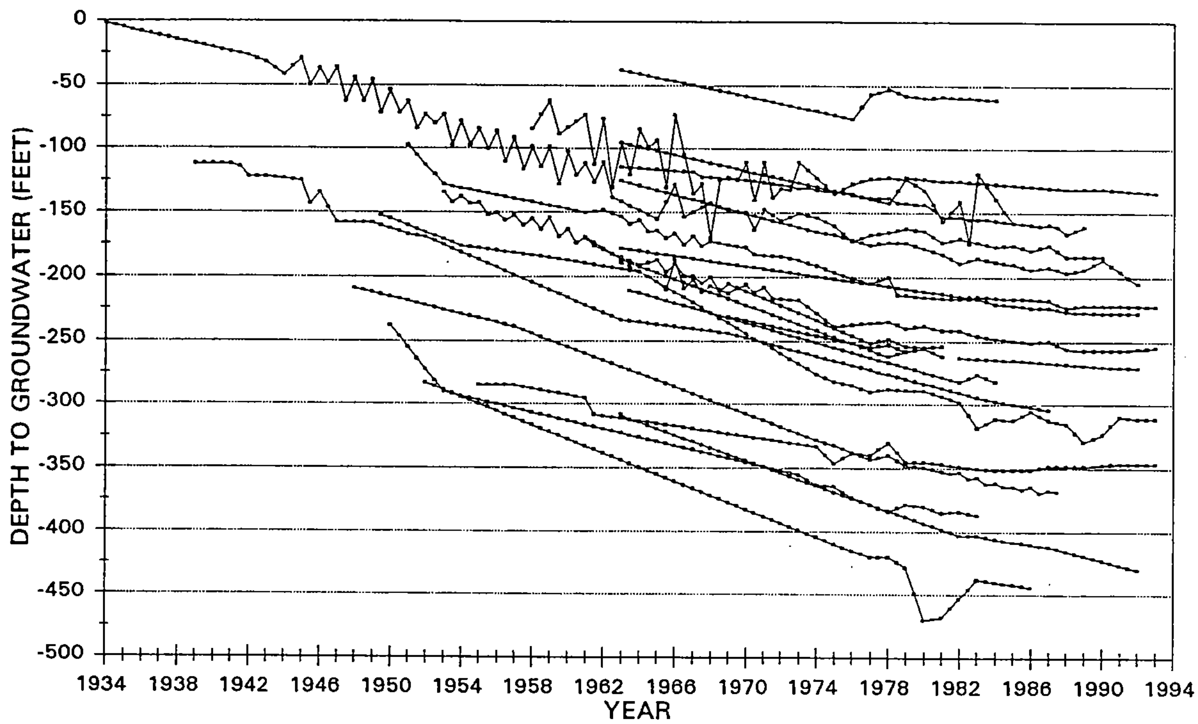

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Hydrographs in Areas that have Transitioned from Agricultural to Urban

November 1995
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Figure 4–21

PWS-0200-0101

CHAPTER 5

WATER CONSERVATION

Although not truly a water resource, water conservation can stretch available resources by decreasing demands. The importance of long-term conservation has been emphasized by the recent prolonged drought and the fact that water demands are projected to exceed available supplies in the near future. This chapter develops and evaluates water conservation alternatives for the Antelope Valley. Elements of the chapter include a description of the service area, discussion of current water conservation regulations, summary of existing water conservation programs in the Valley, description of existing and projected water demands, and discussion on available water conservation measures as well as case studies on the effectiveness of the most viable measures. Finally, a water conservation program for the Antelope Valley is presented, followed by a discussion of the effects that conservation may have on the reliability of water supplies.

SERVICE AREA

As previously described in Chapter 2 and Chapter 3, the Antelope Valley encompasses approximately 2,400 square miles in northern Los Angeles County, southern Kern County and western San Bernardino County. The water demands within the Antelope Valley are serviced by a variety of water purveyors, including large wholesale agencies, irrigation districts, special districts providing primarily municipal and industrial water, investor-owned water companies, mutual water companies, and private well-owners. Land uses within the Valley have primarily focused on agriculture; however, the Valley is in transition from predominantly agricultural uses to predominantly residential and industrial uses. An estimated 332,000 people currently reside within the Valley. As shown in Table 3-1, it is projected that the population will reach nearly 1,000,000 people by the year 2020. Mean daily summer temperatures range from 63° Fahrenheit (F) to 93° F, and mean daily winter temperatures range from 34° F to 57° F. Major communities within the Valley include Boron, Edwards Air Force Base, Lancaster, Mojave, Palmdale and Rosamond.

As shown in Table 3-1, it is anticipated that the City of Palmdale (Palmdale), the City of Lancaster (Lancaster) and the Community of Rosamond (Rosamond) will have the largest number of people in the Antelope Valley. By the year 2020, the populations are estimated to be 326,815, 269,558 and 52,696, respectively. Therefore, this chapter focuses primarily on these three urban areas as well as agricultural water uses.

WATER CONSERVATION REGULATIONS

A number of federal and state regulations currently encourage water conservation. The regulations include plumbing efficiency standards, urban water management, agricultural water management, and other issues such as graywater and landscape irrigation. A brief description of these regulations is presented below.

Plumbing Efficiency Standards

The Energy and Policy Act of 1992 establishes efficiency standards for toilets, urinals, faucets, and showerheads manufactured in the United States after January 1994. The Act provides some exceptions for facilities such as prisons and commercial buildings.

The Health and Safety Code (Section 17921.3) establishes efficiency standards for toilets sold or installed in California after January 1994. Section 17921.3 establishes a 1.6 gallon per flush requirement for all toilets, urinals and associated flushometer valves sold or installed in California.

Urban Water Management Plans

The Urban Water Management Planning Act requires that urban water retailers supplying more than 3,000 acre-feet of water per year or serving more than 3,000 customers prepare an Urban Water Management Plan (UWMP) by the end of 1985. In 1991, the Act was amended to require that 1) the plans be updated at least every five years, 2) the plans include additional elements, and 3) urban water suppliers, whether serving customers directly or indirectly, prepare a plan. In addition, the Act requires that UWMPs 1) describe and evaluate water reclamation activities, 2) provide estimates of projected reclaimed water use, and 3) describe findings, actions and planning relating to the use of internal and external water audits, and incentive programs. In 1993, the Act was amended to require that the UWMP include a Water Shortage Contingency Plan.

The Public Utilities Commission (PUC) in Decision 90-08-055 issued on 8 August 1990, ordered all Class A water utilities to develop and file Water Management Programs addressing long-term strategies for managing water resources. On 16 September 1992 in Decision 92-09-084, the PUC ordered that effective 1 January 1994, each Class A water utility shall as part of its next general rate case, (1) file an updated water management program, and (2) evaluate the performance of its water management programs.

Agricultural Water Management

The California Agricultural Water Management Planning Act requires all water suppliers providing more than 50,000 acre-feet per year to agricultural growers in California to prepare and submit informational reports identifying potential agricultural water conservation programs. In addition, if water conservation programs identified are applicable, the Act requires the suppliers to prepare and submit a water management plan. In 1991, the Act was amended to require a description of water recycling activities to be included in the informational reports and water management plans.

The Agricultural Water Suppliers Efficient Water Management Practices Act requires the California Department of Water Resources (DWR) to establish an advisory committee to evaluate efficient water management practices for agricultural water suppliers. The Act establishes the mechanism for implementation of the practices. The implementation of the practices is on a cooperative basis similar to that of the urban best management practices.

The Agricultural Water Management regulation authorizes an agricultural water supplier to institute a water conservation or efficient water management program. The program may include making improvements to the supplier's facilities and providing assistance or consultation to its customers on conservation methods.

Other Regulations

Section 14875 of the Water Code legalizes installation and retrofitting of graywater systems in single family residences. Section 14875 authorizes cities and counties to adopt state standards for installation of graywater systems in residential buildings and allows the cities and counties to adopt more stringent standards for graywater systems, or prohibit graywater systems within their jurisdiction.

The Water Conservation in Landscaping Act establishes provisions of a model conservation landscaping ordinance for adoption on the local level. The Act requires cities and counties to adopt the state's DWR model ordinance for the development of water efficient landscapes if the cities and counties have not adopted their own ordinances.

EXISTING CONSERVATION PROGRAMS IN THE ANTELOPE VALLEY

Water conservation programs existing in the Antelope Valley are primarily directed at urban areas. These programs are provided through agencies like the City of Lancaster, the Los Angeles County Waterworks Districts (LACWW), Palmdale Water District (PWD) and Rosamond Community Services District (RCSD). The Agricultural Stabilization and Conservation Service (ASCS) office provides agricultural conservation programs for farmers and ranchers. The following section describes both urban and agricultural conservation programs existing in the Antelope Valley.

Urban Conservation Programs

Urban water conservation programs in the Antelope Valley include ordinances, literature and advertising, and phased water conservation plans as described below.

<u>Conservation Ordinances</u>. The City of Lancaster adopted Ordinance No. 629 in December 1992. This ordinance details landscape development specifications to minimize use of water. The ordinance specifies acceptable water saving irrigation systems and low water-use plant materials. The specifications apply to all new and rehabilitating (including developer installed) landscape development projects, both

public and private. Cemeteries, registered historical sites, and projects with a landscaped area of less than 1,000 square feet are exempt from the ordinance. The owner or consultant for any project requiring landscape development as part of the project development is required to submit a Landscape Documentation Package to the City for review. The Landscape Documentation Package will typically include landscape and irrigation drawings, maximum water allowance calculations, irrigation schedules, maintenance schedules, soils analysis report, an approved or tentative grading plan, and a copy of the approved tract or parcel map.

In addition to the ordinance for landscape development specifications, the City of Lancaster also has provisions for graywater use in its municipal plumbing code, Ordinance No. 604. The provisions apply to the construction, alteration and repair of existing graywater systems and to the installation of new systems (allowed in residential occupancies only). The graywater systems supply underground irrigation to trees and other deep-rooted plants using household water which has not come into contact with toilet waste or wastewater from kitchen sinks, dishwaters, or laundry tubs. Permits must first be obtained in order to construct a new graywater system.

Similarly with the City of Lancaster, the County of Los Angeles (LA County) also adopted landscaping and graywater ordinances. On 17 December 1992, LA County adopted Ordinance No. 92-0135 in compliance with the Water Conservation in Landscaping Act. The ordinance establishes a procedure for designing, installing, and maintaining water efficient landscapes in new and rehabilitated projects. Effective 26 September 1991, LA County's ordinance for Graywater Systems for Residential Occupancies provides for construction, alteration and repair of graywater systems for on-site underground irrigation of trees and other deep-rooted plants. Both ordinances apply to the unincorporated areas of the county.

On 21 March 1991, LA County adopted a water wasting ordinance that applied to only unincorporated areas of the county. The ordinance placed limitations on water usage (i.e., washing down paved surfaces, excessive landscape watering, etc.). Water purveyors serving the unincorporated area of the county and all LACWW customers were notified of the ordinance and the $500 fine for noncompliance. This ordinance was terminated on 1 January 1993.

As of February 1991, the PWD adopted water conservation regulations prohibiting the use of water for hose washing of sidewalks, walkways, buildings, and driveways. The regulations also establishes limits on a variety of water uses such as washing motor vehicles, filling decorative fountains, serving drinking water at restaurants, and watering landscaped areas. The prompt repair of leaks from indoor and outdoor plumbing fixtures by all residents is also required under these regulations. In addition, the owner and manager of every short-term commercial lodging facility must post a notice of a water shortage and associated compliance measures.

Conservation Literature and Advertising. Produced by LACWW for the Antelope Valley is a booklet titled "Antelope Valley Colorful Landscapes for Water Conservation." The booklet describes how residents can develop beautiful, water conserving landscapes through low water-use plants, efficient irrigation systems and improved watering techniques.

LA County has been involved in various activities to raise public awareness on the subject of water conservation. A number of public meetings were held by LA County in conjunction with the ordinances regarding the need to conserve water. Water conservation literature and water conservation kits were distributed at the meetings. In addition, arrangements were made with the Lancaster Unified School District to promote water awareness month by providing them with conservation kits, book covers, brochures, posters, and other materials. The County also participated in and helped sponsor the Landscaping for Water Conservation Conference put on by the Antelope Valley College.

RCSD sends informational brochures to its customers during periods of drought requesting its users to practice water conservation.

Phased Water Conservation Plan. LACWW has developed a set of rules intended "to minimize the effect of a shortage of water supplies on the customers of any or all of the Districts during a water shortage emergency." The Phased Water Conservation Plan characterizes the percentage of water supply shortages based on nine phases and involves the issuance of conservation surcharges to users for quantities of water used above the set target water use for a given phase once the supply shortage percentage has been determined. For example, if the LACWW determines that a 20% water shortage will be suffered for a given year, then users will be charged normal rates for up to 80% use and will be surcharged for any use above 80%. Calculation of the surcharges is based upon whether the user's meter size is less than or greater than a specified size. In addition to conservation surcharges, water users are also required to comply with additional water conserving measures related to landscape watering as the percentage of supply shortage increases.

Agricultural Conservation Programs

The Agricultural Conservation Program provided through the ASCS is currently the only available conservation program for agricultural areas in the Antelope Valley. A description of the program as well as a summary of current practices by the Soil Conservation Service is provided below.

Agricultural Conservation Program. The ASCS of the U.S. Department of Agriculture (USDA) provides an Agricultural Conservation Program (ACP) which offers cost sharing to farmers and ranchers to encourage conservation practices on agricultural land that will result in long-term benefits. The ACP is intended to 1) help prevent soil erosion and water pollution, 2) protect and improve productive farm and ranch land, 3) conserve water used for agriculture, 4) preserve and develop wildlife habitat and 5) encourage energy conservation measures. Water conservation programs eligible for cost-sharing are listed as follows:

- Permanently installed systems
- Lining irrigation ditches
- Land leveling
- Tailwater recovery systems or other installations where the installation is an integral part of the irrigation system being reorganized for the conservation of soil or water.

The Federal Government pays up to 80 percent of the cost of needed conservation practices.

Soil Conservation Service. The Soil Conservation Service (SCS) in Lancaster indicates that although a formal conservation program is not currently in place in the Antelope Valley, farmers are practicing conservation through use of efficient irrigation systems. For example, SCS reports that orchard farms are primarily using drip irrigation, and alfalfa farms are primarily using wheel sprinkler irrigation. These two irrigation systems are considered very efficient compared to other forms of irrigation, such as flood irrigation (SCS noted that although the Department of Airports (DOA) practices flood irrigation, the water supply is from the Palmdale Water Reclamation Plant (WRP), and it is the intent of the DOA to consume as much water as possible to assist the WRP in discharge of the reclaimed water).

EXISTING AND PROJECTED WATER DEMANDS

As discussed in Chapter 4 and depicted on Figure 4-7, estimated water demands are expected to exceed available water supplies in the near future (assuming overdrafting of the groundwater basin will not continue). Water conservation can play a key role in the Valley's water management strategy.

The following section summarizes existing and projected water demands presented in Chapter 4 for Palmdale, Lancaster and Rosamond. Existing and projected agricultural water usage is also presented. Low, medium and high water demand projections based on low, medium and high population projections for the three urban areas are presented in Chapter 4. The medium water demand projection curves are utilized in this chapter.

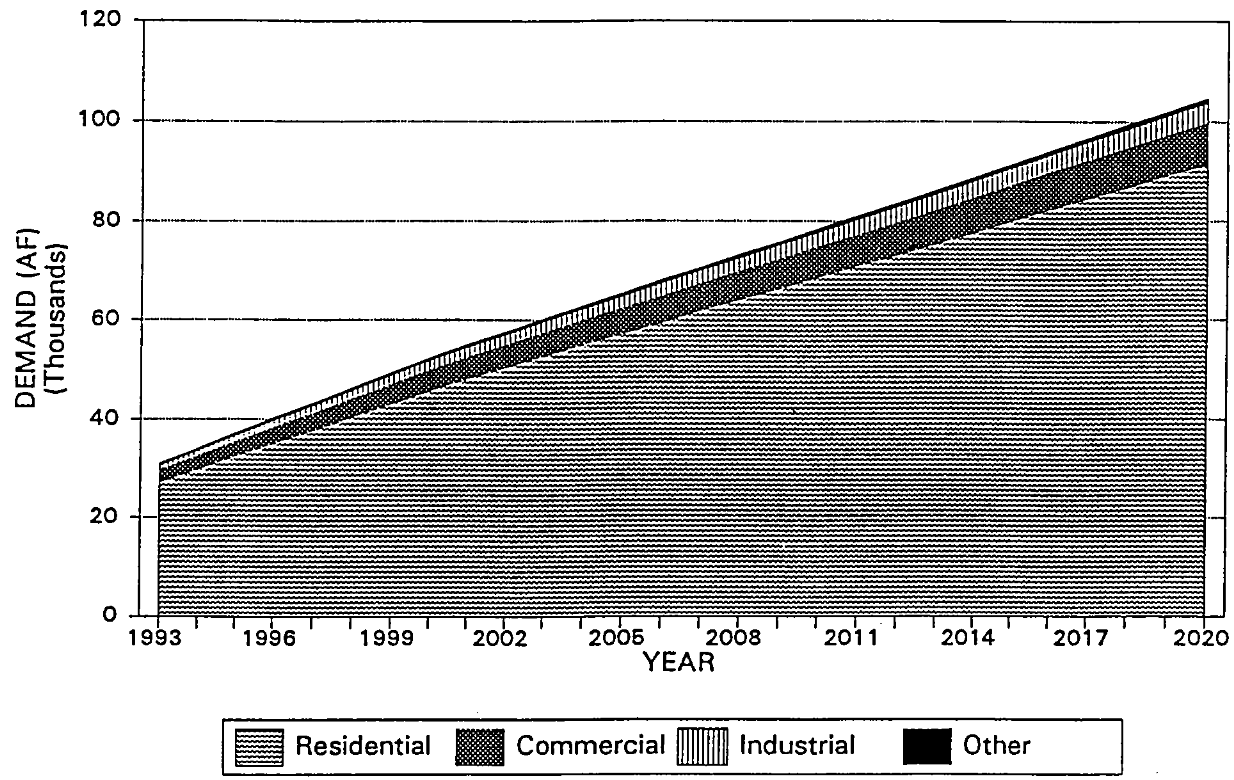
Urban Water Demands

Urban water use in Palmdale, Lancaster and Rosamond is comprised of residential, commercial, industrial, and other uses. Residential use ranges from 50 to 88 percent of the total water demands for these three areas and includes both interior and exterior water use for homes and apartments. Per capita water use in residential areas can vary greatly depending upon climate, landscaping, and density. Most of this variation is related to exterior landscape irrigation. Commercial water use ranges from 7 to 13 percent of the total and can include restaurants, laundries, office buildings, retail stores, golf courses, and other businesses. Industrial water use ranges from 0.02 to 33 percent of the total and is used for cooling, processing, manufacturing, and sanitation. Other water uses range from 1 to 15 percent of the total and can include schools, prisons, hospitals, parks, and fire departments. Figures 5-1 through 5-3 show projected water demands for Palmdale, Lancaster and Rosamond respectively, broken down into residential, commercial, industrial and other categories. Figures 5-4 through 5-6 show the approximate breakdown by percentages for each category for each area. Descriptions of water demand projections for Palmdale, Lancaster and Rosamond are provided below.

City of Palmdale. Water demand projections for Palmdale are based on a per capita demand of 0.32 acre-feet/person/year derived from 1993 population and water use data from PWD and applied to the medium population projection presented in Chapter 3. The breakdown of water use for each user class (residential, commercial, industrial and other) by percentage of the total water use was obtained from information supplied by LACWW and PWD. It is estimated that of the total water used in Palmdale, approximately 87 percent is used by the residential class, 8 percent is used by the commercial class, 4 percent is used by the industrial class, and 1 percent is used by the others. The percentages of water use for each user class are assumed to remain the same over the evaluation period (1994 to 2020).

City of Lancaster. Water demand projections for Lancaster are based on a per capita demand of 0.35 acre-feet/person/year derived from information provided in the City of Lancaster 1992 State of the City (SOC) report and applied to the medium population projection presented in Chapter 3. The SOC report provides estimates of current (1991) and projected water use for each user class. It is estimated that of the total water used in Lancaster in 1991, approximately 51 percent was used by the residential class, 14 percent was used by the commercial class, 19 percent was used by the industrial class and 16 percent was used by the others. The SOC report projects proportionally higher growth in the industrial class, thereby decreasing the proportion of water use for the residential, commercial and other classes. It is estimated that total water use in the year 2020 will comprise of approximately 50 percent residential, 8 percent commercial, 33 percent industrial and 9 percent other uses.

Community of Rosamond. Water demand projections for Rosamond are based on a per capita demand of 0.17 acre-feet/person/year derived from 1993 population and water use data from RCSD and applied to the medium population projection presented in Chapter 3. It is estimated that of the total water used in Rosamond in 1993, approximately 86 percent was used by the residential class, 7 percent was used by the commercial class, 0.02 percent was used by the industrial class and 7 percent was used by the others. (Note that the industrial water demand is not shown on Figures 5-3 or 5-6 due to the small percentage of total water use.) The percentages of water use for each user class is assumed to remain the same over the evaluation period (1994 to 2020).



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Projected Water Demand
by User Class – Palmdale

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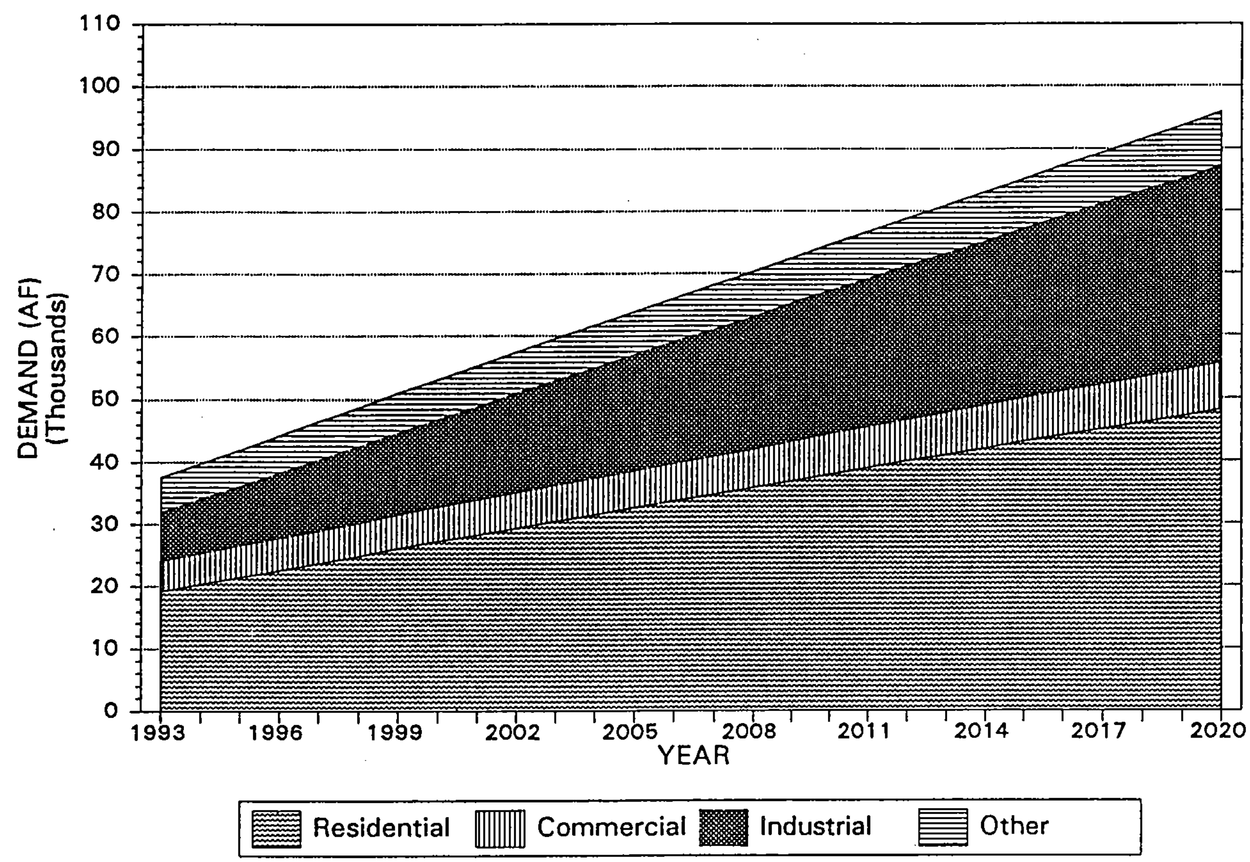
Figure 5–1



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**Projected Water Demand
by User Class – Lancaster**

November 1995
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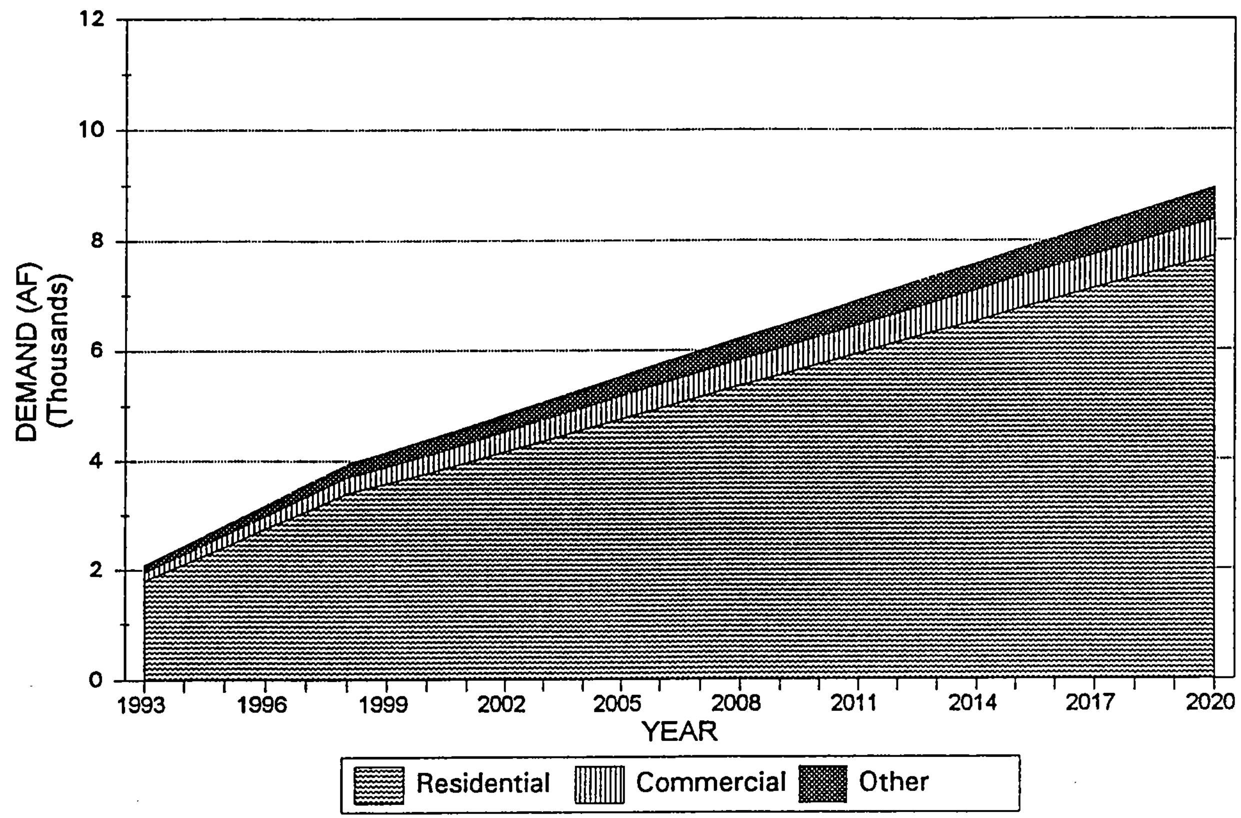
Figure 5–2



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Projected Water Demand by User Class – Rosamond

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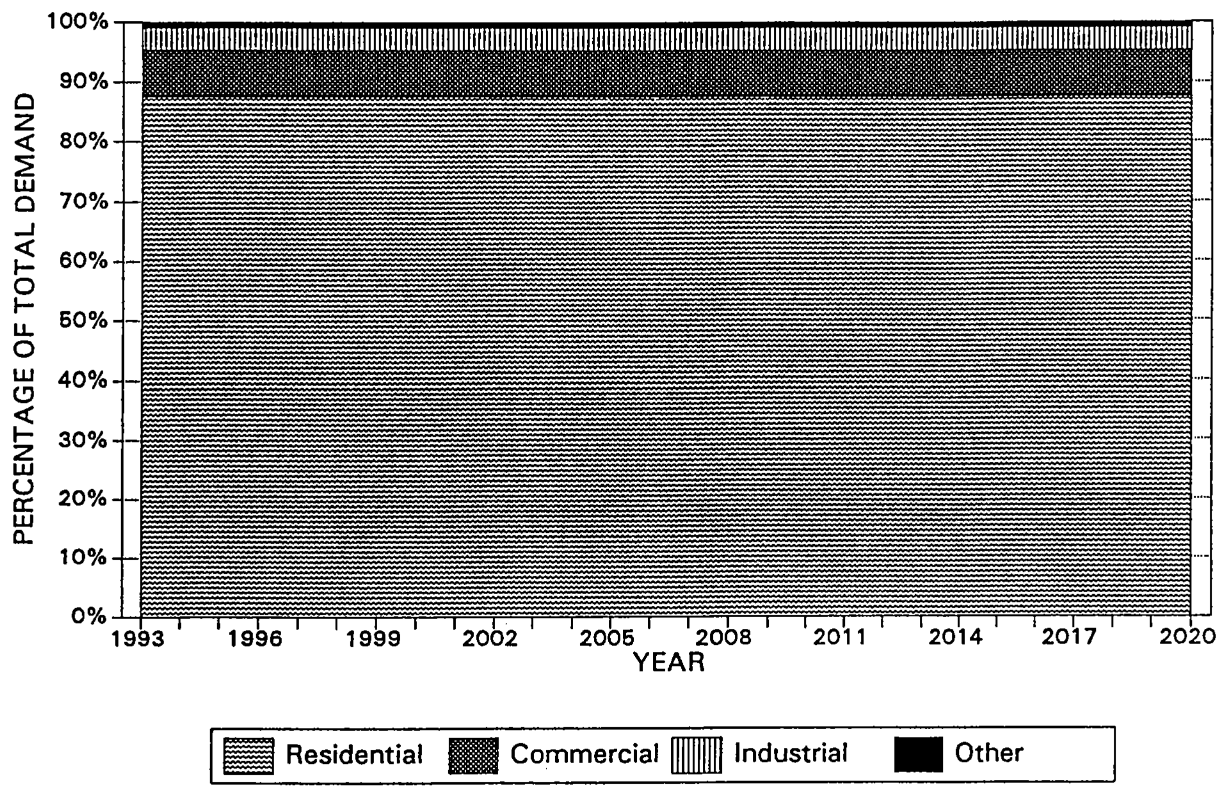
Figure 5–3



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Water Demand Breakdown by User Class – Palmdale

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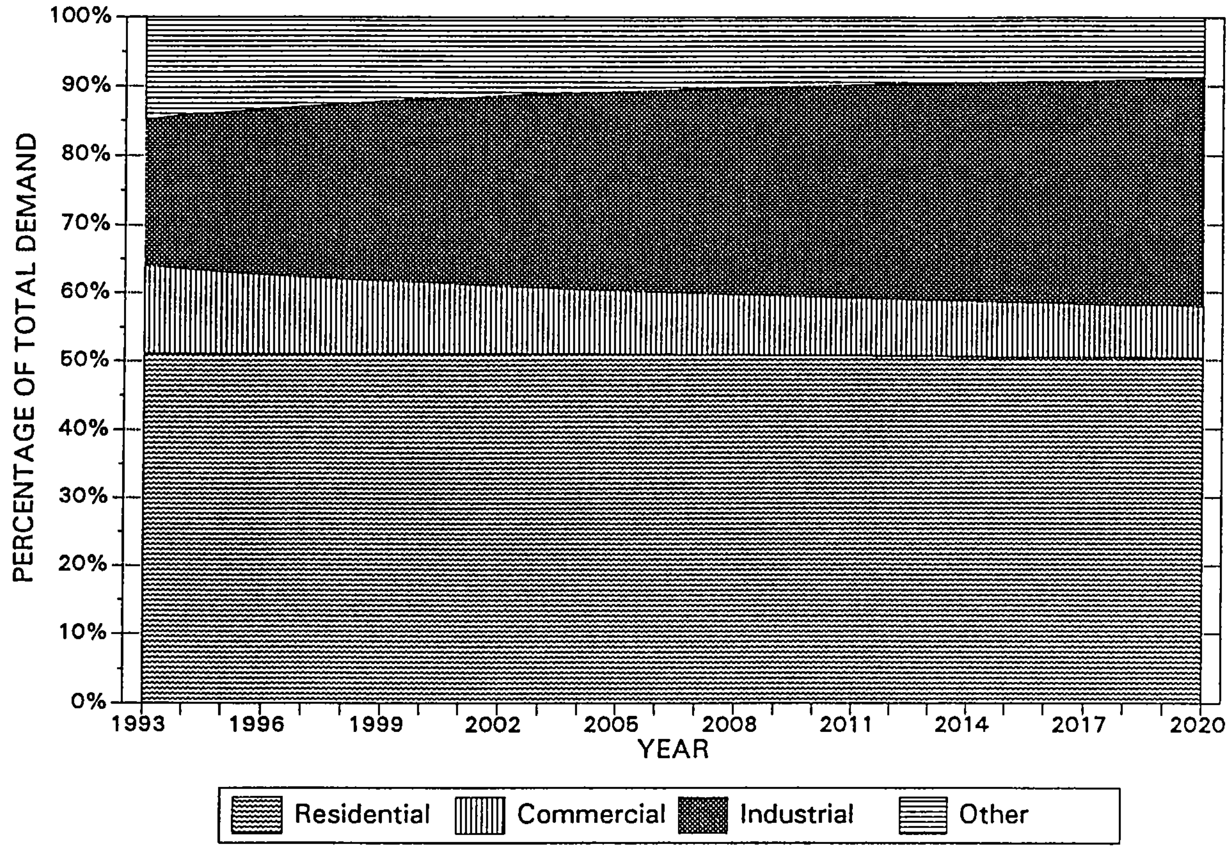
Figure 5–4



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Water Demand Breakdown by User Class – Lancaster

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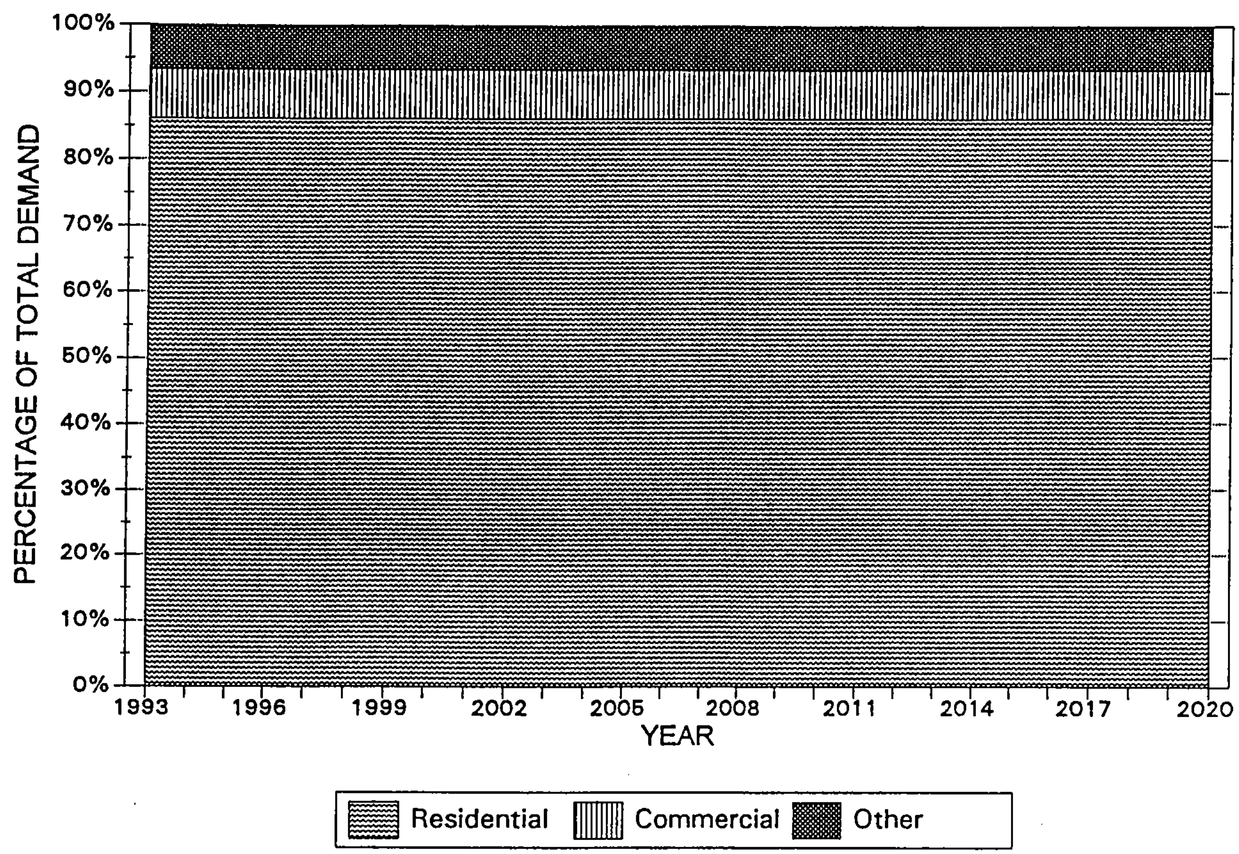
Figure 5–5



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Water Demand Breakdown by User Class – Rosamond

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Figure 5–6

Figure 5–6

Agricultural Water Demands

As shown in Table 4-1, current and projected 2020 agricultural water uses in the Antelope Valley are approximately 58,700 acre-feet and 39,100 acre-feet, respectively. These water demands include agricultural farmlands identified as high potential reclaimed water users in Chapter 6. Because the reclaimed water supply is projected to significantly exceed the reclaimed water demands, and the disposal of treated wastewater (i.e. reclaimed water) is highly dependent on maintaining agricultural farmlands, water conservation opportunities do not include the farmlands that have been identified as high potential reclaimed water users. Therefore, current and projected agricultural water demands shown in Table 5-1 and on Figure 5-7 do not include farmlands identified as high potential users of reclaimed water.

WATER CONSERVATION MEASURES

The role of water conservation in water resources management has steadily increased in recent years. According to DWR, many water purveyors began incorporating water conservation into their planning in the early 1970s by distributing water-saving devices to their customers, providing public information and education programs, and implementing leak detection and repair programs. During the 1976-77 drought, more severe water conservation measures such as rationing and revised rate structures became commonplace. Because of its practical and economic values, many California water purveyors now regard water conservation as an integral part of their water supply planning. In addition to increased practice by water purveyors, a considerable amount of literature on water conservation has been published. Due to this increased attention, there is now a wide variety of effective water conservation measures available.

Urban Water Conservation Measures

Urban water conservation measures are identified in the September 1991 Memorandum of Understanding Regarding Urban Water Conservation in California and the Urban Water Management Planning Act.

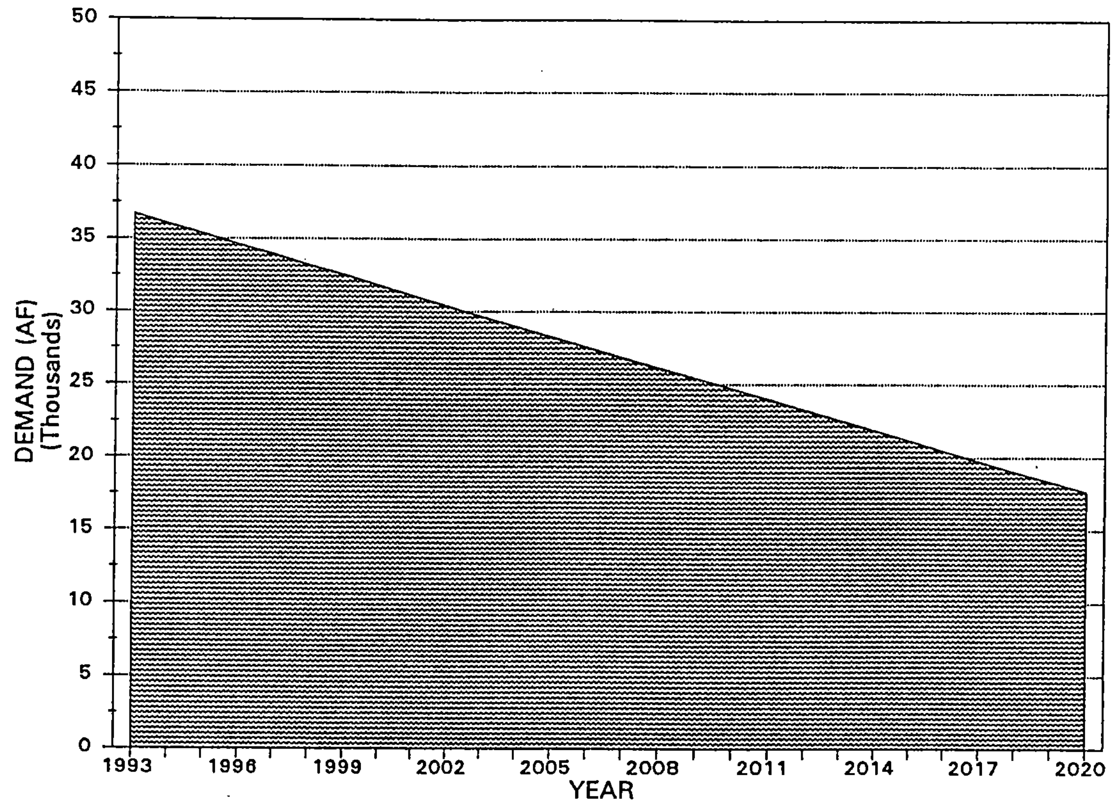
<u>Memorandum of Understanding</u>. The Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California was entered into in 1991 by urban water suppliers, public advocacy organizations and other interested groups who recognized the need for conservation due to increasing water demands for urban, agricultural and environmental uses. (Currently, none of the members of the Antelope Valley Water Group are signatories to the MOU.) Urban water conservation practices or Best Management Practices (BMPs) identified in the MOU are intended to reduce long-term urban water demands and are defined as a policy, program, practice, rule, regulation or ordinance or the use of devices, equipment or facilities which meets either of the following criteria:

TABLE 5-1

CURRENT AND PROJECTED AGRICULTURAL LAND AND WATER USE
TO UNDERGO CONSERVATION PROGRAM

Crop	Acreage (1)	Net Annual Water Use (2) (inches)	Gross Annual Water Use (3) (acre-feet/acre)	Annual Water Demand (4) (acre-feet)
1993 Irrigated Crops				
Alfalfa	2,970	48.55	6.2	18,414
Pasture/Turf	720	41.18 (5)	5.3	3,816
Grain	260	10.73	1.4	364
Field Crops	32	10.73	1.4	45
Truck Crops	2,645	17.02	2.2	5,819
Deciduous Trees/Vines	2,165	29.67 (6)	3.8	8,227
Total	8,792			36,685
2020 Irrigated Crops				
Alfalfa	1,485 (7)	48.55	6.2	9,207
Pasture/Turf	360 (7)	41.18 (5)	5.3	1,908
Grain	130 (7)	10.73	1.4	182
Field Crops	16 (7)	10.73	1.4	22
Truck Crops	1,323 (7)	17.02	2.2	2,911
Deciduous Trees/Vines	900 (8)	29.67 (6)	3.8	3,420
Total	4,214			17,650

(1) From USGS 1994 draft report "Land Use and Water Use in the Antelope Valley, California", Table 1 without the estimated acreage identified as high potential reclaimed water users.
(2) From USDA Soil Conservation Service (SCS). Rainfall occuring during the growing season is assumed to be insignificant.
(3) Net annual water use divided by an irrigation efficiency factor of 0.65 and converted to acre-feet/acre.
(4) Acreage multiplied by the gross annual water use.
(5) Average of pasture and turf net annual water use as provided by SCS.
(6) Average of almonds, orchards, pecans, pistachios, and walnuts net annual water use as provided by SCS.
(7) Assumed to be half of the 1993 acreage.
(8) From USGS 1994 draft report, Table 1. Estimate provided to USGS by DWR.



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Projected Agricultural Water Demand

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Figure 5–7

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- An established and generally accepted practice among water suppliers that results in more efficient use or conservation of water.

- A practice for which sufficient data are available from existing water conservation projects to indicate that significant conservation or conservation related benefits can be achieved; that the practice is technically and economically reasonable and not environmentally or socially unacceptable; and that the practice is not otherwise unreasonable for most water suppliers to carry out.

The following is a list of the BMPs identified in the MOU. A description of each BMP is included in Appendix A.

- Interior and exterior water audits and incentive programs for single family residential, multi-family residential, and governmental/institutional customers.

- Plumbing, new and retrofit.

- Distribution system water audits, leak detection and repair.

- Metering with commodity rates for all new connections and retrofit of existing connections.

- Large landscape water audits and incentives.

- Landscape water conservation requirements for new and existing commercial, industrial, institutional, governmental, and multi-family developments.

- Public information.

- School education.

- Commercial and industrial water conservation.

- New commercial and industrial water use review.

- Conservation pricing.

- Landscape water conservation for new and existing single family homes.

- Water waste prohibition.

- Water conservation coordinator.

- Financial incentives.

- Ultra low flush toilet replacement.

In addition to identifying BMPs, the MOU also included Potential Best Management Practices (PBMPs). The intent of the MOU was to study and then determine whether or not the PBMP's met the criteria designated as BMPs. The following is a list of the PBMPs under study identified in the MOU:

- Rate structures and other economic incentives and disincentives to encourage water conservation.
- Efficiency standards for water using appliances and irrigation devices.
- Replacement of existing water using appliances (except toilets and showerheads whose replacements are incorporated as BMPs) and irrigation devices.
- Retrofit of existing car washes.
- Graywater use.
- Distribution system pressure regulation.
- Water supplier billing records broken down by customer class (e.g., residential, commercial, industrial).
- Swimming pool and spa conservation including covers to reduce evaporation.
- Restrictions or prohibitions on devices that use evaporation to cool exterior spaces.
- Point-of-Use water heaters, recirculating hot water systems and hot water pipe insulation.
- Efficiency standards for new industrial and commercial processes.

<u>Urban Water Management Planning Act</u>. As previously discussed, the Urban Water Management Planning Act requires urban water retailers supplying more than 3,000 acre-feet of water per year or serving more than 3,000 customers to prepare an UWMP to achieve conservation and efficient use of water. The Act requires the UWMP to evaluate water management practices identified below:

- Consumer education.
- Metering.
- Water saving fixtures and appliances.
- Pool covers.

- Lawn and garden irrigation techniques.
- Low water use landscaping.
- Internal and external water audits for single-family residential, multi-family residential, institutional, commercial, industrial, and governmental customers.
- Incentive programs to encourage customer audits and program participation.
- Distribution system water audits.
- Leak detection and repair.
- Large landscape water audits and incentives for conversion to water reuse.
- Financial incentives to encourage use of reclaimed water.
- Incentive programs to facilitate development of dual water systems for use of reclaimed water in new construction, for flushing toilets and urinals, landscaping, golf courses, cemeteries, irrigation, and other appropriate purposes.
- Plans to eliminate use of once-through cooling systems, non-recirculating water systems, and non-recycling decorative water fountains and to encourage recirculation of water if proper public health and safety standards are maintained.
- Wastewater reclamation.
- Exchanges or transfer of water on a short-term or long-term basis.
- Management of water system pressure and peak demands.
- Issues relevant to meter retrofitting for all uses
- Incentives to alter water use practices, including fixture and appliance retrofit programs.
- Changes in pricing, rate structure, and regulations.

A copy of the Urban Water Management Planning Act and subsequent amendments is included in Appendix B.

Agricultural Water Conservation Measures

Agricultural water conservation measures are identified in the DWR November 1993 draft "California Water Plan Update" (Bulletin 160) and are described below. A description of the Mobile Agricultural Water Conservation Laboratory program is also presented.

<u>Bulletin 160</u>. Bulletin 160 reports that programs offered through the University of California, California State Universities, local Resource Conservation Districts and the USDA have resulted in constant improvement in use of resources for agricultural productions in California. Through the collective efforts of these groups, DWR reports that irrigation efficiencies have increased and water requirements have decreased. As discussed previously, enactment of the Agricultural Water Suppliers Efficient Water Management Act in 1990 requires the DWR to establish an advisory committee to evaluate Efficient Water Management Practices (EWMPs) for agricultural water suppliers.

The following is a list of identified EWMPs:

- Improve water measurement and accounting.
- Conduct irrigation efficiency studies.
- Provide farmers with "normal-year" and "real time" irrigation, scheduling and crop evapotranspiration (ET) information.
- Monitor surface water qualities and quantities.
- Monitor soil moisture.
- Provide on-farm irrigation system evaluations.
- Monitor quantity and quality of drainage waters.
- Evaluate and improve water user pump efficiencies.
- Designate a water conservation coordinator.
- Improve the condition and type of flow measuring devices.
- Automate canal structures.
- Line or pipe ditches and canals.
- Modify distribution facilities to increase the flexibility of water deliveries.
- Construct or line regulatory reservoirs.

Riverside-Corona Resources Conservation District

The Riverside-Corona Resource Conservation District's (RCRCD) "Irrigation Water Management on Agricultural Lands" dated March 1993 reported that data gathered from field tests show that agricultural irrigators can save 20 to 50 percent in water costs if recommendations and adjustments provided by the Mobile Lab program are implemented. The report estimated that 600 to 1,200 acre-feet of water has been saved each year over the past 5 years, resulting in $210,000 to $420,000 savings each year by local irrigators in western Riverside County. More than 200 farmers and ranchers have used the Mobile Lab to troubleshoot system problems and make scheduling recommendations, and over 400 evaluations on 10,000 acres have been completed by the RCRDC Mobile Lab. Over 2,300 evaluations have been completed by Mobile Labs throughout California.

Pond-Shafter-Wasco Resource Conservation District

Estimates provided by the Pond-Shafter-Wasco Resource Conservation District indicate that approximately 1,500 acre-feet of water could be saved on 6,642 acres of farmland if the irrigation systems were operating more efficiently. The water savings is based on averages over a six year period and is regarded as potential savings from implementation of the recommendations and adjustments provided by the Mobile Lab Program.

A.A. Naumann, Inc

The Regional Water Quality Control Board, Resource Conservation District, United Water Conservation District, Pleasant Valley County Water District, City of Oxnard, Casitas Municipal Water District and the Association of Water Agencies of Ventura County are participating agencies in a pilot project involving testing of underground reusable drip irrigation tape for row crops on the A.A. Naumann Ranch in Ventura County. Most row crops grown in Ventura County are furrow or furrow/sprinkler irrigated, which is reported to be less efficient than buried drip irrigation for the application of water, fertilizers and pesticides. The drip irrigation resulted in a 66 percent savings in water per acre compared to furrow irrigation (2.3 acre-feet versus 7 acre-feet), while product yield increased by almost 10 percent. Pesticide use declined by 33 percent. Savings through reduction of fertilizer, pesticide and water use, accompanied by increases in production yield resulted in a good initial return on the investment of the underground drip irrigation system.

RECOMMENDED WATER CONSERVATION PROGRAMS

This section briefly describes the measures recommended for inclusion in the water conservation plan for the Antelope Valley. Because agricultural water use is expected to decline significantly during the planning period (1994-2020), the plan consists primarily of urban conservation programs developed for the City of Palmdale, City of Lancaster and Community of Rosamond. A brief discussion on the agricultural water conservation program is included in the overall plan for the Antelope Valley. Evaluation of urban water conservation measures was performed utilizing the DWR's Water Plan computer software. Benefit to cost (B/C) analyses were performed for each recommended urban water conservation measure to determine cost effectiveness. A discussion on the B/C analyses as well as an implementation plan for each water conservation measure is also included.

City of Palmdale

Table 5-2 identifies the conservation measures recommended for the City of Palmdale. The water conservation program for Palmdale consists of 6 measures: 2 existing and 4 potential. The two existing measures, Ultra Low-Flush Toilet Ordinance for New Residential and Standards for New Large Landscapes, are measures established in regulations previously described. The 4 potential conservation measures recommended for consideration by the City of Palmdale are described below.

Retrofit Kit Program. This program involves the provision of fixture retrofit kits to 5,900 housing units built prior to 1980. The measure is intended to reduce residential water consumption by eliminating some of the high water using fixtures typically found in older housing units (pre-1980). The kits include the following:

- Two toilet tank displacement dams to reduce the volume of water used by non-conserving toilets.
- Two leak detection tablet packets to identify equipment-related leakage in residential toilets.
- One ultra-low flow showerhead to achieve water savings through replacement of one non-conserving showerhead.

Information and Education, Residential. This program is designed to increase customer "water" awareness and promote understanding of local community water conservation projects. The program may involve in-school education by providing educators with a water conservation curriculum, a teacher training workshop and/or through water conservation assemblies. Information may be disseminated to the public through bill stuffers, brochures, print media, television, etc. The information packages may include the following:

- Information on water-wise versus water-wasteful practices designed to increase customer awareness of indoor and outdoor water use.

- Lawn watering guides to provide customers with easy to follow instructions on how to determine the appropriate watering time required to adequately irrigate their own turfgrass.

- Information on "Xeriscape principles" to increase customer awareness of water-saving techniques that may be implemented in residential landscapes.

PWS-0200-0123

TABLE 5-2

SELECTED URBAN WATER CONSERVATION MEASURES

Area	*Measure*
City of Palmdale	• Ultra Low-Flush Toilet Ordinance, New Residential • Standards for New Large Landscapes • Retrofit Kit Program • Information and Education, Residential • Seasonal Rates, Residential • Uniform or Increasing Block Rates, Residential
City of Lancaster	• Ultra Low-Flush Toilet Ordinance, New Residential • Standards for New Large Landscapes • Information and Education, Residential • Residential Water Audit and Retrofit Kit • Seasonal Rates, Residential • Seasonal Rates, Commercial • Seasonal Rates, Industrial • Uniform or Increasing Block Rates, Residential • Uniform or Increasing Block Rates, Commercial • Uniform or Increasing Block Rates, Industrial • Large Turf Irrigation Audits
Community of Rosamond	• Ultra Low-Flush Toilet Ordinance, New Residential • Standards for New Large Landscapes • Seasonal Rates, Residential • Uniform or Increasing Block Rates, Residential • System Water Audit, Leak Detection, and Repair • Residential Retrofit Kit

Seasonal Rates, Residential. This program involves implementation of higher water rates during peak water use periods and is intended to encourage customers to conserve water during summer months when consumption is high due to landscape irrigation requirements.

Uniform or Increasing Block Rates, Residential. This program involves implementation of a modified rate schedule to charge the same amount for each unit of water sold (uniform) or more per unit of water as consumption rises (increasing block). The program is intended to encourage customers to use water conserving practices and devices in order to avoid higher per unit water charges associated with increased water use.

Implementation of the Ultra-Low-Flush Toilet Ordinance and the Standards for New Large Landscapes will be the responsibility of the City of Palmdale. Implementation of the Seasonal and Block Rates will be the responsibility of the individual water purveyors. The Retrofit Kits and Information and Education measure can be implemented by both the City and the individual water purveyors.

Total water savings during the planning period (1994-2020) are estimated to be 225,800 acre-feet. The B/C ratio of the plan is 4.7. Figure 5-8 depicts projected water demand with and without the water conservation program recommended for the City of Palmdale.

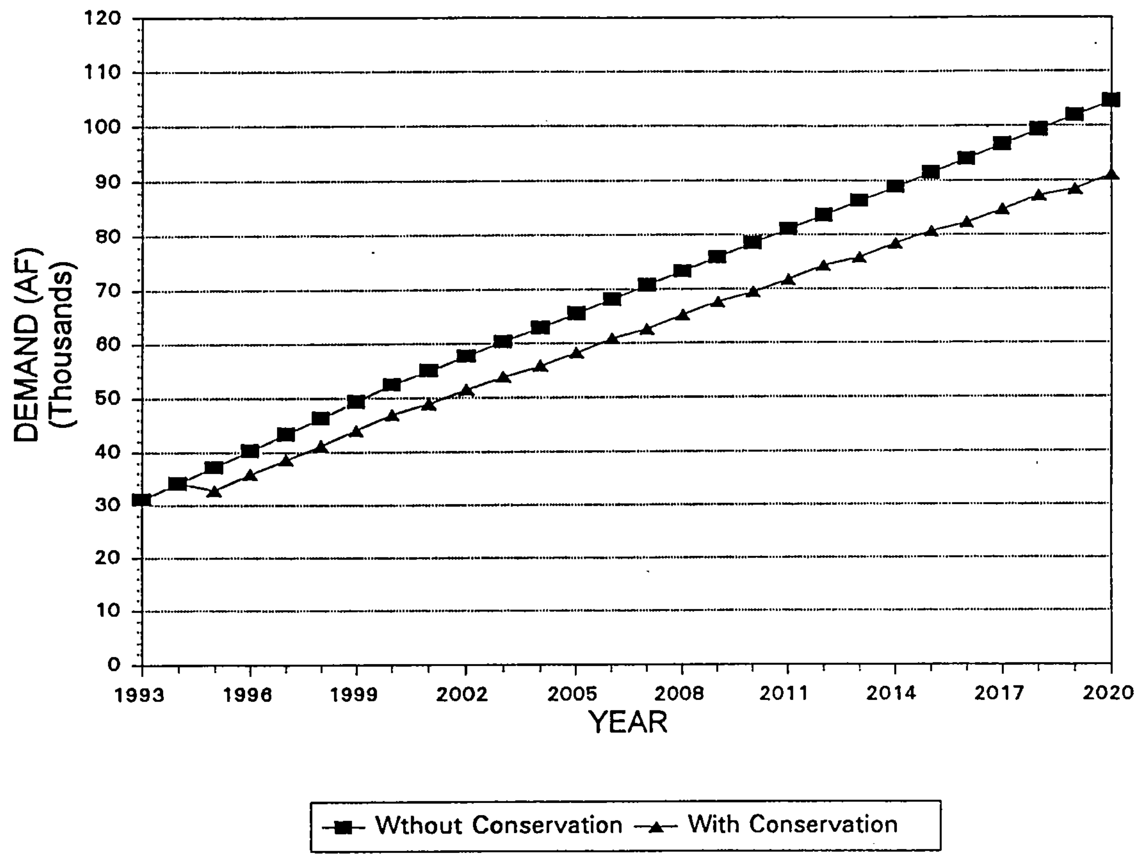
City of Lancaster

Table 5-2 identifies the conservation measures recommended for the City of Lancaster. The water conservation program for Lancaster consists of 11 measures: 2 existing and 9 potential. The two existing measures are the Ultra Low-Flush Toilet Ordinance for New Residential and Standards for New Large Landscapes, established in regulations described previously. Because commercial and industrial users comprise a large percentage of water demand in Lancaster as shown on Figure 5-5, commercial and industrial conservation programs are recommended for the City. The 9 potential conservation measures recommended for consideration by the City of Lancaster are described below.

Information and Education, Residential. Discussed under "City of Palmdale."

Residential Water Audit and Retrofit Kit. This program is conducted at the request of the homeowner and usually involves the following:

- Identification and discussion of water uses with the homeowner.
- Offer to install low-flow showerheads, tank displacement dams, and faucet aerators, and check for toilet leaks using leak detection tablets.
- Repair of toilet leaks if detected.
- Provision of guides and information on additional water conserving actions and lawn watering.



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Projected Water Demand
with Conservation
Palmdale

November 1995
K/J 934620.00

Figure 5–8

PWS-0200-0126

Figure 5–8

Availability of free water audits is promoted through the public information program as an incentive for homeowners to request them.

Seasonal Rates, Residential, Commercial, Industrial. Discussed under "City of Palmdale."

Uniform or Increasing Block Rates, Residential, Commercial, Industrial. Discussed under "City of Palmdale."

Large Turf Irrigation Audits. This program involves prioritizing existing commercial and multi-family sites according to irrigated acreage and past water use. Targeted customers are sent an audit program letter and commercial irrigation guides. The actual audit involves the following:

- Production of a customized irrigation schedule for the customer.

- Audit follow-up including provision of weather information for updated schedules.

The intent of the program is to enable landscape managers to do timely equipment maintenance and to efficiently apply water for irrigation throughout the year.

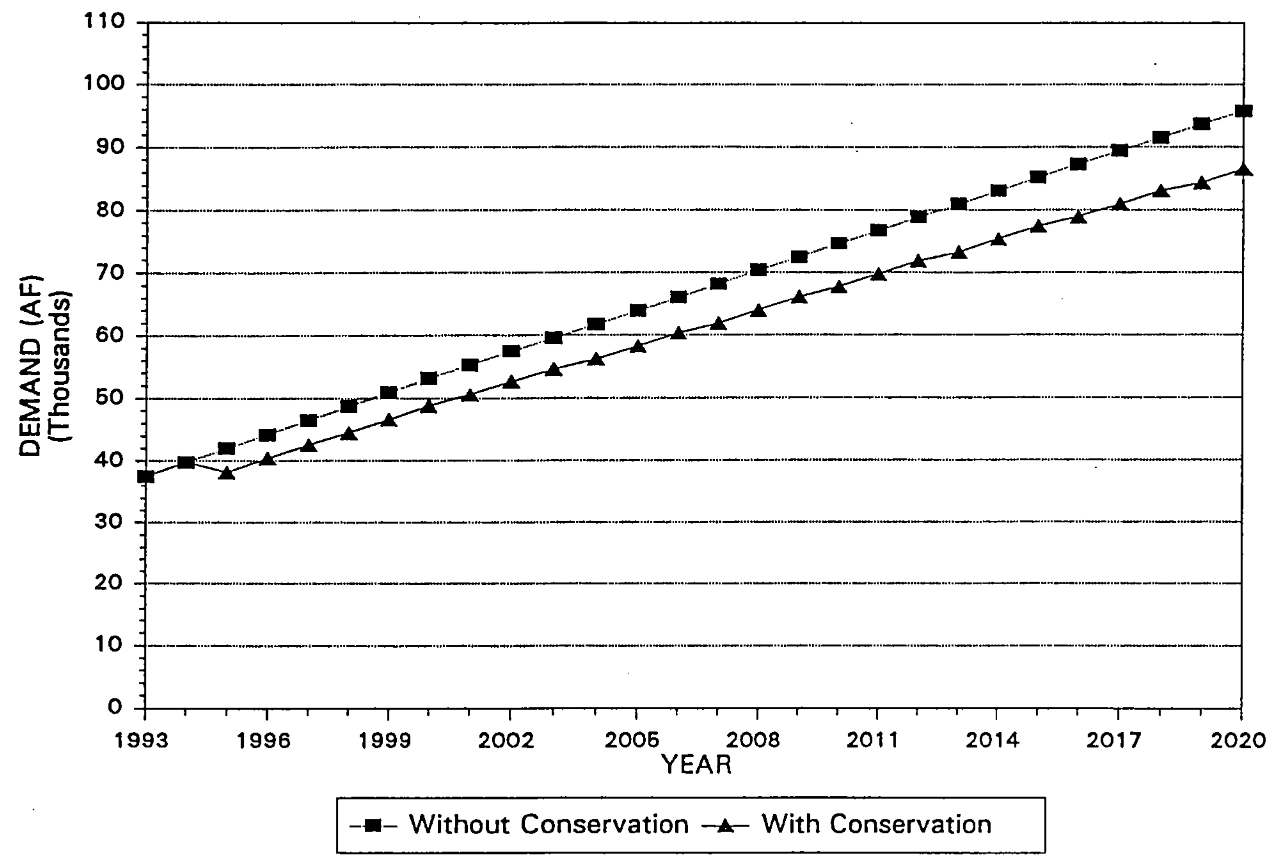
Implementation of the Ultra-Low-Flush Toilet Ordinance and the Standards for New Large Landscapes will be the responsibility of the City of Lancaster. Implementation of the Seasonal and Block Rates and the Large Turf Audits will be the responsibility of the individual water purveyors. The Retrofit Kits and Information and Education measure can be implemented by both the City and the individual water purveyors.

Total water savings during the planning period (1994 to 2020) are estimated to be 170,100 acre-feet. The B/C ratio of the plan is 3.0. Figure 5-9 depicts projected water demand with and without the water conservation program recommended for the City of Lancaster.

Community of Rosamond

Table 5-2 identifies the conservation measures recommended for the Community of Rosamond. The water conservation program for Rosamond consists of 6 measures: 2 existing and 4 potential. The two existing measures, Ultra Low-Flush Toilet Ordinance for New Residential and Standards for New Large Landscapes, are measures established in regulations previously described. The 4 potential conservation measures recommended for consideration by the Community of Rosamond are described below.

Seasonal Rates, Residential. Discussed under "City of Palmdale."



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Projected Water Demand
with Conservation
Lancaster

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K/J 934620.00

Figure 5–9

PWS-0200-0128

Figure 5–9

Uniform or Increasing Block Rates, Residential. Discussed under "City of Palmdale."

System Water Audit, Leak Detection, and Repair. This program involves an audit of the distribution system by the agency to determine the amount of water that is unaccounted for through inaccurate meter readings, malfunctioning valves, leakage and theft, subsequently leading to a repair program. The water audits are done once a year. DWR estimates that water savings from actions taken following a water audit can vary from 3 to 30 percent.

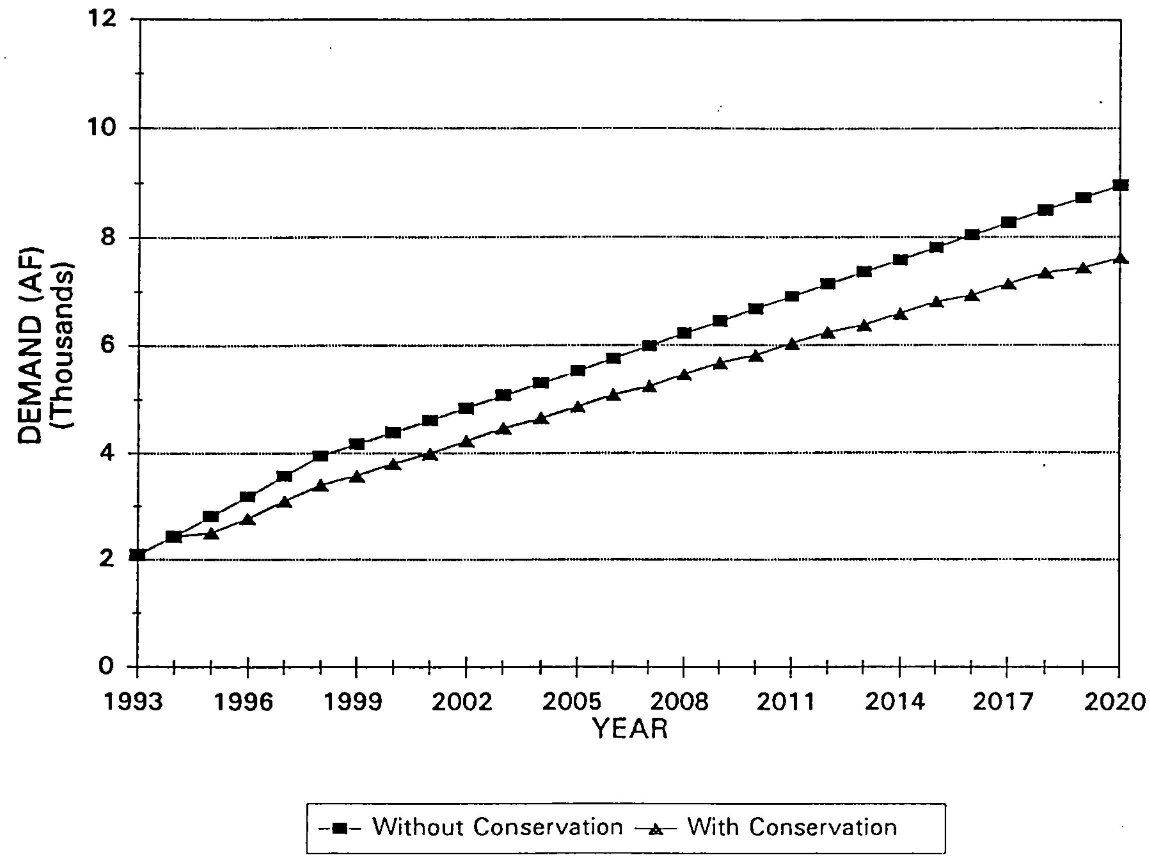
Residential Retrofit Kit. This program involves the provision of fixture retrofit kits to 3,000 housing units. The measure is intended to reduce residential water consumption by eliminating some of the high water using fixtures. The kits include the following:

- Lawn watering guides to provide customers with easy to follow instructions on how to determine the appropriate watering time required to adequately irrigate his or her own turfgrass.
- Two toilet tank displacement dams to reduce the volume of water used by non-conserving toilets.
- Two leak detection tablet packets to identify equipment-related leakage in residential toilets.
- One ultra-low flow showerhead to achieve water savings through replacement of one non-conserving showerhead.
- One faucet aerator to reduce water use.

Implementation of the Ultra-Low-Flush Toilet Ordinance and the Standards for New Large Landscapes will be the responsibility of the County of Kern. Implementation of the Seasonal and Block Rates and the System Water Audit will be the responsibility of the individual water purveyors. The Retrofit Kits can be implemented by both the County and the individual water purveyor.
Total water savings during the planning period (1994 to 2020) are estimated to be 21,700 acre-feet. The B/C ratio of the plan is 4.5. Figure 5-10 depicts projected water demand with and without the water conservation program recommended for the Community of Rosamond.

Benefit to Cost Analyses

Water conservation programs described above were evaluated utilizing the DWR Water Plan software. The Water Plan software allows the user to input specific information applicable to each service area. This information includes:



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Antelope Valley Water Resources Study

Projected Water Demand
with Conservation
Rosamond

November 1995
K/J 934620.00

Figure 5–10

PWS-0200-0130 Figure 5–10

- water consumption
- water rates
- marginal cost of water
- electric rates and marginal cost
- natural gas rates and marginal cost
- sewer rates and marginal cost

The software then allows the user to select or design water conservation programs for analysis.

After a program is selected, information pertaining to each measure within the program is input. This information includes:

- Number of items delivered by year over the study period.

- Responsible party for the capital, installation, and operation and maintenance costs.

- Percentage of people expected to participate.

Once the service area and measure information are input, the B/C analysis can be run. The B/C ratio is the ratio of the present value of benefits to the present value of costs resulting from water conservation measures. An investment is cost-effective when the ratio of the present value of benefits to the present value of costs (or B/C) exceeds 1.0. Benefits of water conservation are calculated by estimating water savings from each program which are multiplied by the value of water; yielding the estimated benefits from water conservation in dollars. Costs of water conservation include device and administrative costs associated with each conservation measure. Device costs include capital, installation, and operation and maintenance. Administrative costs include salaries of personnel associated with conservation, delivery, incentive payments, and advertising.

Results of the B/C analyses for the conservation measures analyzed for each area are summarized in Table 5-3. The overall B/C ratios for the City of Palmdale, City of Lancaster, and Community of Rosamond were calculated to be 4.7, 3.0, and 4.5 respectively.

Agricultural Water Conservation Program

As discussed previously, the Agricultural Water Suppliers Efficient Water Management Practices Act requires the DWR to establish an advisory committee to evaluate EWMPs aimed at agricultural water suppliers concerning conservation of irrigation water. Because the evaluation of the EWMPs will require detailed planning by each water agency and will include analysis of technical feasibility, social and district economic criteria and legal feasibility of each practice, an assessment of the impact of implementation of EWMPs (i.e., costs and water savings) is not currently available through the DWR.

TABLE 5-3

BENEFIT TO COST RATIO SUMMARY

Program	*Agency*
City of Palmdale	
• Ultra Low-Flush Toilet Ordinance, New Residential (1)	0.1
• Standards for New Large Landscapes (1)	1.4
• Retrofit Kit Program	1.9
• Information and Education, Residential	1.8
• Seasonal Rates, Residential	327.4
• Uniform or Increasing Block Rates, Residential	545.6
Total	4.7
City of Lancaster	
• Ultra Low-Flush Toilet Ordinance, New Residential (1)	2.5
• Standards for New Large Landscapes (1)	2.7
• Information and Education, Residential	2.6
• Residential Water Audit and Retrofit Kit	2.6
• Seasonal Rates, Residential	3.1
• Seasonal Rates, Commercial	3.0
• Seasonal Rates, Industrial	3.0
• Uniform or Increasing Block Rates, Residential	3.1
• Uniform or Increasing Block Rates, Commercial	3.0
• Uniform or Increasing Block Rates, Industrial	3.1
• Large Turf Irrigation Audits	2.9
Total	3.0
Community of Rosamond	
• Ultra Low-Flush Toilet Ordinance, New Residential (1)	2.1
• Standards for New Large Landscapes (1)	1.1
• Seasonal Rates, Residential	3.3
• Uniform or Increasing Block Rates, Residential	3.3
• System Water Audit, Leak Detection, and Repair	21.0
• Residential Retrofit Kit	2.1
Total	4.5

(1) Existing regulations

In addition, due to all the variables associated with agriculture (i.e., crop type, soil type, acreage, irrigation system, management, etc.), it may be difficult to produce a software program that will provide B/C ratios for agricultural measures similar to DWR's Water Plan for urban conservation measures which uses typical values for costs and water savings obtained from historical information. Therefore, until DWR's assessment of the EWMPs is complete, analyses of potential agricultural conservation measures for the Valley cannot be provided. However, based on the available case studies, an agricultural water conservation program can be recommended on a preliminary basis. It is recommended that a Mobile Lab program be established to serve agricultural areas in the Antelope Valley. Although the RCRCD 1993 report reported a potential 20 to 50 percent water savings through the Mobile Lab program, for purposes of this report, a conservative estimate of 10 percent is used. This estimate results in total water savings during the planning period (1995-2020) of 68,800 acre-feet. Figure 5-11 depicts the projected agricultural water demands with and without the Mobile Lab program.

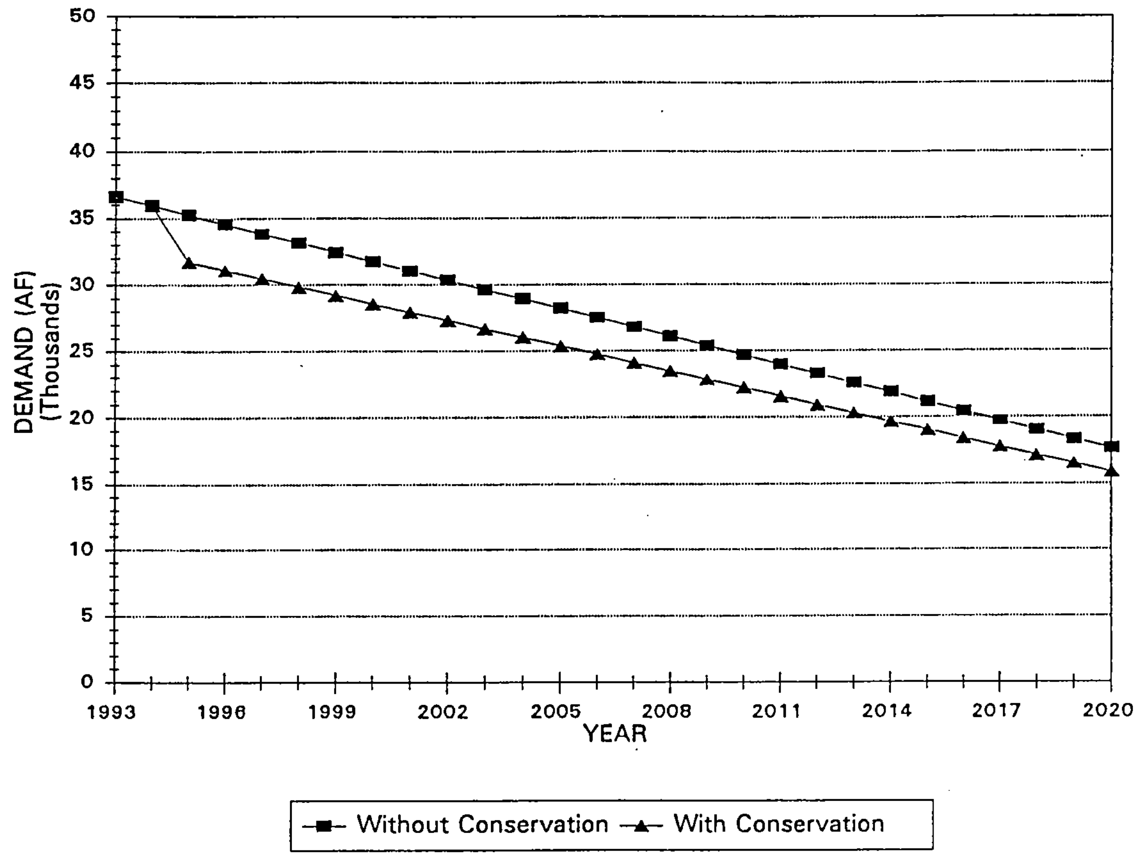
Implementation Schedule

An implementation schedule as well as the estimated water savings for each conservation measure described above is shown in Table 5-4. Implementation of the urban conservation measures is assumed to begin in 1994 and continue through the year 2020. Estimated water savings from the urban measures range from 0.67 to 87,356 acre-feet for the City of Palmdale, 0.34 to 43,775 acre-feet for the City of Lancaster, and 0.34 to 7,821 acre-feet for the Community of Rosamond. The estimated water savings is shown as the total amount of water saved over the entire implementation period (1994 to 2020). Implementation of the agricultural conservation measure is assumed to begin in 1995 and continue through the year 2020. Estimated water savings for the agricultural measure is 68,800 acre-feet over the entire implementation period (1995 to 2020).

It is important to note that a cooperative attitude from all agencies involved may help to contribute to the success of implementation of the conservation program.

EFFECTS OF WATER CONSERVATION ON WATER SUPPLY AND DEMAND

Figure 5-12 depicts the medium water demand with and without implementation of conservation measures and projected supply estimates at the 50, 80, and 90 percent probability levels. The most optimistic supply assumption (i.e., delivery of 100 percent of available water supplies) is also shown. Figure 5-12 is identical to Figure 4-16 with one exception: a second demand curve is provided to show the affect on the projected water demands from implementation of the conservation program discussed in this chapter. As shown on Figure 5-12, without exceeding groundwater extractions of 59,100 acre-feet per year, the probability of meeting the estimated 1993 water demand is approximately 73 percent. Without a conservation program, by the year 1998 (projected population of 451,000), 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2000 (projected population of 499,000), 100 percent of the



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**Projected Water Demand
with Conservation
Agricultural**

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K/J 934620.00

Figure 5–11

PWS-0200-0134

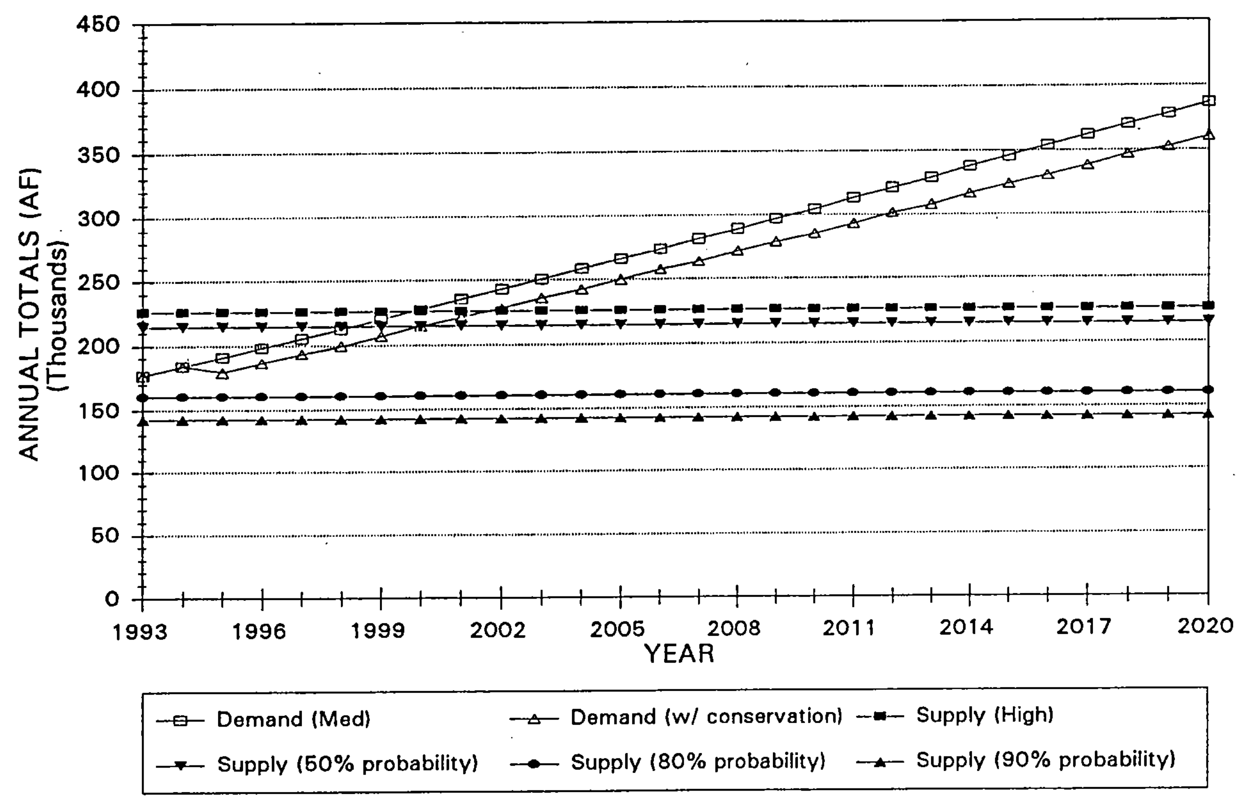
Figure 5–11

TABLE 5-4

IMPLEMENTATION SCHEDULE
AND ESTIMATED WATER SAVINGS

Conservation Measure	*Implementation Years*	*Estimated Water Savings (acre-feet)*
City of Palmdale		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.67
• Standards for New Large Landscapes [1]	1994-2020	40
• Retrofit Kit Program	1994-2020	7,357
• Information and Education, Residential	1994-2020	78,642
• Seasonal Rates, Residential	1994-2020	52,415
• Uniform or Increasing Block Rates, Residential	1994-2020	87,356
Total		225,811
City of Lancaster		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.34
• Standards for New Large Landscapes [1]	1994-2020	80
• Information and Education, Residential	1994-2020	25,233
• Residential Water Audit and Retrofit Kit	1994-2020	1,245
• Seasonal Rates, Residential	1994-2020	43,775
• Seasonal Rates, Commercial	1994-2020	6,575
• Seasonal Rates, Industrial	1994-2020	10,927
• Uniform or Increasing Block Rates, Residential	1994-2020	43,775
• Uniform or Increasing Block Rates, Commercial	1994-2020	10,961
• Uniform or Increasing Block Rates, Industrial	1994-2020	18,210
• Large Turf Irrigation Audits	1994-2020	9,325
Total		170,106
Community of Rosamond		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.34
• Standards for New Large Landscapes [1]	1994-2020	40
• Seasonal Rates, Residential	1994-2020	5,694
• Uniform or Increasing Block Rates, Residential	1994-2020	5,694
• System Water Audit, Leak Detection, and Repair	1994-2020	7,821
• Residential Retrofit Kit	1994-2020	2,496
Total		21,745
Agricultural • Mobile Lab Program	1995-2020	68,800
Grand Total		486,462

(1) Existing regulations



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Supply and Projected Demand
(Includes Conservation)

November 1995
K/J 934620.00

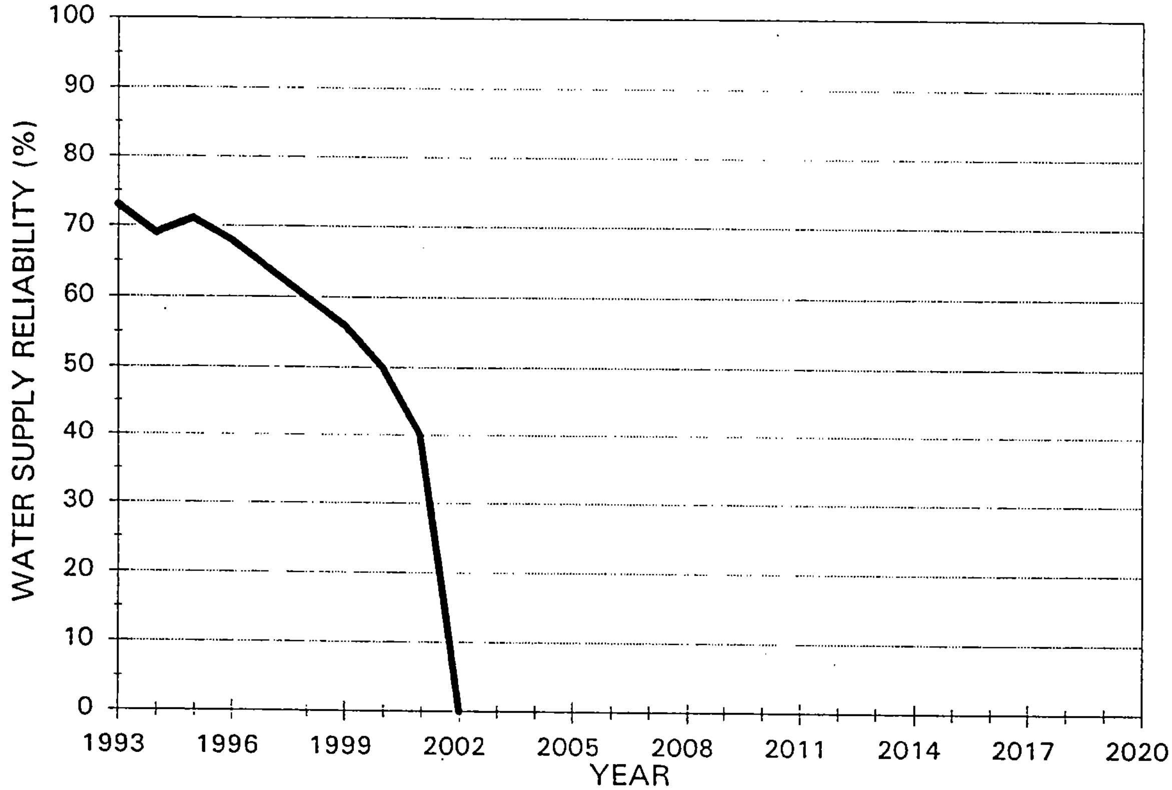
Figure 5–12

PWS-0200-0136

Figure 5–12

potential water supplies would be required to meet the water demand. With a conservation program, by the year 2000, 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2002 (projected population of 547,000), 100 percent of the potential water supplies would be required to meet the water demand.

Figure 5-13 is based upon Figure 5-12 and shows the probable operating level of available water supplies. As shown in Figure 5-13, the water supply reliability is expected to decrease. By the year 2002, assuming that overdrafting of the groundwater basin does not occur, it is anticipated that the water demands will exceed the available supplies. This means that the probability of meeting 100 percent of the water demands is zero.



NOTE: RELIABILITY IS BASED ON NOT EXCEEDING GROUNDWATER EXTRACTIONS OF 59,100 AF/YR.

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Reliability of Available Water Supplies
(Includes Conservation)

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K/J 934620.00

Figure 5–13

PWS-0200-0138

TABLE 6-1

EXISTING WASTEWATER FACILITIES IN THE ANTELOPE VALLEY

Facility Name	Areas Served	Current Plant Conditions			Planned Plant Conditions			
		Flow (mgd)	Capacity (mgd)	Treatment Level	Flow (mgd)	Capacity (mgd)	Expected Year	Treatment Level
Palmdale WRP	Palmdale	7.4	8.0	Secondary	9.5	15.0	1994	Secondar y
Lancaster WRP	Lancaster Quartz Hill	8.4	10.0	Secondary Tertiary	12.9	16.0	1995	Secondar y Tertiary
Rosamond WRP	Rosamond	0.8	2.0	Primary	1.0	2.0	1996	Tertiary
Edwards AFB WRP	Edwards AFB	1.7	1.5	Primary	1.8	2.5	1995	Tertiary
Mojave WRP	Mojave	0.4	0.6	Secondary	No current plans for expansions			
Plant 42 WRP	U.S. Air Force	0.25	1.0	Primary	No current plans for expansions			
Desert Lake WRP	Desert Lake	0.08	0.14	Primary	No current plans for expansions			
Boron WRP	Boron	0.12	0.21	Primary	No current plans for expansions			
Edwards AFB Missile Test Site WWTF	Edwards AFB	0.05	0.06	Primary	No current plans for expansions			
Edwards AFB N. Base Research WWTF	Edwards AFB	0.075	0.125	Primary	No current plans for expansions			
Boron Federal Prison WWTF	Boron Federal Prison	0.01	0.017	Primary	No current plans for expansions			

mgd = million gallons per day
WRP = water reclamation facility
WWTF = wastewater treatment facility

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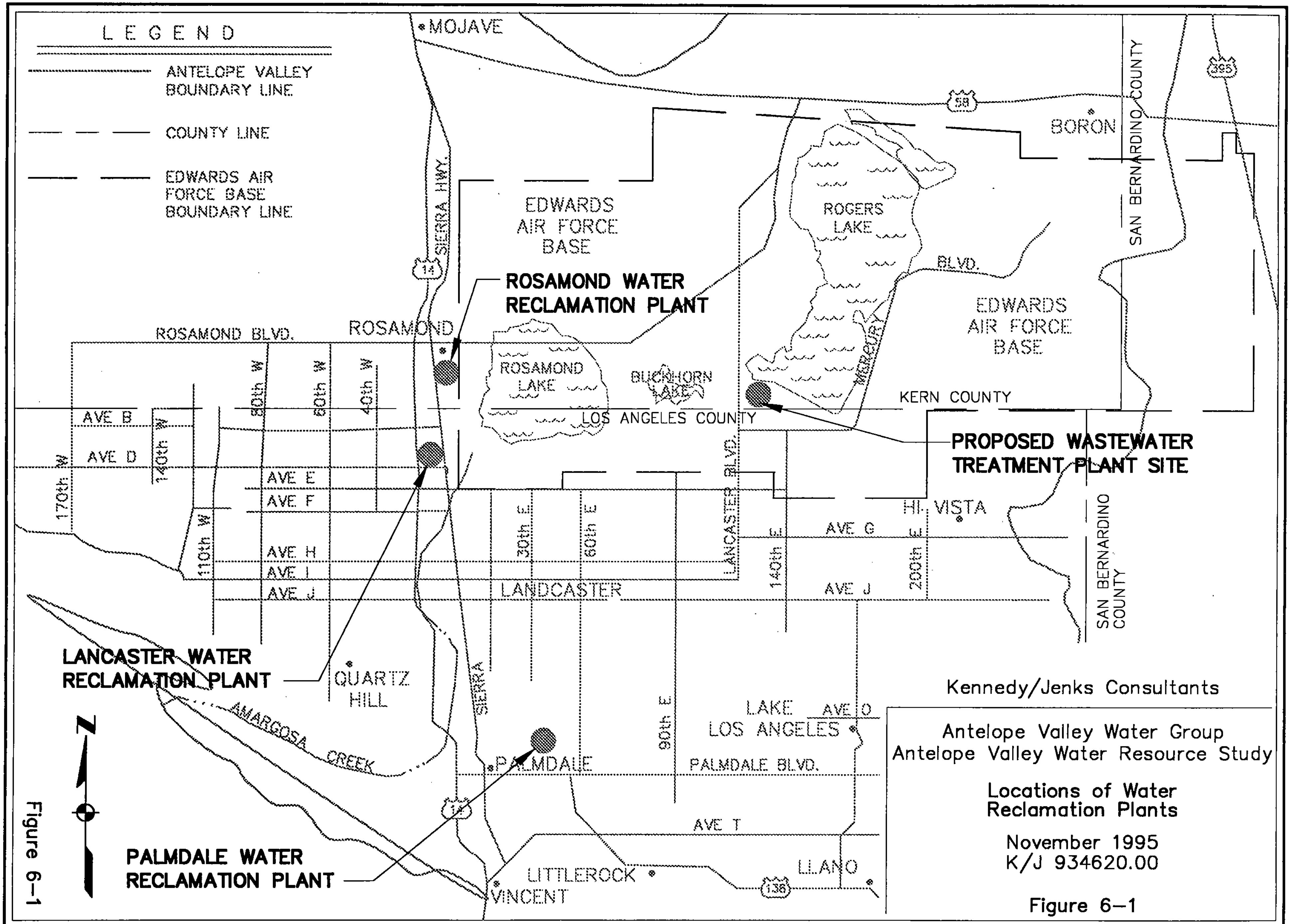
LEGEND
ANTELOPE VALLEY BOUNDARY LINE
COUNTY LINE
EDWARDS AIR FORCE BASE BOUNDARY LINE
MOJAVE
SIERRA HWY.
14
58
395
BORON
SAN BERNARDINO COUNTY
EDWARDS AIR FORCE BASE
ROGERS LAKE
BLVD.
MERCURY
ROSAMOND WATER RECLAMATION PLANT
ROSAMOND BLVD.
ROSAMOND
ROSAMOND LAKE
BUCKHORN LAKE
KERN COUNTY
LOS ANGELES COUNTY
PROPOSED WASTEWATER TREATMENT PLANT SITE
AVE B
AVE D
AVE E
AVE F
AVE H
AVE I
AVE J
170th W
140th W
110th W
80th W
60th W
40th W
30th E
60th E
90th E
140th E
200th E
LANCASTER BLVD.
LANDCASTER
HI VISTA
AVE G
AVE J
LANCASTER WATER RECLAMATION PLANT
QUARTZ HILL
AMARGOSA CREEK
SIERRA
PALMDALE
PALMDALE BLVD.
LAKE LOS ANGELES
AVE O
AVE T
LITTLEROCK
VINCENT
LLANO
138
PALMDALE WATER RECLAMATION PLANT
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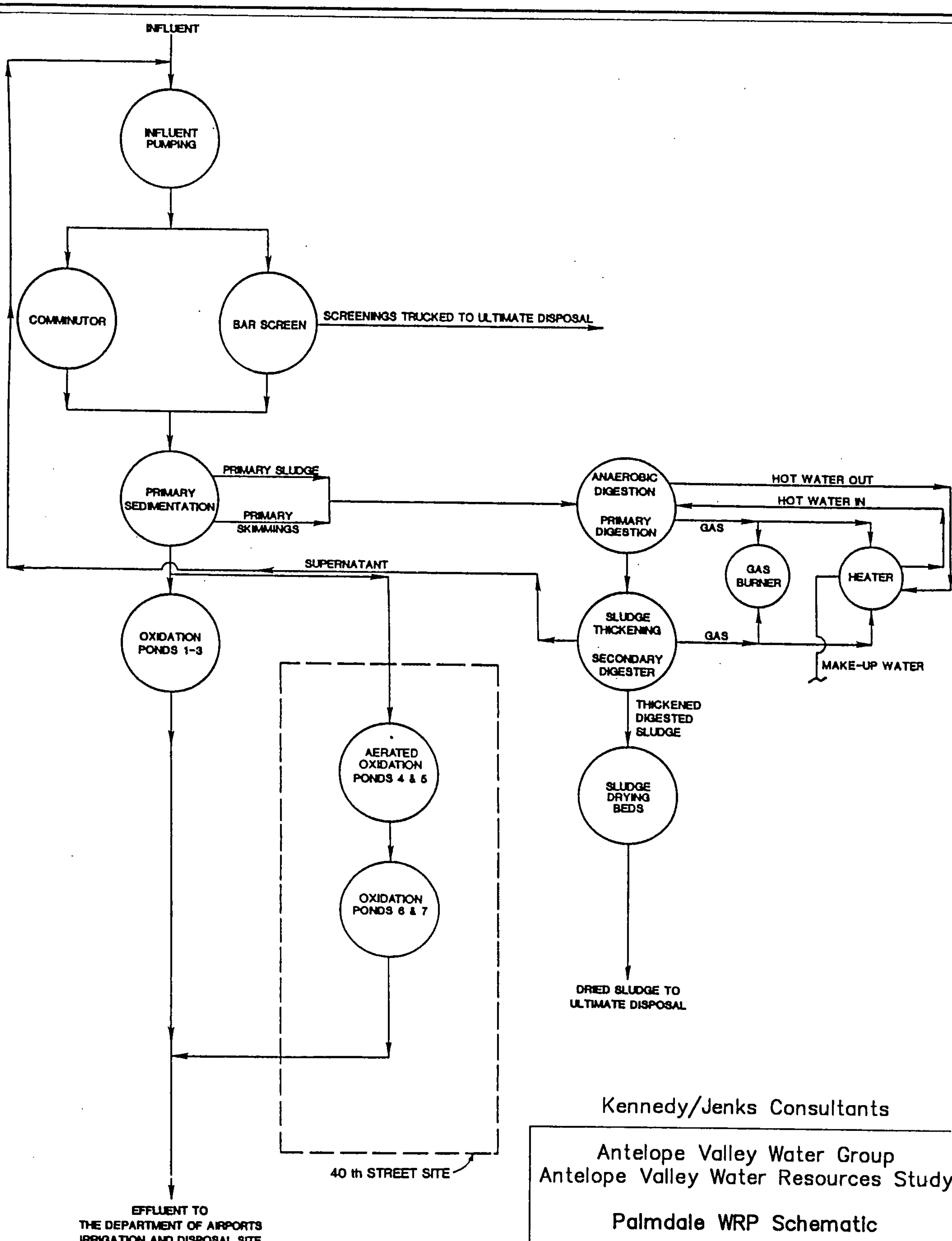
Antelope Valley Water Resource Study
Locations of Water Reclamation Plants
November 1995
K/J 934620.00
Figure 6–1

Figure 6–1



Source: County Sanitation Districts of Los Angeles County

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Palmdale WRP Schematic

November 1995
K/J 934620.00

Figure 6–2

PWS-0200-0141

plant's flow is treated to a secondary treatment level. Total capacity of the plant is 10.0 mgd. A schematic of the plant's process is presented on Figure 6-3. Undisinfected secondary effluent from the WRP is used for irrigating farmland at Nebeker Ranch. Tertiary quality effluent is used at Apollo Lakes County Parks for lake and irrigation use. The remaining effluent is disinfected and then discharged to Paiute Ponds. To accommodate anticipated growth in the Antelope Valley, CSDLAC is planning to expand the plant to a capacity of 16.0 mgd in 1995.

Rosamond WRP. Rosamond Community Services District (RCSD) operates a wastewater treatment plant located approximately 0.5 miles east of the Southern Pacific Railroad and approximately 1 mile north of the Kern County/Los Angeles County border. The Rosamond WRP is a 2.0 mgd primary treatment facility. Effluent from the Rosamond WRP is currently discharged to evaporation ponds. RCSD is planning to convert the existing system to a 2.0 mgd tertiary treatment facility in 1996.

Edwards AFB WRP. Edwards AFB operates a wastewater treatment plant located approximately 2 miles east of Lancaster Boulevard and approximately 1/4 mile north of the South Base well fields. The Edwards AFB WRP is a 1.5 mgd primary treatment facility. Effluent from the plant is currently discharged to evaporation ponds. Edwards AFB is designing a 2.5 mgd tertiary treatment facility scheduled to be constructed in 1995.

Wastewater Flow

Historic Flows. Average daily flow rates for the WRPs during the period from 1970 through 1992 are summarized in Table 6-2 and depicted on Figures 6-4 through 6-7. Average daily flow rates at all four plants have been steadily increasing over the past several years. Palmdale WRP's average flow of 7.9 mgd in 1991 approached the average daily flow design capacity of 8.0 mgd. Average daily flow rates of 1.7 mgd at the Edwards WRP were slightly above the design capacity of 1.5 mgd from 1988 through 1992.

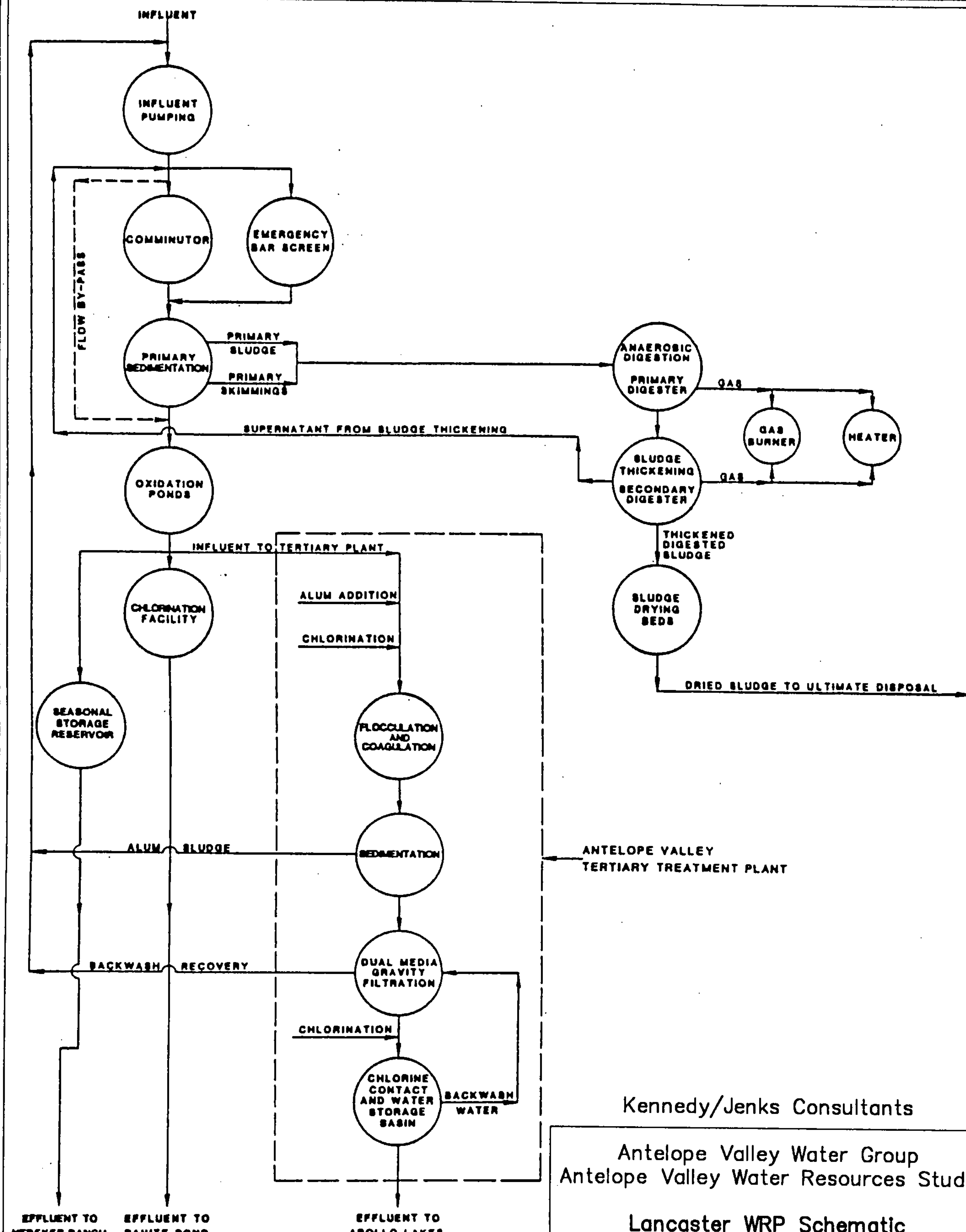
Projected Flows. The projected flows for the WRPs to the year 2020 are also depicted on Figures 6-4 to 6-7. Two projections are shown for the Palmdale and Lancaster WRPs. (See Figures 6-4 and 6-5.) The low projection for the Palmdale WRP and the high projection for the Lancaster WRP were provided by CSDLAC and are based on the adopted 1989 Growth Management Plan in the Air Quality Management Plan (AQMP/GMP) by the Southern California Association of Governments (SCAG). The other projections on Figures 6-4 and 6-5 were developed based on the medium population projections for the cities of Palmdale and Lancaster presented in Chapter 3 and the wastewater flow per capita in the AQMP/GMP. The SCAG projections are shown for comparison purposes only. Based on the medium projections developed for this study, the average daily wastewater flow in the year 2020 is estimated to be 37.2 mgd for the Palmdale WRP and 29.8 mgd for the Lancaster WRP. Similar to the Palmdale and Lancaster

TABLE 6-2

HISTORICAL AVERAGE DAILY FLOWS

Year	Palmdale WRP (mgd)	Lancaster WRP (mgd)	Rosamond WRP (mgd)	Edwards AFB WRP (mgd)
1970	1.1	3.2	NA	NA
1971	1.3	3.6	NA	NA
1972	1.3	3.7	NA	NA
1973	1.6	4.0	NA	NA
1974	1.6	3.9	NA	NA
1975	1.6	4.0	NA	NA
1976	1.6	4.0	NA	NA
1977	1.6	3.8	NA	NA
1978	1.7	3.8	NA	NA
1979	1.8	4.3	NA	NA
1980	1.9	4.7	NA	NA
1981	2.1	4.8	NA	NA
1982	2.2	4.9	NA	NA
1983	2.4	5.3	NA	NA
1984	2.8	5.7	NA	NA
1985	3.3	5.5	0.3	1.3
1986	3.8	5.8	0.3	1.3
1987	4.6	6.2	0.4	1.3
1988	4.8	6.5	0.4	1.7
1989	6.4	7.7	0.6	1.7
1990	7.2	8.3	0.7	1.7
1991	7.9	8.1	0.7	1.7
1992	7.4	8.4	0.7	1.7

NA: Not Available



Source: County Sanitation Districts of Los Angeles County

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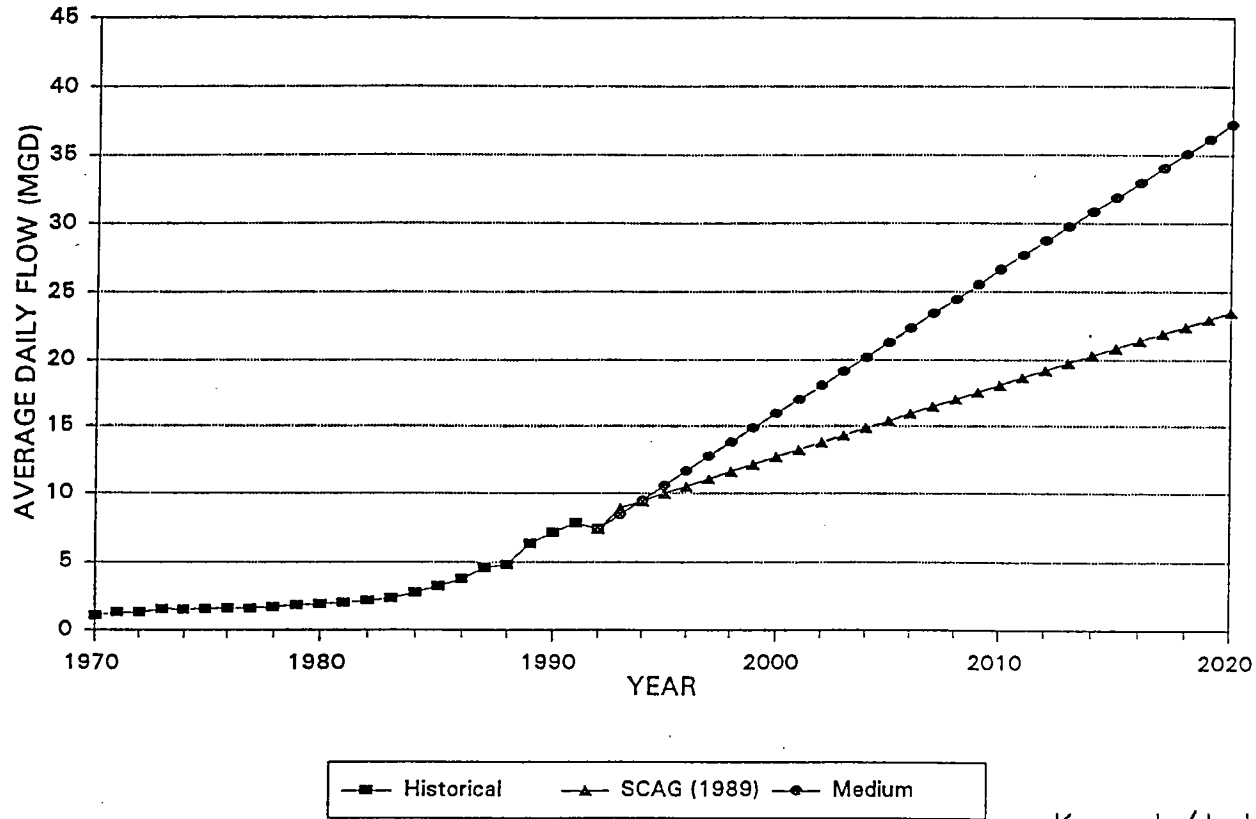
Lancaster WRP Schematic

November 1995
K/J 934620.00

Figure 6–3

PWS-0200-0144



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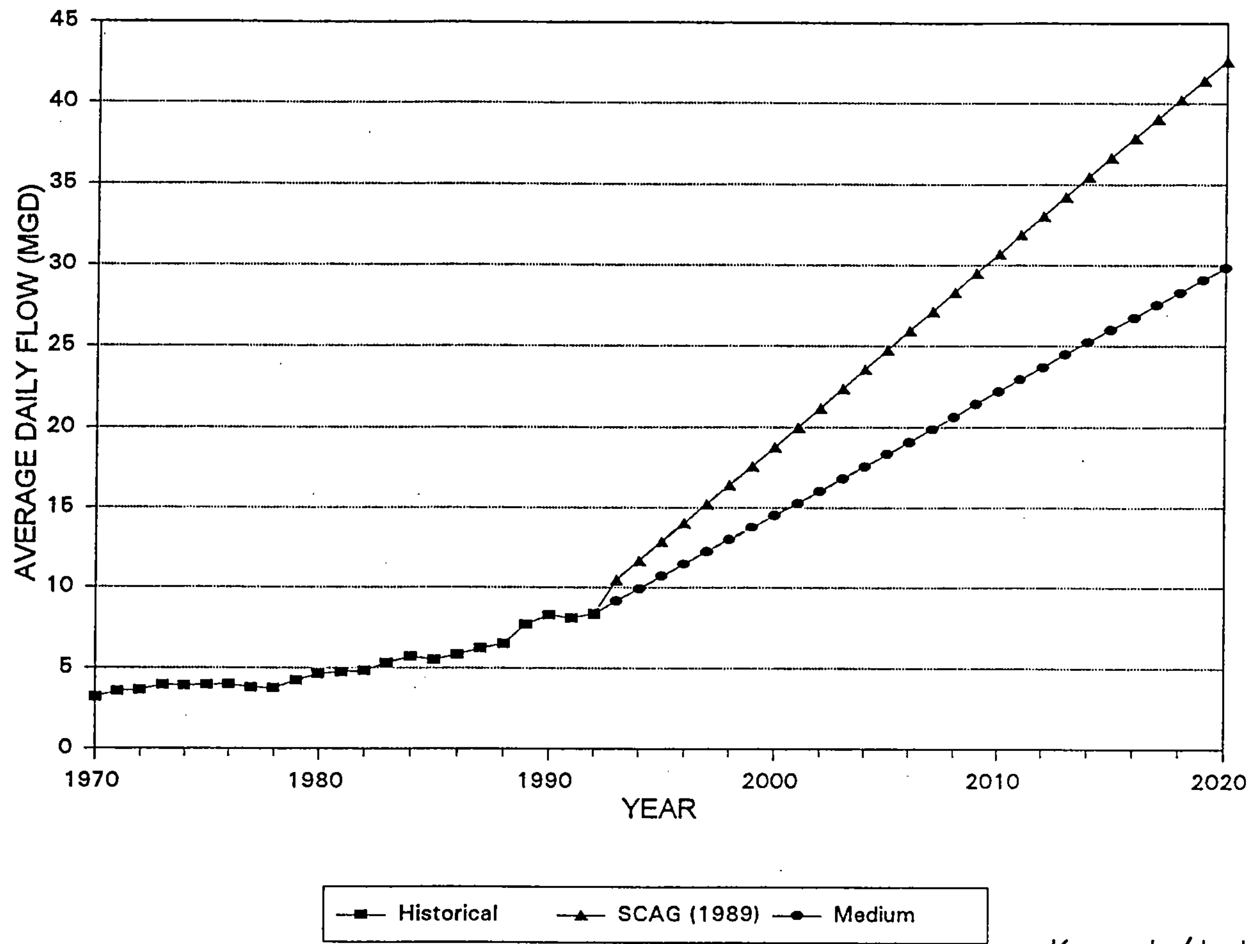
Antelope Valley Water Resources Study

Historical and Projected Flows
Palmdale WRP

November 1995
K/J 934620.00

Figure 6–4



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Antelope Valley Water Resources Study

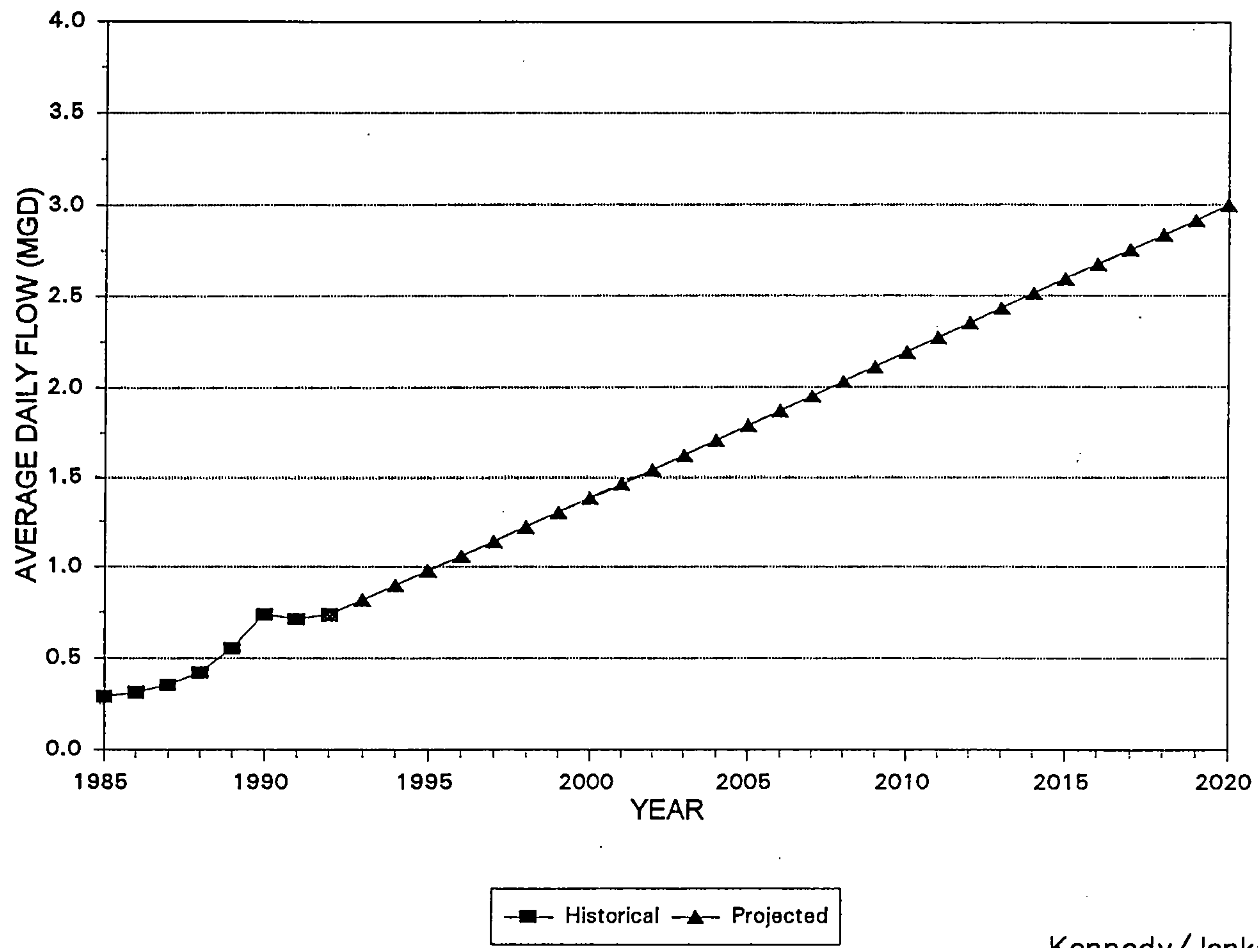
Historical and Projected Flows
Lancaster WRP

November 1995
K/J 934620.00

Figure 6–5

PWS-0200-0146

Figure 6–5



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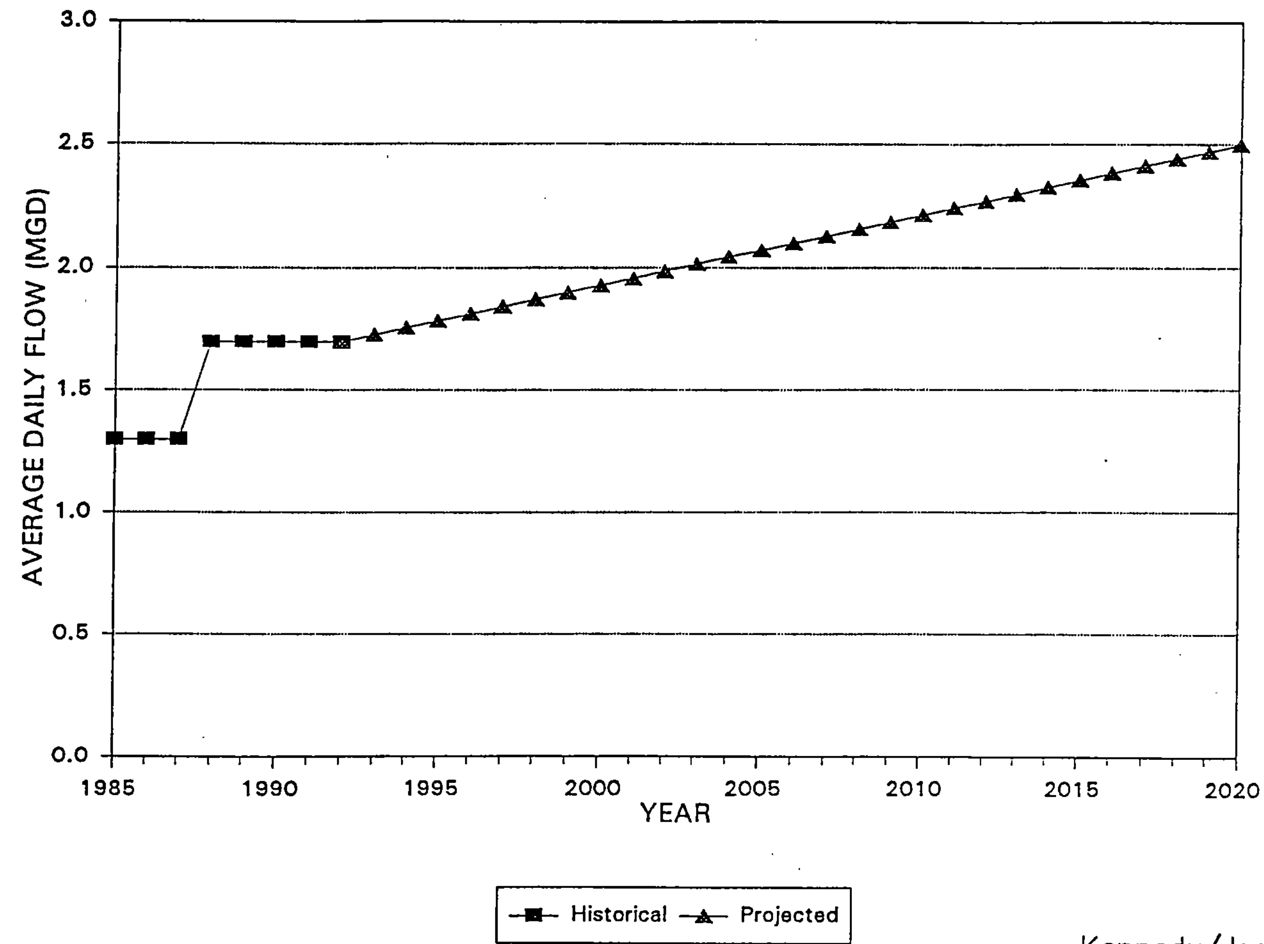
Historical and Projected Flows
Rosamond WRP

November 1995
K/J 934620.00

Figure 6-6



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Antelope Valley Water Resources Study

Historical and Projected Flows
Edwards AFB WRP

November 1995
K/J 934620.00

Figure 6–7

PWS-0200-0148 Figure 6–7

WRPs, projected wastewater flows for the Rosamond WRP were developed based on the medium population projection presented in Chapter 3 and the average historical wastewater flow per capita. Projected flow for the Edwards AFB WRP was obtained from a report entitled "Project Definition for U.S. Air Force Wastewater Treatment Facilities at Edwards Air Force Base" (CH2M Hill, 1991). The average daily wastewater flows in the year 2020 for the Rosamond WRP and the Edwards AFB WRP are estimated to be 3.0 and 2.5 mgd respectively.

It is important to consider seasonal wastewater flows rather than average daily flows when developing a reclaimed water system, because reclaimed water demands typically peak in the summer months and are minimal in the winter months. Figures 6-8 through 6-10 present the projected 2020 seasonal flow patterns for the Palmdale, Lancaster and Rosamond WRPs. The 2020 patterns were developed based on the current seasonal flow patterns.

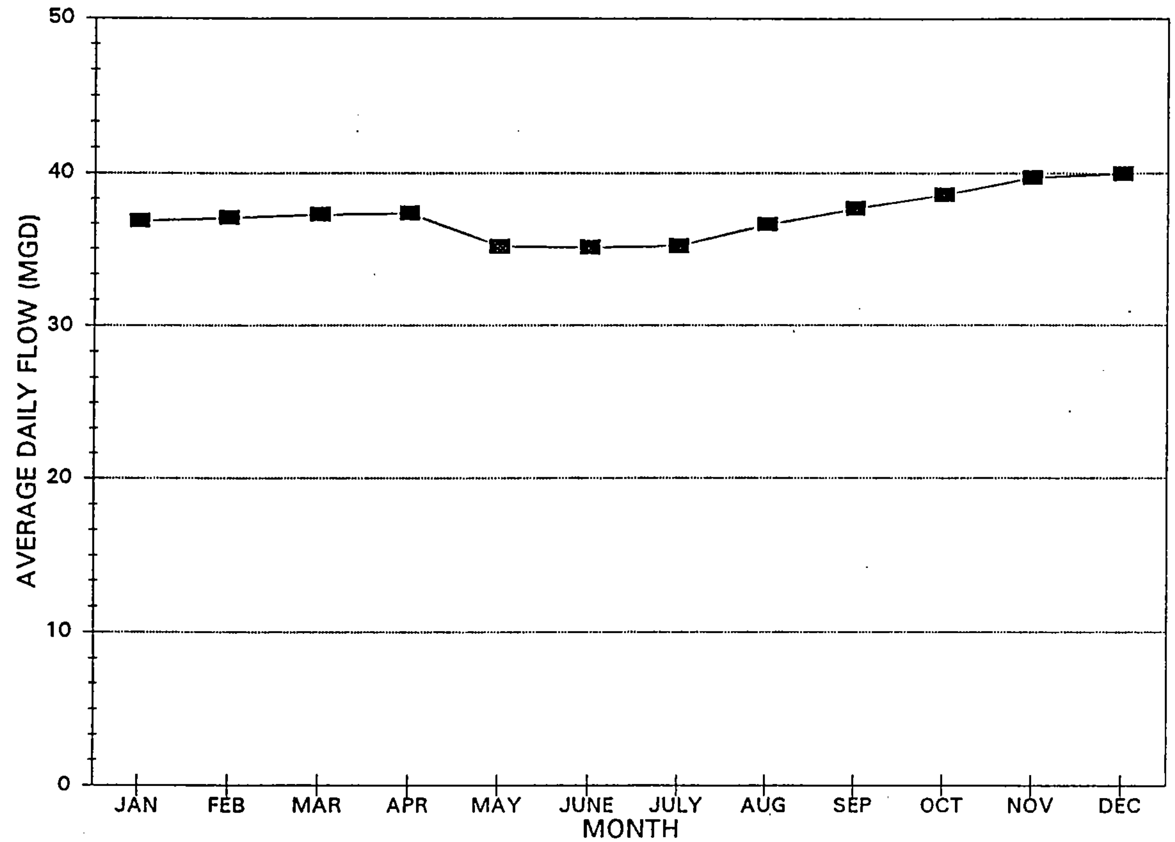
Wastewater Quality

Reclaimed Water Quality Requirements. Effluent quality from the Palmdale and Lancaster WRPs is regulated by the California Regional Water Quality Control Board - Lahontan Region (RWQCB-LH). Waste discharge requirements specifying the wastewater quality requirements for effluent discharged have been issued for these two plants (Board Order Nos. 6-93-18 and 6-93-75, respectively). The Palmdale and Lancaster WRPs also have reclamation requirements issued by the RWQCB-LH specifying wastewater quality requirements for reclamation of effluent at the Department of Airports (Board Order No. 6-90-64) and Nebeker Ranch (Board Order No. 6-86-58), respectively.

Depending on the place and purpose of reclaimed water use, the necessary treatment processes and the maximum allowable concentration of constituents vary. These variations are addressed in the reclamation permits. Reclaimed water uses are limited to the uses identified in the permits.

Effluent Quality. Average concentrations of effluent constituents measured in 1992 for the Palmdale and Lancaster WRPs are listed in Table 6-3. The tertiary-treated wastewater from Lancaster WRP is "adequately disinfected, oxidized, coagulated, clarified, filtered wastewater" as specified for use of reclaimed water in nonrestricted recreational impoundments, the use subject to the most stringent requirements under current state regulations.

Potential Irrigation Water Use. Table 6-4 lists guidelines for irrigation water quality standards and compares the effluent water quality from the Palmdale and Lancaster WRPs to the standards. From the guidelines, it can be seen that sodium and chloride contents in the effluent are relatively high and may prove toxic to some plants after repeated irrigations. If sensitive plants are to be irrigated with the effluent, application of the water by a drip system or surface system should be considered. In addition, ammonia and nitrate concentrations and boron concentrations fall in the "increasing problems" range and could prove toxic to



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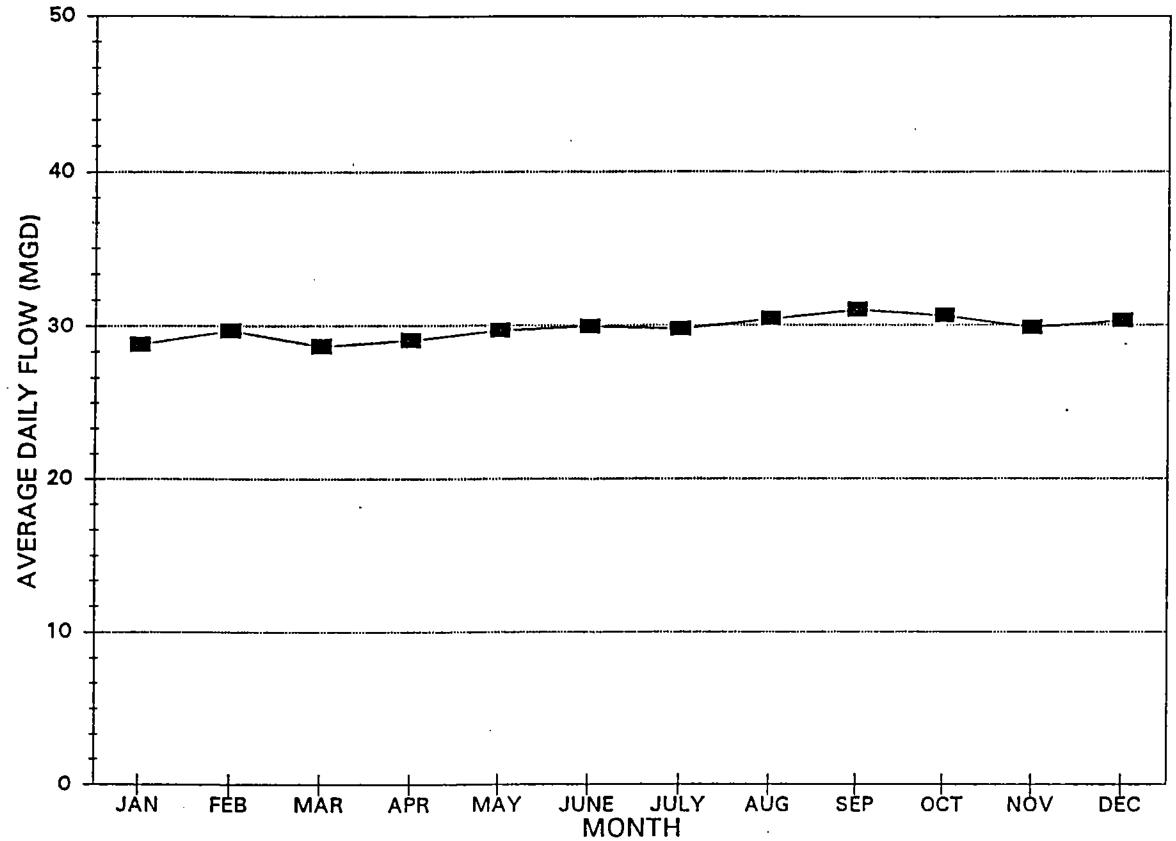
Projected 2020 Seasonal Flows
Palmdale WRP

November 1995
K/J 934620.00

Figure 6–8



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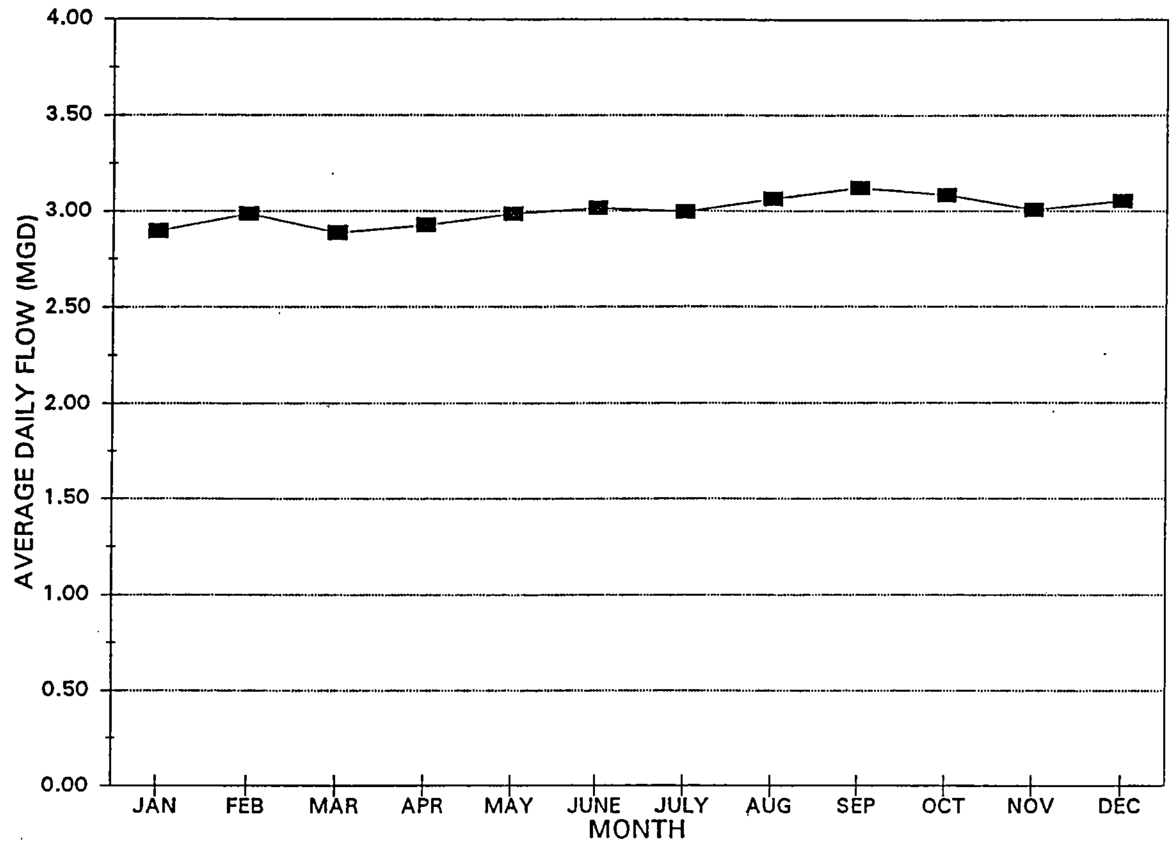
Projected 2020 Seasonal Flows
Lancaster WRP

November 1995
K/J 934620.00

Figure 6–9

PWS-0200-0151

Figure 6–9



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Antelope Valley Water Resources Study

Projected 2020 Seasonal Flows
Rosamond WRP

November 1995
K/J 934620.00

Figure 6–10

TABLE 6-3
EFFLUENT QUALITY AND WATER RECLAMATION REQUIREMENTS
PALMDALE AND LANCASTER WRPs

Constituent (units)	***Average Effluent Quality [1] For 1992***			***Maximum Limit [2]***
	Palmdale WRP Secondary	***Lancaster WRP Secondary***	***Lancaster WRP Tertiary***	
Total Dissolved Solids (mg/L)	600	561	1076 [3]	1,000
Chloride (mg/L)	112	126	232 [3]	300
Sulfate (mg/L)	79	105	299 [3]	450
Coliform Group (MPN/100 ml)	NM	<2	<2	2.2
Nitrate + Nitrate (mg/L)	3.53	1.8	NM	10
Turbidity (NTU)	NM	NM	0.8	2
pH (pH units)	8.1	8.1	NM	6.0 - 9.0
Arsenic (mg/L)	<0.001	0.004	NM	0.05
Barium (mg/L)	0.03	0.02	NM	1.0
Cadmium (mg/L)	<0.01	<0.005	NM	0.010
Total Chromium (mg/L)	<0.02	<0.02	NM	0.05
Copper (mg/L)	<0.02	<0.02	NM	1.0
Lead (mg/L)	<0.04	<0.04	NM	0.05
Mercury (mg/L)	<0.0001	<0.0001	NM	0.002
Selenium (mg/L)	<0.001	<0.001	NM	0.01
Silver (mg/L)	<0.005	<0.005	NM	0.05
Zinc (mg/L)	0.22	0.07	NM	5.0
Fluoride (mg/L)	0.28	0.44	NM	1.6
Total Identifiable Chlorinated Hydrocarbons (μg/L)	0.03	0.02	NM	NS
Phenols (mg/L)	<0.01	0.006	NM	1.0

(1) Arithmetic mean of effluent analytical data (CSDLAC, Annual Monitoring Report for 1992, 15 March 1993). Frequency of analyses varies among constituents; frequency specified in the Monitoring and Reporting Programs outlined in RWQCB-LH Order Nos. 93-18 and 93-75.

(2) Reclaimed water limitations specified in RWQCB-LH Order No. 89-31 (Palmdale WRP) and RWQCB-LH Order No. 89-32 (Lancaster WRP). Trace constituent concentration limits obtained from California Department of Health Services, California Administrative Code, Title 22, Division 4, Chapter 15, "Domestic Water Quality and Monitoring" (1989)

(3) Monitored at the Apollo Park Recreational Lakes.

NS: Not Specified.
mg/L: milligrams per liter.
MPN/100 ml: Most probable number per 100 milliliters.
NTU: Nephelometric turbidity units.
μg/L: micrograms per liter.
NM: Not monitored.

TABLE 6-4

COMPARISON OF EFFLUENT WATER QUALITY TO IRRIGATION WATER QUALITY STANDARD GUIDELINES [1]

Problem	Related Constituents	Units	Water Quality Guidelines			Effluent Quality [6]	
			No Problems	Increasing Problems	Severe Problems	Palmdale WRP	Lancaster WRP
Salinity[2]	Electroconductivity	umho/cm	750	750-3,000	3,000	1003	1038
Permeability	Electroconductivity	umho/cm	500	500-200	200	1003	1038
	Adjusted SAR [3]	Ratio	6.0	6.0-9.0	9.0	(5)	(5)
Specific Ion Toxicity	Sodium (by adj. SAR)	Ratio	3	3.0-9.0	9.0	(5)	(5)
	Chloride	mg/l	142	142-355	355	112	126
	Boron	mg/l	0.5	0.5-2.0	2.0-10	0.47	0.65
Specific Ion Toxicity from Foliar Absorption	Sodium	mg/l	69	69	--	137	139
	Chloride	mg/l	106	106	--	112	126
Miscellaneous	Ammonia & Nitrate N. [4]	mg/l	5	5-30	30	11.2	7.6
	Bicarbonate, HCO_3	mg/l	90	90-520	520	(5)	(5)
	pH	pH	6.5-8.4	low or high	--	8.1	8.1

(1) Adapted from R.S. Ayres and D.W. Westcott, "Water Quality for Agriculture, Irrigation and Drainage Paper 29", FAO, Rome, 1976.
(2) Plants vary in tolerance to salinity.
(3) Adjusted Sodium Absorption Ration (SAR) is calculated to include the added effects of precipitation or dissolution of calcium and magnesium in soil and is related to CO_3 and HCO_3 concentrations.
(4) For sensitive crops.
(5) Not available.
(6) Secondary treated water.

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sensitive plants over a period of time. Salinity of the WRPs effluent also falls in the "increasing problems" range. However, plants vary widely in tolerance to salinity (Nebeker Ranch has experienced no salinity problems in 6 years of reclaimed water use for irrigation of alfalfa (CSDLAC, 1994)). Provision of adequate soil drainage will help to alleviate any potential problems due to salinity.

The nutrient composition (nitrogen and phosphorus) of the effluent is actually beneficial for irrigation and may result in a reduction in fertilizer use.

REGULATORY REQUIREMENTS

Production, discharge, distribution, and use of reclaimed water are subject to federal, state, and local regulations, the primary objectives of which are to protect public health. A synopsis of the regulatory requirements and the methods of administration are included in Appendix C.

MARKET ASSESSMENT FOR RECLAIMED WATER

Potential reclaimed water users within the WRP areas are identified in the following section. For each potential user, estimates are provided for annual demand, peak monthly demand, peak daily demand, and the hourly distribution of water demand during peak months. Seasonal demand patterns for the users are also presented. Finally, the requirements for potential users to convert their existing water systems to reclaimed water are discussed.

Potential Users

Examination of city and area maps for the Antelope Valley, Restricted Materials Use Permits from the Office of Agricultural Commissioner - County of Los Angeles, Development Summary Reports from the Cities of Palmdale and Lancaster Planning Departments, Tentative Tract Activity Reports from the Kern County Planning and Development Services Department, and discussions with CSDLAC, City, County and water purveyor staff, as well as land developers, led to identification of existing and future potential users of reclaimed water from the Palmdale, Lancaster and Rosamond WRPs. Potential users of reclaimed water from the Edwards AFB WRP were identified in Boyle Engineering Corporation's November 1992 draft report titled "Effluent/Sludge Disposal Study - Edwards Air Force Base Wastewater Treatment Plant Project, Corps of Engineers, Sacramento District."

The criteria for placement on the initial list of potential reclaimed water users (for Palmdale, Lancaster and Rosamond) were as follows:

- proximity to the WRPs
- acreage greater than 100 acres for developments

TABLE 6-5

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand		Operating Conditions During Peak Day			Peak Hour Demand (gpm)
						(af/dy)	(1000 gpd)	Days/ week	From - To	Total Hours	
13	Alfalfa Farm	Existing	Secondary-U	995	185.6	6.40	2,272.3	7	12 am - 12 am	24	1,578
13A	Alfalfa Farm	Existing	Secondary-U	622	116.0	4.00	1,420.2	7	12 am - 12 am	24	986
13B	Alfalfa Farm	Existing	Secondary-U	995	185.6	6.40	2,272.3	7	12 am - 12 am	24	1,578
13C	Alfalfa Farm	Existing	Secondary-U	373	69.6	2.40	852.1	7	12 am - 12 am	24	592
15A	DOA Test Farm	Existing	Secondary-U	32	7.5	0.32	93.6	7	12 am - 12 am	24	65
15B	DOA Pistachio Farm *	Existing	Secondary-U	112	29.4	0.90	338.3	7	12 am - 12 am	24	235
15C	DOA Chestnut Farm *	Existing	Secondary-U	149	39.2	1.20	451.1	7	12 am - 12 am	24	313
15D	DOA Barley Farm *	Existing	Secondary-U	304	57.2	2.20	643.3	7	12 am - 12 am	24	447
18A	Sod Farm	Existing	Secondary-D	684	126.1	5.20	1,683.4	7	12 am - 12 am	24	1,169
173	Paiute Ponds *	Existing	Secondary-D	1,456	228.4	7.37	2,400.0	7	12 am - 12 am	24	1,667
174A	Wagas Land Duck Ponds	Existing	Secondary-D	1,558	186.0	6.00	1,954.8	7	12 am - 12 am	24	1,358
176	Young Ranch	Existing	Secondary-D	253	43.1	1.39	453.0	7	12 am - 12 am	24	315
	Secondary System Total			26,493	4,814	166	58,121				40,362
	Rosamond System										
200	Rosamond Elementary School	Existing	Tertiary	17	3.1	0.10	32.6	7	10 pm - 8 am	10	54
201	Hamilton Elementary School	Existing	Tertiary	65	11.9	0.38	125.2	7	10 pm - 8 am	10	209
202	Rosamond High School	Existing	Tertiary	66	12.1	0.39	127.2	7	10 pm - 8 am	10	212
203	Tropico Middle School	Existing	Tertiary	26	4.8	0.15	50.1	7	10 pm - 8 am	10	83
204	Rare Earth Continuation School	Existing	Tertiary	17	3.1	0.10	32.6	7	10 pm - 8 am	10	54
205	Rosamond Park	Existing	Tertiary	30	5.5	0.18	57.8	7	12 am - 6 am	6	161
206	West Park	Existing	Tertiary	15	2.8	0.09	28.9	7	12 am - 6 am	6	80
207	Desert Highlands Development	Future	Tertiary	209	29.8	1.15	373.3	6	12 am - 6 am	6	1,037
208	Desert Highlands Golf Course	Future	Secondary-D	90	16.5	0.63	206.8	6	12 am - 6 am	6	574
209	Tract 5052	Future	Tertiary	15	2.8	0.09	29.4	7	12 am - 6 am	6	82
210	Tract 5172	Future	Tertiary	58	10.7	0.35	112.6	7	12 am - 6 am	6	313
211	Tract 5188	Future	Tertiary	12	2.2	0.07	23.1	7	12 am - 6 am	6	64
212	Tract 5195	Future	Tertiary	20	3.6	0.12	38.2	7	12 am - 6 am	6	106
213	Tract 5196	Future	Tertiary	19	3.5	0.11	37.0	7	12 am - 6 am	6	103
214	Tract 5198	Future	Tertiary	19	3.5	0.11	37.0	7	12 am - 6 am	6	103
215	Tract 5204	Future	Tertiary	19	3.6	0.11	37.5	7	12 am - 6 am	6	104
216	Tract 5313	Future	Tertiary	4	0.7	0.02	7.8	7	12 am - 6 am	6	22

TABLE 6-5

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	Operating Conditions During Peak Day: From - To	Operating Conditions During Peak Day: Total Hours	Peak Hour Demand (gpm)
217	Tract 5394	Future	Tertiary	6	1.0	0.03	10.8	7	12 am - 6 am	6	30
218	Tract 5400	Future	Tertiary	38	7.0	0.23	74.0	7	12 am - 6 am	6	206
220	Tract 4558	Future	Tertiary	12	2.2	0.07	23.4	7	12 am - 6 am	6	65
	Rosamond System Total			758	130.5	4.50	1,465.0				3,661
	Edwards AFB System										
1	Wing Headquarters	Existing	Tertiary	11	1.8	0.06	19.1	7	10 pm - 8 am	10	32
16	Muroc Manner	Existing	Tertiary	19	2.8	0.09	29.7	7	10 pm - 8 am	10	50
1020	IFAST	Existing	Tertiary	19	1.9	0.06	20.3	7	10 pm - 8 am	10	34
1200	Base Operations	Existing	Tertiary	6	1.0	0.03	10.1	7	10 pm - 8 am	10	17
1220	Test Pilot School	Existing	Tertiary	5	0.7	0.02	7.8	7	10 pm - 8 am	10	13
1250	Offices	Existing	Tertiary	0	0.0	0.00	0.2	7	10 pm - 8 am	10	0
1260	Offices	Existing	Tertiary	5	0.8	0.03	8.2	7	10 pm - 8 am	10	14
1400	Engineering	Existing	Tertiary	9	1.3	0.04	13.7	7	10 pm - 8 am	10	23
1440	Ridley Mission Control Center	Existing	Tertiary	25	2.8	0.09	29.5	7	10 pm - 8 am	10	49
1600	T-38	Existing	Tertiary	13	1.1	0.03	11.1	7	10 pm - 8 am	10	19
1609	C-17	Existing	Tertiary	0	0.0	0.00	0.2	7	10 pm - 8 am	10	0
1610	Colonial Inn	Existing	Tertiary	4	0.5	0.02	5.6	7	10 pm - 8 am	10	9
1633	Offices	Existing	Tertiary	3	0.5	0.02	5.1	7	10 pm - 8 am	10	9
1830A	Enviornmental	Existing	Tertiary	5	0.7	0.02	7.1	7	10 pm - 8 am	10	12
2201	Softball Field	Existing	Tertiary	10	1.6	0.05	16.4	7	10 pm - 8 am	10	27
2419	Grass Island	Existing	Tertiary	3	0.4	0.01	4.5	7	10 pm - 8 am	10	8
2421	Civilian Personnel	Existing	Tertiary	3	0.5	0.02	4.9	7	10 pm - 8 am	10	8
2430	OSI	Existing	Tertiary	8	1.2	0.04	12.3	7	10 pm - 8 am	10	20
2453	Education Center	Existing	Tertiary	3	0.4	0.01	4.6	7	10 pm - 8 am	10	8
2500	Oasis Club	Existing	Tertiary	15	2.2	0.07	23.1	7	10 pm - 8 am	10	39
2600	Comm. Building	Existing	Tertiary	7	1.0	0.03	10.3	7	10 pm - 8 am	10	17
2650A	CSC	Existing	Tertiary	13	1.9	0.06	20.3	7	10 pm - 8 am	10	34
2656	Library Park	Existing	Tertiary	16	2.3	0.07	24.4	7	10 pm - 8 am	10	41
2665	Library	Existing	Tertiary	16	2.4	0.08	25.0	7	10 pm - 8 am	10	42
2670	Post Office	Existing	Tertiary	6	0.9	0.03	9.8	7	10 pm - 8 am	10	16
2700	Chapel	Existing	Tertiary	21	3.1	0.10	32.9	7	10 pm - 8 am	10	55

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TABLE 6-5

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand		Operating Conditions During Peak Day			Peak Hour Demand (gpm)
						(af/dy)	(1000 gpd)	Days/ week	From - To	Total Hours	
2750	FTEMF	Existing	Tertiary	54	7.9	0.26	83.2	7	10 pm - 8 am	10	139
2800	Procurement	Existing	Tertiary	17	2.6	0.08	27.1	7	10 pm - 8 am	10	45
2858	Comm. Bulding	Existing	Tertiary	3	0.4	0.01	4.4	7	10 pm - 8 am	10	7
2860	Security Police	Existing	Tertiary	10	1.5	0.05	15.9	7	10 pm - 8 am	10	26
3497	Self Help	Existing	Tertiary	2	0.3	0.01	3.0	7	10 pm - 8 am	10	5
3500	Civil Engineering	Existing	Tertiary	2	0.2	0.01	2.4	7	10 pm - 8 am	10	4
3507	Dog Pound	Existing	Tertiary	6	0.8	0.03	8.7	7	10 pm - 8 am	10	15
3510	Vehicle Maintenance Shop	Existing	Tertiary	1	0.0	0.00	0.4	7	10 pm - 8 am	10	1
3535	Headquarters	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
3535	Off-Site (Rosamond Blvd).	Existing	Tertiary	19	2.9	0.09	30.6	7	10 pm - 8 am	10	51
3804	Jet Test Cell	Existing	Tertiary	4	0.4	0.01	3.7	7	10 pm - 8 am	10	6
3810	Jet Maintenance Facility	Existing	Tertiary	31	4.5	0.15	47.4	7	10 pm - 8 am	10	79
3920	Altitude Chamber	Existing	Tertiary	4	0.6	0.02	6.5	7	10 pm - 8 am	10	11
3940	Programs	Existing	Tertiary	3	0.4	0.01	4.5	7	10 pm - 8 am	10	8
3950	Office	Existing	Tertiary	3	0.5	0.02	4.9	7	10 pm - 8 am	10	8
3950A	Offices	Existing	Tertiary	8	1.2	0.04	12.4	7	10 pm - 8 am	10	21
Q	Dorms	Existing	Tertiary	207	30.8	0.99	323.2	7	10 pm - 8 am	10	539
R	Rosamond Blvd, So. Muroc Dr.	Existing	Tertiary	13	1.9	0.06	20.3	7	10 pm - 8 am	10	34
5201	Softball Field	Existing	Tertiary	12	1.9	0.06	19.5	7	10 pm - 8 am	10	33
5208	Wings Field	Existing	Tertiary	29	4.3	0.14	45.4	7	10 pm - 8 am	10	76
5210	Youth Center	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
5211	Hap Arnold Park	Existing	Tertiary	10	1.4	0.05	14.9	7	10 pm - 8 am	10	25
5213	Robers Field	Existing	Tertiary	22	3.3	0.11	34.4	7	10 pm - 8 am	10	57
5214	Bowling	Existing	Tertiary	2	0.3	0.01	3.4	7	10 pm - 8 am	10	6
5215	Little League Field	Existing	Tertiary	7	1.0	0.03	10.6	7	10 pm - 8 am	10	18
5216	Softball Field	Existing	Tertiary	12	1.8	0.06	18.8	7	10 pm - 8 am	10	31
5220	Soccar Field	Existing	Tertiary	10	1.5	0.05	16.0	7	10 pm - 8 am	10	27
5221	Little League Field	Existing	Tertiary	13	2.0	0.06	20.6	7	10 pm - 8 am	10	34
5500	Hospital	Existing	Tertiary	23	2.6	0.08	27.5	7	10 pm - 8 am	10	46
5510	Hospital Barracks	Existing	Tertiary	5	0.8	0.02	7.9	7	10 pm - 8 am	10	13
5513	Dental Clinic	Existing	Tertiary	24	3.6	0.12	37.5	7	10 pm - 8 am	10	63
5550	Veterinary Clinic	Existing	Tertiary	3	0.4	0.01	4.0	7	10 pm - 8 am	10	7
5560	Fire Station	Existing	Tertiary	7	1.1	0.04	11.6	7	10 pm - 8 am	10	19
5600	Officer's Club	Existing	Tertiary	30	4.4	0.14	46.6	7	10 pm - 8 am	10	78
5601	VIP Billeting	Existing	Tertiary	11	1.7	0.05	17.3	7	10 pm - 8 am	10	29

TABLE 6-5

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	From - To	Total Hours	Peak Hour Demand (gpm)
5602	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5603	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5604	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5606	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
6000	Commissary	Existing	Tertiary	12	1.8	0.06	18.5	7	10 pm - 8 am	10	31
6002	Branch Bank	Existing	Tertiary	6	0.8	0.03	8.8	7	10 pm - 8 am	10	15
6005	Baskin Robbins	Existing	Tertiary	6	0.9	0.03	9.4	7	10 pm - 8 am	10	16
6006	Burger King	Existing	Tertiary	10	1.5	0.05	15.6	7	10 pm - 8 am	10	26
6441	Preschool	Existing	Tertiary	2	0.3	0.01	3.4	7	10 pm - 8 am	10	6
6445	Social Actions	Existing	Tertiary	1	0.1	0.00	1.2	7	10 pm - 8 am	10	2
6447	Housing Chapel	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
6459	Child Care Center	Existing	Tertiary	4	0.7	0.02	6.8	7	10 pm - 8 am	10	11
7020	Old Youth Center	Existing	Tertiary	26	3.8	0.12	40.4	7	10 pm - 8 am	10	67
B	Park	Existing	Tertiary	25	3.7	0.12	39.3	7	10 pm - 8 am	10	66
C	Park	Existing	Tertiary	23	3.4	0.11	35.4	7	10 pm - 8 am	10	59
F	Park	Existing	Tertiary	62	9.2	0.30	96.9	7	10 pm - 8 am	10	162
G	Park	Existing	Tertiary	4	0.6	0.02	5.8	7	10 pm - 8 am	10	10
H	Park	Existing	Tertiary	12	1.8	0.06	18.4	7	10 pm - 8 am	10	31
I	MH Park Playground	Existing	Tertiary	5	0.8	0.03	8.2	7	10 pm - 8 am	10	14
J	Famcamp	Existing	Tertiary	33	4.9	0.16	51.1	7	10 pm - 8 am	10	85
K	Schools	Existing	Tertiary	156	23.2	0.75	243.7	7	10 pm - 8 am	10	406
L	Golf Course	Existing	Tertiary	934	139.6	4.50	1,467.0	7	10 pm - 8 am	10	2,445
M	Love Avenue	Existing	Tertiary	14	2.2	0.07	22.9	7	10 pm - 8 am	10	38
N	Miscellaneous Use	Existing	Tertiary	82	3.0	0.10	31.9	7	10 pm - 8 am	10	53
O	Industrial Use	Future	Tertiary	28	3.9	0.13	41.0	7	10 pm - 8 am	10	68
P	Irrigation Use	Future	Tertiary	307	43.2	1.39	454.0	7	10 pm - 8 am	10	757
	Edwards AFB System Total			2,685	384.7	12.41	4,043.2				6,739
	GRAND TOTAL			35,624	6,335	216	74,483				79,225

* Current user of reclaimed water
Secondary-D: Disinfected Secondary
Secondary-U: Undisinfected Secondary

PWS-0200-0159

Reclaimed water users already receiving reclaimed water are indicated with an "*" in Table 6-5. Total annual demand, peak month demand and peak day demand for these current users of reclaimed water are 6,460, 1,192 and 41 acre-feet, respectively. Actual demand data were used when available.

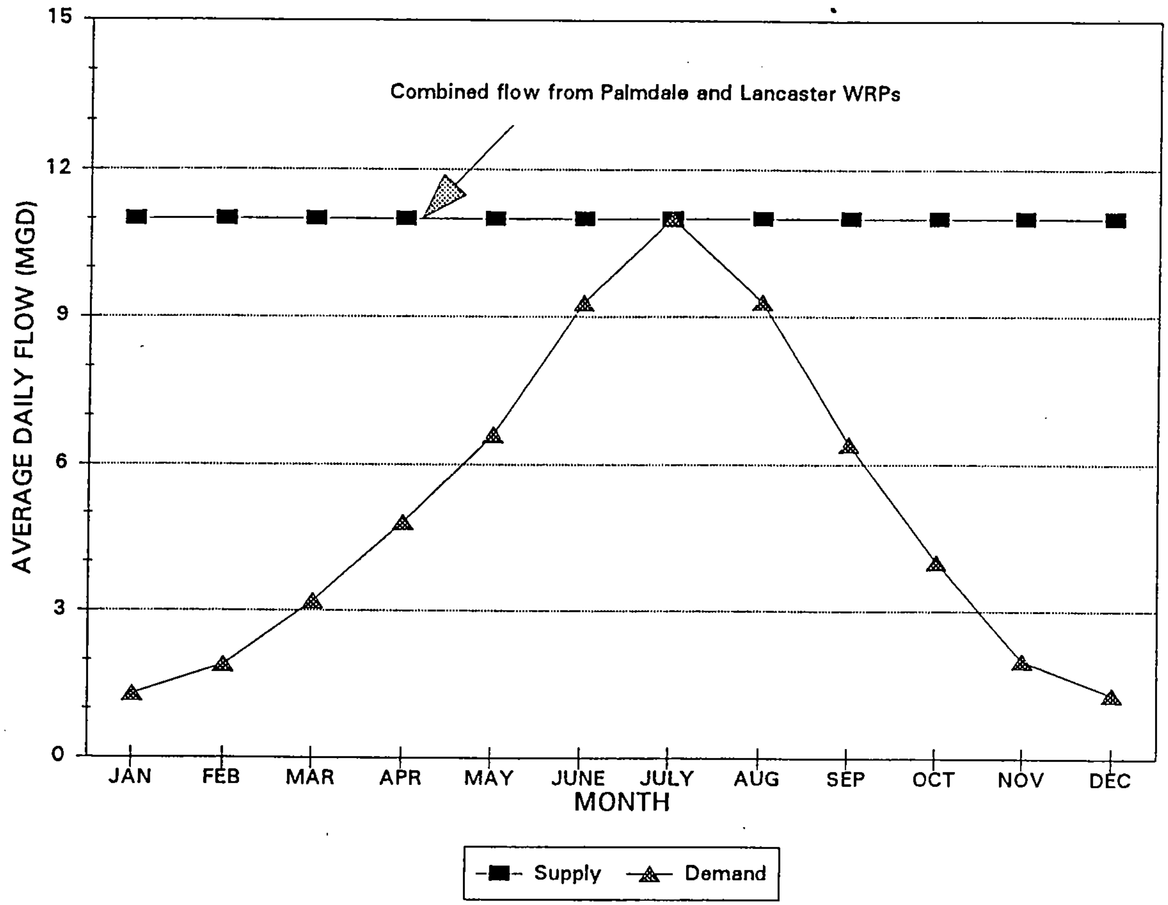
Seasonal water demand patterns were developed for Palmdale/Lancaster tertiary and secondary systems and the Rosamond system service areas based on irrigation requirements provided by SCS and conversations with existing growers of crops in the Antelope Valley. Figures 6-11, 6-12 and 6-13 present the developed seasonal water demand patterns versus the projected 2020 seasonal WRP effluent flows for the tertiary, secondary and Rosamond systems, respectively. It was assumed that partial conversion to tertiary treatment of the Palmdale and Lancaster WRPs would occur to meet peak day demands of the high potential users within the tertiary system service area. The remaining flows at the plants would be allocated to the secondary system service area. Figure 6-12 indicates that the secondary supply from the Palmdale and Lancaster WRPs cannot meet the peak day demand by approximately 4.0 mgd.

Onsite Conversion Requirements

The California Department of Health Services has prepared guidelines for use of reclaimed water which are based on the reclamation criteria set forth in Title 22. The guidelines address what steps should be taken in converting water systems to reclaimed water systems. Two primary goals of the guidelines are to prevent cross connection between the potable water and reclaimed water systems and to make the public aware that reclaimed water is being used.

For users with separate irrigation and potable water systems, the primary requirement will be to disconnect the irrigation system from the potable water service and connect it to the reclaimed water service. Reduced pressure principal backflow prevention devices will need to be installed on the potable service immediately downstream of the meter. For those users with irrigation systems that tie to their potable water systems at several locations, the systems will have to be separated. Additionally, all hose bibs on the user's reclaimed water systems will need to be replaced by quick coupling connections. Public areas, such as golf courses, parks, and schools, will need to post signs notifying the public that reclaimed water is being used for irrigation. Parks, schools, and other users with exposed drinking fountains near landscaped areas will have to provide shields to prevent reclaimed water from coming into contact with the drinking fountains.

The costs of these conversion requirements will be incurred by the users. In general, the costs are anticipated to be relatively low; however, because the cost will depend on meter size and complexity of the irrigation system, costs will vary from user to user.



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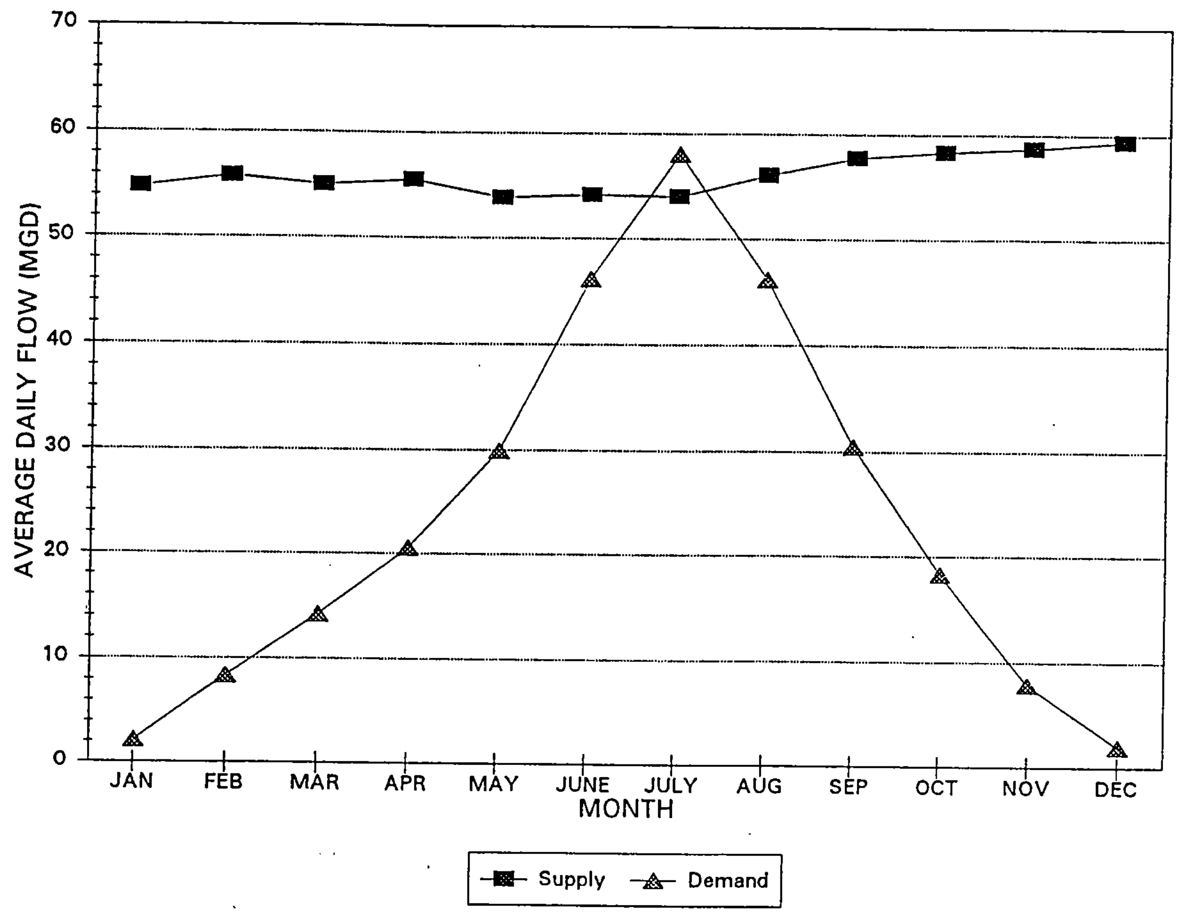
Antelope Valley Water Resources Study

Seasonal Demand Pattern Versus
WRP Flow – Tertiary System

November 1995
K/J 934620.00

Figure 6–11

Figure 6–11



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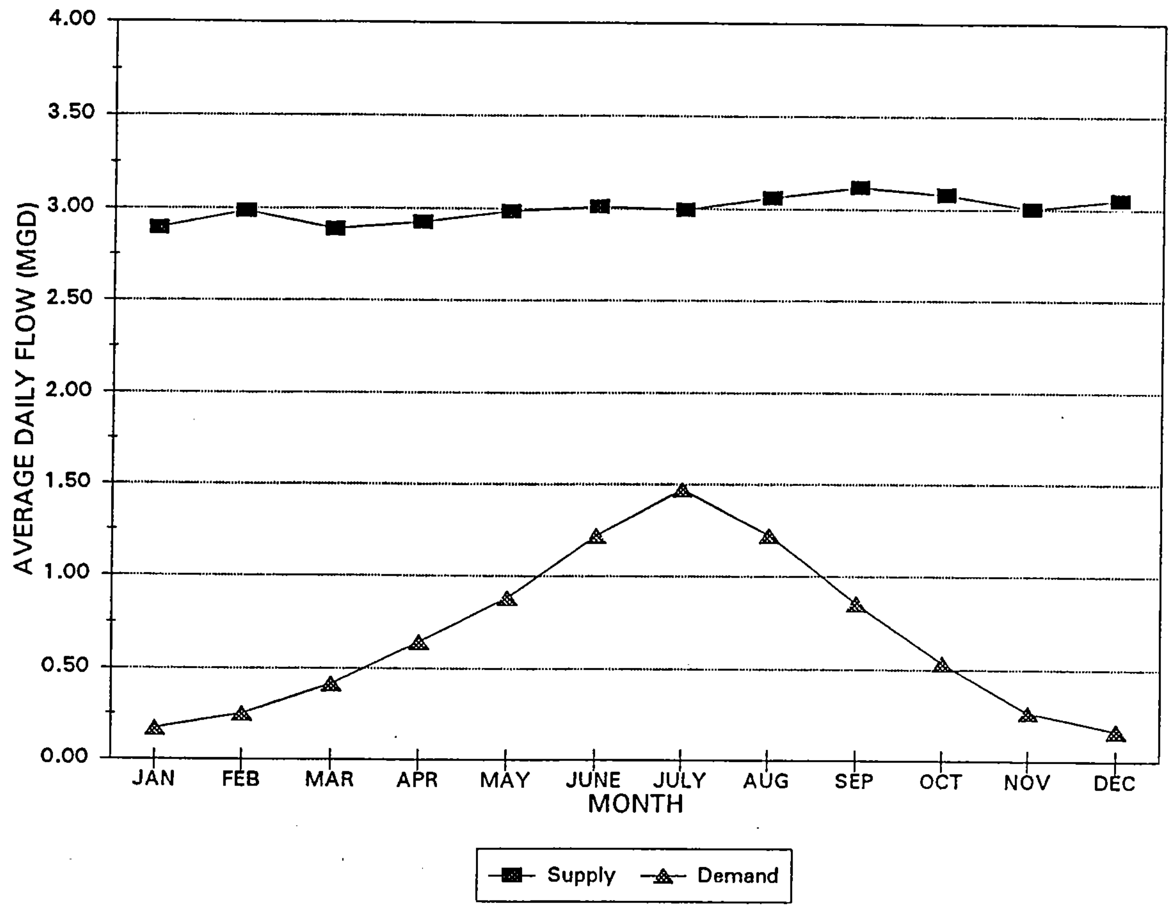
Seasonal Demand Pattern Versus
WRP Flow – Secondary System

November 1995
K/J 934620.00

Figure 6–12



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Antelope Valley Water Resources Study

Seasonal Demand Pattern Versus
WRP Flow – Rosamond System

November 1995
K/J 934620.00

Figure 6–13

PWS-0200-0163

Figure 6–13

CONCEPTUAL PLAN

The development of the reclaimed water systems was based on established planning criteria. These criteria are the concepts and assumptions that ultimately form the service criteria of the system. The following section presents the criteria for and development of the systems, as well as the details of the conceptual plan for the reclaimed water systems. Because Edwards AFB is currently designing a tertiary treatment facility and reclaimed water system, discussion in the following section focuses on the Palmdale, Lancaster and Rosamond WRPs, followed by a brief description of the proposed facilities at Edwards AFB.

Criteria and Assumptions

Criteria and assumptions were established for each component of the Palmdale, Lancaster and Rosamond reclaimed water systems, including the reclaimed water supply, the main pump stations, the booster pump stations, the storage reservoirs, and the distribution system. These criteria and assumptions, summarized in Table 6-6, are discussed in the following sections.

<u>Reclaimed Water Supply</u>. Reclaimed water will be supplied to the reclaimed water systems by the four WRPs. Initially, plant production may not be adequate to meet the total demands of the systems; however, as potable water demands increase and, consequently, reclaimed water production increases, the water available to meet system demands will also increase. Projected production of the WRPs versus projected demands is depicted on Figures 6-11 to 6-13. It appears that production of the Lancaster and Palmdale WRPs cannot meet peak day demands in the year 2020. Design of the systems is based on projected plant production for the year 2020 and an assumption of equalized effluent flow.

<u>Main Pump Stations</u>. A main pump station will be located at each WRP to provide reclaimed water to the distribution systems. The pump station capacity is dependent upon plant production, as well as reclaimed water demands, and will be designed to meet peak day demands. Proposed storage reservoirs will provide for reductions in the required main pump station capacities by allowing peak hour demands to be met with a combination of pumped water and water from storage reservoirs. It is assumed that the pump stations will operate 24 hours per day. The main pump stations will be controlled by water level sensors in the storage reservoirs.

<u>Booster Pump Stations</u>. The functions of the booster pump stations are to boost the system pressure from low service zones to high service zones or, due to the relatively flat terrain, to boost delivery pressures from reservoirs to users. In order to minimize pump station and pipeline capacities, booster pump stations designed to boost system pressures from low zones to high zones will operate 24 hours per day and, therefore, will be designed to meet peak day demand of the high zone. Booster pump stations designed to boost delivery pressures from reservoirs will operate only during the users' operating hours and, therefore, will be designed to meet peak hour demands of the user served.

TABLE 6-6

SUMMARY OF RECLAIMED WATER SYSTEM CRITERIA

System Components	*Criteria*
Reclaimed Water Supply	• Assume projected plant production for year 2020. • Assume equalized effluent flow.
Main Pump Stations	• Pumps will operate 24 hours during peak day demands. • Size for peak day demands.
Booster Pump Stations	• To serve high zones, size for peak day demands. • To serve users from reservoirs, size for peak hour demands.
Storage Reservoirs	• Provide storage for peak demand. • Reservoir elevations should be adequate to provide optimum delivery pressures to most users. • Provide surface storage adequate to meet peak season demands.
Distribution System	• Size to meet the peak hour demands. • Maximum design velocity is 6 feet per second. • Maximum system pressure: 185 psi. • Optimum delivery pressure range: 55 to 150 psi. • All buried piping is "purple" high-pressure PVC (currently 24-inch diameter is maximum available) or ductile iron pipe.

Storage Reservoirs. The recommended operating storage capacity to be provided for the reclaimed water systems is equivalent to the peak day demand. Reservoir elevations will be dictated by the required system and delivery pressures as discussed below. Reservoirs provide supplemental supply during peak demand days. Capacity should be based on the supplemental supply necessary to meet all demands during the peak season.

Distribution System. Distribution system design is dependent upon flow, velocity, and pressure criteria. The distribution systems will be sized to handle the peak hour demands. High velocities, which may impair pipeline useful life and increase energy requirements to deliver water, are not desirable. Maximum design flow velocity in the system will be 6 feet per second.

Two pressure criteria were considered in the planning of the system. Defined as the pressure at any point within the distribution system, system pressure is dependent upon reservoir levels, reclaimed water demands and pumping conditions. The maximum system pressure will be 185 pounds per square inch (psi). Delivery pressure refers to the pressure at which reclaimed water is delivered to the users. Optimum delivery pressure ranges from 55 psi to 150 psi.

Components of the Plan

The development of the recommended reclaimed water system was based on the above criteria and assumptions. The recommended conceptual plan is divided into 4 main reclaimed water systems:

- Palmdale and Lancaster Tertiary System (tertiary system)
- Palmdale and Lancaster Secondary System (secondary system)
- Rosamond System
- Edwards AFB System

Plate 2 shows the conceptual plans (except for Edwards AFB), the location of the reclaimed water users and the service zones. Because a conceptual plan already exists for Edwards AFB System, it is discussed separately. The tertiary system would serve tertiary treated reclaimed water to approximately 34 users in three service zones. Service zone maximum water surface elevations are 2,620, 2,840 and 2,920 feet above sea level. The secondary system would serve secondary treated reclaimed water to approximately 23 users in one service zone (maximum water surface elevation of 2,680 feet). The Rosamond system would serve tertiary treated water to approximately 20 users in one service zone (maximum water surface elevation of 2,620 feet).

Main pump stations would be located at the reclaimed water supply. Each of the service zones would contain storage reservoirs, distribution system piping, and booster pump stations.

Reclaimed Water Supply. Reclaimed water would be supplied to the tertiary and secondary systems from the Palmdale and Lancaster WRPs. Similarly, reclaimed water would be supplied to the Rosamond system from the Rosamond WRP. The total system demand for reclaimed water is approximately 5,688 acre-feet per year for the tertiary system, 26,493 acre-feet per year for the secondary system, and 758 acre-feet per year for the Rosamond system. It is anticipated that reclaimed water would be constantly available from the WRPs.

Under normal operating conditions for the tertiary system, reclaimed water from the Lancaster WRP would serve service zone 2620, and reclaimed water from the Palmdale WRP would serve zones 2840 and 2920. An 8.0 mgd and a 3.0 mgd tertiary treatment plant would be constructed at the Lancaster WRP and the Palmdale WRP, respectively. A 2.0 mgd tertiary plant would be constructed at the Rosamond WRP. The tertiary treatment process at the plants would include oxidation, flocculation, clarification, filtration and disinfection.

Without a storage supply, the secondary supply remaining from the Palmdale and Lancaster WRPs after partial conversion to tertiary appears inadequate to meet the peak day demand of the secondary system users by approximately 3,000 gallons per minute (gpm). (See Figure 6-12.) The secondary system facilities have been planned accordingly.

Main Pump Stations. Reclaimed water pump stations would be located at the WRPs and would be used to transport the reclaimed water to the storage reservoirs and to the users in each zone. With the exception of the Secondary system main pump station, the main pump stations are designed to operate at a constant flow rate (24-hour operation) and to provide total daily flow equivalent to the peak day demand. Without a storage supply, projected secondary flows at the Lancaster and Palmdale WRPs appear inadequate to meet projected secondary peak day demands, therefore, the secondary system main pump stations are designed to provide maximum secondary flow available from the WRPs. The recommended capacities of the main pump stations are shown in Table 6-7.

Booster Pump Stations. Included in the recommended plan are seven booster pump stations (BPS) located throughout the distribution system. BPS 1 through BPS 5 are a part of the tertiary system; BPS 6 is a part of the secondary system; and BPS 7 is a part of the Rosamond system. BPS 1 is at the head of service zone 2920 to increase system and delivery pressures from the 2840 zone. Due to the relatively flat terrain in Lancaster, BPS 2 through BPS 4 are located at the reservoirs within service zone 2620 to increase delivery pressures to users in the zone. BPS 5 serves as a backup supply source for service zones 2920 and 2840 allowing reclaimed water from the Lancaster WRP to flow to these zones. BPS 6 would be located at the open reservoir (described in the next section) within service zone 2680 to provide supplemental water for peak days when WRP supply is inadequate to meet demands. BPS 7 would be required to increase delivery pressures for the Desert Highlands Development in the Rosamond system. BPS capacities range from 1,320 to 8,935 gpm. Booster pump station locations are shown on Plate 2 and capacities and operating hours are listed in Table 6-8.

TABLE 6-7

MAIN PUMP STATION CAPACITIES

System	Capacity (gpm)
Tertiary System	
Palmdale WRP	2,000
Lancaster WRP	5,600
Secondary System	
Palmdale WRP	25,800
Lancaster WRP	15,700
Rosamond System	
Rosamond WRP	1,050

Storage Reservoirs. The conceptual plan includes construction of eight new reclaimed water storage reservoirs and utilization of one existing storage reservoir. Each service zone would have one reservoir with the exception of the 2620 zone (tertiary system) which would have three and the 2680 zone (secondary system) which would have three reservoirs (one existing). The storage capacity in each zone would be equal to peak day demand with the exception of the 2680 zone (secondary system) which would be sized large enough to provide supply supplemental to WRP supply as required to meet peak day demands. Six of the nine reservoirs are assumed to be above-ground steel tanks and would range in size from 1.0 million gallons (MG) to 4.6 MG. Reservoir No. 6 in the 2680 zone is assumed to be open and lined and would be capable of holding a minimum of approximately 400 acre-feet of water.

Additionally, storage would be provided for the Lancaster and Palmdale WRPs to hold secondary treated water for periods when irrigation water is not required due to precipitation. In addition, storage would provide the added benefit of reducing wastewater effluent discharged to Paiute ponds during the winter. The capacity of the reservoir would allow for storage of 14 days or approximately 2,500 acre-feet of total secondary reclaimed water flow. This storage capacity is sufficient to provide the 400 acre-feet of water required to meet peak day demands.

Currently, the Lancaster WRP has storage ponds capable of holding approximately 1,535 acre-feet of water. Therefore, an additional 965 acre-feet of storage is required. Because only 400 acre-feet of water is required from storage to meet peak day demands in the 2680 zone, it is recommended that two separate reservoirs be constructed: one 400 acre-feet open, lined reservoir and one 565 acre-feet open, unlined reservoir. This would reduce capital costs. Storage reservoir locations are shown on Plate 2 and reservoir volumes are listed in Table 6-9. The maximum water surface elevations are determined by the system and delivery pressure criteria and are also listed in Table 6-9.

TABLE 6-8

BOOSTER PUMP STATION CAPACITIES

Booster Pump Station	*Zones Served*	*Operating Hours (hrs./day)*	*Capacity (gpm)*
Tertiary System			
1	2920	24	1,320
2	2620	8	1,520
3	2620	8	5,660
4	2620	8	8,935
5	2920	As required	5,600
Secondary System			
6	2680	24	3,000
Rosamond System			
7	Desert Highlands	6	1,611

Distribution System. The recommended pipeline routes for the reclaimed water systems are shown on Plate 2. The distribution systems consist of approximately 486,000 lineal feet of pipe ranging from 6 to 42 inches in diameter. The lengths and diameters of the pipeline segments for each system are presented in Table 6-10. Purple, high-pressure, polyvinyl chloride (PVC) pipe is the primary pipe type used in the tertiary and Rosamond systems. Because 24 inches is the maximum diameter currently available for purple PVC pipe, and the majority of pipeline in the secondary system is greater than 24 inches in diameter, ductile iron pipe is used in the secondary system.

Cost Estimates

Table 6-11 presents criteria used in estimating costs. Cost estimates presented in this report are order-of-magnitude type estimates expected to be accurate within ± 25 percent. The cost estimates were developed from general cost curves, information from suppliers, other studies and Kennedy/Jenks Consultants' previous experience. The main pump station costs include costs for all materials, equipment, construction and testing. Incorporated into the reservoir construction costs are the costs for grading, materials, and construction. Pipeline construction costs assume in-street construction with a moderate degree of utility crossings and include items such as valves, traffic control and road resurfacing. Booster pump station costs consist of costs for all materials, equipment, construction and testing. System flushing and testing costs assume that approximately 1,000 feet of pipe would be tested per day. Not included in the cost estimate are pipeline easements and pump station/reservoir property costs.

TABLE 6-9

RESERVOIR VOLUMES AND ELEVATIONS

Reservoir Number	*Service Zone*	*Volume (MG)*	*Maximum Water Surface Elevation (feet)*
Tertiary System			
1	2840	1.0	2840
2	2920	2.0	2920
3	2620	1.0	2620
4	2620	2.4	2620
5	2620	4.6	2620
Secondary System			
6	2680	400 AF	2680
7	2680	565 AF	2350
8	2680	1535 AF (E)	2300
Rosamond System			
9	2620	1.5	2620

(E) Existing
(AF) Acre-feet

The estimated construction cost of the reclaimed water system is shown in Table 6-12. As shown in the table, the treatment facilities for the tertiary and the Rosamond systems are $24,417,000 and $7,731,000 respectively. The distribution facilities for the tertiary, secondary, and Rosamond systems are $36,456,000, $67,486,000, and $8,296,000 respectively. The total cost for construction of the entire regional system is approximately $144,386,000 (1994 dollars). Construction costs include 15 percent for contractor overhead and profit, 20 percent for engineering/administration and 25 percent for contingencies.

TABLE 6-10

PIPELINE DIAMETERS AND LENGTHS

	Material	Diameter (In.)	Length (Ft).
Tertiary System	Ductile Iron	30	100
	PVC	24	1,600
	PVC	18	93,800
	PVC	16	9,500
	PVC	14	43,700
	PVC	12	27,600
	PVC	10	24,900
	PVC	8	7,500
	PVC	6	12,800
		Subtotal -	221,500
Secondary System	Ductile Iron	42	43,100
	Ductile Iron	36	48,800
	Ductile Iron	24	15,840
	Ductile Iron	20	14,700
	Ductile Iron	16	5,400
	Ductile Iron	14	18,700
	Ductile Iron	12	5,500
	Ductile Iron	10	20,500
	Ductile Iron	6	1,300
		Subtotal -	173,840
Rosamond System	PVC	16	2,000
	PVC	12	39,200
	PVC	10	19,400
	PVC	8	21,800
	PVC	6	8,600
		Subtotal -	91,000
Total			486,340

TABLE 6-11

COST CRITERIA

Component	*Cost Criteria*
Tertiary Treatment Plant	Based on Dave Richard's "A Summary of Wastewater Reclamation Costs in California"
Main Pump Stations	Cost curve based on historical data
Booster Pump Stations	Cost curve based on historical data
Reservoirs [2]	50¢/gal.
Open Reservoir (unlined)	2¢/gal.
Open Reservoir (lined)	7¢/gal.
Pipelines [3]	
42-inch D.I.	$210/ft.
36-inch D.I.	$180/ft.
30-inch D.I.	$150/ft.
24-inch D.I.	$120/ft.
20-inch D.I.	$100/ft.
16-inch D.I.	$80/ft.
14-inch D.I.	$70/ft.
12-inch D.I.	$60/ft.
10-inch D.I.	$50/ft.
6-inch D.I.	$30/ft.
24-inch PVC	$96/ft.
20-inch PVC	$80/ft.
18-inch PVC	$72/ft.
16-inch PVC	$64/ft.
14-inch PVC	$56/ft.
12-inch PVC	$48/ft.
10-inch PVC	$40/ft.
8-inch PVC	$32/ft.
6-inch PVC	$24/ft.
System Flushing and Testing [4]	$1/ft.

(1) All figures represent installed costs.
(2) Includes tank, foundation, appurtenances, excavation, paving, fencing, landscaping and telemetry.
(3) Assume $4.00/diameter-inch for PVC - and $5.00/diameter-inch for ductile iron.
(4) Assumes 1,000 ft./day at $1,000/day.

TABLE 6-12

PRELIMINARY COST ESTIMATE

COMPONENT	ESTIMATED COST (1994 Dollars)
I. Treatment Facilities	
A. Tertiary System	
Palmdale - 3.0 mgd	$ 6,200,000
Lancaster - 8.0 mgd	9,061,000
SUBTOTAL	$ 15,261,000
Contractor's OH & Profit (15%)	2,289,000
Engineering/Admin (20%)	3,052,000
Contingency (25%)	3,815,000
TOTAL (Tertiary System)	$ 24,417,000
B. Rosamond System	
Rosamond - 2.0 mgd	$ 4,832,000
SUBTOTAL	4,832,000
Contractor's OH & Profit (15%)	725,000
Engineering/Admin (20%)	966,000
Contingency (25%)	1,028,000
TOTAL (Rosamond System)	$ 7,731,000
TOTAL (Treatment Facilities)	$ 32,148,000
II. Distribution Facilities	
A. Tertiary System	
1. Main Pump Stations	
Palmdale - 2,000 gpm	$ 518,000
Lancaster - 5,600 gpm	1,004,000
2. Booster Pump Stations	
No. 1 - 1,320 gpm	$ 249,000
No. 2 - 1,520 gpm	275,000
No. 3 - 5,660 gpm	648,000
No. 4 - 8,935 gpm	875,000
No, 5 - 5,600 gpm	648,000
3. Reservoirs	
No. 1. - 1.0 mg	$ 500,000
No. 2. - 2.0 mg	1,000,000
No. 3. - 1.0 mg	500,000
No, 4. - 2.4 mg	1,200,000
No. 5. - 4.6 mg	2,300,000
4. Distribution Pipelines	
30-inch D.I. (100 LF)	$ 15,000
24-inch PVC (1,600 LF)	154,000
18-inch PVC (93,800 LF)	6,754,000
16-inch PVC (9,500 LF)	608,000
14-inch PVC (43,700 LF)	2,447,000
12-inch PVC (27,600 LF)	1,325,000
10-inch PVC (24,900 LF)	996,000
8-inch PVC (7,500 LF)	240,000
6-inch PVC (12,800 LF)	307,000
5. System Flushing and Testing	$ 222,000
SUBTOTAL	$ 22,785,000
Contractor's OH & Profit (15%)	3,418,000
Engineering/Admin (20%)	4,557,000
Contingency (25%)	5,696,000
TOTAL	$36,456,000
CONTINUED ON RIGHT	
B. Rosamond System	
1. Main Pump Station	
Rosamond - 1,050 gpm	$ 324,000
2. Booster Pump Stations	
No. 7 - 1,611 gpm	$ 288,000
3. Reservoirs	
No. 9 - 1.5 mg	$ 750,000
4. Distribution Pipelines	
16-inch PVC (2,200 LF)	$ 128,000
12-inch PVC (39,200 LF)	1,882,000
10-inch PVC (19,400 LF)	776,000
8-inch PVC (21,800 LF)	698,000
6-inch PVC (8,600 LF)	206,000
5. System Flushing and Testing	$ 91,000
SUBTOTAL	$ 5,143,000
Contractor's OH & Profit (15%)	771,000
Engineering/Admin (20%)	1,029,000
Contingency (25%)	1,353,000
TOTAL (Rosamond System)	$ 8,296,000
C. Secondary System	
1. Main Pump Stations	
Palmdale - 25,800 gpm	$ 2,591,000
Lancaster - 15,700 gpm	1,846,000
2. Booster Pump Stations	
No. 6 - 3,000 gpm	$ 421,000
3. Open Reservoir	
No. 6 - 400 AF	$ 9,123,000
No. 7 - 565 AF	3,682,000
4. Distribution Pipelines	
42-inch D.I. (43,100 LF)	$9,051,000
36-inch D.I. (48,800 LF)	8,784,000
24-inch D.I. (15,840 LF)	1,901,000
20-inch D.I. (14,700 LF)	1,470,000
16-inch D.I. (5,400 LF)	432,000
14-inch D.I. (18,700 LF)	1,309,000
12-inch D.I. (5,500 LF)	330,000
10-inch D.I. (20,500 LF)	1,025,000
6-inch D.I. (1,300 LF)	39,000
5. System Flushing and Testing	$ 174,000
SUBTOTAL	$ 42,178,000
Contractor's OH & Profit (15%)	6,327,000
Engineering/Admin (20%)	8,436,000
Contingency (25%)	10,545,000
TOTAL (Secondary System)	$ 67,486,000
TOTAL (Distribution Facilities)	$112,238,000
GRAND TOTAL	$ 144,386,000

PWS-0200-0173

The cost estimates were developed to provide a reference for financial planning. The actual construction cost and project cost would depend on the final project scope, the schedule for construction, and market conditions at the time of construction. Feasibility of the project and funding needs must be considered and reviewed thoroughly in order to select the proper option and to provide adequate funding.

Edwards AFB System

Edwards AFB is currently designing a 2.5-mgd tertiary wastewater treatment plant, located south of the South Base entry gate and east of Switch Station #4. (See Figure 6-1.) The following is a list of facilities for the planned reclaimed water distribution system identified in Boyle Engineering Corporation's July 1993 "Early Preliminary Design Submittal, Volume 1, Design Narrative":

- A 3,125-gpm main pump station at the wastewater treatment plant.
- A 3,125-gpm booster pump station.
- A 2.2-mg storage reservoir.
- Approximately 31,740 feet of PVC pipe ranging from 4 to 18 inches in diameter.

The estimated capital cost of the planned distribution facilities is $6,300,000. Operation and Maintenance (O&M) costs were estimated to be $140,000 per year.

EXCESS RECLAIMED WATER SUPPLY

Figures 6-11 through 6-13 depict seasonal demand patterns for the tertiary, secondary and Rosamond systems. As shown in the figures, excess reclaimed water supply would be available from all three systems after demands have been met. It is estimated approximately 6,400 acre-feet from the tertiary system, 37,500 acre-feet from the secondary system (excludes 2,500 acre-feet diverted to open reservoirs in the 2680 Zone) and 2,500 acre-feet from the Rosamond system would be available from the WRPs annually. The excess supplies can be discharged through the following methods:

- Surface Spreading
- Groundwater Injection
- Evaporation

Currently, Rosamond CSD has approximately 80 acres of land near their existing WRP that could be used for spreading. In addition, the DOA owns approximately 2,600 acres that are currently used to spread wastewater from the Palmdale WRP. However, the DOA has plans to eventually farm most of the land.

Tertiary treated water from the three WRPs could be recharged into the groundwater basin. This approach would depend on factors such as availability of land, location, soil type, and percolation rates. Two potential recharge sites are shown on Plate 2. The first site, identified in Earth Systems Consultants draft February 1994 Summary Report regarding test boring along the Amargosa Creek, is located along the Amargosa Creek between 10th and 25th Street West. The second site is located on DOA's property along Little Rock Creek. Previous studies at this site could not be identified. As shown on Plate 2, both sites are located near reclaimed water pipelines outlined in the conceptual plan. Groundwater recharge potential is also discussed in Chapter 5 - Aquifer Storage and Recovery Methods.

Pan evaporation data from CSDLAC's March 1993 "Lancaster Water Reclamation Plant Water Balance" indicates that approximately 107 inches or 9 feet of evaporation occurs at the Lancaster WRP on an annual basis. Assuming a depth of 9 feet for evaporation ponds, approximately 8 square miles of land is required to evaporate 46,400 acre-feet of water.

PERMIT REQUIREMENTS

Numerous permits will be required for construction and operation of the conceptual plan. A summary of potential regulatory requirements is shown in Table 6-13.

Federal

A Nationwide 404 Permit from the United States Army Corps of Engineers (Corps) is required for activities impacting the waters of the United States. Because some construction activities may occur within the riverbed (river crossings), it is recommended that the Corps be notified in writing of the proposed activities.

State

The following state agencies may require permits and/or approvals for the reclaimed water systems:

- California Department of Fish & Game
- California Department of Transportation
- California Department of Health Services
- Regional Water Quality Control Board
- State Water Resources Control Board

The 1601 Agreement from the California Department of Fish & Game (DFG) is required for all crossings or activities which may impact a stream or natural drainage way. This requirement includes construction of pipelines on bridges if construction activity occurs within the stream. In addition, crossings of minor streams may require 1601 Agreements.

TABLE 6-13

POTENTIAL REGULATORY REQUIREMENTS
FOR THE
RECLAIMED WATER SYSTEMS

	Agency	*Type of Approval*
I. FEDERAL PERMITS	United States Army Corps of Engineers	Nationwide 404 Permit
II. STATE PERMITS	California Department of Fish and Game	1601 Agreement for impact on or activity in streams
	California Department of Transportation	Encroachment Permit
	California Department of Health Services	Cross connection control
	Regional Water Quality Control Board	NPDES Construction Activity Permit
	Regional Water Quality Control Board	Reclamation Permit
	Regional Water Quality Control Board	Engineering Report Requirements
	State Water Resources Control Board	Petition for Change in Place and Purpose of Use
III. LOCAL PERMITS	Los Angeles County Department of Health Services	Onsite (cross connection control) (user) facilities approval
	Los Angeles County Department of Health Services	Distribution system design & construction approval
	Kern County Environmental Health Department	Onsite (cross connection control) (user) facilities approval
	Kern County Environmental Health Department	Distribution system design & construction approval
	City of Palmdale	Encroachment Permit
	City of Lancaster	Encroachment Permit
	Los Angeles County Department of Public Works	Excavation Permit
	Los Angeles County Flood Control District	Encroachment Permit
	Kern County Transportation Department	Encroachment Permit

An encroachment permit from the California Department of Transportation would be required for any work done within the state right-of-way. This includes installation of a pipeline in or across a highway, installation of a pipeline in a roadway crossing under a highway, support of a pipeline on a bridge crossing over a highway, and activities that impact on-ramp and off-ramp traffic.

The California Department of Health Services (DHS) would be involved during implementation of the reclaimed water systems. The DHS is concerned with cross connections, separation of pipelines, and any activity that may result in contamination of drinking water. The DHS would review plans and specifications prior to construction.

The RWQCB-LH regulates the source and the end use of reclaimed water. Its main involvement in the tertiary and secondary reclaimed water systems would be through the CSDLAC to modify the reclamation requirements to include the specific reclaimed water users and to review the Engineering Report describing treatment and distribution facilities and users. RWQCB-LH's main involvement in the Rosamond system would be through RCSD and would be similar to tertiary and secondary system involvement. In addition, National Pollutants Discharge Elimination System (NPDES) Construction Activity Permits may need to be obtained. These permits are required for stormwater runoff from construction projects impacting an area of 5 acres or more.

Water rights and funding alternatives would require involvement from the State Water Resources Control Board (SWRCB). Approval of a Petition for Change of Place and Purpose of Use is required for any change in discharge location or quantity of wastewater. If a low interest loan is chosen as a funding alternative, applications for the Water Reclamation Loan Program and State Revolving Fund are through the SWRCB. In addition to the permits and approvals described above, compliance with the California Environmental Quality Act (CEQA) would be required.

Local

Concerned with drinking water contamination (cross connection control), the Los Angeles County Department of Health Services and the Kern County Environmental Health Department requires plan review and inspection of the distribution system and onsite user facilities. The County Department of Health Services coordinates with RWQCB-LH and State DHS.

Encroachment permits are required for all construction work done within local right-of-way. These include the Cities of Palmdale and Lancaster, the Los Angeles County Department of Public Works (Excavation Permit), the Los Angeles County Flood Control District, and the Kern County Transportation Department.

OTHER INSTITUTIONAL ISSUES

Before providing reclaimed water service, it would be necessary to secure agreements between the following entities:

- CSDLAC and purveyors
- Purveyors and users
- CSDLAC and DOA

A contract between CSDLAC and the purveyors is required for sale of reclaimed water to the purveyors. Contracts between the purveyors and users and between CSDLAC and DOA (customer service agreement) would establish the requirements for use of reclaimed water and would specify that the users understand the regulations controlling use of reclaimed water.

FINANCING ALTERNATIVES

To finance the construction cost of the reclaimed water facilities, sufficient capital may be obtained through the following funding sources:

- Water Reclamation Loan Program
- State Revolving Fund
- Small Reclamation Projects Act of 1956
- Connection Fees

Water Reclamation Loan Program

The development of cost-effective water reclamation projects for the augmentation of water supplies constitutes the main purpose of the Water Reclamation Loan Program (WRLP). The WRLP is administered by the SWRCB's Office of Water Recycling and provides $30 million to local public agencies under the Clean Water and Water Reclamation Bond Law of 1988. These funds are available to assist in the design and construction costs of water reclamation projects. Although a maximum loan amount per project is not specified in the Bond Loan, SWRCB policy limits each project to $5 million. Loans covering 100 percent of eligible costs may be provided for a maximum period of 20 years at an interest rate of one-half the rate paid by the State on the most recent sale of state general obligation bonds. The present rate is 4 percent. A water reclamation project is eligible for the WRLP under the 1988 Bond Law if it is cost-effective compared to the cost of new freshwater supply alternatives and if no federal assistance is available at the time of need. Available funds would generally be committed to those projects with completed facilities planning which have met all loan program requirements and are ready to proceed. General requirements include a completed facilities plan with a project report, a complete environmental document, and a draft revenue program. In addition, all projects must comply with CEQA prior to loan authorization. According to SWRCB staff, funds for projects in the near future are very limited.

CHAPTER 7

AQUIFER STORAGE AND RECOVERY

This chapter evaluates the feasibility of implementing an aquifer storage and recovery program within the Antelope Valley. Elements of the chapter include an overview of aquifer storage and recovery methods, followed by discussions on the hydrogeology of the Antelope Valley, hydraulic characteristics of the Antelope Valley aquifers, current condition of the aquifers, quantity and quality of available groundwater information, potential water sources for recharge, regulatory issues, and characteristics for good infiltration and injection sites. A summary of relevant studies, as well as factors specific to surface infiltration, and discussions on potential surface recharge areas, feasibility of infiltration, potential injection sites and feasibility of injection are also presented.

OVERVIEW OF AQUIFER STORAGE AND RECOVERY METHODS

One of the elements of the Antelope Valley Water Resource Study is an evaluation of the feasibility of Aquifer Storage and Recovery (ASR). For purposes of this evaluation, ASR will include the following methods of storing and recovering water from the groundwater basin:

- Spreading/Infiltration - use of surface spreading basins to allow infiltration of water into the aquifer.
- Injection - use of new or existing wells for direct injection of water into the aquifer.
- In-lieu Use - use of an alternative source of water, other than groundwater, when available, and use of groundwater when the alternative source is unavailable. In-lieu use is not discussed in this chapter but is addressed as part of the overall water resources management plan.

ASR should be considered a conjunctive use program which integrates the management of local groundwater basins with use of imported supplies of surface water. Some of the benefits of an ASR program include:

- Improved water supply reliability.
- Optimized use of alternative water supplies.
- Reduction of subsidence problems.
- Reduction of pumping lifts.
- Increased flexibility of operations.

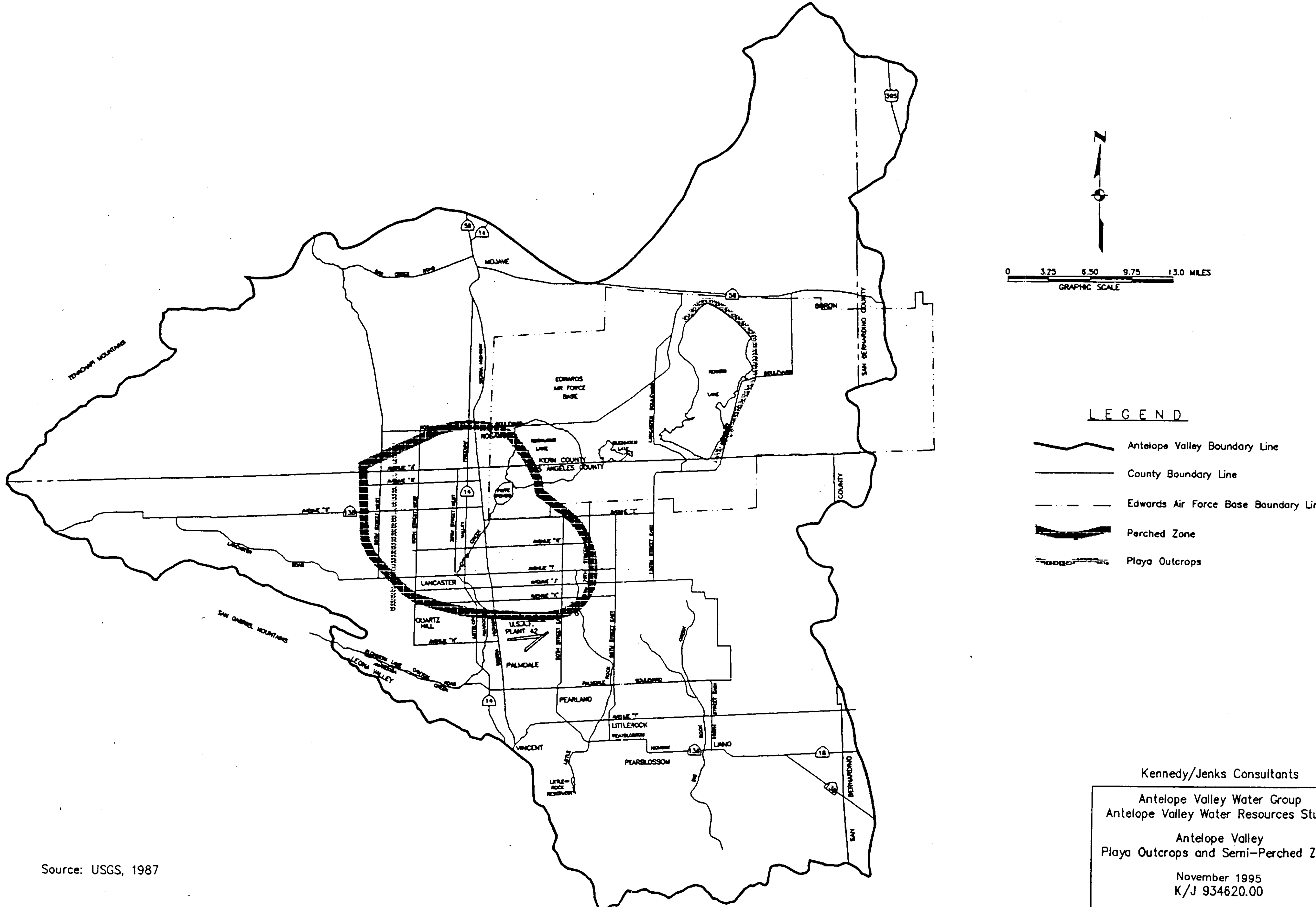
HYDROGEOLOGY OF THE ANTELOPE VALLEY

The Antelope Valley is roughly triangular in shape and approximately 2,400 square miles in area. The Tehachapi Mountains form the northwestern boundary of the Valley to an altitude of 7,981 feet while the San Gabriel Mountains form the southwestern boundary to an altitude of 9,399 feet. The San Andreas Fault runs along the base of the San Gabriel mountains on the south and the Garlock Fault runs along the base of the Tehachapi Mountains on the north. In addition to the main San Andreas and Garlock Fault systems, the Antelope Valley floor is criss-crossed with faults, dividing the Valley into many different geologic sub-units as shown on Plate 1. These faults may also act as barriers to groundwater flow as evidenced by disparities in groundwater levels across the fault zones.

The geologic formations of the Antelope Valley can be divided into two main groups: the consolidated, virtually non-water-bearing rocks along the mountainsides and at the bottom of the groundwater basin, and the unconsolidated deposits which are the principal water-bearing formations of the Valley. The consolidated rock consists mostly of igneous intrusive and metamorphic rocks of pre-Tertiary age, and basalt, continental volcanic, and marine and continental sedimentary rocks of Tertiary age. In certain areas of the Valley where the rock outcrops occur (such as on many buttes), the consolidated rock can act as a hydraulic barrier to groundwater flow.

The unconsolidated deposits include younger and older alluvium, older fan deposits, windblown dune sand, and playa deposits. Closer to the center of the Valley, the older alluvial materials consist of finer materials such as compact gravel, sand, silt, and clay interbedded with more permeable aquifer materials. These finer silts and clays can form impermeable lenses which inhibit movement of water and can result in isolated perched water tables. In addition to the isolated clay layers, a more extensive shallow perched water body exists and is shown in outline on Figure 7-1. The clay lenses that form the shallow perched zone are thought to be remnants of old lake features which can form barriers to groundwater flow at shallower depths. The shallow perched zone generally occurs within 80 feet of the ground surface and traps poorer quality water that can contain high concentrations of bacteria, chloride, dissolved solids, nitrate, and pesticides.

Below the shallow-perched zone in the main floor of the Valley, playa or old lakebed (lacustrine) deposits of Pliocene through Holocene age exist. These deposits are composed of siltstone, clay, and marl. These beds can be up to 400 feet thick and can be interbedded with coarser material of up to 20 feet in thickness. These thick layers are often described as blue clay and are a main feature of the aquifer system in the central part of the Valley. In certain areas, the lacustrine deposits divide the unconsolidated deposits into an upper principal unconfined aquifer and a lower confined deep aquifer as shown on the generalized cross-sections on Figures 7-2 and 7-3. Near the southern boundary of the Antelope Valley, the lacustrine layer is overlain by 300 to 500 feet of alluvium, while at the northern boundary of the



PWS-0200-0181

Source: USGS, 1987

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Antelope Valley
Playa Outcrops and Semi-Perched Zone

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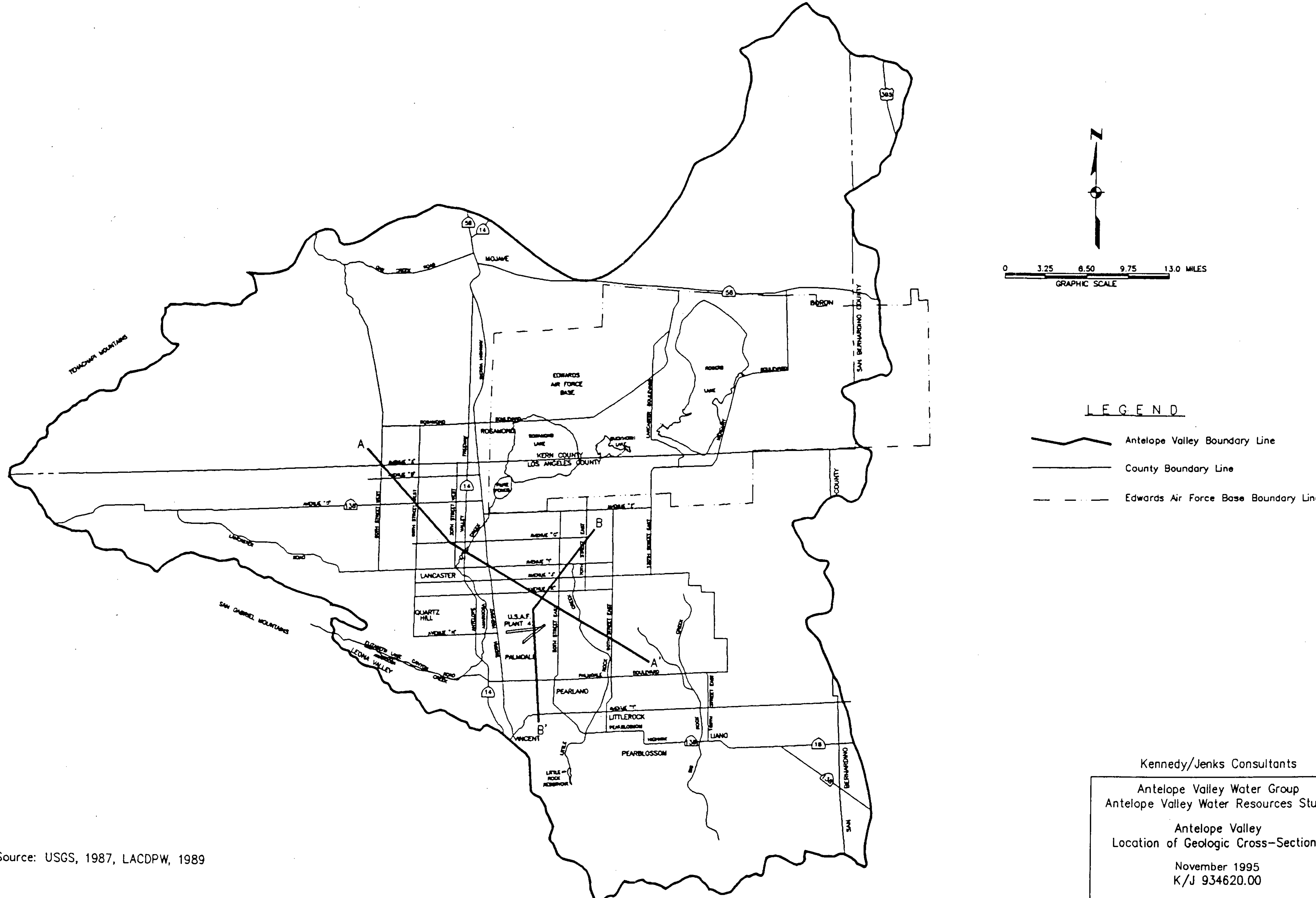
Figure 7-1



Source: USGS, 1987, LACDPW, 1989

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Antelope Valley
Location of Geologic Cross-Sections

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Figure 7-2

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Valley, it is exposed at the land surface. (See Figure 7-1). In this multi-layered system, the overall thickness of the deposits can be more than 1,900 feet (USGS, 1967) and could be as great as 10,000 feet (USGS, 1960).

For the purposes of ASR, the younger and older alluvium deposits found near the base of the San Gabriel Mountains are of particular interest because of the coarse sands and gravels commonly found in those areas. In addition, those areas near the base of the mountains are in a single aquifer system because the lacustrine layer does not appear to extend that far. The alluvial deposits near the hills are estimated to be up to 900 feet thick (USGS, 1993).

The entire groundwater basin of the Antelope Valley is estimated to have 68 million acre-feet of storage of which 13 million acre-feet is currently available (DWR, 1980). Approximately 55 million acre-feet of groundwater was estimated to remain in storage as of 1975. This stored water, however, may not be entirely accessible due to 1) uneconomical pumping depths, 2) distance between the groundwater basin and current users, and 3) the potential for causing land subsidence.

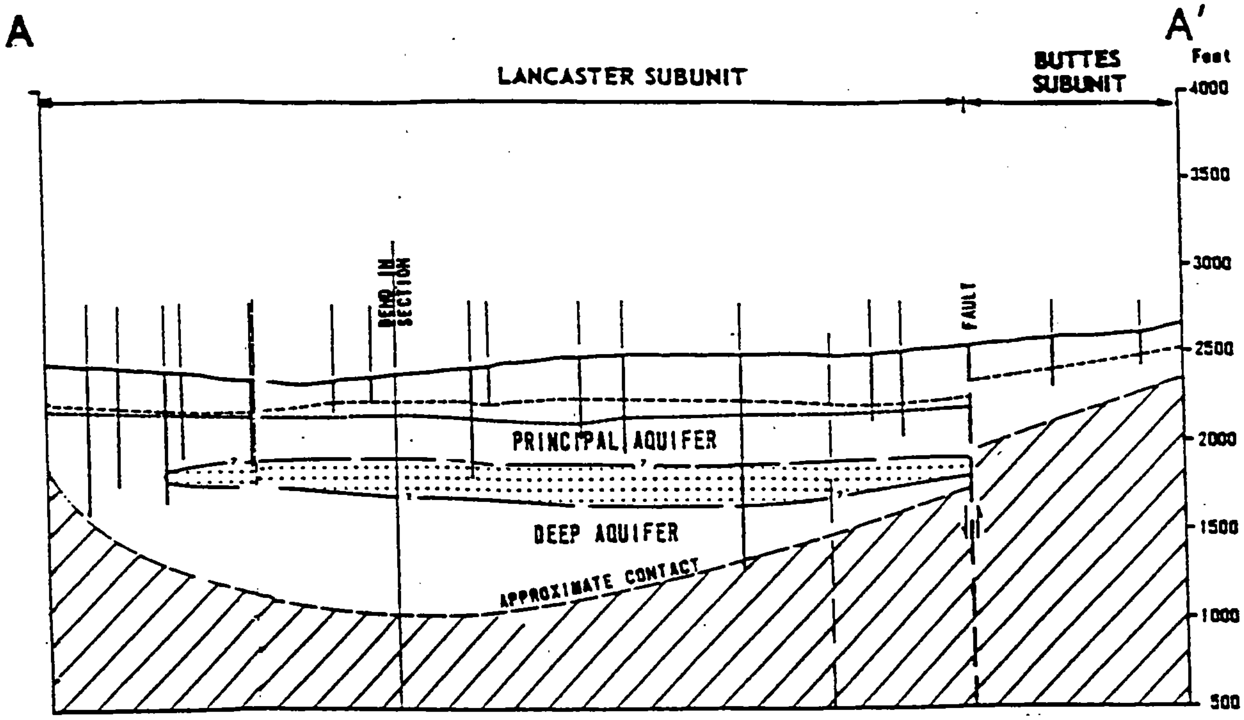
Existing Groundwater Recharge Sources

At present, the principal source of recharge of the groundwater in the Antelope Valley is runoff, principally recharged in the foothills of the mountains. Numerous studies have been conducted to estimate natural recharge since 1924, some based on little data. The most recent studies estimate natural recharge at 31,200 to 59,100 acre-feet per year (USGS, 1993). This estimate is based on the assumptions that the contribution to recharge from precipitation on the Valley floor is negligible and diversions and evaporation accounts for up to 10,000 acre-feet per year. The three main creeks that contribute runoff to the Valley are Amargosa Creek, Little Rock Creek, and Big Rock Creek. The Big Rock and Little Rock Creeks alone are estimated to contribute more than 50 percent of the runoff. Total runoff from the San Gabriel mountains (including runoff from Big Rock and Little Rock Creeks) have been estimated to contribute up to 80% of the total recharge.

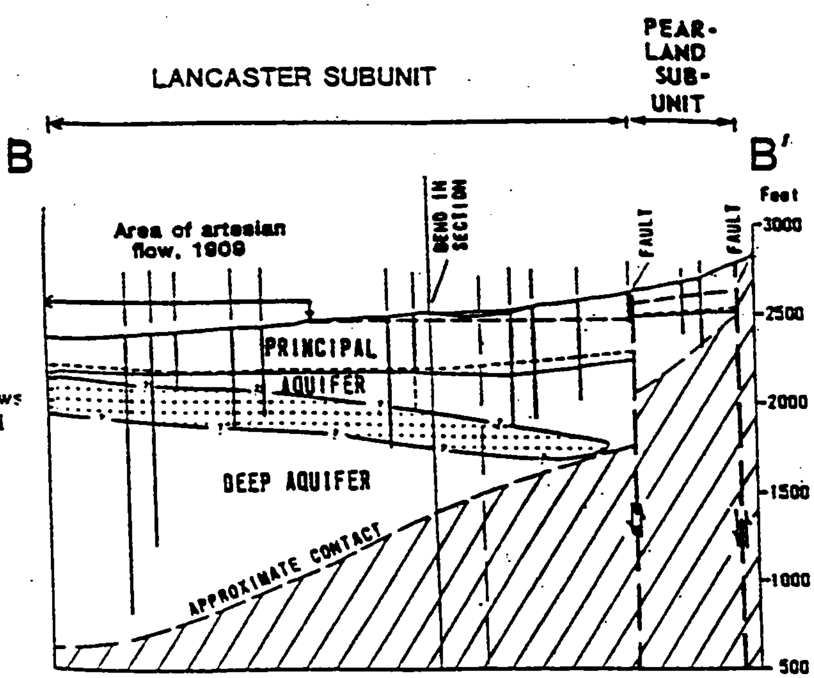
Other sources of recharge include irrigation return flow, leaking water conveyance lines, wastewater collection and treatment facilities, and artificial recharge. Depending on the thickness and characteristics of the unsaturated zone, these sources may or may not contribute to recharge of the groundwater. In addition, there have been no estimates of the quantities of these other sources that actually recharge the groundwater.

HYDRAULIC CHARACTERISTICS OF THE ANTELOPE VALLEY AQUIFERS

An important element of the assessment of any aquifer to its feasibility for ASR are the hydraulic characteristics of the aquifer which determine its response to pumping and recharge of outside sources of water. The primary hydraulic characteristics of interest are the hydraulic conductivity and storage available in the aquifer media.



Generalized geologic cross-section A-A'



Generalized geologic cross-section B-B'

UNCONSOLIDATED DEPOSITS

LACUSTRINE DEPOSITS

CONSOLIDATED ROCKS

FAULT—Approximately located: arrows indicate direction of relative vertical movement

WELL—Dashed where perforated

WATER LEVEL, 1909

WATER LEVEL, 1964

WATER LEVEL, 1982

Geology modified from Bloyd (1967) and Durbin (1978)
Lacustrine deposits shown diagrammatically

Location of section lines shown on Figure 7-2

Source: LACDPW, 1989

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Geologic Cross-Sections

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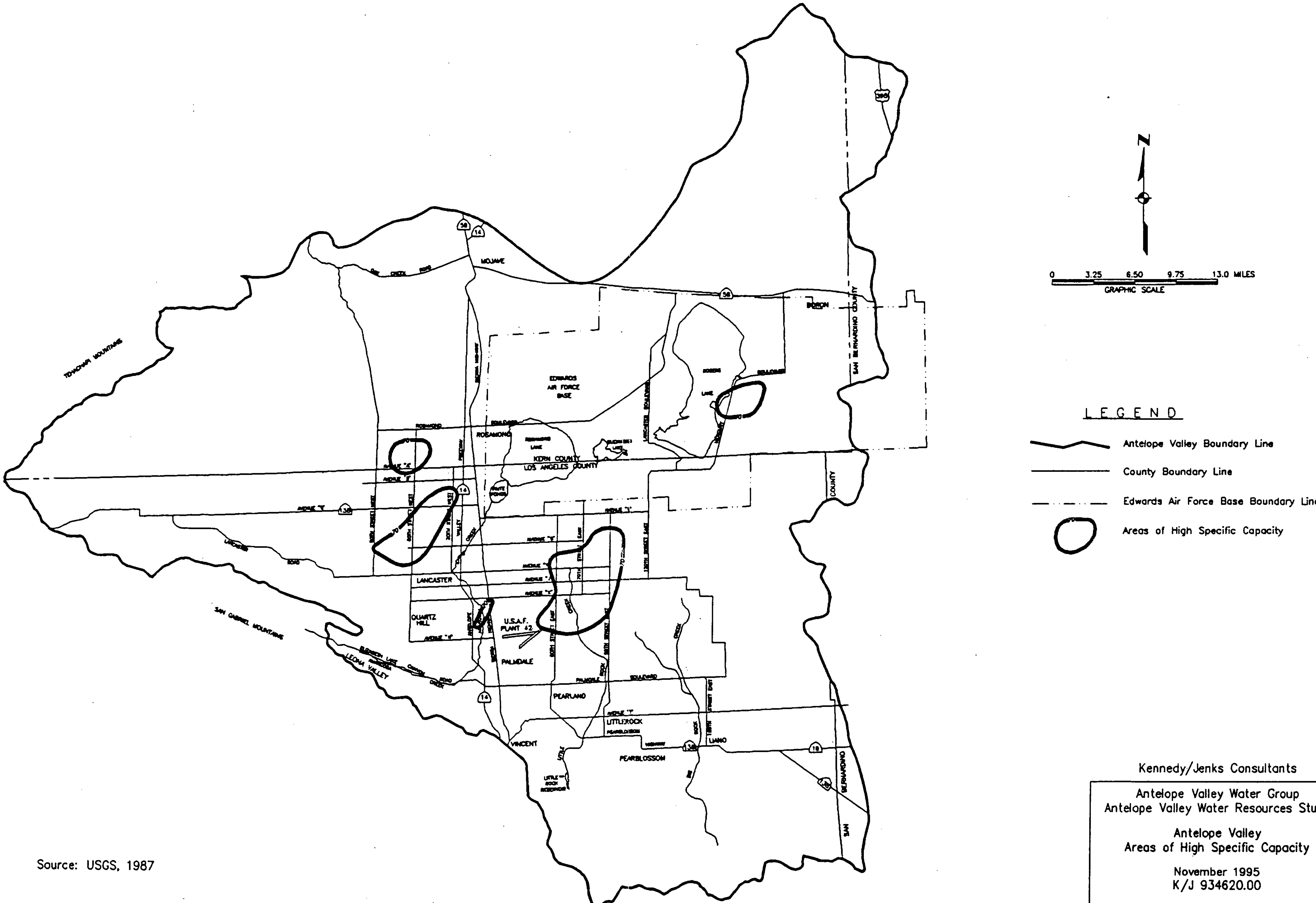
Figure 7-3

Hydraulic conductivity (K) which is commonly measured in centimeter per second (cm/sec) or feet per second (ft/sec) describes the aquifer's ability to transmit water as a function of both the porous media and the fluid. Hydraulic conductivities for alluvial materials such as sands and gravels are in the range of 10^{-2} to 10^{-3} cm/sec or 10^{-4} to 10^{-5} ft/sec. In multi-layered aquifer systems such as in Antelope Valley, the horizontal hydraulic conductivity is governed by coarse grained materials and is higher than the vertical hydraulic conductivity which is governed by the fine-grained materials.

The hydraulic conductivity multiplied by the thickness of the aquifer can be used to estimate the transmissivity (T) which is the ability of the aquifer to transmit water laterally. The transmissivity is commonly measured in gallons per day per foot (gpd/ft) or square feet per day (ft^2/day). In aquifers of 5 to 100 meters thick, values of $T > 100,000$ gpd/ft or 13,800 ft^2/day are good aquifers for potential ASR use. Aquifers with T values lower than 100,000 gpd/ft may be acceptable for ASR use; however, this will depend on the specific site conditions. Transmissivity and hydraulic conductivity values are good measures of the ability of the aquifer to accept additional water. The transmissivity can be used to estimate the specific capacity or productivity of a well which has the units of gallons per minute per foot of drawdown.

The ability of an aquifer to store water is described in a parameter called the storage coefficient, defined as the volume of water released by the aquifer from storage per unit surface area of aquifer per unit decline in hydraulic head. For confined aquifers, the storage coefficient is called storativity (S) which is a dimensionless coefficient that describes the water produced as a function of aquifer compaction and water expansion. For unconfined aquifers, the storage coefficient is called specific yield and describes the water yielded from the water-bearing material by gravity drainage as a percent of aquifer volume. Typical values of storativity are 0.005 to 0.00005 while typical values of specific yield are 0.01 to 0.30. Specific values for storativity and specific yield in the Antelope Valley are a function of the depositional environment and will vary from place to place.

Estimates for hydraulic conductivity, transmissivity and storage in Antelope Valley have been obtained through pump tests conducted in and around Edwards Air Force Base (AFB). Values range from 4,600 to 26,800 ft^2/day for transmissivity, 0.017 to 0.13 ft/day (2×10^{-7} to 1.5×10^{-6} ft/sec) for vertical hydraulic conductivity in the lacustrine clay, and 0.00036 to 0.13 for the storage coefficient (USGS, 1993). Estimates of transmissivity from specific capacity tests in wells range from 600 to 32,000 ft^2/day (USGS, 1994). Pump test data outside of the Edwards AFB grounds appear sparse. Other estimates of specific capacity have been compiled in earlier USGS reports such as USGS 1967 which developed a contour map of specific capacities ranging from 3,800 to 15,400 ft^2/day, primarily representing the unconfined zone. The areas of highest specific capacity are shown on Figure 7-4.



Source: USGS, 1987

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Areas of High Specific Capacity

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Figure 7-4

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Storage coefficients such as specific yields have been estimated from lithologic logs. Around Edwards AFB, the storage coefficient ranges from 3 to 15 percent, with an average of 9 percent. Estimates for other areas of the Valley have shown specific yield estimates of 5 to 20 percent (USGS, 1993).

Finally, a parameter of relevance to surface recharge is the infiltration or percolation rate in inches per minute. In areas near the alluvial fans, surface soils are generally relatively coarse which indicates relatively high percolation rates. Very few published studies have been conducted which document percolation rates; however, field testing is relatively easy to conduct.

CURRENT CONDITION OF THE AQUIFERS

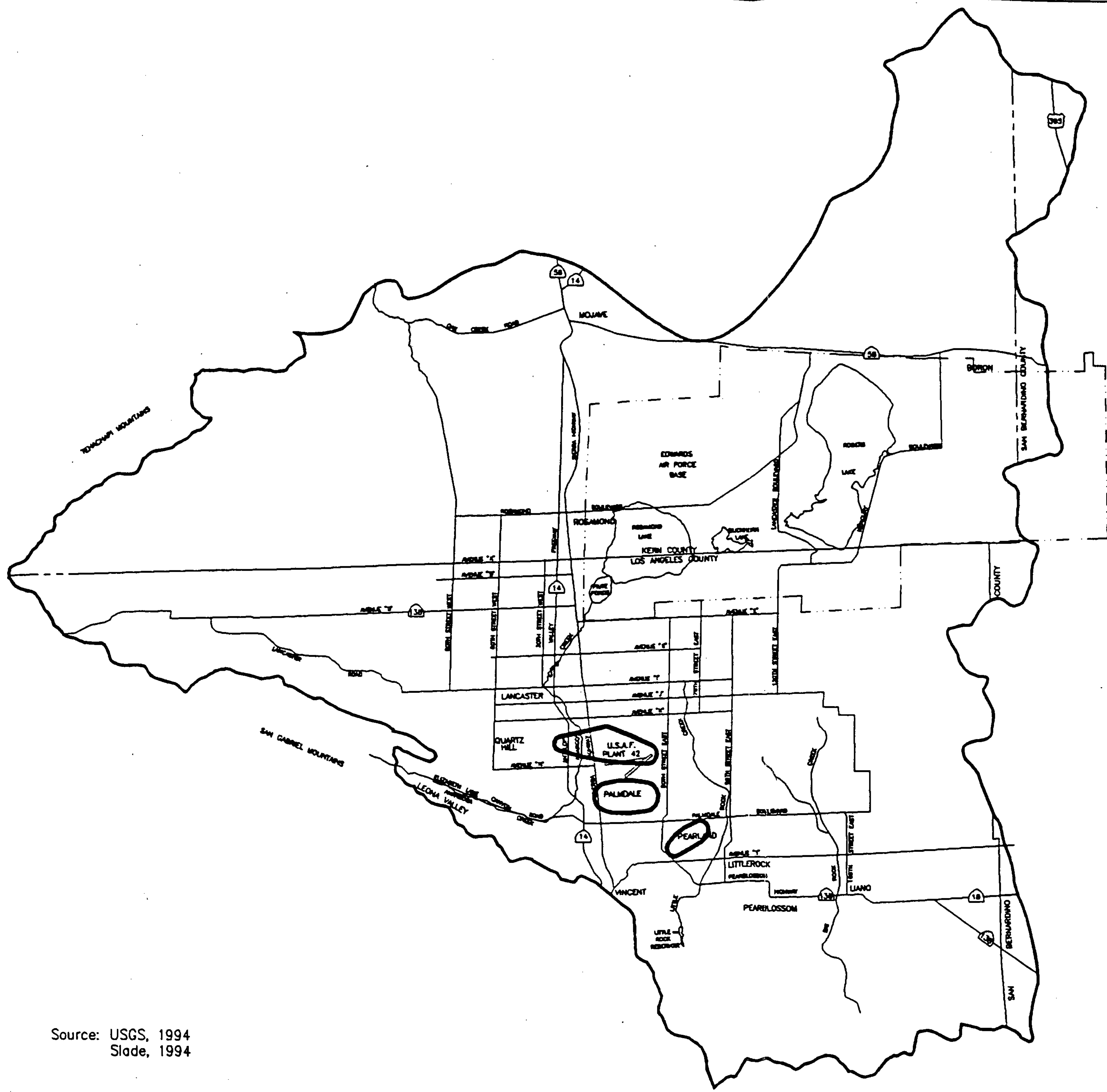
A brief description of the water levels and water quality for the groundwater aquifer in the Antelope Valley is presented below.

Water Levels

Irrigated agriculture started in the Antelope Valley in the 1890s with documented evidence of 50,000 acres of land irrigated with surface water. However, the unreliability of surface water led to the development of groundwater use starting in 1912 with the highest pumping occurring in the 1950s and 1960s. By 1919, there were an estimated 500 wells drilled in Antelope Valley with the number rising to about 600 wells in 1940 and more than 1,000 by 1950. In 1956, there were about 135,000 acres of dry and irrigated agricultural land under production in the Valley (USGS, 1967) with a peak annual water usage of about 415,000 acre-feet per year (USGS, 1993).

As the Valley has developed, many of the agricultural land uses have been converted to urban and industrial land uses. For the first time since the 1890s, groundwater pumpage for municipal supply exceeded the demand for agricultural supply in 1988 (USGS, 1993). The estimated total water demand in 1990 for the Valley was about 128,000 acre-feet per year which was met by surface water, groundwater and State Water Project (SWP) water.

Groundwater levels have declined by as much as 200 feet (USGS, 1994). This decline has significantly increased pumping costs, resulting in overdrafting of the aquifer and land subsidence. The introduction of imported water from the SWP to the Valley in 1973 reduced the demand for groundwater, thereby allowing groundwater levels to recover somewhat, which subsequently may have reduced the rate of subsidence (USGS, 1995). However, there is still a significant groundwater depression in the Valley as shown on Figure 7-5. In addition to the groundwater depression identified by the USGS, two groundwater depressions have been identified in the Lancaster and Pearland Sub-units (Slade, 1994). The locations are also shown on Figure 7-5. (Conversation with Palmdale Water District suggests that the depression in the Pearland Sub-unit may not be a groundwater depression but merely a change in gradient.)



N

0 3.25 6.50 9.75 13.0 MILES
GRAPHIC SCALE

L E G E N D

Antelope Valley Boundary Line

County Boundary Line

Edwards Air Force Base Boundary Line

Groundwater Depressions

Source: USGS, 1994
Slade, 1994

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Groundwater Depressions
in Antelope Valley

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Figure 7-5

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The high pumping rates of the 1950s and 1960s resulted in groundwater overdraft and subsidence of the ground surface as shown on Figure 7-6. Some of the areas of highest subsidence are coincident with current groundwater depressions. Studies by the USGS in 1993 indicate that the maximum estimated land subsidence from 1930 to 1992 was about 6.6 feet. In addition, there are approximately 290 square miles which have subsided by at least 1 foot, relating to a reduction in aquifer storage of about 50,000 acre-feet (USGS, 1994).

Water Quality

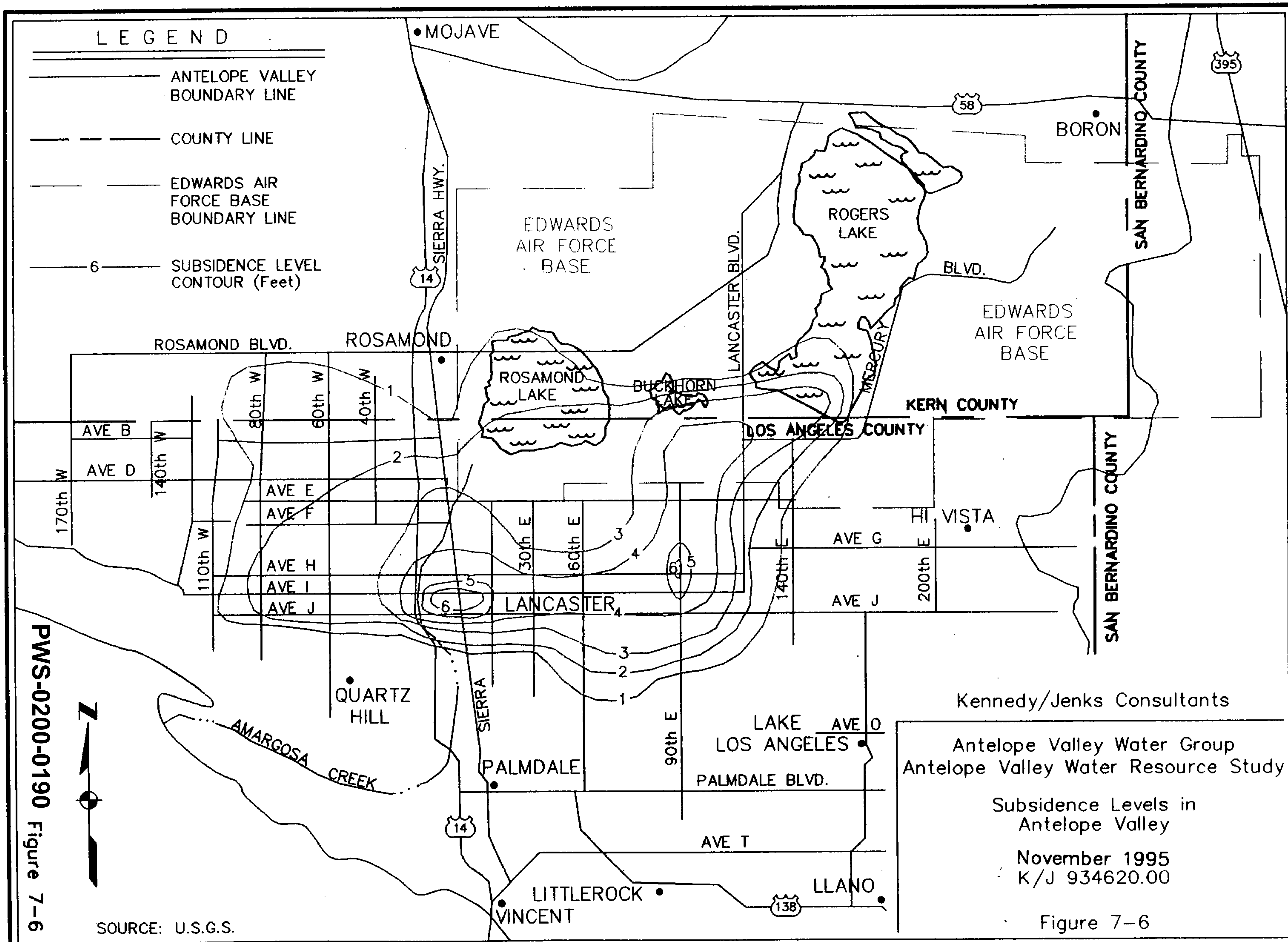
Water quality is generally good (i.e., Total Dissolved Solids (TDS) < 1000 parts per million (ppm)) Valley-wide except for the northeast part of Valley, the borders of the Lancaster Sub-unit, and some shallow wells in North Edwards and Boron. Poorer water quality appears to be associated in areas with hard-rock outcrops and areas underlain by the shallow playa deposits where evaporation has concentrated solutes. In general, the water quality over time has remained relatively unchanged over the entire Valley and generally meets maximum contaminant limits (MCLs) (USGS, 1987). The exceptions to the good groundwater quality are some high concentrations of boron associated with naturally-occurring boron deposits, and high nitrates associated with fertilizer use and poultry farming near the areas of Little Rock and Quartz Hill. Most of the groundwater withdrawals for municipal and agricultural use are drawn from the upper principal aquifer. Water quality data for specific areas are provided in later sections.

QUANTITY AND QUALITY OF AVAILABLE GROUNDWATER INFORMATION

Over three thousand wells have been drilled in Antelope Valley that have been recorded with the DWR. The USGS has prepared a computerized water-level database for these wells where the data fields include the local well number based on township, range, and section; the use of the water; the depth of well; the perforated interval; elevation of the land surface; the date of data collection, and the water level elevation. These data are not available for all of the wells and many of the wells contain measurements for only a few years. A listing of the well numbers would take many pages and therefore is not included in this report. A diskette with the well numbers and water level data is available.

In order to have a more complete picture of the aquifer characteristics at a single well, three basic pieces of information are required for that well including:

- Water level data over time.
- Water quality data over time.
- Well construction data such as geologic well logs, driller's logs, perforated intervals, construction material, and electric logs.



PWS-0200-0190 Figure 7-6

The omission of the well-construction data make evaluations of changes to the water quality or water levels in the groundwater difficult. The situation is made even more difficult in a multi-layer aquifer system as occurs in parts of the Antelope Valley.

Water Level Data

The USGS has compiled a database of water levels from their own data as well as those of the Department of Water Resources, for over 3,000 wells in the Antelope Valley (USGS, 1994b). However, the sheer size of the Valley prevents detailed study because even the 3,000 wells results in an average well density of about 2 wells per square mile. The USGS monitors water level for about 200 of those wells, however the majority of the 3,000 wells have data from only one point in time. Only 260 wells contain long-term water level data as shown on Figure 7-7.

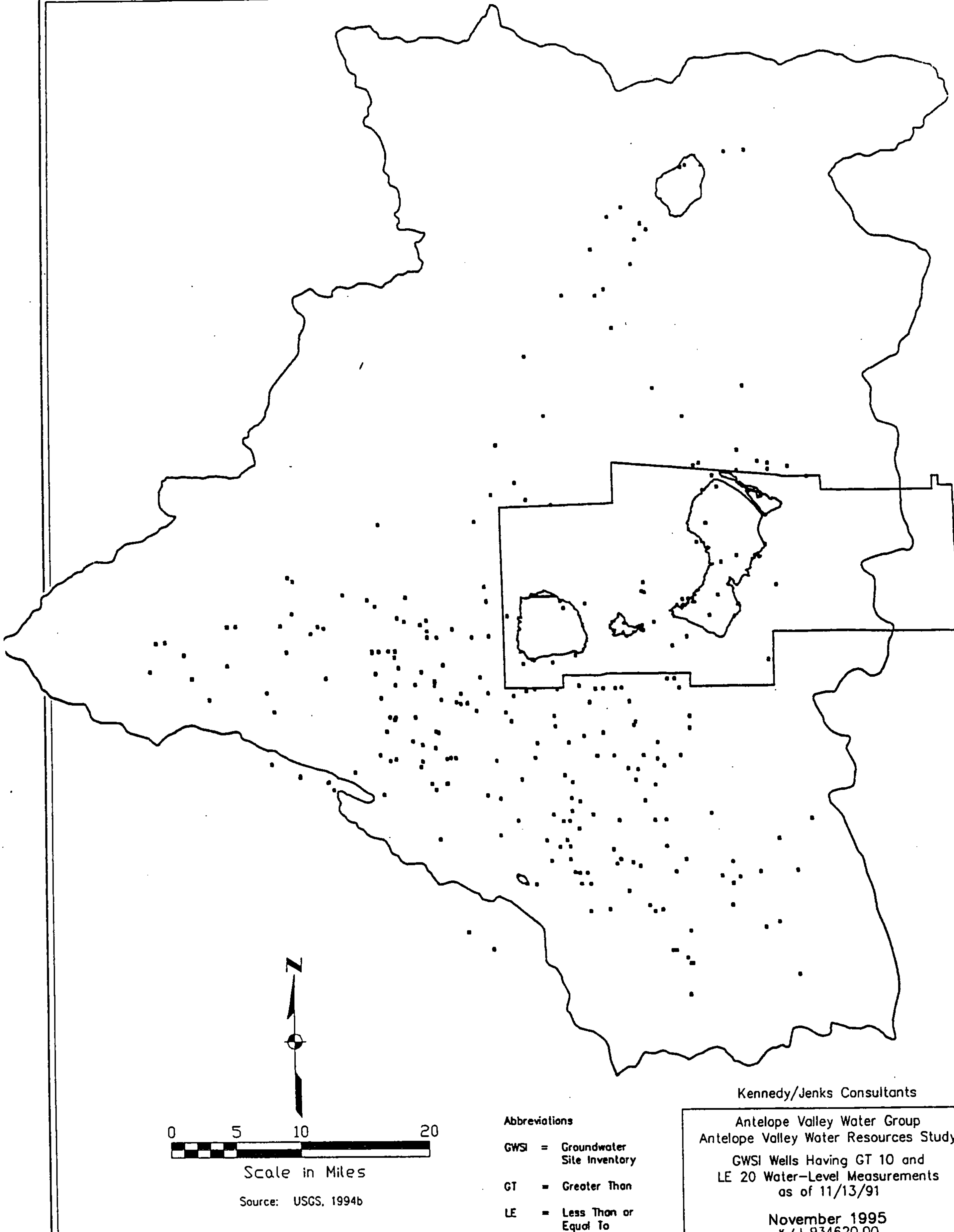
Water Quality Data

Similarly, the water quality data that were available from the USGS and from a CD-ROM of groundwater data are also quite sparse. As shown on Figure 7-8, there are over 2,500 wells with 1 water quality sample (most data were collected in the 1950s and 1960s). However, as shown on Figure 7-9, the number of wells with more than 10 water quality samples drops significantly to about 60 wells. Many of the wells of interest have water quality data that are more than 15 years old. The USGS has continued to monitor approximately 40 wells for water quality parameters in the Antelope Valley.

The water quality data that are currently available can only give a general overview of the condition of the aquifer. Additional site-specific data will be necessary to assess the condition of the aquifer and the potential impacts of recharge on the overall groundwater quality.

Well Construction Data

In addition to water quality and water level data, well data (such as lithologic logs and descriptions of construction) are also an important component. Because of the multi-layered aquifer system in the Antelope Valley, the well logs and knowledge of the depth and perforated intervals of the wells are vital to assessing the hydrogeology and the potential interactions between various aquifer zones. Based on the studies by the USGS, it appears that there are about 2,500 wells for which well construction data are available as shown on Figure 7-10. USGS, working with the Antelope Valley-East Kern Water Agency (AVEK) in the 1970s and 1980s, created a database of information for the wells in the more urbanized portions of the Valley. The database indicates whether well logs exist for specific wells. These data could provide an accessible source upon which site-specific investigations could be based.



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GWSI Wells Having GT 10 and LE 20 Water-Level Measurements as of 11/13/91

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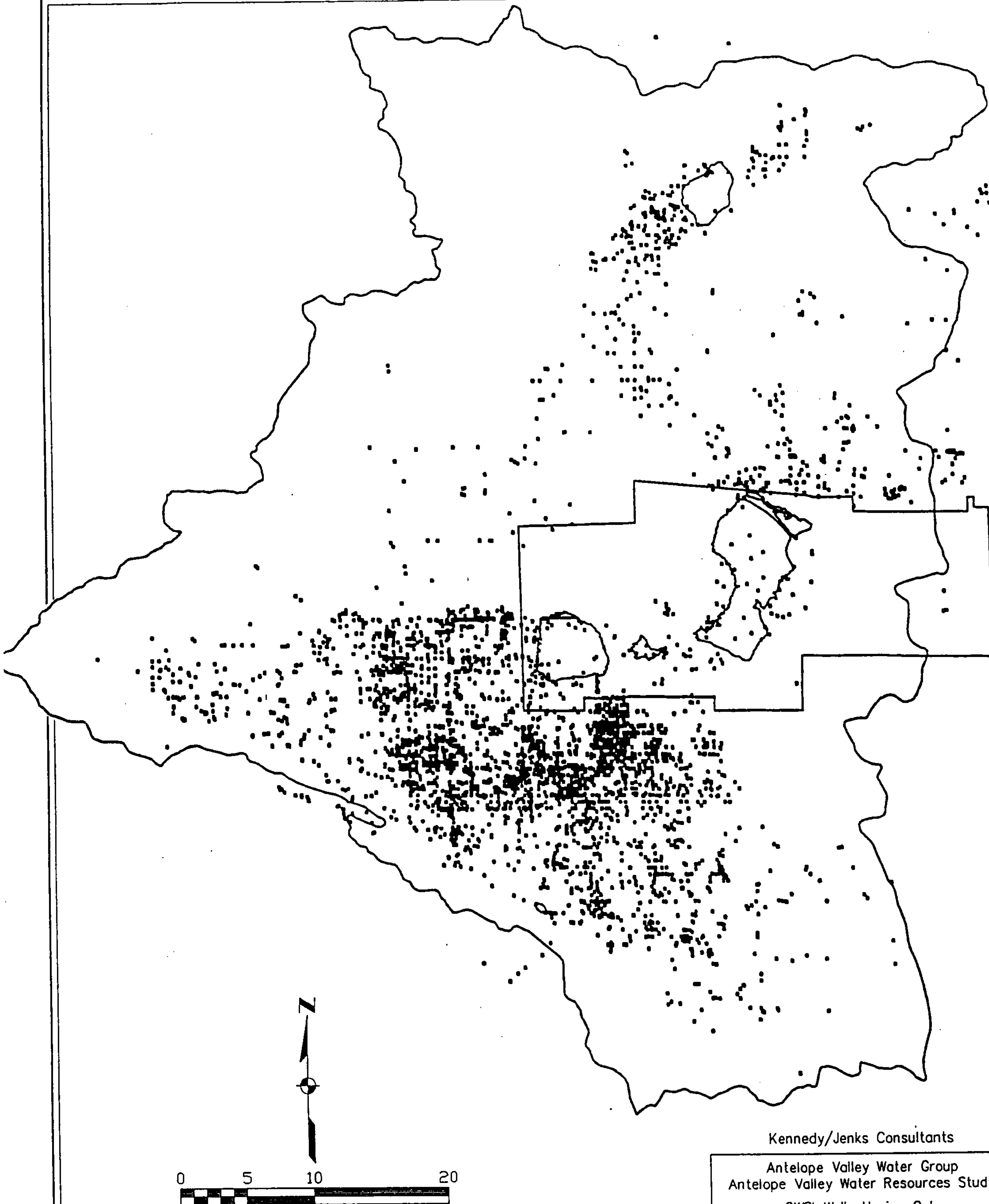
Figure 7-7



Source: USGS, 1994b

Abbreviations

GWSI = Groundwater Site Inventory

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GWSI Wells Having Only One Chemical Analysis as of 11/13/91

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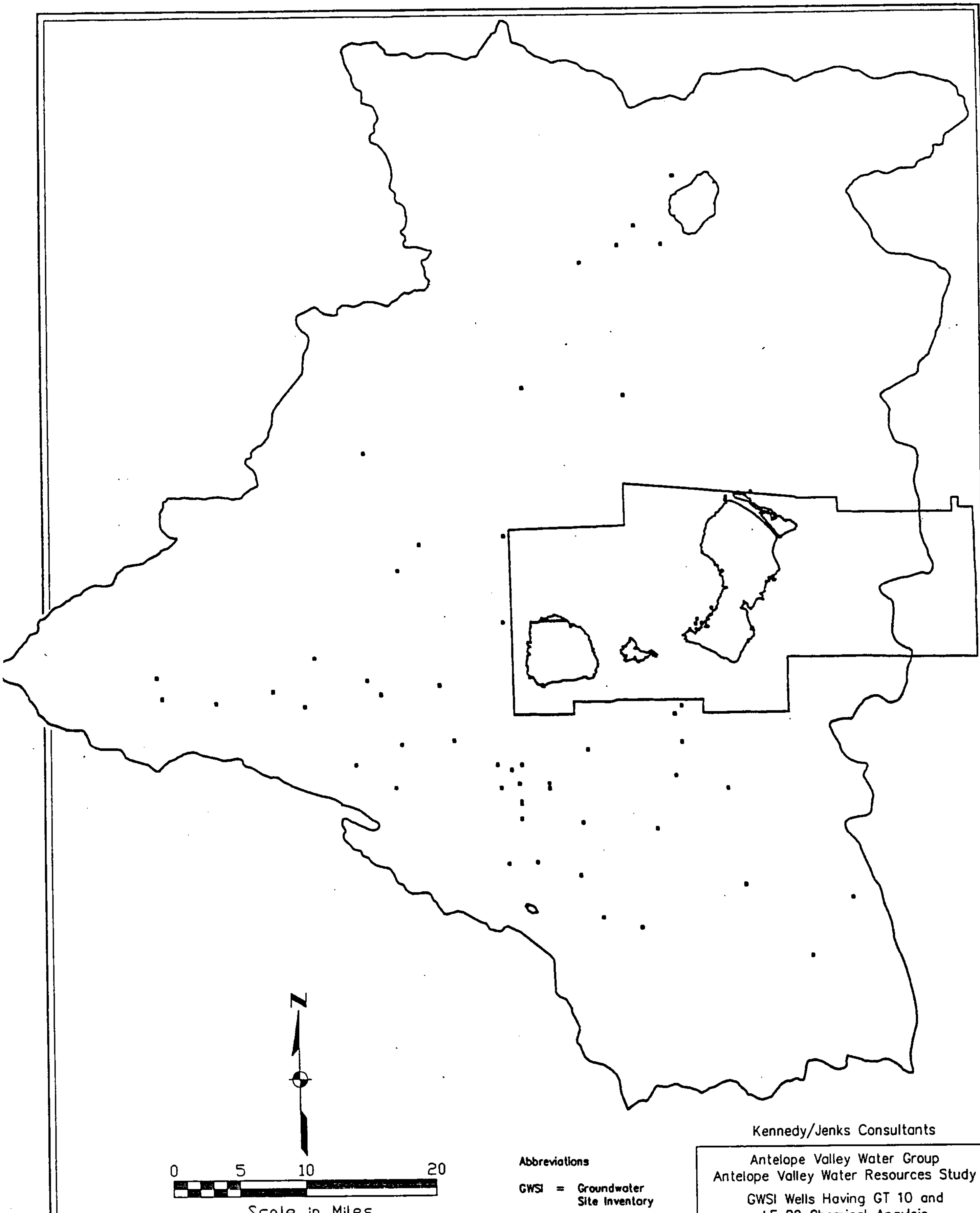
Figure 7-8



Source: USGS, 1994b

Abbreviations

GWSI = Groundwater Site Inventory

GT = Greater Than

LE = Less Than or Equal To

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GWSI Wells Having GT 10 and LE 20 Chemical Anaylsis as of 11/13/91

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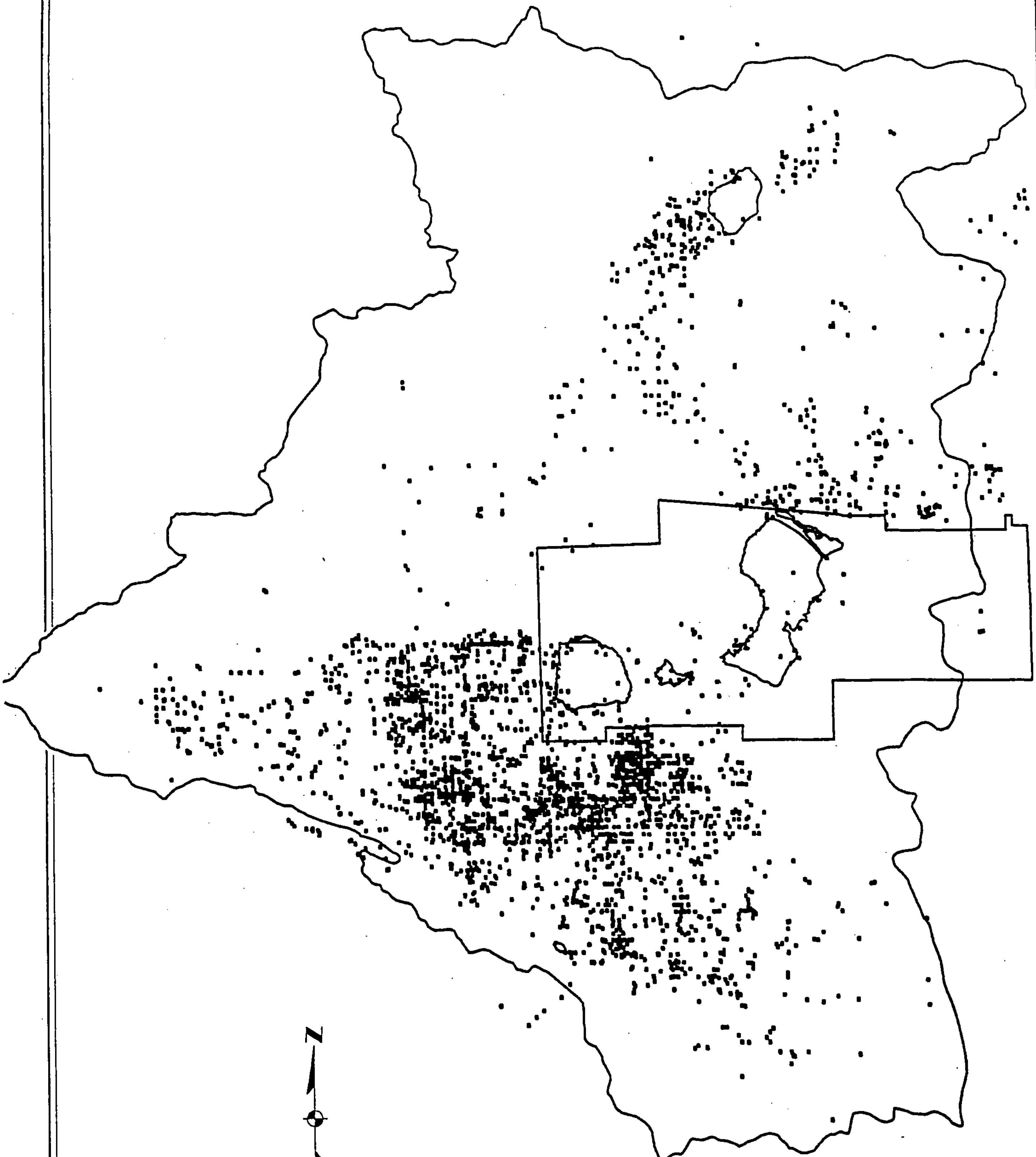
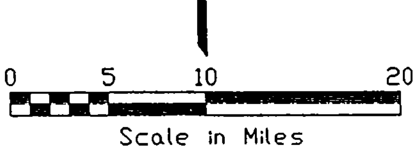
Figure 7–9





Source: USGS, 1994b

Abbreviations

GWSI = Groundwater Site Inventory

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GWSI Wells Having Construction Data for Period of Record as of 11/08/91

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Figure 7-10

PWS-0200-0195

POTENTIAL WATER SOURCES FOR RECHARGE

There are a variety of source waters that could be available for recharge into the groundwater of the Antelope Valley. They include:

- SWP
  - Treated potable water
  - Untreated water directly from the California Aqueduct

- Reclaimed Water (for spreading only)
  - Secondary treatment
  - Tertiary treatment

- Surface Water
  - Little Rock Creek and Little Rock Reservoir
  - Big Rock Creek
  - Amargosa Creek

The locations of the potential sources of recharge water for the Valley are shown on Figure 7-11. In addition, the range in TDS values of the potential sources of water in the Antelope Valley is shown on Figure 7-12. The average raw SWP TDS value is an average of the annual average from 1976 to 1989 and 1993 (1993 TDS average is obtained from the average of January through June of 1993).

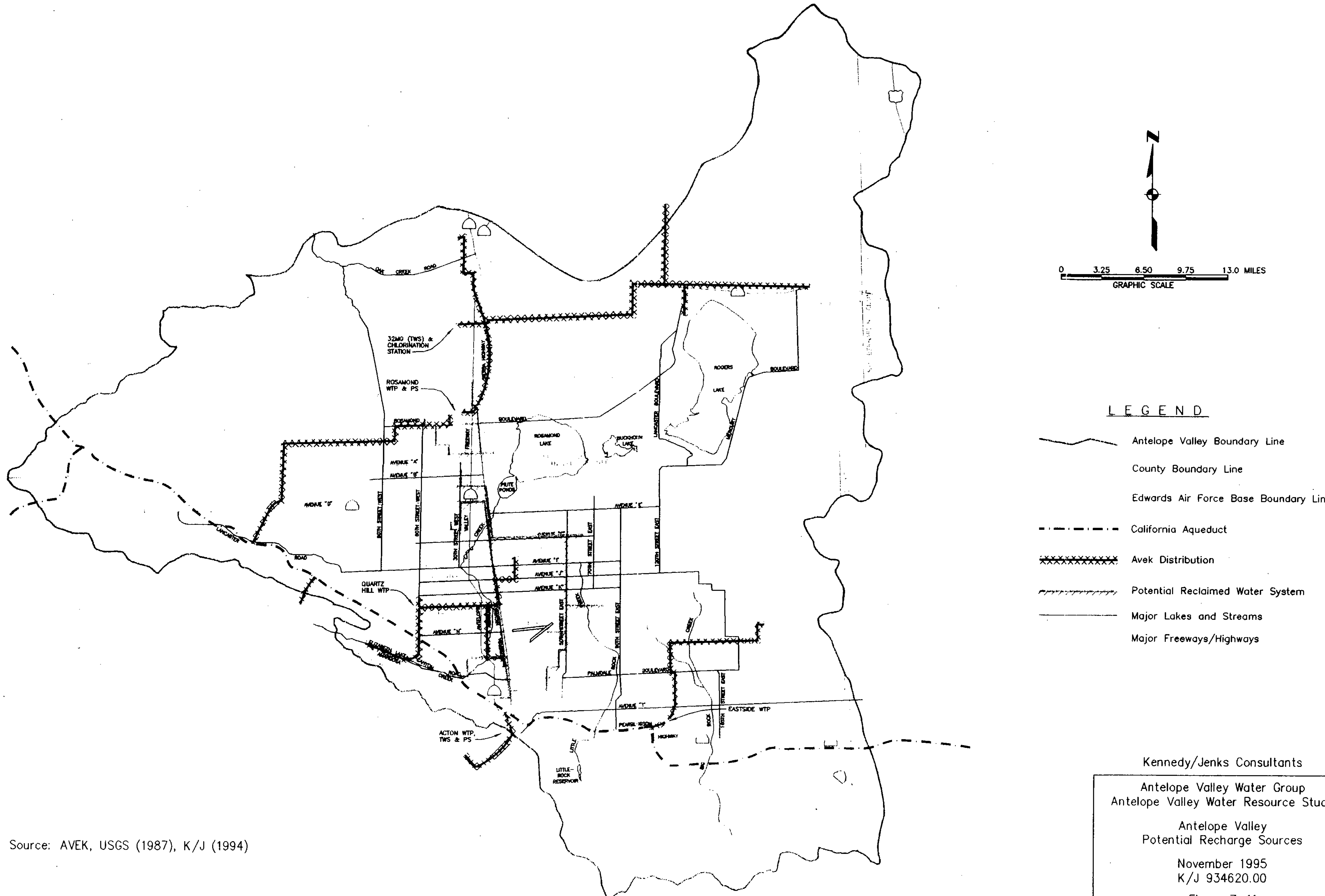
The highest groundwater TDS level within the wells for which data were evaluated was 1,840 mg/L in a well located on Edwards AFB where perched water tables and the accompanying high salts occur. The low groundwater TDS of 125 mg/L occurred in a well in the Los Angeles County Waterworks (LACWW) wellfield near Lancaster. The average TDS value was estimated at about 300 mg/L based on the wells for which water quality was evaluated.

REGULATORY ISSUES

Groundwater recharge programs are currently regulated under several jurisdictions depending on the location and type of recharge program and the nature of the source waters. At present, neither the Environmental Protection Agency (EPA) nor the California Regional Water Quality Control Board-Lahontan Region (RWQCB-LH) (agencies expected to have the greatest involvement), have set procedures for review of groundwater recharge projects. Discussions with EPA staff indicate that they review groundwater recharge programs on a case-by-case basis.

Federal Regulations

The EPA regulates the discharges of waste to the subsurface under its Underground Injection Control (UIC) program as part of the Safe Drinking Water Act (SDWA). The UIC program divides injection wells into 5 classes. Wells that inject potable water or reclaimed water would be classified as Class V wells which would require, at present, only documentation of the injection. However, EPA staff indicate that



Source: AVEK, USGS (1987), K/J (1994)

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Potential Recharge Sources

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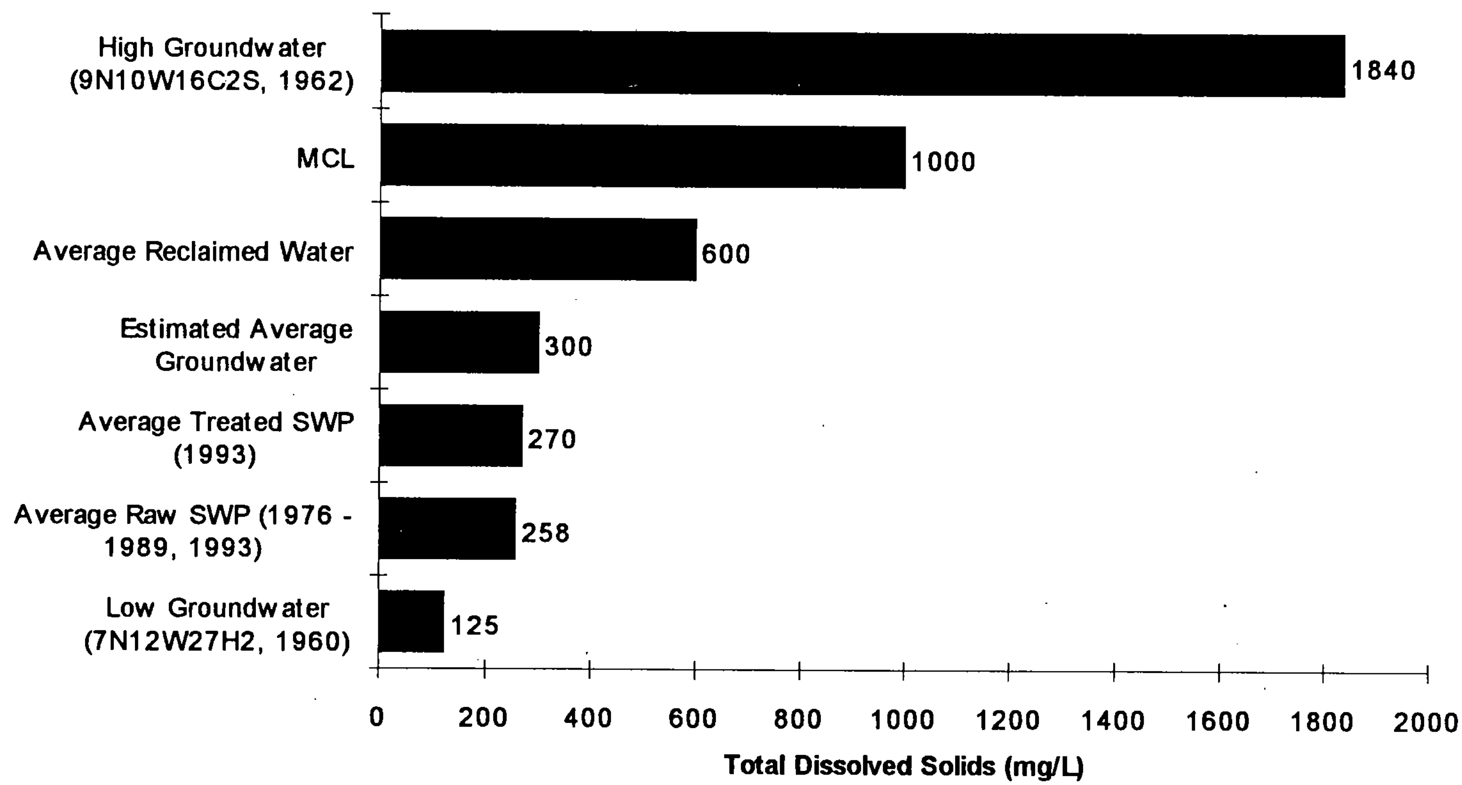
Figure 7-11

PWS-0200-0197



Note: Groundwater samples collected between 1960 - 1992 at wells in Antelope Valley

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Water Quality Comparison in Antelope Valley

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Figure 7-12

they are concerned with potential degradation of the aquifer by salts and TDS, but assess the injection or recharge on a case-by-case basis, taking into account the potential beneficial uses of the recharged water. Discharges to dry creek beds, particularly of reclaimed water, may require a National Pollutant Discharge Elimination System (NPDES) permit which is administered by the RWQCB-LH.

State Regulations

A groundwater recharge program for the Valley may be regulated by the RWQCB-LH and the Department of Health Services. Both are discussed below.

RWQCB-LH. The RWQCB-LH Water Quality Control Plan for the South Lahontan Basin (Basin Plan) lists no numerical Water Quality Objectives for groundwater. However, narrative objectives for groundwater contained in the Basin Plan include:

- Non-degradation policy which allows changes to water quality if:
    - The change is consistent with maximum benefit to the people of the State.
    - The change does not unreasonably affect present and anticipated beneficial uses of water.
    - The change does not result in water quality less than that prescribed in water quality control plans or policies.

- Groundwater shall not contain taste or odor-producing substances that cause a nuisance or adversely affect beneficial uses.

- Groundwater used for domestic or municipal supply shall have a median concentration of coliform organisms over a seven-day period of less than 2.2/100 milliliters.

- Groundwaters designated for domestic or municipal supply shall not contain concentrations of chemical constituents in excess of the specified MCL.

- Groundwaters designated for domestic or municipal supply shall not contain concentrations of radionuclides in excess of the specified MCL.

If reclaimed water is discharged to spreading grounds that are within the dry creek beds of any of the creeks, the discharge may be regulated under the NPDES program that the RWQCB-LH administers for the EPA.

In the past, the RWQCB-LH has issued either waste discharge requirements or waivers of waste discharge requirements for implementation of groundwater recharge programs. The RWQCB-LH will also be concerned with the potential degradation of the aquifer by salts and TDS but also assesses the individual recharge or injection on a case-by-case basis.

Department of Health Services. The Department of Health Services (DHS) regulates drinking water quality, hazardous waste and reclaimed water use and may advise the RWQCB-LH on discharge requirements. In addition, the DHS is currently working on revising the requirements for recharge of reclaimed water in Title 22. For direct injection, requirements are expected to include 1) oxidized, filtered and disinfected water as well as organics removal through granular activated carbon (GAC) absorption or reverse osmosis (RO) treatment, 2) a maximum groundwater basin contribution of 50 percent for reclaimed water, 3) a minimum retention time of 12 months in the basin prior to withdrawal at a domestic supply well, and 4) a minimum horizontal distance of 2,000 feet between the point of injection and the point of withdrawal at a domestic supply well.

For surface spreading, different requirements are expected to be applied to different levels of treated wastewater. There are expected to be three categories of treated wastewater acceptable for spreading:

- Category I (oxidation, filtration, disinfection and organics removal through GAC or RO treatment).
- Category II (oxidation, filtration, and disinfection).
- Category III (oxidation and disinfection).

Category I would require 1) a maximum groundwater basin contribution of 50 percent for reclaimed water, 2) a depth to groundwater of 20 feet if percolation rates are less than 0.3 inches per hour (in/hr) (a depth of 10 feet if percolation rates are less than 0.2 in/hr), 3) a minimum retention time of 6 months in the basin prior to withdrawal at a domestic supply well, and 4) a minimum horizontal distance of 500 feet between the point of injection and the point of withdrawal at a domestic supply well. Category II would require 1) a maximum groundwater basin contribution of 20 percent for reclaimed water, 2) a depth to groundwater of 20 feet if percolation rates are less than 0.3 in/hr (a depth of 10 feet if percolation rates are less than 0.2 in/hr), 3) a minimum retention time of 6 months in the basin prior to withdrawal at a domestic supply well, and 4) a minimum horizontal distance of 500 feet between the point of injection and the point of withdrawal at a domestic supply well. Category III would require 1) a maximum groundwater basin contribution of 20 percent for reclaimed water, 2) a depth to groundwater of 50 feet if percolation rates are less than 0.3 in/hr (a depth of 20 feet if percolation rates are less than 0.2 in/hr) 3) a minimum retention time of 12 months in the basin prior to withdrawal at a domestic supply well, and 4) a minimum horizontal distance of 1,000 feet between the point of injection and the point of withdrawal at a domestic supply well.

An engineering report on the proposed groundwater recharge project will be required to be submitted to the RWQCB-LH and the DHS. Monitoring wells will be required to detect the influence of the recharge operation.