is uninhabited.

The Lower Colorado Region is composed of a complex of plateaus, mountains, deserts, and plains, with elevations ranging from 75 feet above sea level, near Yuma, Arizona, to more than 12,600 feet at Humphreys Peak, near Flagstaff, Arizona.

The climate of the Region varies as widely as does its topography. Maximum temperatures range from more than 100 degrees in the desert to the mild 70's in the mountainous areas. Average annual precipitation varies from less than 5 inches at Yuma to more than 30 inches in the higher mountains.

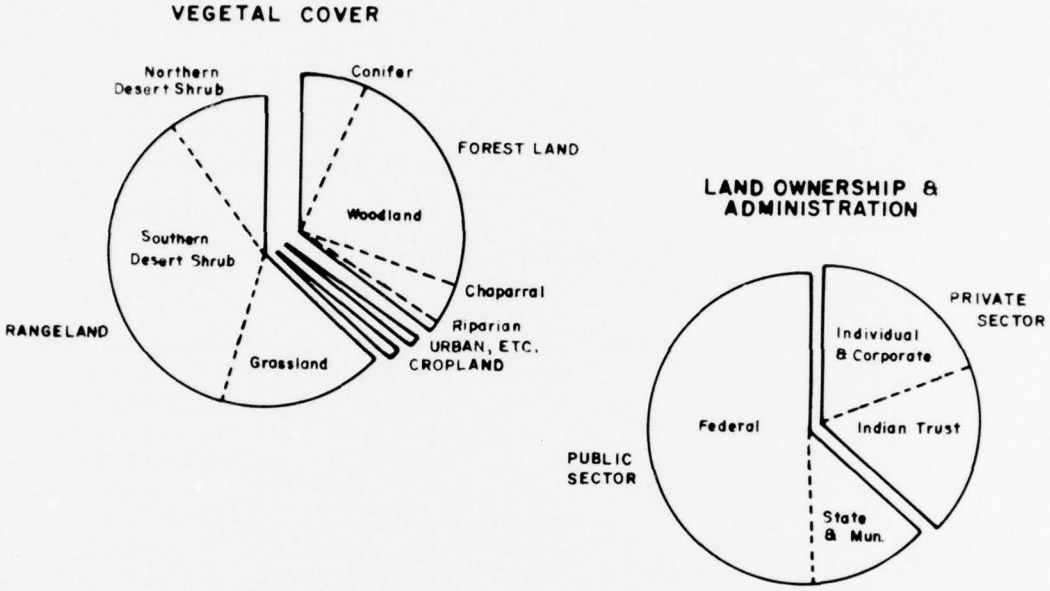
The Lower Colorado Region has a wide variation in vegetal cover types. The forest types extend from the small alpine areas on top of the highest mountain peaks; through the coniferous forest zones of spruce-fir, Ponderosa pine, and the pinon-juniper and oak woodlands, and the chaparral types. The rangeland type extends from the forest type through the northern and southern desert shrubs, the northern and desert grasslands, down through a small area of true desert near the mouth of the Colorado River on the boundary between Mexico and Arizona. Scattered throughout the Region are areas of cultivated land, including irrigated pasture, with the largest blocks in the lower Gila and the southern half of the Lower Main Stem Subregions. More than 500,000 acres of the Region are developed as urban and industrial areas. More than 340,000 acres of the Region are occupied by water in the form of streams, lakes, and reservoirs.

About 52 percent of the total land is federally owned, 12 percent is in state and other public ownership, and 36 percent is private land. About one-half of the latter is in Indian reservations held in trust by the Federal government.

Timber Resource

Mountain Grass and Woodlands

Desert Lowlands



In 1965, about 2 percent of the Region was in cropland; 64 percent, pasture and range; 33 percent, forest and woodland; and less than 1 percent in urban, transportation, utilities, etc. More than 76 million acres were grazed by domestic livestock on rangeland, forest land, and cropland. Commercial timber was produced on about 5.5 million acres. About 5.5 million acres within the Region were designated for outdoor recreation, almost 3 million acres being in national parks and monuments. More than 0.8 million acres were in designated wilderness areas and 1.9 million acres were managed primarily for fish and wildlife. More than 4.1 million acres were within military reservations.

Suitable land is available to satisfy almost every purpose or need of the Region, but land development is curtailed, in most areas, by an insufficient supply of water. For example, the Region contains almost 40 million acres with soils suited for irrigated agricultural production with 1.54 million acres developed but, due primarily to a limited water supply, only 1.3 million acres were irrigated in 1965.

Except for the limited availability of water supply, the Region is bountifully provided with resources, space, and general environment which will support future growth. Probably the most stimulating single factor on the growth of the Region is the climate which permits activities such as irrigated agriculture, construction, entertainment, tourism, and outdoor recreation during the entire year.

ECONOMIC PROJECTIONS

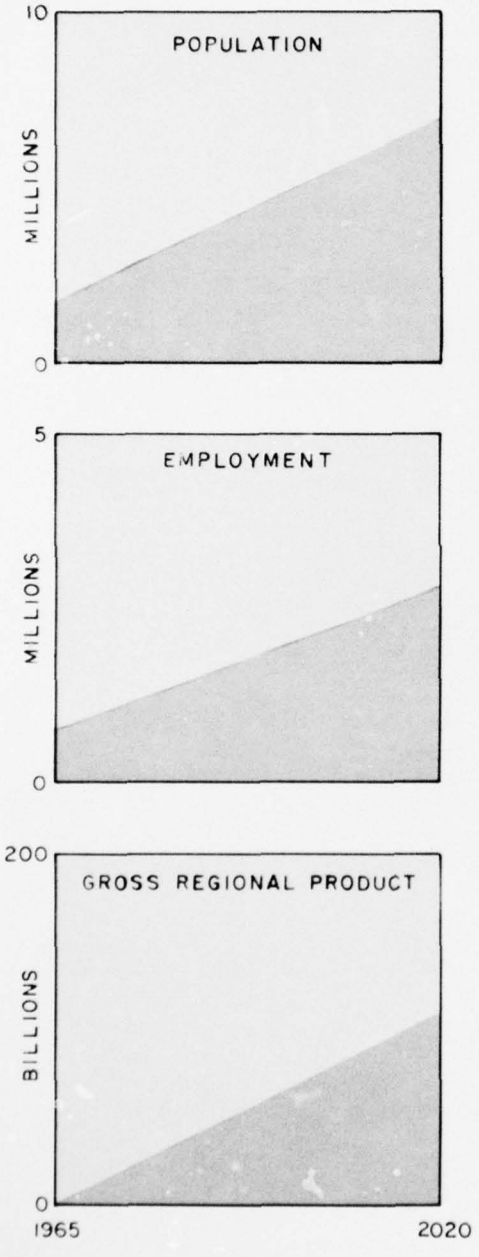
Two of the most important constraints in this study are:

1. Projections of regional growth and development are generally constrained in accordance with national projections developed by the Departments of Commerce and Agriculture (Office of Business Economics and Economic Research Service). These projections were modified by the States of the Lower Colorado Region to reflect to local conditions and trends.

2. Legislative constraints and the guidelines for framework studies prohibit study of importation of water among areas under the jurisdiction of more than one river basin commission or interagency committee. For these studies, desalting of sea water and further exploitation of ground water were considered the principal sources of additional water supplies for the Region and are the bases for the general magnitude of costs presented in this report. Costs presented also include those for local water supply developments, vegetation management, and facilities for conveying Colorado River water to central Arizona and southern Nevada.

Phoenix, Arizona, experienced a phenomenal population growth of 540 percent between 1950 and 1970 while expanding in area from 17 to 250 square miles. Maricopa County showed a population growth of 280 percent during the same period.

ECONOMIC GROWTH

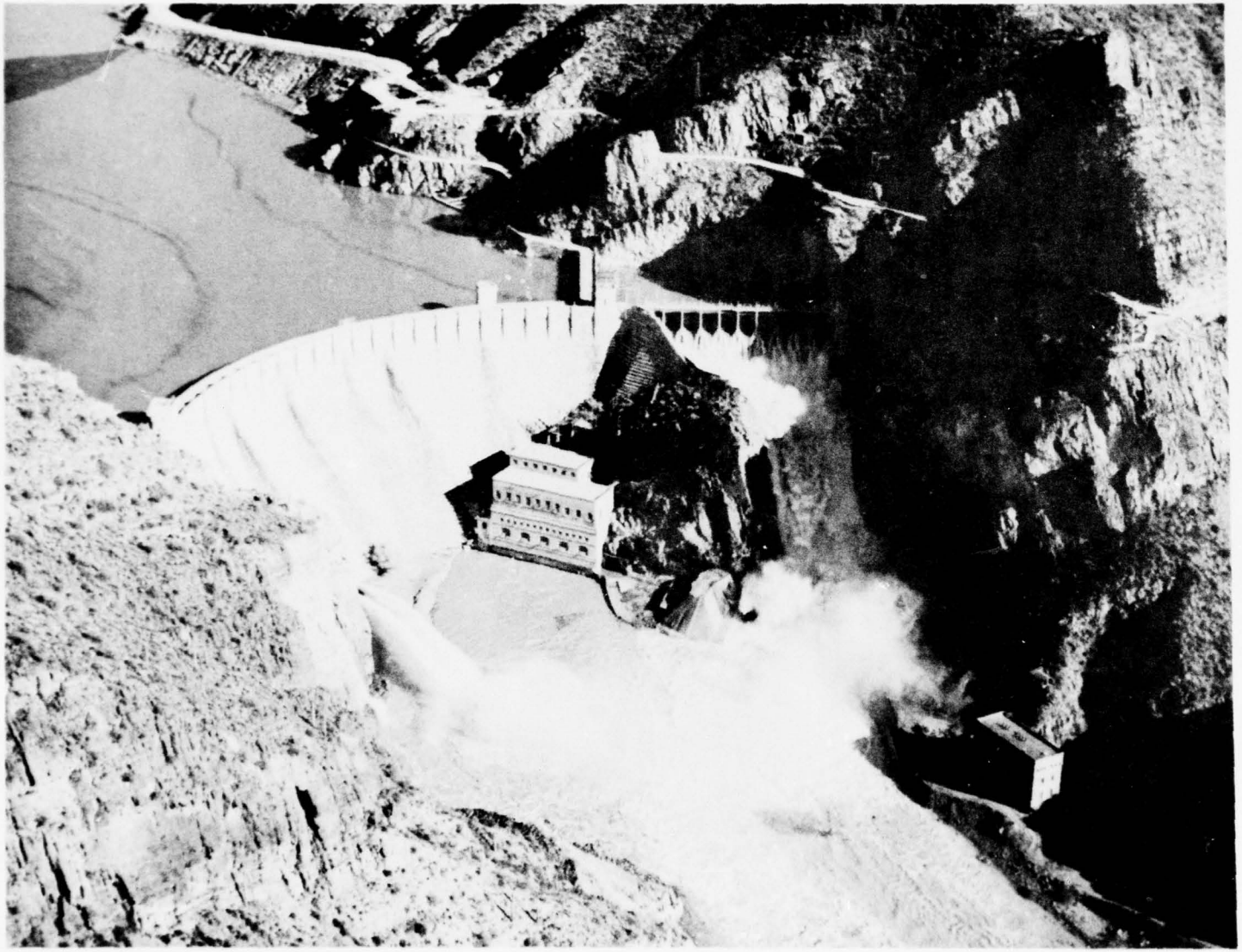


The Lower Colorado Region is a part of the fastest growing area in the United States. Population projections reflect an annual regional growth of 3.7 percent from year 1965 to 1980, 3.2 percent from year 1980 to 2000, and 2.3 percent from year 2000 to 2020 compared with the projected annual growth rate for the Nation of 1.3 percent. Regional population is projected to increase from 1.9 million in 1965 to almost 7 million by 2020.

Employment in the Region is projected to increase from about 676,000 in 1965 to almost 3 million by year 2020 (320 percent increase), when about 40 percent of the total population will be employed.

Per capita personal income in the Region for 1965 was $2,292, about 10 percent below the national average, and is projected to nearly equal that of the Nation, more than $12,000 in 2020.

In general, output levels of the primary industries, agriculture, forestry, and mining, are expected to more than double during the projection period, but manufacturing and the noncommodity producing industries will contribute greater percentages of total output in 2020. Gross regional product is projected to increase from the 1965 level of $6.0 billion to $113.5 billion in year 2020.



Theodore Roosevelt Dam, completed in 1911 on the Salt River in Arizona, is the forerunner of multipurpose water storage projects in the Region and still provides flood control, water for irrigation, municipal and industrial uses, hydroelectric power generation, and recreation.

WATER REQUIREMENTS AND RESOURCES

In 1965, the three primary sources of water available for use in the Lower Colorado Region were: a portion of Colorado River flows delivered at Lee Ferry, Arizona; local runoff; and local ground water supplies. See summary of water requirements and supply on page 36.

Allowing for all losses, depletions, and exports and excluding ground-water overdraft, the total water supply available for use in the Region was 5.75 million acre-feet in 1965 and is projected to decrease to 4.02 million acre-feet in 2020 as a result of increased depletions in the Upper Basin.

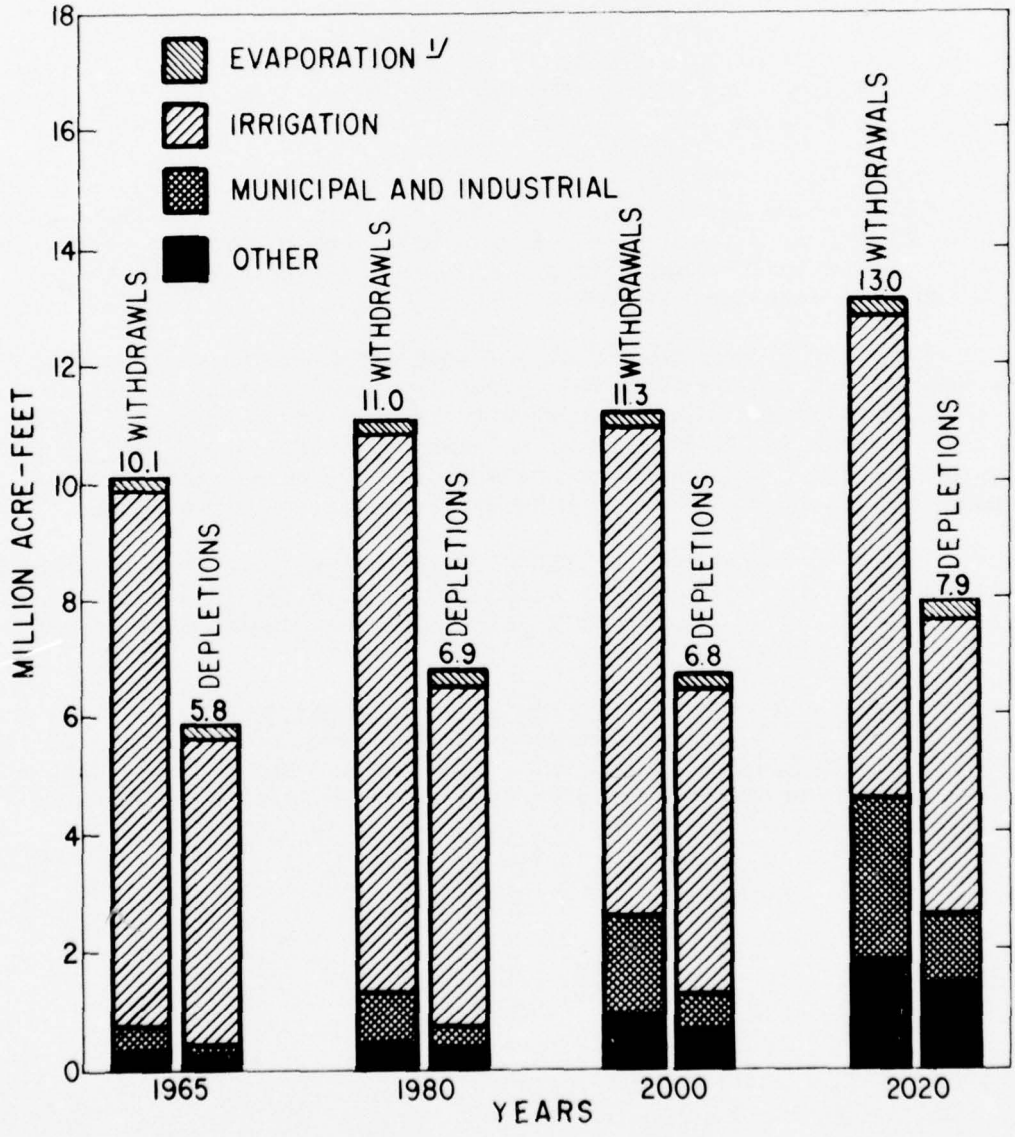
Total water requirement (withdrawals) for the Region is projected to increase from the 1965 base of about 10.1 million acre-feet to about 13.0 million acre-feet in year 2020. Total water consumed (depletion) is projected to increase from 5.8 million acre-feet in 1965 to about 8.5 million acre-feet in 2020.

In 1965, ground-water reserves were being overdrawn (depleted) at a rate of 2.5 million acre-feet annually due largely to a lack of facilities for enabling the Region to utilize its share of Colorado River water. In the absence of an imported water supply, the ground-water overdraft will continue and the regional water deficiency is projected to reach 4.5 million acre-feet annually by year 2020.

Until augmentation of regional water supplies is accomplished and/or salinity control measures are installed, the increased use of water in the Colorado River Basin will result in further quality degradation of the Colorado River.

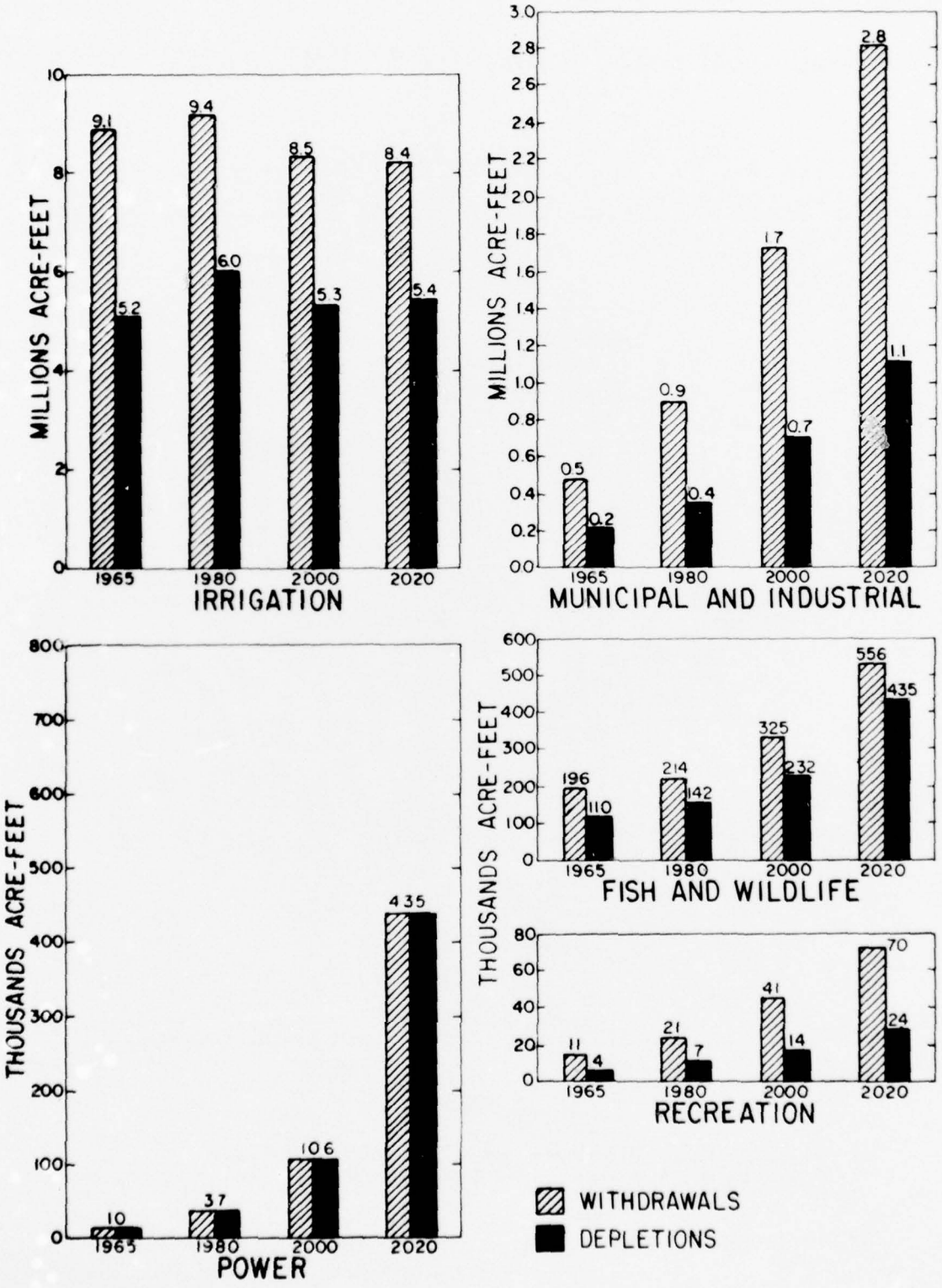
Maintenance of an acceptable level of water quality is vital to the economy, environment, and general well-being of the people of the Region. Presently deficient water supplies and the probable cost of future imported water dictate maximum water utilization, including reuse or recycling.

PROJECTED REGIONAL WATER REQUIREMENTS

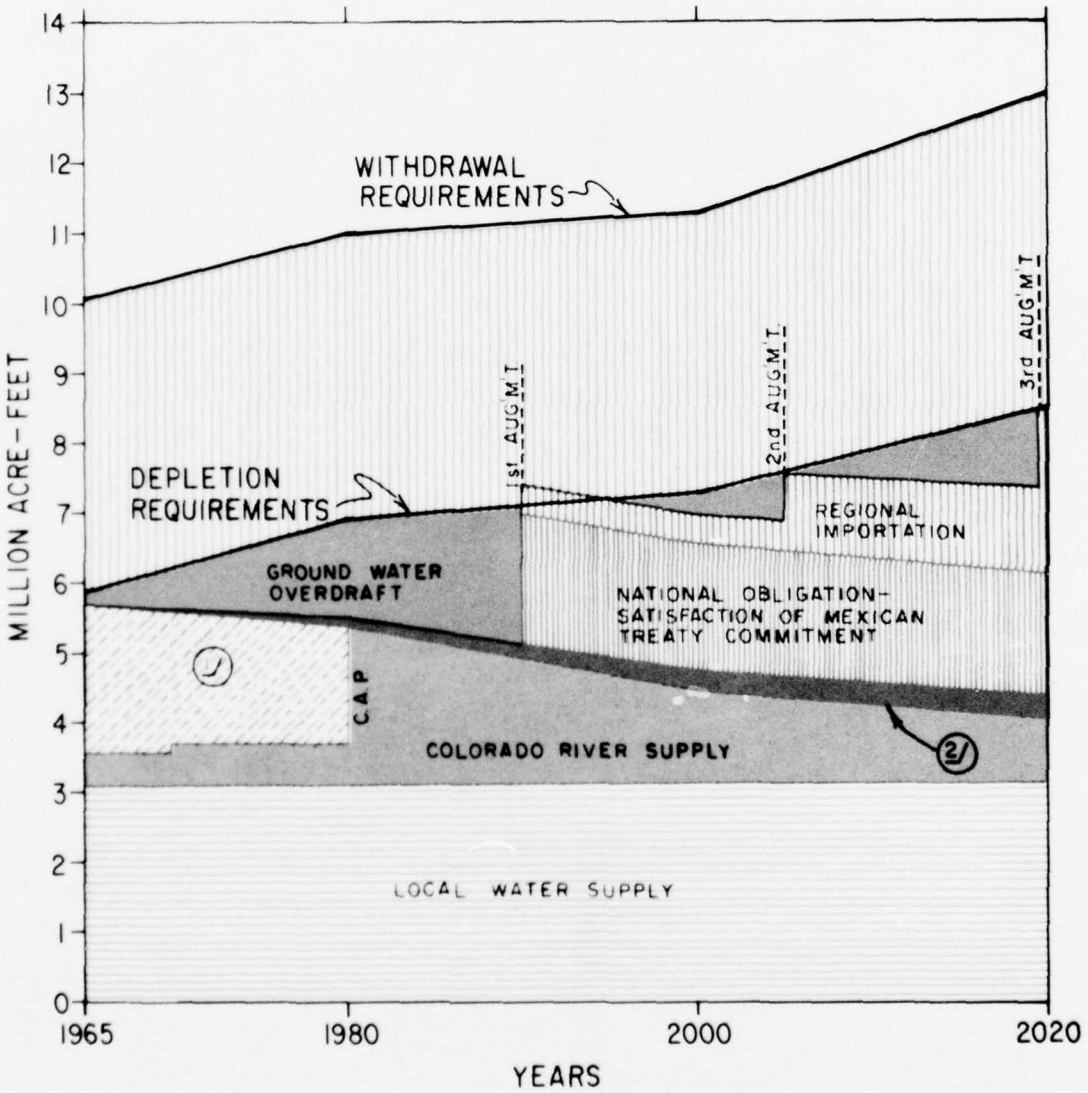


1/ Excluding Colorado River mainstem evaporation, losses estimated to be 1.2 million acre-feet annually.

PROJECTED REGIONAL WATER REQUIREMENTS BY USES



PROJECTED WATER REQUIREMENTS AND SUPPLY



1/ AVAILABILITY OF COLORADO RIVER WATER AFFECTED BY LACK OF DIVERSION FACILITIES. REQUIREMENTS ARE MET BY GROUND WATER OVERDRAFT

2/ WITHIN REGION AUGMENTATION

LAND REQUIREMENTS AND RESOURCES

Assuming continued application of the multiple-use principle, the land resource base of the Region appears to be sufficient in variety and amount to satisfy the projected land-use requirements through the year 2020. The many changes in land use necessary to satisfy projected land requirements must be planned to minimize conflicts among uses and to reduce cost.

The following tabulation shows present and projected major land-use requirements for the period of study and acreage suitable and available for various uses in 1965.

Unit: 1,000 Acres

Land Use	Suitable & Available 1965	Use in 1965	Projected Requirements 1980	2000	2020
Cropland	16,808	1,816	1,891	1,905	1,852
Livestock Grazing	76,054	76,054	73,739	69,902	65,807
Timber Production	5,458	5,458	5,358	5,153	5,044
Urban and Industrial	1/	513	863	1,230	1,564
Outdoor Recreation	1/	5,542	5,888	6,012	6,146
Wilderness Areas	3,458	861	1,458	3,158	3,458
Fish and Wildlife	3,223	3,223	3,546	7,175	15,020
Military	4,126	4,126	4,126	4,126	4,126
Transportation and Utilities	1/	660	858	1,030	1,145
Water Yield Improvement	3,685	114	289	824	1,229

1/ Most of the land resources of the Region are considered suitable for these purposes.

FRAMEWORK PROGRAM

The Region's rapid population growth rate, its concentration in few locations, the fragile nature of the desert environment, and the extremely limited water supplies, require that particular attention be directed to the environmental impacts which may occur as the result of development necessary to insure the well-being of the people of the Region. Such considerations have been of paramount concern to planners in nearly every phase of the framework studies. Main items of concern include: preservation of cultural, scenic, and natural values; protection and management of land resources; safeguarding the quality of water supplies; maintenance of agricultural areas; enhancement of fisheries; and the preservation of wildlife habitat.

See bar graph, page 35, for estimated total cost of the 1965 to 2020 regional framework program needed to satisfy projected requirements.

Multipurpose Water Supply

Presently authorized water supply projects included in the 1965 to 1980 framework program include the following: the Central Arizona Project, a multipurpose project which will provide facilities to convey up to 1.67 million acre-feet of Colorado River water to central Arizona, will make exchanges of water possible for uses in upstream reaches in Arizona, and will make 18,000 acre-feet of water available to New Mexico annually; the staged Southern Nevada Water Project, which will initially provide facilities to convey 0.13 million acre-feet of water from Lake Mead to the Las Vegas, Nevada, metropolitan area for municipal and industrial uses; and the Dixie Project which will provide supplemental and new irrigation water in addition to water for municipal and industrial uses in southern Utah.

Also to be provided during this time period, is the recovery of approximately 270,000 acre-feet of water annually along the Colorado River. In addition, 35,000 acre-feet of water could be recovered annually from the Gila River.

The 1965 to 1980 land treatment and management program provides water yield improvement measures on about 175,000 acres of forest lands to increase average annual water yield by about 30,000 acre-feet.

After implementation of the early action program, a water supply deficiency of about 1.5 million acre-feet will remain.

The continuing water supply program will provide water to satisfy the increasing demands and to greatly reduce the ground-water overdraft. The only foreseeable method to effectively augment the regional water supply is by importation from outside the Region.

The framework program provides for importing 2.25 million acre-feet of water annually to the Lower Colorado Region including 1.5 million acre-feet, plus 0.3 million acre-feet of associated losses, to satisfy the national obligation to Mexico, and 0.45 million acre-feet as a regional program. Lake Mead would provide regulatory storage for the imported water thus allowing maximum use of the importation facilities.

If the initial water importation were in operation at year 2000, there would still remain a regional annual water deficiency of about 0.44 million acre-feet which would increase to about 2.1 million acre-feet annually by 2020. Between years 2000 and 2020, an additional augmentation in the amount of 1.9 million acre-feet annually is recommended. Under this plan, the Region's annual deficiency in year 2020 would be about 0.17 million acre-feet. Pumping from ground-water basins will still be required and it is expected that some ground-water overdraft will continue, particularly in outlying basins remote from augmentation service areas.

Other means of providing suitable water for multipurpose uses, by year 2020, include the treatment of 0.68 million acre-feet annually of conventionally treated municipal and industrial waste water for reuse in Clark County, Nevada, and in Maricopa and Pima Counties, Arizona; and the treatment of 0.9 million acres of forest lands to increase annual water yield by 0.15 million acre-feet. Augmentation of water supplies in the central Arizona area could provide, through water exchanges, additional water for use in upstream areas for municipal, industrial, and mineral production needs, as well as for alleviating irrigation water deficiencies. Reservoir storage totaling 0.4 million acre-feet is provided to regulate flows for use in the upstream areas, largely in the Gila Subregion.

Water Quality

High levels of dissolved mineral salts in surface and ground waters are the major water quality problem in the Region. The Colorado River Basin framework program for salinity improvement could remove about 2.3 million tons of salts annually by the year 2020, with about 2.2 million tons being included in the Upper Basin portion of the program.

The early action salinity control program for the Colorado River Basin provides for the impoundment and evaporation of flows from LaVerkin Springs in Utah, which would remove more than 100,000 tons of salt annually. The program for Clark County, Nevada, consists of a plant for further treatment of secondary treated municipal and industrial wastes in the Las Vegas area. Facilities similar to that for Clark County and provisions for reuse of reclaimed water are also provided for further treatment of secondary treated municipal and industrial waste water occurring in the Phoenix and Tucson urban centers.

The continuing water-quality program after 1980 includes several waste water treatment plants and reuse facilities at or near the places of use. A desalting plant could be utilized in the lower Gila-Salt River drainage which would also aid the salt balance in the Gila Subregion. A desalting plant could also be utilized to treat effluents from the Las Vegas area. Optimum utilization of the water resources will require extensive treatment facilities to attain a high degree of water quality control. Augmentation of the Colorado River with high quality import water would have effects of major significance on improvement of the quality of this principal water source. Continuing studies of the Region's increasingly complex water quality problems are recommended.

In addition, the land treatment and management program described in the following section would materially reduce the suspended sediment in the Region's surface water supply.

Continued studies are proposed for the identification and solution to physical, engineering, legal, and institutional considerations necessary to implement a sound water quality program for the Region.

Land Treatment and Management

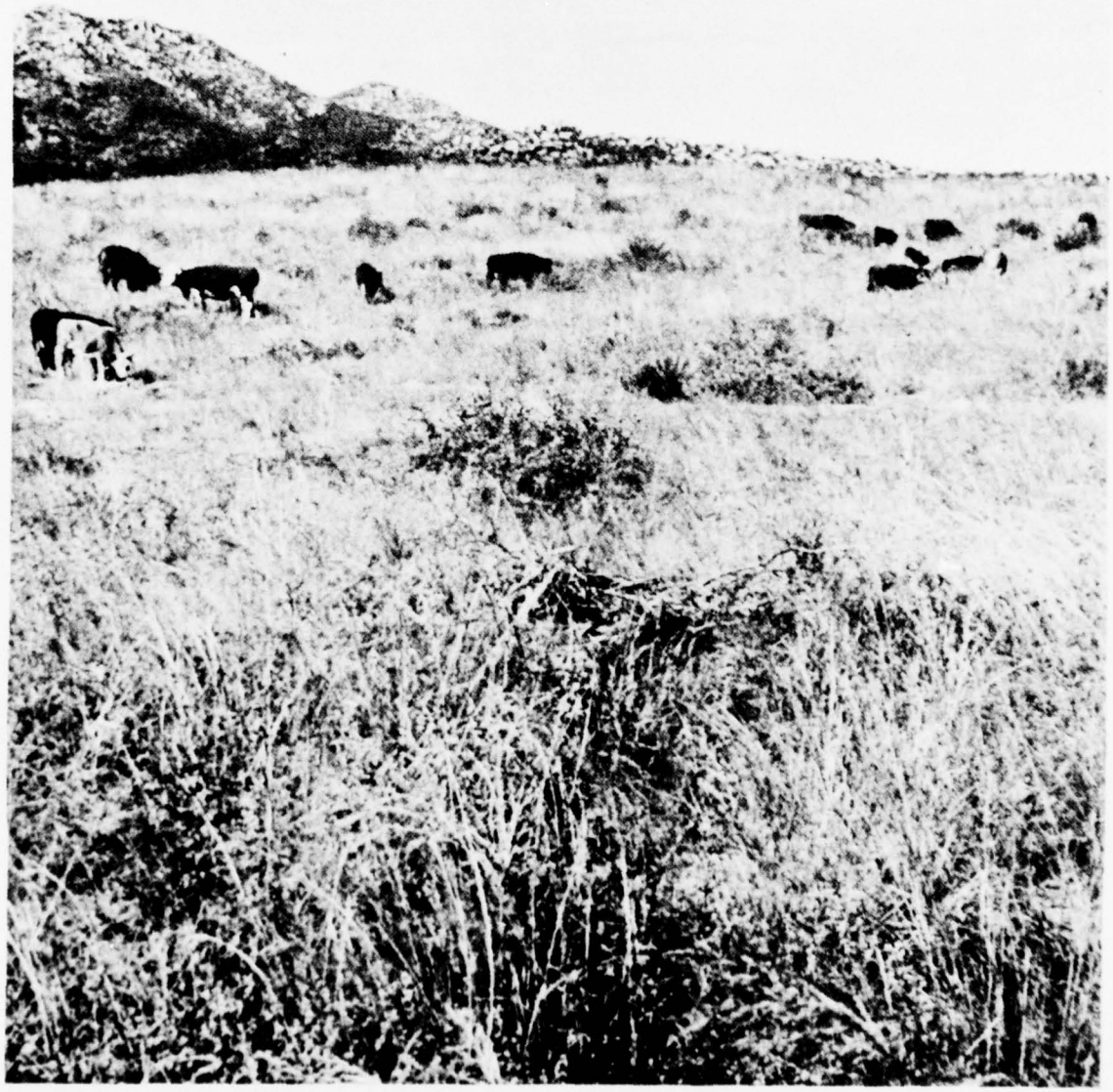
The land treatment and management program includes practices and measures which improve the quality, quantity, and timing of runoff; reduce erosion and sediment production; and improve the efficiency of use of most factors of production. The program represents a composite level which reconciles environmental protection and production objectives. To be effective, the program must harmonize with all water and related resource programs required to satisfy present and projected demands within the Region.

Treatment would be included on nearly 20 million acres by 1980 at an estimated cost of $278 million. From 1981 to 2020, an additional 44 million acres would be treated at an estimated total cost of $854 million. In most cases, the same acre will require treatment more than once during the study period because of development of improved methods, or the limited life of the measure or practice installed.

Cropland--Measures such as diversions, levees and dikes, channel improvement, floodways, and streambank protection were considered for floodwater and erosion control on cropland.

The program includes measures on about 573,000 acres of cropland between 1965 and 1980 and 1.6 million acres during the 1981 to 2020 period. About 52 percent of the program would be applied in the Lower Main Stem Subregion; 2 percent in the Little Colorado Subregion; and the remaining 46 percent in the Gila Subregion.

Rangeland--The land treatment and management program for rangeland was formulated to reduce erosion and sediment, control runoff, improve forage production, prevent and suppress wildfire, and associated programs.



Area converted from chaparral to grass for increased water yield and improved forage

The program includes treatment of 15.3 million acres of rangeland during the 1965 to 1980 period and treatment on about 35 million acres between years 1981 and 2020.

Forest Land--Programs for development and management of forest land and resources are designed to utilize and maintain or improve the total productive capacity of the land and water, including wood, forage, recreation, wildlife, and water to meet the regional and national needs of the people.

Structural and other management and development programs are designed to reduce sheet, gully, and streambank erosion, control peak runoff, and prevent downstream floods. Roads, trails, and other improvements are designed, constructed, and maintained to minimize erosion and sediment yield and deposition.

The program includes the treatment of 3.6 million acres of forest land during the 1965 to 1980 period. The demands for forest resources and uses by 2020 will require the treatment and management of about 7.6 million acres of forest lands during the period from 1981 to 2020. Treatment of forest land to increase water yield by about 180,000 acre-feet annually through vegetative management and to improve timber and forage production is recommended.

Urban and Other--Measures, such as diversions, levees and dikes, channel improvement, floodways, and establishment of vegetation were considered for erosion, floodwater, and sediment control in urban and mined areas, and along roadsides, utility rights-of-way, etc.

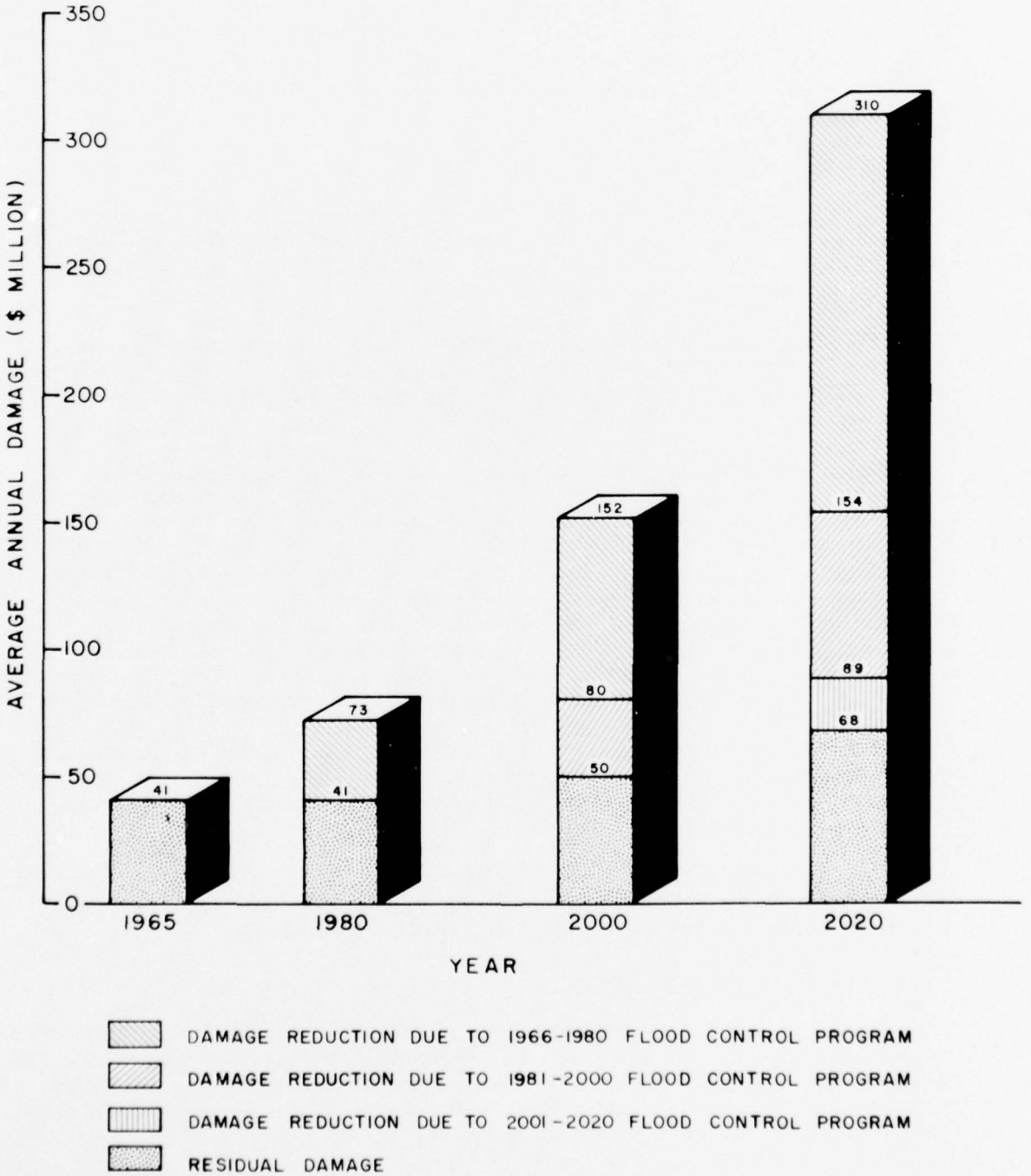
A total of 182,000 acres of urban and other lands would receive treatment between 1965 and 1980. During the 1981 to 2020 period, 510,000 acres would receive treatment.

Flood Control

The Region is subject to severe and sudden floods, with some flood damage occurring every year. Almost all land suitable for general development is subject to some degree of flood damage, either from a defined stream or from overland flow. Average annual flood damages were estimated at $41 million under 1965 conditions of development.

Included in the early action program is 3.1 million acre-feet of floodwater storage which has an estimated cost of $228 million. Multipurpose reservoirs provide 2.1 million acre-feet of the total floodwater storage. The program includes local protection projects containing about 273 miles of levees and 586 miles of channel improvements costing about $110 million and land treatment measures on 188,000 acres of cropland costing about $6.3 million. The program includes making maximum use of flood plain management as a means of preventing flood damage. This program would include flood forecasting, zoning, building codes, health regulations, flood proofing, and purchase of private lands subject to flooding for open space use.

EFFECTS OF FLOOD CONTROL PROGRAM 1965 - 2020



The program would reduce damages by $32 million annually. The estimated remaining damages would be $41 million annually.

The continuing flood control program includes impoundments totaling 1.2 million acre-feet of storage, 535 miles of channel improvements, 165 miles of levees, treatment on 545,000 acres of cropland, and flood plain management. Remaining damages at the end of the study period would total $68 million annually. (For these remaining damages there appear to be no feasible solutions.) With no additional flood control measures after 1965, annual flood damages of $310 million are estimated by the year 2020.

Irrigation and Drainage

Irrigated land is expected to increase from 1.3 million acres in 1965 to 1.6 million acres in 2020. Urbanization is expected to remove about 200,000 acres from production. The total new irrigation development would be about 500,000 acres.

The early action irrigation program includes increased conservation of existing water supplies, more efficient utilization of lands developed for irrigation and new irrigation development of 200,000 acres, of which about 110,000 acres would be on Indian lands.

Water management measures, such as land leveling, ditch lining, water control structures and pipelines, are included for better control and more efficient onfarm use of irrigation water and/or to reduce costs of irrigation. A total of 573,000 acres of cropland would be treated, by 1980, at a total cost of $56.3 million. Though the irrigated lands harvested will increase by 228,000 acres, the total acreage irrigated will increase only 173,000 acres and increased water utilization efficiencies will result in a slight decrease in water withdrawal requirements. Additional drainage facilities, primarily in the Lower Main Stem Subregion, are provided to serve 68,000 acres at a cost of $14.4 million.

The continuing program for installation of measures for irrigation water management on 1.6 million acres is provided to achieve the projected efficiency of onfarm irrigation water use and to maintain the productive capacity of the land.

With the addition of imported water supplies and projected increases in irrigated lands after 1980, the plan provides for new drainage facilities to serve an additional 120,000 acres by year 2020.

Municipal and Industrial Water

Projects presently under construction or authorized for construction constitute most of the municipal and industrial water supply early action program and will provide 446,000 acre-feet of water by 1980. Desalting feasibility studies have been initiated to consider treatment of brackish water supplies for several municipalities.

Headworks of the Southern Nevada Water Project, a part of the early action program, will supply water to the Las Vegas metropolitan area

Other communities are expected to meet most of their water needs through 1980 by continued development of ground-water resources.

Municipal and industrial water withdrawal requirements are expected to increase by about 2 million acre-feet between 1981 and 2020.

The major municipal water development would be participation in a regional water importation program. The fully developed facilities provided by the Southern Nevada Water Project will meet the water needs of Las Vegas Valley until about year 2000. A 100-million gallon-per-day desalination plant is included in the framework program for treatment of municipal wastes in Clark County in the 1981 to 2000 time frame, after which a new source of water supply will be needed. Desalting facilities having capacities totaling 123 million gallons per day are included in the program to treat brackish ground water for municipal uses in several communities. An import of 7,500 acre-feet from the San Juan River is included to supply water for municipal uses in Gallup, New Mexico. Multipurpose regulatory storage facilities in upstream areas would meet the needs of many of the smaller communities. Continued development of ground-water supplies, with desalting where necessary, will meet the needs of most of the other small communities.

Recreation

Recreation needs of the Region are projected to increase from 144 million recreation days in 1965 to 671 million recreation days (including fishing and hunting) in 2020. Within the bounds of existing legal, institutional, financial, and physical conditions, only about 42 percent of these needs can be met. Satisfaction of the remaining 58 percent of the needs will require elimination or modification of these constraints.

Water-based recreation needs will climb to 193 million recreation days annually by 2020. Under the framework plan, maximum water augmentation, development, and use will supply a large part of the water-based recreation needs.

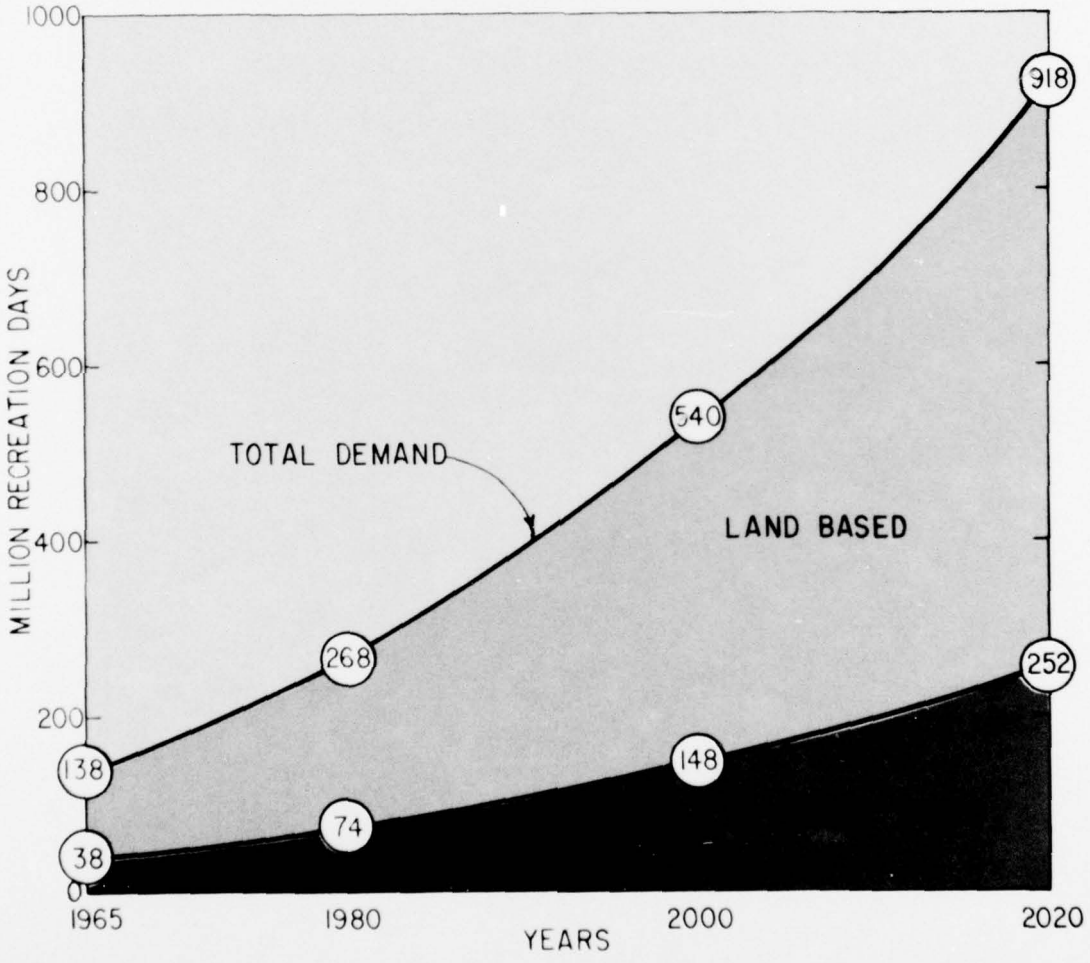
An increase of about 60,000 acres of non-Federal development will be needed by year 2020 to satisfy recreation needs.

The single-purpose recreation program is essentially one of land acquisition, recreation development, and operation, maintenance and replacement of facilities. By the year 1980, about $194 million for development and acquisition will be required to meet total recreation needs. Water-based recreation needs will total 43 million recreation days by 1980 and will cost over $173 million for development and acquisition.

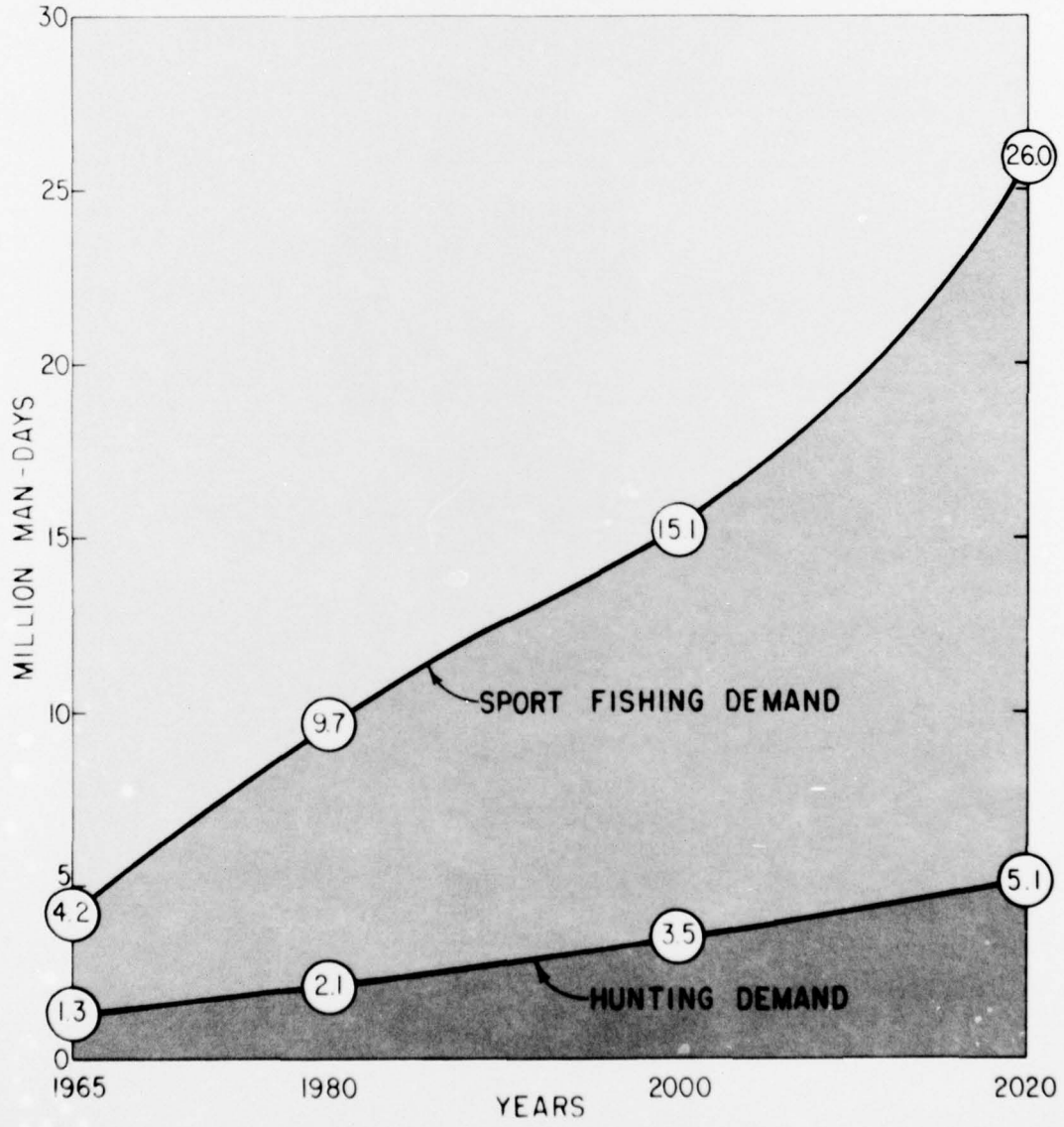
The continuing (1981-2020) recreation program will require the acquisition of 46,000 acres of land to satisfy projected needs. An expenditure of $858 million will be required for acquisition and development.

Boating, skiing, swimming, and sunning are most popular on Lake Mead

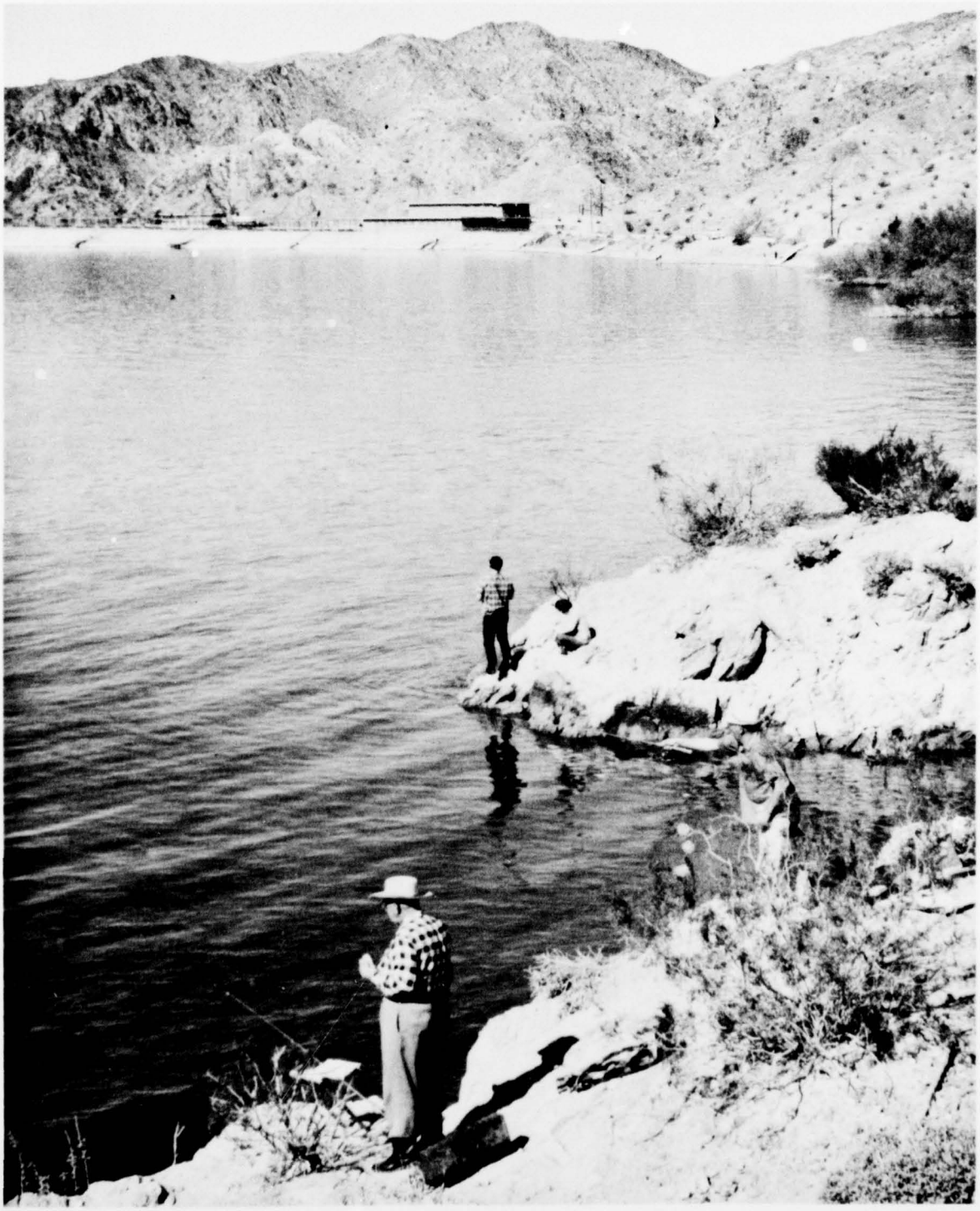
PROJECTED RECREATION DEMAND



PROJECTED SPORT FISHING AND HUNTING DEMANDS



Fishing deep water upstream from Hoover Dam



Trout fishing on Lake Mohave--Federal Fish Hatchery in background supplies 150,000 pounds of stock fish annually

Multipurpose reservoirs in the Gila Subregion would make available about 15,000 surface acres of water for recreational use, of which about 9,000 acres would be within 75 miles of the major urban centers.

Fish and Wildlife

The annual demand for fishing would increase from a 1965 level of 4 million man-days to 26 million man-days in year 2020. Multipurpose developments expected to be constructed by 1980 would provide about 1.2 million man-days of fishing annually. During the 1981 to 2020 period, multipurpose reservoirs would create new fishing waters providing 1.02 million man-days of fishing annually.

The framework program also includes development of 1,960 acres of primary-purpose fish habitat in the 1965 to 1980 period. Associated fisherman access facilities are provided to assure optimum fishing use of the total habitat expected to be in existence in 1980. The program also provides the equivalent of one cold water and two warm water hatcheries by 1980 to stock the available habitat.

To meet future wildlife needs, approximately 330,000 acres of existing riparian and wetland habitat would need to be set aside between 1965 and 1980 to be administered principally for wildlife management. The early action program also includes additional access roads into remote areas, fencing, and the development of wildlife watering facilities.

To stock the habitat required to meet projected fishing demands, the continuing program provides for one cold water hatchery every 8 to 10 years and one warm water hatchery every 6 to 8 years. The continuing program also suggests that 11.5 million acres receive additional consideration for wildlife lands during this program period. Additional access roads, fencing, and wildlife watering devices are recommended for installation.

Mineral Resource Development

Adequate mineral resources are available to meet the expected increased production, $511 million in 1965 to $1.93 billion in year 2020. Water withdrawal requirements would increase from 105,000 to 360,000 acre-feet during this period. Water requirements of the mineral industry may be met by direct diversion of imported water; by upstream developments on the basis that downstream rights would be met by exchange for imported water; or by continued ground-water development, where available.

Environmental impacts of prospecting, developing, mining, and processing ores will need to be minimized, especially with respect to air and water pollution, ecology, and esthetics.

Mineral Production--necessary for the Nation's welfare and a major contributor to the Region's economy. About 60 percent of the Nation's copper is taken from open-pit mines located in the Lower Colorado Region.

Electric Power

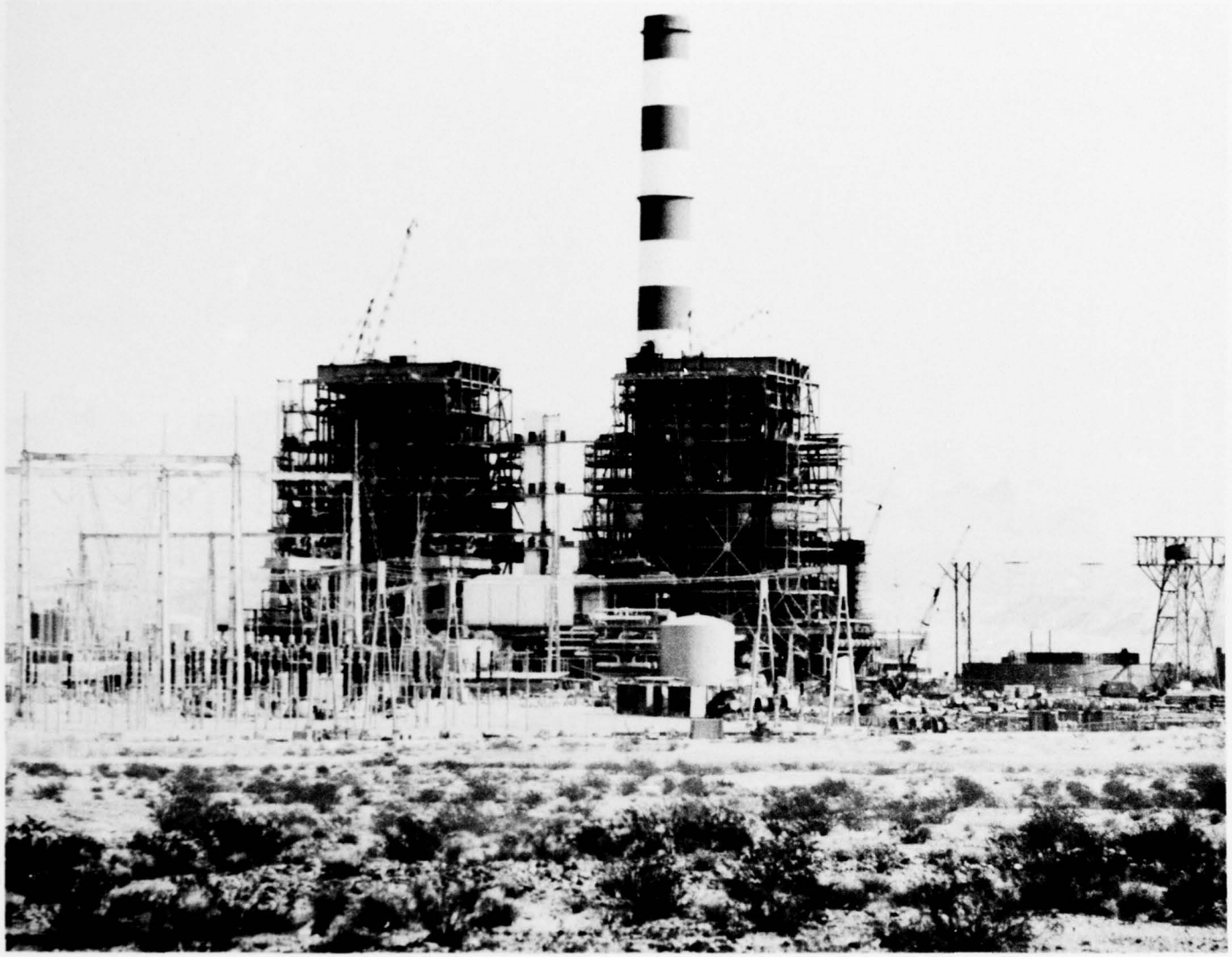
By 1980, the Region will need 8.3 million kilowatts of peaking capacity, more than twice the 1970 demand of 3.9 million kilowatts. It is anticipated that during this period, the principal sources of additional electric energy will be imports from the Upper Colorado Region which will supply about 4.3 million kilowatts. Electric generating capacity to be developed within the Region during this period is estimated to be 0.8 million kilowatts from the Montezuma pumped storage plant to be located near Phoenix and 1.5 million kilowatts of nameplate capacity from a fossil-fueled thermal plant being constructed in southern Nevada.

Electric power requirements are projected by the Federal Power Commission to increase by 40-fold from 2.7 million kilowatts in 1965 to 108.5 million kilowatts by 2020. The development program to meet these demands consists of transmission facilities for imports, fossil-fuel thermal plants, nuclear-fuel thermal plants, and pumped-storage hydroplants.

Further studies will be needed to determine where the power facilities should be located. Factors to be studied will include the costs of conveying cooling water to water-deficient areas versus the cost of transmitting energy longer distances; the hazards of thermal and nuclear pollution; conflicts with preservation of natural or scenic areas; and other environmental factors. Consideration will need to be given to the use of dry-type cooling in lieu of water cooling. The magnitude of increased electric power production needed will require close attention to design requirements for pollution control measures.

Initiating the Program

The implementation of the development program to fulfill the future needs of the Region requires immediate action to accelerate programs for water resources and related land development by over threefold. Most of the early action programs are continuations of those currently underway. Though the Region has had one of the fastest growth rates in the Nation, and is one of the most critical water deficient areas, water resource development has progressed more slowly than that of most other areas. This slowness of response to the needs can be attributed largely to the sheer complexity of the problems, the magnitude of developments necessary to solve them, and the legal problems which have retarded the Region's ability to fully utilize its share of Colorado River water. While the latter has been partially resolved by authorized projects, the others such as funding, continue to harass the Region's efforts to meet its present needs or to implement programs to satisfy future needs. Consequently, the action programs have fallen far behind, resulting in the accumulation of a tremendous backlog of development needs. The timing of a program of water importation to the Region is most critical, because implementation of many other elements of the framework program is dependent on an adequate and timely water supply.

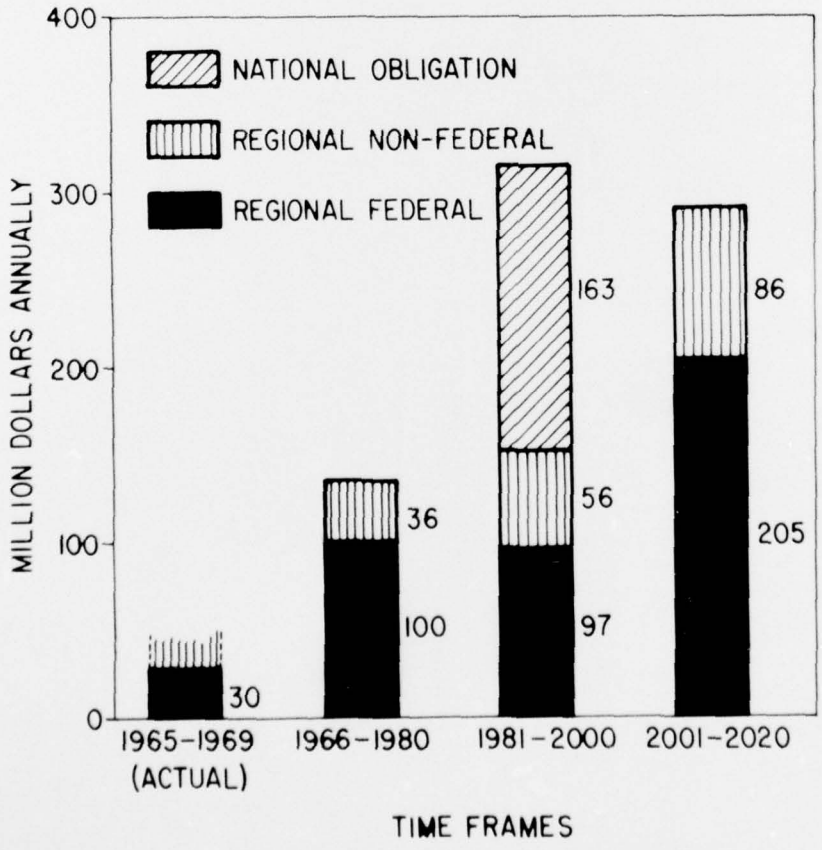


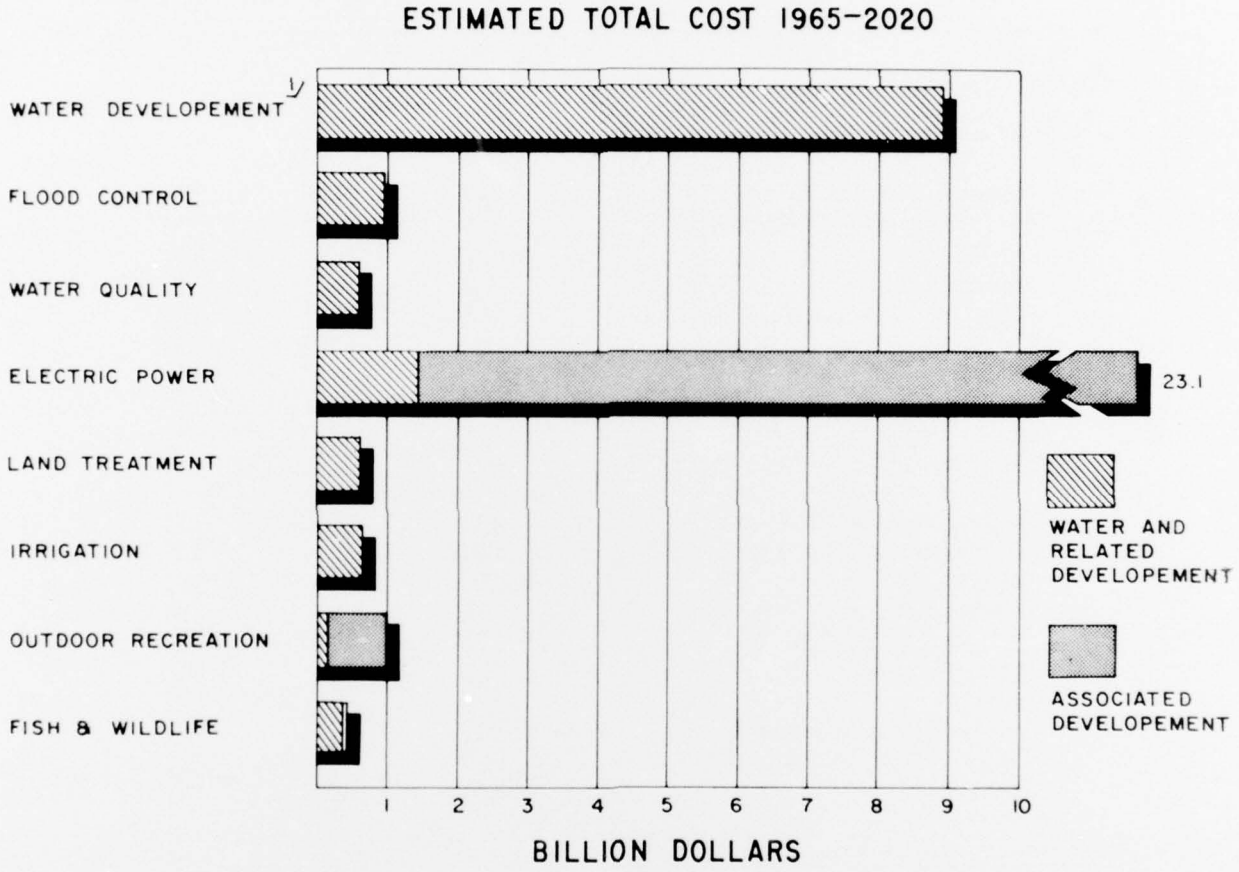
Mohave power plant under construction, fossil-fueled, located on the Colorado River at the southern tip of Nevada, has a rated capacity of 1,580 megawatts of power - USBR

Funding

The funding of existing programs would need to be accelerated by over threefold if all elements are to be completed by 1980. The $720 million Central Arizona Project, representing nearly 50 percent of the Federal portion of the regional early action program, is the principal authorized project needing acceleration.

The funding schedule needed to catch up with the Region's development needs has been spread over a 35-year period to year 2000. At that time, the Region's backlog of needs would essentially be satisfied and the 2000 to 2020 funding program would need only to satisfy the needs arising during that 20-year period.





1/ MULTIPURPOSE FOR ALL USES

Summary of Water Requirements and Supply
1965-2020

	1965	Total Annual Demand 1980	2000	2020
Water Requirements				
Withdrawals (1,000 Acre-Feet)				
Reservoir Evaporation 1/	230	286	328	359
Municipal and Industrial	450	863	1,703	2,778
Irrigation	9,138	9,429	8,496	8,405
Recreation	11	21	41	70
Fish and Wildlife	196	214	325	556
Electric Power Cooling	10	37	106	435
Mining	105	176	264	357
Total	10,140	11,026	11,263	12,960
Depletions (1,000 Acre-Feet)				
Reservoir Evaporation 1/	230	286	328	359
Municipal and Industrial	198	358	677	1,149
Irrigation	4,626	5,326	5,312	5,381
Recreation	4	7	14	24
Fish and Wildlife	110	142	232	405
Electric Power Cooling	10	37	107	435
Mining	52	89	135	185
Losses Associated with Recycling and Reuse	600	640	460	580
Total	5,829	6,885	7,265	8,518
Water Supply Without Augmentation (Unit: Million Acre-Feet)				
Colorado River Water Available for Use in Lower Colorado Region	2.63	2.25	1.33	0.90
Local Water Supply	3.12	3.12	3.12	3.12
Total Supply Available for Use in the Lower Colorado Region 2/	5.75	5.37	4.45	4.02
Lower Colorado Region Depletion Requirements	5.83	6.88	7.26	8.52
Regional Water Deficiency 3/	0.08	1.51	2.81	4.50

Summary of Water Requirements and Supply (Continued)

	Total Annual Demand			
	1965	1980	2000	2020
Water Supply with Augmentation (Unit: Million Acre-Feet)				
Colorado River Available for Use in Lower Colorado Region	2.63	2.25	1.33	0.90
National Obligation to Mexican Water Treaty 4/	--	--	1.80 3/	1.80 3/
Local Water Supply	3.12	3.12	3.12	3.12
Total Supply Available for Use in Lower Colorado Region 2/	5.75	5.37	6.25	5.82
Lower Colorado Region Depletion Requirements	5.83	6.88	7.26	8.52
Regional Water Deficiency 3/	0.08	1.51	1.01	2.70
Regional Augmentation 5/	--	0.03	0.57	2.53
Remaining Deficiency 6/	0.08	1.48	0.44	0.17

1/ Excludes mainstream Colorado River reservoir evaporation accounted for in the determination of availability of Colorado River water.

2/ Excluding ground-water overdraft.

3/ Lack of facilities prevented utilization of the Region's full share of Colorado River water resulting in a ground-water overdraft of about 2.5 million acre-feet. In the future to limit the water supply deficiency to that tabulated would require: distribution of the available supply to areas of shortage, total utilization of the resource including recycling,and that no allowance be made for transporting salts from the Region.

4/ Consists of 1.5 million acre-feet per annum for delivery to Mexico plus an estimated 0.3 million acre-feet associated losses. In accordance with Public Law 90-537, Section 202, "The Congress declares that the satisfaction of the requirements of the Mexican Water Treaty from the Colorado River constitutes a national obligation which shall be the first obligation of any water augmentation project planned pursuant to Section 201 of this Act and authorized by Congress."

5/ As recommended in the Lower Colorado Region framework program.

6/ To be supplied by ground-water overdraft.

For assistance with additional questions or general information about the Lower Colorado Region Comprehensive Framework Study, write:

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Lower Colorado Region State-Federal Interagency Group
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Boulder City, Nevada 89005

☆ GPO 790-002