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METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

FILED
by the Board of Directors of
The Metropolitan Water District
of Southern California
at .s meeting held

AUG 21 1990

Karen E. Dorf
EXECUTIVE SECRETARY

The Regional Urban Water Management Plan for The Metropolitan Water District of Southern California

Final Draft 1990 Plan

July 1990

LIST OF ACRONYMS

AB	Assembly bill
AE	Arvin-Edison Water Storage Distric
AF	Acre-feet
AFY	Acre-feet per year
ANSI	American National Standards Institute
BMP	Best management practices
CALTRANS	California Department of Transportation
CIMIS	California Irrigation Management Information System
CRA	Colorado River Aqueduct
CVC	Cross Valley Canal
CVP	Central Valley Project
CVWD	Coachella Valley Water District
DBP	Disinfectant by-products
DFG	Department of Fish and Game
DHS	Department of Health Services
DOF	Department of Finance, California State
DWA	Desert Water Agency
DWR	Department of Water Resources, California State
EPA	Environmental Protection Agency
ET	Evapotranspiration
GAC	Granulated activated carbon
GPCD	Gallons per capita per day
GPD	Gallons per day
GPM	Gallons per minute
IA	Irrigation Association
IID	Imperial Irrigation District
IRWD	Irvine Ranch Water District
IWR-MAIN	Institute for Water Resources Municipal and Industrial Needs
KWH	Kilowatt hour
LADWP	Los Angeles Department of Water and Power
LPP	Local Project Program
M&I	Municipal and Industrial
MAF	Million acre-feet
MAFY	Million acre-feet per year
MCL	Maximum contaminant levels
MWD	Metropolitan Water District
MWD-MAIN	Metropolitan Water District Municipal and Industrial Needs
NTU	Nephlometric turbidity units
PMCL	Planning and Management Consultants, Ltd.
PVID	Palo Verde Irrigation District
SANDAG	San Diego Association of Governments
SB	Senate Bill
SBVMWD	San Bernardino Valley Municipal Water District
SCAG	Southern California Association of Governments
SDCWA	San Diego County Water Authority
SDWA	Safe Drinking Water Act
SGPWA	San Gorgonio Pass Water Agency
SGVMWD	San Gabriel Valley Municipal Water District
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule, federal
THM	Trihalomethanes
ULF	Ultra-low flow
VCRCD	Ventura County Resource Conservation District

THE REGIONAL URBAN WATER MANAGEMENT PLAN FOR THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

I. INTRODUCTION

URBAN WATER MANAGEMENT IN SOUTHERN CALIFORNIA

Urban Water Management Planning Act

This report has been prepared in response to the Urban Water Management Planning Act (Water Code), Water Code Sections 10610 through 10656, which were added by Statute 1983, Chapter 1009, and became effective on January 1, 1984 (Appendix A). The Act was known as Assembly Bill (AB) 797 while pending before the Legislature. The Act requires that "every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to prepare and adopt...an urban water management plan."

The Metropolitan Water District of Southern California (Metropolitan) is not legally required to prepare an urban water management plan because it is a wholesale, rather than a retail, supplier of water. However, Metropolitan prepared an initial plan in July 1985. This current Regional Urban Water Management Plan (Plan) is a revision of the 1985 plan to be used for Metropolitan's own planning purposes. It will also be used to assist its member agencies in the preparation of their own local plans. It includes a description of those water conservation and water management activities that Metropolitan currently conducts or may conduct within the next 10 years on a regional basis in cooperation with its member agencies. It does not include a discussion of the specific activities being conducted by Metropolitan's member agencies or subagencies. Presumably, these activities will be included in plans prepared by those agencies. It is anticipated that many of the urban water suppliers in Metropolitan's service area will use information from this Plan in developing their local plans. Planning elements of this Plan will not necessarily be adopted by the urban water suppliers or public agencies directly providing water because participation in any regional planning activity is voluntary (pursuant to Water Code Section 10620). The adoption of these planning elements by such agencies or their customers would require the consent of those suppliers or public agencies.

Subject to applicable laws and regulations, Metropolitan's Board of Directors establishes the policies under which Metropolitan operates. As such, the Board has established policies to encourage the efficient use of water in its service area. Metropolitan will continue to implement and expand current conservation efforts through voluntary water conservation programs conducted in cooperation with its member agencies. Implementation of some of these proposed programs will require Board approval.

The Metropolitan Water District of Southern California

Formation and Purpose

Metropolitan is a public agency and quasi-municipal corporation, organized in 1928 by a vote of the electorates of 13 Southern California cities. This occurred following the adoption of the original Metropolitan Water District Act (Act) by the California Legislature.

Initially, Metropolitan was formed to build the Colorado River Aqueduct to import water from the Colorado River. This water was to supplement local water supplies of the original 13 Southern California member cities. Deliveries of Colorado River water began in the early 1940s. In 1972, Metropolitan started distributing supplies from the State Water Project to meet supplemental demands in Metropolitan's growing service area. Currently, Metropolitan imports water from two sources: the Colorado River via the Colorado River Aqueduct and from Northern California via the State Water Project and its California Aqueduct.

Metropolitan's primary purpose under the Act is to develop, store, and distribute water at wholesale rates for domestic and municipal purposes to its member public agencies. The Act also provides that if additional water is available, such water may be sold for other beneficial uses.

The Act also enables Metropolitan to levy taxes on property within its service area, establish water rates, impose a water standby or service availability charge, incur bonded indebtedness, issue notes and short-term revenue certificates, and exercise the power of eminent domain for the purpose of acquiring property. Metropolitan's Board of Directors is authorized to establish terms and conditions under which additional areas may be annexed to Metropolitan except for annexations to its existing original 13 member agencies and to five city member agencies of the San Diego County Water Authority. For annexations completed prior to adoption of Proposition 13 in 1978, the charge is collected through the levy of special ad valorem taxes. For annexations after 1978, a cash fee is charged for each new annexation.

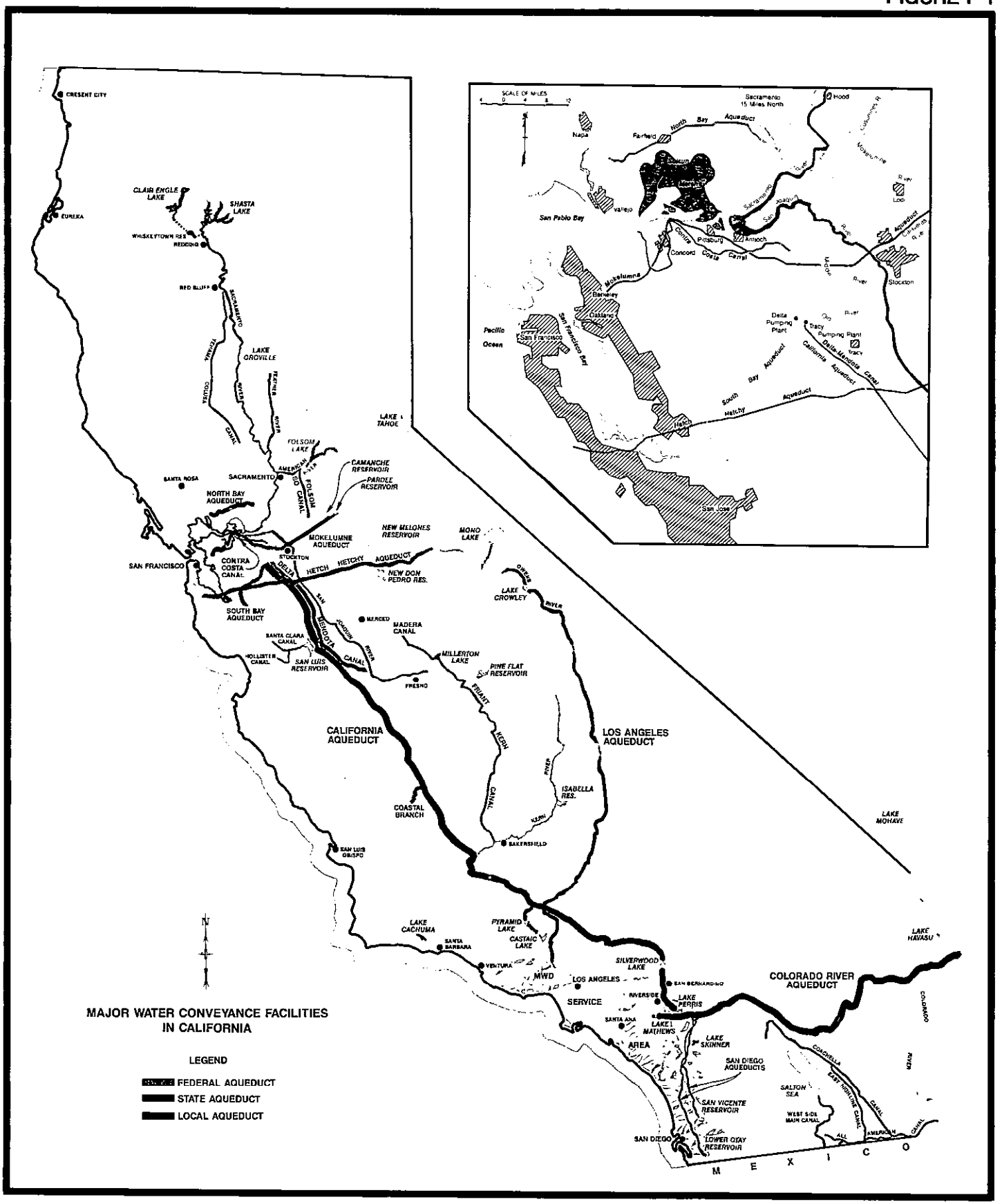
Metropolitan is authorized to develop hydroelectric generating facilities within or outside the state to enable it to utilize its water and waterworks to generate electrical power. This electrical power may be for its own use, or it may be sold or exchanged with other governmental agencies and retail suppliers of electric energy. Metropolitan is also authorized to finance such hydroelectric generating facilities through the issuance of water revenue bonds. Electric revenue bonds (or notes in anticipation thereof) may also be issued for these purposes.

Service Area

Metropolitan's 5,139 square-mile service area includes the Southern California coastal plain and extends about 200 miles along the Pacific Ocean from the city of Oxnard on the north to the Mexican border on the south and reaches 70 miles inland from the coast (Figure I-1). The service area incorporates approximately 5 percent of the land area of the state. Included in this area are portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

There are very few additional areas likely to be annexed to Metropolitan in the future. Potential annexations are limited to a few "islands" in western Riverside and San Diego

FIGURE I-1


CRESCENT CITY
EUREKA
CLAIR ENGLE LAKE
SHASTA LAKE
WHISKEYTOWN RES
REDDING
RED BLUFF
SACRAMENTO
TRINITY
COLUSA
RIVER
CANAL
LAKE OROVILLE
FEATHER
RIVER
LAKE TAHOE
FOLSOM LAKE
AMERICAN RIVER
FOLSOM SOUTH CANAL
CAMANCHE RESERVOIR
PARDEE RESERVOIR
SANTA ROSA
NORTH BAY AQUEDUCT
MOKELUMNE AQUEDUCT
NEW MELONES RESERVOIR
MONO LAKE
STOCKTON
SAN FRANCISCO
CONTRA COSTA CANAL
DELTA
HETCH HETCHY AQUEDUCT
NEW DON PEDRO RES.
LAKE CROWLEY
OWENS RIVER
SOUTH BAY AQUEDUCT
MERCED
SAN JOAQUIN RIVER
MADERA CANAL
SANTA CLARA CANAL
HOLLISTER CANAL
SAN LUIS RESERVOIR
CANAL
MILLERTON LAKE
PINE FLAT RESERVOIR
FRESNO
FRIANT
KERN
CANAL
CALIFORNIA AQUEDUCT
LOS ANGELES AQUEDUCT
ISABELLA RES.
KERN RIVER
COASTAL BRANCH
BAKERSFIELD
SAN LUIS OBISPO
LAKE MOHAVE
LAKE CACHUMA
SANTA BARBARA
PYRAMID LAKE
CASTAIC LAKE
VENTURA
MWD SERVICE AREA
LOS ANGELES
SILVERWOOD LAKE
SAN BERNARDINO
RIVERSIDE
LAKE PERRIS
SANTA ANA
LAKE MATHEWS
LAKE SKINNER
COLORADO RIVER AQUEDUCT
LAKE HAVASU
COLORADO RIVER
SAN DIEGO AQUEDUCTS
COACHELLA CANAL
EAST HIGHLINE CANAL
SALTON SEA
SAN VICENTE RESERVOIR
WEST SIDE MAIN CANAL
ALL AMERICAN CANAL
SAN DIEGO
LOWER OTAY RESERVOIR
MEXICO
SCALE OF MILES
Sacramento
15 Miles North
Hood
Napa
Fairfield
North Bay Aqueduct
Mokelumne River
San Pablo Bay
Vallejo
Pittsburg
Antioch
Concord
Contra Costa Canal
Mokelumne
Stockton
Berkeley
Oakland
Pacific Ocean
San Francisco
San Francisco Bay
Delta Pumping Plant
Tracy Pumping Plant
Tracy
Delta-Mendota Canal
South Bay Aqueduct
Hetch Hetchy Aqueduct
San Jose
N
MAJOR WATER CONVEYANCE FACILITIES IN CALIFORNIA
LEGEND
FEDERAL AQUEDUCT
STATE AQUEDUCT
LOCAL AQUEDUCT

counties surrounded by areas within Metropolitan, the remaining part of the Oxnard Plain in southern Ventura County, and minor expansion of the eastern boundary of San Diego County. These areas will likely be annexed as they are urbanized. Collectively, the potential annexations amount to approximately 2 percent of the area presently within Metropolitan. However, the growth within the current service area is the major factor affecting water demands.

Member Agencies

Metropolitan is composed of 27 member agencies, including 14 cities, 12 municipal water districts, and one county water authority. Annexations of new agencies have occurred over the 60-year period since Metropolitan was formed in 1928. In all, the residents of more than 145 cities and 94 unincorporated communities are served by Metropolitan's member agencies. Table I-1 sets forth the member agencies of Metropolitan as well as the cities and communities within the member agencies. The geographical areas served by these member agencies are shown in Figure I-2. Member agencies receive water from Metropolitan at various delivery points on its system and pay for such water at uniform rates for each class of service established by the Board. For planning purposes, each member agency advises the General Manager annually (in December of each year) of its anticipated water delivery requirements for the following five years. Charges for water delivered are invoiced monthly and are usually paid by the end of the second month following delivery.

As a water wholesaler, Metropolitan has no retail customers and supplies treated and untreated water directly to its member agencies. Metropolitan's 27 member agencies deliver to its customers a combination of local groundwater, surface water, reclaimed water, and water obtained through Metropolitan. For some member agencies, Metropolitan supplies all the water used within that agency's service area, while others obtain varying amounts of water from Metropolitan to supplement local supplies. On average, Metropolitan provides about 55 percent of the water supply needs of its service area. Later sections of this plan provide information on the water supplies of each member agency. Some member agencies provide retail water service, while others are the local wholesaler of Metropolitan's supplies. As shown on Table I-2, 15 member agencies provide retail service to customers, 10 provide only wholesale service, and two provide a combination of both. Throughout Metropolitan's service area, there are approximately 250 retail water supply agencies directly serving the population. Agencies providing retail service will be preparing their own Urban Water Management Plans.

Board of Directors and Management Team

The Board currently consists of 51 authorized director positions. Directors serve without compensation by Metropolitan. Each member agency has at least one representative on the Board. Representation and voting rights are based upon each agency's assessed valuation. The Board administers its policies through the Metropolitan Water District Administrative Code (Administrative Code), which was adopted by the Board in 1977. The Administrative Code is periodically amended to reflect new policies or changes in existing policies that occur from time to time.

The management of Metropolitan Water District is under the direction of its General Manager, who serves at the discretion of the Board, as does Metropolitan's Auditor and General Counsel. The total number of Metro-

TABLE I-1

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA MEMBER AGENCIES (27)

Municipal water districts (12)

Calleguas
Central Basin
Chino Basin
Coastal
Eastern
Upper San Gabriel Valley
Western
Foothill
Las Virgenes
Orange County
Three Valleys
West Basin

Member Cities (14)

Anaheim
Beverly Hills
Burbank
Compton
Fullerton
Glendale
Long Beach
Los Angeles
Pasadena
San Fernando
San Marino
Santa Ana
Santa Monica
Torrance

San Diego County Water Authority

Cities Within Member Agencies

Calleguas MWD
- Camarillo
- Camarillo Heights*
- Fairview*
- Las Posas Valley*
- Moorpark
- Oak Park*
- Oxnard
- Santa Rosa Valley*
- Simi Valley
- Thousand Oaks

Central Basin MWD
- Artesia
- Bell
- Bellflower
- Bell Gardens
- Cerritos
- Commerce
- Cudahy
- Downey
- East Compton*
- East La Mirada*
- East Los Angeles*
- Florence*
- Graham*
- Hawaiian Gardens
- Huntington Park
- La Habra Heights
- Lakewood
- La Mirada
- Los Nietos*
- Lynwood
- Maywood
- Montebello
- Norwalk
- Paramount
- Pico Rivera
- Santa Fe Springs
- Signal Hill
- South Gate
- South Whittier*
- Vernon
- Walnut Park*
- West Compton*
- West Whittier*
- Whittier
- Willowbrook*

Chino Basin MWD
- Chino
- Fontana
- Montclair
- Ontario
- Rancho Cucamonga
- Upland

Coastal MWD
- Capistrano Beach*
- Corona del Mar
- Costa Mesa
- Dana Point*
- Laguna Beach
- Newport Beach
- San Clemente
- South Laguna*

Eastern MWD
- East Hemet*
- Good Hope*
- Hemet
- Homeland*
- Lakeview-Nuevo*
- Mead Valley*
- Moreno Valley
- Murrieta Hot Springs*
- Perris
- Quail Valley*
- Romoland*
- San Jacinto
- Sun City*
- Sunnymead*
- Temecula
- Valle Vista*
- Winchester*

Foothill MWD
- Altadena*
- La Canada Flintridge
- La Crescenta*
- Montrose*

Las Virgenes MWD
- Agoura Hills
- Calabasas*
- Chatsworth Lake Manor*
- Hidden Hills
- Malibu Lake*
- Monte Nido*
- Westlake Village

Orange County MWD
- Brea
- Buena Park
- Cypress
- El Toro*
- Fountain Valley
- Garden Grove
- Huntington Beach
- Irvine
- Laguna Hills*
- Laguna Niguel*
- La Habra
- La Palma
- Los Alamitos
- Mission Viejo
- Orange
- Placentia
- Rossmoor*
- San Juan Capistrano
- Seal Beach
- Stanton
- Tustin
- Tustin Foothills*
- Villa Park
- Westminister
- Yorba Linda

Three Valleys MWD
- Charter Oak*
- Claremont
- Covina Knolls*
- Diamond Bar
- Glendora
- Industry
- La Verne
- Pomona
- Rowland Heights*
- San Dimas
- So. San Jose Hills*
- Walnut

Upper San Gabriel Valley MWD
- Arcadia
- Avocado Heights*
- Baldwin Park
- Bradbury
- Citrus*
- Covina
- Duarte
- El Monte
- Hacienda Heights*
- Irwindale

Upper San Gabriel Valley (Cont.)
- La Puente
- Mayflower Village*
- Monrovia
- Rosemead
- San Gabriel
- South El Monte
- South Pasadena
- South San Gabriel*
- Temple City
- Valinda*
- West Covina
- West Puente Valley*

West Basin MWD
- Alondra Park*
- Angeles Mesa*
- Carson
- Culver City
- Del Aire*
- El Nido-Clifton*
- El Segundo
- Gardena
- Hawthorne
- Hermosa Beach
- Howard*
- Inglewood
- Ladera Heights*
- Lawndale
- Lennox*
- Lomita
- Malibu*
- Manhattan Beach
- Marina del Rey*
- Palos Verdes Estates
- Point Dume*
- Rancho Palos Verdes
- Redondo Beach
- Rolling Hills
- Rolling Hills Estates
- Ross-Sexton*
- Topanga Canyon*
- Victor*
- View Park*
- West Athens*
- West Carson*
- West Hollywood
- Westmont*
- Windsor Hills*
- National Military Home*
- Wiseburn

Western MWD of Riverside County
- Bedford Heights*
- Corona
- Eagle Valley*
- El Sobrante*
- Green River*
- Lake Elsinore
- Norco
- Riverside
- Temescal
- Woodcrest*
- March A.F.B.*

San Diego CWA
- Alpine*
- Bonita*
- Camp Pendleton*
- Cardiff-by-the-Sea*
- Carlsbad
- Casa De Oro*
- Castle Park*
- Chula Vista
- Del Mar
- El Cajon
- Encinitas
- Escondido
- Fallbrook*
- Lakeside*
- La Mesa
- Lemon Grove
- Leucadia*
- Mount Helix*
- National City
- Oceanside
- Otay*
- Poway
- Rainbow*
- Ramona*
- Rancho Santa Fe*
- San Diego
- San Marcos
- Santee
- Solana Beach
- Spring Valley*
- Valley Center*
- Vista

* Denotes Unincorporated Areas

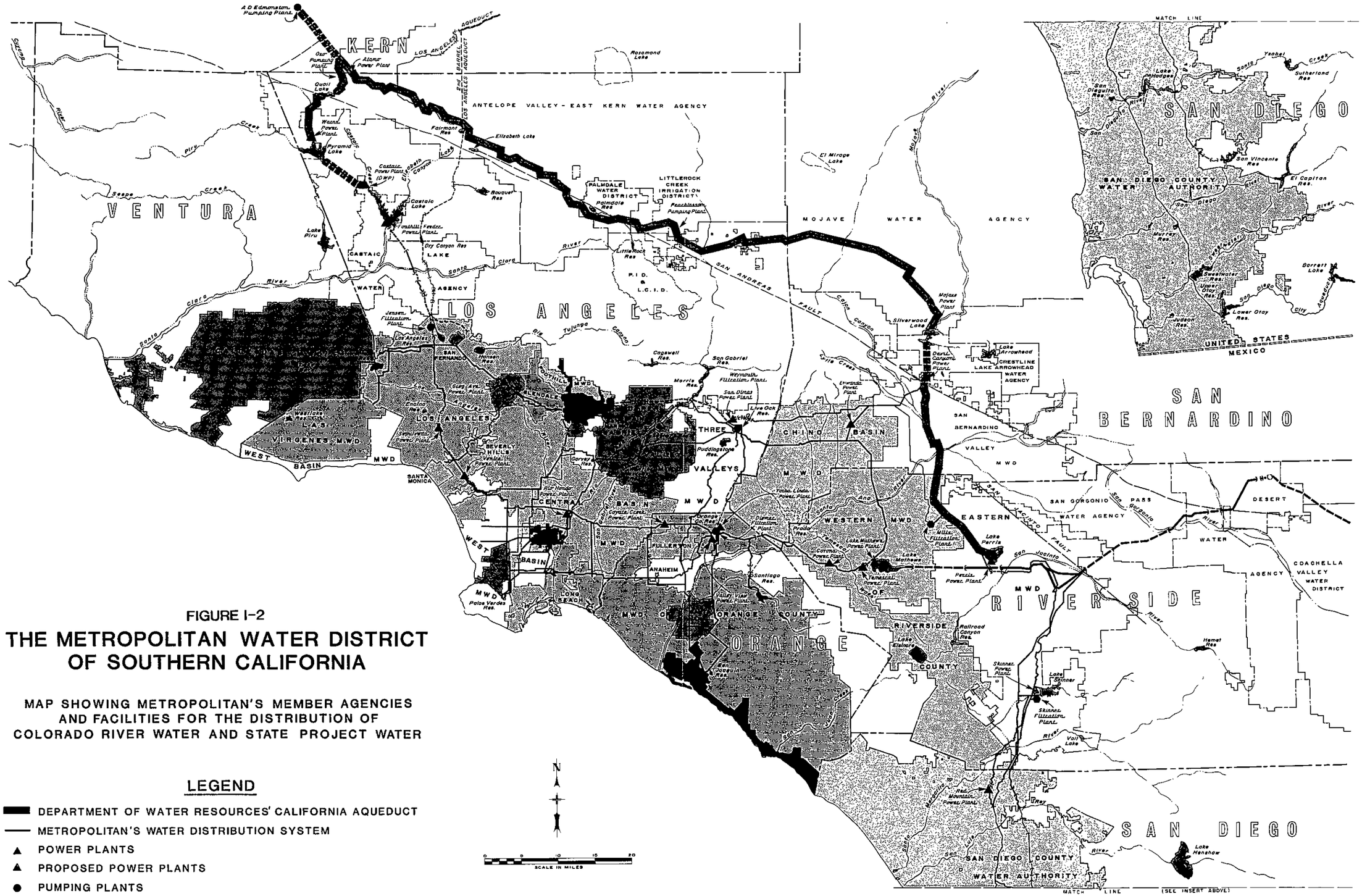


FIGURE I-2

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

MAP SHOWING METROPOLITAN'S MEMBER AGENCIES AND FACILITIES FOR THE DISTRIBUTION OF COLORADO RIVER WATER AND STATE PROJECT WATER

LEGEND

- DEPARTMENT OF WATER RESOURCES' CALIFORNIA AQUEDUCT
- METROPOLITAN'S WATER DISTRIBUTION SYSTEM
- ▲ POWER PLANTS
- ▲ PROPOSED POWER PLANTS
- ● PUMPING PLANTS
- ● WATER FILTRATION PLANTS

REVISED TO APRIL 1990
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TABLE I-2

TYPE OF WATER SERVICE PROVIDED
BY METROPOLITAN'S MEMBER AGENCIES

Member Agency	Retail or Wholesale
Los Angeles County	
Beverly Hills	Retail
Burbank	Retail
Central Basin MWD	Wholesale
Compton	Retail
Foothill MWD	Wholesale
Glendale	Retail
Las Virgenes MWD	Retail
Long Beach	Retail
Los Angeles	Retail
Pasadena	Retail
San Fernando	Retail
San Marino	Retail
Santa Monica	Retail
Three Valleys MWD	Wholesale
Torrance	Retail
Upper San Gabriel MWD	Wholesale
West Basin MWD	Wholesale
Orange County	
Anaheim	Retail
Coastal MWD	Wholesale
Fullerton	Retail
MWD of Orange County	Wholesale
Santa Ana	Retail
Riverside County	
Eastern MWD	Retail & Wholesale
Western MWD	Retail & Wholesale
San Bernardino County	
Chino Basin MWD	Wholesale
Ventura County	
Calleguas MWD	Wholesale
San Diego County	
San Diego County Water Authority	Wholesale

politan employees on February 1, 1990, was 1,700.

DEVELOPMENT PROCESS OF THE 1990 REGIONAL MANAGEMENT PLAN

Public Hearings

Note: [This section will be completed after the hearings process is completed.]

Board Actions

Note: [This section will be completed after the Board's vote (or actions).]

FORMAT OF THIS REPORT

The chapters in this report correspond to the outline presented in the Water Code, specifically Sections 10631, 10632, and 10633 (Appendix A).

The elements set forth in Section 10631 are required to be included in all plans. Those set forth in Section 10632 are required to be included in all plans prepared by agencies that will have a "need for expanded or additional water supplies." Section 10633 requires a discussion of the impacts of implementing the alternative water management practices discussed in Sections 10631 and 10632.

The first two chapters following this Introduction describe water use in Metropolitan's service area and identify the water supplies available. Water supply and drought management programs are described in Chapters IV

and V, respectively. Finally, Chapters VI, VII, and VIII describe Metropolitan's current conservation measures, conservation through pricing and rate structures, as well as the use of best management practices in achieving more efficient use of water. The individual chapters corresponding with the specific provisions of the Act are noted below:

Chapter II, Water Use

Section 10631:(a) past, current, and projected water use.

Chapter III, Water Supplies

Section 10630: water management planning.

Chapter IV, Water Supply Management Programs

Section 10632:(a) wastewater reclamation, (b) exchanges or transfers of water on short-term or long-term basis.

Chapter V, Management Response during Drought or Other Emergencies

Section 10631:(e) frequency and magnitude of supply deficiencies.

Chapter VI, Current Water Conservation Measures

Section 10631:(b) current conservation measures in practice; Section 10632:(d) incentives to alter water use practice; (e) public information and education programs.

Chapter VII, Conservation Through Pricing Rate Structures, and Regulations

Section 10631:(f) changes in pricing, rate structure, and regulations.

Chapter VIII, Expansion of Conservation Program

Section 10631:(c) alternative conservation measures and (d) schedule of implementation.

The last two chapters are concerned with water management practices that could provide additional water savings or modify future water demands by reducing water use within Metropolitan. The practices covered include management of water demand through pricing as well as the use of innovative conservation methods.

II. WATER USE

ECONOMIC TRENDS IN SOUTHERN CALIFORNIA

Water use in Metropolitan's service area is related to economic, demographic, and climatic factors. Increases in population and regional economic growth are two factors that have influenced water use in the past and will continue to do so in the future.

Southern California has experienced dramatic economic growth during the recent decades. Presently, it contains the nation's second largest concentration of people, business, and industry. Of the 10 most rapidly growing counties (in terms of population) in the United States, five are in Metropolitan's service area.

Population Growth

The California Department of Finance's (DOF) population estimate for January 1, 1989, indicates that approximately 14.5 million people reside within Metropolitan's service area. This represents about 50 percent of the state's population of 28.7 million. Annual growth rates in the past have varied, with an increase of about 200,000 annually in the 1970s and early-to-mid-1980s and from about 300,000 to 350,000 annually in the late 1980s. The historic population is shown in Figure II-1.

Table II-1 contains information on the current population of each of Metropolitan's member agencies, with totals by county. By far, Los Angeles County contains the largest portion (56 percent) of the population within Metropolitan's service area. The most populated cities within Metropolitan's service area are Los Angeles (largest city in the state), San Diego (second largest in the state), Long Beach, Anaheim, and Riverside. Table II-2 shows that although only 13 percent of the land area of the six Southern California counties is within Metropolitan's service area, nearly 90 percent of the population of the six counties resides within Metropolitan's boundaries.

Population projections for the region have been prepared by the regional planning agencies: the Southern California Association of Governments (SCAG), the San Diego Association of Governments (SANDAG), and by the State Department of Finance (DOF). Projections by SCAG and SANDAG indicate that population will increase from the current 14.5 million to 18.2 million by the year 2010, or an increase of 3.7 million. This is equivalent to an annual average increase of 175,000 people per year. However, the current growth follows an average rate of more than 300,000 people per year. The latest DOF forecast, made in 1986, indicates a slightly lower population projection for 2010 than those estimated by SCAG and SANDAG. This is because the DOF projections have not accounted for the recent large increases in population in its forecasts.

The SCAG and SANDAG projections are being used by the cities (municipal governments) and counties within Metropolitan's

service area for their planning purposes: i.e., federal programs related to regional planning for transportation, wastewater treatment plant capacity, and compliance with air quality standards. For these reasons, Metropolitan uses the SCAG and SANDAG projections to estimate future water demands and infrastructure requirements.

The current and projected population by county, within Metropolitan's service area for the years 1989 and 2010, is shown in Table II-3. Approximately one-half of the projected population increase in Metropolitan's service area is expected to occur in Los Angeles and Orange counties. The other half of the population expansion is expected to take place in emerging growth centers of Ventura, San Bernardino, Riverside, and San Diego counties. Figure II-2 shows the historic and projected population by county. About one-half of the region's future economic and population growth is projected to take place in the hotter inland areas.

Housing and Service Area Expansion

SCAG and SANDAG forecast steady growth in residential housing in all six counties within Metropolitan's service area. The total occupied housing stock (Table II-3) is expected to increase by 1.7 million dwelling units, from 5.1 million in 1989 to about 6.8 million units by the year 2010, a rate of more than 80,000 annually. This represents a 34 percent increase from 1989 to 2010, compared to a 26 percent increase in population over the same period. This differential growth is a result of decreasing average household size. Household occupancy size (i.e., total population divided by total occupied dwelling units) is expected to decrease from 2.86 to 2.69 persons per dwelling by the year 2010, as noted in Table II-3.

Industrial and Commercial Activities

The gross product of the regional economy in Metropolitan's service area is projected to be $380 billion in 1991 (1986 dollars), representing about 50 percent of the state's gross product and about 7 percent of the gross national product. More than 80 percent of the economic activity (based on the number of persons employed) in the six-county region occurs in the manufacturing, commercial, services, finance, banking, and real estate sectors. The remaining 20 percent includes farming, construction, utilities, and transportation.

Table II-4 summarizes current and projected industrial and commercial/institutional employment in Metropolitan's service area. The number of people employed in commerce and industry is expected to increase from about 7 million in 1989 to about 9 million in 2010. This increase of about 32 percent generally follows housing and population projections. More than 85 percent of the new jobs will be created in the commercial and institutional sector, with the balance in the industrial sector.

Some geographical shifts in employment can be observed from the percent increase in employment in the various counties (Table II-4). Over the 21-year period (1989-2010), the greatest employment increases are expected to occur in Riverside and San Bernardino counties (90-100 percent), followed by Ventura, Orange, and San Diego counties (40-50 percent) and Los Angeles County (20 percent). Consistent with national statistics, the regional trend is the shift of employment toward service and commercial activities.

FIGURE II–1

HISTORIC POPULATION
OF METROPOLITAN SERVICE AREA

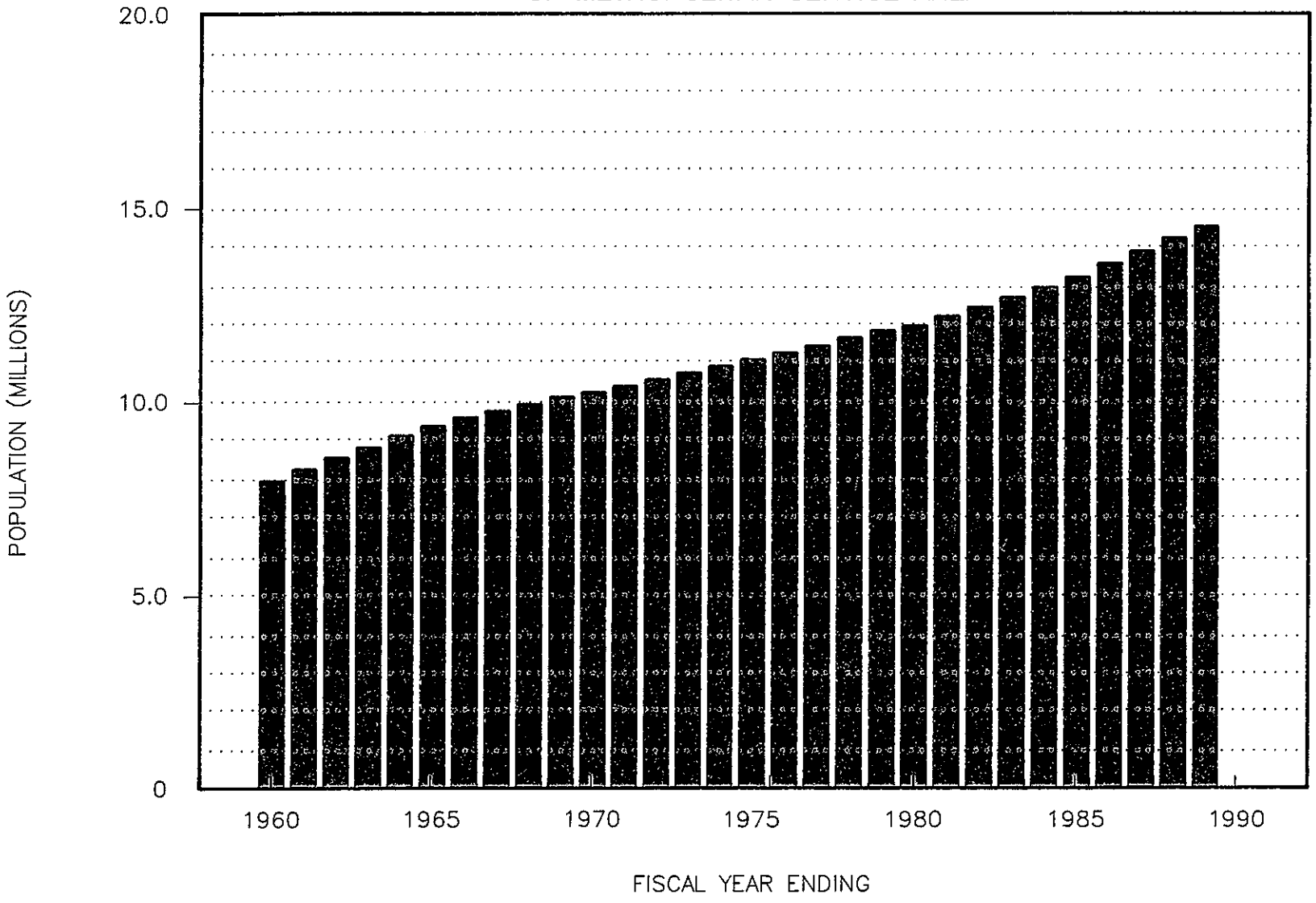


FIGURE II-2

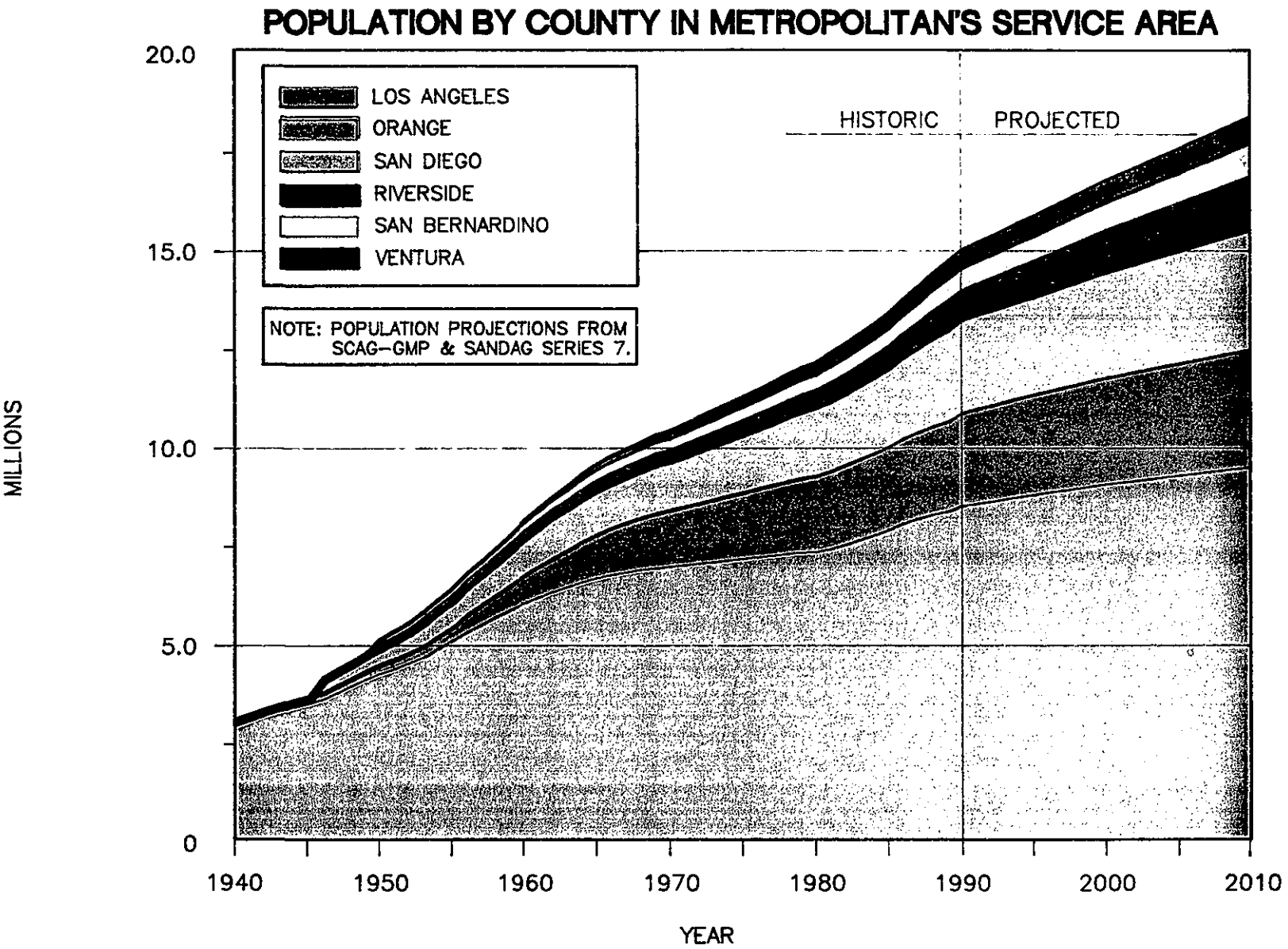

POPULATION BY COUNTY IN METROPOLITAN'S SERVICE AREA
LOS ANGELES
ORANGE
SAN DIEGO
RIVERSIDE
SAN BERNARDINO
VENTURA
HISTORIC
PROJECTED
NOTE: POPULATION PROJECTIONS FROM SCAG-GMP & SANDAG SERIES 7.
20.0
15.0
10.0
5.0
0
MILLIONS
1940
1950
1960
1970
1980
1990
2000
2010
YEAR

TABLE II-1

METROPOLITAN'S MEMBER AGENCY POPULATION FOR 1989

Member Agency	Population	Percent of Total Population
Beverly Hills	34,300	0.2
Burbank	93,800	0.6
Central Basin MWD	1,368,649	9.4
Compton	93,000	0.6
Foothill MWD	85,211	0.6
Glendale	166,100	1.1
Las Virgenes MWD	54,444	0.4
Long Beach	419,800	2.9
Los Angeles	3,400,500	23.4
Pasadena	132,200	0.9
San Fernando	20,700	0.1
San Marino	13,800	0.1
Santa Monica	96,500	0.7
Three Valleys MWD	456,680	3.1
Torrance	142,200	1.0
Upper San Gabriel MWD	754,015	5.2
West Basin MWD	818,439	5.6
Los Angeles County Total	**8,150,338**	**56.1**
Anaheim	244,300	1.7
Coastal MWD	201,560	1.4
Fullerton	111,700	0.8
MWD of Orange County	1,485,540	10.2
Santa Ana	237,300	1.6
Orange County Total	**2,280,400**	**15.7**
Eastern MWD	293,034	2.0
Western MWD	454,429	3.1
Riverside County Total	**747,463**	**5.1**
Chino Basin	533,477	3.7
San Bernardino County Total	**533,477**	**3.7**
San Diego CWA	2,345,654	16.2
San Diego County Total	**2,345,654**	**16.2**
Calleguas MWD	459,035	3.2
Ventura County Total	**459,035**	**3.2**
Grand Total MWD	**14,516,367**	**100.0**

Source: California Department of Finance and Metropolitan-developed statistics.

TABLE II-2
1989 AREA AND POPULATION IN THE SIX COUNTIES OF METROPOLITAN'S SERVICE AREA

County	Total County	In MWD Service Area	Percent in MWD
Land Area (square miles)			
Los Angeles	4,080	1,394	34
Orange	786	695	88
San Diego	4,314	1,419	34
San Bernardino	20,154	242	1
Riverside	7,249	1,041	14
Ventura	1,865	348	19
Total	38,448	5,139	13
Population (in thousands)			
Los Angeles	8,650	8,150	94
Orange	2,280	2,280	100
San Diego	2,418	2,346	97
San Bernardino	1,325	533	40
Riverside	1,015	748	74
Ventura	654	459	70
Total	16,342	14,516	89

Source: California Department of Finance, County Assessor Office, and Metropolitan-developed statistics.

TABLE II-3

RESIDENTIAL POPULATION AND HOUSING TRENDS IN METROPOLITAN'S SERVICE AREA 1989-2010 (In Thousands)

County	1989	2010	Change 1989-2010	Percent Change 1989-2010
Population				
Los Angeles	8,150	9,303	+1,153	14.1
Orange	2,280	2,986	+706	31.0
Riverside	748	1,347	+599	80.1
San Bernardino	533	849	+316	59.3
San Diego	2,346	3,066	+720	30.7
Ventura	459	680	+221	48.1
Total	**14,516**	**18,231**	**+3,715**	**25.6**
Total Occupied Units				
Los Angeles	2,856	3,422	+566	19.8
Orange	815	1,137	+322	39.5
Riverside	247	512	+265	107.3
San Bernardino	166	299	+133	80.1
San Diego	844	1,181	+337	39.9
Ventura	145	228	+83	57.2
Total	**5,073**	**6,779**	**+1,706**	**33.7**
Persons-Household				
Los Angeles	2.85	2.72	-0.13	-4.6
Orange	2.80	2.63	-0.17	-6.1
Riverside	3.02	2.63	-0.39	-12.9
San Bernardino	2.78	2.84	0.06	+2.2
San Diego	3.21	2.60	-0.61	-19.0
Ventura	3.17	2.98	-0.19	-6.0
Total	**2.86**	**2.69**	**-0.17**	**-5.9**

Source: SCAG and SANDAG, 1990

TABLE II-4

INDUSTRIAL AND COMMERCIAL EMPLOYMENT IN METROPOLITAN'S SERVICE AREA 1989 - 2010 (In Thousands)

County	1989	2010	Change 1989-2010	Percent Change 1989-2010
Industrial Employment				
Los Angeles	869	874	+5	0.6
Orange	246	340	+94	38.2
Riverside	39	95	+56	143.6
San Bernardino	41	100	+59	143.9
San Diego	131	203	+72	55.0
Ventura	29	50	+21	72.4
Total	**1,355**	**1,662**	**+307**	**22.7**
Commercial/Institutional Employment				
Los Angeles	3,318	4,084	+766	23.1
Orange	918	1,338	+420	45.8
Riverside	181	324	+143	79.0
San Bernardino	143	271	+128	89.5
San Diego	926	1,302	+376	40.6
Ventura	114	179	+65	57.0
Total	**5,600**	**7,498**	**+1,898**	**33.9**
Total Employment				
Los Angeles	4,187	4,958	+771	18.4
Orange	1,164	1,678	+514	44.2
Riverside	220	419	+199	90.5
San Bernardino	184	371	+187	101.6
San Diego	1,057	1,505	+448	42.4
Ventura	144	229	+85	59.0
Total	**6,956**	**9,160**	**+2,204**	**31.7**

Source: SCAG and SANDAG, 1990.

Agricultural Activity

Agriculture in Metropolitan's service area makes a significant contribution to the regional economy. The primary agricultural areas within Metropolitan's service area are located in San Bernardino, San Diego, and Riverside counties and, to a lesser extent, in Orange and Ventura counties. Very little irrigated agriculture exists in Los Angeles County.

In total, the recent annual gross crop value is about $2.0 billion. The total economic contribution of agriculture to the region, as estimated by some leading agricultural economists, is upward of three times the crop value. Based on this multiplier, the value of agriculture to the regional economy would approach $6 billion (Table II-5).

TABLE II-5

VALUE OF AGRICULTURE IN METROPOLITAN'S SERVICE AREA 1988

County	Crop Value ($ Million)	Predominate Crops
Orange	250	Nursery, Orchard
Riverside	630	Citrus, dairy
San Diego	520	Nursery and avocados
San Bernardino	410	Dairy
Ventura	110	Citrus, Nursery
Los Angeles	40	Nursery
Total	**1,960**	

For the most part, crops grown in the area (especially in the areas utilizing the higher-cost Metropolitan water supplies) are limited to higher-value crops such as nursery stock, strawberries, avocados, and specialty crops. Current agricultural water use is about 380,000 acre-feet per year (AFY) year of which Metropolitan supplies approximately 50 percent to irrigate an estimated 186,000 acres of cropland and orchards. By the year 2010, agricultural water use is expected to decrease to 310,600 AFY as land is removed from production to support urban development.

Growth Management

Economic growth in Southern California depends upon national and global economic factors (such as interest rates, unemployment, capital spending trends, and the like), as well as regional population and job growth trends. Population, housing, and employment growth in Metropolitan's service area are assumed to occur at levels projected by local, regional, and state planning agencies. Metropolitan's programs and facilities are sized and planned in compliance with SCAG and SANDAG projections which incorporate growth management programs as promulgated in their Growth Management Plan.

REGIONAL WATER DEMANDS

Total water use in Metropolitan's service area is currently estimated at 3.8 million acre-feet per year (MAFY), with 3.4 MAFY used for municipal and industrial purposes (M & I) and 0.4 MAFY used for agricultural purposes. Water use is expected to increase in the future as the population continues to grow. The increase in M & I demands will be partially offset by the reduction in agricultural demands.

Historically, water use in Metropolitan's service area has increased from 2.79 MAF in 1970 to 3.03 MAF in 1980 and to about 3.80 MAF in 1989 (Figure II-3). The increase during the 1970s was 9 percent, while the increase in the first nine years of the 1980s amounted to 25 percent, reflecting a larger population growth rate in the later period.

A greater portion of the recent population growth has occurred in the drier inland areas, which require more water for landscaping and cooling. The climate in Metropolitan's service area ranges from moderate temperatures throughout the year in the coastal areas to hot and dry summers in the inland areas. Generally, the region can be divided into three broad zones, as shown in Figure II-4. Moving inland across these zones, daily maximum summer temperatures increase from 70-80 degrees at the coast to 105-110 degrees in the inland area. Also, annual rainfall ranges from 12 inches per year along the coast to around 5 inches per year in the hotter inland areas of Riverside and San Bernardino counties. The coastal plain and interior valley areas, which contain the major portion of the population, averages 10 inches of annual rainfall.

Also, higher demands for water have resulted from the below-normal precipitation levels in the late 1980s. As shown in Figure II-3, regional use decreased significantly during the statewide drought in 1976-77 as a result of drought-related water conservation efforts. Water use started returning to historic trends with the return of nearer-to-normal water supply conditions. However, with the higher-than-average rainfall in the early-to-mid-1980s, water use declined substantially again; and then it increased significantly in the late 1980s with the return of below-average rainfall patterns.

Municipal and industrial water use accounts for more of the increase in demand, as agricultural water use has been declining with urbanization. Agricultural water use in 1989 accounted for about 10 percent of total use. This compares to 1970, when agricultural water use accounted for 19 percent, and 14 percent in 1980.

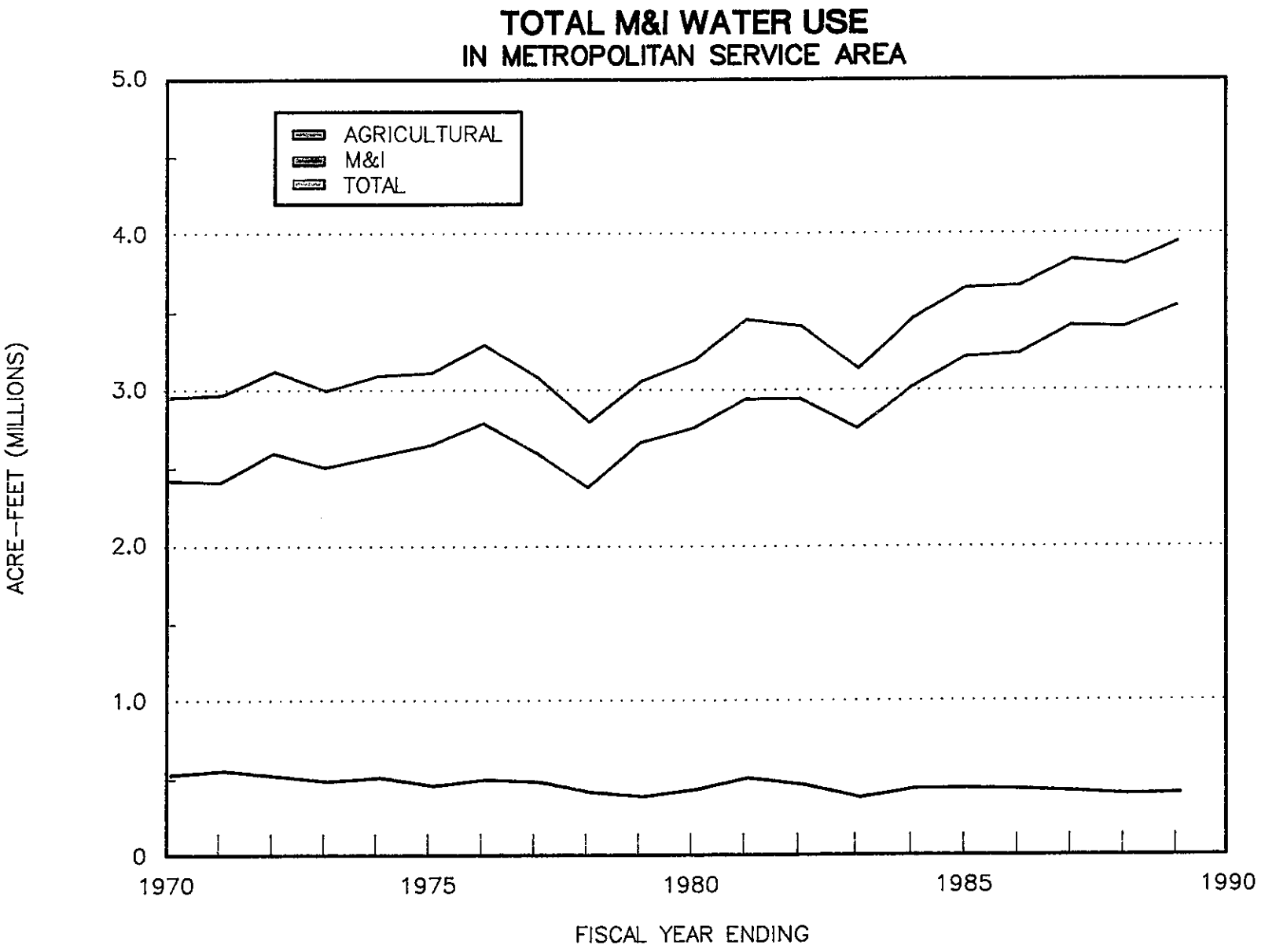
Major Water Use Components

Water use in the Metropolitan service area has recently been assessed based on water use and water production records obtained from 28 retail water agencies. Together, these agencies serve approximately 6.4 million persons (or almost 50 percent of total population served). The water use records provided by these agencies were disaggregated into various urban sectors. Water use within each sector was analyzed to determine its indoor and outdoor components.

Figure II-5 and Table II-6 show the percent breakdown of urban water use in Southern California by major sectors of users and by indoor and outdoor purposes of use within each sector. An estimated 59.4 percent of all urban use occurs in the residential sector. Another one-third (31.4 percent) represents nonresidential uses such as commercial, industrial, public, irrigation, and other. The remainder (9.2 percent) is unaccounted use which includes underregistration of water meters, some unmetered public uses like hydrant flushing, firefighting, and street washing, and leaks in the distribution system, some of which may be unavoidable.

A major portion of total annual M & I use is nonseasonal (or base use) which remains constant throughout the year (Table II-6). However, about one-fourth (26 percent) is seasonal. That is, it varies from month to month and from year to year depending on weather conditions. Less than one-third (28.3 percent) of the M & I

FIGURE II–3


TOTAL M&I WATER USE
IN METROPOLITAN SERVICE AREA
AGRICULTURAL
M&I
TOTAL
5.0
4.0
3.0
2.0
1.0
0
ACRE-FEET (MILLIONS)
1970
1975
1980
1985
1990
FISCAL YEAR ENDING

CLIMATIC ZONES IN SOUTHERN CALIFORNIA

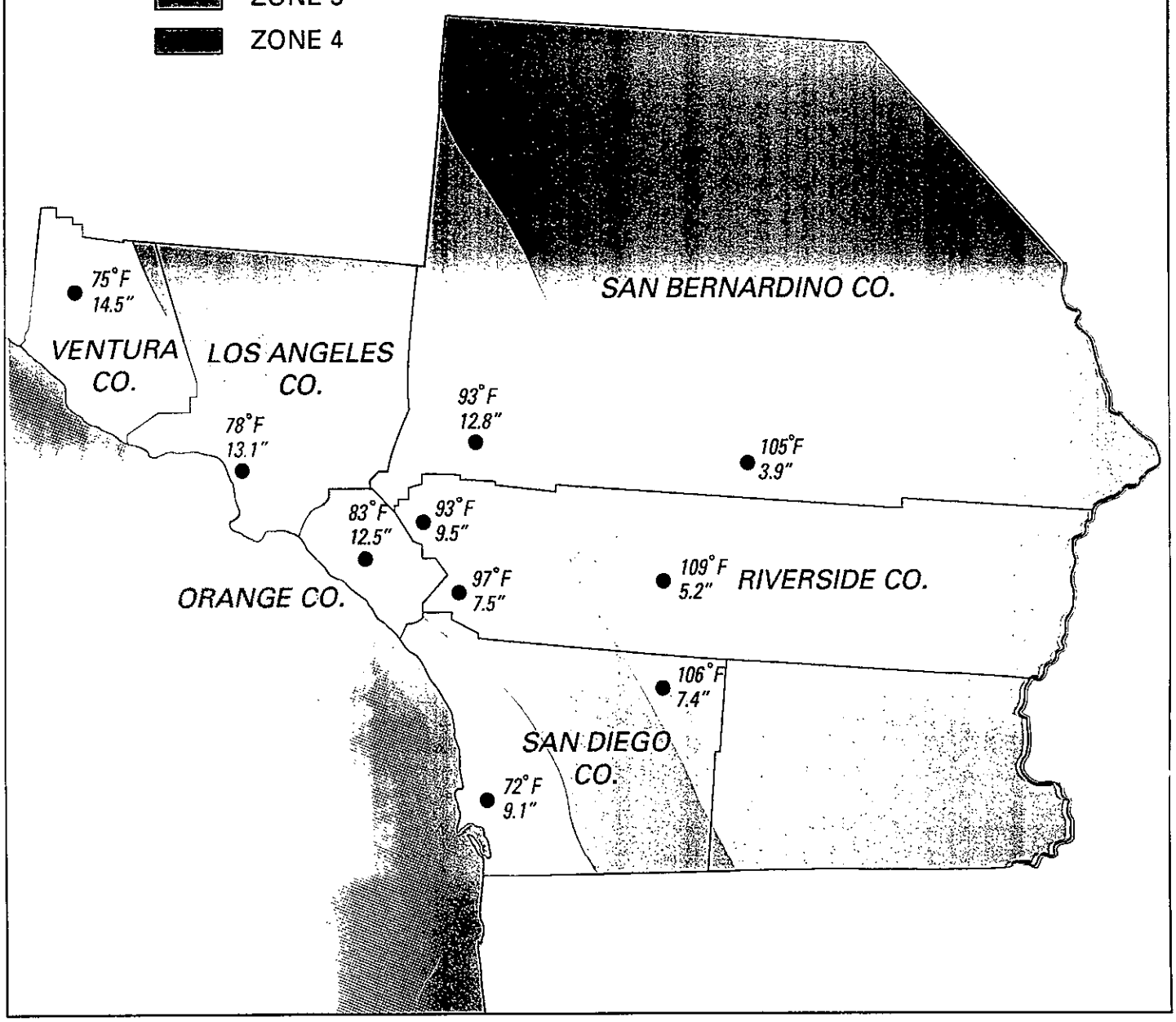


FIGURE II–5

M & I WATER USE BY SECTOR

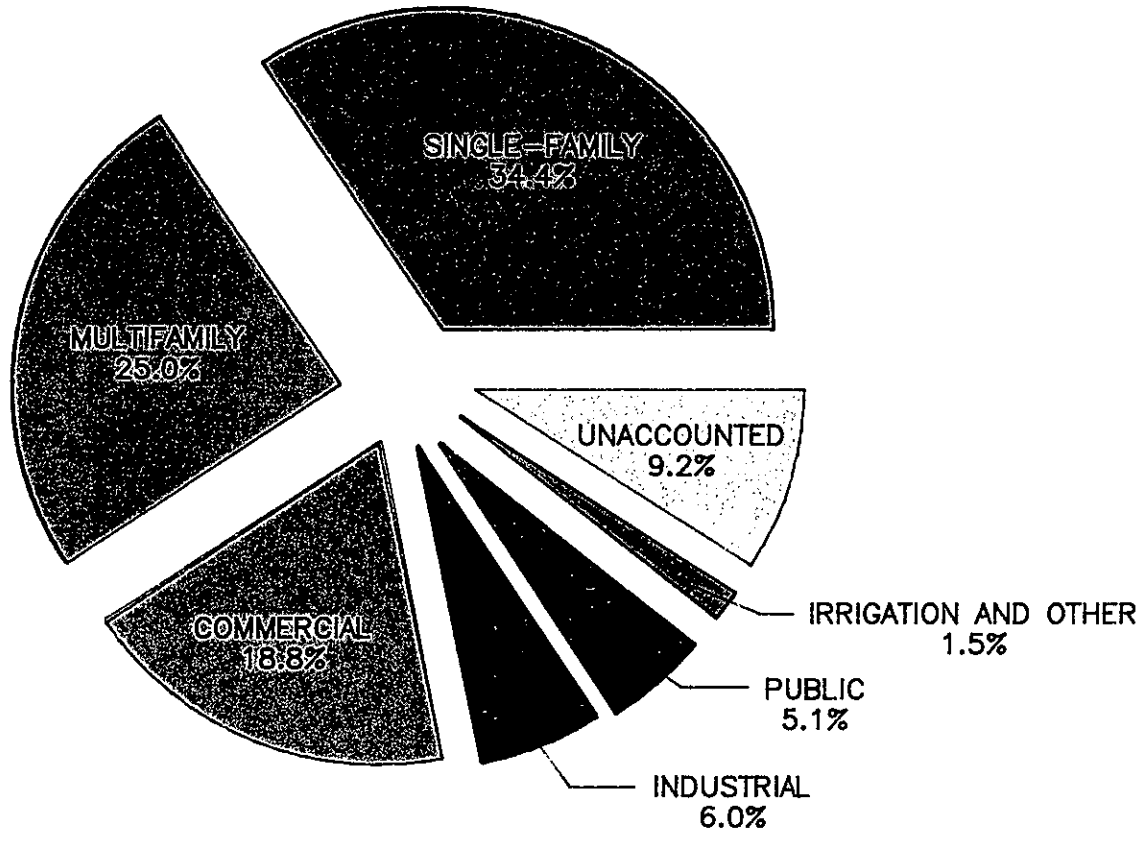


TABLE II-6

SECTORIAL AND SEASONAL DISAGGREGATION OF M&I WATER USE IN SOUTHERN CALIFORNIA

(MOST LIKELY RANGES GIVEN IN PARENTHESES)[a]

User Sector/Subsector	Disaggregation of Urban Sectors	ESTIMATED PERCENT OF TOTAL ANNUAL USE[b]						
		Seasonal Disaggregation				Components of Outdoor Use		
		Nonseasonal (Base Use)	Seasonal (Peak Use)	Indoor Use	Outdoor Use	Irrigation	Cooling (AC)[c]	Other
RESIDENTIAL SECTOR								
Single family	34.4	68.7 (65-75)	31.3 (25-35)	65.4 (60-70)	34.6 (30-40)	30.8	0.0	3.8
Multifamily	25.0	83.9 (80-90)	16.1 (10-20)	82.2 (75-85)	17.8 (15-25)	16.1	0.4	1.3
Total residential	**59.4**	**72.1 (70-80)**	**27.9 (20-30)**	**69.6 (65-75)**	**30.4 (25-35)**	**27.2**	**0.2**	**3.0**
NONRESIDENTIAL SECTOR								
Commercial	18.8	74.9 (70-80)	25.1 (20-30)	71.3 (70-75)	28.7 (25-30)	21.8	6.9	0.0[e]
Industrial	6.0	79.5 (75-90)	20.5 (10-25)	79.5 (75-90)	20.5 (10-25)	12.3	8.2	0.0[e]
Public	5.1	46.2 (30-50)	53.8 (50-70)	46.2 (30-50)	53.8 (50-70)	53.8	0.0[d]	0.0[e]
Other	1.1	58.0 (30-60)	42.0 (40-70)	58.0 (30-60)	42.0 (40-70)	42.0	0.0[d]	0.0[e]
Irrigation	0.4	34.0 (10-50)	66.0 (50-90)	0.0	100.0	100.0	0.0	0.0
Total nonresidential	**31.4**	**70.0**	**30.0**	**67.4**	**32.6**	**26.9**	**5.7**	**0.0**
UNACCOUNTED USE	**9.2**	**100.0**	**0.0**	**100.0**	**0.0**	--	--	--
TOTAL URBAN USE	**100.0**	**74.0**	**26.0**	**71.7**	**28.3**	**24.6**	**1.9**	**1.8**

Source: MWD Report: Seasonal Components of Urban Water Use in Southern California. February 1990.

[a] The "most likely range" shows the lower and upper bounds of the estimated average values.
[b] Average values represent current estimates which are subject to revision as additional data become available in the future.
[c] Air conditioning.
[d] Cooling and other uses are included under landscape irrigation.
[e] Other uses in these sectors are included under landscape irrigation.

water is used for outdoor purposes, including the irrigation of urban landscapes (24.6 percent), cooling towers in commercial and industrial buildings (1.9 percent), and other minor outdoor uses such as maintenance of swimming pools, dust control, and car washing (1.8 percent).

A brief description of water use characteristics in each major sector is given below.

Residential Sector

Table II-7 presents estimates of average annual residential water use in the area served by Metropolitan in 1985. The average residential home used an estimated average of 327 gallons per day (gpd), which is equivalent to 119 gallons per person per day (gpcd). This estimate corresponds to an average use of 384 gpd in single-family homes and 256 gpd in all other types of homes (multifamily). An average single-family home in the coastal plain (Zone 2) uses an estimated 421 gallons of water per day, or 154 gallons per person per day (Table II-8). A similar home located on the coastal fringe (Zone 1) would use 282 gpd (33 percent less) and 522 gpd (24 percent more) if it was located inland (Zone 3). Average annual use in homes other than single-family (i.e., duplexes, triplexes, apartments, mobile home parks, townhouses, and condominiums), which are referenced here as multifamily structures, is estimated at 258 gallons per day in Zone 2 (the coastal plain). It changes with climatic region, following the pattern of single-family use.

Table II-9 and Figure II-6 summarize the estimates of disaggregated water uses in the residential sector in the Metropolitan service area. The breakdown of residential uses into the seasonal and nonseasonal components is based on the estimates derived from the "minimum-month" analyses of water use records. These estimates were adjusted for winter irrigation in order to obtain the percent breakdown for indoor and outdoor uses.

Indoor use was disaggregated using the literature data on typical quantities of water used for various indoor activities. Indoor use in Southern California is estimated at 85 gpcd in single-family homes and 75 gpcd in multifamily units.

Commercial Sector

In 1985, average water use per account in a sample of 15 water supply agencies was 2,144 gallons per day. In terms of water use per person employed in commercial activities, the estimated use is 80 gallons per employee per day. On average, water use in the commercial sector represents approximately 21 percent of total M & I water use.

The most likely range of seasonal commercial use in the Metropolitan service area is 20 to 30 percent of total M & I use (Figure II-7). This range has been constructed around the 1987 estimate of 25.1 percent because the long-term average of 30.3 percent does not reflect the generally observed declining trend in seasonal commercial use between 1980 and 1988.

Industrial Sector

Although industrial water use in most cities represents less than 10 percent of total municipal water use, this proportion ranged from 1 to 26 percent in a sample of 11 water agencies. Average use per industrial account ranges from 1,230 gpd to 44,849 gpd. In 1985, the average water use per account in the 11 sampled agencies was 4,043 gpd. In terms of water use per employee in the manufacturing sector, the estimates fell within a range from 14 gpd to 391 gpd. In 1985, the average use per employee was 103 gpd.

TABLE II-7

ESTIMATES OF AVERAGE ANNUAL RESIDENTIAL WATER USE IN SOUTHERN CALIFORNIA 1985

Residential Sector	Gallons Dwelling Unit Per Day	Percent of Housing Units Sampled	Gallons Per Person Per Day	Percent of Total Population Sampled[b]
Single-family	384	36.0	140	40.6
Multifamily	256	49.5	94	39.8
All residential	327	46.3	119	44.7

Source: MWD Report, "Seasonal Components of Urban Water use in Southern California", 1990.

[a] The estimated number of housing units in the Metropolitan service area in 1985 were 4,672,783 occupied housing units; 2,665,013 single-family units; and 2,007,770 multifamily units (other than single-family).

[b] Population sampled is calculated as the product of housing units and persons per household in each study area. Total population in the Metropolitan service area was estimated to be 13,379,987 in 1985.

TABLE II-8

GEOGRAPHIC DIFFERENCES IN AVERAGE ANNUAL RESIDENTIAL USE IN SOUTHERN CALIFORNIA

Climatic Zone/Sector	Gallons Per Dwelling Unit Per Day	Gallons Per Person Per Day
ZONE 1 (COASTAL FRINGES)		
Single-family	282	104
Multifamily	248	94
All residential[a]	261	97
ZONE 2 (COASTAL PLAINS)		
Single-family	421	154
Multifamily	258	94
All residential[a]	337	123
ZONE 3 (INLAND)		
Single-family	522	156
Multifamily	241	70
All residential[a]	482	162

Source: MWD Report, "Seasonal Components of Urban Water Use in Southern California," 1990.

[a] Some irregularities in the estimates are due to small samples of cities in individual climatic zones and sample sizes that differ by user sector.

TABLE II-9

DISAGGREGATION OF RESIDENTIAL WATER USE

Component of Use	Percent of Total Annual Use		
	Total Residential Sector	Single-Family Sector	Multi-family Sector
Nonseasonal use			
Average[a]	**72.1**	**68.7**	**83.9**
Most likely range[b]	70-80	65-75	80-90
Seasonal Use			
Average	**27.9**	**31.3**	**16.1**
Most likely range	20-30	25-35	10-20
Indoor Use			
Average	**69.6**	**65.4**	**82.2**
Most likely range	65-75	60-70	75-85
Toilets	25.1	22.2	31.2
Showers/baths	20.2	18.3	25.6
Washing machines	13.2	14.4	12.3
Faucets	9.0	8.5	11.5
Dishwashers	2.1	2.0	1.6
Outdoor use			
Average	**30.4**	**34.6**	**17.8**
Most likely range	25-35	30-40	15-25
Lawn/garden irrigation	27.2	30.8	16.1
Swimming pool use	1.6	2.0	0.4
Car washing	1.4	1.8	0.9
Air conditioning	0.2	0.0	0.4

Source: MWD Report, "Seasonal Components of Urban Water Use in Southern California," 1990.

a Average values represent current estimates which are subject to revision as additional data become available in the future.

b The "most likely range" indicates the lower and upper bound of the estimated average values.

FIGURE II–6

SEASONAL DISAGGREGATION OF RESIDENTIAL USE

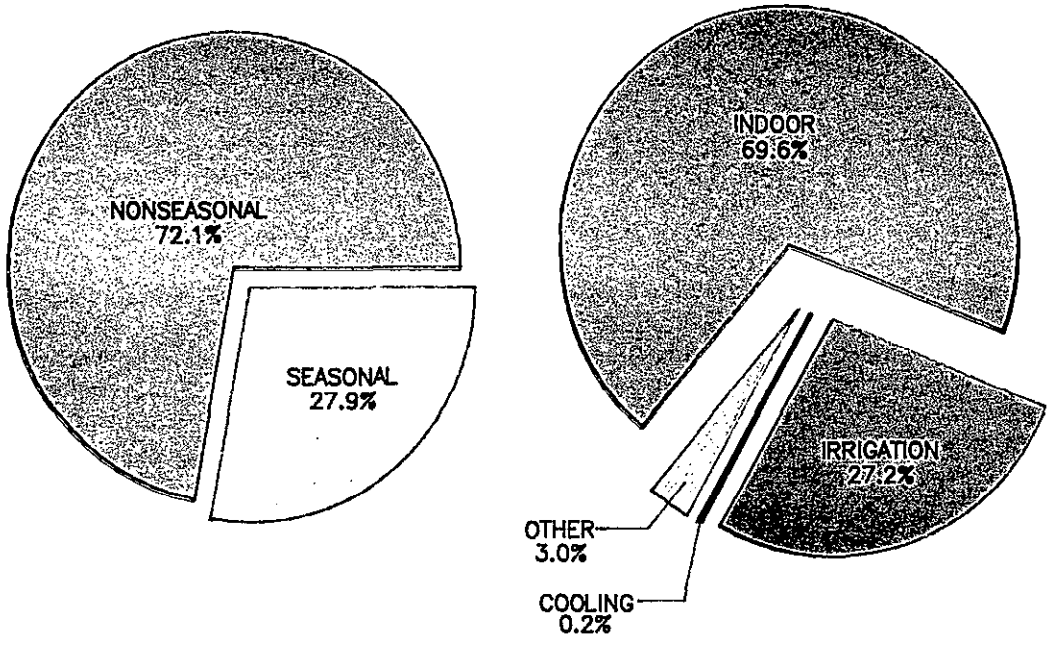
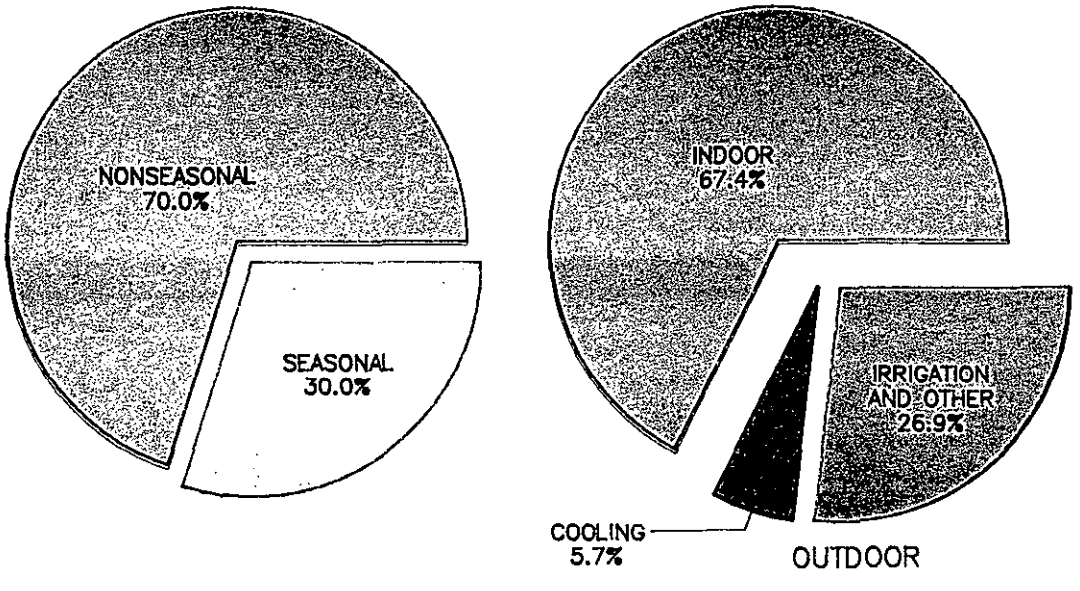


FIGURE II–7

SEASONAL DISAGGREGATION OF NONRESIDENTIAL USE



The seasonal water use in the industrial sector represents about 10 to 25 percent of total annual use. Most of this water (about two-thirds) is used as make-up water for cooling towers. The remaining one-third is applied for maintenance of landscapes and other outdoor uses, primarily dust control and washing of concrete surfaces.

Public, Other, and Unaccounted Sectors

In addition to the three major sectors (i.e., residential, commercial, and industrial), some water agencies distinguish in their records one or more minor categories of metered water use. These categories may be labeled as "public," "irrigation," "fire," or "other." An evaluation of water records indicated that public, irrigation, and other uses, on average, represent 6.6 percent of total urban water use in Southern California (Table II-6). Unaccounted uses account for approximately 9.2 percent of production.

The MWD-MAIN Water Use Forecasts

Water Demand Projection Methodology

To assist in projecting water demands, Metropolitan has contracted with Planning and Management Consultants, Ltd. (PMCL), of Illinois to calibrate the U.S. Army Corps of Engineers' IWR-MAIN (Municipal and Industrial Needs) water demand forecasting system to Metropolitan's service area. This econometric model was first developed in the early 1960s and was extensively updated for the U.S. Army Corps of Engineers' Institute of Water Resources in the early 1980s. In recent years, Metropolitan has modified the system by incorporating water use models that reflect the water use patterns of Southern California. This local version of the computer model is referred to as the MWD-MAIN Water Use Forecasting System. The MWD-MAIN System develops separate projections for the four major water use sectors: residential, commercial, industrial, and public/unaccounted.

In projecting long-term water demands, the MWD-MAIN System accounts for a wide variety of economic, demographic, and climatic factors. In forecasting residential water demands, the MWD-MAIN System takes into consideration: population, housing mix, household occupancy, housing values, weather conditions, and the implementation of conservation measures. In the case of commercial and industrial water use, the projected demands are a function of employment in the numerous types of commercial, institutional, and manufacturing establishments as well as water/wastewater prices and conservation practices.

Although the MWD-MAIN System, by default, projects water demands under normal weather conditions, it can also generate forecasts for varied weather conditions. This allows Metropolitan, for example, to project water demands during a year with above-average or below-average rainfall conditions.

Metropolitan has retained Dr. David Maidment of the University of Texas at Austin to analyze the historic climate and water use data to measure the effects of weather on water demands. The results of this analysis have shown that the above-normal water demand was about 7 percent greater than normal (average weather) occurring every one-in-twenty years. The range is lower in the coastal areas (about 5 percent) and greater in the hotter inland areas (up to 14 percent).

Projected Water Use

The projected municipal and industrial demands in Metropolitan's service area were generated by incorporating SCAG's and SANDAG's projected population, housing, and employment data into the MWD-MAIN System. This forecast incorporates the effects of pre-1980 conservation practices as well as water conservation measures that are currently practiced in Metropolitan's area. The forecast results (Table II-10) show that municipal water use within Metropolitan's service area will increase from a current use of 3.3 MAFY to 4.3 MAFY by the year 2010, based on normal weather conditions, or a 32 percent increase. In the drier years, the demands could reach 4.6 MAFY by the year 2010. These projections include conservation savings from the 1981 and 1992 California Plumbing Codes, public education programs, and the effects of changes in retail prices from 1980 to 1990.

Trends in Future Urban Water Use

The total water use in Metropolitan's service area is expected to grow because of continuing increases in population for Southern California. However, the growth in water demand may be lower or higher than the rate of population growth, depending on a number of forces that are known to influence water use. Some of these forces are already affecting water use and are expected to further modify future water demands.

Factors Causing Increase in Water Use Rates

Several factors will tend to increase water use rates in the future (e.g., a gross per capita use measured as the total water use divided by total population). Major factors in this category are illustrated in Figure II-8 and are described as follows:

(1) Decreasing household size. The nationwide/statewide trend is toward decreasing household size (i.e., greater numbers of homes with fewer occupants per household). Because some household water uses (i.e., landscaping) remain approximately the same regardless of household size, this trend will tend to increase per capita water use.

(2) Increasing household income. Substantial increases in income will lead to home improvement investments. These expenditures often include water-using appliances and installations (e.g., additional landscaping and cooling systems.)

(3) Geographic growth differentials. An increasing proportion of residential and commercial growth is occurring in the hot, inland valley sections of Metropolitan's service area, such as San Bernardino and Riverside counties, and requires more water. This increasing requirement for water reflects the higher demand for cooling and landscape maintenance in these arid regions.

(4) An increasing regional per capita product. A greater share of the population will be employed in the coming decades causing the gross regional product to grow faster than population.

Factors Causing Decrease in Water Use Rates

Several factors are expected to decrease water use rates (i.e., gross per capita use) in Metropolitan's service area. Two factors are related to shifts in water use sectors. Other factors represent water conservation. Signifi-

TABLE II-10
PROJECTED M&I WATER NEEDS OF METROPOLITAN'S SERVICE AREA (AFY)

County/Service Area	1990	Projected Demand with Current Conservation Practices[a] 2010	%Change
Los Angeles			
Residential	1,143,700	1,296,100	13
Commercial/Inst.	321,300	421,300	31
Industrial	115,900	112,300	-3
Other[b]	152,700	185,100	21
TOTAL	**1,733,600**	**2,014,800**	**16**
Orange			
Residential	383,800	489,900	28
Commercial/Instit.	97,800	142,400	46
Industrial	32,800	43,700	33
Other	54,500	74,300	36
TOTAL	**568,900**	**750,300**	**32**
Riverside			
Residential	139,500	278,700	100
Commercial/Instit.	35,600	57,700	62
Industrial	11,800	27,300	132
Other	33,400	71,100	113
TOTAL	**220,300**	**434,700**	**97**
San Bernardino			
Residential	97,900	166,100	70
Commercial/Instit.	44,000	65,400	49
Industrial	17,300	35,500	105
Other	41,600	73,200	76
TOTAL	**200,800**	**340,200**	**69**
San Diego			
Residential	302,200	404,900	34
Commercial/Instit.	88,700	124,200	40
Industrial	14,600	23,500	61
Other	63,900	92,500	45
TOTAL	**469,400**	**645,100**	**37**
Ventura			
Residential	73,700	104,900	42
Commercial/Instit.	17,600	26,500	51
Industrial	5,700	8,300	47
Other	11,900	18,100	53
TOTAL	**108,800**	**157,800**	**45**
Total MWD Service Area			
Residential	2,140,600	2,740,500	28
Commercial/Instit.	605,000	837,600	38
Industrial	198,100	250,700	27
Other	358,100	514,200	44
TOTAL	**3,301,900**	**4,343,000**	**32**

a The projected demand includes the conservation effects of public information and education campaigns and the 1981 and 1992 building code requiring water-conserving fixtures. The 1990 and 2010 estimated water demands reflect long-term "normal" weather conditions.

b "Other" water use may include some free service, irrigation, fire, and system losses.

cant effects on water use will result from conservation measures which are currently practiced in the Metropolitan service area. Major factors in this category are shown in Figure II-9 and are described as follows:

(1) An increasing share of multifamily housing units in the total housing stock. Because multifamily structures share landscaping and swimming pools and generally have fewer water-using appliances (e.g., washing machines or dishwashers), the average water use is lower than in detached single-family residences (about 30 gallons per day less per dwelling unit). Currently, housing units in multifamily structures represent about 43 percent of the housing stock and are expected to account for 48 percent by 2010.

(2) The 1981 and 1992 California Plumbing Codes. The requirement of water-efficient plumbing fixtures will continue to affect water use rates in all new structures (residential and commercial) and all remodeled bathrooms. The 1981 code requires (a) toilets with a maximum average of 3.5 gallons per flush, (b) urinals with 1.5 gallons per flush, and (c) showerheads and faucets with a maximum average flow rate of 2.75 gallons per minute. The 1992 code will require the installation of toilets with 1.6 gallons per flush in all new buildings built after January 1, 1992.

(3) Education programs. The effect of educational programs will depend upon the level of saturation of the public.

(4) Conservation programs. Reductions in water use will result from the implementation of best management conservation practices such as (a) residential retrofit programs induced by Metropolitan's Conservation Credits Program, (b) the expansion of ongoing leak detection and repair programs conducted by retail agencies, and (c) landscaping water efficiency measures, including education about water practices and low water-using plants.

(5) Changes in retail prices. Price increases since the late 1970 levels to the current (1989) price levels (in real terms) provide incentives to consumers to use water more efficiently.

These reduction factors are expected to offset most of the increases in usage rates due to income, population trends, and urban growth and allow Metropolitan to maintain current water use rates in the future at the most efficient level if the ongoing and planned conservation programs are successful. It is important to note, however, that although the water demand forecast in Table II-10 shows an increasing per capita demand, the residential water use rate (residential water use divided by the number of households) is decreasing.

FIGURE II–8

FACTORS WHICH MAY INCREASE WATER DEMAND

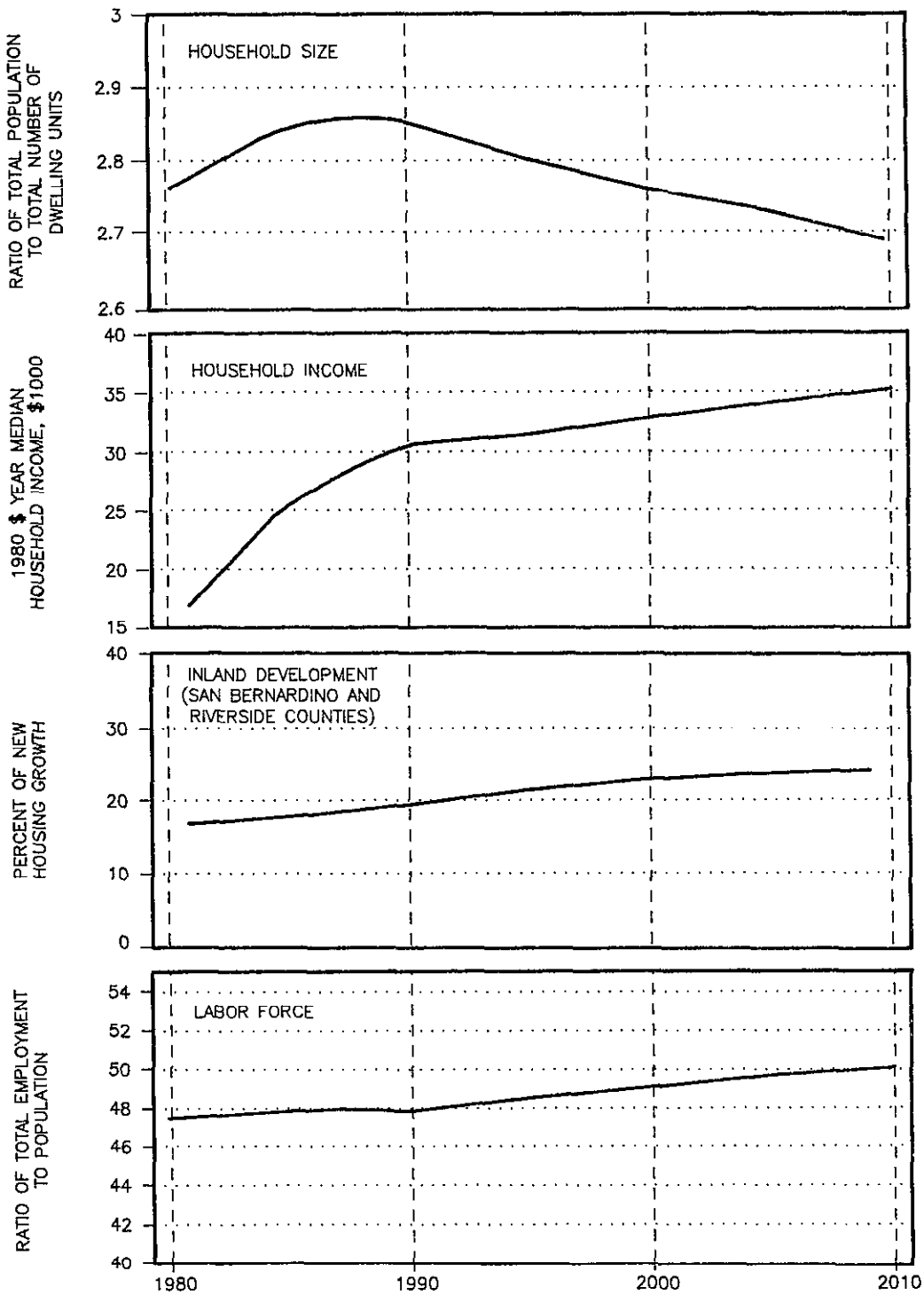
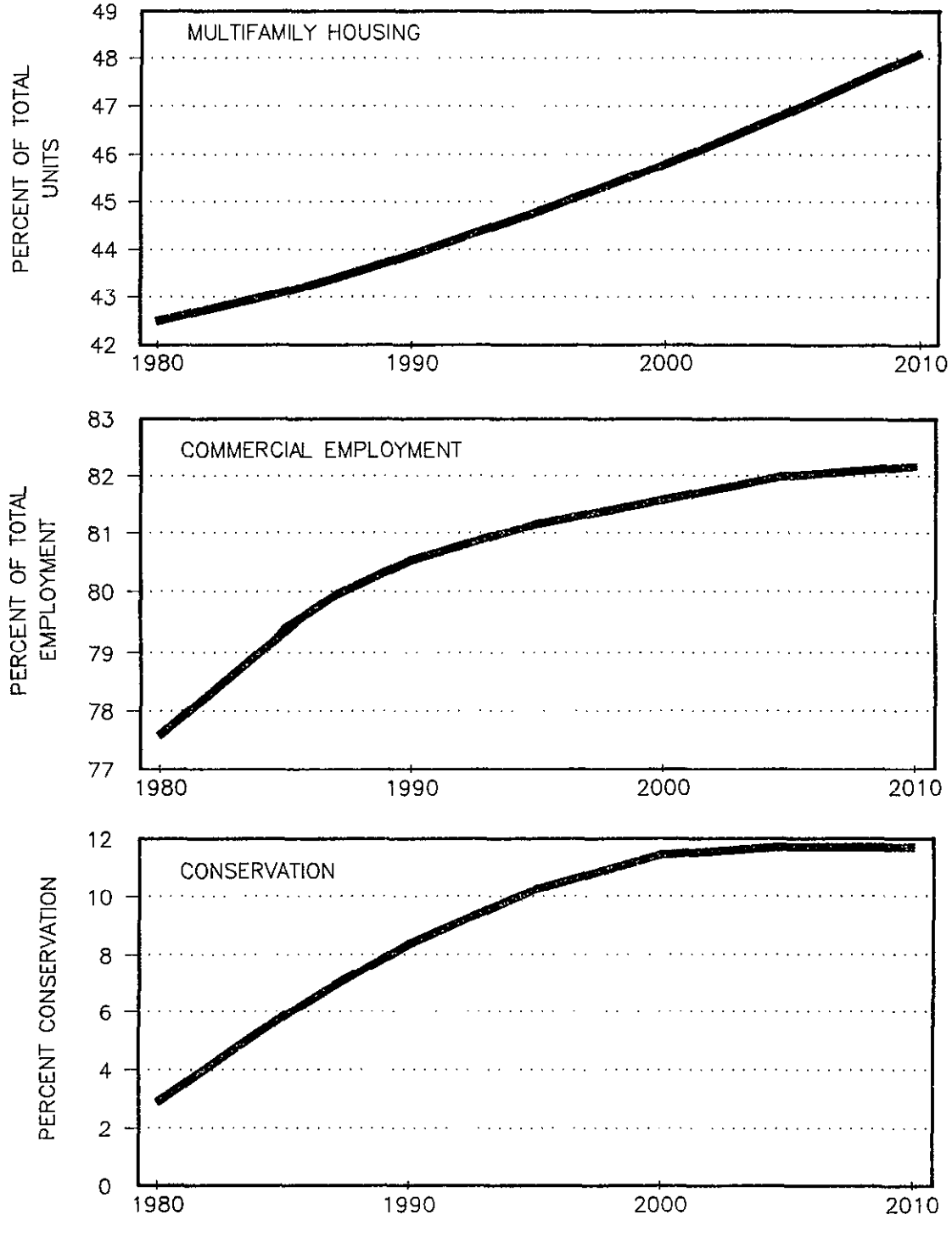


FIGURE II-9

FACTORS WHICH MAY DECREASE WATER DEMAND



III. WATER SUPPLIES

Water supplies available to Metropolitan's service area are obtained from both local and imported sources. Local groundwater, surface water, and reclaimed wastewater constitute about 35 percent of the area's current water needs.

Imported supplies from the Los Angeles Aqueduct, Metropolitan's Colorado River Aqueduct, and Metropolitan's entitlement to State Project water provide on the average the remaining 65 percent of the regional needs. Metropolitan provides supplemental water supplies that meet about 55 percent of the regional water needs. In the future, as demands for water increase with population growth, an increasing portion of the regional water demands will be supplied by Metropolitan. The location of Metropolitan's service area and the three major aqueducts used to import water into Metropolitan's service area are shown in Figure I-1 (Chapter I). The historic use of the various local and imported supplies are shown in Figure III-1. Table III-1 shows the quantities of water obtained by member agencies from local and imported supplies during fiscal year 1988-89.

LOCAL WATER SUPPLIES

Local water supplies available to the region include surface water, groundwater, and reclaimed water supplies. Virtually all of the major river systems in Southern California have been developed into a comprehensive system of dams, flood control channels, and percolation ponds for supplying local water and artificially recharging groundwater basins such that only a small portion of runoff in the area is released to the ocean. It is only during the largest of storms that freshwater reaches the ocean. For example, studies by the Los Angeles County Department of Public Works have shown that 90 percent of the rainfall and runoff in the county either percolates naturally into the ground or is captured in the flood control reservoirs for later release to recharge groundwater basins. In addition to runoff, water reclamation is an increasingly important source of water for the region. Fluctuation in local supplies occurs with variations in rainfall. Should there be a prolonged period of below-normal rainfall, local water supplies would be decreased. Conversely, a prolonged period of above-normal rainfall would increase the local supplies. The sources of groundwater basin replenishment are local precipitation and runoff from the coastal ranges and artificial recharge with imported water supplies. Reclaimed wastewater is also used to replenish groundwater basins, subject to strict public health controls.

Major Groundwater Basins

Groundwater supplies account for about 90 percent of the natural local water supplies. These supplies are found in many basins throughout Metropolitan's service area, with safe yield

in some basins exceeding 200,000 AFY (Table III-2). The locations of the major basins are shown in Figure III-2. The groundwater is collected through the natural percolation of rainfall and stream runoff into the groundwater basin. In addition, runoff in certain areas is retained in flood control reservoirs constructed in major drainage areas and released into spreading basins or ponds for additional percolation into the groundwater basins. Groundwater is then pumped to meet local needs.

Most of the groundwater basins in Metropolitan's service area are managed by either local agencies, such as the Orange County Water District for the Orange County Basin or by court-appointed watermasters. Adjudication basins in Metropolitan's service area include Raymond Basin, Central Basin, West Coast Basin, Main San Gabriel Basin, Upper Los Angeles River System, and Chino Basin. These basins are managed in such a way that extractions are limited, or replenishment is provided using Metropolitan imported supplies when the safe yield of the basin or other groundwater management criteria are being exceeded. In general terms, basin management plans include protection from seawater intrusion, water quality deterioration, excessive lowering of water levels, while providing a hedge against water shortages. The dependable natural groundwater supplies (i.e., safe yield) in the region are on the order of 1.0 MAFY. The replenishment of basins with reclaimed water provides additional groundwater supplies. Indeed, the region's groundwater basins are a key asset for the development of water management plans in the future.

The recent drought conditions have caused a significant reduction in the amount of local water in groundwater basin storage. Figure III-3 shows the changes in local groundwater storage (about 1 MAF) over the past six years. This reduction is the result of below-normal rainfall in five out of the past six years (Figure III-4).

The existing and projected quality of groundwater supplies is of great concern to Metropolitan. Recently, trace amounts of organic chemicals have been found in some Southern California groundwater basins. Figure III-2 shows the current estimated loss in production due to mineral and organic water quality problems. Since the 1930s, about 74,000 AFY of historic groundwater production have been lost because of high mineral concentrations (primarily nitrates and total dissolved solids). Organics in groundwater have resulted in additional losses in production, currently estimated at about 6,500 AFY.

Some basins, such as the San Gabriel and San Fernando, have organics above the current drinking water standards in 50 percent of the wells tested. While many of these wells have been returned to production through blending or other means, their use in the future may be jeopardized by more stringent state and federal standards for organic compounds. The potential for adoption of more stringent federal and state water quality standards and for movement of these constituents within groundwater basins raises uncertainties as to the future availability of a portion of these local supplies. Loss of local production capacity due to groundwater quality problems may be viewed as a temporary problem because the value of the resource to Southern California is too great to allow its abandonment. Consequently, cleanup facilities may have to be constructed to enable existing wells to return to useful production. A number of federal, state, and local agencies are spending substantial funds on groundwater cleanup projects. However, it appears that more projects will need to be implemented in the future. Water quality issues demand attention and will undoubtedly be the subject of

FIGURE III–1

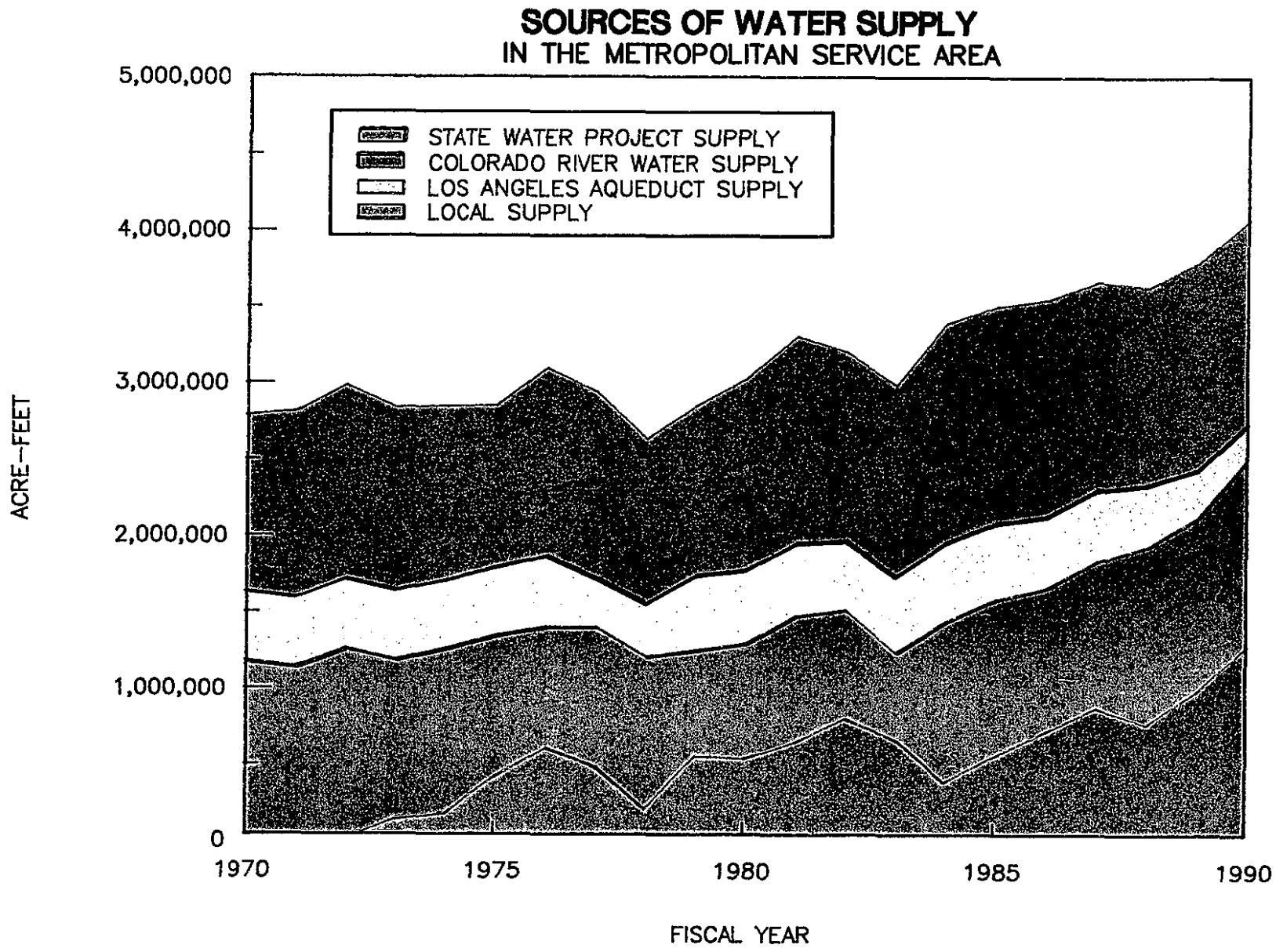

SOURCES OF WATER SUPPLY
IN THE METROPOLITAN SERVICE AREA
STATE WATER PROJECT SUPPLY
COLORADO RIVER WATER SUPPLY
LOS ANGELES AQUEDUCT SUPPLY
LOCAL SUPPLY
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
ACRE–FEET
1970
1975
1980
1985
1990
FISCAL YEAR

TABLE III-1

MAJOR SOURCES OF WATER SUPPLY FOR METROPOLITAN'S MEMBER AGENCIES 1988-1989 (AFY)

Member Agency	Local Water Supplies	Metropolitan Deliveries	Los Angeles Aqueducts	Total Water Supply
Beverly Hills	0	14,594	0	14,594
Burbank	921	22,775	0	23,696
Central Basin MWD	124,604	141,019	0	265,623
Compton	7,243	5,153	0	12,396
Foothill MWD	5,958	10,891	0	16,849
Glendale	4,104	27,555	0	31,659
Las Virgenes MWD	1,021	22,033	0	23,054
Long Beach	30,244	47,298	0	77,542
Los Angeles	137,333	230,148	328,205	695,686
Pasadena	14,741	23,928	0	38,669
San Fernando	2,206	1,645	0	3,851
San Marino	5,394	333	0	5,727
Santa Monica	7,777	9,883	0	17,660
Three Valleys MWD	54,799	68,065	0	122,864
Torrance	7,641	22,804	0	30,445
Upper San Gabriel MWD	138,337	55,279	0	19.,616
West Basin MWD	6,512	190,685	0	197,197
Los Angeles County Total	**877,031**	**894,088**	**328,205**	**1,771,122**
Anaheim	47,777	25,802	0	73,579
Coastal MWD	9,552	43,803	0	53,355
Fullerton	18,529	16,213	0	34,742
MWD of Orange County	178,403	244,095	0	422,498
Santa Ana	34,753	15,816	0	50,569
Orange County Total	**289,011**	**345,729**	**0**	**634,741**
Eastern MWD	95,594	48,490	0	144,084
Western MWD	175,524	77,860	0	253,384
Riverside Co. Total	**271,118**	**126,350**	**0**	**397,468**
Chino Basin	160,024	46,354	0	206,377
San Bernardino County Total	**160,024**	**46,354**	**0**	**206,377**
San Diego CWA	61,785	592,216	0	654,001
San Diego County Total	**61,785**	**592,216**	**0**	**654,001**
Calleguas MWD	27,482	104,153	0	131,635
Ventura County Total	**27,482**	**104,153**	**0**	**131,635**
Grand Total MWD	**1,358,243**	**2,108,890**	**328,205**	**3,795,338**

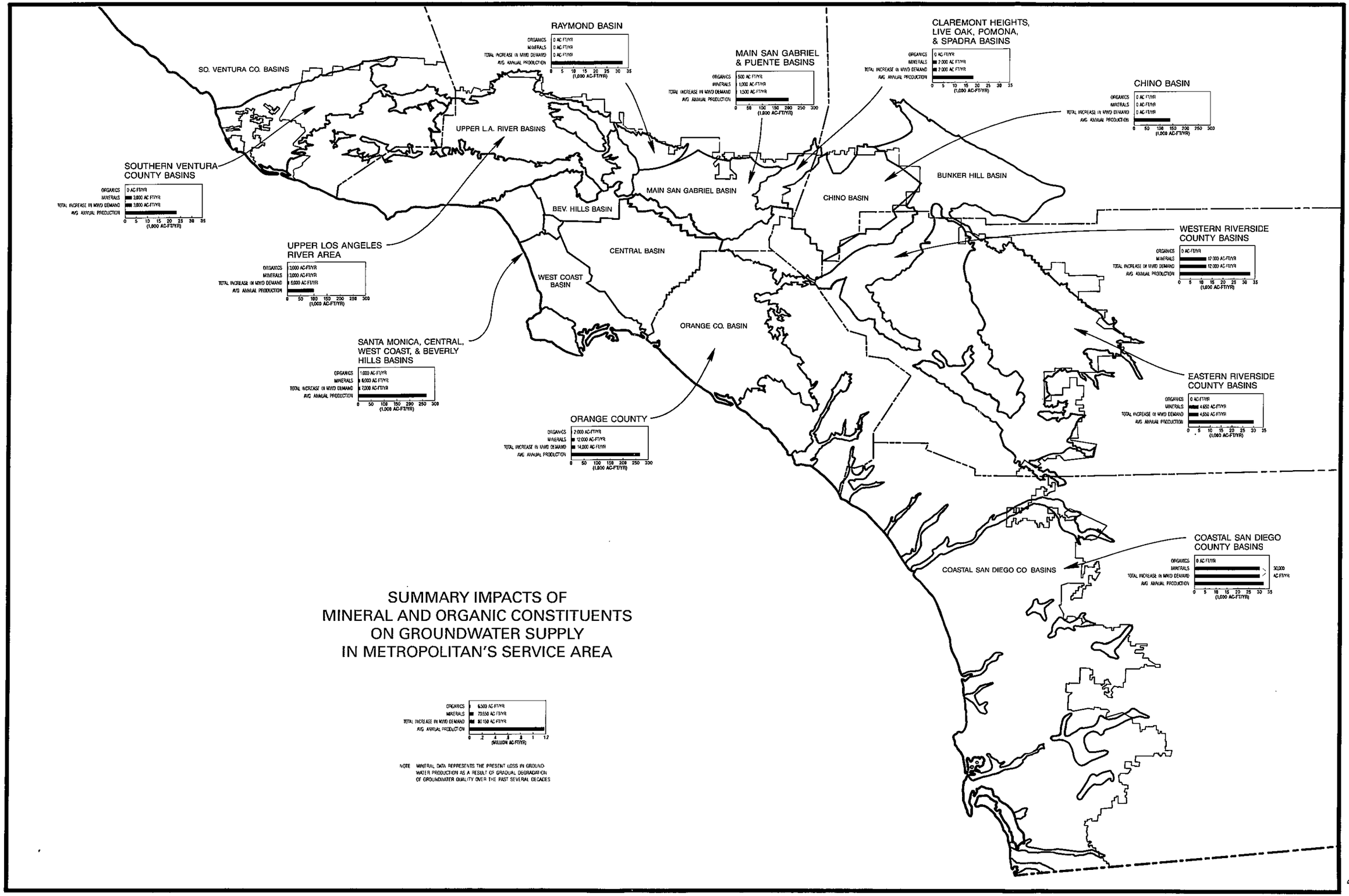
TABLE III-2

DEPENDABLE LOCAL GROUNDWATER SUPPLIES[a] IN METROPOLITAN'S SERVICE AREA (In Thousand AFY)

Location	Dry Year Supplies
Ventura County	20
Upper Los Angeles River Area	100
Raymond	30
Main San Gabriel & Puente	180
Claremont Heights, Live Oak, Pomona & Spadra	20
Santa Monica, Central & West Coast	220
Orange County	110
Eastern and Western Riverside County (including imports from San Bernardino Basin)	200
Chino	140
Coastal San Diego County	30
Total	1,060

[a]The yields of groundwater basins includes some surface water recharge.

FIGURE III-2



SUMMARY IMPACTS OF MINERAL AND ORGANIC CONSTITUENTS ON GROUNDWATER SUPPLY IN METROPOLITAN'S SERVICE AREA

NOTE MINERAL DATA REPRESENTS THE PRESENT LOSS IN GROUNDWATER PRODUCTION AS A RESULT OF GRADUAL DEGRADATION OF GROUNDWATER QUALITY OVER THE PAST SEVERAL DECADES

FIGURE III–3

GROUNDWATER STORAGE TRENDS*

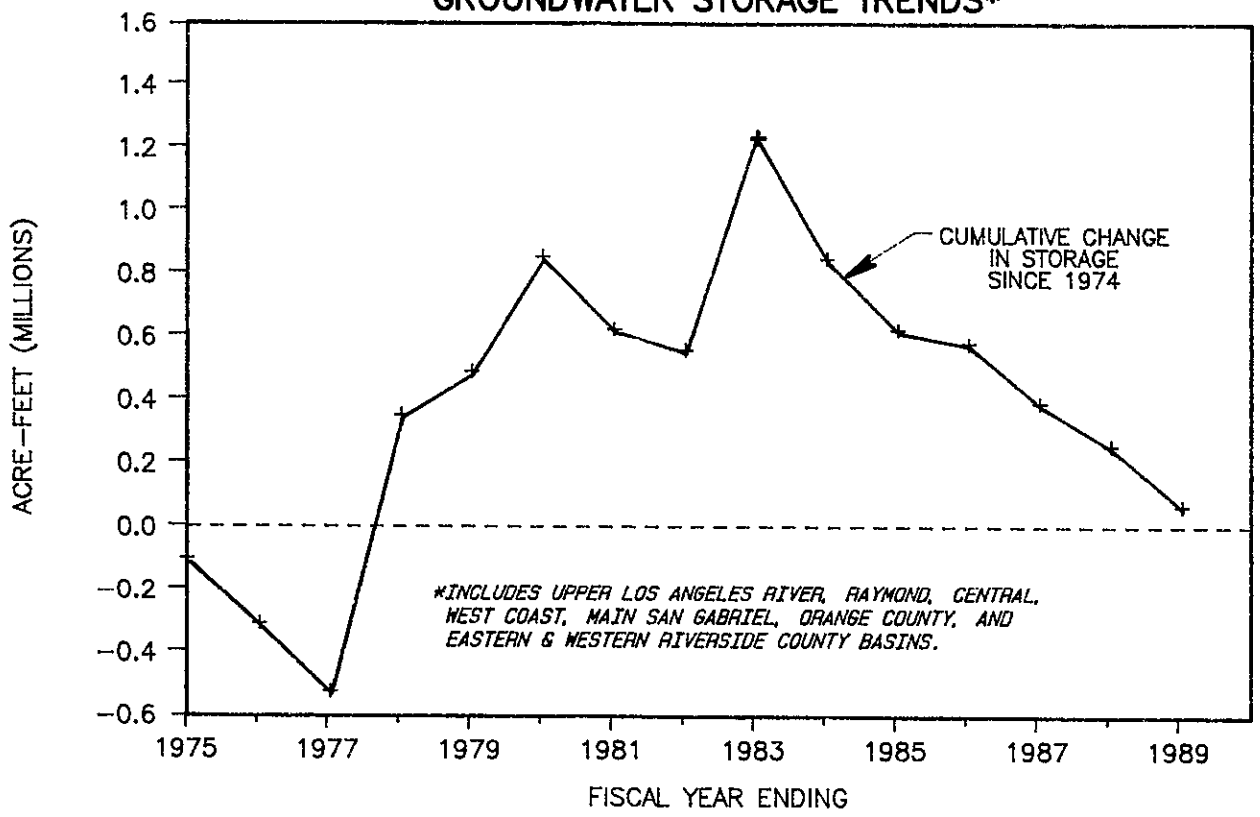
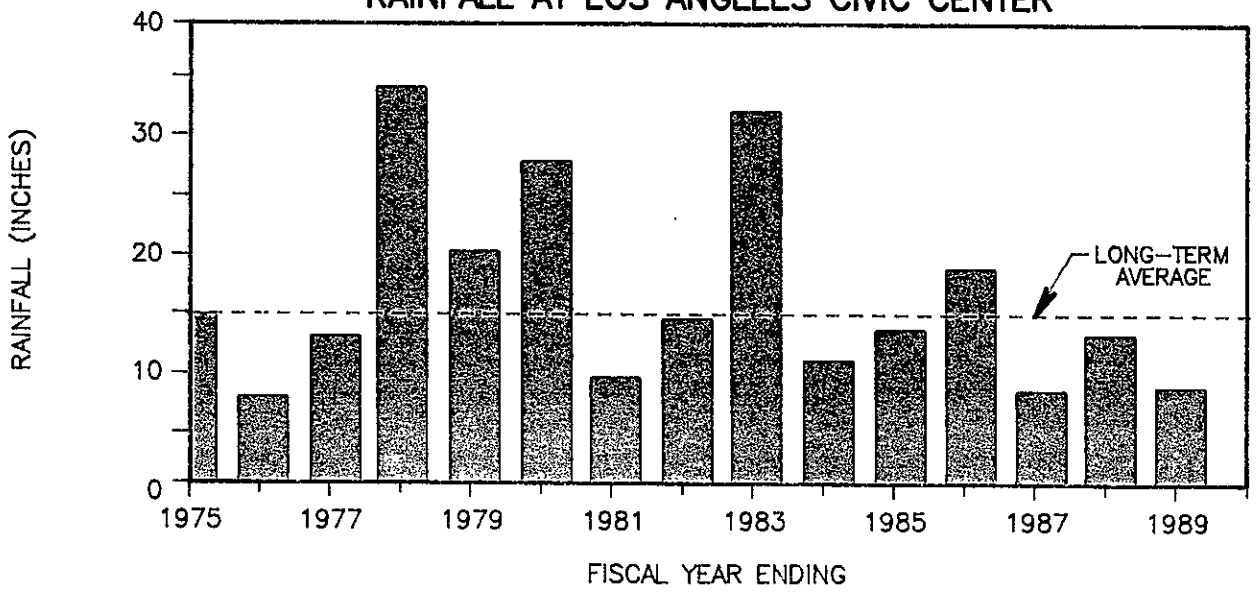


FIGURE III–4

RAINFALL AT LOS ANGELES CIVIC CENTER



intense investigation and potential legislative action. Current planning studies assume that these water quality problems will not affect the long-term availability of groundwater, as there are efforts being undertaken to develop treatment and management approaches to reclaim these supplies and maintain their availability in the future.

Major River Systems and Reservoirs

Local surface-water resources consist of runoff captured in storage reservoirs, held for later direct use, and of some direct diversions from streams into local water systems. There are currently 18 major reservoirs that are owned and operated by local water agencies (Figure III-5). The major reservoirs and their capacities are listed by member agency and subagency in Table III-3. These reservoirs provide a storage capacity of 817,000 AF. The firm annual yield of these local surface supplies is about 100,000 AFY. It varies widely between wet and dry years, and most reservoirs are operated with minimal carry-over storage. The most significant portion occurs in San Diego County and in the foothills of the San Gabriel Mountains.

Water Reclamation

Reclaimed wastewater in Metropolitan's service area has been used for several decades. Water reclamation involves (1) recapturing or treating wastewater, degraded or contaminated groundwater, or other nonpotable water for beneficial uses, (2) its transportation to the place of use, and (3) its actual use.

Wastewater reuse and water reclamation are integral parts of Southern California's water supplies. Locally, water reclamation projects are integrated into a complex regional water supply system which maximizes the use of imported and local supplies.

In October 1988, Metropolitan conducted a telephone survey of water and wastewater agencies to determine the number of existing/under-construction reclaimed water projects in Southern California. The survey identified 43 existing/under-construction reclamation projects which provide reclaimed water to more than 100 separate sites. As shown in Table III-4, these 43 projects will ultimately deliver 197,300 AFY of reclaimed water.

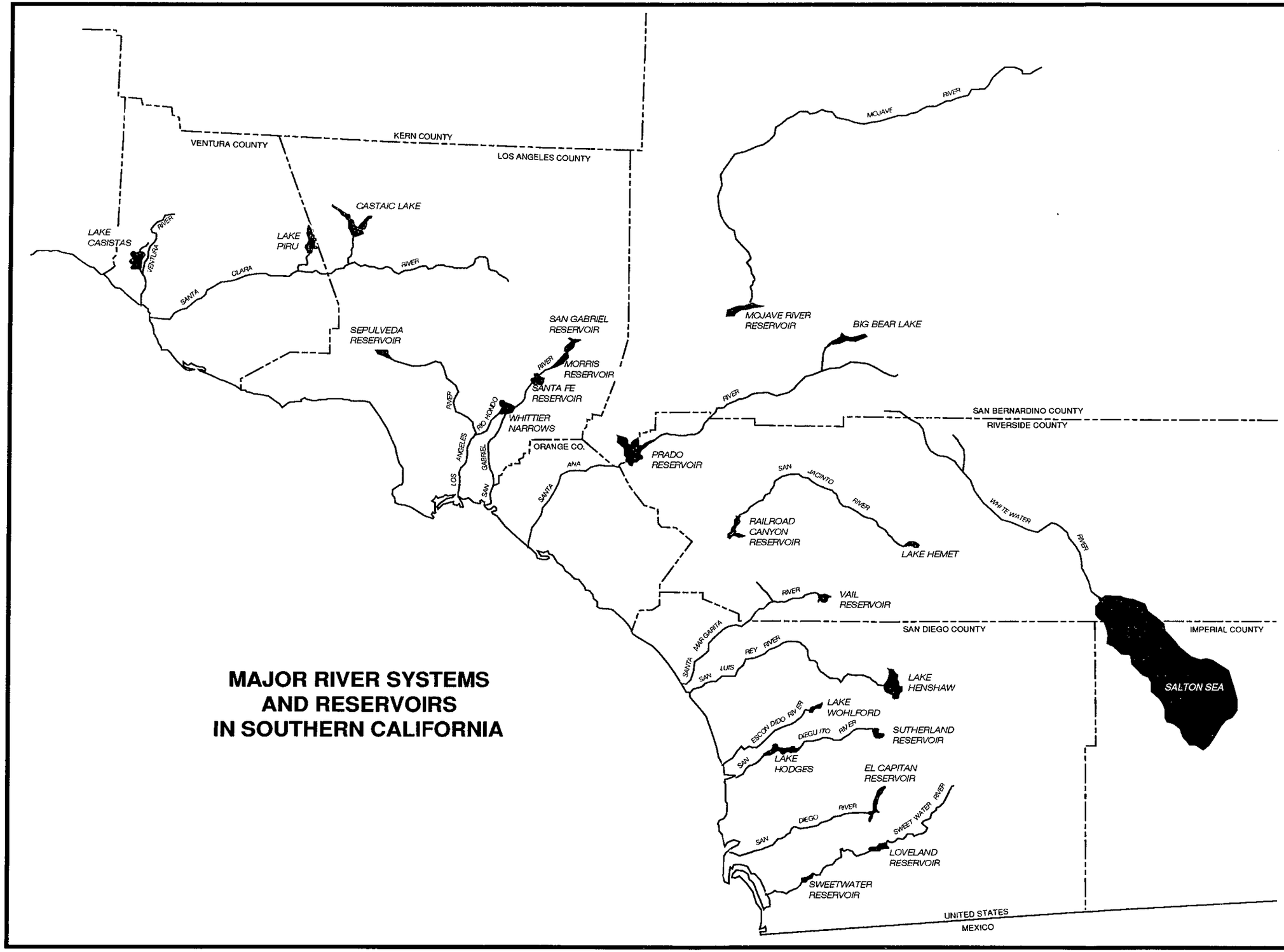
Many reclamation projects in Southern California have gone beyond traditional irrigation purposes to encompass groundwater recharge and industrial applications. Industrial applications include power plant cooling water and process water for paper plants. The largest use of reclaimed water in Southern California is for groundwater recharge. Groundwater replenishment is the most efficient use of reclaimed water, allowing large amounts of wastewater to be used at a relatively modest cost. The reclaimed water is either injected into seawater intrusion barriers or percolated in spreading basins for eventual reuse in potable systems. Direct use of reclaimed water is primarily for irrigation purposes. A variety of golf courses, cemeteries, school yards, parks, street medians, and freeway landscaping in Southern California are irrigated with reclaimed water.

To ensure the maximum reuse of reclaimed supplies, Metropolitan is providing financial assistance to local agencies (through the Local Projects Program) to build treatment plants and distribution system facilities to increase the use of reclaimed water and thus reduce the demand on the importation system. Most of the regional increase in the reclamation of wastewater will be under this program. Table III-5 shows the projected use of reclaimed water

TABLE III-3

MAJOR LOCAL STORAGE RESERVOIRS IN METROPOLITAN'S SERVICE AREA

Member Agency/Subagency	Reservoir	Capacity 1,000 AF
Calleguas MWD	Lake Bard	1.0
Eastern MWD		
Rancho California WD	Vail Lake	51.0
Lake Hemet MWD	Lake Hemet	14.0
Las Virgenes MWD	Westlake Reservoir	10.0
MWD of Orange County		
Irvine Ranch WD & Serrano ID	Santiago	25.0
San Diego CWA		
Bueno Colorado MWD	Henshaw	53.0
Escondido	Lake Wohlford and Dixon	9.5
Helix ID	Cuyamaca Dam and Lake Jennings	18.0
City of San Diego	Barrett	44.8
	El Capitan	112.8
	Lake Hodges	33.6
	Morena	50.2
	Lower Otay	49.5
	San Vicente	90.2
	Sutherland	29.0
National City South Bay ID	Lake Loveland	25.4
	Sweetwater	27.7
Western MWD of Riverside		
Temescal Water Company	Railroad Canyon	12.0
TOTAL		**817.0**



MAJOR RIVER SYSTEMS AND RESERVOIRS IN SOUTHERN CALIFORNIA

TABLE III-4

RECLAIMED WATER USE IN SOUTHERN CALIFORNIA

1988 SURVEY

Type of Use	Yield AFY
Groundwater	122,779
Irrigation/industrial	66,979
Groundwater treatment	7,550
Total	**197,308**

within Metropolitan's service area. Under favorable conditions, by 2010, total use of reclaimed water (direct reuse plus groundwater recharge) would reach about 433,000 AFY.

The projections for expansion of water reclamation within Metropolitan's service area are not assured because they are subject to several constraints. The most important constraint is the public health concern. The California Department of Health Services is currently developing water quality criteria to regulate direct and indirect use of reclaimed water.

IMPORTED WATER SUPPLIES

As local supplies currently provide only about 35 percent of the service area water needs, the balance is made up from imported sources. Most member agencies and retail water suppliers depend on imported water for a portion of their water supply. For example, the city of Los Angeles, the largest city in the state, obtains about 85 percent of its water from imported sources. The city of San Diego, the second largest in the state, obtains about 90 percent of its water from imported sources. The magnitude of these imported water requirements is similar to that in other metropolitan sections of the state, such as the San Francisco and East San Francisco Bay areas. Each of the imported sources of water available to Metropolitan's service area is shown in Table III-6 and briefly described below.

Los Angeles Aqueducts

The city of Los Angeles imports water through the Los Angeles Aqueducts from the Owens Valley and Mono Basin. The original Los Angeles Aqueduct was completed in 1913 and imported water from the Owens Valley. In 1940, the aqueduct was extended to Mono Basin. A second Los Angeles Aqueduct, which parallels the original aqueduct, was completed in 1970.

The aqueducts have historically supplied an average of about 450,000 AFY, consisting of 360,000 AFY from surface-water and groundwater supplies in the Owens Valley and 90,000 AFY from surface supplies in the Mono Basin. However, in drier periods, deliveries can be considerably lower.

The continuing ability of the Los Angeles Aqueducts to deliver 450,000 AFY on the average is unlikely because of litigation aimed at reducing the city's diversion from the Mono Basin. The amount of water that can be delivered from the Los Angeles Aqueducts is also affected by the city's groundwater management agreement with the county of Inyo for the Owens Valley. For planning purposes, an average supply of 450,000 AFY and a firm

supply of 312,000 AFY is used. During severe droughts, the supplies can be reduced even more. The current statewide drought and ongoing litigation have reduced the Los Angeles Aqueduct supplies to 327,000 AF in fiscal year 1988-1989 and to 210,000 AF in fiscal year 1989-1990.

Colorado River Supply

Metropolitan has water delivery contracts for Colorado River water with the U.S. Department of the Interior for 1.212 MAFY and an additional 180,000 AFY of surplus water. However, as a result of the 1964 U.S. Supreme Court decree in Arizona v. California, Metropolitan's dependable supply of Colorado River water was reduced to less than 550,000 AFY. This reduction in dependable supply occurred with the commencement of Colorado River water deliveries by the Central Arizona Project.

Although Metropolitan has a priority to divert 550,000 AFY of California's 4.4 MAFY basic apportionment under its water delivery contract with the Secretary of the Interior, current water use by holders of present perfected rights (such as Indian reservations, towns, and other individuals along the Colorado River that predate Metropolitan's rights) would reduce the dependable diversions by about 30,000 AFY. Conveyance losses along the Colorado River Aqueduct of 50,000 AFY would further reduce the amount of Colorado River water received in the coastal plain. Considering these reductions, Metropolitan could obtain 470,000 AFY on a dependable basis.

Under agreements with Coachella Valley Water District (Coachella) and the Desert Water Agency (Desert), Metropolitan exchanges Colorado River water for Coachella's and Desert's State Water Project entitlements. Through a third agreement, Metropolitan delivers Colorado River water in advance to Coachella and Desert for groundwater storage. As needed, Metropolitan will be able to continue to use its full Colorado River supply augmented by up to 61,200 AFY of Coachella's and Desert's State Water Project entitlements, while Coachella and Desert use the previously stored Colorado River water.

Implementation of a water conservation program with Imperial Irrigation District (IID), the largest agricultural user of Colorado River water, began in January 1990. In brief, the IID/Metropolitan agreement provides for Metropolitan to finance the costs of specific conservation projects. The program calls for structural and nonstructural conservation measures including lining existing canals, constructing local reservoirs and spill interceptor canals, installing nonleak gates and automation equipment, and instituting distribution system and on-farm management activities. In return, Metropolitan will be entitled to divert from the Colorado River, or store in a reservoir, a quantity of water equal to the amount of conserved water resulting from these projects, which is estimated to total 106,110 AFY upon full implementation.

Metropolitan's ability to divert additional Colorado River water in the short term (beyond the 576,110 AFY) will be dependent upon hydrologic conditions in the Colorado River Basin and the demand for water by other users who also hold rights to Colorado River water, such as the California agricultural agencies and the states of Arizona and Nevada.

TABLE III-5

PROJECTED WASTEWATER RECLAMATION WITHIN MEMBER AGENCY SERVICE AREAS OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA (AFY)

Member Agency	1990		2000		2010	
	Direct Reuse[a]	Ground-water Recharge	Direct Reuse	Ground-water Recharge	Direct Reuse	Ground-water Recharge
Burbank	900	0	900	0	900	0
Central Basin MWD	1,600	50,000	7,700	50,000	7,700	50,000
Foothill MWD	100	0	1,600	0	1,600	0
Glendale	600	0	2,500	0	2,500	0
Las Virgenes MWD	4,000	0	4,100	0	4,100	0
Long Beach	3,000	0	3,900	0	3,900	0
Los Angeles	1,000	0	9,300	0	9,300	0
Santa Monica	0	0	2,100	0	2,100	0
Three Valleys	7,300	0	11,000	0	11,600	0
Torrance	0	0	0	0	3,000	0
Upper San Gabriel MWD	1,500	0	1,600	0	1,600	0
Los Angeles County Total	**20,000**	**50,000**	**44,700**	**50,000**	**48,300**	**50,000**
Coastal MWD	600	0	1,600	0	1,600	0
MWD of Orange County	12,000	127,000	42,000	161,000	51,000	181,000
Orange County Total	**12,600**	**127,000**	**43,600**	**161,000**	**52,600**	**181,000**
Eastern MWD	12,000	0	14,000	0	14,000	0
Western MWD	2,500	0	8,000	0	8,000	0
Riverside County Total	**14,500**	**0**	**22,000**	**0**	**22,000**	**0**
Chino Basin MWD	1,800	0	11,200	0	19,300	0
San Bernardino County Total	**1,800**	**0**	**11,200**	**0**	**19,300**	**0**
San Diego County Water Authority	2,400	6,000	14,200	6,000	48,200	6,000
San Diego County Total	**2,400**	**6,000**	**14,200**	**6,000**	**48,200**	**6,000**
Calleguas MWD	300	0	1,100	0	5,900	0
Ventura County Total	**300**	**0**	**1,100**	**0**	**5,900**	**0**
Grand Total MWD	**51,600**	**183,000**	**136,800**	**217,000**	**196,300**	**237,000**

[a]Direct reuse involves the use of municipal wastewater for landscaping, agricultural irrigation, and industrial purposes.

TABLE III-6

COMPARISON OF EXISTING WATER SUPPLIES WITH PROJECTED DEMANDS FOR METROPOLITAN'S SERVICE AREA (MAF)

	1995	2000	2010
Average Years (based on average runoff)			
1. Local production[a]	1.36	1.37	1.38
2. L.A. Aqueducts[b]	0.45	0.45	0.45
3. Colorado River[c]	0.58	0.58	0.58
4. State Water Project[c]	1.51	1.53	1.53
TOTAL	**3.89**	**3.92**	**3.94**
Projection of normal demand[d]	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Potential shortage at normal demand[e]	-0.06	-0.28	-0.71
Potential shortage at above-normal demand	-0.34	-0.57	-1.04
Dependable Water Supply (such as a repeat of the 1928-34 dry period)			
1. Local production[a]	1.36	1.37	1.38
2. L.A. Aqueducts[b]	0.31	0.31	0.31
3. Colorado River[c]	0.58	0.58	0.58
4. State Water Project[c]	1.17	1.16	1.14
TOTAL	**3.41**	**3.42**	**3.41**
Projection of normal demand[d]	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Potential shortage at normal demand[e]	-0.54	-0.78	-1.24
Potential shortage at above-normal demand	-0.82	-1.07	-1.57
Probable Minimum Water Supply (such as a repeat of the 1976-77 drought)			
1. Local Production[a]	1.36	1.37	1.38
2. L.A. Aqueducts[b]	0.30	0.30	0.30
3. Colorado River[c]	0.58	0.58	0.58
4. State Water Project[c]	1.08	1.05	1.01
TOTAL	**3.31**	**3.29**	**3.27**
Projection of normal demand[d]	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Potential shortage at normal demand[e]	-0.64	-0.91	-1.38
Potential shortage at above-normal demand	-0.92	-1.20	-1.71

[a] Sources include local and groundwater supplies and Metropolitan sponsored water reuse.
[b] Sources available solely to the city of Los Angeles
[c] Sources available to Metropolitan after accounting for losses.
[d] Demands may be lower during severe droughts due to implementation of short-term water conservation measures and increased public awareness; demands could be greater in years of below-normal local rainfall and higher temperatures. Demands include both municipal and agricultural water use and are based on adopted SCAG and SANDAG growth plans.
[e] Shortages under 1928-34 dry period and 1976-77 drought conditions could be reduced by implementation of water management measures. Included in these measures would be possible short-term exchanges and transfers to assist in meeting Metropolitan's requirements.

State Water Project (SWP) Supplies

Metropolitan first received deliveries of SWP supplies in 1972. Metropolitan has contracted for the delivery of 2,011,500 AFY, about 48 percent of the total planned project yield. The contract for all agencies provided for the buildup in deliveries over time, with most agencies reaching their maximum annual entitlement by the year 1990. Metropolitan receives deliveries of SWP supplies via the California Aqueduct at Castaic Lake in Los Angeles County, the Devil Canyon Afterbay in San Bernardino County, and Box Springs Turnout and Lake Perris in Riverside County.

The initial facilities of the SWP (i.e., Oroville Dam, San Luis Dam, California Aqueduct, and associated pumping plants) were completed in the early 1970s. Currently, the SWP is providing a dependable supply of about one-half of the ultimate amount that the state is contracted to deliver.

The dependable supply is the amount of water expected to be available during a repeat of the seven-year dry period which occurred from 1928 to 1934 in California (called the average annual critical period supply by the California Department of Water Resources). It is estimated to total 2.2 MAF in 1990 and decline to 2.1 MAF by the year 2000 as water use in Northern California increases. It is also estimated that in the year 2010 about 1.14 MAF of this supply would be available to Metropolitan, on average over a seven-year dry cycle, approximately one-half of Metropolitan's contract amount.

The SWP was conceived so that additional facilities to increase the yield would be constructed over time as the contract deliveries increased. However, no surface reservoir storage or Delta transfer facilities have been built to increase the yield since completion of the California Aqueduct nearly 20 years ago. At the same time, Metropolitan's need for water from the SWP has been increasing.

Comparison of Dependable Water Supplies with Demands

The comparison of existing local and imported water supplies with demands is shown in Table III-6. Potential water shortages are shown for each of the hydrologic scenarios. These shortrages could be as high as 1.38 MAF in year 2010 (based on normal demands) if a repeat of the 1976-77 drought occurs. During dry periods (such as a repeat of the 1928-34 conditions) and during a drought (such as a repeat of the 1976-77 drought), demands may be lower due to short-term water conservation, and supplies may be higher due to short-term exchanges and transfers. There are also uncertainties with some of the existing supplies that may cause even greater shortages.

POTENTIAL WATER SUPPLIES

Metropolitan has many water supply initiatives underway to reduce projected shortages outlined in Table III-6. These initiatives include water exchanges and transfers, efficient management of supplies, and other programs to increase potential supplies. Some of these initiatives are discussed here, and elaborated in Chapter IV, while other programs are discussed in Chapters IV and VI. Prior to the implementation of a number of these programs, resolution of certain issues is required. These issues, depending on the particular program considered, may include technical, legal, and financial matters, mitigation of environmental impacts, State and/or Federal

legislative or regulatory approvals, and negotiations of agreements with other agencies. While all of these programs are being pursued, no one project can fully offset shortages in supplies. Since the feasibility of these programs are not certain at this time, the increase in supplies is referenced as "potential" water supplies.

Potential Colorado River Supplies

Additional Colorado River water might be available in the future from several sources and programs:

(1) Surplus Water. When the Colorado River System reservoirs are nearly full, water from the Colorado River is sometimes available over and above normal apportionments. During these times, the Secretary of the Interior may declare that surplus Colorado River water is available for use by Metropolitan. Surplus water was available between 1986 and 1988 and is projected to be available in the future from time-to-time. However, because of a three-year dry period in the Colorado River watershed, no surplus water was available in 1990.

(2) Unused Arizona and Nevada Water. The Secretary of the Interior has the discretion to allow California to use any water that Arizona and Nevada have available from the Colorado River under their contracts, but do not use. Nevada is not expected to use its full apportionment until after the year 2000. Thus, up to 100,000 AFY of Nevada's apportionment may be available for Metropolitan's use for some period of time. However, it is difficult to predict the criteria the Secretary will use in determining whether to release any unused water to California. Arizona and Nevada, as well as the Upper Basin states, are on record as wanting the Secretary to keep the Colorado River system reservoirs as full as possible rather than releasing unused water to California.

(3) Unused Agricultural Water. Of California's apportionment of 4.4 million acre-feet per year (MAFY) from the Colorado River, 3.85 MAFY (less the amount of water made available to Metropolitan under the water conservation agreement with the Imperial Irrigation District) are available for use by agricultural agencies in California. If the agricultural agencies do not use their entire available supply, Metropolitan has the right to divert the unused portion. Forecasts can be made during the year to project how much of the agricultural water will go unused for the current calendar year. Based on such forecasts, Metropolitan can plan its operations to take advantage of this unused agricultural water in the latter part of the year. In some years, annual deliveries could be increased by as much as 100,000 to 200,000 AF through this arrangement. Although agricultural use was less than 3.85 MAF throughout much of the mid-1980s, there was no unused agricultural water available in 1989.

(4) Imperial Irrigation District (IID) Water Conservation Agreement. Through negotiations with IID, an additional 150,000 AFY of conserved water may become available.

(5) All-American Canal and Coachella Branch Lining. Up to 70,000 acre-feet of water may be conserved annually if about 30 miles of the All-American Canal are lined. Similarly, lining 38 miles of the Coachella Branch may conserve up to 30,000 AFY.

(6) Imperial County Groundwater Storage and Recovery Program. Under this concept, Colorado River water would be stored in a groundwater basin in southeastern Imperial County and later be recovered. An investiga-

tion of the potential yield of this program is underway.

(7) Colorado River Banking. Under this concept, Metropolitan would limit its diversions from the Colorado River and store the remainder of its entitlement in Lake Mead. During the years when water is banked, additional SWP deliveries to the coastal plain would replace the stored Colorado River water. About 200,000 AFY may eventually be available through this program.

(8) Land Fallowing Programs. Under this concept, Metropolitan would pay landowners in the Palo Verde Valley to leave land fallow in exchange for use of about 100,000 AFY of water. Similar concepts are being considered for the Imperial Valley.

Potential State Water Project (SWP) Supplies

Due to many complex issues, the facilities needed to increase the yield of the SWP have not been constructed. The Department of Water Resources current efforts to increase the SWP yield are focused on various programs including:

(1) West Delta Management Program. To protect the reliability and quality of the Delta water supply to the SWP, and to control subsidence on Sherman Island, DWR along with the Department of Fish and Game (DFG) are pursuing acquisition of agricultural land on Sherman Island with the goal of establishing a wildlife habitat management program.

(2) South Delta Management Program. Facilities are proposed to provide sufficient channel capacity in order to fully utilize the four additional pumps at the Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) to capture surplus flows in the Delta. The program would also address problems related to water levels and quality in the southern Delta. DFG has, however, expressed concern related to possible adverse impacts on Delta fisheries.

(3) North Delta Management Program. Facilities are proposed in the north Delta to improve SWP yield, enhance Delta fishery conditions, as well as provide flood control benefits.

(4) Los Banos Grandes Reservoir. This proposed 1.75 million acre-foot surface reservoir located near and functioning similarly to San Luis Reservoir would provide additional SWP storage and yield south of the Delta.

(5) Kern Water Bank. This combination of groundwater storage programs being developed in Kern County would provide additional SWP storage and yield south of the Delta.

(6) Central Valley Project Water Purchase. A proposed agreement would allow DWR to make interim purchase of Central Valley Project (CVP) water from the U.S. Bureau of Reclamation in exchange for wheeling CVP water through the California Aqueduct.

These programs, if implemented, could supply an additional 450,000 AFY of reliable supplies to Metropolitan.

The State Water Resources Control Board as part of its Bay/Delta water rights hearing is now in the process of developing terms and conditions for the export of water from the Sacramento-San Joaquin Delta. This action could lead to decreases or increases in the amounts of water available to the State Water Project and other projects diverting water from the Delta. Metropolitan is participating in these hearings

by providing information on water needs and addressing issues pertaining to environmental conditions in the Delta and San Francisco Bay.

Comparison of Potential Water Supplies with Demands

A summary of the existing and potential supplies compared to demands is shown in Table III-7. In average years, water can be stored for later use at both normal and above-normal demands. During dry periods and normal demands, there would be very little water available for storage; during drought conditions, there would be no water available for storage. There would be a potential water shortage at above-normal demands for both of these conditions. The groundwater and surface water storage programs shown in Table III-7 also include short-term exchanges and transfers needed to reduce shortages.

QUALITY OF WATER SUPPLIES

Water quality regulations are an increasingly important factor in Metropolitan's selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities. Water quality constituents, as well as water treatment plant performance, are becoming more strictly regulated by federal, state, and local entities. Thus, future water quality regulations will play a significant part in the evaluation of proposed alternatives to improve Metropolitan's water supply system.

Historical Perspective

The number of water quality regulations is increasing rapidly, as illustrated in Figure III-6, which shows an exponential increase in the number of regulated water contaminants. The first two water constituents of health-related significance were regulated in 1914. The number of regulations increased slowly during the next 70 years. However, between the year 1986, when the Safe Drinking Water Act (SDWA) was amended, and the year 2000, the number of health-related regulations promulgated by the Environmental Protection Agency (EPA) will increase from 23 to more than 183.

EPA proposals to revise drinking water regulations, congressional amendments to the SDWA that mandate increased regulation, and State Department of Health Services (DHS) regulations will collectively impact Metropolitan's water quality monitoring and treatment requirements.

Impacts of Proposed Drinking Water Regulations on Metropolitan

Future regulations will establish maximum contaminant levels (MCLs) for water quality constituents and specify treatment requirements. These regulations will result in increased monitoring and modifications to current treatment processes. Metropolitan will be most significantly impacted by two regulatory issues: (1) the Surface Water Treatment Rule and (2) the Disinfectant By-Products Regulation.

The Surface-Water Treatment Rule

The EPA's proposed Surface-Water Treatment Rule (SWTR), published in the Federal Register on November 3, 1987, specifies which surface-water sources must be filtered and provides performance criteria for filtration and disinfection. For systems that are required to use filtration, effluent turbidity must be less than or equal to 0.5 NTU (nephlometric turbid-

TABLE III-7

COMPARISON OF EXISTING AND POTENTIAL WATER SUPPLIES WITH PROJECTED DEMANDS FOR METROPOLITAN'S SERVICE AREA (MAF)

	1995	2000	2010
Average Years (based on average runoff)			
Existing Supplies	3.89	3.92	3.95
Potential Supplies			
1. Local projects	0.01	0.05	0.15
2. Groundwater and surface water storage programs	0.00	0.00	0.00
3. Colorado River	0.10	0.35	0.45
4. State Water Project improvements and water transfers	0.37	0.39	0.56
Subtotal	0.48	0.79	1.16
Total Existing and Potential Supplies	**4.37**	**4.71**	**5.11**
Projection of normal demand	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Water available for storage			
At normal demand	0.42	0.51	0.46
At above-normal demand	0.14	0.22	0.13
Dependable Water Supply (such as a repeat of the 1928-34 dry period)			
Existing Supplies	3.41	3.42	3.41
Potential Supplies			
1. Local Projects	0.01	0.05	0.15
2. Groundwater and surface water storage programs[a]	0.03	0.00	0.08
3. Colorado River	0.10	0.35	0.45
4. State Water Project improvements and water transfers	0.40	0.42	0.56
Subtotal	0.54	0.82	1.24

TABLE III-7 (Continued)

COMPARISON OF EXISTING AND POTENTIAL WATER SUPPLIES WITH PROJECTED DEMANDS FOR METROPOLITAN'S SERVICE AREA (MAF)

	1995	2000	2010
Total Existing and Potential Supplies	**3.95**	**4.24**	**4.65**
Projection of normal demand	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Water available for storage or shortages in existing supplies			
At normal demand	0.00	0.04	0.00
At above-normal demand	-0.28	-0.25	-0.33
Probable Minimum Water Supply (such as a repeat of the 1976-77 drought)			
Existing Supplies	3.31	3.29	3.27
Potential Supplies			
1. Local Projects	0.01	0.05	0.15
2. Groundwater and surface water storage programs[a]	0.29	0.30	0.02
3. Colorado River	0.10	0.35	0.45
4. State Water Project improvements and water transfers	0.24	0.21	0.76
Subtotal	0.64	0.91	1.38
Total Existing and Potential Supplies	**3.95**	**4.20**	**4.65**
Projection of normal demand	3.95	4.20	4.65
Projection of above-normal demand	4.23	4.49	4.98
Water available for storage or shortages in existing supplies			
At normal demand	0.00	0.00	0.00
At above-normal demand	-0.28	-0.29	-0.33

[a] Also includes short-term water exchanges and transfers needed to reduce shortages.

FIGURE III–6

REGULATORY TIMETABLE FOR HEALTH-RELATED CONTAMINANTS

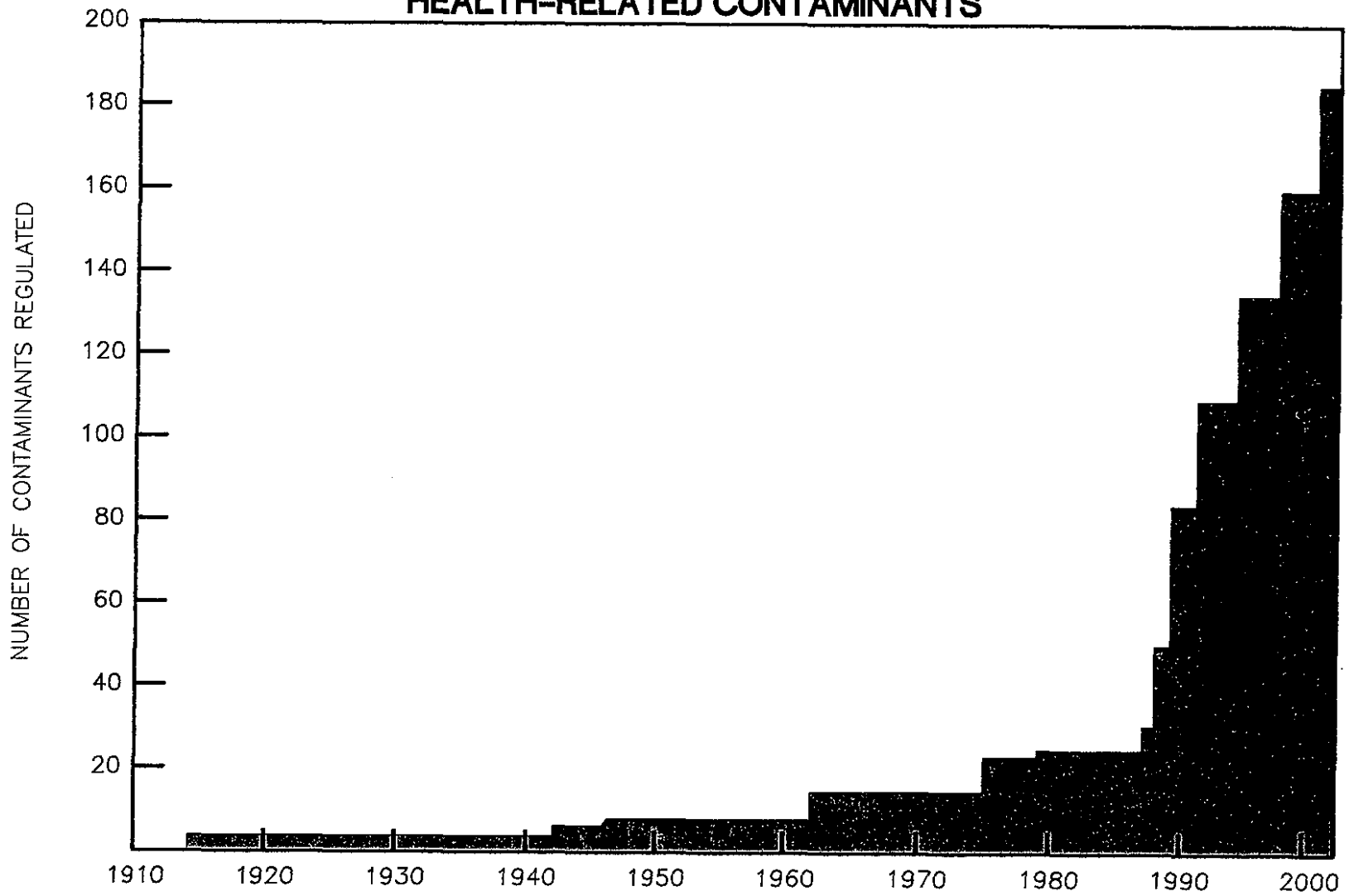
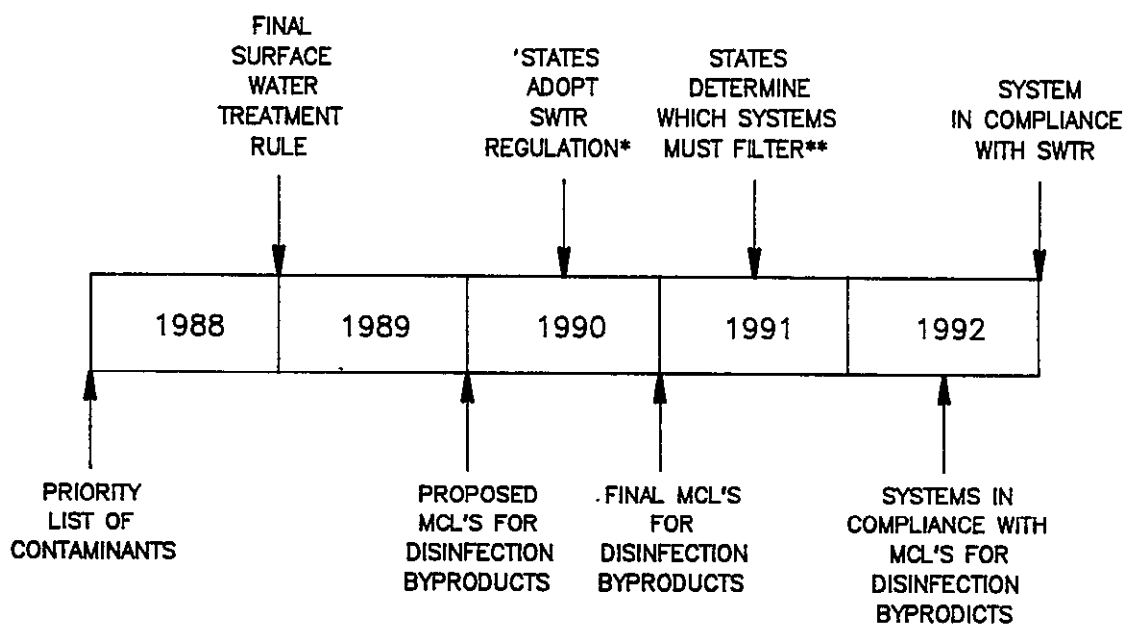


FIGURE III–7

PROPOSED REGULATORY MILESTONES



** CALIFORNIA'S VERSION OF THE SWTR MAY BE PROMULGATED EARLIER THAN SHOWN.*

*** CALIFORNIA'S SWTR REQUIRES FILTRATION FOR ALL SURFACE WATER SOURCES.*

ity units) in 95 percent of the monthly samples. The treatment plants must achieve at least 99.9 percent removal and/or inactivation of Giardia lambia cysts and at least 99.99 percent removal and/or inactivation of enteric viruses. The draft DHS version of the SWTR (March 17, 1988) is more restrictive than the federal version and includes an average daily effluent turbidity design goal of 0.2 NTU for filtration plants.

The EPA has proposed guidance on using the "CT" concept for measuring disinfection performance for the inactivation of Giardia and enteric viruses. The product of disinfectant concentration ("C") and disinfectant contact time ("T") would be used to indicate the percent inactivations of Giardia and enteric viruses achieved during treatment. Metropolitan may need to modify current disinfection practices to comply with the disinfection performance requirements. Since both the federal and state regulators are in the process of finalizing the SWTR, the full impact of the filtration and disinfection requirements is not known presently.

Disinfectant By-Products

In the near future, the EPA will propose regulations on disinfectants and their by-products. These regulations are expected to lower the existing MCLs for trihalomethanes (THMs) and include MCLs on other disinfectants by-products (DBP). It is also expected that these regulations will include treatment requirements.

While disinfection practices must be adequate to meet the Giardia and virus inactivation requirements of the SWTR, the disinfectant by-products must be low enough to comply with the by-products regulations. These opposing regulations are moving on similar time lines, as shown in Figure III-7, and must be considered in the future design and operation of Metropolitan's facilities.

Metropolitan is investigating the use of ozone and ozone with hydrogen peroxide as alternate disinfectants to reduce THMs. Depending on the final DBP regulations, it is likely that Metropolitan will be required to retrofit ozonation facilities to its existing plant and include them in all new plants.

Although granular activated carbon (GAC) has been designated by the U.S. Congress as "feasible technology" to control synthetic organic chemicals (including THMs), GAC was found to be much more costly than ozone for equivalent THM control.

Summary of Water Quality Impacts

Water quality is becoming a more explicit consideration in Metropolitan's distribution system planning than in previous decades. More stringent drinking-water standards may lead to the addition of new processes at Metropolitan's treatment plants, such as ozonation. Stricter treatment performance standards may lead to reduced capacity ratings at existing treatment facilities, thus requiring greater physical plant capacity to treat the same amount of water. In the past, Metropolitan has been able to operate the treatment plants above their rated filtration capacity during peak periods. In the future, water quality regulations may dictate a more conservative treatment plant operation and the provision of greater reserve capacity at Metropolitan's plants.

IV. WATER SUPPLY MANAGEMENT PROGRAMS

PROGRAM GOALS

The goal of Metropolitan's water management program is to maximize efficient use of existing supplies and to assure adequate supplies to meet future water demands.

Metropolitan regards an adequate supply of water essential to its public purpose. Included in this goal is the maintenance of the quality of life in Southern California. Furthermore, water supplies must meet the water quality mandates for urban use.

CHALLENGES IN WATER SUPPLY PLANNING

Rapid urban growth in Southern California has made it necessary to design and build water facilities with substantial capacity sufficient to accommodate population growth and industrial development. In the past, Metropolitan's supply programs were developed based on (1) projection of future water requirements, (2) identification of adequate sources of supply, and (3) a design of the necessary transmission, treatment, storage, and distribution facilities.

There are several considerations which have been incorporated into Metropolitan's water supply planning. These considerations include (1) limited availability of new sources of supply, (2) increasingly more stringent water quality standards, (3) environmental concerns, and (4) changing political attitudes toward structural solutions to supply problems.

Regional surface-water and groundwater supplies have become nearly fully developed. Availability of groundwater in some locations is becoming limited by aquifer depletion or source contamination. Therefore, efficient use of existing sources and their protection from contaminants are necessary.

The Safe Drinking Water Act of 1974 and its recent amendments have required water agencies to comply with increasingly stringent limits on a large number of contaminants in drinking water. This has led to a significant increase in the cost of water treatment. Also, environmental legislation, including the National Environmental Policy Act (1970) and the Federal Water Pollution Control Act (1972) and its Amendments (1977, 1987), has severely constrained the opportunities and alternatives in urban water supply. Water supply development has been coordinated with wastewater planning, and construction of water facilities are subject to extensive environmental review and regulation.

Finally, the increasing concerns for environmental quality have resulted in a more active role by members of the public in resource management decisions. The need for new supply development receives unprecedented scrutiny from environmental groups.

With these considerations, water planners have extended their perspective beyond traditional supply augmentation projects. The most profound change involves the use of demand management alternatives. However, a number of supply management alternatives are being considered by Metropolitan. These alternatives fall into the following categories:

(1) More efficient utilization of existing water supplies (e.g., water salvage through the reduction of losses through lining of canals, improved irrigation methods, and improved regulation)

(2) Conjunctive use of groundwater aquifers for additional storage of surface water for improved long-term yield of groundwater sources

(3) Reclamation of wastewater

(4) Increasing runoff through watershed management or cloud seeding

(5) Desalinization of brackish groundwater or seawater

Some of these alternatives, in combination with demand management projects, have enhanced the ability of Metropolitan and its member agencies to provide adequate water supplies at the minimum economic, social, and environmental costs. The various programs include groundwater basin management, water quality management activities, and the other activities that maximize use of existing water supplies.

OVERVIEW OF PAST AND CURRENT WATER MANAGEMENT PROGRAMS

Groundwater Management Programs

Over 90 percent of natural local supplies in Southern California are produced from groundwater basins. These supplies account for a significant portion of all water used in this area. In addition, portions of the imported supplies are stored in groundwater basins for future use. These basins are managed through a variety of programs designed to maintain their usability, to avoid overdraft, and to maximize their ability to meet water demands.

Many local groundwater storage programs have been implemented over the years to make maximum use of local water supplies. These programs have included the collection of local runoff in surface storage reservoirs at the base of the mountains and the diversions of water flows into percolation ponds for artificially recharging groundwater basins.

The storm waters of San Antonio Creek, in Los Angeles County, have been impounded and spread since 1895. Since these early operations, the county flood control districts in Southern California have played a major role in developing and maintaining extensive recharge facilities thus limiting storm water runoff to the ocean. Local runoff and reclaimed water have been conserved in spreading grounds, injection wells, reservoirs, and unlined river channels. An additional responsibility of the county flood control districts is the operation of seawater barrier projects in Los Angeles and Orange counties to prevent seawater intrusion in the coastal groundwater basins.

Metropolitan has entered into cyclic storage agreements with Chino Basin and San Gabriel which provide for the delivery and storage of imported waters. When water supplies are abundant, advance deliveries of Metropolitan's groundwater replenishment supplies are provided for later use. When imported supplies are limited, Metropolitan has the option of meeting the replenishment demands of the agencies managing these basins through surface deliveries or a transfer of the stored water.

Groundwater supplies have been fully developed, with pumping rights in many of the basins established by adjudication or managed by local agencies. Groundwater management agencies (1) provide orderly withdrawals to ensure long-term safe yields or other criteria, (2) maintain an orderly market for the sale or lease of groundwater-pumping rights, (3) assess pump taxes which are used to buy imported or reclaimed replenishment waters needed in excess of natural recharge, and (4) pay for the spreading operations by which replenishment water augments underground supplies. For example, on the coastal plain, groundwater managers buy imported water from Metropolitan at replenishment rates and assess retail purveyors for their annual well pumpage in amounts sufficient to repay replenishment costs.

In most of the basins, long-term safe yields are established according to local groundwater recharge. These safe yields consist of recharge from natural precipitation and return flow from delivered groundwater less losses from subsurface outflow, rising water outflow, evaporation, and infiltration into sewers.

Conjunctive use of groundwater basins means that imported surface-water supplies and existing groundwater supplies are used in concert to meet the needs of the consumer. The groundwater basin is artificially recharged with the imported surface-water supplies during years of ample supplies. During years of inadequate supplies, the previously stored water is pumped from the groundwater basin and used to replace diminished surface-water supplies. Surface water that has been used to recharge basins typically includes storm waters and water that is imported into a basin. There are more than 70 such recharge facilities within Southern California that are currently being used to replenish groundwater basins, as shown in Figure IV-1. Table IV-1 shows a 50-year history of water delivered to member agencies for groundwater replenishment.

The Interruptible Water Service and Seasonal Storage programs (described in the later sections of this chapter) have been conceived around this idea of conjunctive storage management. The Interruptible Water Service Program is essentially a standard agreement between Metropolitan and its member agencies to hold local water in storage for use during a temporary deficiency in imported water. In the Seasonal Storage Program, imported water is stored in the low-demand and plentiful supply months of the winter. Water so stored can then be withdrawn by the local agency in either the summer peak-demand period or during droughts.

Much of the water stored by local agencies under the Interruptible Water Service and Seasonal Storage programs is served directly into either surface reservoirs or is recharged into groundwater storage. In addition, Metropolitan affords agencies the opportunity to store these supplies by in lieu means. In lieu storage is accomplished when an agency purchases imported water in lieu of the use of local water. Agencies within Metropolitan are able to utilize these in lieu means by increasing their use of imported water while reducing the use of local water thus allowing the local water to accumulate in storage for future use. In many in-

TABLE IV-1
WATER USED FOR GROUNDWATER REPLENISHMENT
(Acre-Feet)

Member Agencies	Type of Replenishment	1949-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	Total
Anaheim	Temp. In-Lieu	24,248	10,143	11,703	—	—	15,149	9,079	—	—	4,615	74,937
Burbank	Temp. In-Lieu	4,447	2,280	4,323	—	—	—	—	—	—	—	11,050
Calleguas MWD	Temp. In-Lieu	2,464	—	—	—	—	—	—	—	—	1,620	4,084
Central Basin MWD	Temp. In-Lieu	15,014	4,949	9,554	—	—	8,222	3,238	—	—	1,565	42,542
	Spreading	2,007,110	42,232	6,495	30,000	2,436	1,501	40,625	21,495	44,501	34,542	2,230,937
	Injection	61,954	4,843	4,107	4,859	5,198	4,024	4,724	4,610	6,958	6,538	107,815
Chino Basin MWD	Temp. In-Lieu	10,951	3,820	5,317	—	—	61	84	—	—	—	20,233
	Spreading	29,565	14,698	15,565	19,042	13,188	13,777	12,188	16,330	13,609	15,636	163,598
Coastal MWD	Temp. In-Lieu	—	671	190	—	—	354	701	—	—	411	2,327
Compton	Temp. In-Lieu	202	294	442	—	—	340	1,200	—	—	—	2,478
Eastern MWD	Spreading	567	—	—	—	—	—	—	—	—	—	567
Foothill MWD	Temp. In-Lieu	1,470	—	—	—	—	—	326	—	—	—	1,796
Fullerton	Temp. In-Lieu	10,038	3,233	6,418	—	—	9,501	2,927	—	—	2,770	34,887
Glendale	Temp. In-Lieu	2,226	3,324	4,094	—	—	1,501	992	—	—	1,125	13,262
Las Virgenes MWD	Temp. In-Lieu	—	—	—	—	—	—	—	—	—	474	474
Long Beach	Temp. In-Lieu	6,512	1,980	1,926	—	—	6,022	848	—	—	1,061	18,349
Los Angeles	Temp. In-Lieu	3,023	2,420	4,596	—	—	—	4,951	—	—	—	14,990
	Spreading	73,005	6,537	9,713	—	—	—	—	—	—	—	89,255
MWD of Orange County	Temp. In-Lieu	35,801	9,670	16,470	—	—	27,775	11,955	—	—	11,613	113,284
	Spreading	2,425,004	42,783	32,490	32,336	20,765	4,547	29,819	31,779	27,126	38,752	2,685,401
Pasadena	Temp. In-Lieu	11,170	—	1,280	—	—	—	4,039	—	—	910	17,399
San Diego CWA	Temp. In-Lieu	—	—	—	—	—	—	24,018	—	—	—	24,018
Santa Ana	Temp. In-Lieu	2,230	1,477	1,686	—	—	1,243	529	—	—	653	7,818
	Spreading	—	17	—	—	—	—	—	—	—	—	17
Santa Monica	Temp. In-Lieu	7,193	160	—	—	—	467	—	—	—	—	7,820
	Injection	1,179	1,088	1,188	554	2,141	1,845	131	—	2,251	1,822	12,199
Three Valleys MWD	Temp. In-Lieu	4,402	3,042	3,502	—	—	4,109	—	—	—	—	15,055
Torrance	Temp. In-Lieu	1,728	1,014	2,028	—	—	3,439	1,700	—	—	—	9,909
Upper San Gabriel Valley MWD	Temp. In-Lieu	1,002	—	—	—	—	—	206	—	—	—	1,208
	Spreading	247,817	12,491	34,690	59,150	31,534	14,828	—	3,000	25,000	37,570	466,080
West Basin MWD	Temp. In-Lieu	12,603	3,276	3,994	—	—	7,165	4,581	—	—	1,230	32,849
	Injection	444,047	32,653	30,988	28,282	36,710	38,257	34,738	25,730	31,600	31,522	734,527
Total		5,446,972	209,095	212,759	174,223	111,972	164,127	193,599	102,944	151,045	194,429	6,961,165

Source: MWD, Annual Report 1988.

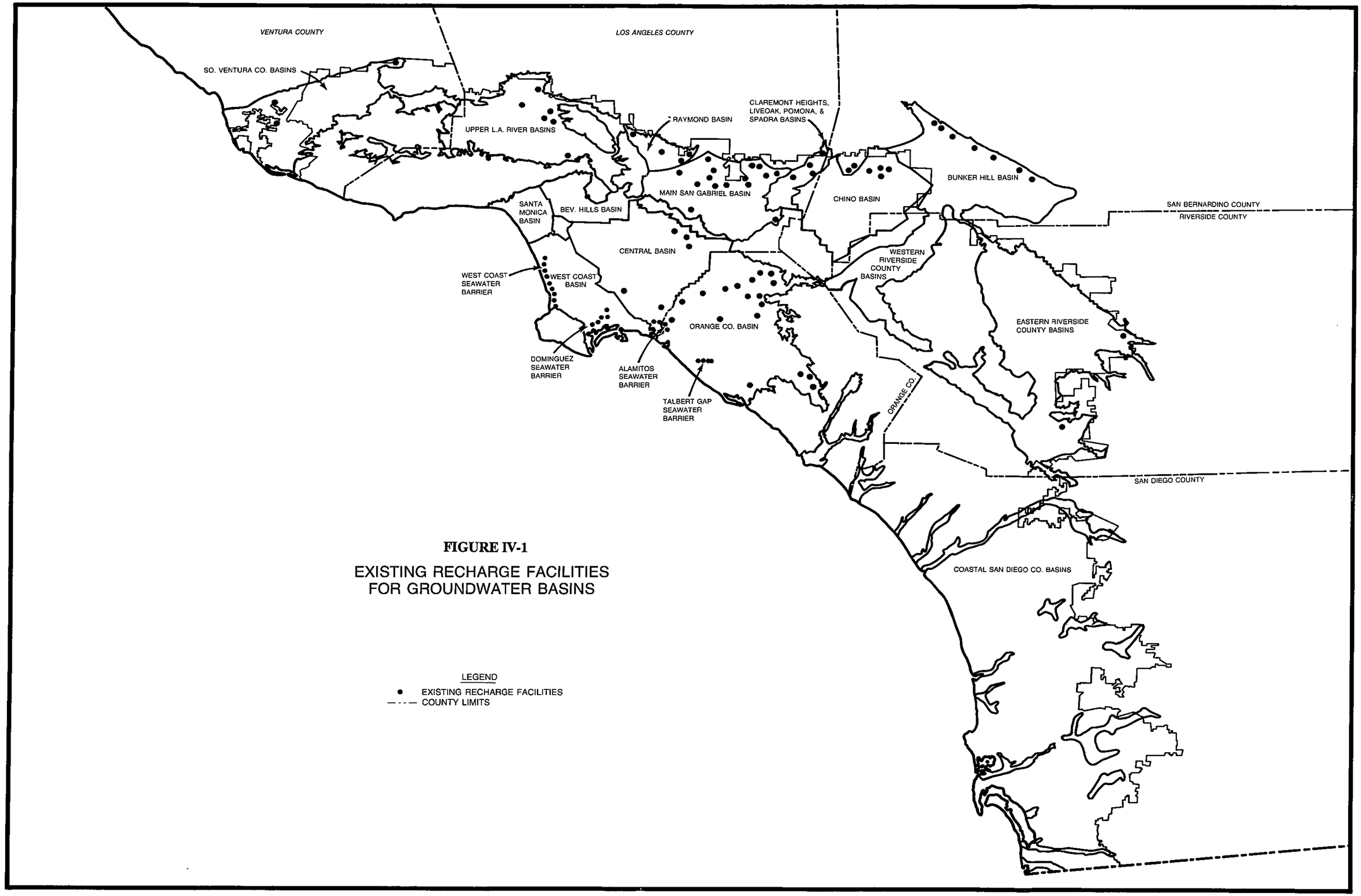


FIGURE IV-1

EXISTING RECHARGE FACILITIES
FOR GROUNDWATER BASINS

LEGEND

- EXISTING RECHARGE FACILITIES
- COUNTY LIMITS

stances, the in lieu storage operation utilizes less energy than a direct-storage operation. These energy savings add to the incentives that Metropolitan offers to increase storage when supplies are available. Conversely, the incentives encourage agencies to utilize water from local storage when imported water supplies are potentially deficient.

Metropolitan is promoting further conjunctive use of imported surface-water supplies with the storage capacity available in Southern California's groundwater basins. Metropolitan, in cooperation with its member agencies, is presently investigating the opportunity for additional conjunctive use programs in many groundwater basins.

Surface Water Management

In addition to management of groundwater basins, surface reservoirs are utilized to capture local runoff, to store imported supplies, and to regulate the delivery system.

In 1988, Metropolitan began a preliminary effort to expand reservoir storage capacity. This program, entitled the "Eastside Reservoir Study," was undertaken to (1) determine the amount of storage needed in the future, (2) identify alternative sites for the storage, (3) narrow the list of potential sites, and (4) evaluate the potential for a reservoir at one or more of those sites.

The new reservoir(s) would provide an additional capacity of 1.1 MAF needed for emergency, carry-over, and seasonal storage purposes. The storage facilities under consideration in western Riverside County would increase storage capacity in the eastern and southern portions of Metropolitan's service area. Additional reservoirs in the region would be located near existing major water distribution systems (i.e., SWP and Colorado River). The new facilities would permit gravity water flow throughout the Metropolitan service area thus increasing Metropolitan's ability to provide water during emergency situations.

Water Reclamation

Water reclamation is an integral part of the Metropolitan's water supply management program. Wastewater reuse and reclamation of low-quality water allow the more efficient use of both imported and local supplies. A detailed discussion of water reclamation is presented in Chapter III. The implementation of water reclamation projects is facilitated by the Local Projects Program discussed in the following section.

LOCAL PROJECTS PROGRAM

Program Description

To assist the development of reclamation and other local water supply projects, Metropolitan's Board initiated the Local Projects Program (LPP) in 1981. The program provides financial support to local agencies which develop local water supply projects and correspondingly reduce their demands for Metropolitan's imported supplies. The LPP has primarily assisted local agencies in the development of water reclamation projects. The program, as originally implemented, provided capital funds to local agencies. In return, Metropolitan owned the project yield. Under this program, Metropolitan contributed approximately $10 million toward construction of the South Laguna Reclamation Project and the Las Virgenes Reclamation Project. These two

projects are complete and operational and have an ultimate yield of approximately 3,600 AFY. Metropolitan also negotiated an agreement to participate in the Arlington Basin Desalter Project, from which Metropolitan will purchase approximately 6,100 AFY of desalted water.

To qualify for inclusion in the LPP, a local agency must demonstrate that its proposed project meets the following criteria:

(1) The project produces "new water" which replaces a firm demand on Metropolitan.

(2) The project requires Metropolitan's financial assistance to be economically viable.

(3) The project must be implementable under Metropolitan's enabling Act.

(4) A facilities plan and market analysis must be complete.

(5) Public health and regulatory permits must be obtainable.

Between 1986 and April 1990, the financial contribution was equivalent to Metropolitan's avoided energy cost for pumping an equivalent amount of water through the State Water Project. In April 1990, Metropolitan's Board modified the financial contribution offered by the LPP. The current LPP contribution is a flat rate of $154 per AF. This amount is based on Metropolitan's avoided costs to treat and deliver water and takes into account service area needs. The LPP Contribution may be revised by Metropolitan's Board every three to five years. As an alternative to making annual contributions based on yield, the LPP provides that Metropolitan could make a one-time capital contribution which would be financially equivalent to the estimated annual contributions.

The LPP has proven to be both popular and successful with Metropolitan's member agencies. As shown in Table IV-2, Metropolitan has participated in 17 local projects, with an ultimate yield of approximately 41,000 AFY. Currently, 12 additional projects, with an estimated yield of 36,000 AFY, are in various stages of review.

Constraints to Reclamation

The projections for expanded development of water reclamation within Metropolitan's service area are not assured, given the many constraints confronting water suppliers in the process of developing reclaimed water projects. The major issues preventing substantially greater use of reclaimed water include funding, regulatory requirements, institutional arrangements, and public acceptance.

Cost

High cost is the reason most often given by local agencies for not constructing new reclamation projects. Reclamation projects are expensive, as they normally require a new distribution system, separate from a potable system, which delivers a relatively minor amount of yield. The cost of reclamation projects virtually always exceeds the current price of imported supplemental supplies from Metropolitan. Metropolitan developed the LPP to assist in overcoming this financial constraint because in its role as the regional water supplier, Metropolitan effectively distributes the costs to all agencies within its service area, which benefit when any new supplies are developed to offset regional shortages. The recent increase in the LPP contribution is intended to offset, at least partially, the disincentives associated with high project costs.

TABLE IV-2

LOCAL PROJECTS PROGRAM

Projects	Project Yield (AFY)
Approved Projects	
Original Program:	
South Laguna Reclamation Project	860
Las Virgenes Reclamation Project	2,700
Arlington Basin Desalter Project	6,100
Total	9,660
Revised Program:	
Long Beach Reclamation Project	1,,700
Irvine Reclamation Project	10,000
Santa Margarita Reclamation Project	3,600
Crescenta Desalter	1,600
Lakewood Water Reclamation Project	440
Green Acres Reclamation Project	7,000
South Laguna Expansion Project	700
Fallbrook Reclamation Project	1,200
Calabasas Extension Project	700
Glendale Reclamation Project	600
Trabuco Canyon Reclamation Exp. Project	800
Shadowridge Reclaimed Water System	375
Los Angeles Greenbelt Project	1,610
Santa Maria Reclamation Project	1,600
Total	31,925
Total Yield of 17 Approved Projects	41,585
Proposed Projects	
San Pasqual Aquaculture Project	600
Santa Margarita Expansion Project	1,014
Moulton Niguel Reclamation Project	8,000
OCWD/Irvine Groundwater Desalter	6,400
Rowland W.D. Groundwater Project	325
Pomona Reclaimed Storage Reservoir	2,500
Sepulveda Basin Reclamation Project	3,500
Santa Monica Groundwater Project	2,100
Walnut Valley Reclaimed Reservoir	600
Rancho Valley Reclaimed Reservoir	6,000
San Clemente Reclamation Project	3,800
Triunfo North Ranch Reclamation Project	1,000
Total Yield of 12 Proposed Projects	35,839
GRAND TOTAL	77,424

Source: MWD Draft Status Report on the Local Projects Program

Regulatory Requirements

Two state agencies are involved in regulating water reclamation projects. The regional Water Quality Control Boards are the permitting authorities, and the Department of Health Services advises as to health concerns and standards. Combining water quality concerns and health effects requires concise goals and standards to be successful. Title 22 of the California Administrative Code provides specific guidelines for treatment levels and the corresponding reuse opportunities. However, there are no uniform criteria for groundwater recharge with reclaimed water. Currently, state statutes mandate that regulatory agencies review and determine requirements for each recharge project individually, a time-consuming and often-contradictory process. Proposed Department of Health Services criteria would regulate groundwater recharge projects based on blending ratios rather than on specific water quality criteria.

Institutional Arrangements

Often, multiple local agencies are involved in a proposed reclamation project. For example, reclaimed water from a single wastewater source may be used by a number of reclaimed water distributors, or the reclaimed water may be treated and delivered by an agency in one geographical area and used by another group in another geographic area. Also, a sanitary agency may wish to deliver reclaimed water within a water district's service area. In most instances, it requires a committed agency that is willing to negotiate with other affected agencies to develop a reclamation project.

Public Acceptance of Reclaimed Water

Most agencies find they need to implement a public education program along with their reclamation project. Reclaimed water users and the general public need to be educated on the benefits of using reclaimed water as well as being reassured about the health effects associated with reclaimed water use.

Metropolitan is actively working with local, regional, and state agencies to overcome the various constraints facing reclamation projects. Metropolitan encourages the use of reclaimed water through its LPP and is committed to overcoming the constraints which face the developers of reclaimed water facilities by promoting cooperative statewide efforts to develop reclamation, advocating and lobbying for favorable legislation, promoting safe and beneficial use of reclaimed water, supporting consistent regulations for groundwater recharge projects, supporting regional or statewide reuse symposiums, and participating in workshops and public relations programs.

INTERRUPTIBLE WATER SERVICE PROGRAM

In March 1981, the Metropolitan Board of Directors adopted the Interruptible Water Service Program. The program provides economic incentives to encourage member agencies to store imported water in either surface reservoirs or groundwater basins for use during periods of peak use or during droughts.

Under the Interruptible Water Service Program, Metropolitan enters into standard agreements with its member agencies to provide imported water at discounted rates for local storage. The stored water is to be used during a temporary deficiency in imported

supplies. A participating agency is required to (1) submit a statement that it will be able to sustain the reduction or interruption without adversely affecting service to the public, and that it has or will have water in storage and distribution facilities to do so; and (2) if the agency's statement shows reliance on water stored in an adjudicated groundwater basin, the agency must be able to increase groundwater withdrawal to sustain the interruption.

The amount of water available in interruptible service during each 12-month period beginning in July is determined by Metropolitan's Board of Directors in March of each year. In order to assist member agencies in operating their systems, the estimates of the availability of interruptible water are made for two additional successive years. The General Manager is authorized to reduce or eliminate any delivery in interruptible service in an emergency.

In cases when requests for interruptible supplies exceed the available water, the General Manager may reduce or eliminate the delivery of interruptible water in the following order (i.e., beginning with the first-listed use):

(1) Groundwater replenishment by spreading or injecting
(2) In lieu groundwater replenishment
(3) Reservoir storage
(4) Agricultural purposes limited to the growing of field and nursery crops and row crops
(5) Agricultural purposes limited to the growing of trees and vines
(6) Agricultural purposes limited to the feeding of fowl or livestock
(7) Seawater barrier groundwater replenishment

All agricultural deliveries are sold in interruptible service. These deliveries can be reduced or interrupted after a lapse of one year from the notice of discontinuance if the interrupted supplies are needed for domestic or municipal uses within Metropolitan's service area.

A seven-year summary of water deliveries under the Interruptible Water Service Program is shown in Table IV-3. Current water deliveries under interruptible service represent approximately one-third of all Metropolitan deliveries.

SEASONAL STORAGE PROGRAM

The Seasonal Storage Program, adopted by Metropolitan in 1989, provides an incentive for member agencies to purchase water from Metropolitan during winter months for local storage. It is aimed at achieving greater conjunctive use of imported and local supplies, encouraging construction of additional local production facilities, and reducing member agencies' dependence on Metropolitan's deliveries during the peak summer months.

New storage is required for five general purposes. First, new storage is necessary to provide emergency reserves of water. These supplies would be utilized following a major earthquake which could disrupt service from the aqueduct systems serving Southern California. Second, storage facilities are needed to regulate peak flows on the aqueduct systems and major conveyance pipelines of Metropolitan's distribution system. Third, new facilities can provide carry-over storage reserves for use during droughts. Fourth, increased production of local water in the summer months lessens the drawdown of Metropolitan and state storage supplies allowing higher carry-over storage volumes to be held for droughts. Fifth, seasonal

TABLE IV-3
Interruptible Water Service Program: Past Deliveries
(Thousand Acre-Feet)

Fiscal Year Ending	Treated Interruptible Service	Untreated Interruptible Service	Total Interruptible Deliveries	Percent of all Metropolitan Deliveries
1982	221	393	614	41
1983	209	268	477	39
1984	323	226	549	38
1985	294	296	590	38
1986	235	279	514	31
1987	304	314	618	34
1988	316	330	646	34

Source: Waterworks Bonds Document, 1989

regulation by local agencies extends the adequacy of Metropolitan's delivery system which will ultimately lead to cost reductions for distribution system additions.

Greater utilization of existing and potential local agencies' storage reserves is generally regarded as an economical method of providing a portion of Metropolitan's service area with needed future storage reserves. Metropolitan's plans for new system additions and supplies presume an improved use of local storage that can be encouraged with economic incentives. The cost to local agencies of simply maintaining existing production capabilities is rapidly escalating. Some production wells have been lost due to contamination and to increasingly stringent water quality regulations for use of water with detectable levels of impurities. Seasonal storage service also provides an economic incentive for local agencies to invest in new water production and treatment facilities needed to restore and enhance local agencies' capability to produce local water. These facilities can also provide storage for Metropolitan's water supplies during periods of abundant availability.

Regional benefits from the seasonal storage service include enhancing Metropolitan's ability to capture and use excess surface flows from both the State Water Project and the Colorado River. This service also improves the capability of the region to produce more groundwater and to use local surface reservoirs during sustained droughts and emergencies. The storage of Metropolitan's water in the winter months of October through April better utilizes available imported supplies. Also, increased local water production in droughts and peak-demand periods increases available supplies for agencies not utilizing groundwater while providing adequate supplies for the agencies managing groundwater basins. The program de-

creases demands on Metropolitan's system during the summer months and increases the use of the system during the low-demand season when facilities would otherwise be under utilized.

The amounts of water delivered into the local storage reserves of member agencies (in this case spreading deliveries into groundwater storage) are normally delivered in the low-demand months of October through April. The effect of making these deliveries to storage is to smooth the monthly variation in deliveries from Metropolitan. In lieu groundwater replenishment and reservoir storage operate in a similar manner.

EXCHANGES AND TRANSFERS OF WATER

Past and Current Exchanges

Presently, Metropolitan has several active exchange agreements. Metropolitan has been involved with temporary exchanges in the past, including some carried out during the 1976-77 drought. The primary exchange agreements are discussed below.

Desert Water Agency and Coachella Valley Water District

During 1967, Metropolitan entered into water exchange agreements with the Desert Water Agency (DWA) and the Coachella Valley Water District (CVWD). The DWA and the CVWD serve the northern and southern portions of the Coachella Valley, respectively. All three participants in the agreements are State Water Contractors. However, because there are no facilities to convey water from the State Water Project (SWP) to the Coachella Valley, neither the DWA nor the CVWD is able to take delivery of their SWP entitlements. Rather than build facilities to take delivery of SWP water, the two agencies initiated negotiations with Metropolitan which culminated in agreements that allow the two agencies to exchange their SWP entitlements for a like amount of Colorado River water. The exchange agreements specify that Metropolitan will deliver Colorado River water via the Colorado River Aqueduct to service connections in the Upper Coachella Valley. From that point, CVWD and DWA convey the water to spreading basins via the Whitewater River. In return, Metropolitan will take delivery of a like amount of state water through the East Branch of the California Aqueduct.

The current agreements extend through the year 2035. Under a third agreement, Metropolitan delivers Colorado River water to CVWD and DWA for the Coachella Valley groundwater basin. The advance storage agreement permits Metropolitan to continue to utilize CVWD's and DWA's State Water Project entitlements and suspend deliveries of Colorado River water for recharge. Water stored in the groundwater basin can be used by the DWA and CVWD, and Metropolitan can maximize the use of the Colorado River Aqueduct (CRA). By April 1986, Metropolitan had a balance of 552,000 AF in the Coachella groundwater account. Due to the recent drought, Metropolitan has suspended delivery of CRA water to CVWD and DWA while continuing to receive the CVWD and DWA State Water Project entitlements. The balance of water in the account as of December 31, 1989, was 419,520 AF.

San Gabriel Valley Municipal Water District

Prior to 1975, a groundwater overdraft condition existed throughout the Main San Gabriel Basin, including the western portion of

the basin known as the "Alhambra Pumping Hole." This general overdraft condition resulted in a lawsuit that adjudicated the water rights of the Main San Gabriel Basin. Six of the seven producers extracting water from the Alhambra Pumping Hole are members of the Upper San Gabriel Valley Municipal Water District, a Metropolitan member agency. The other producer is the city of Alhambra, a member agency of the San Gabriel Valley Municipal Water District (SGVMWD). The SGVMWD has a contract with the state for water from the State Water Project. In connection with the adjudication and to help reduce the overdraft of the basin, it was agreed that Metropolitan would deliver approximately 3,000 AFY of water to the city of Alhambra through the Upper San Gabriel Valley Municipal Water District. The city of Alhambra would then reduce pumping by 3,000 AFY, thereby reducing the overdraft.

In exchange for providing the 3,000 AF, Metropolitan receives the right to use capacity in San Gabriel Valley Municipal Water District's Devil Canyon-Azusa pipeline. This will augment the capacity of Metropolitan's Rialto pipeline. The agreement can be terminated only by mutual agreement of the contracting parties.

Tijuana, Mexico

In 1972, the United States Bureau of Reclamation, Metropolitan, the International Boundary and Water Commission, and certain other agencies entered into an agreement providing for delivery of up to 20,600 AFY of Colorado River water to the city of Tijuana. This is water that Mexico is entitled to receive under the 1944 Treaty between the United States and Mexico regarding the waters of the Colorado and Rio Grande rivers. The water was transported through Metropolitan's Colorado River Aqueduct and water conveyance systems to San Diego County. This agreement was terminated on August 13, 1983. It was anticipated that with the completion of Tijuana's own aqueduct system, Metropolitan would not be required to convey any more water. However, in 1989, Tijuana experienced a break in its distribution system. On the basis of previous agreements, Metropolitan was asked by the federal government to work in conjunction with the San Diego County Water Authority (a Metropolitan Member Agency) and the Otay Water District to provide emergency water to Tijuana, Mexico. During 1989, the three agencies provided approximately 323 AF of water to Tijuana. Metropolitan, the Otay Water District, the San Diego County Water Authority, U.S. Bureau of Reclamation and the International Boundary and Water Commission are currently considering an agreement which will enable them to deliver water to Tijuana during emergency situations in the future.

Drought-Emergency Exchanges

During the 1976-77 drought period, there were two exchanges that illustrate the value of independent multiple water supply developments. In 1976, a water service exchange agreement provided for delivery of up to 10,500 AF of Metropolitan's 1976 State Project entitlement to the Dudley Ridge Water District in Central California. In exchange, Dudley Ridge paid Metropolitan the cost of importing an equivalent quantity of Colorado River water, plus the Delta Water Charge, plus the difference between the price charged by Metropolitan for State Project water and Colorado River water. The water delivered to Dudley Ridge was used to irrigate crops in the Central Valley that probably would have been lost during the drought.

In 1977, with the drought continuing, Metropolitan entered into an agreement with the California State Department of Water Resources (DWR) which provided that Metropolitan release, to the state, between 300,000 and 400,000 AF of its 1977 entitlement. An exchange agreement between Metropolitan, DWR, the United States Bureau of Reclamation, the State Water Resources Control Board, East Bay Municipal Water District, Contra Costa County Water District, and the Marin Municipal Water District was signed on February 10, 1977. The water released by Metropolitan was used to serve areas in Northern and Central California. The agreement provided for Metropolitan's subsequent reimbursement for any expenses incurred in importing an equivalent amount of Colorado River water and that any energy transfers would be the responsibility of DWR.

San Luis Dam Emergency

On September 14, 1981, an embankment slippage at San Luis Reservoir significantly affected the water supply available to certain water service contractors during the summer of 1982. To help mitigate this emergency condition, it was agreed that Metropolitan would release up to 250,000 AF of its 1982 State Water Project entitlement. Water released would be for use by the affected contractors of both the federal and state systems. To offset the reduction in Metropolitan's SWP deliveries, Metropolitan pumped an equivalent amount of water from the Colorado River. Metropolitan was reimbursed for expenses incurred while importing the additional Colorado River water. Energy transfers were the responsibility of DWR.

Kern River Intertie

In 1983, high flows in the Kern River flooded the Tulare Lake Basin. Metropolitan participated in two agreements to take delivery of excess flood flow through the Kern River Intertie into the California Aqueduct and, eventually, into Castaic Lake. The agreements were made with DWR, Tulare Lake Basin Water Storage District, Delta Lands Reclamation District No. 770, Southern California Edison Company, and the Los Angeles Department of Water and Power. Metropolitan's participation helped alleviate flooding in the Tulare Lake Basin by taking delivery of approximately 87,000 acre-feet of floodwater at no increased cost. The utilities took delivery of the energy from the power plants that was available because of Metropolitan's reduced Colorado River demand. The Kern River Intertie was used twice during high flows in 1986. The total amount diverted was about 17,500 AF. While not actually a water exchange program, the Kern River Intertie Agreement is another example of how Metropolitan participates in water management programs that benefit not only Southern California but also other areas of the state.

San Bernardino Valley Municipal Water District

The San Bernardino County Board of Supervisors requested that Metropolitan and the San Bernardino Valley Municipal Water District (SBVMWD) negotiate and enter into a water exchange agreement. This agreement stipulates that Metropolitan provide a firm water supply of 150 AFY of Colorado River water to the Havasu Landing area. In exchange, Metropolitan receives an equivalent amount of SBVMWD's SWP supply at the Devil Canyon Power Plant. Havasu Landing has no Colorado River water rights, and recent recreation growth caused demands to exceed the limited local supply.

Agreement for Interim Water Supply for the City of Needles

In December of 1984, Metropolitan, the Coachella Valley Water District, and the city of Needles entered into an agreement whereby Metropolitan agreed to divert up to 10,000 AF of surplus Colorado River water for storage and later use by the city of Needles. Needles does not have sufficient Colorado River water rights to meet its demand. Surplus water has been stored in the Coachella Valley Groundwater Basin for eventual use by the city of Needles. Whenever its water supplies are deficient, Needles may use up to 2,000 AFY of stored water. This agreement is to terminate in 1990.

City of Los Angeles

As a contingency plan for emergency situations, Metropolitan and the Los Angeles Department of Water and Power (LADWP) have established an intertie between LADWP's first Los Angeles Aqueduct and Metropolitan's Magazine Canyon facility. This water is delivered through a service connection located south of the Jensen Filtration Plant. With this connection to the Foothill Feeder, LADWP can deliver water into Metropolitan's system, and Metropolitan can deliver State Water Project water into LADWP's system. The interconnection at Magazine Canyon will allow Metropolitan to take up to 400 cfs of LADWP Aqueduct water, subject to availability. LADWP has also constructed a 250 cfs interconnection with the East Branch of the SWP. This provides flexibility to deliver water from LADWP for use along the East Branch of the SWP, as well as exchange deliveries to Metropolitan.

These interconnections have been used twice since 1985. Metropolitan and LADWP are currently seeking to secure a long-term agreement with the DWR to establish these interties as permanent parts of the respective systems.

Proposed Exchange Agreements

Metropolitan is considering several proposals for future exchange agreements. Four proposals are discussed below.

Colorado River Banking Plan

The Colorado River Banking Plan is a means of creating an additional supply of water, for an interim period, by making use of State Project water.

The plan calls for Metropolitan to adjust its Colorado River deliveries in accordance with the availability of water from the State Water Project. In years when SWP supplies are adequate, Metropolitan would take more SWP water and correspondingly less of its Colorado River entitlement. The difference between Metropolitan's Colorado River entitlement and its actual diversions would remain in Lake Mead and be credited to Metropolitan's account. Any water lost by spills, evaporation, or seepage resulting from additional stored water would be deducted from Metropolitan's account. As needed, Metropolitan would draw on its accumulated net water credits in Lake Mead.

The banking plan would depend on several factors including (1) availability of storage space in Lake Mead, (2) capacity in the SWP and Colorado River Aqueducts, (3) flexibility in Metropolitan's distribution system, and (4) agreement among the participating agencies and certain Colorado River Basin states. The yield will depend on the factors listed above and the incremental evaporation and seepage losses incurred at Lake Mead. Without addi-

tional State Water Project and Metropolitan facilities, the yield would be reduced.

Arvin-Edison Water Exchange Program

Metropolitan, under a proposed agreement with Arvin-Edison Water Storage District (AE) in Kern County, expects to store as much as 135,000 AFY of State Project water in the southern San Joaquin Valley. During wet periods, Metropolitan could accumulate a storage account of up to 800,000 acre-feet. In dry periods, the program would make approximately 100,000 AFY available for use in the Metropolitan service area.

During years when Metropolitan has unused State Water Project (SWP) entitlement, Metropolitan would make water available to AE at the Cross Valley Canal (CVC) turnout from the California Aqueduct. This water would be transported through the CVC into AE's service area and be used in two replenishment programs: first, a spreading program for the direct, artificial recharge of the AE groundwater basin; second, an "in lieu" replenishment program in which surface water is delivered to farms in lieu of groundwater pumping.

All water made available by Metropolitan would accrue in a Metropolitan storage account. After accounting for potential losses from the AE aquifers (expected to be small), all water in the account would be available for use in later years by Metropolitan on an "acre-foot-for-acre-foot basis."

During years when Metropolitan requires additional water, deliveries to AE would cease, and AE would make surface water available to Metropolitan from its federal Central Valley Project (CVP) contract entitlement. AE would replace the surface supply transferred to Metropolitan by pumping water previously stored underground. During conditions similar to the 1928-34 drought, Metropolitan would receive an average of 93,000 AFY.

AE water users are assured that Metropolitan will receive water only in exchange for water previously made available for storage in the AE groundwater basin.

Los Angeles County and San Gabriel Valley

Under terms of an agreement signed October 11, 1977, between Metropolitan, Los Angeles County Flood Control District, and the San Gabriel Valley Protective Association, the Flood Control District has agreed to assume ownership and operation of Morris Dam and Reservoir. The facility is located on the San Gabriel River. Metropolitan currently operates the facility for water conservation and flood control for the benefit of downstream water users. The actual transfer of ownership to the Flood Control District will become effective after certain requirements, specified in the agreement, are completed. When the transfer of ownership is completed, Metropolitan will assign its 175 AFY permit to the San Gabriel Valley Protective Association. This permit is for diversion or use of local water in the Main San Gabriel Basin. Metropolitan will retain the right to store at least 2,000 acre-feet of imported water in the reservoir as part of its operation of the proposed Middle Reach of the Foothill Feeder. In addition, Metropolitan may use any water in the reservoir as a source of supply in the event of an outage in Metropolitan's distribution system.

Metropolitan completed a seismic study of Morris Dam in 1989. The completion of this study is a major step in the transfer of Morris Dam to the Flood Control District. The United States Navy currently owns a torpedo test facil-

ity at Morris Reservoir. To facilitate the transfer of ownership to the Flood Control District, Metropolitan's contract with the Navy must be negotiated to accommodate the transfer of ownership of the dam to the Flood Control District. Metropolitan also contracts with the Bureau of Land Management for flood easements; these contracts must also be renegotiated to accommodate for the transfer of ownership of Morris Dam.

San Gorgonio Pass Water Agency

The high cost of extending distribution facilities from the California Aqueduct to the San Gorgonio Pass Water Agency (SGPWA) has led to a proposed water exchange between Metropolitan and SGPWA. Under the terms of the agreement, Metropolitan would take delivery of SGPWA's State Water Project entitlement at Devil Canyon Afterbay, and SGPWA would take Colorado River Aqueduct water from a point near SGPWA's eastern boundary.

V. MANAGEMENT RESPONSE DURING DROUGHT OR OTHER EMERGENCIES

NEED FOR MANAGEMENT RESPONSE

The effective management of water supply deficiencies is one of the most important responsibilities of Metropolitan. Possible deficiencies in Metropolitan's supplies may be caused by droughts, failures of major water transmission facilities during earthquakes, an acute contamination of supplies due to chemical spills, or other adverse conditions. The need for an effective management program to mitigate water supply shortages arises from Metropolitan's experiences during the drought of 1976-77 and the ongoing four-year drought which began in 1987. The following sections describe Metropolitan's drought response measures during these two events. Similar response programs will be formulated to cope with drought emergencies in the future.

RESPONSE TO 1976-77 DROUGHT

Major actions of Metropolitan during the 1976-77 drought in California included (1) changes in the operation of imported and local sources of supply and (2) reduction of urban water demand in Southern California through voluntary conservation and economic incentives. Table V-1 gives a chronological account of events and actions that took place during the critical period of the drought.

Management of Supplies

Metropolitan's modified operations of supply sources involved a significant increase in the rates of pumping a supply of water from the Colorado River. All 45 pumps on the Colorado River Aqueduct were put into a 24-hour-a-day, seven-day-a-week operation. The increased use of Colorado River water allowed Metropolitan to release 320,000 acre-feet of the State Project water for use in the northern and central portions of the state. In addition, the operation of local sources of supply was changed to maintain sufficient carry-over storage and groundwater reserves in case the drought would continue throughout 1978 and 1979.

Demand Reduction

On the demand side, a combination of measures was undertaken by Metropolitan and member agencies in order to achieve a reduction in total regional water use. An appeal to all citizens for a voluntary 10 percent cutback was reinforced by two multimedia public information campaigns and a distribution of 100,000 water conservation kits to member agencies. Metropolitan's wholesale water rates were adjusted to include a 100 percent surcharge for all deliveries in excess of 90 percent of the deliveries in the corresponding month of the previous year.

TABLE V-1

METROPOLITAN'S RESPONSE TO 1976-77 DROUGHT

Date	Action/Event
End of 1975	The northern two-thirds of California recorded below-average rain and snow.
December 1976	California Department of Water Resources (DWR) announced that it expected to meet all of its contract entitlement obligations to Metropolitan in 1977.
February 1, 1977	Metropolitan made arrangements with Southern California Edison Company for power to operate a total of 8 pumps at each of 5 pumping plants on the Colorado River Aqueduct (a total of 40 pumps).
February 11, 1977	An exchange agreement was reached between the DWR and Metropolitan under which 320,000 acre-feet of Metropolitan's entitlement were released for use in the northern and central portions of the state that had no alternate sources of supply, with a provision to reserve 80,000 acre-feet of State Project water in San Luis Reservoir near Los Banos for possible use by the city of Los Angeles.
February 15, 1977	DWR ordered 60 percent agricultural and 10 percent municipal and industrial cutbacks in water deliveries for all contractors of the State Water Project (SWP).
February 17, 1977	Metropolitan's Board of Directors passed a resolution requesting that all citizens cut back their water use by 10 percent on a voluntary basis. Measures included in the resolution were: (1) Member agencies would prepare a drought emergency study. (2) Member agencies that delivered agricultural water would initiate an agricultural water conservation program. (3) Member agencies would study the feasibility of alternate rate structures and surcharges which would provide economic incentives for the conservation of water. (4) Metropolitan would draft a model ordinance prohibiting wasteful uses of water. (5) Member agencies would prepare a list identifying nonessential or wasteful water uses. (6) Metropolitan working with member agencies, public interest groups, and trade associations would assume publicity for, and wide distribution of, devices and practices for home and business water conservation.
March 1, 1977	State Project water ceased to be lifted over the Tehachapi Mountains for delivery to Southern California. Metropolitan turned on all 9 pumps at each of its 5 pumping plants on the Colorado River Aqueduct. All 45 pumps went into operation on a 24-hour-day, 7-day-a-week schedule, with no backup pump available.
April 1, 1977	Metropolitan's Board of Directors' resolution providing for economic incentives to achieve 10 percent water conservation went into effect. The incentive for conservation involved a 100 percent surcharge for all deliveries in excess of 90 percent of deliveries in 1976 in the corresponding month. Also, a $20 credit was given for each acre-foot of water savings below 90 percent of 1976 deliveries.

TABLE V-1 (Continued)

METROPOLITAN'S RESPONSE TO 1976-77 DROUGHT

Date	Action/Event
May 1977	Metropolitan launched its $250,000 advertising campaign, "25 Things You Can Do To Save Water" with messages printed in 22 newspapers with a combined circulation of 3.3 million and carried in 3,171 radio announcements on 94 radio stations.
Summer 1977	Metropolitan prepared another campaign, "Do A Good Turn. Save Water." About 100,000 conservation kits were purchased by Metropolitan and made available at cost to member agencies.

Source: MWD Annual Report, 1977.

These and other actions (see Table V-1) resulted in significant reductions in water use. The amount of water savings resulting from conservation varied by agency from a low of 6 percent to a high of 30 percent. The overall average was between 12 to 15 percent.

DROUGHT ACTION PLAN 1988

In April 1988, Metropolitan's management, anticipating a possible third consecutive year of drought, had prepared a Drought Action Plan 1988. In September 1987, eight months before the formulation of the drought plan, Metropolitan's Board was presented a drought contingency plan which set forth a three-year framework of progressively stringent conservation measures to be passed according to the severity of the drought. The Drought Action Plan of 1988 was designed to implement the second-year measures contained in the drought contingency plan.

The primary goals of the plan were:

(1) To optimize operations of the major water supply projects to make best use of available water
(2) To coordinate local storage for best yields of surface reservoirs and groundwater basins
(3) To establish a goal of 10 percent reduction in demands for imported supplies below projected levels
(4) To provide timely and continuous information on the drought to the public and its elected officials

These goals were to be achieved in partnership with the member agencies and other jurisdictions. The specific actions included in the Drought Action Plan 1988 are described below.

Coordinated Supply Operations

Starting in 1987, Metropolitan initiated action to mitigate the drought by changing its State Water Project order to minimize summer

deliveries and by rescheduling and delaying to the extent possible the rehabilitation of the Colorado River Aqueduct. Moving into 1988, federal, state, and contractor work groups had been formed to coordinate the operation of the Colorado River Aqueduct, State Water Project, and Central Valley Project supplies for maximum combined yield and to adopt aggressive water conservation programs within all contractors' service areas.

Regional Storage Management

The purpose of this effort was to build storage reserves in regional reservoirs and local groundwater basins to help withstand the continuing drought. In April 1987, Metropolitan took steps to suspend the Desert-Coachella advance delivery operations. The water which had been delivered in advance during earlier years was being used during the drought, as intended, thereby increasing the availability of Metropolitan's supplies.

Other groundwater replenishment and in lieu storage programs have been practiced since April 1987, whenever possible, to store excess water which would otherwise have been released to the ocean.

Special measures were being recommended to enhance local water production. Some of Metropolitan's member agencies or subagencies have the capacity to produce local water in excess of their interruptible commitments. It had been proposed that such agencies be allowed to produce such water in 1988-89 with no impact on their interruptible orders.

Metropolitan has negotiated reservoir storage agreements with the city of Los Angeles and the San Diego County Water Authority to store specific quantities of water in those agencies' reservoirs, as available, for drought use. Member agencies and subagencies were also encouraged to interconnect their local distribution systems in order to maximize the availability of groundwater reserves.

Should the drought severity have increased, the interruptible service provisions contained in the Administrative Code would have been invoked. In order that all classes of interruptible service would receive equal treatment, Metropolitan requested by separate letter that agricultural users be given the required one-year notice of possible interruption.

Ten-Plus-Ten Demand Reduction Program

The goal of this voluntary conservation program was to achieve a 10 percent reduction in demands on Metropolitan. This was in addition to the estimated 10 percent reduction already achieved by ongoing "every-year" conservation activities in Metropolitan's service area (however, recent analyses indicate that the current normal demand conservation savings are about 7 percent). The Ten-Plus-Ten Program was expected to result in 200,000 AFY of water savings below projected demands for 1988-1989. The specific measures that were requested included the following:

(1) Odd-Even Watering. Across-the-board, watering by even street addresses only on even calendar days; watering by odd addresses on odd calendar days.

(2) Watering Hours. Across-the-board, no watering during peak morning and evening hours and during the hot part of the day.

(3) Anti-Waste Measures. Request that all appropriate local jurisdictions adopt resolutions or ordinances against excess runoff, leaks, sidewalk and driveway cleaning, decorative fountains, and other nonessential water uses.

(3) Conservation Kits. Distribute 100,000 retrofit kits to the member agencies. The kits contained shower flow restrictors, a toilet displacement bag, and dye tablets to find leaks.

(4) Leak Detection. Assist the member agencies and subagencies to step up their ongoing leak detection and repair efforts.

(5) Hot Line. Establish a telephone hot line to assist the public during the drought.

(6) CIMIS. Work with the University of California Extension Service and the Resource Conservation Districts to accelerate the expansion of its California Irrigation Management Information System.

(7) Seminars. Conduct seminars jointly with the Department of Water Resources (DWR) and the member agencies to assist water agencies in "how to" save water.

(8) Maximize Water Reclamation. Work with member and subagencies on extending and expanding water reclamation programs.

In addition, Metropolitan resolved to build support for legislation which would provide for low-water-use landscaping and irrigation systems in new industrial, commercial, government, and multifamily developments, and in model homes at new single-family developments.

Public Information and Education Program

The Drought Action Plan 1988 required timely and continuing information and updates to the public and its elected officials. The main elements of the information program included the following:

(1) Press Conferences. To announce the Ten-Plus-Ten Program and to describe the conservation programs now in place and the new programs being implemented to achieve further reductions. Another objective was to motivate the public to observe the odd-even watering program and the daily watering hours.

(2) Major Media Advertising. Joint program with member agencies; included radio (MWD), television (LADWP), and newspaper ads (MWD and members). Additional advertising media were evaluated.

(3) Conservation Newsletter. Issued at intervals to discuss Southern California conservation efforts: for distribution to leaders and elected officials throughout California, the media, the environmental leadership, and others.

(4) Weathercasts. Provided color slides emphasizing conservation to weathercasters as on-air backdrops.

(5) Sports Arenas. Were requested to carry conservation messages on their electronic signs during major events.

(6) Freeways. Requested that the California Department of Transportation (CALTRANS) post signs along freeways, which note use of reclaimed water where appropriate, and maintain sprinklers for minimum water use.

(7) Restaurants. Table tent cards were distributed to restaurants in conjunction with the Restaurant Association urging patrons to reduce water use.

(8) Schools. Provided 8,000 primary schoolteachers with drought information; distributed conservation tips to more than 250,000 students.

(9) Public Seminars. Cooperated with Southern California Water Committee and member agencies to develop public seminars on water-saving measures.

(10) Fairs and Home Shows. Live presentation featuring conservation measures which public can practice.

(11) Plant Tags. Distributed "Drought Resistant" plant tags through Nurseryman's Association.

(12) Speakers Bureau. Provided drought presentations to service clubs and other meetings.

In addition, a variety of new printed materials were prepared and distributed, including a brochure on the need to conserve, conservation tips, a conservation calendar, and conservation stickers for use in public rest rooms and hotels/motels.

Effectiveness of 1988 Response Measures

The implementation of the Drought Action Plan 1988 was instrumental in reducing regional demands by 190,000 AF. The coordinated use of supply sources permitted local agencies to maintain relatively constant production of local groundwater. However, the reduced replenishment of groundwater basins and below-normal rainfall in the region in five out of the past six years caused a 1 MAF reduction in local storage (see Figure III-3, Chapter III).

DROUGHT ACTION PLAN 1990

Expected Water Supply Shortfalls

In April 1990, water supply conditions at the sources of all imported water used in Metropolitan's service area were well below normal. California had entered the fourth consecutive year of drought. A continuing lack of rainfall in Southern California caused the demands for imported supplies to rise from just over 2 MAF in 1988 to slightly less than 2.4 MAF in 1989 and to about 2.5 MAF expected during 1990. This 25 percent increase in demands for Metropolitan's supplies is a result of (1) the population growth within Metropolitan's service area at a rate of about 300,000 new residents annually, (2) increased outdoor use of water by residences and businesses caused by dry weather conditions, (3) increased demand for groundwater replenishment deliveries to compensate for the abnormally low local runoff during the 1987-89 period, and (4) the loss by the city of Los Angeles of the use of much of its Mono Basin supply. All of these factors contributed to a supply shortfall within the Metropolitan service area during 1990

indicating a need to reduce regional demands by 200,000 AFY. Continuing dry conditions in 1991 could lead to a supply shortfall of as much as 500,000 AFY.

Drought Action Plan

In order to respond to the potential supply shortfalls in 1990 and 1991, Metropolitan's Board of Directors has adopted the Drought Action Plan 1990. Two basic objectives of the plan are:

(1) To reduce total water demands in Metropolitan's service area by at least 10 percent, especially during the hot summer months

(2) To retain this saved water, to the maximum degree possible, in storage

These objectives were to be achieved by implementing seven drought response measures:

(1) Reduction Goal. Metropolitan set and publicized a goal to achieve at least a 10 percent reduction in total demands from 1989 levels, adjusted for population increases.

(2) Drought Rebate Program. The need for financial incentives and an assessment of alternative approaches were discussed at meetings with the member agency managers on March 2 and March 30, 1990. As a result of those discussions, Metropolitan offered a rebate for a June 1 through September 30 period to any member agency that reduced total water demand within its service area during that period to less than 95 percent of that used during the same period in 1989, adjusted for population increases. The rebate was set at $100 per acre-foot of reduction below this 95 percent level at each retail agency. The maximum amount of the rebate will be limited to the total cost of supplemental water purchased in 1989 from Metropolitan. To receive the rebate, an agency must certify that the conservation was not achieved through increased use of other sources nor through the withdrawal of water from storage.

(3) Water Conservation Packages. Metropolitan purchased 1,000,000 water conservation packages to be distributed to its member agencies for distribution to retail purveyors' customers. The contents of the packages were designed to heighten consumer awareness for the need to conserve water. The packages include shower flow restrictors, dye tablets to check for toilet leaks, a package of drought-resistant plant seeds, a package of soil polymers to hold water in the root zone of plants, and printed water conservation information materials. The cost of these packages was $400,000.

(4) Weathercaster Slides. Metropolitan provides computer-generated slides for use by weathercasters at local television stations. These slides emphasize the need to maintain carry-over storage at the highest practicable levels going into 1991. These slides were found to be very popular with the weathercasters in 1988.

(5) Restaurant Tent Cards. Also used in 1988, these cards are placed on tables of restaurants to explain why water is served only upon request.

(6) Plant Tags. As in 1988, "Drought Resistant" plant tags were distributed through the Nurserymen's Association.

(7) Newspaper Slicks. Camera-ready articles and artwork on the current drought have been provided to member agencies and subagencies for use in local newspapers.

(8) Task Force on Implementation. A Metropolitan staff task force was created to assist local water purveyors in developing and adopting water conservation ordinances. This task force could also assist member agencies and subagencies in discussions on the need for increased water use efficiency in public infrastructures such as parks, golf courses, freeway and street medians, and other similar areas.

Emergency Water Conservation Ordinance

The Task Force on Implementation received a very positive response to the plan from water supply and other local entities in Metropolitan's service area. A number of requests were received for assistance in drafting local drought ordinances to help reduce the threat of water shortages. In response, Metropolitan has prepared the model Emergency Water Conservation Ordinance as presented in Appendix B.

The ordinance is designed to provide a permanent mechanism that would allow local entities to deal with water shortage emergencies. It sets forth three basic implementation phases keyed to the severity of the water shortage. The local entity would implement the plan only after a public hearing and formal published determination of the shortage emergency.

The implementation phases prohibit certain types of water use, require percentage reductions in water uses, and impose surcharges on excess water uses. In addition to the excess-use surcharges, the ordinance provides increasing sanctions for repeated use of water for prohibited purposes. The penalties include a warning citation, additional surcharges, and installation of flow restrictors.

This ordinance was drafted so that it could be used or adapted by a wide range of water supply agencies and does not exhaust all possible measures that could be included in a water conservation plan. Member agencies were encouraged to review closely the ordinance for its applicability to their agency's needs before it is adopted.

VI. CURRENT WATER CONSERVATION MEASURES

OVERVIEW OF WATER CONSERVATION PROGRAM

Metropolitan's Conservation Policy

During the last decade, the arena of long-term water resources planning has been broadened to include conservation as a promising management alternative. Water suppliers are currently undergoing the same change which took place in the energy industry during the 1970s. Metropolitan has made water conservation an integral part of water resources planning. This required consideration of the full implications of conservation in an engineering, economic, social, and environmental sense.

In order to make conservation a viable alternative to the development of new water supplies, Metropolitan has developed innovative water conservation programs and made a commitment to incorporate conservation into short-term and long-term water management plans. This required exposing specific conservation measures to rigorous scrutiny. A careful examination of empirical evidence for achievable water savings, public acceptability of water conservation, and other conservation impacts showed that great uncertainties have to be overcome before conservation alternatives can be fully incorporated into water supply planning.

In order to facilitate implementation of conservation practices, in August 1987, Metropolitan adopted a specific policy "... to undertake the support of water conservation programs" (MWD Administrative Code, Section 4209). Under this policy, Metropolitan may develop and implement water conservation programs and enter into agreements with member public agencies and other organizations to make more efficient use of water resources through water conservation programs, so long as such agreements serve a beneficial purpose to Metropolitan and its member agencies.

In September 1988, Metropolitan's Board of Directors approved the Conservation Credits Program which introduced economic incentives to member agencies and their subagencies to undertake water conservation measures. This program, together with Metropolitan's supply management programs (i.e., Local Projects Program, Interruptible Water Service Program, and Seasonal Storage Program), formed the backbone of Metropolitan's innovative approach to water resources management.

Long-Term Program Goal

The long-term goal of Metropolitan's water conservation program is to achieve and maintain a high level of efficiency in water use in Metropolitan's water service area. The specific objectives include:

(1) Elimination of wasteful practices in water use (i.e., dispensing water in an inefficient manner)

(2) Development of information on both current and potential conservation practices that would enhance the efficiency of water use without excessive commitments of other resources

(3) Timely implementation of conservation practices that will achieve additional improvement in present water use efficiency

The following section provides a detailed description of the major elements of the program.

Major Components of Conservation Program

The three major components of the Metropolitan's water conservation program are:

(1) Economic and financial incentives to encourage efficient use of water in Metropolitan's water service area

(2) Public information and education activities

(3) Water conservation research and development to reduce the uncertainty surrounding the effectiveness of alternative conservation measures

Each of these major components is discussed in the following sections. The economic and financial incentives include (1) programs aimed at providing financial assistance to member agencies undertaking conservation projects and (2) the design and implementation of wholesale rates to encourage conservation and the maximum efficiency in utilizing existing water supplies. The focus of the second element is informing water users in Southern California about the importance of water conservation and providing them with details on methods for achieving conservation in households and businesses. Finally, the third component, water conservation research and development, uses Metropolitan's resources to develop and evaluate the technical, economic, and social effects of alternative conservation techniques.

CONSERVATION CREDITS PROGRAM

Program Description

Metropolitan's Water Conservation Credits Program authorizes the General Manager to seek proposals from member agencies and subagencies to undertake conservation projects. Metropolitan currently pays $154 per acre-foot for demonstratable water savings up to one-half of the cost of each qualifying conservation project.

In order to qualify for the Conservation Credits Program, a water conservation project must:

(1) Have demonstrable water savings.
(2) Reduce demands on Metropolitan.
(3) Be technically sound.
(4) Have local support.
(5) Require Metropolitan's participation to make the project financially and economically feasible.

Each proposal is considered on a case-by-case basis, leading to an agreement with the appropriate member agencies and subagencies.

The Conservation Credits Program serves as a primary vehicle for implementing water conservation projects in Metropolitan's service area. Presently, the approved conservation projects, when fully implemented, are expected to result in combined savings of about 8,000 AFY. The goal of the program is to achieve conservation savings in the range of 50,000 to 150,000 acre-feet per year. In order to meet this goal, Metropolitan's Board of Directors will periodically review the effectiveness of the program and adjust the economic and/or financial incentives to encourage and reflect the actual conservation benefits to the region. The effectiveness of the programs will depend on the type of conservation projects and the number of proposals submitted by member agencies and subagencies.

Water conservation has both local and regional benefits. The local benefits include reduced sewer loadings, reduced use of electricity and natural gas for heating water, and reduced water distribution costs. Regional water supply benefits include reduced cost of aqueduct pumping and potential savings in treatment and distribution costs. However, in many cases, the local benefits of conservation are not sufficient to offset total project costs, which would include direct program costs such as new staffing and hardware as well as administrative overhead, loss of rate revenue by retail water purveyors, and other factors. In such cases, the Conservation Credits Program provides financial incentives for the implementation of conservation programs and allows sharing of costs between local entities and Metropolitan.

Each Project Agreement is negotiated on an individual basis, and those agreements costing more than $75,000 are submitted to the Board for approval and funding. The typical program facilitates the implementation of most measures, provides for prompt action during droughts, and ensures equal treatment of all member agencies. Special case projects include such measures as leak detection and repair, CIMIS, xeriscape or "water wise" landscaping, industrial conservation, and others.

A particular project may have special benefits for Metropolitan other than the water savings. Such benefits could include technology development, important research results, protection of a vital resource, or permanent loss of an opportunity to achieve efficiency gains if the project is not implemented. These benefits are considered in the Conservation Credits Program decision process.

Approved Conservation Credits Programs

By April 1990, eight Conservation Credit Programs had been approved by Metropolitan and are currently in various stages of implementation. The estimated water savings and costs of these programs are shown in Table VI-1. A brief description of several programs is given below.

Pasadena Residential Water Survey

The first Conservation Credits Program proposal was received from the city of Pasadena (a Metropolitan member city). The project involved a pilot indoor/outdoor water survey of 2,400 residential homes in the city and included installation of showerhead and toilet retrofit devices and recommendations for improvement of irrigation efficiency in the surveyed homes. Metropolitan contributed approximately 13 percent of the project cost plus the consultant costs for evaluation.

TABLE VI-1

APPROVED CONSERVATION CREDITS PROGRAMS

City/Agency	Type of Program	Estimated Water Savings (AF) Annual	Total	Total Project Cost ($)	MWD Credits ($)	Consulant Cost ($)
Pasadena	Residential indoor/outdoor survey	90	450	272,000	33,900 (13%)[a]	19,000
Irvine Ranch Water District	Residential retrofit/survey	135	675	270,000	135,000 (50%)	120,000
Pasadena	Residential kit retrofit	1,000	5,000	802,000	375,000 (47%)	100,000
Santa Monica	Toilet retrofit	935	7,900	2,362,000	600,000 (25%)	110,000
San Diego	Residential kit retrofit	1,400	7,000	1,075,000	525,000 (44%)	74,000
San Diego CWA	Large turf survey	1,000	5,000	285,000	142,500 (50%)	60,000
Los Angeles DWP	Toilet/retrofit	250	2,500	900,000	185,250 (21%)	50,000
Los Angeles DWP	Residential kit retrofit	2,560	12,800	2,200,000	1,100,000 (50%)	140,000
	TOTAL	7,730	43,125	8,166,000	3,096,650	673,000

[a]Percent of total project cost.

Irvine Ranch District Retrofit and Survey

In May 1989, Irvine Ranch Water District (IWRD), in cooperation with the Municipal Water District of Orange County, proposed a pilot conservation project. This project entails retrofitting 4,000 homes with ultra-low-flow showerheads and toilet dams and performing a complete indoor and outdoor water use survey in an additional 1,000 homes. The objectives of the project include an in-depth evaluation of the actual water savings achieved as well as identification of possible inefficiencies in indoor and outdoor water use. The total project cost is $270,000 with anticipated water savings of 675 AF over a five-year period. Metropolitan has contributed 50 percent of this cost.

Pasadena Water and Energy Residential Conservation Programs

In May 1989, the city of Pasadena submitted a conservation credits proposal for assistance in funding a citywide Water and Energy Residential Conservation Program. The Pasadena project entails a door-to-door campaign to provide free distribution and installation of water and energy-efficient devices. The program has been offered to 36,400 homes in the city with less than five units per structure. The total cost of the water portion of the program is $802,000. The project is expected to save about 5,000 AF of water over a five-year period, all of which would have to be otherwise imported by Metropolitan.

Santa Monica Ultra-Low-Flow Retrofit

In April 1989, the city of Santa Monica requested Metropolitan's assistance in implementing a project to retrofit existing plumbing fixtures (toilets and showers) with ultra-low-volume toilets and ultra-low-flow showerheads. Under this project Santa Monica offers a $100 rebate for each ultra-low-flush toilet and low-flow showerhead installation and provides for a monthly conservation incentive fee for nonparticipants. This fee is $1.00 for single-family residences and $0.65 for multifamily residences. When fully implemented, the project is expected to include 12,000 homes, or about 25 percent of all residences in Santa Monica. Over a five-year period the project is expected to save 7,900 AF of water at a total project cost of $2,362,500. Metropolitan's share of the project is $600,000.

San Diego County Turf Survey Program

In January 1990, the San Diego County Water Authority (SDCWA) submitted a proposal to perform a survey of large turf grass areas in San Diego county. The purpose of the survey is to improve irrigation efficiency resulting in a corresponding savings of water. The SDCWA project is the first major large turf survey program in Metropolitan's service area featuring detailed follow-up and the development of innovative water conservation technologies. The survey is expected to save about 5,000 AF of water over a five-year period. The first 18-month phase of the project is estimated to cost $285,000. Metropolitan has contributed 50 percent of this cost.

Los Angeles Bathroom Retrofit Pilot Program

In April 1990, the city of Los Angeles proposed implementation of a bathroom retrofit pilot program. The goal of the program is to distribute bathroom retrofit kits to about 100,000 homes over a one-year period. The retrofit kits will consist of low-flow showerheads, toilet dams, leak detection tablets, installation instructions, and water conservation literature. The total cost of the project is estimated to be $2,200,000. The savings over a five-year period are expected to reach 12,800 AF.

San Diego Residential Retrofit Program

The city of San Diego submitted a proposal to retrofit bathroom fixtures in 50,000 single-family homes (about one-quarter of all homes in the city built prior to 1981). The project is expected to begin in July 1990 and will consist of distributing water-conserving devices, including toilet dams, low-flow showerheads, and dye tablets to detect toilet leaks. It has been estimated that this program will cost $1,075,000 and may save 1,400 AFY or 7,000 AF over a five-year period.

PUBLIC INFORMATION AND EDUCATION PROGRAMS

Public information campaigns continue to be the most popular means of encouraging consumers to use water efficiently. Metropolitan has made a commitment to assume leadership in developing and implementing effective public information and education programs in Southern California. Primary elements of this activity focus on two goals:

(1) Persuading consumers of the benefits of water conservation

(2) Providing consumers with information on how to conserve water

These goals define the content of conservation messages. In recent years, a substantial research effort has been initiated by Metropolitan to enhance the design of effective public information campaigns.

For many years Metropolitan has maintained an active and effective public affairs and education program. Metropolitan's public affairs program is divided into six specific areas of concentration: (1) written publications, (2) education programs, (3) community relations, (4) liaison activities and legislation, (5) efficient landscaping programs, and (6) mass-media campaigns.

Within this general framework, Metropolitan has developed a wide range of individual programs and activities. These activities have been very effective in encouraging consumers to adopt conservation measures which reduce water demands. Public information and education programs will continue to be an important part of Metropolitan's water management and conservation efforts.

Written Publications

Since 1985, Metropolitan has distributed over 2 million pieces of literature that promote water management and conservation. Metropolitan currently publishes three periodicals. Aqueduct is an award-winning full-color magazine that is published on a quarterly basis. Focus on Water is a newsletter that is also published quarterly. People is an internal publication for Metropolitan employees and retirees.

Each of these publications includes conservation articles and themes on a regular basis. Metropolitan has more than 30 different brochures and pamphlets that deal with a wide variety of subjects relating to water. These brochures are available free of charge to the public and are widely distributed throughout the Metropolitan service area. Table VI-2 contains a synopsis of the literature available that directly relates to water conservation.

TABLE VI-2

METROPOLITAN'S WATER CONSERVATION LITERATURE
(Selected Brochures)

No.	Title	Contents
1.	"Be Water Tight. 25 Ways to Save Water"	A brochure presents 25 ways to save water in a residence, both indoors and outdoors.
2.	"How Saving Water Saves Energy"	A brochure which discusses the relationship between water and conservation and the conservation of other resources like natural gas and electricity.
3.	"How to Have A Green Garden in a Dry State"	A full-color brochure which displays water efficient plants. The brochure shows that low-water-using plants can be colorful and pleasing while being water efficient. The brochure also provides three sample layouts of residential landscapes.
4.	"The Story of Drinking Water"	A comic book written for elementary-school children and shows how water is developed for consumer use.
5.	"A Journey Down the Colorado River Aqueduct"	An illustrated brochure designed for young children, it discusses the importance of water from the Colorado River, by Metropolitan, and discusses the use of water in the home.
6.	"Reclaiming Water"	A brochure which discusses the sources, uses, and methods of treating reclaimed water. It was designed to increase public awareness and acceptance of the use of reclaimed water.
7.	"For Summer-Dry California--Water Saving Planting Ideas"	A 12-page full-color article reprinted from Sunset Magazine with a comprehensive listing of low-water-using plant materials.
8.	"Drip"	An updated reprint of a 1981 Sunset Magazine article describing various drip irrigation systems and how to install them.
9.	"How Much Water Does Your Lawn Really Need?"	A reprint from Sunset Magazine which provides comprehensive information for homeowners on efficient turf irrigation practices.
10.	"Take A Day Off"	A brochure developed by Metropolitan staff which provides a quick reference for homeowners on efficient irrigation practices based on climate zone and evapotranspiration rates.
11.	"WATER--California's Future in the Balance"	A brochure which gives an overview of the critical issues relating to water that are under consideration in California.
12.	"You Can Make A Difference"	A brochure developed by Metropolitan staff, especially for the drought of 1988. It provides a quick reference for consumers on how much water is used in a typical residence for routine functions.

Public Education Programs

Since 1983, Metropolitan has maintained an active educational resources program. The basic emphasis of this program is to provide curriculum resource materials, to provide teacher training, and to conduct special programs in the area of water awareness. Since 1985, Metropolitan's education program has trained more than 12,000 teachers and has reached more than 400,000 students in the Metropolitan service area. The following are some examples of the types of public education that have been or are currently being conducted.

World of Water Class

For the third year, Metropolitan hosted a two-day water education training class for teachers. The class featured the AIMS (Activities Integrating Math and Science) Program. The 55 teachers who participated in this class earned one unit of college credit.

Assembly Programs

In addition to providing resource materials and training seminars, Metropolitan staff members also conduct assembly programs at various schools in the Metropolitan service area. The assembly programs have proved to be the most effective way of teaching the maximum number of teachers and students about water issues and conservation.

Primary School Water Education

Demonstrations and experiments involving water-related concepts are available to teachers who are currently using "Admiral Splash" or "Water for Ursa" (Metropolitan's primary curriculum programs). The experiments present concepts relating to surface tension, buoyancy, flocculation, and gravity flow, as well as elements aimed at increasing the appreciation of the value of water and the need to conserve it.

High School Water Education

Two pilot programs, Political Science and Economics, were field tested this year. Two additional modules to this program will be tested in the near future and will focus on Biology and Physical Science. The high school programs stress conservation as part of the curriculum.

The Geography of Water

This is a new curriculum resource that was developed and completed this year. The focus of the learning unit will be to study California's water supply by emphasizing California's physical features, precipitation, population, economy, as well as water supply and distribution.

Films

Films are an important part of Metropolitan's education program. Metropolitan distributes its films on a loan basis to a wide variety of schools and organizations within its service area. Table VI-3 contains a synopsis of films available through Metropolitan.

Community Relations

Tours

Metropolitan conducts tours of its facilities along with tours of State Water Project facilities. These tours are instrumental in educating the public on issues relating to water conservation. Since 1985, more than 27,000 people have participated in tours hosted by Metropolitan

TABLE VI-3

EDUCATIONAL FILMS AND SLIDE SHOWS

No.	Title	Contents
1.	"Wasting Not"	An adaptation of a slide show to demonstrate the kinds of things being done in industry in southern California to conserve water.
2.	"Without Water"	A humorous approach to how many things we take for granted that require water to produce.
3.	"Noah Water to Waste"	Television personality Richard Simmons offers a refreshing look at water conservation.
4.	"The Guzzler Gang"	A children's film uses cartoon characters to teach the proper use of water in the home.
5.	"Water Follies: A Soak Opera"	An award-winning cartoon which uses a humorous theme to illustrate the uses and abuses of water in the home.
6.	"The Day the Water Stopped"	A miniadventure film which emphasizes the difficulty of bringing water to Southern California.
7.	"Your Water Your Future"	A film which outlines California's supply-and-demand situation.
8.	"Gardening California Style"	A film which presents ways to conserve water through efficient gardening and irrigation techniques.

where a conservation message has been delivered. These tours are important because many of the participants are community leaders, and consequently, the value of the conservation message is enhanced.

Speakers Bureau

Metropolitan maintains a speakers bureau staffed by more than 50 employee volunteers. Since 1985, these volunteers have given presentations to more than 24,000 people. While the subject matter of the presentations covers a wide range of water issues, the members of the bureau frequently include a conservation message as part of their presentation.

Exhibits

Metropolitan provides a variety of exhibits to fairs, malls, banks, and other locations where there is a high volume of foot traffic. Since

1985, Metropolitan-sponsored exhibits have reached approximately 800,000 people.

Water Awareness Week

Metropolitan has played a major role in the statewide Water Awareness Week since its inception. In 1989, Metropolitan hosted a symposium on the "Greenhouse Effect on Water Resources." The symposium was attended by more than 200 people. In addition to the symposium, Metropolitan's educational program conducted a wide range of activities that included 1,750 teachers and more than 60,000 students. Participation in Water Awareness Week will continue to be a part of Metropolitan's water conservation outreach program.

Liaison Activities and Legislation

As a regional wholesaler of supplemental water, it is important for Metropolitan to maintain active relationships with interested parties. In its service area, Metropolitan maintains active and constant communication with its member agencies through its monthly Member Agency Managers Meeting and through the Southern California Conservation Committee, which is composed of the conservation coordinators from Metropolitan's member and subagencies. Topics and programs relating to conservation are actively discussed by both of these organizations. In addition to liaison activities with its member agencies, Metropolitan participates in several other organizations including the Association of California Water Agencies, the American Water Works Association, the Southern California Water Committee, and the California Department of Water Resources, Office of Water Conservation Advisory Committee. Each of these organizations maintains active conservation committees and programs.

Metropolitan reviews and supports legislation that will promote effective water conservation at the local, state, and federal levels. Table VI-4 lists legislation that Metropolitan has supported that relates to conservation.

Efficient Landscaping Programs

Metropolitan has developed two basic programs to assist in conserving water on the landscape. They are the CIMIS/Audit Program and the Xeriscape Program.

California Irrigation Management Information System/Audit Program

The California Irrigation Management Information System (CIMIS)/Audit Program is composed of two components: the CIMIS weather station network and the audit training module. CIMIS consists of a network of automated weather stations which are linked via phone lines to DWR's mainframe computer in Sacramento. Each CIMIS weather station has seven instruments which record air speed and direction, air and soil temperature, solar radiation, relative humidity, and precipitation.

There are currently 10 CIMIS weather stations located throughout Metropolitan's service area. The stations are located in Somis near Santa Paula, Pomona, Riverside, Rancho California, San Diego, Oceanside, Escondido, the Hollywood Hills, the University of California's South Coast Field Station in Irvine, and Three Valleys Water District's treatment plant in Claremont. Metropolitan has also signed an agreement with the city of Santa Monica for the siting of an additional station at their Mount Olivette Reservoir.

TABLE VI-4

CURRENT LEGISLATION IN SUPPORT OF WATER CONSERVATION

Title	Contents	Status
National Plumbing Products Efficiency Act	Federal legislation would set national standards for plumbing products such as toilets, urinals, and faucets	In committee
Assembly Bill 2355	This legislation would require all new buildings built after January 1, 1992, to have water closets and flushometer valves that use no more than 1.6 gallons per flush.	Passed
Assembly Bill 325	This bill would require the California DWR to work with a task force to adopt, by 1/1/92, a model water efficient landscape code which agencies may adopt. Each local agency must, by 1/1/93, adopt similar code or demonstrate why code is unnecessary or moel code will be deemed adopted by agency.	In committee
Assembly Bill 1375	This bill would enact the Water Quality and Water Conservation Bond Law of 1990 which, if adopted, would authorize for purposes of financing a specified program to aid in the acquisition and construction of groundwater treatment and groundwater recharge facilities, and water conservation programs, the issuance of bonds in the amount of $200 million.	In committee
Senate Bill 1520	This bill would create a tax credit of $100 for each ultra-low-flush toilet or urinals (1.6 gallons per flush or less) until 1996.	In committee
Assembly Bill 1571	This bill would enact the California Water Conservation Bond Act of 1990 which, if adopted, would authorize for purposes of financing a specified water resources conservation and development program the issuance of bonds in the amount of $100 million.	In committee

Turf Audit Program. Metropolitan has initiated a training program for managers and irrigators of large-turf areas such as golf courses, parks, cemeteries, and common areas. The Audit Program is designed to teach them how to evaluate the efficiency of their irrigation system, how to identify poor irrigation practices, and how to use CIMIS weather data to schedule irrigation frequency and volume. This program is administered for Metropolitan by the University of California Cooperative Extension Service in the counties of Los Angeles, Orange, Riverside, San Bernardino, and San Diego. The Ventura County Resource Conservation

District (VCRCD) administers the program within Metropolitan's service area in Ventura County.

Under terms of the agreements with Metropolitan, the University of California and VCRCD are required to train a minimum of 240 irrigators and irrigation managers each year in Metropolitan's audit program. Because of the nature of the program, courses are taught in the spring and fall. The first training session was recently completed with a total of 267 individuals trained in the university's program and 22 in Ventura County. In cooperation with the Irrigation Association (IA), a one-day seminar has been developed as part of the audit program. The seminar is devoted to instructing irrigators on how to modify their systems to better implement irrigation system audits. After completion of an audit training class, each participant is contacted and is offered the opportunity to have the cooperative extension personnel come to his/her place of business and assist in the evaluation of their system. Following this walk-through evaluation, the extension personnel are required to determine if the irrigation system manager is utilizing the CIMIS Program. If the manager is utilizing CIMIS, they are asked to comment on the performance of the system. If the manager is not using CIMIS, they are questioned as to why not and asked to give their opinion on how the program can be improved.

Promotion of Xeriscape

Metropolitan has been involved in the xeriscape movement for nearly a decade. Metropolitan has offered financial and staff support to both the Southern California Program based in Orange County and the San Diego Xeriscape Conferences. Financial support was also provided to the city of Yorba Linda for their 1988 Xeriscape Conference. In addition, Metropolitan cosponsored, with the city of Pasadena's Department of Water and Power and the L.A. State and County Arboretum, a Xeriscape Conference for homeowners in July of 1989.

Mass-Media Campaigns

In 1987 and 1988, Metropolitan spent over $1.4 million dollars on a special advertising program to alert the public about the statewide drought. The program was successful; it is estimated that the program was instrumental in reducing demands by 190,000 AF. During 1988, the weekly demand-reduction total was provided to the local television stations in the form of a slide which was used on the Friday night weathercast. The campaign also included distribution of literature especially designed with a drought conservation message, increased activity by Metropolitan's Speaker's Bureau, distribution of restaurant tent cards, and publication of a special newsletter to water agencies.

In 1989, Metropolitan began an extensive long-term media campaign to increase water users awareness of the importance of water as a resource and of the need for conservation. The cost for this program in 1989 was $1.3 million. Metropolitan will spend $2.6 million in 1990. The 1989 and subsequent media campaigns will emphasize the information gained from studies on the impact of the campaign in order to effect long-term behavioral changes in the use of water. In addition, $600,000 of the 1990 media campaign funds are designated for continued drought awareness information programs. An evaluation of the campaign indicated that there was a significant increase in the public's awareness on water issues and their personal water use as a result of the media campaign. It is anticipated that the media campaign will continue as part of long-term efforts to increase water conservation.

CONSERVATION RESEARCH AND DEVELOPMENT

Metropolitan has made a strong commitment to conservation, research, and development. Specific research projects are aimed at consumer adoption of water conservation measures and the development of information on technical, economic, environmental, institutional, and social effects of conservation alternatives. The major research areas and up-to-date findings and the benefits of their implementation are discussed in Table VI-5.

Public Information Research Program

In recent years a substantial research effort has been initiated by Metropolitan to enhance the effectiveness of public information campaigns promoting water conservation.

Consumer Response to Drought

The initial research project, Consumer Response to Drought (Table VI-5), involved an extensive review of efforts to influence public use of natural resources, especially the use of water during drought. From the demonstrated results of these programs, a set of guidelines was developed to inform Metropolitan on the design of mass-media campaigns urging water conservation. Also, the research of previous droughts indicated that urban water users will take action to conserve water if they:

(1) Believe that there is a need to conserve water (e.g., a serious drought).

(2) Believe that all members of the community are asked to conserve and make sincere conservation efforts.

(3) Believe that their personal conservation efforts will help mitigate the adverse consequences of water shortages.

(4) Believe that their commitments to further the welfare of the community, rather than self-interest, will have desirable long-term consequences.

(5) Believe that their efforts will involve only minimal personal cost and inconvenience.

Evaluation of Mass-Media Campaigns

Two major Metropolitan-sponsored programs, the Summer of 1988 Drought Campaign and the Summer of 1989 Conservation Campaign were evaluated. Although individually focused, these programs shared essentially the same central goal: to influence consumers toward greater knowledge of, more positive attitudes toward, and increased practice of, water conservation measures. The evaluation studies on the two campaigns were designed to assess the success of the programs in achieving that goal.

Each of the four surveys yielded time-specific data. This provided a comprehensive description of consumers' status on the subject of water use and conservation (i.e., what they knew, how they thought and felt, and what they did about it). The pre- and post-campaign survey design permitted assessment of the campaign's effectiveness. With analysis of the survey results, Metropolitan was able to determine changes in consumer knowledge and attitudes toward drought situations and measure any increased practice of water conservation.

TABLE VI-5

METRPOLITAN'S RESEARCH PROJECTS IN SUPPORT OF WATER CONSERVATION PROGRAM

	Project Title	Research Objective(s)	Completion Dates
1.	Assessment of Current Water Conservation	To identify current conservation activities of Metropolitan, its member agencies and retail water agencies.	May 1987
2.	Development of MWD-MAIN Water Use Forecasting Model	To model water demand in the Metropolitan service area for the purpose of generating water use forecasts.	November 1987
3.	Consumer Response to Drought	To review the research on factors which govern the consumer adoption of water conservation during drought.	June 1988
4.	Consumer Response to the Drought Media Campaign in Southern California	To measure the impacts of 1988 drought media campaign on consumer knowledge, attitude and behavior.	March 1989
5.	Pilot Water Conservation Projects	To determine the best methods of implementing residential water audits, residential leak detection and residential retrofits.	October1989
6.	Seasonal Components of Urban Water Use in Southern California	To determine the seasonal components of water in the major urban sectors.	February 1990
7.	Nonresidential Water Use Survey and Analysis	To examine the distribution of nonresidential uses of water among major classes and the feasibility of developing employee-use rates for estimating nonresidential water requirements for Southern California.	March 1990
8.	Water Use and Conservation in the Metropolitan Water Service Area	To update water demand projections and projections and assess the impacts of potential water conservation programs.	March 1990
9.	Analysis of Residential Household Water Use	To assess the impact of the 1988 Drought Media Campaign and to estimate residential household water use models.	April 1990

TABLE VI-5 (Continued)

METROPOLITAN'S RESEARCH PROJECTS IN SUPPORT OF WATER CONSERVATION PROGRAM

	Project Title	Research Objective(s)	Completion Dates
10.	Evaluation of Santa Monica Residential Toilet Retrofit Program	To develop a reliable methodology to measure the actual water savings attributable to the Santa Monica ULF toilet retrofit project	1992
11.	Evaluation of the Irvine Ranch Water District and Survey project	To develop a reliable methodology to measure actual water savings and the determinants of of savings in results	1992
12.	Evaluation of Water Conservation Programs	To improve the set of techniques used to measure the effects of water conservation measures	1992
13.	Evaluation of the Los Angeles Pilot Plumbing Retrofit Program	To measure consumer acceptability and actual water savings of the retrofit program	1992
14.	Evaluation of the Los Angeles ULF Toilet Rebate Program	To determine annual and seasonal conservation effects and the uncertainty associated with the estimates of the toilet rebate program	1992
15.	Evaluation of Pasadena's Retrofit Project	To measures water conservation savings attributable to the retrofit program	1992

The findings of the surveys are consistent with those found in studies of a variety of campaigns aimed at influencing elements of life style. Habitual, ingrained patterns of behavior are inherently resistant to change. The necessity for change must be dramatic and convincing. One's individual actions must be perceived as making a difference, and one's actions must not result in being disadvantageously placed relative to others. Finally, ownership of a home brings into perspective an entire psychological universe: commitment to property, concern for its maintenance, emotional and financial investment in its continued well-being, and sensitivity to possible threats. All of these act to encourage concern for the home's base of natural resources.

The 1988 Drought Campaign achieved its stated major goals. First, it identified the positions of consumers regarding knowledge of, attitudes toward, and practice of, water conservation. Second, and more important, it demonstrated changes in all three of these areas in the desired direction. These changes can be attributed to the campaign effort.

The study of the 1989 campaign strongly made two points. First, it raised the likelihood of probable limits on the extent to which the public can be persuaded. That is, the 1989 effort moved consumers little beyond the extraordinary progress achieved in the 1988 campaign. Second, the 1989 data repeat with emphasis, the 1988 finding, that the practice of conservation is overwhelmingly associated with the perceived need for it. That need is not a function of ideology, it is, rather, based firmly on the associated perceptions of environmental crisis and resource scarcity. Both campaigns lead to the ultimate conclusion that the continuance of conservation practices rests on the continuation of concern over the availability of water.

There may be other possible motivations for conservation, such as economic benefit and the shock of a reality-based awareness of the amount of water being used. The strength of these factors should be examined in the future. For now, it is the concern over water supply that mobilizes the consumer to conserve.

Research on Landscaping Technologies

Metropolitan supports research programs aimed at reducing overall water use on the landscape. The first, completed in 1985, was a five-year study of the water requirements of six commonly used turf grasses.

Of the six turf grasses included in the study, three were cool-season turfs such as Kentucky Bluegrass and Tall Fescue, while the other three were warm-season varieties such as Hybrid Bermuda and Zoysia. The results of this study clearly showed that cool-season varieties cannot tolerate reductions in their overall water requirements. The cool-season varieties do poorly relative to tolerance and invasion by other species and are simply poorly adapted to Southern California's environment.

Warm-season species were able to withstand reductions in applied water by as much as 60 percent below evapotranspiration (ET) rate for sustained periods, and yet still performed well. Also, they were not subject to disease or pest infestation. The results of this study were used in determining ET coefficients for turf and are being used in the CIMIS/Audit Program.

A study of water use by commonly used landscape trees was the second research project to be funded by Metropolitan. This three-year study was completed in June 1989 and developed ET coefficients for four commonly used ornamental trees. These coefficients are being adapted for use in the CIMIS/Audit Program.

A third study is aimed at determining the water use requirements of 36 commonly used ornamental shrub species. This three-year study will test stress response of these shrubs to water applications at 100, 80, 60, and 40 percent of ET. The results of all three studies will be used in education programs to enable landscape professionals and homeowners to match turf, trees, and shrubbery of similar water needs on a landscape that is water-efficient and aesthetically pleasing.

Research on Retrofit Methods and Conservation Audits

The conservation alternatives included in several research efforts were:

(1) Residential water audits
(2) Residential leak detection
(3) Retrofit kit distribution and low-flow showerhead survey

The overall purpose was to determine the best methods of implementing these three water conservation programs in Metropolitan's service area by examining the implementation modes of these programs, their cost-effectiveness, and customer receptivity. The project included the first field test of residential water audits and sonic equipment for leak detection. The type of retrofit program conducted for Metropolitan had not been previously used in Southern California. The project was structured to develop implementation guidelines for the three programs and to involve member agencies in new water conservation programs.

The residential water audit pilot program was designed to test the receptivity of homeowners to interior and exterior water audits as well as their willingness to adopt water-saving measures voluntarily following an audit. Five water agencies in different climate zones in Metropolitan's service area were selected: city of Burbank, city of Costa Mesa, Eastern Municipal Water District, Las Virgenes Municipal Water District, and city of San Diego.

The water audit was well received and found useful by customers. The small sample size of the pilot program made it difficult to draw meaningful conclusions as to amounts of water saved. Estimates of water savings were reported as 7 percent (21 gpd) for individual homes for inside water use, while outside water use changes varied greatly.

The leak detection program was initiated in the cities of Pasadena and Torrance. Sonic leak detection equipment was used to find leaks in household plumbing, a unique application of this technology. Leaks were located in 21 percent of the surveyed homes in Torrance and in 35 percent of homes surveyed in Pasadena. Upon notification of these leaks, a 40 percent repair rate was determined in Torrance, with a 22 percent repair rate in Pasadena (based upon response to follow-up telephone calls). This program was well received by the community participants. Water savings from this program were estimated to be approximately 4.5 gpd for each surveyed house.

The retrofit pilot program was implemented in the Westchester area of Los Angeles. One goal of the program was to determine whether the number of follow-up visits had an impact on the overall rate of customer installation of the retrofit kits.

The installation rates and resultant water savings were lower than those reported for full-scale projects at other locations (i.e., San Jose). These results may be due in part to the small size of the project, little advance public notice, or other uncontrollable factors.

VII. CONSERVATION THROUGH PRICING, RATE STRUCTURES AND REGULATIONS

PRICING POLICY

This chapter provides a review of the water resource pricing policies of Metropolitan. Because more than 75 percent of Metropolitan's total revenue is derived from water sales, the pricing policy can be instrumental in controlling the use of Metropolitan's supplies and influencing the investment in additional resource development projects.

Historical Pricing Approach

Historically, Metropolitan's pricing policy has been based on the principle of charging "like rates for like services." This principle is imbedded in a system of water rates that is frequently referred to as "postage stamp-pricing." Under this pricing system, separate rates are established for different types of service (e.g., noninterruptible treated-water service, interruptible untreated-water service, emergency service, and others). However, the price of water for a given service does not discriminate against member agencies located at more distant locations relative to Metropolitan's aqueducts. The postage stamp pricing system is used because Metropolitan's local delivery system is completely interrconnected, and the cost of water transmission within the six-county service area represents only a very small fraction of the total cost of water importation and treatment.

Current Approach to Pricing

During the last decade, Metropolitan has developed a pricing policy based on the use of incentive programs, which encourages efficient use of imported supplies and promotes better water management in Southern California. This policy recognizes that Metropolitan, as a wholesale agency, has no authority, nor does it have the ability, to establish retail water rates in its service area. The wholesale price of water purchased from Metropolitan represents only one of many factors that affect retail prices and retail structures of water rates. As a result of the rate-setting procedures used by retail agencies and the fact that Metropolitan's supplies are primarily used as a supplement to local supplies, on average, only about 10 to 20 percent of the percentage increase in Metropolitan rates will appear in retail prices. Therefore, a 10 percent increase in Metropolitan wholesale rates would result in only a 1 to 2 percent increase in average retail rates.

Because of Metropolitan's lack of authority to establish retail water rates, it has implemented an innovative system of positive economic incentives. They achieve the same effect as major increases in wholesale prices but do not require a change in the general wholesale rate and will not generate a substantial amount of excess revenue. Since 1981, six incentive programs have been developed and implemented. These programs include:

(1) Interruptible Water Service Program of 1981
(2) Local Projects Program of 1981
(3) Water Conservation Credits Program of 1988
(4) Seasonal Storage Program of 1989
(5) The 1977 Drought Pricing Surcharge Program
(6) The 1990 Drought Pricing Rebate Program

All of these programs are periodically modified in order to improve their effectiveness in achieving efficient use of water in the region. Each program is discussed in this chapter or other chapters of this plan.

METROPOLITAN'S FINANCIAL STRUCTURE

Sources of Revenue

In discussing Metropolitan's water rates, it is necessary to put them in context with the other sources of Metropolitan's revenue. As a public agency, Metropolitan does not operate to earn a profit. Also, it is exempt from many types of taxes. However, it has certain costs that must be paid each year, and consequently it must receive sufficient revenue to cover its costs. Metropolitan's primary source of income is revenue from the sale of water. Other sources include property taxes, annexation charges, electric power sales revenue, interest earnings, and miscellaneous income such as rent for land.

Water revenues and tax revenues are the two most important sources of income. Currently Metropolitan's water rates and tax rates are based on a "proportionate-use formula" that was adopted in 1979. The purpose of this formula is to provide an equitable method of allocating capital costs between water users and taxpayers. The basic concept of the proportionate-use formula is that funds collected through water rates cover all delivery costs, operations and maintenance, and a portion of capital costs representing the "used" capacity of Metropolitan's delivery system. Funds collected through tax levies cover the remaining capital costs which represent the "unused" capacity of the delivery system. The proportionate-use formula will remain in effect until the beginning of fiscal year 1990-91. A new rate structure will become effective as a result of an action taken by the state legislature.

Regulatory Actions

In September 1983, the California Legislature passed and the Governor approved Statute 1983, Chapter 1324. It added Section 97.6 to the Revenue and Taxation Code. This code requires Metropolitan to submit a report to the legislature, detailing its plans and recommendations for reducing its reliance on property taxes. The statute also provided that Metropolitan could not impose a property tax rate for voter-approved indebtedness for fiscal year 1982-83 unless at least 80 percent of Metropolitan's Board of Directors found that a fiscal emergency existed that required an increase.

In March 1984, Metropolitan submitted a report to the California Legislature in response to the requirements of Revenue and Taxation Code, Section 97.6. In this report, a two-year exemption from the above tax limitations was requested while Metropolitan's staff, Board of Directors, and consultants analyzed Metropolitan's financial conditions and prepared recommendations to reduce Metropolitan's reliance on taxes.

In April 1984, Metropolitan's Board of Directors proposed an amendment to the Metropolitan Water District Act in response to the Revenue and Taxation Code, Section 97.6. This amendment was intended to establish Metropolitan's future taxation policy. SB 1455 was approved by the legislature as Statute 1984, Chapter 271 and signed by the Governor in June 1984. It included the addition of Section 124.5 to the Metropolitan Water District Act. After July 1, 1990, Metropolitan will limit its tax levy, other than special annexation taxes, to the amount needed to pay (1) the general obligation bond debt service of the Metropolitan Water District and (2) that portion of Metropolitan's payment obligation allocable to debt service on the state's general obligation bonds (the Burns-Porter Act Bonds) which were outstanding in 1984 and which had been used to finance State Water Project facilities of benefit to Metropolitan. Taxes will cease to be levied when the general obligation bonds of Metropolitan and the State Water Project are fully paid. Chapter 271 of the California Statute 1984 provides that in times of financial necessity, however, taxes may be increased beyond this limit.

Implementation of Section 124.5 will cause a gradual increase in water rates as a greater portion of Metropolitan's capital costs will be collected through water rates rather than property taxes. Until water deliveries began in 1941, Metropolitan's activities were, by necessity, supported entirely through the collection of property taxes. Since then, revenues from water sales have increased and now represent nearly 75 percent of Metropolitan's total revenues. The basic rate for untreated water for domestic and municipal uses has increased from $8 per acre-foot in fiscal year 1941-42 to $197 per acre-foot for fiscal year 1988-89, while the general tax rate for Metropolitan's purposes has been gradually reduced from a peak equivalent rate of 0.1250 percent of full assessed valuation in fiscal year 1945-46 to 0.0110 percent of full assessed valuation in fiscal year 1988-89. By the year 2024, when the bonds have been fully paid, it is projected that Metropolitan will no longer levy an ad valorem property tax.

WHOLESALE WATER RATES

History of Metropolitan Wholesale Water Rates

Table VII-1 presents Metropolitan's historical water rates. Major revisions of water rates took place in 1974 and 1981. The pricing structure affects the "average cost" of water to member agencies. Between 1980 and 1989, the average cost of Metropolitan's water has increased from $97 to $231 per acre foot (Table VII-2). This average cost is obtained by dividing water sales revenue (accrual) by total volume of water sold. Between 1980 and 1989, the average cost per acre-foot has increased by 138 percent. However, after removing the effects of general price inflation (by converting the historical rates to constant dollars), the real increase in Metropolitan's was 61 percent or 7.6 percent per year. In the future, Metropolitan's water rates are projected to increase because additional water supplies will be developed, additional water treatment and distribution facilities will be constructed, and the operation, maintenance, and replacement costs are likely to increase.

As the wholesale price for water service continues to increase, member agencies will find it necessary to increase local water rates. The specific effect on a member agency's retail rates depends on how much water an agency purchases from Metropolitan, how each agency plans to handle any price increases, and which

TABLE VII-1

HISTORY OF METROPOLITAN WATER RATES
(DOLLARS PER ACRE-FOOT)

Period		Softened & Filtered Water			Filtered Water			Untreated Water		
		Domestic	Agri-cultural	Underground Reple-nishment	Domestic	Agri-cultural	Underground Reple-nishment	Domestic	Agri-cultural	Underground Reple-nishment
8/01/41	6/30/48	15.00	--	--	--	--	--	8.00	--	--
7/01/48	6/30/50	18.00	--	--	--	--	--	8.00	--	--
7/01/50	11/30/54	20.00	--	--	--	--	--	10.00	--	--
12/01/54	4/30/55	18.00	--	--	--	--	--	8.00	--	--
5/01/55	10/31/55	22.00	--	--	--	--	--	10.00	--	--
11/01/55	11/30/55	18.00	--	--	--	--	--	8.00	--	--
12/01/55	4/30/56	20.00	--	18.00	--	--	--	10.00	--	8.00
5/01/56	6/30/57	20.00	--	--	--	--	--	10.00	--	--
7/01/57	6/30/58	22.00	--	--	--	--	--	12.00	--	--
7/01/58	6/30/60	25.00	22.00	22.00	--	--	--	15.00	12.00	12.00
7/01/60	12/31/60	23.00	20.00	20.00	--	--	--	15.00	12.00	12.00
1/01/61	12/31/61	25.00	20.75	20.75	--	--	--	17.00	12.75	12.75
1/01/62	12/31/62	27.00	21.50	21.50	--	--	--	19.00	13.50	13.50
1/01/63	12/31/63	29.00	22.25	22.25	--	--	--	21.00	14.25	14.25
1/01/64	6/30/64	32.00	23.00	23.00	29.00	20.00	20.00	24.00	15.00	15.00
7/01/64	6/30/65	34.00	24.25	24.25	30.00	20.25	20.25	25.00	15.25	15.25
7/01/65	6/30/66	37.00	25.00	25.00	33.00	21.00	21.00	28.00	16.00	16.00
7/01/66	6/30/67	40.00	26.00	26.00	36.00	22.00	22.00	31.00	17.00	17.00
7/01/67	6/30/68	43.00	27.00	27.00	39.00	23.00	23.00	34.00	18.00	18.00
7/01/68	6/30/69	46.00	28.00	28.00	42.00	24.00	24.00	37.00	19.00	19.00
7/01/69	6/30/70	49.00	29.00	29.00	45.00	25.00	25.00	40.00	20.00	20.00
7/01/70	6/30/71	53.00	30.00	31.00	49.00	26.00	27.00	44.00	21.00	22.00
[a]7/01/71	6/30/72	57.00	31.00	33.00	53.00	27.00	29.00	48.00	22.00	24.00
[a]7/01/72	8/12/73	61.00	32.50	36.00	57.00	28.50	32.00	52.00	23.50	27.00
[a]8/13/73	9/30/74	68.00	37.00	42.00	63.00	32.00	37.00	56.00	25.00	30.00

TABLE VII-1 (Continued)
HISTORY OF METROPOLITAN WATER RATES (DOLLARS PER ACRE-FOOT)

Period		Treated			Untreated		
		Domestic	Agricultural	Replenishment	Domestic	Agricultural	Replenishment
10/01/74	6/30/75	63.00	32.00	37.00	56.00	25.00	30.00
7/01/75	6/30/76						
Colorado		67.00	34.00	41.00	58.00	25.00	32.00
State		77.00	44.00	51.00	68.00	35.00	42.00
7/01/76	6/30/77						
Colorado		75.00	42.00	49.00	62.00	29.00	36.00
State		81.00	48.00	55.00	68.00	35.00	42.00
[b]7/01/77	6/30/78	84.00	50.00	58.00	67.00	33.00	41.00
7/01/78	12/31/78	95.00	61.00	69.00	74.00	40.00	48.00
1/01/79	6/30/79	100.00	66.00	74.00	79.00	45.00	53.00
7/01/79	6/30/80	104.00	70.00	78.00	79.00	45.00	53.00
7/01/80	6/30/81	115.00	76.00	85.00	90.00	51.00	60.00

Period		NONINTERRUPTIBLE		INTERRUPTIBLE		EMERGENCY		RECLAIMED[d]
		Untreated	Treated	Untreated	Treated	Untreated	Treated	
		Domestic, Replenishment, and Reservoir		Domestic, Replenishment, Agricultural and Reservoir		Domestic	Domestic	
[c]7/01/81	6/30/82	96.00	121.00	61.00	86.00	300.00	325.00	--
7/01/82	6/30/83	114.00	140.00	79.00	105.00	318.00	344.00	--
7/01/83	12/31/83	144.00	172.00	100.00	128.00	344.00	429.00	84.00
1/01/84	6/30/85	197.00	229.00	153.00	185.00	591.00	623.00	84.00
7/01/85	6/30/86	192.00	224.00	148.00	180.00	586.00	618.00	84.00
7/01/86	6/30/89	197.00	230.00	153.00	186.00	591.00	624.00	84.00
[e]7/01/89	Present	197.00	230.00	153.00	186.00	591.00	624.00	84.00

a Prices for State project water, starting in April 1972, were $5.00 greater than corresponding prices for Colorado River water and, starting in August, 1973, were $10.00 greater through September30, 1974.

b Differential rates for State and Colorado River water were eliminated July 1, 1977.

c New rate structure became effective July 1, 1981.

d Reclaimed rate established November 1, 1983.

e Rates for interruptible service and seasonal storage service are reduced by $5.00 per acre-foot for water sold to any member public agency whose governing body adopts a resolution stating its commitment that the savings resulting from such reduction will be placed into a special account to be used for programs to store or conserve water that will be available to meet domestic or municipal demands.

TABLE VII-2

AVERAGE COST OF METROPOLITAN'S SUPPLIES

Fiscal Year	Water Sales Accrued ($ Million)	Water Sales (1,000 AF)	Average Cost Per AF (Nominal Dollars)	Average Cost Per AF (1989 $)
1980-81	141.3	1,462	97	151
1981-82	146.1	1,503	97	136
1982-83	146.0	1,227	119	157
1983-84	245.6	1,428	172	222
1984-85	315.8	1,574	201	250
1985-86	329.4	1,642	201	239
1986-87	373.5	1,826	205	236
1987-88	392.6	1,922	204	226
1988-89	486.8	2,109	231	243

The average cost was calculated by dividing the total water sales revenue by the quantity of water sold. Metropolitan 1988-89 Financial Report

TABLE VII-3

ADOPTED WATER RATES FOR FISCAL YEAR 1990-1991

Type of Service	Water Rate $/AF	Water Rate $/1000 gal.
Noninterruptible		
Untreated	197	0.61
Treated	230	0.71
Interruptible[a]		
Untreated	153	0.47
Treated	186	0.57
Emergency		
Untreated	591	1.81
Treated	624	1.91
Seasonal[a]		
Untreated	115	0.35
Treated	135	0.41
Reclaimed	84	0.26

[a] Rates for interruptible service and seasonal storage service are reduced by $5.00 per acre-foot for water sold to any member public agency whose governing body adopts a resolution stating its commitment that the savings resulting from such reduction will be placed into a special account to be used for programs to store or conserve water that will be available to meet domestic or municipal demands.

types of service an agency relies on. Table VII-3 shows the water rates adopted for fiscal year 1990-91. The current water service rates are briefly discussed below.

Water Service Rates

Noninterruptible Water Service

Water delivered for domestic and municipal purposes requiring continuity of service is delivered as noninterruptible supply. Noninterruptible service refers to water that is used for domestic and municipal purposes. It is not subject to interruption or reduction in demands except as a last resort during shortages.

Interruptible Water Service

Interruptible service includes the portion of water delivered for domestic and municipal purposes that could be interrupted or reduced for a one- to three-year period. Some of these supplies are used for direct groundwater replenishment (spreading), in lieu groundwater replenishment, surface storage, or seawater barrier projects. Interruptible service also includes water delivered for agricultural purposes. Such service is subject to interruption for an indefinite period upon one year's notice.

Emergency Water Service

Emergency service is available only in the event a member agency cannot sustain the interruption to which it had agreed and thus requires uninterrupted water deliveries to see it through the emergency.

Reclaimed Water

The wholesale price of reclaimed water is set below its production cost in order to encourage the use of renovated water.

POSITIVE INCENTIVE PRICING PROGRAMS

Interruptible Water Service Program of 1981

In March 1981, the Metropolitan Board of Directors adopted an incentive program which provides economic incentives to encourage member agencies to store imported water in either surface reservoirs or groundwater basins for use during periods of peak use or during droughts. A detailed description of this program is given in Chapter IV. The Interruptible Water Service Program encourages the integration of member agencies storage operations with Metropolitan's imported supplies and meets the supplemental water needs for which alternative supplies do not exist.

Local Projects Program of 1981

Metropolitan provides economic incentives to local agencies to encourage the development of water reclamation and desalinization projects under the Local Projects Program established in 1981. A more detailed description of this program is given in Chapter IV. Under this program Metropolitan provides a financial contribution of $154 per AF of "new water" from a local project which replaces a firm demand for Metropolitan supplies. This incentive provides local agencies with strong financial incentives to pursue reclamation and de-

salinization projects that would otherwise be uneconomic.

Water Conservation Credits Program of 1988

Because of uncertainties in potential consumer response to price changes and the limited effect of Metropolitan's wholesale rates on retail prices of water, another innovative approach to accomplishing water conservation through economic incentives (other than retail prices) was implemented in 1989.

The financial incentives for water conservation are a part of the Water Conservation Credits Program. Under this program Metropolitan will pay member agencies and subagencies $154 per acre-foot for demonstratable water savings up to one-half of the cost of each qualifiable conservation project. A detailed description of this program is included in Chapter VI.

Seasonal Water Storage Program of 1989

The Seasonal Storage Program, adopted by Metropolitan in 1989 is described in Chapter IV. It provides an economic incentive for member agencies to purchase water from Metropolitan during winter months for local storage. It is aimed at encouraging construction of additional local storage and treatment facilities and at reducing member agencies' dependence on Metropolitan's deliveries during the peak summer months. Greater utilization of existing and potential local agencies' storage reserves is generally regarded as an economical method of providing a portion of needed future storage in Metropolitan's service area.

The 1977 Drought Pricing Surcharge Program

During periods of potential shortages, Metropolitan uses price incentives to encourage water conservation by member agencies and their customers. Past drought pricing policies used a combination of financial penalties and positive incentives which were tailored to the severity and duration of drought.

The economic incentive during the 1977 drought involved a 100 percent surcharge which was added to the domestic and municipal rate for all quantities of water delivered in each month in excess of 90 percent of deliveries in 1976 in the corresponding month. The surcharge, which began April 1, 1977, was applied each month thereafter, with an allowance for adjustments in subsequent months, whenever water use fell below the 90 percent level. As a further incentive, a $20 credit was given for each acre-foot of water by which an agency reduced its demand below 90 percent of 1976 deliveries.

The $20 credit incentive was to be applied from April 1 to September 30, 1977. However, the margin of savings achieved below the 90 percent base amount was required to be maintained by each agency during the entire economic inventive program, which was tentatively scheduled to end March 31, 1978. If this margin was not maintained, the $20 credit was to be returned to the District.

This pricing program together with the public education program and the free distribution of 100,000 conservation kits resulted in a short-term reduction in demand in Southern California estimated at between 12 to 15 percent.

The 1990 Drought Pricing Rebate Program

In order to achieve a 10 percent reduction in demand in 1990, Metropolitan adopted a drought rebate program which offers strong positive financial incentives to develop effective programs that reduce water demands. Under the drought rebate program, member agencies will receive a rebate of $100/AF for all reductions in 1990 total retail water demands during the months of June, July, August, and September below 95 percent of demands during the same months in 1989, after adjusting for population growth. Member agencies have the option of passing all or any portion of the rebate through to their subagencies. Payments to member agencies will be made only for reductions in water use beyond 5 percent. This is because reductions of approximately this magnitude should occur due to the $3.4 million summer conservation media campaign of 1990 and due to increasing general awareness of the drought as the result of the summer media campaigns of 1988 and 1989. Drought rebate payments are based on changes in total retail water demands and not on changes in demands for Metropolitan water to encourage real conservation. Payments to eligible member agencies require certification that reduced demands on Metropolitan are not achieved through increased use of other supply sources or through withdrawals from local storage. Furthermore, the reduction in retail demand eligible for payment will not exceed the total supplemental water purchases from Metropolitan in 1989.

CONSERVATION EFFECTS OF RETAIL PRICING

Metropolitan's rate structure described in the previous sections is designed to encourage the efficient use of imported supplies by member agencies and their subagencies. Metropolitan's wholesale rates encourage these agencies to set their retail prices and the structures of retail water rates so that households and businesses in Southern California use water efficiently.

It should be noted, however, that Metropolitan is a wholesale water agency. As such, it has no retail customers and, therefore, no retail water rates. Metropolitan has no authority, nor does it have the ability, to establish retail water rates in its service area. Any discussion of retail rates, such as increasing block, seasonal prices, and other conservation incentive structures is included in plans prepared by local agencies. In fact, Water Code Section 10610.2(b) states that "The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level." The following sections describe the average retail prices in Southern California and present the theoretical relationships between prices and water use.

Retail Prices of Water

A survey of retail prices of water services in Southern California was conducted as part of a Metropolitan water demand study. Table VII-4 summarizes retail "average prices" of water obtained from 45 agencies in the six counties in Metropolitan's water service area. The 1980 weighted average price was $0.72/1000 gallons, while the 1990 average price has risen to $1.55/1000 gallons, an apparent increase of 115 percent over 10 years. However, after converting the 1980 value to 1990 dollars (thus removing the effect of general price inflation), the real increase in water price was 40 percent for the decade.

TABLE VII-4

1990 RETAIL WATER PRICES IN SOUTHERN CALIFORNIA

County	Number of Sampled Agencies[a]	Range of Average Prices $/1000 gal. $/AF	Weighted County Average $/1000 gal. $/AF
Los Angeles	17	1.11 - 2.63 362 - 857	1.62 528
Orange	12	0.84 - 2.42 274 - 789	1.37 446
Riverside	4	0.91 - 2.05 297 - 668	1.04 339
San Bernardino	2	0.92 - 1.35 300 - 440	1.14 371
San Diego	6	1.52 - 2.72 496 - 887	1.70 554
Ventura	4	1.42 - 1.79 463 - 584	1.56 509
Total Area	45	0.84 - 2.72 274 - 887	1.55 505

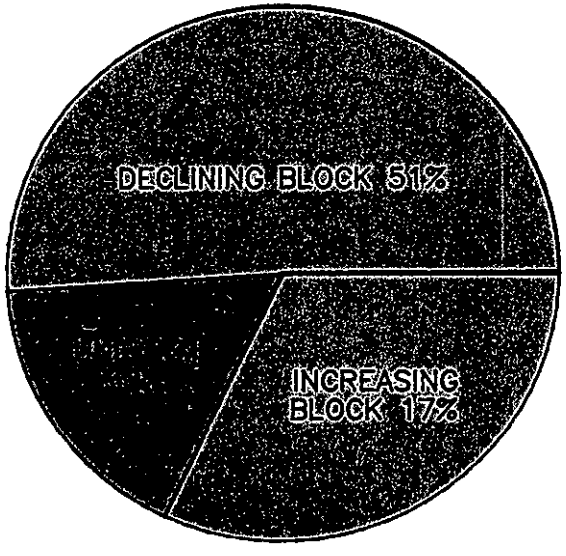
[a]The 45 agencies surveyed serve approximately 9 million people (or 65 percent of the population in Metropolitan's service area).

A summary of the types of retail water rate structures that are used by 51 local agencies is presented in Table VII-5. The percentage of water rate by type in Metropolitan's service area and in the nation are compared in Figure VII-1. All surveyed agencies charged retail customers based on the quantity of water used during a monthly or bimonthly billing period. Twelve agencies also used sewer charges which depended on the quantity of water used. The prevailing rate structure in Southern California is a uniform rate. Twenty agencies use a simple uniform rate under which the total charge consists of a fixed service charge (depending on meter size) and a commodity charge calculated as the product of the number of units used and a uniform charge per unit (typically one unit is 100 cubic feet (CCF)). Another common type of a uniform rate is one with minimum-use allowance, where a small quantity of water is included in the service charge.

FIGURE VII–1

WATER RATE STRUCTURE: PERCENT BY TYPE

A. U.S. WATER AGENCIES



B: SOUTHERN CALIFORNIA AGENCIES

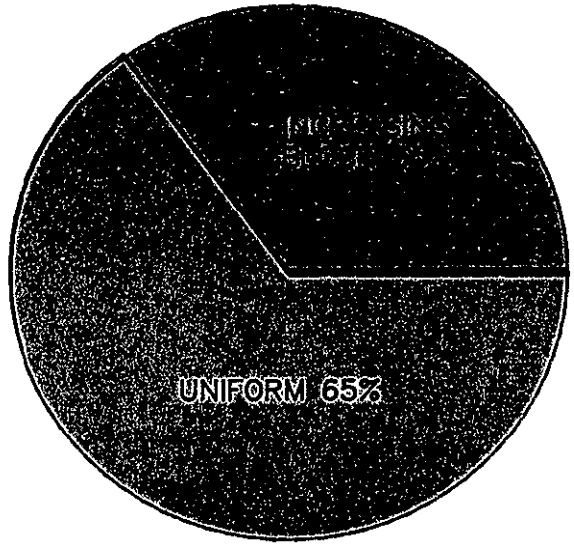


TABLE VII-5

WATER RATE STRUCTURES: PERCENT BY TYPE

Type of Rate Structure	Number of Agencies	Percent
Uniform rates	33	65
Uniform with industrial rate	1	2
Uniform rate	20	40
Uniform with minimum allowance	10	19
Uniform with geographic differentials	1	2
Uniform with seasonal differentials	1	2
Increasing block rates	18	35
Increasing block	11	21
Increasing block w/minimum allowance	4	8
Increasing block w/industrial rate	2	4
Increasing block with geographic differential	1	2
TOTAL	51	100%

Increasing (or inverted) block rate is the other most common type of retail rate structure in Southern California. Under this rate the incremental charge per each billing unit of water (typically 100 cubic feet) depends on the number of units used. The traditional increasing block is used by 11 agencies. Four agencies use increasing block rates with a minimum-use allowance included as a service charge.

Seasonal and geographical rate differentials are used by three agencies including the city of Los Angeles. These differentials are combined either with a uniform or an increasing block structure.

In summary, all agencies surveyed use conservation-oriented rate structures (uniform and increasing block) which provide economic incentives for consumers to conserve water. The retail rate structures in Metropolitan's service area depart from the nationwide industry norm of using declining block rates. Only three agencies used a lower block charge at a higher

quantity used; however, this charge is designed specifically for industrial and commercial users who use, respectively, more than 80, 100, or 250 CCF per billing period in each agency.

The retail prices are a function of many factors, one of which is the wholesale price of water purchased from Metropolitan. A recent Metropolitan study of the relationship between the wholesale price and the retail price suggests that only about 10 to 20 percent of the percentage increase in Metropolitan rates will appear in retail prices. This is a result of the rate-setting procedures of retail agencies and the fact that Metropolitan supplies are primarily used as a supplement to local supplies.

As shown in Table III-1 (Chapter III), Metropolitan's water supplies account for about 55 percent of the total water used within its service area. The remainder comes from local groundwater and other supplies, including the supply from the Los Angeles Aqueducts. These supplies are less expensive than Metropolitan's water and therefore lower the cost of the total supply of water available to retail water purveyors. On the other hand, retail water purveyors have constructed, maintained, and operated extensive distribution systems in addition to developing their own supplies and purchasing water from Metropolitan. The costs of these systems tend to boost overall retail water rates above Metropolitan's wholesale rate.

While retail water rates are generally higher than wholesale rates, they are also less subject to price escalation. Local water supplies in Metropolitan's service area are almost fully developed, and future capital expenditures for new projects will be limited. The additions to the existing local distribution systems in most cases will be small increments added to the large, existing systems. For these reasons, it is anticipated that retail water rates will increase less rapidly than Metropolitan's wholesale rates. Consequently, urban water demands are not expected to be significantly affected by future price increases.

Consumer Response to Changes in Water Rates

The understanding of consumer behavior in responding to changes in water rates is critical to the efficient management of urban water demand. Retail water agencies in Southern California can implement price incentives only if they can predict the effects of price changes upon the current and future use of water by their customers. However, the current status of knowledge does not allow predictions of the effectiveness of alternative rate designs in reducing water use with a level of reliability that is required in water supply planning.

Metropolitan has undertaken a major research effort in order to examine the potential of using price incentives to conserve water in Southern California. Some preliminary findings of this research are summarized below.

Theoretical Basis of Price Effects

Economists predict the consumer response to price based on the theory which states that the quantity demanded is a function of price paid for the last unit of water used. This responsiveness to price is often characterized in terms of the price elasticity of water demand, a dimensionless measure of the relationship between a fractional change in water use which will result from a fractional change in price when other factors affecting water demand remain unchanged. Figure VII-2 illustrates the price-demand relationships and also shows the effects of nonprice variables on water demands. The price elasticity of water demand is typically

measured through statistical analysis of a large number of observations on price and quantity demanded. Table VII-6 is a compilation of price elasticity estimates from previous studies of urban water demand. However, many of these studies lack the sophistication of study design and appropriate databases to produce reliable estimates of price elasticity. Most frequently the questionable reliability of estimated price elasticity coefficients is a result of poor quality of data (sample selection), choice of explanatory variables, and other elements of study design.

Measurement Problems

Metropolitan's research on the relationship between price and water demand indicates that there are four major issues which remain unresolved:

(1) The need to identify a proper measure of the price variable in multiple-part price structures (such as increasing-block or decreasing-block rates)

(2) Unverified assumption about the observed price being independent of water use

(3) The distinction between short-term and long-term responses to price changes

(4) The interaction between price response (demand reduction) and the effects of other conservation measures

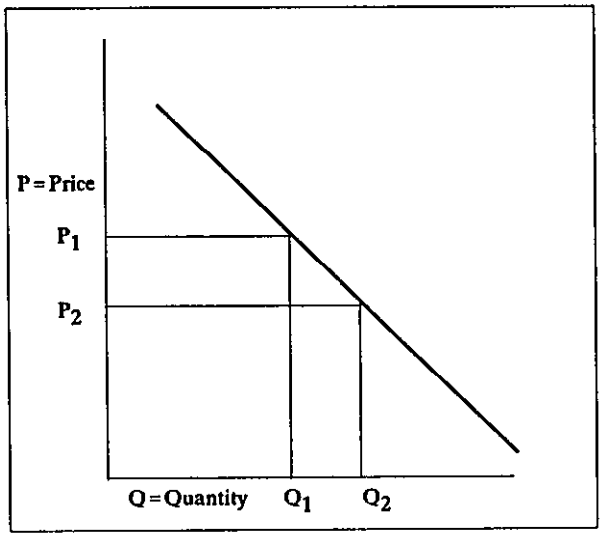
About 90 percent of retail water agencies sell water under multipart tariffs. If the observations on price are taken from such tariffs, then neither marginal nor average price is capable, at least in theory, of capturing the response of consumers to alternate rate designs and price levels. For most rate designs, average price is a fair surrogate for marginal price while reflecting changes in total water bill due to changes in service charge.

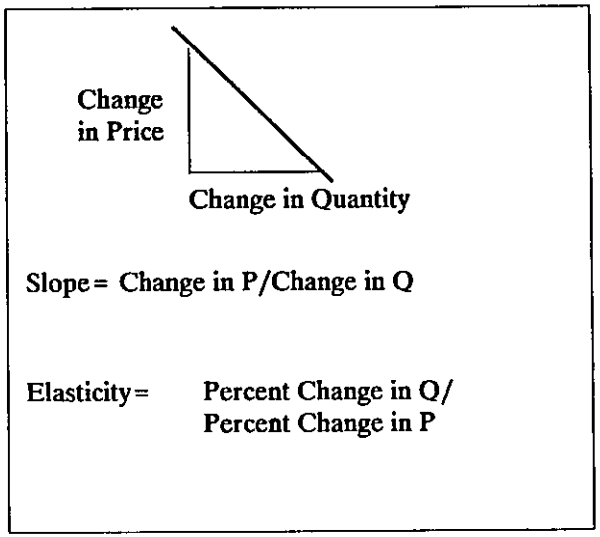
Most empirical studies of water demand assume that the observed prices are independent of water use. In reality, the prices are determined through a rate-setting process in which the revenue is related to total quantity of water used, and price should be treated as a dependent variable. Considering the most common rate-making philosophy of spreading the total cost of water service among consumers (i.e., average-cost pricing), one may argue that water use in some small communities is not low because the price of water is high, instead the prices are set high because water use is low. An increase in water use in such communities could lead to the reduction of water rates. The problem of nonexogenous prices is most severe in cross-sectional studies, where the observed variation in the level of water use among different communities may be incorrectly attributed to variation in prices.

The responsiveness of water users to price signals can be expected to be greater over a long period of time when the stock of water-consuming capital goods can be replaced with more efficient goods (i.e., front-loaded washing machines, drip irrigation system). The lack of information on the time required to achieve a desired level of adjustment in water use is compounded further by the problem of determining the range of validity for point price elasticity estimates. Theoretically, only the effects of small changes in price are quantified by price elasticity. Therefore, for example, the effects of an average 60 percent retail price increase in a given year cannot be accurately predicted using point price elasticity estimates.

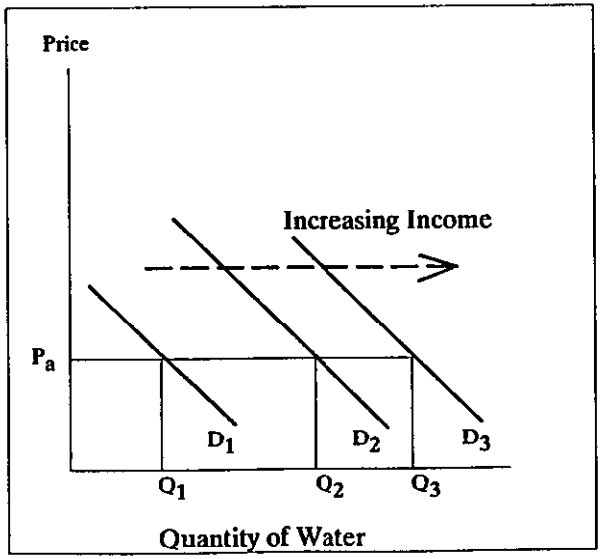
FIGURE VII-2

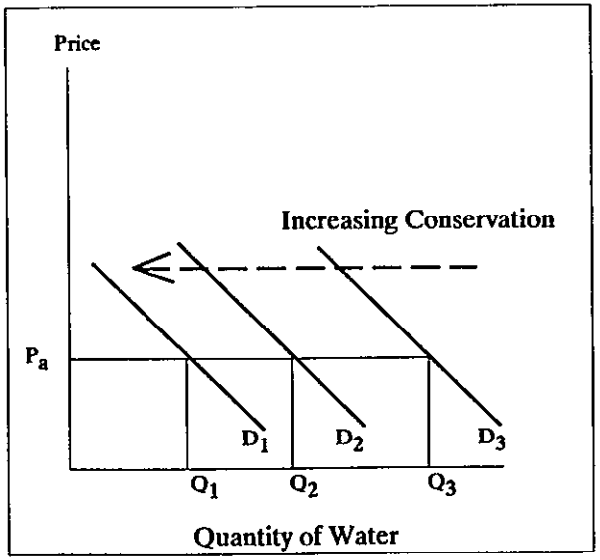
WATER PRICE-DEMAND RELATIONSHIP





(a) Slope and Elasticity





(b) Effects of Income and Conservation on Water Demand

TABLE VII-6

ESTIMATED ELASTICITIES OF DEMAND FOR WATER

Reported Price Elasticity	Author	Year	Type of Analysis
-0.12 to -1.00	Seidel & Baumann	1957	MUNICIPAL DEMAND
-0.12 to -1.00	Flack	1965	Average Price & Cross-Sectional Data
-0.27 to -0.82	Wong	1972	
-0.65	Metcaff	1929	
-0.67 to -1.23	Gottlieb	1963	
-0.77	Gardner & Schick	1964	
-1.10	Bain et al.	1966	
-0.02 to -0.28	Wong	1972	MUNICIPAL DEMAND
-0.39 to -0.46	Sewell & Roueche	1972	Average Price & Time Series or Pooled Data
-0.41 to -0.65	Young	1974	
-0.43 to -0.45	Morgan & Smoloen	1973	
-0.47	Hansen & Norayson	1973	
		1973	
-0.60 to -0.63	Clark & Goddard	1977	MUNICIPAL DEMAND Marginal Price & Cross-Sectional Data
-0.05 to -0.70	Carver & Boland	1980	MUNICIPAL DEMAND Marginal Price & Time Series or Pooled Data
-0.18 to -0.34	Jones & Morris	1984	AVERAGE ANNUAL & MONTHLYRESID.
-0.20 to -0.68	Male & Fredrick	1979	Average Price & Cross-Sectional Data
-0.25 to -0.28	Turnovsky	1969	
-0.26 to -0.45	Primeaux & Hollman	1973	
-0.30 to -0.69	Foster & Beattie	1979	
-0.61 to -0.67	Ware & North	1967	
-0.92	Grunewald et al.	1978	
-1.02 to -1.09	Conley	1967	
-0.14 to -0.33	Pope et al.	1975	AVERAGE ANNUAL & MONTHLY RESID.
-0.62	Gibbs	1978	Average Price & Time Series or Pooled Data
-0.15 to -0.24	Gardner	1979	AVERAGE ANNUAL & MONTHLY RESID.
-0.16 to -0.39	Morris & Jones	1980	Marginal Price & Cross-Sectional Data
-0.24 to -0.31	Camp	1978	
-0.39	Fourt	1958	
-0.44	Hittman Assoc. Inc.	1970	
-0.73	Ben-Zvi	1980	
-0.93	Grima	1972	
-0.21 to -0.30	Cessuts & Ryan	1979	AVERAGE ANNUAL & MONTHLY RESID.
-0.27	Danielson	1979	Marginal Price & Time Series or Pooled Data
-0.51	Gibbs	1978	
-0.56 to -0.86	Hogarty & Mackey	1975	

TABLE VII-6 (Continued)

ESTIMATED ELASTICITIES OF DEMAND FOR WATER

Reported Price Elasticity	Author	Year	Type of Analysis
-0.07 to -0.21	Jones & Morris	1984	AVERAGE ANNUAL & MONTHLY RESID. Two-Part Price Variable & Cross-Sectional Data
-0.18 to -0.50	Agthe & Billings	1980	AVERAGE ANNUAL & MONTHLY RESID.
-0.27 to -0.49	Billings & Agthe	1980	Two-Part Price Variable
-0.56 to -0.66	Billings	1982	
-0.29	Morris & Jones	1980	WINTER RESIDENTIAL
-0.23	Howe & Linaweaver	1967	Marginal Price & Cross-Sectional Data
-0.75	Grima	1972	
-0.79	Ben-Zvi	1980	
-0.30	Danielson	1979	WINTER RESIDENTIAL Marginal Price & Pooled Data
-0.06	Howe	1982	WINTER RESIDENTIAL Marginal Price with Bill Difference & Cross-Sectional Data
-0.73	Morris & Jones	1980	SPRINKLING USE
-0.73 to -1.57	Howe & Linaweaver	1967	Marginal Price & Cross-Sectional Data
-0.82	Ben-Zvi	1980	
-1.07	Grima	1972	
-1.38	Danielson	1979	SPRINKLING USE Marginal Price & Pooled Data
-0.55	Morgan & Smolen	1976	SPRINKLING USE Average Price & Time Series Data
-0.43 to -0.57	Howe	1982	SPRINKLING USE Marginal Price with Bill Difference & Cross-Sectional Data
			INDUSTRIAL DEMAND
-0.81	Rees	1969	Aggregate Industry
-0.47 to -0.84	Turnovsky	1969	
-0.61 to -0.70	Elliot & Seagraves	1972	
-0.33 to -0.80	Grebstein & Field	1979	

TABLE VII-6 (Continued)

ESTIMATED ELASTICITIES OF DEMAND FOR WATER

Reported Price Elasticity	Author	Year	Type of Analysis
-3.29 to -6.71	Rees	1969	Food & Drink Firms
-2.42	Ben-Zvi	1980	
-0.43 to -0.63	Etheridge	1970	Poultry Processing
-0.80	Ridge	1972	
-0.30	Ridge	1972	Brewery
-0.60	Ridge	1972	Fluid Milk
-1.44 to -2.88	Rees	1969	Paper Products
-0.56	Ben-Zvi	1980	
-0.98	Ziegler	1984	
-0.96	Rees	1969	Chemical Firms
-1.47	Ben-Zvi	1980	
-0.89	DeRooy	1974	Coaling
-0.36	DeRooy	1974	Processing
-0.48	DeRooy	1974	Steam Generation
-0.56	Ben-Zvi	1980	Lumber
-0.15	Ben-Zvi	1980	Petroleum
-1.13	Ben-Zvi	1980	Stone & Clay
-2.50	Rees	1969	Nonmetallic Minerals
			COMMERICAL DEMAND
-0.12 to -0.24	Lynne	1978	Motels & Hotels
-0.17	Lynne	1978	Eating & Drinking
-0.76	Lynne	1978	Grocery & Supermart
-1.33	Lynne	1978	Department Stores
-0.48	Lynne	1978	Other Commercial

Finally, the effect of price change cannot be easily separated from the effects of conservation measures. Consumers may reduce their water use in response to a price increase by installing low-flow showerheads and modifying their toilets to use less water. Citywide retrofit programs preempt this response option and should effectively lower the elasticity of water demand with respect to price.

Metropolitan has sponsored two independent studies on the effects of price (and other factors) on water use in Southern California. Each study used a different data set and was conducted by different investigators.

The first study used household level data from a random sample of 500 detached single-family residences in Southern California. The results of this study indicate that elasticity with respect to changes in marginal price alone (all other elements of rate structure held constant) was measured in the range of -0.004 to -0.015 for winter water use (November to April) and -0.132 to -0.175 for summer use (April to October). The elasticity with respect to changes in service charge (or other nonmarginal charges) was measured in the range of -0.027 to -0.142 for winter water use and -0.158 to -0.182 for summer use. These estimates suggest that the overall elasticity of "across-the-board" changes in water rates (or an approximate response to changes in average price) range from -0.03 to -0.16 in winter and -0.29 to -0.36 in summer.

The second study used aggregate water use records for a sample of Southern California water agencies. These data were collected to support Metropolitan's long-range water use forecasting with the MWD-MAIN model. The elasticities measured using the agency-level data were incorporated into the forecasting model and are shown in Table VII-7. The most likely ranges of price elasticity were derived using alternative estimates from the aggregate data as well as household-level data for single-family homes.

Evidence of Consumer Response to Retail Price Changes

As mentioned earlier, Metropolitan's wholesale rates have limited influence on retail prices in the water service area. As indicated previously, a weighted average retail price has increased by 40 percent (in real terms, that is, relative to prices of other goods) during the last decade. During the same period, urban water use decreased by 210,000 acre-feet per year (or 6.4 percent) over what it would have been without price changes and water conservation. This reduction would suggest the elasticity of average price of -0.16. However, a savings of about 120,000 acre-feet is attributed to nonprice conservation measures (including indoor plumbing code, public education campaigns, retrofit programs, and others). Therefore, the "net" or "residual" elasticity of this price increase is
-0.07. This value indicates that a 10 percent increase in average retail price would lead to a 0.7 percent reduction in water use. However, because not all water use reductions attributed to nonprice measures are truly unrelated to price increases, part of the water savings achieved through education campaigns, retrofit programs, and other measures may also be due to price increases.

Alternatives to Retail Pricing

The data presented in the previous section suggest that price by itself is not a very powerful conservation alternative. Changes in retail prices during the last decade have not brought about changes in water demand of magnitudes

TABLE VII-7

ESTIMATES OF PRICE ELASTICITY IN SOUTHERN CALIFORNIA

User Sector/Dimension of Use	Price Elasticity Used in MWD-MAIN Forecasting Model	Most Likely Range of Price Elasticity from Empirical Studies
Single-family		
Winter season use	-0.24	-0.10 to -0.30
Summer season use	-0.39	-0.20 to -0.50
Multifamily		
Winter season use	-0.13	-0.00 to -0.15
Summer season use	-0.16	-0.05 to -0.20
Nonresidential		
Commercial, Institutional, Industrial, Public		
Annual use	-0.27	-0.10 to -0.50

that would be predicted based on the ranges of price elasticity presented in Table VII-7.

While pursuing additional research on consumer response to price in Southern California and encouraging its member agencies to adopt conservation-oriented rate designs, Metropolitan has adopted a pricing policy for encouraging the use of technological measures to reduce water use. This policy is implemented through the Conservation Credits Program, the Local Projects Program, and other economic and financial incentives directed to member agencies and their subagencies.

VIII. EXPANSION OF CONSERVATION PROGRAM

CONCEPTUAL APPROACH

The existing conservation measures discussed in the previous chapters have made a significant impact on current levels of water use in Metropolitan's service area. Relative to pre-1980 conditions (i.e. 1980 retail price levels and the pre-1980 level of conservation activities) and "average" weather, the effectiveness of conservation measures (including public education, the 1981 and 1992 plumbing codes, and the effect of changes in retail prices from 1980-1990) is expected to increase from the current water savings of 7 percent of total municipal and industrial demand to about 11 percent in 2010.

To achieve additional savings, Metropolitan and several other urban water districts in the state have proposed the development and implementation of additional water conservation techniques called "best management practices." Two types of practices are distinguished: "present" and "potential." The present best management practices are conservation methods for which water savings, economic, environmental, and social effects are being documented in field applications. Documented savings from these practices will be incorporated into the overall water supply planning program of the agencies participating in the program. The potential best management practices are those with uncertain outcomes which require the development of technical, economic, and social acceptability data before a major commitment of resources for their implementation can be made. Also, the savings of potential best management practices will be incorporated into long-term plans of balancing demand with supply in Southern California after the practice has been designated as a best management practice and reliable data on water savings become available.

The best management practice approach to water conservation could provide water suppliers with the assurance of reasonable water conservation estimates being used in the State Water Resources Control Board (SWRCB) water rights decisions, while at the same time providing the SWRCB with the assurance it needs that water is being used efficiently.

Water use reductions achievable through implementation of best management practices will be expressed in ranges. The lower end of these ranges will represent reliable, achievable savings based on well designed and monitored field demonstration programs. The water agencies participating in the program will commit to programs and schedules which go beyond the reliable savings to achieve the maximum levels of savings which are technically, economically, and socially feasible. The upper end of these ranges will represent potentially achievable savings.

The conceptual approach to the continuing evaluation of current best management practices and to the selection and development of potential practices is depicted in the diagram on Figure VIII-1. This approach allows Metro-

politan to analyze and synthesize demand-reduction program impacts in reducing water use and to predict the effectiveness of any contemplated changes in the program. The feedback from monitoring and evaluation will allow Metropolitan to:

(1) Enhance public information programs.
(2) Reinforce current conservation behavior.
(3) Identify opportunities for program improvement.
(4) Design and implement additional best management practices.

Because many best management practices have to be implemented at the retail agency level, Metropolitan will use several modes of implementation. The primary vehicle for implementation of these practices is Metropolitan's Conservation Credits Program described in Chapter VI. However, not all practices would qualify under this program. For those practices, Metropolitan will develop other implementation vehicles including:

(1) Direct assistance from Metropolitan's staff to member agencies and subagencies.
(2) Financial incentives designed for specific best management practices.
(3) Direct implementation of some practices by Metropolitan.

All Metropolitan's best management practices are organized with regard to:

(1) A detailed design of each practice
(2) A time schedule for development and implementation
(3) The success of current practices and the desired outcomes of new practices
(4) Necessary research and development for proposed measures
(5) An overall goal of Metropolitan to be achieved by the 10-year plan
(6) Planned expenditures and the sources of funds

BEST MANAGEMENT PRACTICES

The following sections describe eight best management practices which are being evaluated as part of Metropolitan's conservation program. These practices are at various stages of the development process; however, they will be implemented by the year 2000 (or 2010 in some cases) if their technical, economic, and other effects are found to be satisfactory. Table VIII-1 gives a summary of targeted water users, implementation methods and planned implementation schedule for these practices. A more detailed discussion of each practice is given below.

Retrofit of Showerheads and Toilets

An indoor residential plumbing retrofit program is designed to reduce domestic water use. It involves replacing existing showerheads with more efficiently designed heads, which limit the flow rate of a shower to less than 3.5 gallons per minute (gpm). It also involves a modification of existing toilets to reduce the volume of water used to flush the toilet. Although such retrofits can and are being performed by individual homeowners, independently of programs sponsored by water agencies, significant water savings can be achieved if a large number of households retrofit these bathroom fixtures.

A city-sponsored retrofit program usually involves free distribution and, sometimes, installation of devices included in a retrofit kit. These kits generally contain the following items:

FIGURE VIII–1

EVALUATION SCHEME FOR BEST MANAGEMENT PRACTICES

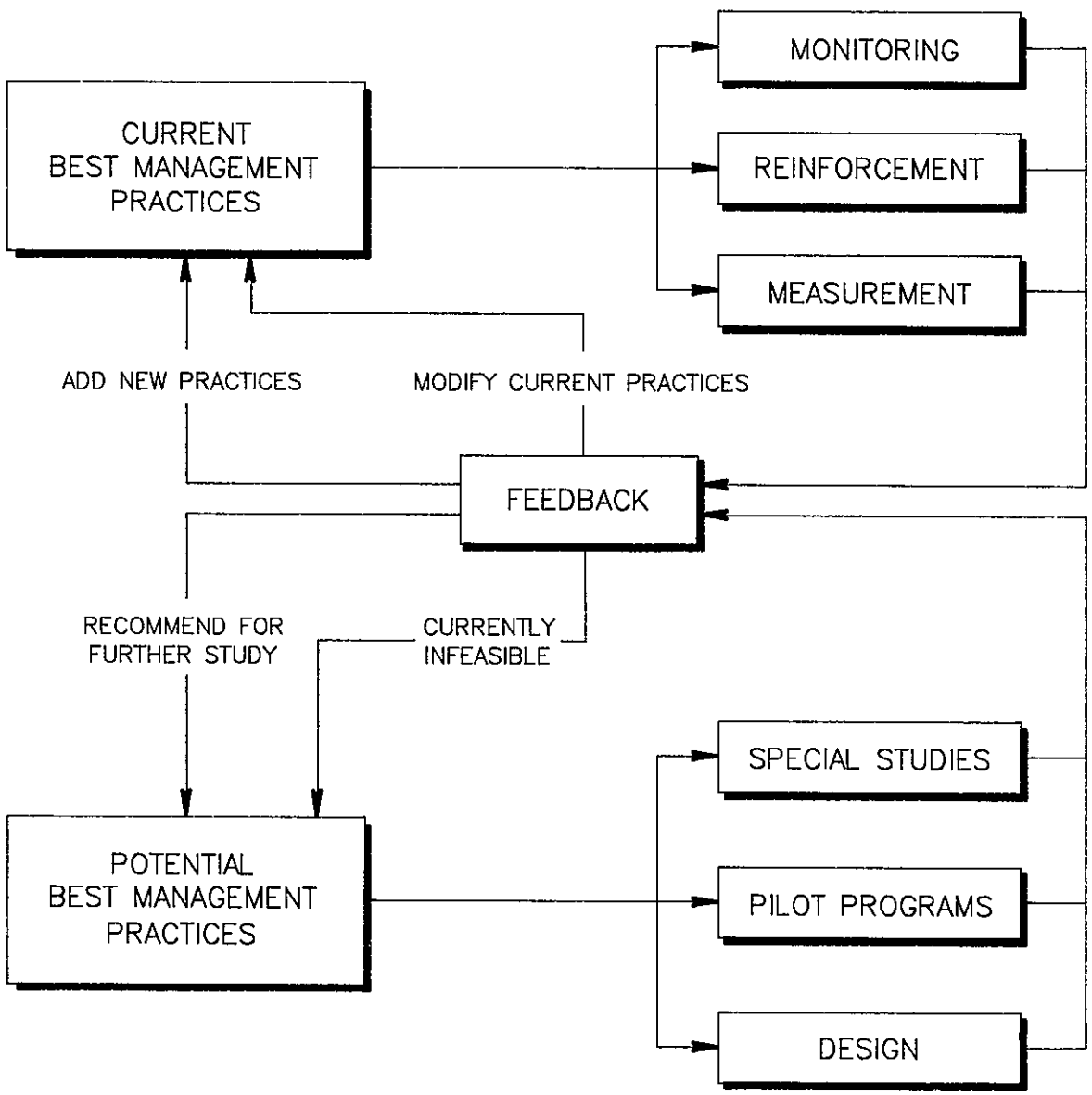


TABLE VIII-1

BEST MANAGEMENT PRACTICES

Measure	Targeted Water Users	Implementation Method	Proposed Schedule
Retrofit of Showerheads and Toilets	2,500,000 single-family homes	250,000 homes canvassed annually	10 years (1990 - 2000)
	1,850,000 multi-family dwelling units	185,000 units retrofitted annually by owner contact method	10 years (1990 - 2000)
Home Water Audits	150,000 single-family homes with high water use rates (greater than 400 gallons/day)	To be developed	10 years (1991 - 2001)
Distribution System Audits' Program	70 percent of retail and wholesale agencies with high unaccounted water use	Water agency participation	5 years (1991 - 1996)
Large Landscape Water Audits	An inventory of large commercial/industrial sites, parks and golf courses	Voluntary participation of owners/ managers	10 years (1991 - 2001)
Landscaping Requirements	All new construction sites	Local government ordinances	5 years (1992 - 1997)
Governmental Retrofits	Selected governmental facilities and public buildings built before 1980	Participation of local agencies	10 years (1991 - 2001)
Commercial water audits	Large commercial users of water: hospitals, hotels, laundries, etc.)	To be developed	10 years (1992 - 2002)
1992 California Plumbing Code	All new or remodeled buildings constructed after 1992	Work with member agencies, building inspectors, real estate developers, and construction firms	1992

(1) Toilet-tank displacement devices (i.e., toilet dams or displacement bags)
(2) Low-flow showerheads (or flow restrictors)
(3) Dye tablets that help identify toilet leaks
(4) Instructions for installation and use of the devices
(5) Information on additional conservation, i.e., conservation tips

There are several methods of program implementation ranging from low-intensity programs such as "depot" distribution and "on-request" deliveries to high-intensity programs using a "door-to-door" distribution and installation (if requested). The low-intensity programs (especially mass mailing of conservation kits) were used extensively during the 1976-77 drought in California. Recent programs implemented in Phoenix and San Jose used the high-intensity approach, which is often referred to by contractors who implement the program as the "canvass system."

Several factors can influence the actual savings of a retrofit program. The obvious variables include (1) water pressure at the plumbing outlets, (2) the model of the retrofitted (old) showerhead or toilet, (3) the degree to which shower valves are open during showering, and (4) the degree to which consumers change their habitual use of the fixture after it has been retrofitted. In addition, the aggregate savings in all homes targeted by a retrofit program will depend on the proportion of households that actually install the devices. Somewhat less obvious variables that could influence water savings achieved in various communities are the demographic characteristics of the residential sector of water users, such as average household size and family composition as well as some socioeconomic variables such as income and education.

Recently, some agencies have questioned the assumption of the expected water savings of 12.2 gallons per capita per day (gpcd) for calculating water savings in California communities that implement residential retrofit campaigns made by the California Department of Water Resources (DWR, 1989). Empirical studies of water savings achieved by retrofitting plumbing are shown in Table VIII-2. The reported average daily savings in retrofitted households range from 16 gallons (Morgan, 1982) and 20.3 gallons (Palmini and Shelton, 1982) to 30.6 gallons (Maddaus, 1987). The existing data indicate that a reasonable estimate of demand reduction due to bathroom plumbing retrofits is about 15 gallons per day (gpd). In terms of potential savings, the upper limit is likely to be about 20 to 25 gpd. Again, if a service-areawide estimate is used, it will be significantly lower because it must be adjusted to reflect the number of residential units that actually installed the devices.

Because all homes built since 1981 are subject to the requirements of the California Plumbing Code, the agency-sponsored retrofit campaigns are directed at structures built prior to 1981. The current housing stock of Metropolitan's service area is estimated at 5.2 million, of which some 4,350,000 have been built before 1981. The majority of local agency retrofits are expected to be implemented through Metropolitan's existing Conservation Credits Program. Metropolitan requires that agencies retrofit programs are implemented using high-intensity programs modeled after the San Jose program.

Home Water Audits (High Use)

This practice requires substantial water agency expenditures. However, it also can

TABLE VIII-2

A COMPARISON OF REPORTED WATER SAVINGS OF RESIDENTIAL RETROFITS

Source	Reported Savings	Estimates Converted To Per Household (And Per Capita) Savings		Remarks
		Gal/Cap/Day	Gal/House/Day	
Morgan, 1980	Average saving of 780 cubic feet per year for each installer household.	6.4[b]	16.0	A sample of 473 households in California, of which 296 installed conservation kits (showerhead flow restrictors, toilet dams, leak detection tablets
Maddaus, 1987	Per capita savings	11.2	30.6[a]	A national sample of 281 homes. Savings devices include 2.75 gpm showerhead and toilet dam.
Palmini and Shelton, 1982	Annual water savings of 7400 gallons per year in a household installing the kit	(--)	20.3	A sample of 105 households in East Brunswick Township, New Jersey. Savings in a household installing one or more of the devices.
Dziegielewski and Opitz, 1988	Average water savings in homes designated as "installers" using a binary variable in a structural water demand model.	5.1[c]	16.5	A sample of 1388 single-family homes in Phoenix, Arizona. A 95 percent confidence interval for household savings is from 6.9 to 26.1 gal/day.

[a]Estimated from per capita using 2.73 persons per household.
[b]Estimated from total household savings using 2.5 persons per household.
[c]Estimated capita savings obtained using 3.22 persons per household (sample mean).

produce substantial improvements in water use efficiency. A home water audit is an evaluation of a homeowner's outdoor and indoor water use by a trained professional.

The cost of water audit per house is high; however, it can be justified if only homes with the greatest potential for savings are audited. Empirical data on water use in individual households show a substantial variation in water use among households. This indicates that a certain fraction of households account for disproportionate amounts of total residential water use in a given community. Conducting water use audits in those homes may allow water agencies to achieve significant savings at a reasonable cost.

A sample of 177 detached single-family homes in San Diego shows that the greatest conservation potential is in reducing the volume of water used for lawn and garden irrigation. Figure VIII-2A shows that during the summer season approximately 27 percent of households use excessive amounts of water outdoors. The remaining 73 percent practice deficit irrigation (that is, they irrigate their lawns at less than actual evapotranspiration corrected for rainfall). Average water application rates in homes that overirrigate are 68 percent above the theoretical water requirements in summer and 146 percent in winter (Figure VIII-2B). Homes applying insufficient amounts of water show approximately a 50 percent deficit during both seasons.

A sample of 72 homes in Los Angeles in summer 1988 shows that approximately 32 percent are surplus irrigators (Figure VIII-3). The use of Hollywood Hills evapotranspiration data for this sample is likely to result in an overestimate of this percentage, so the actual level of surplus-irrigator households probably approximates that of San Diego.

The home water audit savings are achieved by educating the homeowner on water conservation practices and by installing indoor retrofit devices and irrigation control devices and materials.

The devices usually include:

(1) Two low-flow showerheads
(2) Two rubberized/steel toilet dams
(3) A moisture-sensing meter
(4) An automatic hose bib timer
(5) A jar of soil polymer

The activities performed by the auditor include:

(1) Measurement of indoor fixture water-flow rates
(2) Identifying faucet or other fixture leaks
(3) Testing of toilet tanks for leaks
(4) Installation of conservation devices
(5) Comparison of average indoor water requirements and current use
(6) Taking soil probe core
(7) Checking for root development
(8) Testing the sprinkler precipitation rate
(9) Making specific recommendations to the homeowner regarding the required repair of indoor fixtures, optimal watering times and frequency, grass height, and other conservation tips.

The voluntary program is expected to achieve the participation of 10 to 15 percent of targeted high-water users (that is, single-family customers whose summer water use falls into the top 20 percentile group). At this level of participation, between 60,000 to 90,000 homes will be audited.

The implementation of this best management practice is contingent upon the findings of additional research. There is not sufficient

FIGURE VIII–2A

SAN DIEGO

DEFICIT/SURPLUS IRRIGATION

WINTER 1988

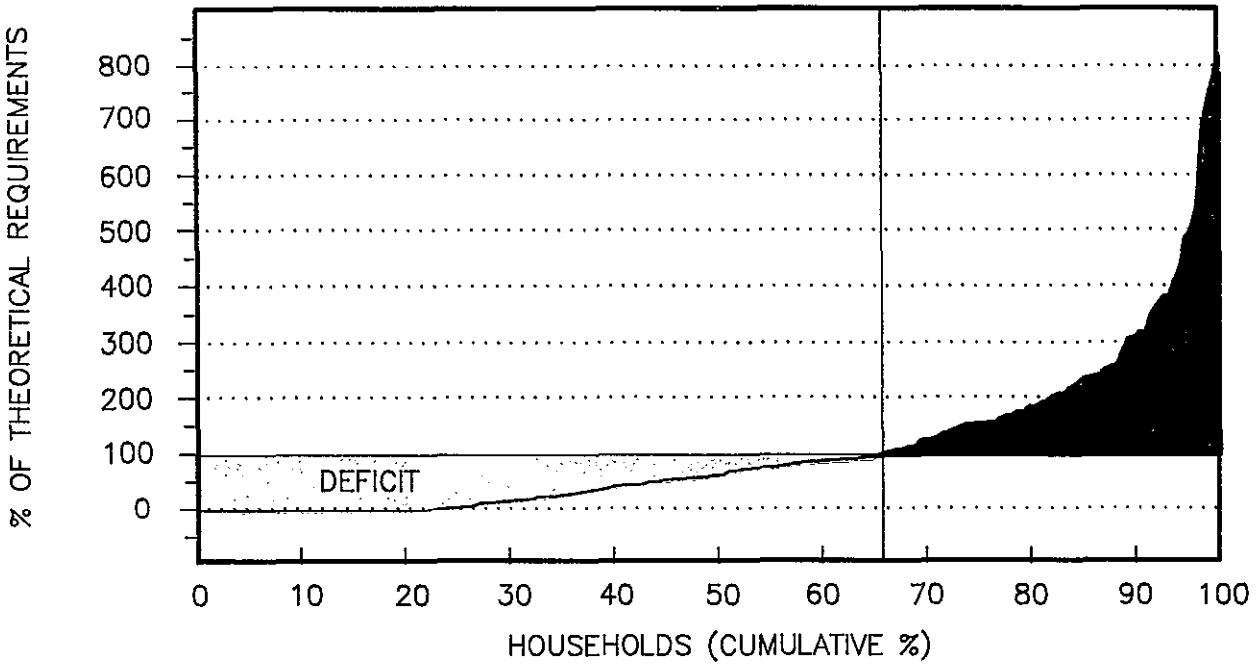


FIGURE VIII–2B

SAN DIEGO

DEFICIT/SURPLUS IRRIGATION

SUMMER 1988

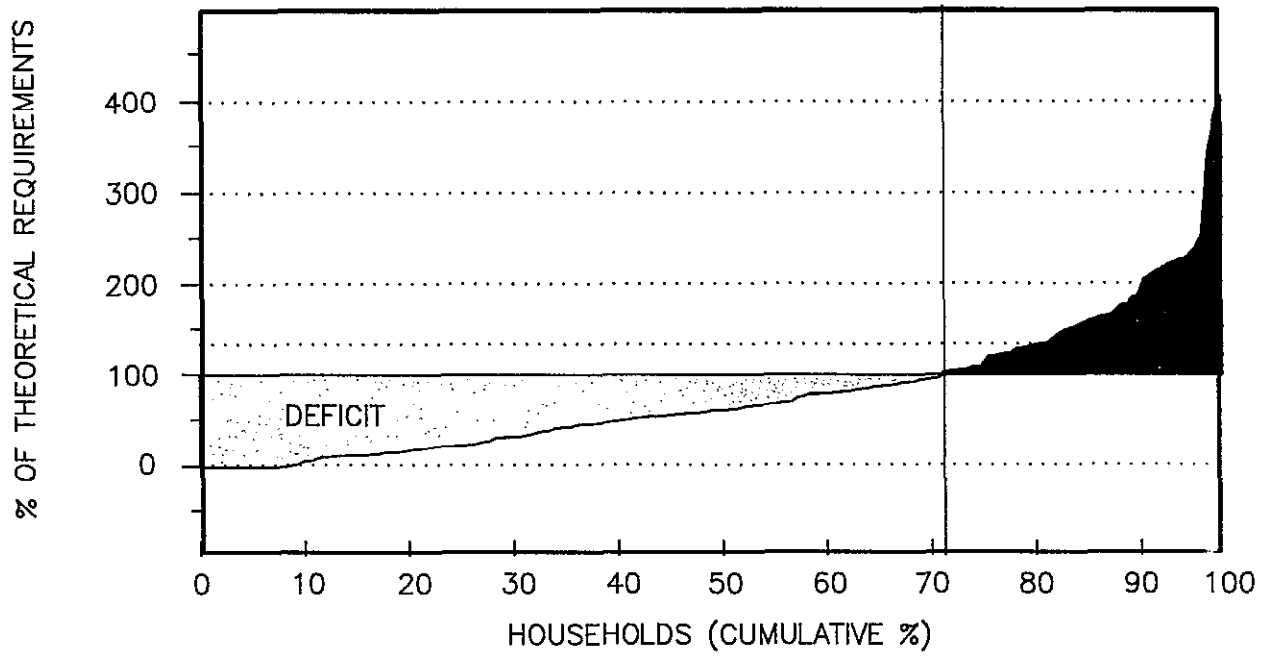
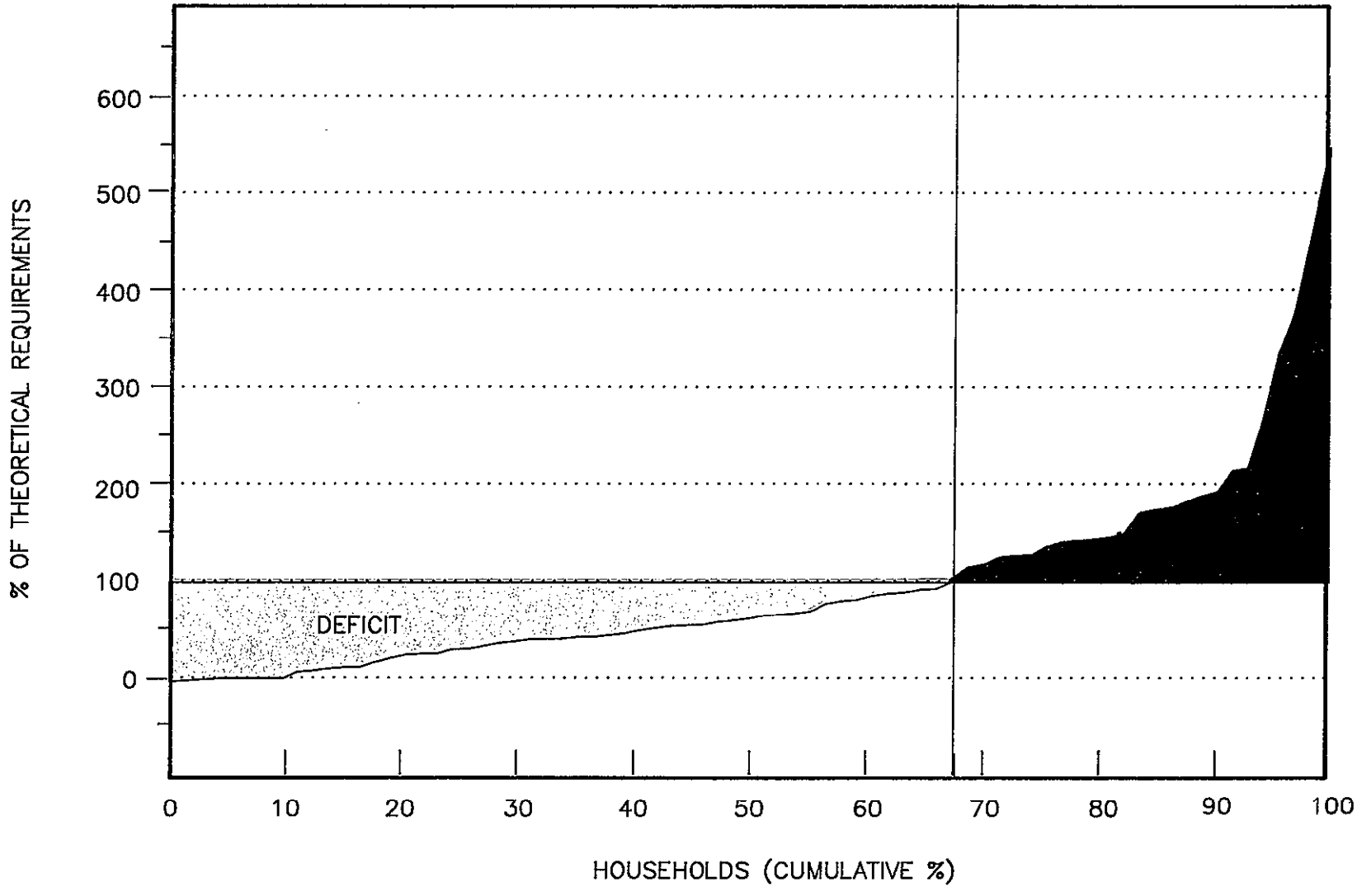


FIGURE VIII–3

LOS ANGELES

DEFICIT/SURPLUS IRRIGATION

SUMMER 1988



information on the expected improvements in water use efficiency and the decay in this efficiency over time. The latter will allow Metropolitan to determine how often the audits have to be repeated in order to maintain the conservation effects.

Distribution System Audits Program and Leak Detection

This management practice is very important because it helps to eliminate some avoidable leaks in the distribution system. It involves a thorough examination of the accuracy of water agency records and distribution system flow control equipment (including pipes, meters, valves, hydrants, and other elements of the system). The water audit is used in order to develop a "balance sheet" representing total volume of water flowing into the system, water sales, unmetered uses, water losses, and recoverable leakage. The result of the water audit is the development of a leak detection and repair plan (if the cost of leak recovery is justifiable).

Data on quantities of water labeled by utilities as "unaccounted and other" were obtained from 35 retail water supply agencies in Southern California. For 1985, a weighted average of unaccounted use for all agencies in the sample was 10.1 percent of total production. The balance of 89.9 percent represents total metered use of the residential, commercial, industrial, and public sectors.

Unaccounted water use may include authorized unmetered uses (such as firefighting, sewer flushing, underregistration of meters, and street cleaning) and unauthorized uses (such as leakage, major breaks, and illegal connections). Normally authorized unmetered uses represent only a small percentage of the total unaccounted water.

Metropolitan is considering the sponsorship of system audits through a financial assistance program similar to the existing Conservation Credits Program. The goal of this best management practice is to achieve the maximum unaccounted water use of 7 to 9 percent of total production.

Large Landscape Water Audits

A landscape water audit involves a careful evaluation of water requirements and actual water use on large landscape areas including commercial/industrial sites, parks, cemeteries, and golf courses. It is designed to assist landscape managers in making more efficient use of water by correcting problems with irrigation systems and devising efficient irrigation schedules. An auditor examines the vegetation, irrigation system, the irrigation schedule of a selected site and then recommends more efficient irrigation practices.

Metropolitan will devise financial incentives and provide training for member agencies and their subagencies to develop inventories of large turf areas, administer the audit program, and monitor the water uses included in the inventory. The continuation and expansion of the program will be contingent upon the effectiveness of the initial audits.

Landscaping Requirements for New Commercial, Industrial, and Multifamily Complexes

Landscape requirements are designed to promote the use of low water-using plants and irrigation systems instead of landscapes with turf and plant materials with high water requirements. The requirements normally regu-

late the amount of turf, type of plants in nonturf areas, types of irrigation control systems, and methods of irrigation. The requirements have been applied in a small number of cities to industrial, commercial, and public agencies, street medians, multifamily complexes, residential developments with common areas, and model home single-family developments.

An important consideration of this best management practice is the effect of urban vegetation on cooling energy and CO_2 emissions. Recent research indicates that there are significant tradeoffs between water and energy use in desert cities of the Southwest. The data indicate that landscaping can affect cooling energy use by as much as 30 percent. Well-irrigated lawns reduce air temperature 2 meters above the turf level by as much as 7 degrees centigrade (or 12 degrees Fahrenheit) compared to a dry soil surface. A rocky desert landscape or a concrete driveway can actually increase the outgoing long-wave radiation by 25 percent compared to a lawn. These effects influence the temperature inside and outside a house.

The development of landscaping requirements for residential and nonresidential structures is important in order to achieve the benefits of shading and evaporative cooling by vegetation without a substantial increase in irrigation water requirements. Proper selection of trees, shrubs, and ground cover in desert climate can achieve the same effect as a well-irrigated lawn or non-native plants with high water requirements.

The initial step for Metropolitan to implement landscape requirements in their service area is to have each member agency prepare a draft (or agree on a common draft) of proposed guidelines. The member agencies working with local water agencies would secure adoption of the draft ordinances by each city and county in Metropolitan's service area separately. It is estimated that it would take five years for all the cities and counties in the service area to adopt ordinances into their city/county building permit approval process and start using them. Metropolitan will provide staff assistance to local agencies that implement this practice and will work on legislation in support of landscaping ordinances.

Both the landscape water audits program and the program to develop landscaping requirements will benefit from the use of satellite photographs. An ongoing project by Metropolitan will utilize photographs from Landsat satellites to detect the overwatering of large tracts of land. By categorizing the types of vegetation and the water intensities, Metropolitan will be able to tailor conservation efforts.

Governmental Retrofit

This best management practice will involve retrofitting toilets and other sanitary fixtures in all public buildings built before 1980. Public administration, schools, universities and other public agencies employ about 2,000,000 persons in Southern California. Each employee uses 15 to 20 gallons of water for sanitary purposes. In addition, rest room facilities in many public buildings are used by the general public.

Retrofit of tank-type toilets and the use of "water wardens" (devices restricting flush volumes of flushomatic toilets and urinals) are expected to reduce sanitary use in public buildings by 1.5 gallons per day per person employed in the building. In cases where there is a frequent use of rest rooms by the general public or visitors, these savings can amount to as much

as 10 gallons per day per employee. Metropolitan will assist local agencies in implementing governmental retrofits under the existing Conservations Credits Program.

Commercial Water Audits

This best management practice involves on-site visits to large commercial users of water such as hotels, hospitals, laundries, car washes, and others. The purpose of each audit is to identify the water conservation potential at each site and offer technical assistance to implement conservation practices. Metropolitan will devise a financial incentives program designed specifically for this practice.

Enforcement of New California Plumbing Code

The new plumbing code will require that (in addition to low-flow showers) 1.6 gallon/flush toilets are used in all new or remodeled buildings constructed after 1992. Because water savings from this measure can be expected only if builders comply with the law, Metropolitan will assist its member agencies and subagencies in providing adequate enforcement of this state law.

The goal of this best management practice is to achieve 95 percent or higher compliance with the requirements of the 1992 plumbing code. Metropolitan will work with member agencies and the city inspectors in their service area. Local water agencies could be provided with financial assistance to conduct inspections of new buildings. Metropolitan will disseminate information about code requirements to all real estate developers and construction firms in Southern California and work toward the revision of American National Standards Institute (ANSI) standards for the plumbing devices.

POTENTIAL BEST MANAGEMENT PRACTICES

In addition to the eight present best management practices, Metropolitan will continue to research ways for achieving further gains in water use efficiency. At present these new measures, referred to as potential best management practices, include:

(1) Conservation-oriented retail pricing practices
(2) Toilet giveaway/rebate program
(3) Industrial water audits
(4) Xeriscape requirements for new construction
(5) Efficient residential landscaping programs

Each of these potential practices is briefly discussed below.

Conservation-Oriented Retail Pricing

Chapter VII describes Metropolitan's wholesale pricing approach to achieve an efficient use of imported water supplies in Southern California. This best management practice will be designed to effect pricing practices at the retail level.

Currently, Metropolitan is funding research on measuring the responsiveness of various user sectors to changes in the price of water. The most recent results of this research have been incorporated into the MWD-MAIN water use forecasting model in order to predict the impact of recent price increases as well as pro-

jected future prices on future water use. Additional research will be funded in order to measure the impacts on water use of alternative designs of water rates.

Metropolitan will disseminate the scientific findings of this research among member agencies and their subagencies. The goal of this best management practice will be to influence the current rate-making practice in Southern California in order to introduce additional price incentives for water conservation.

Toilet Giveaway/Rebate Program

This best management practice is designed to promote voluntary installation of ultra-low-flow (ULF) toilet fixtures (1.6 gallons or less per flush) in all types of housing units. Because the use of these toilets in new construction will be mandatory in the near future, all existing homes in Southern California can achieve additional improvements in water use efficiency (including homes which already have toilets using 3.5 gallons per flush).

The program will be implemented using two modes: (1) distribution of free toilets to customers who request them from their retail water agencies, and (2) provision of a rebate (e.g., $100) to customers who purchase and install the ULF toilet. The goal of this program is to achieve installation of 400,000 toilets by the year 2000 and an additional 400,000 by the year 2010.

The potential household savings due to the installation of 1.6 gallon toilets are not well documented. The engineering estimates derived from reduced flushing volumes indicate that they may range from 8 to 16 gallons per day per each person in a household. The data collected in Phoenix (Anderson and Siegrist, 1989) indicate reductions ranging from 8.6 to 15.2 gallons with an average of 10.8 gallons per day per person.

Industrial Water Audits

An industrial water audit is a study of a facility's water use. The audit consists of the determination of water uses and water needs followed by recommended measures for reducing the water uses.

Industrial customers can have very different water requirements. The differences stem from the type of water uses at each site which may vary from sanitary to process use to evaporative cooling. Therefore, the auditors need to be trained so they can offer a variety of site-specific technical services.

Water audits of large manufacturing plants can take one person between two and five days to complete, depending on the complexity of the site. The audits would be voluntary, and there is no data yet on the participation rates that could be achieved if water agencies offer such a program.

In order to conduct an audit program, the first step will be to compile a list of all possible sites and arrange them in terms of descending daily water use. The second step is to set criteria, which will be used to determine the percentage of the total sites to be audited, starting with the largest water users first. The criteria used in the determination of the percentage is a function of cost effectiveness. For example, if the payback period to implement the audit finding is found to be two years, it may be found that a minimum of 10,000 gpd per site would have to be saved. Thus, only those sites

with the potential to save 10,000 gpd would be audited. This type of information will need to be developed in Metropolitan's service area before a specific audit plan is devised.

Xeriscape Requirements for New Residential Developments

This potential best management practice is an extension of a similar current practice aimed at nonresidential landscapes. Additional information will be gathered to characterize the most efficient and acceptable designs of xeriscaping.

Efficient Residential Landscaping Programs

Landscapes around residential buildings in Southern California can be improved or retrofitted without losing environmental amenities of the neighborhoods. Metropolitan will evaluate alternative existing landscape designs and develop effective methods for encouraging the adoption of such landscapes by homeowners.

Assembly Bill No. 797

CHAPTER 1009

An act to add and repeal Part 2.6 (commencing with Section 10610) to Division 6 of the Water Code, relating to water conservation.

[Approved by Governor September 21, 1983. Filed with Secretary of State September 22, 1983.]

LEGISLATIVE COUNSEL'S DIGEST

AB 797, Klehs. Water: management planning.

(1) Under existing law, local water suppliers may, but are not required to, adopt and enforce water conservation plans.

This bill would require every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to prepare and adopt, in accordance with prescribed requirements, an urban water management plan containing prescribed elements. The bill would require the plan to be filed with the Department of Water Resources, and would require the department to annually prepare and submit to the Legislature a report summarizing the status of the plans. The bill would require each supplier to periodically review its plan in accordance with prescribed requirements, would specify requirements for actions or proceedings arising under the bill, and would specify related matters.

The bill would make legislative findings and declarations in this connection.

The provisions of the bill would remain in effect only until January 1, 1991.

(2) Article XIII B of the California Constitution and Sections 2231 and 2234 of the Revenue and Taxation Code require the state to reimburse local agencies and school districts for certain costs mandated by the state. Other provisions require the Department of Finance to review statutes disclaiming these costs and provide, in certain cases, for making claims to the State Board of Control for reimbursement.

This bill would impose a state-mandated local program as its requirements would be applicable to local public agencies.

However, the bill would provide that no appropriation is made and no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Part 2.6 (commencing with Section 10610) is added to Division 6 of the Water Code, to read:

PART 2.6 URBAN WATER MANAGEMENT PLANNING

CHAPTER 1. GENERAL DECLARATION AND POLICY

10610. This part shall be known and may be cited as the "Urban Water Management Planning Act."

10610.2 The legislature finds and declares as follows:

(a) The waters of the state are a limited and renewable resource subject to ever increasing demands.

(b) The conservation and efficient use of urban water supplies are of statewide concern: however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

10610.4 The Legislature finds and declares that it is the policy of the state as follows:

(a) The conservation and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The conservation and efficient use of urban water supplies shall be guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to achieve conservation and efficient use.

Chapter 2. DEFINITIONS

10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

10611.5 "Conservation" means those measures that limit the amount of water used only to that which is reasonably necessary for the beneficial use to be served.

10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental and industrial uses.

10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

10614, "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such entity.

10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate reasonable and practical efficient uses and conservation activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 7 (commencing with Section 4010) of Part 1 of Division 5 of the Health and Safety Code.

CHAPTER 3. URBAN WATER MANAGEMENT PLANS

Article 1. General Provisions

10620. (a) Every urban water supplier serving water directly to customers shall, not later than December 31, 1985, prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier after December 31, 1984, shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water to customers may adopt an urban water management plan or participate in areawide, regional, watershed, or basinwide urban water management planning; provided, however, an urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

10621. Each urban water supplier shall periodically review its plan at least once every five years. After the review, it shall make any amendments or changes to its plan which are indicated by the review. Amendments or changes in its plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

Article 2. Contents of Plans

10630. It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

10631. A plan shall include all of the following elements:

(a) Contain an estimate of past, current, and projected water use and, to the extent records are available, segregate those uses between residential, industrial, commercial, and governmental uses.

(b) Identify conservation measures currently adopted and being practiced.

(c) Describe alternative conservation measures, if any, which would improve the efficiency of water use with an evaluation of their costs and their environmental and other significant impacts.

(d) Provide a schedule of implementation for proposed actions as indicated by the plan.

(e) Describe the frequency and magnitude of supply deficiencies, including conditions of drought and emergency, and the ability to meet short-term deficiencies.

10632. In addition to the elements required pursuant to Section 10631, a plan projecting a future use which indicates a need for expanded or additional water supplies shall contain an evaluation of the following:

(a) Waste water reclamation.

(b) Exchange or transfer of water on a short-term or long-term basis.

(c) Management of water system pressures and peak demands.

(d) Incentives of alter water use practices, including fixture and appliance retrofit programs.

(e) Public information and educational programs to promote wise use and eliminate waste.

(f) Changes in pricing, rate structures, and regulations.

10633. The plan shall contain an evaluation of the alternative water management practices identified in Sections 10631 and 10632, taking into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.

Evaluation of the elements in Section 10632 shall include a comparison of the estimated cost of alternative water management practices with the incremental costs of expanded or additional water supplies, and in the course of the evaluation first consideration shall be given to water management practices, or combination of practices, which offer lower incremental costs than expanded or additional water supplies, considering all the preceding evaluation factors.

Article 3. Adoption and Implementation of Plans

10640. Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630).

The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

10641. (a) An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water conservation and management methods and techniques.

(b) In order to assist urban water suppliers in obtaining needed expertise as provided for in subdivision (a), the departments, upon request of an urban water supplier, shall provide the supplier with a list of persons or agencies having expertise or experience in the development of water management plans.

10642. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. A privately owned water supplier shall provide an equivalent notice within its service area. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

10644. An urban water supplier shall file with the department a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be filed with the department within 30 days after adoption.

The department shall annually prepare and submit to the Legislature a report summarizing the status of the plans adopted pursuant to this part.

CHAPTER 4. MISCELLANEOUS PROVISIONS

10650. Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part, or within 18 months after commencement of urban water service by a supplier commencing that service after January 1, 1984.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

10651. In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plant by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplies is not supported by substantial evidence.

10652. The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans prepared and adopted under this part. Nothing in this part shall be interpreted as exempting projects for implementation of the plan or for expanded or additional water suppliers from the provisions of the California Environmental Quality Act.

10653. The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board in obtaining that information. The requirements of this part shall be satisfied by any water conservation plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing water management or conservation plan which includes the contents of a plan required under this part.

10654. All costs incurred by an urban water supplier in developing or implementing its plan shall be borne by it unless otherwise provided for by statute.

10655. If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

10656. This part shall remain in effect only until January 1, 1991, and as of that date is repealed, unless a later enacted statute, which is chaptered before January 1, 1991, deletes or extends that date.

SEC. 2. No appropriation is made and no reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution or Section 2231 or 2234 of the Revenue and Taxation Code because the local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service mandated by this act.

TABLE B-1

MODEL EMERGENCY WATER CONSERVATION ORDINANCE

Section 1. Statement of Policy and Declaration of Purpose

(a) Because of the water supply conditions prevailing in the [entity] and/or in the area from which the [entity] obtains a portion of its supply, the general welfare requires that the water resources available to the [entity] be put to the maximum beneficial use to the extent to which they are capable, and that the waste or unreasonable use, or unreasonable method of use of water be prevented and that the conservation of such water be practiced with a view to the reasonable and beneficial use thereof in the interest of the people of [entity] and for the public welfare.

(b) The purpose of this ordinance is to provide a mandatory water conservation plan to minimize the effect of a shortage of water supplies on the customers of the [entity] during a water shortage emergency.

Section 2. Authorization to Implement Water Conservation Ordinance

(a) The [governing body of the entity] is authorized to implement the provisions of this ordinance, following the public hearing required by sub-section (b), upon its determination that such implementation is necessary to protect the public welfare and safety.

(b) Prior to implementation of this ordinance, the [governing body of the entity] shall hold a public hearing for the purpose of determining whether a shortage exists and which measures provided by this ordinance should be implemented. Notice of the time and place of the public hearing shall be published not less than ten (10) days before the hearing in a newspaper of general circulation within the [entity].

(c) The [governing body of the entity] shall issue its determination of shortage and corrective measures by public proclamation published in a daily newspaper of general circulation within the [entity]. Any prohibitions on the use of water shall become effective immediately upon such publication. Any provisions requiring curtailment in the use of water shall become effective with the first full billing period commencing on or after the date of such publication.

Section 3. General Prohibition

No customer of the [entity] shall make, cause, use, or permit the use of water from the [entity] in a manner contrary to any provision of this ordinance or in an amount in excess of that use permitted by any curtailment provisions then in effect pursuant to action taken by the governing board in accordance with the provisions of this ordinance.

Section 4. Phase I Shortage

(a) A Phase I Shortage shall be declared when the [governing body] determines that it is likely that it will suffer a ten percent (10%) shortage in its water supplies.

(b) The following restrictions on the use of water shall be in effect during a Phase I Shortage:

(1) There shall be no hose washing of sidewalks, walkways, driveways, parking areas or other paved surfaces, except as is required for sanitary purposes;

(2) Washing of motor vehicles, trailers, boats and other types of mobile equipment shall be done only with a hand-held bucket or a hose equipped with a positive shutoff nozzle for quick rinses, except that washing may be done at the immediate premises of a commercial car wash or with reclaimed wastewater.

(3) No water shall be used to clean, fill or maintain levels in decorative fountains, ponds, lakes or other similar aesthetic structures unless such water is part of a recycling system.

(4) No restaurant, hotel, cafe, cafeteria or other public place where food is sold, served or offered for sale, shall serve drinking water to any customer unless expressly requested.

(5) All customers of the [agency] shall promptly repair all leaks from indoor and outdoor plumbing fixtures.

(6) No lawn, landscape or other turf area shall be watered more often than every other day and during the hours between 10:00 a.m. and 4:00 p.m.; except that this provision shall not apply to commercial nurseries, golf courses and other water-dependent industries.

(7) No customer of the [agency] shall cause or allow the water to run off landscape areas into adjoining streets, sidewalks or other paved areas due to incorrectly directed or maintained sprinklers or excessive watering.

Section 5. Phase II Shortage

(a) A Phase II Shortage shall be declared when the [governing body] determines that it is likely that it will suffer a shortage of more than ten percent (10%) but less than twenty percent (20%) in water supplies.

(b) The following restrictions on the use of water shall be in effect during a Phase II Shortage:

(1) The restrictions listed in Section 4, subsection (b) shall be in effect, except that the restrictions on water lawn, landscape or other turf area shall be modified to prohibit watering more often than every third day between the hours of 6:00 a.m. and 6:00 p.m.

(2) Commercial nurseries, golf courses and other water-dependent industries shall be prohibited from watering lawn, landscape or other turf areas more often than every other day and between the hours of 10:00 a.m. and 4:00 p.m.; except that there shall be no restriction on water utilizing reclaimed wastewater.

(c) No customer shall make, cause, use or permit the use of water from the [agency] for any purpose in an amount in excess of ___percent (%) of the amount used on the customer's premises during the corresponding billing period during the prior calendar year.

Section 6. Phase III Shortage

(a) A Phase III Shortage shall be declared whenever the governing body diluteness that it is likely that it will suffer a shortage of more than twenty percent (20%) in water supplies.

(b) The following restrictions on the use of water shall be in effect during a Phase III Shortage:

(1) The restrictions listed in Section 4, subsection (b) shall be in effect, except that there shall be no residential outside watering of lawn, landscaping and other turf areas at any time except by

bucket.

(2) Commercial nurseries, golf courses and other water-dependent industries shall be prohibited from watering lawn, landscaping and other turf areas more often than every third day and between the hours of 6:00 a.m. and 6:00 p.m.; except that there shall be no restriction on watering utilizing reclaimed water.

(3) The use of water from fire hydrants shall be limited to fire fighting and related activities and other uses of water for municipal purposes shall be limited to activities necessary to maintain the public health, safety and welfare.

(c) No customer shall make, cause, use or permit the use of water from the [agency] for any purpose in an amount in excess of ___ percent (%) of the amount used on the customers premises during the corresponding billing period of the prior calendar year.

Section 7. Relief from Compliance

(a) A customer may file an application for relief from any provisions of this ordinance. The [chief executive officer of the governing body] shall develop such procedures as he considers necessary to resolve such applications and shall, upon the filing by a customer of an application for relief, take such steps as he or she deems reasonable to resolve the application for relief. The decision of the [chief executive officer] may delegate his or her duties and responsibilities under this section as appropriate.

(b) The application for relief may include a request that the customer be relieved, in whole or in part, from the water use curtailment provisions of Sections 5(c) and 6(c).

(c) In determining whether to grant relief, and the nature of any relief, the [chief executive officer] shall take into consideration all relevant factors including, but not limited to:

(1) Whether any additional reduction in water consumption will result in unemployment;
(2) Whether additional members have been added to the household;
(3) Whether any additional landscaped property has been added to the property since the corresponding billing period of the prior calendar year;
(4) Changes in vacancy factors in multifamily housing;
(5) Increased number of employees in commercial, industrial, and governmental offices;
(6) Increased production requiring increased process water:
(7) Water uses during new construction;
(8) Adjustments to water use caused by emergency health or safety hazards;
(9) First filling of a permit-constructed swimming pool; and
(10) Water use necessary for reasons related to family illness or health.

(d) In order to be considered, an application for relief must be filed with [the agency] within fifteen (15) days from the date the provision from which relief is sought becomes applicable to the applicant. No relief shall be granted unless the customer shows that he or she has achieved the maximum practical reduction in water consumption other than in the specific areas in which relief is being sought. No relief shall be granted to any customer who, when requested by the [chief executive officer], fails to provide any information necessary for resolution of the customer's application for relief.

Section 8. Failure to Comply

(a) For each violation by any customer of the water use curtailment provisions of Section 5(c) and 6(c), a surcharge shall be imposed in an amount equal to _____ percent (%) of the portions of the water bill that exceeds the respective percentages set in those two subsections.

(b) Violation by any customer of the water use prohibitions of Section 3, or subsection (b) of Sections 4, 5 and 6, shall be penalized as follows:

(1) First violation. The [governing body] shall issue a written notice of the fact of a first violation to the customer.

(2) Second violation. For a second violation during any one water shortage emergency, the [governing body] shall impose a surcharge in an amount equal to percent (%) of the customer's water bill.

(3) Third and Subsequent Violations. For a third and each subsequent violation during any one water shortage emergency, the [governing body] shall install a flow restricting device of one (1) gallon per minute capacity for services up to one and one-half (1 1/2) inch size, and comparatively sized restrictors for larger services, on the service of the customer at the premises at which the violation occurred for a period of not less than forty-eight (48) hours. The [governing body] shall charge the customer the reasonable costs incurred for installing and for restoration of normal service. The charge shall be paid before normal service can be restored. In addition, the surcharge provided in subsection (b) (2) shall be imposed.

(c) The [agency] shall give notice of violation to the customer committing the violation as follows:

(1) Notice of violation of the water use curtailment provisions of Sections 5(c) and 6(c) or of first violations of the water use prohibitions of Section 3 or of subsection (b) of Sections 4, 5 and 6 shall be given in writing by regular mail.

(2) Notice of second or subsequent violations of the water use prohibitions of Section 3 or of subsection (b) of Sections 4, 5 and 6 shall be given in writing in the following manner:

(A) by giving the notice to the customer personally;

(B) if the customer is absent from or unavailable at the premises at which the violation occurred, by leaving a copy with some person of suitable age and discretion at the premises and sending a copy through the regular mail to the address at which the customer is normally billed; or

(C) if a person of suitable age or discretion cannot be found, then by affixing a copy in a conspicuous place at the premises at which the violation occurred and also sending a copy through the regular mail to the address at which the customer is normally billed.

(d) The notice shall contain a description of the facts of the violation, a statement of the possible penalties for each violation and a statement informing the customer of his right to a hearing on the merits of the violation pursuant to Section 9.

Section 9. Hearing Regarding Violations

(a) Any customer receiving notice of a second or subsequent violation of sections 4(b), 5(b), or 6(b) shall have a right to a hearing by the [chief executive officer] of the [agency] within fifteen (15) days of mailing or other delivery of the notice of violation.

(b) The customer's timely written request for a hearing shall automatically stay installation of a flow-restricting device on the customer's premises until the [chief executive officer] renders his or her decision.

(c) The customer's timely written request for a hearing shall not stay the imposition of a surcharge unless within the time period to request a hearing, the customer deposits with the [agency] money in the amount of any unpaid surcharge due. If it is determined that the surcharge was wrongly assessed, the [agency] will refund any money deposited to the customer.

(d) The decision of the [chief executive officer] shall be final except for judicial review.

(e) The [chief executive officer] may delegate his duties and responsibilities under this section as appropriate.

Section 10. Additional Water Shortage Measures

The [governing body] may order implementation of water conservation measures in addition to those set forth in Sections 4, 5 and 6. Such additional water conservation measures shall be implemented in the manner provided in Section 2(b).

Section 11. Public Health and Safety Not to be Affected

Nothing in this ordinance shall be construed to require the [agency] to curtail the supply of water to any customer when such water is required by that customer to maintain an adequate level of public health and safety.

Section 12. Severability

If any part of this ordinance or the application thereof to any person or circumstances is for any reason held invalid by a court of competent jurisdiction, the validity of the remainder of the ordinance or the application of such provision to other persons or circumstances shall not be affected.