# APPENDIX E

# ANALYSIS OF DEVELOPING AND IMPLEMENTING A GROUNDWATER RECHARGE REUSE PROJECT IN THE ANTELOPE VALLEY

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***Submitted to:***

***County Sanitation District No. 20 of Los Angeles County***

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## FOREWORD

This *Analysis of Developing and Implementing a Groundwater Recharge Reuse Project in the Antelope Valley* report was prepared by Environmental Science Associates under the direction of Ms. Leslie Moulton. Ms. Moulton has over 20 years of professional experience and has been responsible for a variety of environmental studies including development of master plans for water reuse projects for the Orange County Sanitation Districts, City of San Francisco, and the Dublin San Ramon Services District. In addition, Dr. James Crook, Ph.D., P.E., reviewed this report and provided detailed technical information and an assessment of the regulatory requirements for water reuse in California. Dr. Crook has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. He was principal author of water reuse guidelines published in 1992 by the U.S. Environmental Protection Agency and U.S. Agency for International Development. Dr. Crook previously directed the California Department of Public Health Services' water reclamation and reuse program and developed California's first comprehensive water reuse criteria.

Resumes for Ms. Moulton and Dr. Crook are included in Attachment B.

## INTRODUCTION

County Sanitation District No. 20 of Los Angeles County (District No. 20) operates the Palmdale Water Reclamation Plant (WRP) that serves the City of Palmdale and portions of Los Angeles County in the Antelope Valley, a closed watershed basin that has no surface water outlet to the ocean. Treated effluent must be reused, evaporated, or exported. The need to find an effluent management solution has generated interest in expanding the reuse of water in the region, including groundwater recharge projects.

The purpose of this report is to analyze the potential of using recycled water for groundwater recharge in the Antelope Valley, including the identification of steps for project development and project constraints. Recycled water, sometimes referred to as reclaimed water, is produced from treating municipal wastewater to a level that must meet standards set forth by the California Department of Health Services (DHS) in Title 22, Division 4, Chapter 3, California Code of Regulations (Title 22). Project development using recycled water involves applications for state and federal permits including the preparation of a detailed Engineer's Report, hydrogeologic testing at possible recharge sites, as well as coalition-building among stakeholders, and public education and outreach. This report reviews the state and federal regulations relevant to groundwater recharge projects in the Antelope Valley, such as the California Water Code, Clean Water Act, Safe Drinking Water Act, California Code of Regulations, and water rights determination. In addition, information about potential sites for groundwater recharge in the Antelope Valley is summarized, and other groundwater recharge projects in California are reviewed. The paper concludes with a summary of the identified constraints facing implementation of a recycled water groundwater recharge project in the Antelope Valley.

## ANTELOPE VALLEY HYDROGEOLOGY

Currently, water demand in the Antelope Valley is met by a combination of groundwater, surface water, and imported water from the State Water Project (SWP). Groundwater has been heavily exploited in the Antelope Valley historically, and currently supplies 50 to 90 percent of annual water demand (Sneed and Galloway, 2003). Even with the availability of surface and imported water supplies to alleviate pressure on groundwater resources, there has been an overall decline of 200 feet in groundwater levels due to cumulative overdrafts (Ikehara and Phillips, 1994). Current groundwater overdrafts result from annual pumping rates of approximately 75,000 acre-feet, which exceed annual natural recharge rates of approximately 41,000 acre-feet (Sneed and Galloway, 2003). Overdrafts have resulted in widespread land subsidence of about one foot over approximately 290 square miles and over six feet in some places (Ikehara and Phillips, 1994). Land subsidence has resulted in aquifer-system compaction, with a reduction in aquifer storage of about 50,000 acre-feet.

The Antelope Valley aquifers are bounded by the consolidated rocks of the San Gabriel and Tehachapi Mountains and the bedrock floor. Within the confines of these barriers, unconsolidated deposits of alluvium, sand, gravel, silt, and playa materials are the primary water-bearing formations that create the aquifers. In general, groundwater in the Antelope Valley is divided vertically into three aquifers: a shallow, unconfined, upper aquifer that is not highly productive; a thicker, deeper, confined middle aquifer that produces the most groundwater; and a thin, lower aquifer that is deepest and also produces little groundwater (United States Geological Survey (USGS), 2003). The unconfined and confined aquifers are separated by impermeable lacustrine deposits of blue clay (siltstone, clay, and marl). Horizontally, the Antelope Valley basin is divided into twelve subbasins, including Lancaster, Pearland, and Buttes, which are near or under the Palmdale WRP (Thayer, 1946; Bloyd, 1967). The Lancaster subbasin, which is the largest and most developed, has all three aquifer zones. The Pearland and Buttes subbasins are single unconfined aquifers that feed the larger adjacent Lancaster subbasin.

As of 1975, there were approximately 55 million acre-feet of groundwater in storage in the Antelope Valley, of which 13 million acre-feet are currently available. Stored groundwater is often inaccessible due to depth, remote locations, low yield, and the potential to cause surface subsidence if pumped.

The principal source of natural recharge to Antelope Valley aquifers is runoff from the San Gabriel Mountains. At the base of the mountains, alluvial deposits of coarse sands and gravels accept and transmit water to the aquifer below. At this location, there is no blue clay layer, the principal and deep aquifers are connected, and surface water percolation directly recharges both confined and unconfined aquifers. Eighty percent of natural recharge comes from mountain runoff, of which over 50 percent is attributed to Big Rock and Little Rock Washes. Little Rock Wash traverses the Buttes, Pearland, and Lancaster subbasins as it meanders northward. Recharge directly from precipitation is negligible. Recent studies estimate that natural recharge ranges from 31,000 to 59,100 acre-feet per year (AFY) (USGS, 1993a). There are no estimates of other sources of recharge such as excessive irrigation, leaking water lines, or incidental recharge.

## POTENTIAL RECHARGE SITES

Artificial recharge is a planned, human activity of augmenting the amount of groundwater available through works designed to increase the natural groundwater replenishment by direct injection with wells or by percolation of surface waters into the underlying groundwater aquifer(s), resulting in a

corresponding increase in the amount of groundwater available for abstraction.[1] Incidental recharge differs from artificial recharge in that it is an unintended consequence of a planned, human activity to manage effluent by a method not designed to augment groundwater, such as discharge to an existing stream. The feasibility of artificially recharging a groundwater aquifer depends on the aquifer's physical characteristics, including its ability to accept and transmit water (hydraulic conductivity and transmissivity), its ability to store water (storage coefficient), and percolation rates of soils. Hydraulic conductivity, transmissivity, and storage have been quantified in certain portions of the Antelope Valley from pump tests conducted within Edwards Air Force Base (EAFB) and from additional estimates made outside of EAFB by the USGS. Parameter results fall within the range of values that define good storage conditions (USGS, 1993a, 1993b, 1993c).

Site selection for artificial recharge depends on a number of criteria. In addition to ideal hydrogeologic conditions, sites should be close to potential recharge water sources and groundwater production sites. Recharge sites should be down gradient from source waters and close to existing wells or pump facilities in order to minimize capital and operational costs. The recycled water quality should be such that it does not increase the levels of any regulated constituents above the specified limits or degrade the existing groundwater quality. The chemical characteristics of both the groundwater and the recycled water should be such that dissolution or precipitation of chemicals, or other adverse chemical reactions, does not occur upon mixing of the waters or passage of the recycled water through the soil.

The Los Angeles County Department of Public Works has identified several preserves that may be viable sites for a surface spreading project including the following: (1) Pallet Creek Preserve; (2) Mescal Creek Preserve; (3) Big Rock Preserve; (4) Bob's Gap Preserve; (5) Grandview Canyon Preserve; and (6) Lancaster Road Preserve (LACDPW, 1986). Some of the recharge preserves lie in the foothills on the opposite side of the California Aqueduct. The furthest site, the Lancaster Road Preserve, is at least 25 miles from the Palmdale WRP.

The City of Palmdale commissioned two studies[2,3] to identify additional suitable groundwater recharge sites in the Antelope Valley. Various sites were examined as potential locations for recycled water surface spreading and injection. Three recharge water sources were considered when evaluating these sites: recycled water, treated and untreated water from the SWP, and excess storm water and urban runoff surface water flows from creeks. The following sites were identified as potentially suitable for recharge

[1] New England Interstate Water Pollution Control Commission White Paper from www.neiwpcc.org/PDF_Docs/ArtRechargeWhitePaper.doc.
[2] Kennedy/Jenks Consultants. 1995. Antelope Valley Water Resources Study, Final Report. K/J 934620.00.
[3] Kennedy/Jenks Consultants. 1999. Palmdale Water Reclamation Concept Study. San Diego, California.

via surface spreading. Distance from the Palmdale WRP and net elevation gain/loss also are important criteria to consider when selecting recharge sites. The sites that are up gradient of the Palmdale WRP would require pumping of the recycled water. Other sites, located down gradient of the Palmdale WRP, could be served by gravity flow.

1. Amargosa Creek south of Avenue "N" between 10th Street West and Division Street: This site is located at the United States Air Force (USAF) Plant 42 in the Lancaster subbasin, approximately four miles from the Palmdale WRP and 40 feet higher in elevation. The Los Angeles County Department of Public Works (LACDPW) has investigated the conditions of this site, testing percolation rates, hydraulic conductivity, transmissivity, and soils samples.[4] Conditions on the east side of Plant 42 are favorable for surface spreading.

2. Little Rock Wash near Avenue "N" between 60th Street and 70th Street East: This site is located in the Lancaster subbasin on Los Angeles World Airport (LAWA) property, approximately 4.5 miles from the Palmdale WRP and 35 feet lower in elevation. This site crosses Little Rock Wash, which should have permeable soils that would allow excess flow from the wash to be applied to this area. This site also is close to the terminus of an existing recycled water pipeline on 40th Street East, north of Avenue P. The pipeline is part of District No. 20's Palmdale WRP.

3. Amargosa Creek near Elizabeth Lake Road and 25th Street West: This site is located in the Lancaster subbasin near the City of Palmdale's proposed flood detention facilities, approximately six miles from the Palmdale WRP and 280 feet higher in elevation. This site is close to potential water sources such as Amargosa Creek and the California Aqueduct.

4. Palmdale Boulevard: A potential spreading basin site is located in the Buttes subbasin at the eastern end of Palmdale Boulevard, east of 70th Street East, approximately five miles from the Palmdale WRP and 80 feet higher in elevation.

5. 70th Street East: A potential spreading basin site is located on the border of the Buttes/Lancaster subbasins on the east side of 70th Street East, north of Palmdale Boulevard, approximately six miles from the Palmdale WRP and 35 feet lower in elevation.

Based on the selection criteria discussed at the beginning of this section, two potential injection sites were identified in the Lancaster subbasin:

[4] Los Angeles County Department of Public Works – Materials Engineering Division. 1991. Antelope Valley Groundwater Recharge Study – Phase 2 Air Force Site Along Amargosa Creek.

1. USAF Plant 42 Site: Studies of recharge potential at this site were conducted by the LACDPW in 1991. Injection into the saturated zone appeared feasible at depths of 460 to 600 feet, where the acceptance rate of injected water was 70 percent of extraction rates.

2. Wells in USGS/LACDPW/AVEK Injection Study: During 1995-1999, multiple pilot injection studies were conducted jointly by USGS, LACDPW, and Antelope Valley – East Kern Water Agency (AVEK) using existing LACDPW production wells (Phillips et al., 2003). Two production wells near Amargosa Creek in Lancaster (Avenue K-8 and Division Street) were converted to injection wells. Many other wells throughout the study area were used to test the response of the aquifer to injection. The study area included most of Air Force Plant 42 and parts of the Cities of Palmdale, Lancaster, and Quartz Hill.

   The studies tested groundwater movement, land subsidence, and the formation of trihalomethanes (THMs) when chlorinated SWP water was injected into the aquifer. Simulation models identified injection and extraction rates for 16 existing and 13 proposed wells. Results of water chemistry analyses indicated the presence of THMs in the groundwater at levels below the MCL, and the concentrations of THMs decreased with residence time (Fram et al., 2002).

For the potential surface spreading and injection sites listed, additional studies would be required to determine actual percolation rates, infiltration capacity, and subsurface water quality relative to the quality of the intended recycled source water. To date, all information, such as the required size of spreading areas, have been based on estimated percolation rates.

## STATE REQUIREMENTS

The State of California acknowledges that recycled water[5] is a valuable resource, suitable for replenishing and supplementing water supplies to meet the increasing demands of a growing population (Water Code §13576). The Water Recycling Act of 1991 (Water Code §13575-13583) sets a statewide goal of recycling 1,000,000 AFY by 2010 (§13577). As of 2002, 544,979 AFY were recycled statewide, with 13 percent of the recycled water provided by the County Sanitation Districts of Los Angeles County (Districts) (see Attachment A). In order to meet the 2010 goal, this act authorizes recycled retail water suppliers, producers, and wholesalers, to cooperate and form agreements to provide recycled water to identified customers and end users, including entities responsible for groundwater replenishment (Water Code §13579). A recycled water producer or wholesaler is not permitted to supply recycled water

[5] Recycled water means treated wastewater of waste that is suitable for direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource (Water Code §13050(n)).

directly to a customer, unless the retail water supplier in the customer's service area chooses to delegate its responsibility to supply recycled water (Water Code §13580.5(2)).

The Regional Water Quality Control Boards (RWQCBs), the State Water Resources Control Board (SWRCB), and the California Department of Health Services (DHS) are the principal agencies responsible for regulating the use of recycled water. Any person who recycles water must file a report with the appropriate RWQCB (Water Code §13522.5), which is responsible for issuing and enforcing permits to protect the beneficial uses of surface and groundwater. Each recycled water distribution system must have a permit from a RWQCB, or be included in a master permit. DHS has adopted water recycling criteria (State of California, 2000) as mandated by the Water Code (§13521). The DHS criteria include recycled water quality limits, treatment process requirements, operational requirements, and treatment reliability requirements. The RWQCB consults with and reviews recommendations from DHS on proposed projects. Permit requirements issued by a RWQCB must be in conformance with the DHS water recycling criteria. Each RWQCB also establishes permit requirements taking into consideration water quality criteria established in Basin Plans (e.g., Water Quality Control Plans) for receiving waters and the State's antidegradation policy (State Water Resources Control Board Resolution No. 68-16, "Statement of Policy With Respect to Maintaining High Quality of Waters in California").

All recycled water projects must submit engineering reports for DHS review (State of California, 2000). DHS provides guidance documents for preparing such reports.[6] A RWQCB may require the submission of a preconstruction report for the purpose of determining compliance with the uniform statewide reclamation criteria (Water Code Section 13523(b)). RWQCBs can also require the submission of technical or monitoring program reports if the RWQCB also provides a written explanation with regard to the need for the reports and identifies the evidence that supports requiring the reports (Water Code Section 13267). Local agencies can impose additional requirements on water recycling projects pursuant to local ordinances.

GROUNDWATER RECHARGE REGULATIONS

The Water Recycling Criteria (CCR §60320) contained in Title 22 include general requirements for groundwater recharge of domestic water supply aquifers by surface spreading. The regulations state that recycled water used for groundwater recharge of domestic water supply aquifers by surface spreading "shall be at all times of a quality that fully protects public health" and that DHS recommendations "will be based on all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to

withdrawal." The criteria require that DHS hold a public hearing prior to making a final determination on the public health aspects of a project. Until more definitive criteria are adopted, proposals to recharge groundwater by either surface spreading or injection will be evaluated on a case-by-case basis, although draft groundwater recharge criteria described below will guide DHS decisions.

Currently proposed groundwater recharge regulations (California Department of Health Services, 2004) have gone through several iterations and, when finalized and subsequently adopted, will be included in the Title 22 Water Recycling Criteria. It is likely that the draft regulations will undergo substantial future revisions prior to adoption. The proposed regulations address both surface spreading and injection projects involving potable reuse of the recovered water. The RWQCBs are authorized to designate groundwater recharge reuse projects (GRRPs). A GRRP is defined in the DHS draft groundwater recharge regulations as follows:

> "…a project that uses recycled water and has been planned and is operated for the purpose of recharging a groundwater basin designated in the Water Quality Control Plan [defined in Water Code §13050(j)] for use as a source of domestic water supply, and that has been identified as a Groundwater Recharge Reuse Project by a RWQCB." (California Department of Health Services, 2004)

Based on the draft regulations, entities that supply recycled water to a GRRP would be required to administer a source control program. The recycled water supplier must also establish and monitor the recycled effluent stream for one year prior to initiating a GRRP. The draft regulations include dilution requirements expressed as "recycled water contribution." The recycled water contribution (RWC) is the fraction of total volume of GRRP recharge water that is recycled water. The draft regulations limit the RWC to a maximum average of 50 percent. Exceptions and increases can be granted under certain conditions.

To ensure groundwater protection from pathogenic microorganisms, recycled water used for either surface spreading or injection in a GRRP must be treated to meet requirements for disinfected tertiary recycled water specified in the DHS water recycling criteria. Per Title 22 recycling criteria, filtration is required, and the turbidity after filtration through filter media cannot exceed 2 nephelometric turbidity units (NTU) within any 24-hour period, 5 NTU more than five percent of the time within a 24-hour period, and 10 NTU at any time. The criteria include disinfection requirements specifying that the concentration of total coliform bacteria cannot exceed a 7-day median of 2.2/100 mL, cannot exceed 23/100 mL in more than one sample in any 30-day period, and cannot exceed 240/100 mL in any sample. For injection projects, additional treatment is required, since the injected recycled water does not percolate

[6] California Department of Health Services, 2004.

through the vadose zone[7] prior to reaching the underground aquifer and, thus, does not benefit from soil aquifer treatment. All injected recycled water must receive reverse osmosis treatment.

Based on the current draft groundwater recharge regulations for surface spreading projects, where recharge occurs via infiltration from controlled application of water to a spreading area, recycled water must be retained underground for at least six months prior to extraction for drinking water supplies, and the extraction point must be at least 500 feet from the recharge location. For subsurface injection projects, where recharge occurs via controlled injection of recharge water below the ground surface, recharge water must be retained underground for at least 12 months, and the extraction point must be at least 2,000 feet from the recharge location.

In addition to microorganisms, recycled water must meet water quality standards for a number of chemical constituents. For some constituents, such as nitrogen compounds, limits can be met in the blended recharge water (i.e., recycled water + diluent water[8]). The monitoring compliance point for nitrogen compounds and total organic carbon (TOC) for surface spreading projects can be either at the point of spreading or within the mound,[9] if vadose zone or mound monitoring is approved by DHS, while for injection projects all water quality requirements must be met at the point of injection.

The DHS draft groundwater recharge regulations allow three alternatives to comply with limits for nitrogen compounds, which are intended to assure that the recycled water or blend of recycled water and diluent water comply with drinking water Maximum Contaminant Levels (MCLs) for nitrate (10 mg/L as N) and nitrite (1 mg/L as N) in any extracted groundwater. Total organic carbon (TOC) concentrations in recycled water to be used for either surface spreading or injection must not exceed 0.5 mg/L divided by the RWC. For spreading projects, both the TOC requirement and the nitrogen compounds requirements can be met in the recycled water in the vadose zone or mound. Recycled water used in both surface spreading and injection projects must meet drinking water primary MCLs for inorganic and organic chemicals, radionuclides, and disinfection byproducts, action levels for lead and copper, and secondary MCLs except that for color. The GRRP operator is required to monitor annually for pharmaceuticals, endocrine disrupting chemicals, and other chemical indicators of municipal wastewater presence specified by DHS based on a review of the GRRP engineering report and the affected groundwater basins.

[7] The vadose zone is the unsaturated zone between the soil surface and the mound of water that forms above the permanent groundwater table as a result of percolation.

[8] Diluent water is a source of water that is not treated wastewater that is used to dilute recycled water.

[9] Water table rise beneath a percolation basin resulting from groundwater recharge via surface spreading.

In addition to monitoring recycled water, the operator of the GRRP must construct monitoring wells between recharge areas and down-gradient drinking water supply wells. Monitoring wells must be located between one to three months travel time from the recharge area (DRAFT CCR §60320.070).

### WATER RECLAMATION REQUIREMENTS

The RWQCBs have the authority to prescribe water reclamation requirements (WRRs) for water that is used or proposed to be used as recycled water (Water Code §13523 (a)). The requirements may be placed on the person providing the recycled water, the user, or both, and must be established in conformance with the DHS Water Recycling Criteria. A GRRP is by definition a planned groundwater recharge reuse project and, thus, is subject to imposition of WRRs by a RWQCB. The WRRs outline the conditions for meeting the DHS recycled water criteria. WRRs can be included with Waste Discharge Requirements (WDRs) issued by a RWQCB for any discharge of waste that might affect the quality of the *waters of the state*. In lieu of issuing WDRs or WRRs, a RWQCB may issue a master reclamation permit to a supplier or distributor, or both, of recycled water (Water Code §13523.1).

## FEDERAL REGULATIONS

### CLEAN WATER ACT

Under the Clean Water Act, the National Pollution Discharge Elimination System (NPDES) permit program is intended to prevent and control the degradation of aquatic ecosystems. Pollutants cannot be discharged from a point source into navigable *waters of the U.S.* without a NPDES permit. The NPDES program applies only to *waters of the U.S.* or to water bodies that are tributary to *waters of the U.S.*[10] In the Antelope Valley, where District No. 20 is located, there are no *waters of the U.S.*, or tributaries thereto. Thus, an NPDES permit would not be required for discharging recycled water to spreading basins or into injection wells recharging the aquifer in the Antelope Valley.

### SAFE DRINKING WATER ACT

Under the Safe Drinking Water Act's Underground Injection Control (UIC) Program, the EPA regulates the injection of fluids into underground formations, including aquifers, septic systems, and cesspools. The purpose of the UIC Program is to protect the quality of underground sources of drinking water. Injection wells are classified into five categories. Wells that inject recycled water into or above underground sources of drinking water are considered Class V wells. Owners and operators of Class V wells must provide documentation (location, legal contact, nature of the activity, etc.) to their State UIC

[10] Personal communication, Jau Ren Chen, RWQCB, Los Angeles Region, 11/24/04, (213) 576-6656.

authority. A UIC permit and documentation would be required for injection wells used for a GRRP. In California, the UIC Program is a joint state-federal program.

## WATER RIGHTS

In California, landowners have the right to extract as much groundwater as they can put to beneficial use. Groundwater management is not the responsibility of the State, but rather of local agencies as authorized by the California Water Code (Water Code §10750 et seq.). Multiple acceptable methods for managing groundwater have been developed, such as adjudicated basins,[11] AB 3030 management plans (Water Code §10753), local county groundwater ordinances, and special acts districts.[12] The Antelope Valley is not an adjudicated basin, and has not adopted any special statutes to guide groundwater management. As a result, two management methods apply in the basin:

1. Overlying rights allow owners of property above a groundwater source to build a well and extract their correlative share of water. The share is not explicitly defined until a basin is adjudicated or managed in some other manner.
2. Local agencies, such as sanitation districts, water authorities, water districts, and conservation districts, are authorized by statute to develop original groundwater management plans.

Conditions of uncertainty about allocated water rights have, to date, contributed to the reluctance to establish a GRRP in the Antelope Valley. Local agencies can only manage groundwater in their own service area, and without allocated water rights, there is little financial incentive for water agencies to fund the recharge of a groundwater supply that is hard to control and can be appropriated by anyone. Currently, non-adjudicated groundwater is the least expensive source of potable water in the Antelope Valley, even if unsustainable usage threatens to increase future costs due to uncertainty.

## SUCCESSFUL GRRPS

Non-potable reuse of recycled water for landscape irrigation and agricultural irrigation have been widely accepted by the public. In California, potable water supplies have intentionally been replenished with recycled water since the 1960s. Groundwater aquifers used for potable supply have been recharged from percolation ponds containing recycled water since 1962 at Montebello Forebay using recycled water produced by the Districts' Whittier Narrows WRP and from injection of recycled water since 1976 by

[11] Overlying landowners and appropriators often turn to the courts to settle disputes over groundwater rights. In an adjudicated basin, the courts determine an equitable distribution of groundwater among property owners and appropriators.

[12] For a summary of all methods of groundwater management, see California Department of Water Resources, Groundwater Management's web site: http://www.groundwater.water.ca.gov/water_laws/index.cfm.

Water Factory 21 in Orange County (California Department of Water Resources, 2003b). Nevertheless, using recycled water to indirectly or directly replenish potable water supplies remains controversial. Current and planned groundwater recharge projects that utilize recycled water are described below and summarized in **Table 1**. **Attachment A** includes a list prepared by SWRCB of treatment facilities producing recycled water as of 2002 in the State of California.

**TABLE 1**
**SUMMARY OF INDIRECT POTABLE RECHARGE PROJECTS (GRRPS AND OTHERS) IN CALIFORNIA**

| Project | Approval Date | Operational Date (Projected) | Recycled water usage | Terminated |
|---|---|---|---|---|
| **Successfully Operational** | | | | |
| LACDPW Seawater Barrier Improvement Program | | | | |
| West Coast Basin | | 1953 | 1995 | |
| Dominguez Gap | | 1971 | a | |
| Alamitos Gap | | 1966 | b | |
| Montebello Forebay Groundwater Recharge Project | | 1937 | 1962 | |
| OCWD Water Factory 21 | | 1976 | 1976 | 2004[c] |
| **Planned** | | | | |
| OCWD Groundwater Replenishment System | 1999 | (2007) | | |
| Chino Basin Recycled Water Groundwater Recharge Project | 2005 | (2005) | | |
| **Unsuccessful** | | | | |
| San Gabriel Valley Groundwater Recharge Project (GWRS) | | | | d |
| Dublin San Ramon Clean Water Revival Project | | | | 1998 |
| San Diego Water Repurification Project[e] | | | | 1999 |
| LADWP East Valley Water Reclamation Project | | | | 2000 |

Sources:
Inland Empire Utilities Agency, Recycled Water web site: http://www.ieua.org/Recycled/recharge.htm.
Orange County Water District, Groundwater Replenishment System web site: http://www.gwrsystem.com/.
Orange County Water District, Water Factory 21 web site: http://www.ocwd.com/_html/wf21.htm.
Los Angeles County Department of Public Works, Water Resources, Seawater Barriers web site: http://ladpw.org/wrd/barriers/.
Los Angeles County Department of Public Works, Water Resources, Spreading Grounds web site: http://ladpw.org/wrd/SpreadingGround/index.cfm.
Recycled Water Task Force. 2003. Better Public Involvement in the Recycled Water Decision Process. White Paper of the Public Information, Education, and Outreach Workgroup.

[a] Permitted for recycled water use; not being injected as of now.
[b] Awaiting RWQCB permit.
[c] New Interim Water Factory 21 is currently in operation and will continue to supply recycled water until the GWRS is completed.
[d] A RWQCB permit is still being sought.
[e] This is a reservoir augmentation project.

LACDPW Seawater Intrusion Barrier Program. In coastal areas where the subsurface saturation zone for saltwater is close to the boundary of freshwater aquifers, excessive pumping of groundwater can result in

seawater intrusion that impacts groundwater used for potable water supplies. Potable water or a combination of recycled and potable water is injected into groundwater basins near the interface with the saltwater zone in order to prevent the intrusion of seawater. The injected water creates a subsurface mound that acts as a hydraulic barrier between the saltwater and the freshwater aquifers. Typically, some of the injected water flows inland into portions of the aquifer where water is withdrawn for potable purposes. When recycled water is used, this results in indirect potable reuse.

The WRD is the regional groundwater management agency for the Central and West Coast groundwater basins in Los Angeles County. Seawater intrusion is a problem in both basins. Both groundwater basins are adjudicated. LACDPW owns and operates three seawater barriers that protect the basins: Alamitos barrier, Dominguez Gap barrier, and West Coast Basin (WCB) barrier. LACDPW works cooperatively with the WRD, which purchases water for injection into the barriers. WRD purchases imported water from the Metropolitan Water District (MWD) and recycled water treated by reverse osmosis by the West Coast Municipal Water District at their facilities located on the site of the City of Los Angeles' Hyperion Treatment Plant. Injection of recycled water into the WCB barrier began in 1995. Although recycled water use at two of the three barriers is permitted, while the third barrier anticipates receiving a RWQCB permit to use recycled water, only imported water is currently injected into the Alamitos and Dominguez Gap barriers (LACDPW, 1998, 1999, 2000, 2001, 2002, 2003).

Montebello Forebay Groundwater Recharge Project. The Montebello Forebay Groundwater Replenishment Project is located within the Central Groundwater Basin in Los Angeles County California, where the Districts' recycled water, blended with imported river water (Colorado River and State Project water) and local storm runoff, had been used for replenishment since 1962. The project is managed by the Water Replenishment District of Southern California (WRD) and is operated by the Los Angeles County Department of Public Works. The Central Groundwater Basin is adjudicated; there are 85 active groundwater agencies operating over 400 active wells in this basin. Water is percolated into the groundwater using two sets of spreading grounds: (1) the Rio Hondo Spreading Grounds that consist of 570 acres with 20 individual basins and (2) the San Gabriel River Spreading Grounds that consist of 128 acres with 3 individual basins and portions of the river. The spreading basins are operated under a wetting/drying cycle designed to optimize inflow and discourage the development of vectors. From 1962 to 1977, the water used for replenishment was disinfected secondary effluent. Filtration (dual-media or mono-media) was added later to enhance virus inactivation during final disinfection. Based on the results of the Health Effects Study (Nellor *et al.,* 1984) and recommendations of the Scientific Advisory Panel (State of California, 1987), authorization was given by the RWQCB in 1987 to increase the annual quantity of recycled water used for replenishment from 32,700 AFY to 50,000 AFY. In 1991, the water

reclamation requirements for the project were revised to allow for recharge up to 60,000 AFY and 50 percent recycled water in any one year as long as the running three-year total did not exceed 150,000 AF per year or 35 percent recycled water. The average amount of recycled water spread each year is about 50,000 AFY. Continued evaluation of the project is being provided by an extensive sampling and monitoring program, and by supplemental research projects pertaining to percolation effects, epidemiology, and microbiology.

OCWD Water Factory 21 and Groundwater Replenishment System. The Orange County groundwater basin supplies 75 percent of the Orange County Water District's (OCWD's) total water demand. OCWD has managed this water basin since its formation in 1933. OCWD's groundwater injection system utilized recycled water from Water Factory 21 to prevent seawater intrusion into the basin until the Interim Water Factory 21 for the Groundwater Replenishment System (GWRS), producing 5 million gallons per day (mgd) of recycled water, was put in service in 2004. Orange County Sanitation District (OCSD) supplies secondary-treated effluent to Interim Water Factory 21, where it is further treated by microfiltration, reverse osmosis, and an advanced oxidation process (AOP). The AOP process includes the addition of hydrogen peroxide prior to UV disinfection. The recycled water is injected into the basin to prevent seawater intrusion; a high percentage of the injected water flows inland to replenish the aquifer, which is used for potable water supplies. This system has been replenishing potable water supplies since 1976, when blended recycled water was first injected into the coastal barrier.

## PROJECTS NOT YET FULLY OPERATIONAL

OCWD/OCSD GWRS. A joint project by OCWD and OCSD, the GWRS has multiple objectives: (1) expansion of the saltwater intrusion barrier; (2) replenishment of potable groundwater supplies; and (3) postponement of construction of an additional effluent outfall into the ocean. The GWRS will employ advanced treatment processes, consisting of microfiltration followed by reverse osmosis and advanced oxidation. This project is currently under construction and is scheduled to be operational in 2007. The environmental review documents were approved in 1999, the final design was approved by OCWD and OCSD in 2001, and the RWQCB, Santa Ana Region, adopted WRRs for the project in 2004. The first phase will use 78,000 AFY, with a total capacity of 140,000 AFY.

A portion of the GWRS recycled water will be pumped about 14 miles along the Santa Ana River to spreading basins in the Anaheim area where water will percolate into the Orange County groundwater

basin. Construction updates, extensive history, and explanations of the project can be found on the GWRS web site.[13]

Chino Basin Recycled Water Groundwater Project. Community leaders and agencies in the Chino groundwater basin, which is adjudicated, have developed an integrated water supply plan to meet future demands for water, which includes using recycled water to recharge the groundwater basin. The Recycled Water Groundwater Project (formerly referred to as the Ely Basins project) is sponsored by the Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster, Chino Basin Water Conservation District, and San Bernardino County Flood Control District. Storm water will be blended with recycled water and used at 20 recharge sites. The Ely recharge basin has served as a pilot project since their operation was restarted in 1999, when IEUA began delivering recycled water from Regional Plant No. 1 at a rate of 5.4 acre-feet per day. Currently the Ely basin recharges 500 AFY of recycled water to the Chino groundwater basin, and it will increase to 2,300 AFY. Chino Basin stakeholders approved the Recycled Water Groundwater Project in 2003, and Phase I is scheduled for implementation in 2005. All 20 recharge sites are expected to be built out over a period of ten years.

## UNSUCCESSFUL INDIRECT POTABLE REUSE PROJECTS

Proposals to use recycled water for potable purposes have, in some cases, received considerable public or political opposition in the last decade. As described by California's Recycled Water Task Force, failed projects illustrate the importance of public involvement in GRRP development and the general lack of public knowledge about water and wastewater issues (California Department of Water Resources, 2003a, 2003b). Particularly powerful, and damaging to the image of recycled water reuse, is the term, "Toilet to Tap," a phrase used frequently by parties opposing GRRPs to instill fear in citizens and generate emotionally-driven sentiments against potable reuse of recycled water.

San Gabriel Valley Groundwater Recharge Project. The initial concept for this indirect potable reuse project was developed during the 1987-1992 drought. The plan would have used tertiary-treated recycled water to recharge the Main San Gabriel Basin aquifer via surface spreading. Project opponents[14] were concerned that the spreading area's soils were not adequate to remove potential contaminants and took out full-page newspaper advertisements that claimed the project was "Toilet to Tap." After challenges by local businesses, the original project was withdrawn in 1997, and with the consent of local businesses was

[13] See GWRS web site: http://www.gwrsystem.com.

[14] The primary opponent was Miller Brewery, which would have utilized groundwater containing recycled water it its beer manufacturing process, and was concerned that this would have led to adverse rumor branding about its product.

proposed to be located in a site further downstream from the primary opponent. Work on the project is still underway, but no date is available for when it might be permitted and/or operational.

Dublin San Ramon Services District's Clean Water Revival Project. This project was developed in the mid-1990s by the Dublin San Ramon Services District (DSRSD) to reduce salt concentrations in the groundwater basin, and also to increase water supplies. Recycled water treated with microfiltration and reverse osmosis was proposed to be used as recharge. In 1998, "Toilet to Tap" headlines appeared in newspapers, causing widespread concern and opposition among citizens. Environmental groups campaigned against the project, stating that it also would encourage growth and provide water for new homes. Ultimately, a political decision was made not to permit this project. However, the system currently is used to produce recycled water for landscape irrigation in the area.

City of Los Angeles Department of Water and Power's East Valley Water Reclamation Project. This project, also developed during the 1987-1992 drought, planned to use tertiary-treated recycled water to recharge groundwater in the San Fernando Valley. After extensive public hearings in 1991 and 1995, newspaper articles in the *Los Angeles Times*, and public notification, the project was permitted and construction of a federally-funded distribution line commenced. The project was permitted to use up to 10,000 AFY (8.9 mgd) of recycled water in a blend containing 20 percent recycled water and 80 percent diluent water (combination of storm water and potable water). Then, in May 2000, after an initial startup test was conducted, an article in the *Daily News* appeared, announcing that a "Toilet to Tap" project was imminent and that the public had not been informed. Project opponents, once again, were concerned that tertiary treatment was not sufficient to protect groundwater from trace organic compounds. The project became a political issue in that year's local mayoral race, and a critical mass opposition ensued. The City of Los Angeles elected to withdraw the permit in April 2002. After spending $55 million on the project, additional costly changes to facilities were made to allow recycled effluent to be used only for landscape irrigation and industrial applications, which are currently being developed.

City of San Diego's Water Repurification Project. This project was conceived during the 1991-1992 drought. Instead of groundwater recharge, the City of San Diego planned to mix recycled water treated by microfiltration, reverse osmosis, and ultraviolet (UV) disinfection, with imported fresh water in a raw water storage reservoir. After at least a one-year detention time in this reservoir, the mixed water would have received conventional drinking water treatment prior to distribution as part of the domestic potable water supply. For five years, there was extensive research that included the operation of pilot treatment plants, public education, and outreach, such as interviews with residents, focus groups, fact sheets, television and newspaper articles, endorsements by scientific panels and citizen advisory panels, and taste

tests. However, in 1998, a combination of factors began to shed a negative light on the project. Imported water became less expensive; political campaigns made the project a controversial issue; and a statement about indirect potable reuse projects made in a National Research Council report[15] that suggested such projects be implemented only as a last resort was taken out of context. This resulted in a public hearing that attracted concerned citizens despite the fact that DHS supported the project. The meeting agenda cover-page contained the words "Toilet to Tap" in large letters. Ultimately, the County of San Diego's Science Advisory Board requested additional study related to public health issues, and the City of San Diego put the project on hold in 1999. The City is currently re-evaluating the feasibility of the project at the behest of local environmental groups.

## LOCAL WATER SUPPLY PLANNING

The Palmdale Water District (PWD) prepared an Urban Water Management Plan (UWMP) in December 2000 pursuant to the California Urban Water Planning Act as amended. The Act requires that all urban water purveyors with more than 3,000 service connections or water usage of 3,000 acre-feet annually prepare and submit an Urban Water Management Plan to the State Department of Water Resources. The UWMP reported the 2000 annual water demand at 26,280 acre-feet. This average annual water demand is estimated to increase to 45,400 acre-feet by the year 2020. The PWD gets its water supplies from surface water (Little Rock Reservoir), groundwater, and imported SWP water. The UWMP estimated a deficit of 3,696 acre-feet during an average year by 2020.

The UWMP acknowledges that the groundwater basin is in overdraft. In 1991, the Antelope Valley Water Resources Study recommended an action plan to minimize demand growth, protect and optimize the use of existing resources, and develop additional water resources.[16] The recommendations included establishing an institutional framework to manage the groundwater basin as well as developing alternative water sources, including the use of recycled water. The UWMP states that recycled water is being considered for use in groundwater recharge and landscape irrigation applications. However, the UWMP does not identify how reclamation projects would be implemented or how they would ultimately affect the region's future water balance.

The groundwater basin in its current state is identified as a public services constraint in the City of Palmdale General Plan, prepared in 1993.[17] The General Plan states that additional measures to import

[15] National Research Council. 1998. Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water. Committee to Evaluate the Viability of Augmenting Potable Water Supplies With Reclaimed Water. Washington D.C., National Academy of Sciences.
[16] PWD UWMP, 2000
[17] City of Palmdale General Plan, 1993

and conserve potable water may be necessary to ensure an adequate and reliable water supply. The Environmental Impact Report (EIR) prepared for the General Plan identifies inadequate water supplies as a significant impact of development as described in the General Plan. Mitigation measures identified in the EIR would minimize the impact to less than significant levels. The EIR states that a local ordinance, requiring water availability assessments as conditions of approval for new development, would ensure that water supply would not pose a significant impact to the General Plan. The General Plan does not propose groundwater recharge with recycled water; however, it does support water recycling as a matter of public policy. Policy PS2.2.6 states, "Work with the Sanitation District to identify users for reclaimed water and support plans for its treatment and distribution."

## CONSTRAINTS TO IMPLEMENTING A GRRP IN THE ANTELOPE VALLEY

Creating a new drinking water source is not a mandate of District No. 20 or an objective of the Palmdale WRP 2025 Facilities Plan (2025 Plan). Although a sanitation district may institute a groundwater recharge project solely as a means of managing effluent, these projects are typically conceived in concert with water supply utilities, as previously discussed, to provide additional water resources in areas where groundwater basins are adjudicated or subject to management plans. In evaluating these projects, other factors need to be considered such as the operational costs of providing the additional treatment and complying with the additional regulatory requirements, which typically are substantially greater than other effluent management alternatives. It would also require a significantly longer period of time to implement. **Attachment A** includes a list of the treatment facilities that produced recycled water in the State of California in 2002, as determined by SWRCB. The list includes 277 facilities and indicates the application or use of the recycled water produced at each treatment plant. The vast majority of treatment plants produce recycled water for agricultural irrigation. Recycled water from only five plants is used for planned groundwater recharge. Three of the five plants are operated by the Districts and produce recycled water for the Montebello Forebay Groundwater Recharge Project.

There may be few successful GRRPs in California due to constraints involving institutional considerations, technical considerations, and public opposition. The following steps would be necessary for District No. 20 to develop a successful GRRP in the Antelope Valley:

- Negotiate a cost-sharing partnership with an overlying water district(s);
- Ensure recovery of recharged treated water in a non-adjudicated basin;
- Obtain public acceptance; and
- Address technical challenges.

The following sections evaluate the potential constraints identified with the proposed GRRP alternative.

## PARTNERSHIP WITH OVERLYING WATER DISTRICT

A GRRP would only be feasible if other stakeholders in the region participated in the project, sharing costs and responsibilities associated with augmenting and managing a drinking water source. The costs of implementing a GRRP would exceed other effluent management alternatives. The Districts can sell treated water to a water district (or water purveyor), therefore the cost of treating the water and operating spreading basins can be recouped to some extent. The Districts' current recycled water pricing policy is to recoup some or all of the O&M costs associated with producing the recycled water to meet WDR and WRR requirements and compatible water reuse activities. The actual charge for recycled water factors in the users recycled water project costs and whatever cost savings are realized by the user as a result of using recycled water. The Districts set the recycled water cost at one half of the total savings by the project owner/user. However, the Districts maintain a price floor and ceiling for recycled water costs. For example, the price of recycled water would never exceed 100 percent of the operation and maintenance (O&M) costs incurred by the Districts to produce the recycled water. Also, the minimum price for recycled water is set at 30 percent of the Districts' O&M costs. The party contracting for the recycled water can roll over project losses (including capital) until all project costs are recovered. During periods of project losses, the price of recycled water would be set at the 30 percent O&M price floor. The Districts guarantee that the quality of the recycled water meets all existing WDRs, WRRs and compatible reuse requirements. If the level of reuse desired by the users requires a higher level of treatment, the project owner (contracting parties such as water district/purveyor) is responsible for all added capital and O&M costs.

The PWD identified in their UWMP that groundwater recharge could potentially augment water supplies in the region. However, a recycled water recharge project may not make fiscal sense while groundwater is otherwise available free of charge in a groundwater basin without a management plan of some type. In an unmanaged basin, anyone operating a groundwater recharge project is not guaranteed that they will be able to pump out the water they put in because the groundwater is available to any overlying landowner who can put it to good use. The UWMP indicates that overdrafting the groundwater basin without a Groundwater Management Plan (GMP) should not be a long-term solution.[18] However, until the groundwater basin is managed in some way, it is not in the interests of the PWD or any other water purveyor to initiate a GRRP to prevent overdraft conditions.

[18] PWD UWMP (page 26)

## ENSURE RECOVERY OF RECHARGED WATER

A critical component of the project's feasibility would be to provide assurance that water recharged into the ground at considerable expense would be recoverable. The basin is not currently adjudicated, and under California law, overlying land owners have water rights to groundwater under their property. A water district would unlikely be willing to participate in a GRRP without assurances that they would be able to construct a production system that would capture the recharged water or otherwise maintain a water balance. This would be a principal consideration in siting recharge facilities and designing extraction facilities. Without such assurances, the water district would essentially be providing a new water source at no cost to other water users, and there would be little financial incentive for water agencies to fund the recharge of a groundwater supply that is hard to control and can be appropriated by anyone. Other users would be free to pump water for beneficial uses, such as agriculture, drinking, etc.

## PUBLIC ACCEPTANCE

The partnership participants would have to ensure that the project was acceptable to the public early on in the planning process and throughout its implementation. Inadequate public outreach and participation could pose significant constraints in implementing the project. Learning from failed projects, even if a GRRP appears to be publicly accepted, support can be turned to disapproval quickly and easily by opposition campaigns and the "Toilet to Tap" label even after a project has been approved and permitted. If there is significant opposition to a GRRP in the Antelope Valley, the project may not get past the initial planning phases. From indications of the current public outreach program for the 2025 Plan, recharging the groundwater with recycled water treated to at least a tertiary level appears to be favored, yet additional evaluation is needed to determine if that support can be maintained and a project effectuated.

A public education program would need to be developed to ensure that citizens understand water supply, water quality, and recycled water treatment processes and issues in the Antelope Valley. This public outreach and participation program would continue from project inception to implementation and thereafter. An educated populace can engage in knowledgeable discussions and critically evaluate a GRRP's value. The heightened interest and controversy surrounding potable water availability for new housing developments has started the educational process. Strategies that have been used to secure public support for other projects include the following:

- Provide information to environmental organizations, community groups, and media outlets about the project; ask for feedback early and address concerns;
- Conduct focus groups and interviews with local residents;
- Establish a citizens advisory group to review the project;

- Establish a telephone information line and web site; and
- Form an independent panel of scientists to objectively review the project.

TECHNICAL CHALLENGES

In order to obtain a permit for a project, an Engineering Report would have to be developed and approved by DHS and the RWQCB. The Engineering Report must address multiple requirements and is technically challenging to prepare. Both an engineer and a geologist registered in California with experience in wastewater treatment and hydrogeology, respectively, are required for report preparation. According to the draft DHS groundwater recharge regulations:

> "The engineering report shall consist of a comprehensive investigation and evaluation of the GRRP, impacts on the existing and potential uses of the impacted groundwater basin, and the proposed means for achieving compliance with sections 60320.010 through 60320.050 and sections 60325 through 60355."

An operations plan must also be prepared and included with the Engineering Report. The Engineering Report must consist of a comprehensive investigation and evaluation of the GRRP and include information such as an engineering plan of the proposed facilities, quantitative descriptions of the aquifer transmissivity, groundwater movement, historic depth-to-groundwater, safe yield of the basin, influence of localized pumping, and usable storage capacity of the groundwater basin. In order to prepare an Engineering Report, field studies, laboratory work, soil column studies, groundwater modeling, design work, etc., would be necessary. In addition, the DHS draft groundwater recharge criteria require one year of recycled water monitoring data for an extensive list of constituents, including TOC, total coliforms, total nitrogen, drinking water MCLs, unregulated chemicals, and priority pollutants.

To meet DHS draft groundwater recharge criteria, several other technical challenges would need to be resolved. These challenges are summarized below:

- Identify a source of diluent water from a non-wastewater source to meet the DHS dilution requirements, which could be difficult in an area where water supplies are already tight;
- For surface spreading projects, identify recharge sites with vadose zones that could provide additional treatment during water percolation; and
- Establish contingency provisions for effluent disposal if the recycled water quality exceeds any water quality limits or causes a problem in the aquifer.

The preparation of the Engineering Report and the permitting process would be extensive and could take up to ten years to complete before the full-scale project could be implemented. As a first step, District No. 20 would have to identify the project and begin the California Environmental Quality Act (CEQA) process. At the same time, work on the Engineering Report would have to begin. Once the CEQA process was completed, it would be necessary to complete and submit the Engineering Report to the DHS and RWQCB. The Engineering Report would have to address all of the requirements in the most recent version of the DHS draft groundwater recharge criteria. Pending completion of the Engineering Report, DHS would hold a public hearing and issue Findings of Fact and Conditions that are needed to assure health protection. DHS would then submit the Findings of Fact and Conditions to the RWQCB. The RWQCB would hold a public hearing and then issue WRRs for the project based on the Findings of Fact and Conditions, and any other requirements deemed appropriate to protect beneficial uses of the groundwater.

The 2025 Plan will recommend construction of facilities to provide tertiary treated water. However, reverse osmosis and microfiltration required by DHS for injection of recycled water are not currently included as part of the recommended project. Thus, injection well recharge projects are unlikely in Antelope Valley in the near future. However, tertiary treated water may be acceptable for use in a surface water recharge project.

## IMPLEMENTING A FULL SCALE PROJECT

Assuming that funding is available and one or more water districts agree to partner with District No. 20, implementing a full-scale project would likely take at least 10 years. **Figure 1** summarizes a conceptual schedule. Implementation of the project would require the following steps:

- Obtain Stakeholder Agreement
- Develop Concept Plan
- Begin Public Education Program
- Conduct CEQA Analysis
- Acquire Property
- Develop Engineering Report
  --perform groundwater modeling
  --conduct site screening analysis
  --collect and test recycled water samples for required constituents
  --prepare engineering design plans
  --conduct field studies to determine quantitative values for soil column and groundwater
  --conduct quantitative and qualitative characterizations of potential diluent water sources
  --monitoring well plan
  --groundwater monitoring plan
  --operations plan

- Obtain Permits
- Obtain Funding
- Construct and Implement Full Scale Project

The schedule might be expedited with support from local elected officials, full support of the public, and full support of a partnering water district. The schedule could experience temporary delay or complete termination if no water districts are interested in partnering, public acceptance is low, or local elected officials are not fully supportive. In addition, the permitting process with the DHS and RWQCB-LR could take longer than shown in the schedule depending on the level of data needed to ensure the project would be protective of public health and groundwater quality. Finally, if the groundwater basin in the Antelope Valley undergoes an adjudication process in the future, a groundwater recharge project might become viable to implement because groundwater could no longer be pumped at uncontrolled rates from the basin and would become expensive and scarce. However, the time required to adjudicate the groundwater basin is unknown.

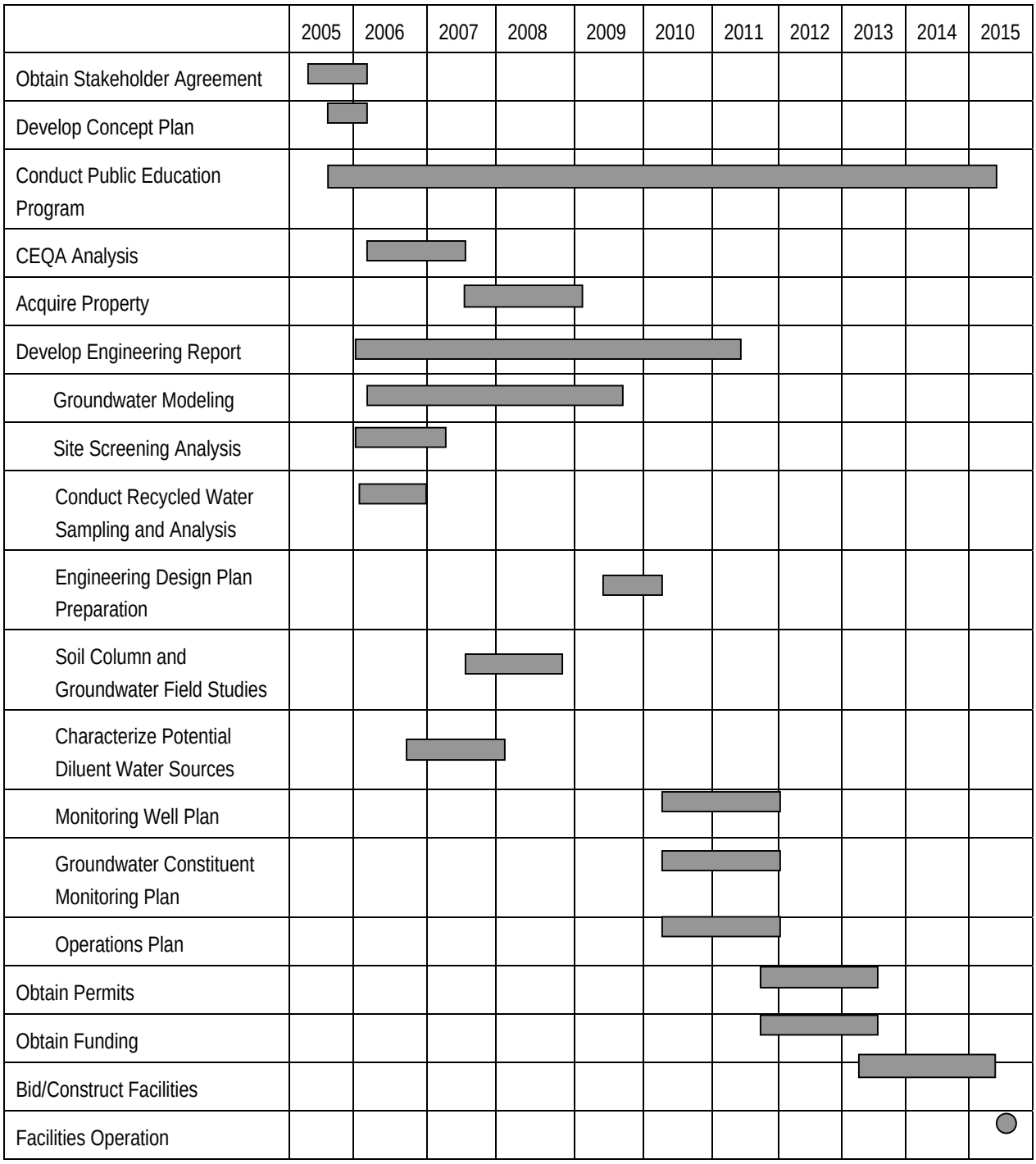
## SUMMARY

In summary, the State considers the use of recycled water to be a priority as California searches for ways of meeting increasing water demand. One method of reusing recycled water is by groundwater recharge. A key component of a successful GRRP requires a partnership between stakeholders, including District No. 20 and at least one interested water agency. Implementing a recharge project without a partnership of stakeholders would be difficult due to financial constraints, political considerations, and public outreach requirements. Even with a committed partnership of stakeholders, implementing a GRRP would likely take at least ten years. Public outreach and education would be essential throughout the process.

Some GRRPs have experienced setbacks in the past decade throughout California due to public or political opposition. However, the concept remains a state priority supported by the SWRCB, and two projects have recently been approved in southern California. As water supplies become more difficult to obtain in the Antelope Valley, a GRRP project may provide a cost-effective solution supported by the public and local officials.

Figure 1

**Concept Schedule for Implementation of Full Scale Recycled Water Groundwater Recharge Project**



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# ATTACHMENT A

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, OFFICE OF WATER RECYCLING, 2002 STATEWIDE RECYCLED WATER SURVEY

California State Water Resources Control Board
Office of Water Recycling

# 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| **Region: 1 - North Coast Regional Water Quality Control Board** | | | | | | **17346 Acre-Feet/Year** | |
| *County:Del Norte* | | | | | | | |
| Best Western Ship Ashore Motel | Facility: | *Ship Ashore STP* | 0.07 | 0.03 | Agricultural Irrigation | 34.0 | 2001 |
| California Department of Corrections | Facility: | *Pelican Bay State Prison WTP* | 3 | 0.7 | Landscape Irrigation | 310.0 | 2001 |
| *County:Humboldt* | | | | | | | |
| Arcata, City of | Facility: | *Arcata WTP* | 2.3 | 2 | Wildlife Habitat or Misc. Enhancement | 1855.0 | 2001 |
| Ferndale, City of | Facility: | *Ferndale WTP* | 1.5 | 0.23 | Agricultural Irrigation | 97.0 | 2001 |
| McKinleyville CSD | Facility: | *McKinleyville WMF* | 1.2 | 0.98 | Agricultural Irrigation | 70.0 | 2001 |
| *County:Mendocino* | | | | | | | |
| Gualala CSD | Facility: | *Gualala WTP* | 0.29 | 0.09 | Landscape Irrigation | 95.0 | 2001 |
| Westport CWD | Facility: | *Westport TP* | 0.02 | 0.01 | Agricultural Irrigation | 12.0 | 2001 |
| Willits, City of | Facility: | *Willits WQCP* | 1.3 | 0.86 | Agricultural Irrigation | 347.0 | 2001 |
| *County:Siskiyou* | | | | | | | |
| Montague, City of | Facility: | *Montague STP* | 0.23 | 0.07 | Agricultural Irrigation | 116.0 | 2001 |
| Weed, City of | Facility: | *Weed WQCF - Shastina System* | 0.38 | 0.21 | Agricultural Irrigation | 153.0 | 2001 |
| Weed, City of | Facility: | *Weed WQCF - Weed System* | 0.25 | 0.17 | Agricultural Irrigation | 153.0 | 2001 |
| *County:Sonoma* | | | | | | | |
| Bodega Bay Public Utility District | Facility: | *Bodega Bay STP* | 0.38 | 0.17 | Landscape Irrigation | 155.0 | 2001 |
| Santa Rosa, City of | Facility: | *Laguna Subregional TP* | 19.2 | 17.5 | Agricultural Irrigation | 10520.0 | 2001 |
| | | | | | Landscape Irrigation | 1651.0 | |
| Sonoma County Water Agency | Facility: | *Airport WTP* | 0.72 | 0.66 | Agricultural Irrigation | 550.0 | 2001 |
| Sonoma County Water Agency | Facility: | *Forestville WTP* | 0.1 | 0.05 | Agricultural Irrigation | 21.0 | 2001 |
| Sonoma County Water Agency | Facility: | *Graton WTP* | 0.14 | 0.07 | Agricultural Irrigation | 27.0 | 2001 |
| Sonoma County Water Agency | Facility: | *Occidental WTP* | 0.05 | 0.02 | Agricultural Irrigation | 6.0 | 2001 |
| Sonoma County Water Agency | Facility: | *Russian River WTP* | 0.51 | 0.36 | Landscape Irrigation | 46.0 | 2001 |
| | | | | | Wildlife Habitat or Misc. Enhancement | 122.0 | |
| Windsor Water District | Facility: | *Windsor STP* | 1.5 | 1.47 | Agricultural Irrigation | 588.0 | 2001 |
| | | | | | Landscape Irrigation | 418.0 | |
| **Region: 2 - San Francisco Bay Regional Water Quality Control Board** | | | | | | **40370 Acre-Feet/Year** | |
| *County:* | | | | | | | |
| Delta Diablo Sanitation District | Facility: | *Recycled Water Facility* | 5 | 1 | Industrial | 1172.0 | 2001 |
| East Bay Dischargers Authority | Facility: | *San Leandro Water Pollution Control Plant* | 1 | 0.1 | Landscape Irrigation | 403.0 | 2001 |
| *County:Alameda* | | | | | | | |
| Dublin San Ramon Services District | Facility: | *Wastewater Treatment Facility* | 3 | 0.14 | Landscape Irrigation | 158.0 | 2001 |
| Livermore, City of | Facility: | *Livermore WRP* | 6.25 | 0.17 | Landscape Irrigation | 617.0 | 2001 |
| Oro Loma/Castro Valley | Facility: | *Oro Loma/Castro Valley WTP* | 20 | 0.08 | Landscape Irrigation | 159.6 | 1987 |
| Union Sanitary District | Facility: | *Raymond A. Boege Alvarado WTF* | 35 | 1.84 | Wastewater Treatment Plant | 1535.0 | 2001 |
| | | | | | Wildlife Habitat or Misc. Enhancement | 3954.0 | |

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| *County:Contra Costa* | | | | | | | |
| Central Contra Costa Sanitary District | Facility: | *Central Contra Costa SD WTP* | 30 | 1.5 | Landscape Irrigation | 500.0 | 2001 |
| | | | | | Wastewater Treatment Plant | 1121.0 | |
| | | | | | Industrial | 31.0 | |
| East Bay MUD | Facility: | *North Richmond WRP* | 5.2 | 1.25 | Landscape Irrigation | 644.0 | 2001 |
| | | | | | Wastewater Treatment Plant | 2129.0 | |
| | | | | | Industrial | 3223.0 | |
| Mt. View SD | Facility: | *Mt. View Wastewater Treatment Plant* | 2.4 | 1 | Wildlife Habitat or Misc. Enhancement | 2244.0 | 2001 |
| West County Wastewater District | Facility: | *West County Wastewater District WTP* | 12.5 | 0.08 | Landscape Irrigation | 150.1 | 1987 |
| *County:Marin* | | | | | | | |
| Las Gallinas Valley Sanitary District | Facility: | *Las Gallinas Valley SD WTP* | 2.9 | 0.18 | Agricultural Irrigation | 377.6 | 1987 |
| Marin Municipal Water District | Facility: | *Las Gallinas Valley Recyling Plant (Marin MWD)* | 2 | 0.41 | Landscape Irrigation | 852.6 | 1987 |
| | | | | | Industrial | 14.0 | |
| | | | | | Other or Mixed Types | 19.6 | |
| Novato Sanitary District | Facility: | *Ignacio Treatment Plant* | 2.02 | 0.33 | Agricultural Irrigation | 1082.0 | 2001 |
| Novato Sanitation District | Facility: | *Novato Treatment Plant* | 4.53 | 0.76 | Agricultural Irrigation | 2164.0 | 2001 |
| *County:Napa* | | | | | | | |
| City of Calistoga Public Works Center | Facility: | *Dunaweal WTP (City of Calistoga)* | 1 | 0.5 | Landscape Irrigation | 442.0 | 2001 |
| Meadowood Resort Hotel | Facility: | *Meadowood Resort Hotel STP* | 0.01 | 0.01 | Landscape Irrigation | 22.0 | 1987 |
| Pacific Union College | Facility: | *Pacific Union College STP* | 0.2 | 0.1 | Agricultural Irrigation | 214.3 | 1987 |
| St. Helena, City of | Facility: | *St. Helena WTP* | 1 | 0.2 | Agricultural Irrigation | 432.0 | 2001 |
| Town of Yountville | Facility: | *Yountville/CA Veterans Home Joint WTF* | 2 | 0.11 | Agricultural Irrigation | 183.0 | 2001 |
| *County:San Francisco* | | | | | | | |
| Bureau of Water Pollution Control | Facility: | *Southeast Water Pollution Control Plant* | 85 | 5.4 | Wastewater Treatment Plant | 6066.0 | 2001 |
| *County:Santa Clara* | | | | | | | |
| Palo Alto, City of | Facility: | *Palo Alto Regional WRP* | 4 | 0.1 | Landscape Irrigation | 148.2 | 1987 |
| San Jose, City of | Facility: | *San Jose/Santa Clara Water Pollution Control Plant* | 50 | 10 | Agricultural Irrigation | 88.0 | 2001 |
| | | | | | Landscape Irrigation | 5395.0 | |
| | | | | | Industrial | 425.0 | |
| | | | | | Other or Mixed Types | 5.0 | |
| Sunnyvale, City of | Facility: | *Sunnyvale Water Pollution Plant* | 29.5 | 0.1 | Landscape Irrigation | 341.0 | 2001 |
| *County:Solano* | | | | | | | |
| Fairfield-Suisun Sewer District | Facility: | *Fairfield-Suisun Wastewater Treatment Plant* | 17.5 | 3 | Agricultural Irrigation | 1842.0 | 2001 |
| *County:Sonoma* | | | | | | | |
| U.S. Filter | Facility: | *Petaluma WWTP* | 5.2 | 1.3 | Agricultural Irrigation | 1935.0 | 2001 |
| | | | | | Landscape Irrigation | 281.0 | |

**Region: 3 - Central Coast Regional Water Quality Control Board** **25295 Acre-Feet/Year**

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| *County:Monterey* | | | | | | | |
| Canada Woods Water Reclamation Facility | Facility: | *Canada Woods WRF* | 0.1 | 0.01 | Landscape Irrigation | 10.8 | 2001 |
| Carmel Area Wastewater District | Facility: | *Carmel TP* | 1.8 | 0.97 | Landscape Irrigation | 629.2 | 2001 |
| Carmel Lahaina Utility Services, Inc. | Facility: | *Santa Lucia Preserve WRF* | 0.1 | 0.005 | Wildlife Habitat or Misc. Enhancement | 5.5 | 2001 |
| Carmel Valley CSD | Facility: | *Carmel Valley CSD* | 0.1 | 0.043 | Landscape Irrigation | 48.5 | 2001 |
| Dole Fresh Vegetables, Inc. | Facility: | *Dole Fresh Vegetables, Inc.* | 0.5 | 0.47 | Agricultural Irrigation | 523.0 | 2001 |
| Kendall-Jackson Winery | Facility: | *Kendall-Jackson Winery* | 0.087 | 0.035 | Agricultural Irrigation | 38.9 | 2001 |
| Monterey Regional Water Pollution Control | Facility: | *Monterey Reg WTP* | 29.6 | 10.2 | Agricultural Irrigation | 12278.0 | 2001 |
| Watertek, Inc. | Facility: | *Indian Springs WTP* | 0.085 | 0.037 | Agricultural Irrigation | 41.5 | 2001 |
| *County:San Benito* | | | | | | | |
| Sunnyslope CWD | Facility: | *Ridgeway Estates WWTP* | 0.25 | 0.01 | Landscape Irrigation | 11.2 | |
| *County:San Luis Obispo* | | | | | | | |
| Cambria Community Services District | Facility: | *Cambria STP* | 1 | 0.386 | Agricultural Irrigation | 432.4 | |
| *County:San Mateo* | | | | | | | |
| Watertek, Inc. | Facility: | *Cascade WWF* | 0.022 | 0.005 | Agricultural Irrigation | 5.1 | 2001 |
| *County:Santa Barbara* | | | | | | | |
| Goleta SD | Facility: | *Goleta SD STP* | 3 | 1.06 | Landscape Irrigation | 714.0 | 2001 |
| Guadalupe, City of | Facility: | *Guadalupe WTP* | 0.96 | 0.36 | Agricultural Irrigation | 403.3 | 2001 |
| Laguna County Sanitation District | Facility: | *Laguna WRP* | 3.2 | 2.56 | Agricultural Irrigation | 2867.8 | 2001 |
| Mission Hills CSD | Facility: | *Mission Hills STP* | 0.57 | 0.205 | Agricultural Irrigation | 229.0 | 2001 |
| Santa Barbara - City Public Works Dept | Facility: | *El Estero WRF* | 4.3 | 1.8 | Landscape Irrigation | 103.4 | 2001 |
| Solvang, City of | Facility: | *Solvang WTP* | 1 | 0.92 | Agricultural Irrigation | 1033.8 | 2001 |
| U. S. Penitentiary | Facility: | *Lompoc STP* | 1.2 | 0.9 | Agricultural Irrigation | 1011.8 | 2001 |
| United Foods Inc. | Facility: | *Pictsweet Frozen Foods* | * | * | Agricultural Irrigation | 3163.0 | 2001 |
| *County:Santa Clara* | | | | | | | |
| OMI, Inc. | Facility: | *South County Regional WWTP* | 3 | 0.78 | Agricultural Irrigation | 64.4 | 2001 |
| | | | | | Landscape Irrigation | 571.1 | |
| *County:Santa Cruz* | | | | | | | |
| Ariel Mushroom Farm, Inc. | Facility: | *Ariel Mushroom Farm, Inc.* | 0.012 | 0.008 | Agricultural Irrigation | 9.0 | 2001 |
| Santa Cruz County Dept of Public Works | Facility: | *CSA No. 7 WRP* | 0.104 | 0.04 | Landscape Irrigation | 44.8 | |
| Santa Cruz County Dept of Public Works | Facility: | *Davenport CSD WWF* | 0.05 | 0.032 | Agricultural Irrigation | 7.7 | 2001 |
| | | | | | Industrial | 26.2 | |
| Scotts Valley, City of | Facility: | *Scotts Valley WTP* | 1.5 | 0.913 | Landscape Irrigation | 1019.4 | |
| Sunrise Mushroom Inc. | Facility: | *Sunrise Mushroom Inc.* | 0.008 | 0.002 | Agricultural Irrigation | 1.8 | 2001 |
| **Region: 4 - Los Angeles Regional Water Quality Control Board** | | | | | | **152962** | **Acre-Feet/Year** |
| *County:Los Angeles* | | | | | | | |
| Adamson Co. | Facility: | *Pt. Dume Club WRP* | * | * | Landscape Irrigation | 45.0 | 1987 |
| Burbank, City of | Facility: | *Burbank WRP, City of* | * | * | Landscape Irrigation | 447.0 | |
| | | | | | Geysers or Energy Production | 432.0 | |

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| Bureau of Sanitation, City of Los Angeles | Facility: | *Donald C. Tillman WRP* | 80 | 55 | Recreational Impoundment | 24429.0 | 2001 |
| | | | | | Wildlife Habitat or Misc. Enhancement | 6384.0 | |
| | | | | | Other or Mixed Types | 9974.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *La Cañada WRP* | * | * | Landscape Irrigation | 116.0 | 2001 |
| County Sanitation Districts of Los Angeles | Facility: | *Long Beach WRP* | 25 | 21 | Landscape Irrigation | 3265.0 | |
| | | | | | Geysers or Energy Production | 1062.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *Los Coyotes WRP* | 38 | 35 | Agricultural Irrigation | 18.0 | 2001 |
| | | | | | Landscape Irrigation | 4732.0 | |
| | | | | | Industrial | 571.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *Pomona WRP* | 13 | 10 | Agricultural Irrigation | 815.0 | |
| | | | | | Landscape Irrigation | 2269.0 | |
| | | | | | Industrial | 4921.0 | |
| | | | | | Groundwater Recharge | 3222.0 | |
| | | | | | Geysers or Energy Production | 35.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *San Jose Creek WRP* | 100 | 54 | Agricultural Irrigation | 150.0 | |
| | | | | | Landscape Irrigation | 2857.0 | |
| | | | | | Industrial | 250.0 | |
| | | | | | Groundwater Recharge | 34143.0 | |
| | | | | | Geysers or Energy Production | 592.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *Whittier Narrows WRP* | 15 | 8 | Landscape Irrigation | 71.0 | 2001 |
| | | | | | Groundwater Recharge | 8882.0 | |
| | | | | | Seawater Barrier | 3750.0 | |
| Dept. of Public Works, City of Los Angeles | Facility: | *Los Angeles-Glendale WRP* | * | * | Landscape Irrigation | 3606.0 | 2001 |
| | | | | | Geysers or Energy Production | 77.0 | |
| Las Virgenes Municipal Water District | Facility: | *Tapia WRP* | * | * | Landscape Irrigation | 5722.0 | 2001 |
| | | | | | Wastewater Treatment Plant | 628.0 | |
| | | | | | Wildlife Habitat or Misc. Enhancement | 53.0 | |
| Los Angeles Cnty Dept Public Works | Facility: | *Malibu Mesa WTF* | * | * | Landscape Irrigation | 142.0 | 2001 |
| West Basin MWD | Facility: | *West Basin WRP - RO System* | 8 | 6 | Seawater Barrier | 6901.0 | 2001 |
| West Basin MWD | Facility: | *West Basin WRP - Title 22 System* | * | * | Landscape Irrigation | 2497.0 | 2001 |
| | | | | | Industrial | 16634.0 | |
| *County:Ventura* | | | | | | | |
| Camarillo Sanitary District | Facility: | *Camarillo SD WRP* | * | * | Agricultural Irrigation | 1293.0 | 2001 |
| Camrosa Water District | Facility: | *Camrosa Water Reclamation Facility* | 2 | 1 | Agricultural Irrigation | 779.0 | 2001 |
| San Buenaventura, City of | Facility: | *San Buenaventura STP, City of* | * | * | Agricultural Irrigation | 583.0 | 2001 |
| | | | | | Landscape Irrigation | 460.0 | |
| Simi Valley, City of | Facility: | *Simi Valley Water Quality Control Facility* | * | * | Wastewater Treatment Plant | 18.0 | |
| | | | | | Other or Mixed Types | 23.0 | |
| Ventura Regional SD | Facility: | *Santa Paula WRF, (OMI)* | * | * | Agricultural Irrigation | 114.0 | 1987 |
| **Region: 5F - Central Valley (Fresno) Regional Water Quality Control Board** | | | | | | **110238 Acre-Feet/Year** | |
| *County:Fresno* | | | | | | | |
| California Department of Corrections | Facility: | *Pleasant Valley State Prison STP* | * | * | Agricultural Irrigation | 384.7 | 1987 |

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| Coalinga, City of | Facility: | *Coalinga WTP, City of* | * | 1.02 | Agricultural Irrigation | 1137.0 | 2001 |
| Coelho, AL JR | Facility: | *Coelho, AL JR* | * | 0.68 | Agricultural Irrigation | 760.6 | 2001 |
| Devine & Wood Farming | Facility: | *Devine & Wood Farming* | * | 0.67 | Agricultural Irrigation | 750.0 | 2001 |
| Freseno, County of | Facility: | *#47-Qual Lake WWTF* | 0.16 | 0.03 | Agricultural Irrigation | 37.4 | 2001 |
| Fresno, City of, Dept. of Public Utilities | Facility: | *Fresno-Clovis Regional Wastewater Recl. Facilities* | 80 | 2.33 | Agricultural Irrigation | 2608.1 | 2001 |
| Giacone, John | Facility: | *Reclamation-Coit Cotton Ginnin* | * | 0.01 | Agricultural Irrigation | 9.0 | 2001 |
| Golden State Vintners | Facility: | *Reclaimation Field* | * | 1.65 | Agricultural Irrigation | 1845.0 | 2001 |
| Mendota, City of | Facility: | *Mendota WTP, City of* | * | * | Agricultural Irrigation | 521.9 | 1987 |
| Orange Cove, City of | Facility: | *Orange Cove WTP, City of* | * | 0.14 | Agricultural Irrigation | 160.0 | 2001 |
| Parlier, City of | Facility: | *West Parlier WTP* | 2 | 0.27 | Agricultural Irrigation | 307.0 | 2001 |
| Peelman, Dolores Et Al | Facility: | *Peelman, Dolores Et Al Recycling Project* | * | 0.14 | Agricultural Irrigation | 159.0 | 2001 |
| Riverdale PUD | Facility: | *Riverdale PUD* | 0.25 | * | Agricultural Irrigation | 0.2 | 2001 |
| Selma-Kingsburg Fowler CSD | Facility: | *Selma-Kingsburg-Fowler CSD WTP* | * | * | Agricultural Irrigation | 324.1 | 1987 |
| Souza, Dan | Facility: | *Dan Souza Reclamation Site* | * | 1.58 | Agricultural Irrigation | 1772.0 | 2001 |
| Westhills Comm College Dist | Facility: | *Westhills Comm College Dist* | * | 1.02 | Agricultural Irrigation | 1137.0 | 2001 |
| *County:KERN* | | | | | | | |
| American Yeast Corporation | Facility: | *American Yeast Corporation* | 0.65 | 0.41 | Agricultural Irrigation | 460.3 | 2001 |
| Arvin County Sanitation District | Facility: | *Arvin CSD WTP* | * | 0.96 | Agricultural Irrigation | 1076.4 | 2001 |
| Bakersfield, City of | Facility: | *Bakersfield WTP No. 2, City of* | * | 16.33 | Agricultural Irrigation | 18288.1 | 2001 |
| Bakersfield, City of | Facility: | *Bakersfield WTP No. 3, City of* | * | 11.53 | Agricultural Irrigation | 12913.5 | 2001 |
| Bear Valley Comm Serv Dist | Facility: | *Bear Valley Comm Serv Dist STP* | * | 0.02 | Landscape Irrigation | 22.4 | 2001 |
| Buttonwillow CWD | Facility: | *Buttonwillow CWD* | * | 0.06 | Agricultural Irrigation | 70.6 | 2001 |
| California Department of Corrections | Facility: | *Tehachapi Correctional Institution* | 0.25 | 0.21 | Agricultural Irrigation | 239.3 | 2001 |
| California Department of Corrections | Facility: | *Wasco State Prison WTP* | 1 | 0.91 | Agricultural Irrigation | 1023.0 | 2001 |
| Delano, City of | Facility: | *Delano WTP, City of* | 4.4 | 4.3 | Agricultural Irrigation | 4817.4 | 2001 |
| I-5 Utility Company, INC | Facility: | *I-5 Utility Company, INC* | * | 0.13 | Agricultural Irrigation | 3.0 | 2001 |
| Kern County Waste Management | Facility: | *Kern Sanitation Authority WTP* | 7 | 3.98 | Agricultural Irrigation | 4455.4 | 2001 |
| Kern County Waste Management | Facility: | *Sheriff's Lerdo Facility WTP* | * | * | Agricultural Irrigation | 307.0 | 1987 |
| Lamont Public Utility District | Facility: | *Lamont PUD WTP* | 4.1 | 1.49 | Agricultural Irrigation | 1666.2 | 2001 |
| Los Angelas, City of | Facility: | *I-5 Reclamation Site* | 18 | 7.75 | Agricultural Irrigation | 8683.5 | 2001 |
| McFarland, City of | Facility: | *McFarland STP, City of* | * | * | Agricultural Irrigation | 560.3 | 1987 |
| Molica Farms | Facility: | *Molica Farms Recycling Project* | * | 3.66 | Agricultural Irrigation | 4100.0 | 2001 |
| North of River Sanitary District | Facility: | *North of River SD WTP* | * | * | Agricultural Irrigation | 3921.4 | 1987 |
| Shafter, City of | Facility: | *Shafter WTP, City of* | * | * | Agricultural Irrigation | 1568.8 | 1987 |
| Sills Properties | Facility: | *Sills Properties Reclamation Site* | 5.5 | 3.96 | Agricultural Irrigation | 4435.0 | 2001 |
| Stallion Springs Comm Serv Dist | Facility: | *Stallion Springs Comm Serv Dist WTP* | * | * | Landscape Irrigation | 18.4 | 1987 |
| Taft, City of | Facility: | *Taft Heights/Ford City SD Joint WTF (City of Taft)* | * | * | Agricultural Irrigation | 429.8 | 1987 |
| Wasco, City of | Facility: | *Wasco WTP, City of* | 1.95 | 1.55 | Agricultural Irrigation | 1740.0 | 2001 |

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| *County:Kings* | | | | | | | |
| California Department of Corrections | Facility: | *Avenal Effluent Storage Reservoir* | * | 0.66 | Agricultural Irrigation | 736.4 | 2001 |
| California Department of Corrections | Facility: | *California State Prison, Corcoran WTF* | * | * | Agricultural Irrigation | 1451.5 | 1987 |
| Corcoran, City of | Facility: | *Corcoran WTP, City of* | * | * | Agricultural Irrigation | 336.2 | 1987 |
| Hakker Brothers Farming | Facility: | *Hakker Brothers Farming Recycling Project* | * | 0.24 | Agricultural Irrigation | 268.0 | 2001 |
| Hanford, City of | Facility: | *Hanford WTP, City of* | * | * | Agricultural Irrigation | 3001.1 | 1987 |
| Kettleman, City of - CSD | Facility: | *Kettleman City CSD* | 0.22 | 0.22 | Agricultural Irrigation | 251.6 | 2001 |
| Lakeside irrigation Water CO | Facility: | *Lakeside Irrigation Water CO Master Reclamation Permit* | * | 1.28 | Agricultural Irrigation | 1428.0 | 2001 |
| Lemoore, City of | Facility: | *Lemoore WTF, City of* | * | * | Agricultural Irrigation | 2450.3 | 1987 |
| Ralph Alcala | Facility: | *Ralph Alcala* | * | 0.1 | Agricultural Irrigation | 111.3 | 2001 |
| | | | | | Recreational Impoundment | 111.3 | |
| W J Mouren Farming, INC | Facility: | *W J Mouren Farming, INC* | 1 | 0.1 | Agricultural Irrigation | 107.0 | 2001 |
| *County:Madera* | | | | | | | |
| California Department of Corrections | Facility: | *Central Calif Women's Facility STP* | 1.45 | 0.47 | Agricultural Irrigation | 526.0 | 2001 |
| Chowchilla, City of | Facility: | *Chowchilla WTP, City of* | * | * | Agricultural Irrigation | 43.3 | 1987 |
| County of Madera Engineering Dept. | Facility: | *Madera, County of, Goldside MD 27 WTP* | * | * | Landscape Irrigation | 39.3 | 1987 |
| Madera, City of | Facility: | *Madera WTP, City of* | 7 | 0.13 | Agricultural Irrigation | 141.2 | 2001 |
| Wildwood Mobile Home Park | Facility: | *Wildwood Mobile Home Park STP* | * | * | Agricultural Irrigation | 11.1 | 1987 |
| *County:Mariposa* | | | | | | | |
| Leonardi, Frank & Mariposa CO | Facility: | *Leonardi, Frank & Mariposa CO* | 0.065 | 0.01 | Agricultural Irrigation | 10.4 | 2001 |
| *County:Merced* | | | | | | | |
| Gustine, City of | Facility: | *City of Gustine WWTF* | 1.4 | 0.68 | Agricultural Irrigation | 757.8 | 2001 |
| Le Grand CSD | Facility: | *Le Grand CSD WWTF* | * | 0.16 | Agricultural Irrigation | 177.1 | 2001 |
| *County:TULARE* | | | | | | | |
| Clarkland Farms | Facility: | *Recycling Project NO. 1* | * | 1.79 | Agricultural Irrigation | 2000.0 | 2001 |
| Clarkland Farms | Facility: | *Recycling Project No. 2* | * | 0.47 | Agricultural Irrigation | 526.0 | 2001 |
| Cutler-Orosi Joint Powers Wastewater | Facility: | *Cutler-Orosi Joint Powers Wastewater Authority STP* | * | * | Agricultural Irrigation | 1352.8 | 1987 |
| Earlimart PUD | Facility: | *Earlimart PUD WWTF* | 0.6 | 0.32 | Agricultural Irrigation | 359.3 | 2001 |
| Exeter, City of | Facility: | *Exeter WTP, City of* | * | * | Agricultural Irrigation | 30.1 | 1987 |
| Ivanohoe PUD | Facility: | *Ivanhoe PUD STP* | 0.56 | 0.33 | Agricultural Irrigation | 368.2 | 2001 |
| Lindsay, City of | Facility: | *City of Linsay WWTF* | 1.24 | 0.86 | Agricultural Irrigation | 966.5 | 2001 |
| Pitigliano, Charles | Facility: | *Pitigliano, Charles Reclamation Facilities* | 12 | 0.53 | Agricultural Irrigation | 595.0 | 2001 |
| Pixley PUD | Facility: | *Pixley PUD WWTF* | 0.2 | 0.07 | Agricultural Irrigation | 83.0 | 2001 |
| Porterville, City of | Facility: | *Porterville WTF, City of* | 4.5 | * | Agricultural Irrigation | 2800.0 | 2001 |
| Richgrove CSD | Facility: | *Richgrove CSD WWTF* | 0.22 | * | Agricultural Irrigation | 0.3 | 2001 |
| Strathmore Public Utility Dist | Facility: | *Strathmore PUD WTP* | * | * | Agricultural Irrigation | 46.0 | 1987 |
| Terra Bella Sewer Maint Dist | Facility: | *Terra Bella Sewer Maint Dist* | * | * | Agricultural Irrigation | 0.3 | 2001 |

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| Tulare, City of | Facility: | *Tulare WPCF, City of* | 9.39 | 3.12 | Agricultural Irrigation | 3499.0 | 2001 |
| Visalia, City of | Facility: | *Visalia Water Conservation Plant, City of* | 20 | 2.41 | Agricultural Irrigation | 2700.0 | 2001 |
| Woodlake, City of | Facility: | *Woodlake WTF, City of* | 1 | 0.11 | Agricultural Irrigation | 120.0 | 2001 |
| Woodlake, City of | Facility: | *Woodlake, City of - WWTF* | 1 | 0.11 | Agricultural Irrigation | 120.0 | 2001 |
| **Region: 5R - Central Valley (Redding) Regional Water Quality Control Board** | | | | | | **1427 Acre-Feet/Year** | |
| *County:Butte* | | | | | | | |
| Sewerage Commission - Oroville Region | Facility: | *Sewerage Commission-Oroville Region WTP* | * | * | Industrial | 61.4 | 1987 |
| Springs of Living Water | Facility: | *Springs of Living Water STP* | * | * | Agricultural Irrigation | 9.2 | 1987 |
| *County:Plumas* | | | | | | | |
| Quincy Comm Serv Dist | Facility: | *Quincy Comm Serv Dist WTP* | * | * | Agricultural Irrigation | 359.2 | 1987 |
| Quincy CSD | Facility: | *Leonhardt Ranch Reclamation* | 1.6 | 0.5 | Agricultural Irrigation | 560.3 | 2001 |
| *County:Shasta* | | | | | | | |
| Shasta College | Facility: | *Shasta College WTP* | 0.08 | 0.04 | Agricultural Irrigation | 45.2 | 2001 |
| Shasta Dam Area PUD | Facility: | *Shasta Dam Area PUD STP* | 1.3 | 0.28 | Agricultural Irrigation | 310.1 | 2001 |
| *County:Shasta County* | | | | | | | |
| Redding, City of | Facility: | *Stillwater WWTP Reclamation* | 4 | 0.03 | Agricultural Irrigation | 30.1 | 2001 |
| *County:Tehama* | | | | | | | |
| Red Bluff, City of | Facility: | *Red Bluff WRP, City of* | 2.5 | 0.05 | Landscape Irrigation | 51.3 | 2001 |
| **Region: 5S - Central Valley (Sacramento) Regional Water Quality Control Board** | | | | | | **40552 Acre-Feet/Year** | |
| *County:Amador* | | | | | | | |
| Amador Regional Sanitation Authority | Facility: | *Amador County Regional Outfall* | 1.2 | 1 | Agricultural Irrigation | 552.4 | 2001 |
| CA Dept. of Corrections | Facility: | *Mule Creek State Prison WWTP* | * | * | Agricultural Irrigation | 35.2 | 1987 |
| Plymouth, City of | Facility: | *Plymouth STP, City of* | * | * | Agricultural Irrigation | 173.8 | 1987 |
| *County:Calaveras* | | | | | | | |
| Calaveras County Water District | Facility: | *Copper Cove WTP* | * | * | Agricultural Irrigation | 58.3 | 1987 |
| Calaveras County Water District | Facility: | *La Contenta TP* | 0.17 | 0.1 | Landscape Irrigation | 46.0 | 2001 |
| Murphys Sanitary District | Facility: | *Murphys SD WTP* | 0.35 | 0.35 | Agricultural Irrigation | 159.6 | 2001 |
| *County:Contra Costa* | | | | | | | |
| Ironhouse Sanitary District | Facility: | *Ironhouse Waste Water Treatment Facility* | 2 | 1.7 | Agricultural Irrigation | 1899.6 | 2001 |
| *County:El Dorado* | | | | | | | |
| El Dorado Irrigation District | Facility: | *El Dorado Hills WRP* | * | * | Landscape Irrigation | 86.0 | 1987 |
| | | | | | Industrial | 218.3 | |
| *County:Lake* | | | | | | | |
| Hidden Valley Lake CSD | Facility: | *Hidden Valley Lake CSD WRP* | * | * | Landscape Irrigation | 238.1 | 1987 |
| Lake County Sanitation District | Facility: | *Kelseyville WTP* | 0.26 | 0.22 | Agricultural Irrigation | 15.0 | 2001 |
| Lake County Sanitation District | Facility: | *Middletown WTP* | 0.4 | 0.15 | Industrial | 46.0 | 2001 |
| Lake County Sanitation District | Facility: | *Northwest Regional WTP* | 2 | 1.3 | Agricultural Irrigation | 1596.0 | 2001 |
| Lake County Sanitation District | Facility: | *Southeast Regional WTP* | 6.1 | 1 | Groundwater Recharge | 2499.7 | 2001 |

NOTE: * Indicates more information needed

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| Lakeport, City of - Municipal Sewer Dist 1 | Facility: | *Lakeport WTP, City of* | * | * | Agricultural Irrigation | 703.0 | 2001 |
| *County:Mariposa* | | | | | | | |
| U.S.D.I. - National Park Service | Facility: | *Wawona WTF-Yosemite NP (US Nat'l Park Service)* | * | * | Landscape Irrigation | 78.1 | 1987 |
| *County:Merced* | | | | | | | |
| Los Banos, City of | Facility: | *Los Banos WTP, City of* | * | * | Agricultural Irrigation | 278.4 | 1987 |
| Merced, City of | Facility: | *Merced WTF, City of* | * | * | Wildlife Habitat or Misc. Enhancement | 1008.5 | 1987 |
| *County:Nevada* | | | | | | | |
| Nevada CSD No. 1 | Facility: | *Lake of the Pines WTP* | * | * | Agricultural Irrigation | 168.8 | 1987 |
| *County:Placer* | | | | | | | |
| Lincoln, City of | Facility: | *Lincoln WRP, City of* | 1.1 | 1 | Agricultural Irrigation | 450.0 | 2001 |
| Placer Cnty Dept. of Public Works | Facility: | *Placer Cnty Serv Area #6-Sheridan (Public Works)* | * | * | Agricultural Irrigation | 33.8 | 1987 |
| Roseville, City of | Facility: | *Roseville Dry Creek WWTP, City of* | * | * | Agricultural Irrigation | 1057.7 | 2001 |
| *County:Sacramento* | | | | | | | |
| Galt, City of | Facility: | *Galt WTP, City of* | * | * | Agricultural Irrigation | 483.2 | 1987 |
| Rancho Murieta CSD | Facility: | *Rancho Murieta CSD WRP* | 3 | 2 | Landscape Irrigation | 598.4 | 2001 |
| *County:San Joaquin* | | | | | | | |
| Lockford Comm Serv Dist | Facility: | *Lockeford Comm Serv Dist WTP* | 0.71 | * | Agricultural Irrigation | 50.9 | 2001 |
| Lodi, City of | Facility: | *White Slough WPCF (City of Lodi)* | * | * | Agricultural Irrigation | 10197.0 | 2001 |
| | | | | | Landscape Irrigation | 2.6 | |
| Manteca, City of | Facility: | *Manteca WQCF, City of* | 6.95 | 4.87 | Agricultural Irrigation | 1853.9 | 2001 |
| *County:Sierra* | | | | | | | |
| Loyalton, City of | Facility: | *Loyalton WTP, City of* | * | * | Agricultural Irrigation | 358.6 | 1987 |
| *County:Stanislaus* | | | | | | | |
| Ceres, City of | Facility: | *Ceres WTF, City of* | * | * | Landscape Irrigation | 53.7 | 2001 |
| Modesto, City of | Facility: | *Modesto WQCF, City of* | 56.7 | * | Agricultural Irrigation | 10204.7 | 2001 |
| Patterson, City of | Facility: | *Patterson WTP, City of* | * | * | Agricultural Irrigation | 135.1 | 1987 |
| Turlock, City of | Facility: | *Turlock WQCF, City of* | 20 | 11.5 | Agricultural Irrigation | 843.9 | 2001 |
| *County:Tuolumne* | | | | | | | |
| California Department of Corrections | Facility: | *Sierra Conservation Center STP* | 0.56 | 0.56 | Agricultural Irrigation | 623.0 | 2001 |
| Groveland Comm Serv Dist | Facility: | *Groveland Comm Serv Dist WTF* | * | 0.15 | Landscape Irrigation | 168.8 | 2001 |
| Jamestown Sanitary District | Facility: | *Jamestown SD WTP (Tuolumne Regional WD)* | * | * | Agricultural Irrigation | 185.7 | 1987 |
| Tuolumne City Sanitary District | Facility: | *Tuolumne City SD WTP* | * | * | Agricultural Irrigation | 101.0 | 1987 |
| Tuolumne Regional WD | Facility: | *Sonora Regional WTP* | 1.85 | 1.4 | Agricultural Irrigation | 1565.1 | 2001 |
| Tuolumne Utilities District | Facility: | *Tuolumne CC WW RECL Users* | 1.8 | 1.4 | Agricultural Irrigation | 1565.1 | 2001 |
| *County:Yuba* | | | | | | | |
| Beale AFB | Facility: | *Sewage TP, Facility 8935* | * | * | Landscape Irrigation | 159.0 | |

**Region: 6 - Lahontan Regional Water Quality Control Board** **24511 Acre-Feet/Year**

## 2002 STATEWIDE RECYCLED WATER SURVEY

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| *County:El Dorado* | | | | | | | |
| South Tahoe PUD | Facility: | *ST Public Utilities District STP* | 8 | 4 | Landscape Irrigation | 4803.0 | 2001 |
| *County:Kern* | | | | | | | |
| 95 CEG/CEOES | Facility: | *Edwards Air Force Base STP* | * | * | Landscape Irrigation | 1341.0 | 2001 |
| | | | | | Wastewater Treatment Plant | 84.0 | |
| California City, City of | Facility: | *California City WTF* | * | 0.67 | Landscape Irrigation | 550.0 | 2001 |
| Ridgecrest, City of | Facility: | *Ridgecrest NWC China Lake, Consol WTP* | 4 | 3 | Landscape Irrigation | 684.0 | 2001 |
| *County:Lassen* | | | | | | | |
| California Department of Corrections | Facility: | *CA Correctional Center STP-Susanville* | 1 | * | Agricultural Irrigation | 955.0 | 2001 |
| *County:Los Angeles* | | | | | | | |
| County Sanitation Districts of Los Angeles | Facility: | *Lancaster WRP* | 16 | 11 | Agricultural Irrigation | 4348.0 | |
| | | | | | Landscape Irrigation | 205.0 | |
| | | | | | Recreational Impoundment | 7347.0 | |
| County Sanitation Districts of Los Angeles | Facility: | *Palmdale WRP* | 15 | 8 | Agricultural Irrigation | 252.0 | |
| *County:Mono* | | | | | | | |
| Mammoth Community Water District | Facility: | *Mammoth CWD STP* | 2 | 1 | Landscape Irrigation | 215.0 | 2001 |
| *County:San Bernardino* | | | | | | | |
| Barstow, City of | Facility: | *Barstow WRF, City of* | * | 2.7 | Agricultural Irrigation | 3024.0 | 2001 |
| CA Dept of Forestry and Fire Protection | Facility: | *Pilot Rock Cons. Camp STP (CA Dept of Forestry)* | * | * | Agricultural Irrigation | 9.0 | 1987 |
| Dir. Of Public Works-Fort Irwin Division | Facility: | *National Training Center STP* | 0.8 | 0.4 | Landscape Irrigation | 400.0 | 2001 |
| | | | | | Industrial | 50.0 | |
| San Bernardino County Service Area 70, | Facility: | *Imp Zone B STP-Helendale* | * | * | Landscape Irrigation | 220.0 | 1987 |
| Victor Valley Wastewater Reclamation Auth. | Facility: | *Victor Valley Muni WTP* | * | * | Wastewater Treatment Plant | 9.0 | 2001 |
| | | | | | Industrial | 15.0 | |
| **Region: 7 - Colorado River Basin Regional Water Quality Control Board** | | | | | | **9747 Acre-Feet/Year** | |
| *County:Imperial* | | | | | | | |
| Calipatria, City of | Facility: | *City of Calipatria WTP* | 0.5 | 0.47 | Wildlife Habitat or Misc. Enhancement | 172.0 | 2001 |
| *County:Riverside* | | | | | | | |
| Coachella Valley Water District | Facility: | *Palm Desert Country Club WRP #9* | 0.42 | 0.2 | Landscape Irrigation | 75.0 | 2001 |
| Coachella Valley Water District | Facility: | *Palm Desert WRP #10* | 15 | 5.16 | Landscape Irrigation | 1884.0 | 2001 |
| Coachella Valley Water District | Facility: | *Thousand Palms WRP # 7* | 2.5 | 1.6 | Landscape Irrigation | 595.0 | 2001 |
| Desert Water Agency | Facility: | *Desert Water Agency WRF* | 10 | 2.69 | Landscape Irrigation | 3018.0 | 2001 |
| Valley Sanitary District | Facility: | *Valley Sanitary District WTF* | 2.5 | 1.5 | Agricultural Irrigation | 1627.0 | 2001 |
| *County:San Bernardino* | | | | | | | |
| Big Bear Area Regional Wastewater Agency | Facility: | *Big Bear Area Regional Wastewater Agency STP* | 4.8 | 2.27 | Agricultural Irrigation | 1324.0 | 2001 |
| USMC, Air Ground Combat Center, Twenty | Facility: | *Air Ground Combat Center STP* | 2.5 | 0.939 | Landscape Irrigation | 1052.0 | 2001 |

# 2002 STATEWIDE RECYCLED WATER SURVEY

## Region: 8 - Santa Ana Regional Water Quality Control Board — 91577 Acre-Feet/Year

| | | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|---|
| *County:* | | | | | | | |
| Orange County Water District | Facility: | *City of Tustin 17th St Desalter* | * | * | Other or Mixed Types | 1974.0 | 2001 |
| *County:Orange* | | | | | | | |
| Irvine Ranch Water District | Facility: | *Michelson Water Reclamation Plant* | 18 | 12 | Agricultural Irrigation | 1309.0 | |
| | | | | | Landscape Irrigation | 15446.0 | |
| | | | | | Industrial | 50.0 | |
| | | | | | Other or Mixed Types | 2983.0 | |
| Orange County Sanitation District | Facility: | *Wastewater Treatment Plant* | * | 235 | Wastewater Treatment Plant | 3042.0 | 2001 |
| Orange County Water District | Facility: | *Green Acres TP* | 7.5 | 7 | Agricultural Irrigation | 78.0 | 2001 |
| | | | | | Landscape Irrigation | 2185.0 | |
| | | | | | Wastewater Treatment Plant | 4520.0 | |
| | | | | | Industrial | 112.0 | |
| Orange County Water District | Facility: | *Water Factory 21* | 30 | 5.5 | Seawater Barrier | 15000.0 | 2001 |
| *County:Riverside* | | | | | | | |
| City of Corona-Utility Services | Facility: | *STP No. 1 and STP No.3* | 10 | 6 | Landscape Irrigation | 560.0 | |
| Eastern Municipal Water District | Facility: | *Hemet/San Jacinto Reg. WRF* | * | * | Agricultural Irrigation | 3103.0 | 2001 |
| Eastern Municipal Water District | Facility: | *Moreno Valley Reg. WRF* | * | * | Landscape Irrigation | 706.0 | 2001 |
| Eastern Municipal Water District | Facility: | *Perris Valley Reg. WRF* | 11 | 8 | Agricultural Irrigation | 6572.0 | 2001 |
| Eastern Municipal Water District | Facility: | *Temecula/Winchester STP* | * | * | Agricultural Irrigation | 17772.0 | 2001 |
| Elsinore Valley MWD | Facility: | *Elsinore Valley Regional WRF* | 8 | 3.5 | Wildlife Habitat or Misc. Enhancement | 4249.1 | 2001 |
| Elsinore Valley MWD | Facility: | *Horsethief Canyon Wastewater Reclamation Facility* | 0.5 | 0.27 | Landscape Irrigation | 302.6 | 2001 |
| Elsinore Valley MWD | Facility: | *Railroad Canyon WRP* | 1.3 | 1.9 | Landscape Irrigation | 367.6 | 2001 |
| Jurupa Community Services District | Facility: | *Indian Hills WRP* | 0.99 | 0.486 | Agricultural Irrigation | 534.0 | 2001 |
| | | | | | Wildlife Habitat or Misc. Enhancement | 112.0 | |
| *County:San Bernardino* | | | | | | | |
| Big Bear Area Regional Wastewater Agency | Facility: | *Big Bear Regional Wastewater Agency* | * | * | Wastewater Treatment Plant | 365.0 | 2001 |
| City of Upland for Upland Hills On-Site | Facility: | *Upland Hills Wastewater Reclamation Plant* | * | * | Landscape Irrigation | 128.0 | 2001 |
| Inland Empire Utilities Agency | Facility: | *Carbon Canyon Water Reclamation Facility* | 10 | 8 | Agricultural Irrigation | 43.0 | 2001 |
| | | | | | Landscape Irrigation | 958.0 | |
| | | | | | Industrial | 27.0 | |
| | | | | | Other or Mixed Types | 134.0 | |
| Inland Empire Utilities Agency | Facility: | *Regional Plant No. 1* | 49 | * | Agricultural Irrigation | 34.0 | 2001 |
| | | | | | Landscape Irrigation | 2436.0 | |
| | | | | | Other or Mixed Types | 68.0 | |
| Inland Empire Utilities Agency | Facility: | *Regional Plant No. 2* | 4 | * | Agricultural Irrigation | 1350.0 | 2001 |
| | | | | | Landscape Irrigation | 4940.0 | |
| | | | | | Industrial | 10.0 | |
| Inland Empire Utilities Agency | Facility: | *Regional Plant No. 4* | 7 | 3 | Landscape Irrigation | 106.0 | 2001 |
| Yucaipa Valley Water District | Facility: | *Henry Wochholz Treatment Plant* | 4.5 | 3.2 | Agricultural Irrigation | 0.2 | 2001 |

NOTE: * Indicates more information needed

California State Water Resources Control Board
Office of Water Recycling

# 2002 STATEWIDE RECYCLED WATER SURVEY

## Region: 9 - San Diego Regional Water Quality Control Board — 30955 Acre-Feet/Year

| | | Design Flow (MGD): | ADWF (MGD): | Type of Use | Annual Flow (Ac-Ft) | Ending Period: |
|---|---|---|---|---|---|---|
| *County:Orange* | | | | | | |
| Moulton Niguel Water District | Facility: *Joint Regional Treatment Plant* | 11.4 | 3.5 | Landscape Irrigation | 6381.0 | 2001 |
| Moulton Niguel Water District | Facility: *Water Reclaimation Plant - 3A* | 2.4 | 1.9 | Landscape Irrigation | 1160.0 | 1987 |
| San Clemente, City of | Facility: *San Clemente WRP* | 2.2 | 0.4 | Landscape Irrigation | 335.0 | 2001 |
| Santa Margarita Water District | Facility: *Oso Creek WRP* | 2 | 0.62 | Agricultural Irrigation | 53.0 | 1987 |
| | | | | Landscape Irrigation | 638.0 | |
| South Coast Water District | Facility: *Coastal STP* | 4.2 | 0.93 | Landscape Irrigation | 942.0 | 1987 |
| Trabuco Canyon Water District | Facility: *Robinson Ranch WRP* | 0.85 | 0.7 | Landscape Irrigation | 781.0 | 2001 |
| *County:Riverside* | | | | | | |
| Eastern Municipal Water District | Facility: *Temecula Valley Regional WRF* | 8 | 5.2 | Agricultural Irrigation | 3369.0 | 1987 |
| | | | | Landscape Irrigation | 338.0 | |
| Rancho California Water District | Facility: *Santa Rosa WRF* | 5 | 2.74 | Agricultural Irrigation | 300.0 | 2001 |
| | | | | Landscape Irrigation | 955.0 | |
| *County:San Diego* | | | | | | |
| Carlsbad Municipal Water District | Facility: *Carlsbad WRF* | 4 | 1.6 | Landscape Irrigation | 1795.0 | 2001 |
| Encina Wastewater Agency | Facility: *Shadowridge WRF, Buena Sanitary District* | 0.65 | 0.25 | Groundwater Recharge | 286.0 | 2001 |
| Escondido, City of | Facility: *Hale Ave Resource Recovery Facility* | * | * | Landscape Irrigation | 427.0 | 2001 |
| Fallbrook PUD | Facility: *Fallbrook WTP # 1* | 3.4 | 1.9 | Agricultural Irrigation | 321.0 | 2001 |
| | | | | Landscape Irrigation | 147.0 | |
| Leucadia County Water District | Facility: *Forest S. Gafner WRP* | 1 | 0.21 | Landscape Irrigation | 235.0 | 2001 |
| Oceanside, City of | Facility: *San Luis Rey WTP* | 10.7 | 6.2 | Landscape Irrigation | 379.0 | 2001 |
| Olivenhain Municipal Water District | Facility: *4S Ranch WRP* | 2 | 0.116 | Other or Mixed Types | 86.0 | 2001 |
| Otay Water District | Facility: *Ralph W. Chapman WRF* | 1.3 | 0.78 | Landscape Irrigation | 1774.0 | 2001 |
| Padre Dam Municipal Water District | Facility: *Padre Dam WRF* | 2 | 2 | Landscape Irrigation | 623.0 | 2001 |
| | | | | Recreational Impoundment | 1216.0 | |
| Ramona Municipal Water District | Facility: *San Vicente WTP* | 0.375 | 0.312 | Agricultural Irrigation | 616.0 | 2001 |
| Ramona Municipal Water District | Facility: *Santa Maria WTP* | 0.6 | 0.521 | Agricultural Irrigation | 269.0 | 2002 |
| Rincon Del Diablo Municipal Water District | Facility: *Hale Avenue Resource Recovery Facility* | * | * | Landscape Irrigation | 427.0 | 2002 |
| San Diego Wild Animal Park | Facility: *San Diego Wild Animal Park STP* | 0.042 | 0.012 | Wildlife Habitat or Misc. Enhancement | 41.0 | 2001 |
| San Diego, City of - MWD | Facility: *North City WRP* | 30 | 8 | Landscape Irrigation | 3480.0 | 2001 |
| San Diego, County of | Facility: *Viejas WPCF-Alpine* | 0.03 | 0.03 | Other or Mixed Types | 34.0 | 1987 |
| San Elijo Joint Powers Authority | Facility: *San Elijo WPCF* | * | * | Landscape Irrigation | 1532.0 | 2000 |
| | | | | Other or Mixed Types | 68.0 | |
| USMC, Camp Pendleton | Facility: *Sewage Disposal Plant #2* | 1.3 | 0.501 | Landscape Irrigation | 280.0 | 2001 |
| Vallecitos Water District | Facility: *Meadowlark WRF* | 2 | 2 | Landscape Irrigation | 1557.0 | 2001 |
| Warner Springs Ranch | Facility: *Warner Springs Ranch WRP* | 0.025 | 0.01 | Landscape Irrigation | 5.0 | 2001 |
| Whispering Palms CSD | Facility: *Whispering Palms WPCF* | 0.45 | 0.25 | Agricultural Irrigation | 105.0 | 2001 |

**TOTAL ANNUAL WATER RECYCLED: 544979 Acre-Feet**

NOTE: * Indicates more information needed

# ATTACHMENT B

RESUMES

**SUMMARY**

Ms. Moulton is Director of ESA's Water/Wastewater Business Group. She has over 20 years of management and technical assessment experience on a wide range of programs. Ms. Moulton has expertise in CEQA, NEPA, and regulatory compliance relevant to biological and water resources. She directs environmental resource and impact assessments, public education programs, mitigation compliance, and permit assistance. She has taught courses and seminars on CEQA at UC Berkeley and through the Association of Environmental Professionals.

**PROFESSIONAL EXPERIENCE**

- Project Director for the *Sanitation Districts of Los Angeles County – Lancaster Water Reclamation Plant 2020 Facilities Plan – Alternatives Development and Program EIR*. Assisted District with alternatives siting, evaluation and screening studies and then with preparation of a Program EIR to address both near-term projects for expanding and upgrading the treatment and expanding an agricultural reuse program to address current and future wastewater disposal. The District has been required by the Lahontan Regional Water Quality Control Board to reduce its current wastewater discharge to Amargosa Creek and Piute Ponds because it causes unauthorized seasonal overflow on to Rosamond Dry Lake within the Edwards Air Force Base property. Substantial expansion of the District's current agricultural reuse program is proposed. The program involves construction of additional storage facilities as well as substantial land acquisition to support the agricultural reuse element. Key issues include surface and groundwater quality, public health, the effects of siting new storage ponds on land uses and biological resources in the area (including the Mojave ground squirrel and the Mariposa lily), potential effects on Edwards Air Force Base and on Piute Ponds. The program has been controversial and Ms. Moulton facilitated well-attended and spirited public meetings during the CEQA process.

- Project Director for the *County Sanitation Districts of Orange County's Strategic Plan Program EIR*. The Strategic Plan will identify the Districts' wastewater infrastructure needs for collection, treatment, and discharge to serve a growing population. Of particular concern is the need to add more peak flow discharge capacity in the form of a new ocean outfall or near shore discharge alternative and the potential to reliably

discharge through a joint water reclamation program with the Orange County Water District. The major issues in the Program EIR are potential impacts to the marine environment, public health, population growth, air quality, and community impacts.

- Project Director for the *Town of Windsor's Recycled Water Master Plan Program EIR*. Directing evaluation three alternative, long-range programs for wastewater disposal management through recycling. Alternatives include varying combinations of expanded landscape and agricultural irrigation with transmission of recycled water to the Geysers Steam field for injection to support steam generation for electricity production. Expansion of local irrigation requires construction of substantial additional storage pond capacity. Also evaluating a wetland creation pilot project and a silvaculture irrigation pilot study.

- Project Manager for the Program EIR on *Roseville Regional Wastewater System Master Plan*. Analysis addresses two distinct regional system alternatives to handle up to 54 mgd, including expansion of the existing Dry Creek Wastewater Treatment Plant (WWTP) and/or development of a new WWTP and new surface water discharge. Agricultural and urban water programs reclamation are also analyzed. Ms. Moulton presented the EIR findings to the City's Public Utilities Commission and City Council.

- Project Manager for the *San Francisco Recycled Water Master Plan and Groundwater Master Plan EIR* and supporting environmental studies, working jointly with the San Francisco Department of Public Works and Water Department, under direction of the City's Office of Environmental Review. ESA is analyzing the site-specific impacts of proposed water recycling and groundwater use facilities, water reuse and user issues, and the local and regional effects of supplementing City water supply with groundwater and recycled water. Specific projects addressed include a 15-mgd tertiary treatment plant, three 10-mg storage tanks, and many miles of transmission and distribution pipeline, pump stations, and wells. The tertiary plant includes UV disinfecting, and will ultimately provide up to 12,000 acre-feet per year of recycled water. Groundwater management issues under investigation include water quality, safe yield, salt water intrusion, subsidence, conjunctive use, and interagency Coordination. Directed public information newsletters and participated in public workshops.

**PROFESSIONAL EXPERIENCE (Continued)**

- Project Manager for the *Dublin San Ramon Services District Water Recycling for Groundwater Replenishment Project EIR.* The EIR analyzes two treatment and disposal alternatives: (1) reverse osmosis treatment and recharge via injection into the potable groundwater aquifer used as a major source of municipal water supply, and (2) tertiary treatment to meet Title 22 unrestricted, non-potable reuse criteria with seasonal aquifer storage and recovery (ASR) prior to use for landscape irrigation. The EIR evaluates 11 injection well sites and multiple injection scenarios in three groundwater sub-basins, several miles of pipeline route alternatives, and the two-treatment/reuse scenarios at equal level of detail. Water quality and protection of potable groundwater supplies and public health are the central issues analyzed.

- Project Director for the *CALFED Los Vaqueros Reservoir Expansion Studies.* ESA is part of a team that provides comprehensive environmental planning and compliance services, including project definition, alternatives development and screening, environmental studies, public outreach, permitting, and CEQA, NEPA, and Federal Endangered Species Act compliance for the Los Vaqueros Reservoir expansion studies. The Department of Water Resources and the U.S. Department of the Interior, Bureau of Reclamation are managing the studies on behalf of CALFED. The Contra Costa Water District owns and operates the Los Vaqueros Reservoir. Ms. Moulton is spearheading the alternatives development and screening effort, which entails investigating multiple water supply sources, diversion point/intake, conveyance corridors, reservoir sizing, and distribution options.

**EDUCATION**

B.A., 1981, Human Biology, environmental planning and marine / estuarine science emphasis, Stanford University

**SOCIETIES**

Association of Environmental Professionals
Water Environment Federation
California Water Environment Association
WateReuse Association

**CONTACT**

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**San Francisco, CA 94501**
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**Email: lmoulton@esassoc.com**

*- Resume -*


**JAMES CROOK, Ph.D., P.E.**
**Environmental Engineering Consultant**

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## *SUMMARY*


An environmental engineer with more than 30 years experience in state government and consulting engineering arenas serving public and private sectors in the United States and abroad. Has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. Was principal author of water reuse guidelines published by the U.S. Environmental Protection Agency and U.S. Agency for International Development. Helped develop water reuse criteria for several states, including California, Florida, Massachusetts, Virginia, and Washington. Currently serves on the National Water Research Institute Research Advisory Board, WateReuse Association Board of Directors, WateReuse Foundation Research Advisory Committee, and the American Water Works Association, International Water Association, and Water Environment Federation Water Reuse Committees. Specific areas of strength include:

- Water Reuse
- Public Health
- Treatment Technology
- Research
- Project Planning/Development
- Regulations/Permitting
- Quality Assurance/Control
- Communication Skills


## *PROFESSIONAL EXPERIENCE*

**INDEPENDENT CONSULTANT, Norwell, MA** **2003 – Present**

Environmental Engineering Consultant – Provides environmental engineering consulting services to public and private entities. Specializes in the area of water reclamation and reuse.

**CH2M HILL, Boston, MA** **2001 – 2003**
**2001 – Present**

Principal Water Reuse Technologist – Firmwide responsibilities in water reuse activities, including strategic planning, technology assessment, technical overview, quality assurance, project management, and business development. Provided expertise in areas such as water reuse regulations, permitting, feasibility studies, master planning, research, and health issues.

**BLACK & VEATCH, Boston, MA** **1994 – 2001**

Director of Water Reuse – Directed B&V's Water Reuse Department. Firmwide responsibility for water reclamation and reuse activities, including strategic planning, business development, technical overview, project coordination, quality assurance, and project management.

**CAMP DRESSER & McKEE INC., Cambridge, MA** **1988 – 1994**

Associate – Directed CDM's water reclamation and reuse activities. Assisted in wastewater treatment and disposal, drinking water supply, and water conservation projects.

**CALIFORNIA DEPARTMENT OF HEALTH SERVICES, Berkeley, CA** **1972 – 1988**

Senior Sanitary Engineer – Directed the California Department of Health Services water reclamation and reuse program. Developed California's first comprehensive water reuse criteria, which have been used as a model by several other states and countries. Developed water reuse use area guidelines and sewage disinfection guidelines for wastewater discharges to surface waters. Conducted research directed at removal of *Giardia lamblia* cysts by water treatment processes, reliability of water reclamation plants, and public evaluation of water reuse options.

## *EDUCATION*

| | | | |
|---|---|---|---|
| Ph.D. | Environmental Engineering | University of Cincinnati | 1972 |
| M.S. | Environmental Engineering | University of Cincinnati | 1969 |
| B.S. | Civil Engineering | University of Massachusetts | 1967 |

## *REGISTRATION*

Licensed Professional Engineer: California and Florida
Grade 5 Water Treatment Plant Operator: California
Certified as Diplomate by the American Academy of Environmental Engineers

## *PROFESSIONAL AFFILIATIONS*

American Academy of Environmental Engineers (AAEE)
American Society of Civil Engineers (ASCE)
American Water Works Association (AWWA)
International Water Association (IWA)
National Research Council (NRC)
National Water Research Institute (NWRI)
Sigma Xi - The Scientific Research Society
Water Environment Federation (WEF)
Water Environment Research Foundation (WERF)
WateReuse Association
WateReuse Foundation

## *AWARDS*

2001 AWWA Water Resources Division Best Paper Award for the AWWA Journal paper entitled *Indirect Potable Use of Reclaimed Water.*

American Academy of Environmental Engineers 2002 Kappe Lecturer.

## *EXAMPLES OF PROJECT EXPERIENCE*

| Client, Project, and Location | Position | Responsibilities |
|---|---|---|
| Inland Empire Utilities Agency, Chino Basin Recharge Master Planning Program, Fontana, California | Consultant and Advisor | Reviewed engineering report on groundwater recharge project. Identified technical and regulatory issues and provided strategies to resolve those issues. Negotiated resolution of regulatory issues with the California Department of Health Services. |
| Massachusetts Department of Environmental Protection, Water Reuse Criteria, Boston, Massachusetts | Consultant | Prepared detailed reports on reclaimed water quality considerations and water reuse criteria in the U.S. Developed suggested water reuse criteria for the state of Massachusetts. |
| City of Redwood City, Proposed Recycled Water Project, Redwood City, California | Consultant and Advisor | Advised the City on health issues associated with reclaimed water use for irrigation and wrote issue papers on: exposure to children; endocrine disruptors and pharmaceuticals; carcinogens; and relative risk from pathogens. |
| Orange County Water District, Groundwater Recharge Study, Los Angeles and Orange Counties, California | Technical Manager | Directed technical activities related to the Alamitos Barrier Project Reclaimed Water Feasibility Study and subsequent Engineering Report. Major responsibilities included assessment, evaluation, and resolution of regulatory and health issues. |
| City of Stockton, NPDES Permit Studies, Stockton, California | Project Engineer | Managed health risk assessment phase of study. Assisted in development of microbial risk model, regulatory coordination, and a comprehensive risk assessment of wastewater discharge into the San Joaquin River. |
| City of Shreveport, Water Reuse Feasibility Study, Shreveport, Louisiana | Project Engineer & Technical Advisor | Provided technical oversight of a water reuse feasibility report prepared for the City of Shreveport. Wrote several sections of the report, including the findings and recommendations. |
| State of Washington, Water Reuse Criteria for Nonpotable Uses and Indirect Potable Reuse via Injection (2 distinct projects), Olympia, Washington | Task Leader and Project Engineer | Identified parameters and issues to be addressed in standards for nonpotable uses of reclaimed water and groundwater recharge of reclaimed water by injection; evaluated other states' standards; and developed criteria for both types of applications for the state of Washington. |
| U.S. Environmental Protection Agency & U.S. Agency for International Development, Water Reuse Guidelines, Washington, D.C. | Principal Investigator | Developed and prepared national water reuse guidelines. The document addresses planning, technical issues, reclaimed water applications, economics, and legal, institutional, and public involvement issues. |
| City of Casablanca, Water Reuse Master Plan, Casablanca, Morocco | Project Engineer | Prepared a comprehensive water reclamation and reuse plan, which included identification of reuse alternatives, selection of wastewater treatment processes, sizing and routing of pipelines, and determination of project costs. |
| Thetford Corporation, Cycle-Let System Evaluation, Santa Monica, California | Project Director | Critically evaluated Thetford's onsite water recycling system; documented the system's treatment effectiveness, monitoring capabilities, reliability, and conformance to state reuse criteria. |

## *COMMITTEES, PANELS, BOARDS, AND COUNCILS*

Orange County Water District Groundwater Replenishment System Independent Advisory Panel (2004-Present)

NWRI Independent Advisory Panel for the Kennewick Riverbank Filtration Study (2004-Present)

Independent Advisory Panel for the City of San Diego Water Reuse Study (2004-Present)

National Research Council Water Science and Technology Board (2001-2004)

WateReuse Association (2000-Present), Board of Directors (2000-Present)

Water Environment Research Foundation Research Council (1999-2004), Vice Chair (2002-2003)

International Water Association Water Reuse Committee (1999-Present)

Scientific Advisory Panel for the Santa Ana River Water Quality & Health Study (1996-2004)

American Water Works Association Water Reuse Committee (1993-Present), Currently Chair

Water Environment Federation Water Reuse Committee (1986-Present), Chair (1994-1998)

WateReuse Foundation Research Advisory Committee (1997-Present)

National Water Research Institute Research Advisory Board (1993-Present)

Virginia Dept. of Environ. Quality Water Reuse Technical Advisory Committee (2001-2002)

International Association on Water Quality Specialist Group on Wastewater Reclamation, Recycling, and Reuse (1988-2001), Vice Chair (1992-1994)

Florida Dept. of Environmental Protection Reuse Rule Technical Advisory Committee (1993-1998)

National Research Council Committee on the Evaluation of the Viability of Augmenting Potable Water Supplies With Reclaimed Water (1996-1998), Chair

Irvine Ranch Water District Risk Assessment Technical Advisory Committee (1994-1995)

National Research Council Groundwater Recharge Committee (1992-1994)

American Water Works Association Dual Distribution Committee (1986-1993)

California Department of Health Services Groundwater Recharge Committee (1989-1993)

Calif. Dept. of Health Services Blue Ribbon Panel on UV Disinfection of Reclaimed Water (1993)

Florida Pollution Control Association Reuse Committee (1989-1992), Chair (1991)

Arizona Dept. of Environ. Quality Water Reuse Regulations Technical Advisory Committee (1992)

American Academy of Environmental Engineers Water Supply and Wastewater Subcommittee (1989-1991)

Orange County Water District Santa Ana River Health Effects Study Scientific Advisory Committee (1991)

American Society of Civil Engineers Water Supply Committee (1987-1990), Chair (1990)

Florida Department of Environmental Regulation Technical Advisory Committee for the Development of Rules for Reuse of Reclaimed Water (1988-1989)

## *PUBLICATIONS*
## (100+ publications; selected examples shown)


Ongerth, H.J., D.P. Spath, J. Crook, and A.E. Greenberg. 1973. Public Health Aspects of Organics in Water. *Jour. AWWA*, 65(7):495-498.

Crook, J. 1978. Health Aspects of Water Reuse in California. *Jour. Environ. Engrg. Div., ASCE*, 104 (EE4): 601-610.

Crook, J. and D.P. Spath. 1980. Water Reuse - Health and Other Aspects. In: *Environment and Health*, N.M. Trieff (ed.), pp. 503-552, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan.

Crook, J. and W.H. Bruvold. 1980. *Public Evaluation of Wastewater Reuse Options*. OWRT/RU-80-2, U.S. Department of the Interior, Office of Water Research & Technology, Washington, D.C.

Riggs, J.L., K. Nakumura, and J. Crook. 1984. Identifying *Giardia lamblia* by Immunofluorescence. In: *Proceedings of the ASCE Environmental Engineering Specialty Conference*, pp. 234-238, June 25-27, 1984, University of Southern California, Los Angeles, California.

Crook, J. 1985. Water Reuse in California. *Jour. AWWA*, 77(7): 60-71.

Crook, J. and D.A. Okun. 1987. The Place of Nonpotable Reuse in Water Management. *Jour. WPCF*, 59(5):237-241.

Ongerth, J.E., J. Riggs, and J. Crook. 1989. *A Study of Water Treatment Practices for the Removal of Giardia lamblia Cysts*. Research Report prepared for the AWWA Research Foundation, Denver, Colorado. Published by the American Water Works Association, Denver, Colorado.

Crook, J., T. Asano, and M.H. Nellor. 1990. Groundwater Recharge with Reclaimed Water in California. *Water Environ. & Tech.*, 2(8):42-49.

Crook, J. 1991. Quality Criteria for Reclaimed Water. *Water Sci. & Tech.*, 24(9):109-121.

Crook, J. 1992. Water Reclamation. In: *Encyclopedia of Physical Science and Technology,* Vol. 17, pp. 560-589, Academic Press, Inc., San Diego, California.

Huntington, R. and J. Crook. 1993. *Technological and Environmental Health Aspects of Wastewater Reuse for Irrigation in Egypt and Israel: Final Project Evaluation*. WASH Field Report No. 418. Prepared for the U.S. Agency for International Development, Near East Bureau, Washington, D.C.

Crook, J., D.A. Okun, and A.B. Pincince. 1994. *Water Reuse*. Project 92-WRE-1. Assessment report published by the Water Environment Research Foundation, Alexandria, Virginia.

Crook, J. 1994. Regulations Affecting the Use of Wastewater on Golf Courses. In: *Proceedings of the 1993 Golf Course Symposium: Water Reuse for Golf Course Irrigation*, pp. 54-90, March 4 & 5, 1993, Newport Beach, California. Published by Lewis Publishers, Chelsea, Michigan.

Crook, J., R.L. Herndon, M.P. Wehner, and M.G. Rigby. 1995. Studies to Determine the Effects of Injecting 100 Percent Reclaimed Water from Water Factory 21. In: *Proceedings of WEFTEC '95, 68th Annual Conference and Exposition, Vol. 6*, pp. 1-11, October 21-25, 1995, Miami Beach, Florida.

Crook, J. 1995. Water Supply Engineering. In: *McGraw Yearbook of Science & Technology: 1996*, pp. 372-375, McGraw-Hill, inc., New York, New York.

Crook, J. 1996. Chapter 21: Water Reclamation and Reuse. In: *Water Resources Handbook*, pp. 21.1-21.36, L.W. Mays (ed.), McGraw-Hill, Inc., New York, New York.

Crook, J. and R.Y. Surampalli. 1996. Water Reclamation and Reuse Criteria in the U.S. *Wat. Sci. Tech.*, 33(10-11):451-462.

Crook, J. 1998. Health and Regulatory Considerations. In: *Using Reclaimed Water to Augment Potable Water Resources*, pp. 23-127, WEF/AWWA Special Publication, Water Environment Federation, Alexandria, Virginia.

National Research Council Committee to Evaluate the Viability of Augmenting Potable Water Supplies With Reclaimed Water (J. Crook, Chair). 1998. *Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies With Reclaimed Water*. National Academy Press, Washington, D.C.

Crook, J. 1998. Water Reclamation and Reuse Criteria. In: *Wastewater Reclamation and Reuse*, pp. 627-703, T. Asano (ed.), Technomic Publishing Co., Ltd., Lancaster, Pennsylvania.

Crook, J., J.A. MacDonald, and R.R. Trussell. 1999. Indirect Potable Use of Reclaimed Water. *Jour. AWWA* 91(8):40-49.

Crook, J. 2000. Regulatory Constraints and other Issues Affecting Urban Water Reuse in the U.S. In: *Proceedings of 1st International Meeting on Technologies for Urban Water Recycling*, pp. 1-23, 19 January 2000, Cranfield University, Cranfield, Bedfordshire, United Kingdom.

Geselbracht, J. and J. Crook. 2000. Meeting TOC Requirements for California Groundwater Recharge Projects. In: *Proceedings of the AWWA/WEF Water Reuse 2000 Conference*, January 30 – February 2, 2000, San Antonio, Texas.

Anderson, J.A., A. Adin, J. Crook, C. Davis, R. Hultquist, B. Jiminez-Cisneros, W. Kennedy, B. Sheikh, and B. van der Mewe. 2000. Climbing the Ladder: A Step by Step Approach to International Guidelines for Water Recycling. In: *Proceedings of the 1st World Congress of the International Water Association, Conference Preprint Book 8 - Wastewater, Reclamation, Recycling and Reuse*, pp. 9-16, 3-7 July 2000, Paris, France.

Crook, J. 2000. Water Reuse: A Health Perspective. In: *Proceedings of Envirovision 2000: Third Annual Conference of the Indian Environmental Association on Industrial Wastewater Recycle and Reuse*, pp. S1(1)-1 – S1(1)-9, May 5-6, 2000, Mumbai, India.

Crook, J., L.J. Johnson, and K. Thompson. 2001. California's New Water Recycling Criteria and Their Effect on Operating Agencies. In: *Proceedings of the American Water Works Association 2001 Annual Conference*, June 17-21, 2001, Washington, D.C.

Freeman, S., G.F. Leitner, J. Crook, and W. Vernon. 2002. A Clear Advantage: Membrane Filtration is Gaining Acceptance in the Water Quality Field. *Water Environ. & Tech*., 14(1):16-21.

Crook, J., R.H. Hultquist, R.H. Sakaji, and M.P. Wehner. 2002. Evolution and Status of California's Proposed Criteria for Groundwater Recharge with Reclaimed Water. In: *Proceedings of the American Water Works Association 2002 Annual Conference*, June 16-20, 2002, New Orleans, Louisiana.

Soller, J.A., A.W. Olivieri, J. Crook, R.C. Cooper, G. Tchobanoglous, R. Parkin, R. Spear, and J.N.S. Eisenberg. 2003. Risk-Based Approach to Evaluate the Public Health Benefit of Additional Wastewater Treatment. *Environ. Sci. Technol.*, 37(9):1882-1891.

Crook, J. 2004. *Innovative Applications in Water Reuse: Ten Case Studies*. Published by the WateReuse Association, Alexandria, Virginia.