Proposal for the

California Department of Water Resources

2004 Water Use Efficiency Proposal

January 11, 2005

California Department of Water Resources
Office of Water Use Efficiency
P.O. Box 942836, Sacramento, CA 94236-0001

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Project Information Form

Applying for:

1. **(Section A)** Urban or Agricultural Water Use Efficiency Implementation Project

❑ Urban ❑ Agricultural

❑(a) implementation of Urban Best Management Practice, #_____

❑ (b) implementation of Agricultural Efficient Water Management Practice, #_____

❑ (c) implementation of other projects to meet California Bay-Delta Program objectives, Targeted Benefit # or Quantifiable Objective #, if applicable

_____

❑ (d) Specify other: _____

2. **(Section B)** Urban or Agricultural Research and Development; Feasibility Studies, Pilot, or Demonstration Projects; Training, Education or Public Information; Technical Assistance

☒ (e) research and development, feasibility studies, pilot, or demonstration projects

❑ (f) training, education or public information programs with statewide application

❑ (g) technical assistance

❑ (h) other

3. **Principal applicant (Organization or affiliation):** California Avocado Commission

4. **Project Title:** Water Use Efficiency using ET Controllers- Research and Development of Irrigation Management Database System.

5. **Person authorized to sign and submit proposal and contract:**

Name, title	Tom Bellamore- Senior Vice-President & Corporate Counsel
Mailing address	38 Discovery, Suite 150 Irvine, CA 92618
Telephone	949-341-1955
Fax.	949-341-1970
E-mail	tbellamore@avocado.org

6. **Contact person (if different):**

Name, title.	Guy Witney Director of Industry Affairs

Mailing address.	38 Discovery, Suite 150 Irvine, CA 92618
Telephone **Fax.**	949-341-1955 949-341-1970
E-mail	Gwitney@avocado.org

7. Grant funds requested (dollar amount): $ 888,918
(from Table C-1, column VI)

8. Applicant funds pledged (dollar amount): $ 264,000

9. Total project costs (dollar amount): $ 1,152,918
(from Table C-1, column IV, row n)

10. Percent of State share requested (%) **77%**
(from Table C-1)

11. Percent of local share as match (%) **23%**
(from Table C-1)

12. Is your project locally cost effective? ☒(a) yes
Locally cost effective means that the benefits to an entity (in dollar terms) of implementing a program exceed the costs of that program within the boundaries of that entity.
(If yes, provide information that the project in addition to Bay-Delta benefit meets one of the following conditions: broad transferable benefits, overcome implementation barriers, or accelerate implementation.) ☐ (b) no

11. Is your project required by regulation, law or contract? ☐ (a) yes
If no, your project is eligible. ☒(b) no
If yes, your project may be eligible only if there will be accelerated implementation to fulfill a future requirement and is not currently required.
Provide a description of the regulation, law or contract and an explanation of why the project is not currently required.

_____
_____
_____

12. Duration of project (month/year to month/year):	12/05 – 12/07
13. State Assembly District where the project is to be conducted:	San Diego County (66) & Ventura County- (37)
14. State Senate District where the project is to be conducted:	San Diego (36 & 38) & Ventura County (17)
15. Congressional district(s) where the project is to be conducted:	San Diego (52) & Ventura County (24)
16. County where the project is to be conducted:	San Diego County and Ventura County
17. Location of project (longitude and latitude)	TBD by soliciting growers
18. How many service connections in your service area (urban)?	NA
19. How many acre-feet of water per year does your agency serve?	0

20. Type of applicant (select one):

- ❑ **(a) City**
- ❑ **(b) County**
- ❑ **(c) City and County**
- ❑ **(d) Joint Powers Authority**
- ❑ **(e) Public Water District**
- ❑ **(f) Tribe**
- ❑ **(g) Non Profit Organization**
- ❑ **(h) University, College**
- ☒ **(i) State Agency**
- ❑ **(j) Federal Agency**
- ❑ **(k) Other**
  - ❑ **(i) Investor-Owned Utility**
  - ❑ **(ii) Incorporated Mutual Water Co.**
  - ❑ **(iii) Specify _____**

21. Is applicant a disadvantaged community? If 'yes' include annual median household income. (Provide supporting documentation.)

- ❑ **(a) yes, _____ median household income**
- ☒ **(b) no**

Signature Page

By signing below, the official declares the following:

The truthfulness of all representations in the proposal;

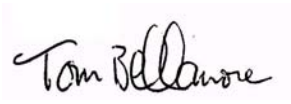
The individual signing the form has the legal authority to submit the proposal on behalf of the applicant;

There is no pending litigation that may impact the financial condition of the applicant or its ability to complete the proposed project;

The individual signing the form read and understood the conflict of interest and confidentiality section and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant;

The applicant will comply with all terms and conditions identified in this PSP if selected for funding; and

The applicant has legal authority to enter into a contract with the State.



Signature	Tom Bellamore Senior Vice-President & Corporate Counsel	January 11, 2005
Signature	Name and title	Date

Statement of Work

Section 1: Relevance and Importance

The goals and objectives of the study are to:

1. Demonstrate the value of evapotranspiration (ET) controllers for avocado and citrus grove irrigation in Southern California, and to
2. Estimate the water savings possible through broad deployment of ET controller technology

The proposed project will investigate the feasibility of developing an Irrigation Management System for the "typical" grower using advanced site-specific evapotranspiration parameter measurement technology, regionally available evapotranspiration data via the California Irrigation Management Information System (CIMIS), and communications technology. CIMIS is a program in the Office of Water Use Efficiency, California Department of Water Resources that manages a network of over 120 automated weather stations in the state of California.

There is a robust agricultural industry in coastal Southern California. Agriculture contributes a total of about $16 billion to the seven Southern California Counties' economies. The vast majority of this activity occurs in the service area of the Metropolitan Water District of Southern California. Agriculture creates about 287,000 jobs and contributes $9.5 billion to the income of individuals.

Economic benefits are not solely associated with the area where agricultural products are grown. For example, although the County of Los Angeles does not have the highest multiplier effects by types of crop and services, it has the highest agricultural processing multiplier effects. This is likely due to the import of raw products from other areas for processing. Additionally, the County of Los Angeles dwarfs the other counties in exporting processed products to other areas. 77% of the seven Southern California Counties foreign exports of processed goods are through Los Angeles County. Also, the Port of Los Angeles leads the nation in exporting products. Other top five containerized exports, raw cottons and meat and poultry, were ranked fourth and fifth respectively (TPLA 05).

California leads the nation in cash receipts for agricultural states. The coastal plain of southern California contributes a substantial portion of California's agricultural production through specialty crops like avocados, lemons, strawberries and grapes. As far as market value of products sold, two of California's top ten agricultural counties are in Southern California. These counties are San Diego and Ventura (CDFA 2004).

Agriculture water use for "interruptible water users" (which comprise mostly tree crop water use) is shown in the table below. In Fiscal Year 2003-2004, the Metropolitan Water District of Southern California delivered 149,820 acre-feet of water for agricultural use (Table 1). Most of this went to tree crop irrigation (primarily avocados, followed by citrus). The San Diego area purchased 100,459 acre-feet of the total - a significant amount of this water went to growers that

are represented by the California Avocado Commission. This water comes from Metropolitan's State Water Project and Colorado River Water supplies. Conservation savings recognized through this proposed project will directly impact imported water needs.

Table 1: Agricultural Water Sales by Metropolitan Water District of Southern California (Fiscal Year 2003-2004)

Table 1: Agricultural Water Sales by MWDSC (FY 2003-2004)		
Month	**Full Service**	**Agricultural**
July	201,140.20	17,818.80
August	213,074.60	18,742.10
September	189,678.50	16,370.10
October	184,033.00	15,710.70
November	132,876.00	8,223.00
December	102,581.50	7,876.00
January	130,848.20	8,205.80
February	103,351.40	4,834.20
March	134,317.00	8,733.90
April	164,978.00	10,973.40
May	204,998.60	17,135.70
June	195,068.20	15,196.30
Totals	**1,956,945.20**	**149,820.00**

According to the San Diego County Water Authority's Agricultural Water Management Plan (Plan):

- **Number of Acres in Agriculture** – 54,641 with 65% of farms less than 9 acres
- **Dollar Value** – $1.25 billion, 7th in State
- **Crops Grown** – Flower and Nursery, Avocados, Vegetables, Citrus, Livestock and Poultry, Specialty Crops
- **Reported Irrigation Water Use** – 135,047 AF
- **Irrigation Water Use Plus Historic Effective Rainfall** – 180,470 AF
- **Agricultural Water Use** – 72% of Irrigation Water Requirement
- **Average Cost of Water to Grower** - $ 650/AF
- **Major Problems** – High cost of water, labor, land and energy; pests and quarantines, and foreign competition

The plan discusses agricultural irrigation water requirements. In the plan it states: "Observations by the Agricultural Water Management Team at Mission Resource Conservation District, Natural Resources Conservation Service, University of California Cooperative Extension and their personal communications with growers *indicate irrigation practices in the county vary widely* (emphasis added). Some growers under-irrigate because of the high cost of water. Other growers over-irrigate in an attempt to produce large, prime fruits and to extend production into the fringes of the growing season when produce has the highest market price."

According to the plan, "Efficient Water Management Practices (EWMPs, which do not include ET controller deployment) have been fully implemented with the exception of the demonstrably inappropriate ones of alternative land use, tailwater/spill recovery, automate canal structures." The plan indicates that, of all the EWMPs, "Provide Water Management Services" may have the most direct impact on water conservation. By definition, these services must include:

1. "On farm irrigation and drainage system evaluation;
2. Normal year and real-time irrigation scheduling and crop evapotranspiration;
3. Surface water; groundwater, and drainage water quality data;
4. Educational programs and material for farmers, staff and the public;
5. Water user pump testing and evaluation."

The potential for significant water savings is real. The project is supported by the San Diego County Water Authority as consistent with their desire to reduce both urban and agricultural demands. The project extends the conservation philosophy in their current Agricultural Water Management Plan by demonstrating and communicating the additional savings potential of ET controller technology to growers.

Further, better irrigation scheduling has the potential to reduce serious peaking issues associated with the treated water aqueducts delivering water from the Metropolitan Water District of Southern California. Such peak management could save millions of dollars in deferred capital spending.

The project will contribute toward or support CA Bay-Delta Program Goals by reducing imported water demands below what they would otherwise be in absence of the proposed project.

Water Savings

Good irrigation management is required for efficient and profitable use of water for irrigating agricultural crops. A major part of any irrigation management program is the decision-making process for determining how much water should be applied to the crop. Especially important in irrigation management is developing an irrigation schedule which takes into account regional and local climatic information (i.e. soil water content, temperature). It is critical to take into account the amount of water that is lost as crop evapotranspiration (ETc) and the amount of water that enters the soil reservoir (as rain or irrigation) to ensure efficient water use. This information can be used in reducing water use while still maintaining adequate yield. All these factors combined suggest that conservation activities in this arena are likely to yield rich dividends in regards to water savings potential.

Water savings potential is a primary function of crop size and the level of over-watering taking place. A recent study of ET controllers in Santa Barbara (Jordan et al., 2004) found a great level of savings when targeting sites with large crop acreages. These findings are important in underscoring the strong relationship between crop size and water savings. Additional studies performed in Irvine, California (Hunt et al. 2001; Diamond, 2003) and one in Denver, Colorado (Aquacraft, 2001 and 2002), specifically examined the efficacy of ET controllers. In addition, a more recent study sponsored by Metropolitan Water District of Southern California (2004) compared the efficacy of ET controllers that modify historical ET data using a temperature sensor and a controller that imputes ET by measuring solar radiation. Although these studies do not suggest that all of the above controllers perform equally well, they do suggest that each has a great potential of saving substantial amounts of water.

From a horticulture standpoint over-irrigation occurs much too often. However, it is most prevalent in the fall months of September, October and November when ET rates are falling and summer irrigation schedules have not yet been revised to meet current weather conditions. Over-irrigation causes three basic problems:

- Over-irrigation pushes water beyond the root-zone and is wasted.
- Over-irrigation causes excessive runoff which contributes to environmental pollution.
- Over-irrigation, in general degrades plant health.

As a result, it becomes more and more imperative to implement water efficiency practices from an environmental and practical perspective.

Potential Water Savings

Water savings potential or conservation potential is the difference between actual outdoor use and what should have been used taking weather variables into account. By way of example, if one acre in an avocado crop is watered with 5 acre-feet/year, using the following ET calculation would reduce water use in that one acre by 1-1.5 acre-feet/year.

Assumptions:

1) A leaching requirement (LR) of 10% to remove the salt buildup from the soil. For any grove, the actual LR can be determined by measuring the electroconductivity of the soil.

2) A distribution uniformity (DU) of 85%. A DU is assigned to an irrigation system by a soil conservation analysis.

3) 109 trees per acre, based on a 20' x 20' spacing.

4) The Ventura orchard is in the CIMIS Region 9 and the San Diego orchard is in the CIMIS Region 16. Each region has its own monthly average reference ET_o which is based on measurements from the existing CIMIS stations. The ET_o values used for the calculation are shown in the following table.

5) The crop coefficients (Kc) for avocados were obtained from the CIMIS website and are listed in Table 2.

Table 2: Crop Coefficients for Avocados

	ETo (in/day)		Kc
Month	**Ventura (Region 9)**	**S.D. (Region 16)**	**Avocados**
January	0.07	0.05	0.4
February	0.1	0.09	0.5
March	0.13	0.13	0.55
April	0.17	0.19	0.55
May	0.19	0.25	0.6
June	0.22	0.29	0.65
July	0.24	0.3	0.65
August	0.22	0.27	0.65
September	0.19	0.21	0.6
October	0.13	0.14	0.55
November	0.09	0.08	0.55
December	0.06	0.05	0.5

inches/day = $\sum((ETo * Kc) / DU)$

Gallons/acre/day= $\sum(ETo * Kc) / 0.85 * 27145$ gal/acre-inch)

Acre-feet/year= $\sum(ETo * Kc / 0.85 * 27145$ gal/acre-inch * 3.07×10^{-6} acre-foot/gal * 30 days/month)

Ventura: Water use (Acre-feet/year) = 3.2/acre; with an additional leaching requirement of 10% the required watering becomes **3.5 acre-feet/year for each acre. A savings of 1.5 acre-feet/year per grove acre.**

San Diego: Water use (Acre-feet/year) = 3.7/acre; with an additional leaching requirement of 10% the required watering becomes **4.0 acre-feet/year for each acre. A savings of 1.0 acre-feet/year per grove acre.**

Assuming 54,000 acres of irrigated agriculture, a potential savings at full deployment of ~50,000 acre-feet is possible. This savings can be realized if growers are aware and convinced of the efficacy of this technology. This is exactly what this project is designed to do. We will leverage the excellent working relationships of the California Avocado Commission as well as the San Diego and Ventura County Farm Bureau's to "get the word out".

By collecting site specific data, the ET_o will be calculated specifically for the individual grove and may result in even greater water savings.

Specific project monitoring, evaluation and benefit documentation methods are described below.

Section 2: Technical and Scientific Merit, Feasibility

For Research and Development Programs:

Hypothesis

The proposed project will investigate the feasibility of developing an Irrigation Management System for the "typical" grower using advanced site-specific evapotranspiration parameter measurement technology, regionally available evapotranspiration data via the California Irrigation Management Information System (CIMIS), and communications technology. It is hypothesized that irrigation volumes can be reduced by using this system to deliver site specific irrigation scheduling information directly to growers for use in manual irrigation decisions. The system will help manage peak demands by using the system to communicate the irrigation scheduling information and peak demand time information directly to automatic irrigation controllers, which can be programmed to utilize the information for efficient irrigation practices.

Background

Good irrigation practice has long been realized as the key to favorable crop yields. Throughout agricultural history the challenge has been to efficiently irrigate crops, so that they receive the necessary amount of water with a minimum of waste; this is still an issue today. In fact, it is reported that globally the efficiency of water in agricultural production is low and only 40 to 60% of the water is effectively used by most crops (Smith, 1995). It is known that poor irrigation management practice is one of major contributors to water waste, with direct and negative impacts to environment and growers including: reduced crop yields, smaller irrigated land area, higher water bills, and increased drainage of pesticides and fertilizer to surface and

groundwater. Intelligent irrigation scheduling has been implemented with some success and is perhaps the best way to minimize irrigation inefficiencies. Irrigation scheduling consists of estimating when and how much water should be used for a specific crop. One scientifically accepted method used to develop an irrigation schedule is to measure various climatic parameters and use standard agricultural science formulas to calculate an evopotranspiration (ET) value for a particular location, time of year and crop (Allen et al., 1998). ET values are directly translatable into required irrigation volumes, hence, reducing the possibility of inefficient irrigation, without compromising crop yields.

The State of California is unique in that large parts of it are very arid or semi-arid and it has very large urban population centers as well as significant agricultural land use. Therefore not only are California's water resources extremely precious as they are sometimes scarce in the arid climate, but at times there are competing interests and needs for water service from its large number and diverse customer base. For example, rural San Diego County is used heavily for agricultural production, while the coastal areas of San Diego County are highly urbanized. The water transmission lines used to import water to this area regularly experience demand peaks in an effort to support the needs of all the county's customers (personal communication, Vicki Driver, San Diego County Water Authority). This suggests that in addition to bolstering the region's current water conservation efforts, a peak demand management strategy may be realized through this project.

The issue of water conservation through irrigation management has long been a key part of California's water resource management strategy. In 1982 the California Department of Water Resources in collaboration with the University of California, Davis developed a system called the California Information Management System (CIMIS), aiding irrigators in the development of scientifically based irrigation schedules. CIMIS generally consists of over 120 automated climatic data collection stations state-wide. This data is stored on a central server in Sacramento where it can be publicly accessed via the Internet by growers (CIMIS, 2004). The growers can then use this information when making irrigation decisions. Though many growers use this system effectively to manage their irrigation decisions, there are many growers who do not use the system, or used the system at one time but have opted not to continue. There are many reasons that are given by those that do not use the system including: not wanting to change irrigation practices that have been used for decades on a particular crop in a particular location, the real or perceived notion that the CIMIS stations are not site specific enough for a particular crop location, and the perception that the hassle of using CIMIS along with irrigation calculators, or other regional climatic data collectors (e.g. USGS and NOAA) is not worth the benefit either in water savings or crop yield.

The issue of demand management is becoming increasingly recognized as an important issue as California's residential, industrial, and agricultural customers continue to stress the water transmission line infrastructure. Though some efforts have been made to schedule water demands for different customers, little has been done in the way of developing an aggressive demand management strategy.

With advances in sensor and communication technology, agricultural science, and the use of existing data networks (e.g. CIMIS), it is possible to develop a system to deliver site specific

irrigation scheduling information directly to growers in a easily usable format. In addition, this information could be used to automate irrigation needs, so that crops could be easily irrigated during off peak demand times; which has the potential for significant water savings and peak demand management.

Materials and Methods

The proposed project aims to investigate the potential for the coordinated use of several available technologies applied to agricultural irrigation for the development of an Irrigation Management System, which could provide an economically feasible way for growers to reduce irrigation needs without jeopardizing crop yields. Not only will the implementation of this type of study be made complex by the need for several different technologies to communicate, and the need to analyze, interpret and make decisions based on this data quickly; but, also the numbers of environmental variables that cannot be specifically controlled for (e.g. wind speed and humidity) that could create conditions that are difficult to analyze and interpret. In an effort to reduce the level of uncertainty and increase the value and usability of the data collected in this study, well thought out and scientifically defensible methods and procedures will be followed by highly competent and trained individuals and the use of state of the art data collection equipment, software, and technology will be used.

Environmental Documentation

The proposed project falls under the CEQA categorical exemption as defined by the California Code of Regulations, Title 14, Chapter 3 Article 19 Sec 15306, which is the categorical exemption under the CEQA guidelines for information gathering. The purpose of this project is to integrate existing regional CIMIS information with site-specific climatic data to provide with accurate and specific ET data to growers, so that effective irrigation water management decisions can be made and result in significant water savings on an individual grove can be achieved. The installation of the ET controllers for the purposes of this study will be conducted over a limited time frame.

No permits are anticipated to be required for this proposal. The ET controller units will be temporarily installed on specific groves and directly on the irrigation system.

Prior to the initiation of the project, a review will be completed to determine if any State or local permits are needed.

Scope of Work and Schedule

A project plan and work schedule with each task, deliverable items, start and end dates, and project costs for each task are described below.

Task 0.0: Project Management

This task entails maintenance of project schedule and budget as well as generation of monthly progress reports. The Project Manager will be Mr. Edward Means. The Principal in Charge will be Dr. Michael J. McGuire. Communication will be through meetings, conference calls, and e-mail.
Regular updates will be posted to the California Avocado Commissions Southern California Agricultural Water Team website (**www.scawt.com**).

Task 1.0: Development of Test Plan

The test plan will be formally documented. The details of the plan will be developed in concert with the UC Cooperative Extension experts, Dr. Ben Faber and Dr. Gary Bender to ensure:

- Test and control groves are properly selected,
- Monitoring and data collection is defined and appropriate,
- Installation and equipment monitoring methods are appropriate,
- Roles and responsibilities are defined, and
- Statistical methods to be used for the data analysis are defined.

This all leads to the primary objective, which is to ensure that scientifically defensible water savings estimates (and costs) are generated.

Task 1.1: Development of QA/QC Manual

To ensure that high quality information is collected, a Quality Assurance/Quality Control Manual will be developed that includes the test plan, data collection requirements, quality control measures, staffing plans, grower obligations, monitoring frequencies, database maintenance requirements, reporting procedures, emergency response (e.g. should controllers fail), etc.

Task 2.0: Develop Database

The Irrigation Management System will be founded on a comprehensive database that tracks information from each of the 12 test plots and integrates relevant CIMIS data. MEC will develop this database on either a PostgreSQL or Oracle platform.

The Irrigation Management System will be developed to communicate site-specific information to enable growers to make informed irrigation scheduling decisions. The database will support communication via a project website, as well as “push” technologies including emails and text messages. These channels will deliver information to growers and supply project information to the project team and funding authorities. Summary information on the study progress will also be available on the website to the general public.

Task 3.0: Develop Data Entry Protocol

The Irrigation Management System will collect and house information ranging from continuous online monitoring data collected by automated stations to periodic irrigation and production information collected by growers. MEC will work with the technology vendors and growers to determine the optimal strategy for uploading data. Relevant CIMIS data will be integrated into the database using the existing CIMIS FTP server. Site-specific monitoring data from each of the monitored groves will be automatically uploaded to the database by telemetry. The specific method of data communication will be established depending on the selected monitoring equipment and physical location of the grove to phone access, mobile phone sites, etc.

Task 4.0: Grove Selection

The project team will leverage existing working relationships between the California Avocado Commission and the grower community to select 12 sites (6 groves in Ventura County and 6 groves in San Diego County) to install, monitor and demonstrate the effectiveness of the technology. The groves will represent both avocado and citrus crops and will be selected to represent a range of exposures (e.g. southwest and northeast) and produce results that are generally applicable throughout Southern California. One irrigation circuit will be selected as the test "plot" and adjacent irrigation circuits will serve as the "control" plots for each grove. There will be several criteria that the selected sites must meet including, but not limited to, the following: 1) grove owner/operator participation and involvement, 2) project staff site accessibility, 3) cell phone reception (or other means) for data transfer, 4) proximity and potential usability of existing CIMIS stations, and 5) detailed current and historical crop yield and water usage data records.

Selected groves will require owners that are fully committed to legitimately assessing the benefits of this technology. They will be required to provide "walk through" staff to monitoring the operations of the ET controller equipment and the irrigation system. Finally, growers will be asked to sign formal commitment letters stipulating the conditions for participation.

Task 5.0: Equipment Selection

The project team will work with potential vendors to provide the equipment for the test. Off-the-shelf technology will be used. Selection of the technology will be made under advisement of Dr. Ben Faber and Dr. Gary Bender of UC Cooperative Extension.

Task 6.0: Equipment Installation

An assessment for each grove will be made regarding applicable climatic data available on the CIMIS website. For the groves that will need additional data collection to supplement available CIMIS data to obtain site-specific information, the appropriate sensors and data telemetry equipment will be installed. There may be some groves that upon assessment will not have any similar characteristics to the nearest CIMIS station, in which case a CIMIS like station will be obtained (available through California Department of Water Resources, supplied by Campbell Scientific) and installed according to CIMIS site specifications. The CIMIS program director

will be notified of the CIMIS like station installation so that a decision can be made whether or not to add it to the CIMIS network. A central server or Irrigation Management System will be developed, all relevant CIMIS data and site specific data, including climatic and crop data for a particular grower, will be transmitted. Upon arrival the data will be utilized in an irrigation volume calculation.

The vendor will install the equipment, with the assistance of the project team. Once installed, the project team will take over monitoring and coordinate any maintenance necessary with vendor personnel.

Task 7.0: Shakedown

We anticipate that a shakedown period of 2 months will be required to ensure that all equipment is operating properly and that growers have a clear understanding of their responsibilities. During this period, the research team will spend considerable time on site ensuring proper operation prior to formally initiating the test.

Task 8.0: Monitoring and Data Collection

The monitoring of the project will be conducted by the project team in accordance with the Test Plan. Weekly site visits are anticipated initially. Review of telemetry data will demonstrate the need for more or less frequent site visits. At least weekly walk throughs of grove irrigation systems will be required and provided by the grower's staff. Climate conditions, ET information, historical and current yield information, water use, water cost, pest management, fertilizer application records, etc. will be collected for each of the test plots.

Task 9.0: Data Analysis

Irrigation Management System Data Analysis*:* Applicable climatic data streams from the nearby CIMIS station and grove site specific climatic data streams will be transmitted to the Irrigation Management System via cell phone (or by telemetry). As part of the Irrigation Management System, a irrigation calculator, similar to the one currently available (CAC 2004), will process and analyze data and transmit a site specific ET value and irrigation volume to each of the individual growers, or automatic irrigation controllers.

Water Savings Analysis*:* The water savings analysis will be performed by comparing actual water usage for a test plot with water usage for a nearby control plot. Typical avocado groves are 10 acres and usually have 4 or more irrigation loops, which service a 1-2 acre portion of the grove. This system will be implemented on at least one of the irrigation loops, while the irrigation practices for the other loops will not be modified. Detailed water usage records will be kept for all irrigation loops so that an analysis and comparison can be made upon completion. In addition, researchers will have access to grove historical water usage records for the particular site so a comparison can be made pre and post Irrigation Management System implementation; for this analysis climatological parameters will be normalized so as to ensure a comparison of actual water usage is made.

***Crop Yield Analysis**:* This analysis will be similar to the water usage analysis. Detailed crop yield information will be kept for the different parts of the grove. Crop yield comparisons between test and control sites, with historical data, and versus water usage data will be made.

Task 10.0: Report Preparation

A draft report and 4 copies will be prepared for the Project Officer. Upon receipt of comments, a final report will be issued within 4 weeks. Monthly progress reports will be submitted detailing project progress, budget expenditures and schedule issues.

Task 11.0: Outreach

Educational outreach will be an important component to ensure that avocado operations across the state are aware of evapotransporation, weather based irrigation controllers, and their significance in reducing water use.

The Commission already has significant expertise in the development and dissemination of industry information and the conduct of education outreach programs. As the industry authority, the Commission has well-established communication channels with its 6,500 grower constituents, and is a respected source of credible information relating to good agricultural practices.

***Irrigation Management System Information**:* The purpose of this study is to supplement existing data resources, and use existing technology and science to place valuable irrigation management information literally at the fingertips of growers. This information communication will be accomplished by the Irrigation Management System communicating the climatic data and irrigation analysis results to the growers by a convenient form of communication (e.g. cell phone, email, or pager). In addition, selected groves (no more than one per location, San Diego and Ventura) will be outfitted with automatic irrigation controllers and valves which will be programmed with peak demand management information and directly receive irrigation scheduling information from the Irrigation Management System.

***Grower Outreach**:* The goal of the grower outreach portion of the project is to ensure that, upon successful implementation of this project, other growers in the state will benefit. Avenues of communication through agencies and organizations like the Farm Bureau, University of California Cooperative Extension, and California Avocado Commission currently utilize, such as newsletters and website postings will be pursued.

SubTask 11.1: Web Data Access for Growers

A project website will be developed that outlines the purpose of the project, key data as it is collected and literature regarding the use of this technology. The web site will serve as both a repository of information for the project team as well as a "portal" for interested stakeholders. The web site will be reached through the existing California Avocado Commission's Southern California Agricultural Water Team's website **(www.scawt.com).** The existence of the website will be publicized through current Commission communications (newsletters, meetings, etc.).

SubTask 11.2: Conduct of Technology Transfer Workshops

The purpose of these workshops will be to engage the agricultural community in this process. Additionally it will provide a hands-on education experience so as to engage a larger group in the Irrigation Management System and the benefits of water conservation and demand management. Concurrent with the implementation of the ET assessment program there will be a significant effort to develop educational programs and to conduct outreach necessary to ensure that the avocado grower community is aware of the project and is provided with periodic updates on its progress. Educational efforts will include a workshop curriculum with a focus on avocado/citrus operations and irrigation practices. The UC Cooperative Extension staff will be involved in these workshops in addition to Commission staff. Two workshops will be conducted (one in Ventura County and one in San Diego County) and a videotape program will be developed and disseminated statewide. The California Avocado Commission newsletter and website will be used to distribute information on the project.

The technology transfer workshops will also impart evapotranspiration information to growers. A detailed curriculum will be developed that will provide those attending with practical and understandable information that can be readily applied in avocado operations. In addition, a videotape/DVD will be prepared that conveys the workshop information developed for the workshops to a much broader audience.

The effectiveness of the outreach/education program will be determined by reporting workshop attendance, compiling workshop evaluation forms, tracking website visits, placing an informational questionnaire on the website, reporting on the distribution of the video program, and by conducting an annual web-based survey of growers to solicit their awareness of the water saving benefits of weather based irrigation controllers.

SubTask 11.3 Publication of Progress and Final Report Information in Newsletters

The progress report information and final project findings will be prominently conveyed to the grower community through the Commission's newsletters and website.

Figure 1 illustrates the tasks necessary to achieve the project deliverables.

Budget and Schedule

The estimated budget and schedule for each task are shown in the two tables (Tables 3 & 4) below and are further described in Section 7. Table 3 provides details on task item budget and direct costs and Table 4 depicts the schedule and deliverables.

Indirect costs are also depicted in Table 3 below. $5,000 has been included for videographer services to produce a high quality video of the Technology Transfer Workshop.

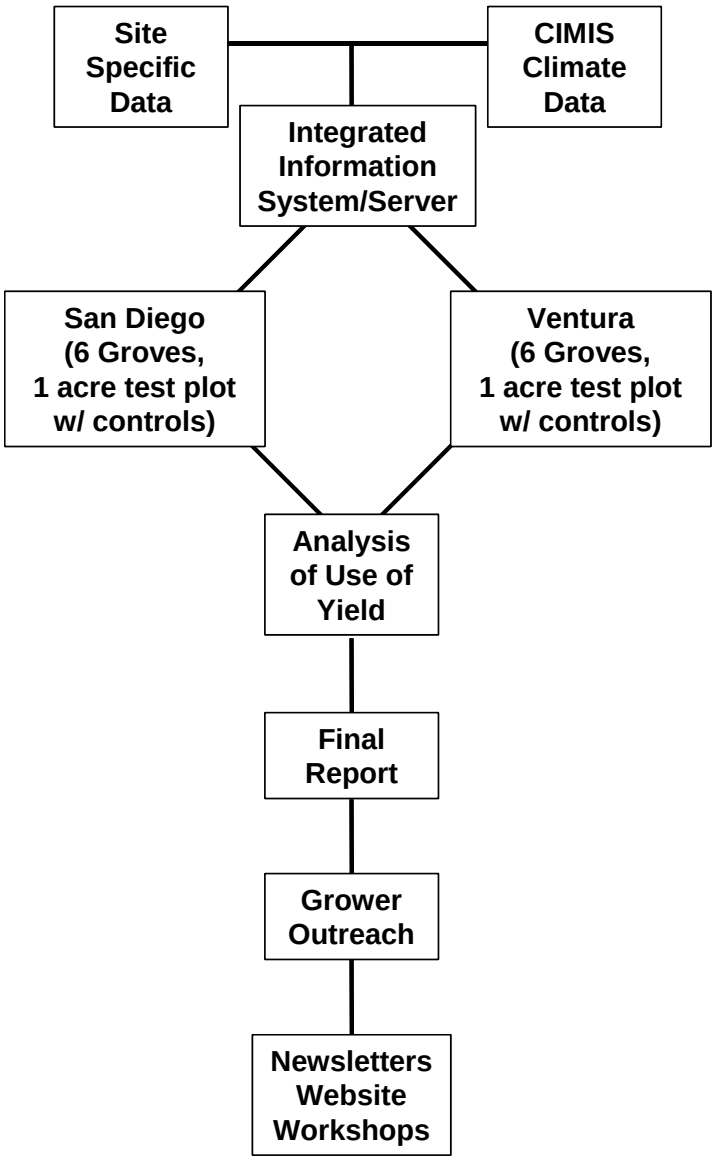


Figure 1: Project Schematic

Table 2: Project Task Budget

Task Budget

Task Number	Tasks	PM ($195/hr)	Staff Eng ($80/hr)	IT Eng ($85/hr)	UCSB ($75/hr) Ag Ext	UCD ($75/hr) Ag Ext	Grower (in-kind hrs, $50/hr)	Task Sub-Total
0.0	Project Management	300						$58,500
1.0	Development of Test Plan	8	20		8	8		$4,360
1.1	Develop of QA/QC manual	4	40		4	4		$4,580
2.0	Develop database	4		160	4	4		$14,980
3.0	Development data entry protocol	4		160	4	4		$14,980
4.0	Grove Selection (12 groves)	16	192		48	48	96	$25,680
5.0	Equipment selection (see direct costs below)	16	80	80	20	20		$19,320
6.0	Equipment installation	16	384	80	40	40	192	$46,640
7.0	Shake down	16	192	80	96	96		$39,680
8.0	Monitoring and data collection (12 mos)	96	2496	496	160	160	4992	$284,560
9.0	Data analysis	80	360		120	120		$62,400
10.0	Report Preparation	80	160		80	80		$40,400
11.0	Outreach							
11.1	Web data access for growers		40	20				$4,900
11.2	2 tech transfer workshops & video	80	80		80	80		$34,000
11.3	Newsletters		80					$6,400
	Hours	**640**	**3924**	**1056**	**584**	**664**	**5280**	$661,380
						In-Kind Value	**$264,000**	**$264,000**

Direct Costs	
Travel (mileage, meals, etc.)	$7,000
ET Controller & Communication Costs	
Weather station($6000/grove x 12 groves)	$72,000
Valve controllers (~$1000 per grove)	$12,000
Telemetry to server(~$3,000 per grove)	$36,000
Telemetry server to grower & 2 grove valves	$25,000
Videographer	$5,000
Tech Transfer Workshop costs	$10,000
Server	$5,000
Total Direct Costs	**$172,000**

Labor subtotal	**$925,380**
Direct Costs	**$172,000**
Subtotal	**$1,097,380**
Contingency	**$55,538**
Project Grand Total including In-kind	**$1,152,918**

Table 3: Project Schedule and Deliverables

Schedule and Deliverables

Task	Task Description	Month																						Deliverable
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
0.0	Project Management																									Monthly, draft and final reports
1.0	Development of Test Plan																									Test Plan
1.1	Develop of QA/QC manual																									QA/QC Manual
2.0	Develop database																									Database
3.0	Development data entry protocol																									Written protocol
4.0	Grove Selection																									Signed Grower participation forms
5.0	Equipment selection																									12 sets of equipment
6.0	Equipment installation																									Installed equipment
7.0	Shake down																									Performance
8.0	Monitoring and data collection																									Monthly updates
9.0	Data analysis																									Draft/Final Report
10.0	Report Preparation																									Draft/Final Report
11.0	Outreach																									
11.1	Web data access for growers																									Development of website
11.2	Tech transfer workshops & video																									Conduct of 2 workshops
11.3	Newsletters																									Publication of 4 progress newsletters

Section 3: Monitoring and Assessment

There are three challenges that will be faced in achieving the project goals. The first is to develop and implement the physical system and computer-based tools that monitor and manage irrigation of an avocado grove, and provide the optimal level of irrigation for the crop. Toward that end, the reliability of the sensors, the communications channels, and the physical controls used to irrigate the crop will be included in the data collection tasks for the project team. The second challenge will be to identify and record, during the project's study period, the parameters that assess project effectiveness, and balance decisions on water use with production quantity and quality. That is, the decisions made to irrigate (or not) at specific times will be based on measured field parameters and the resulting changes in field conditions (e.g., moisture levels) that result from those decisions will be recorded. Finally, it will be important to provide the tools necessary to communicate the results of the study to the affected community as a whole, so that they can benefit from the lessons learned, and the confidence gained, while conducting the study. Results of a field demonstration study do not become fully effective unless the overall community is aware of, and makes use of, the results.

The key effectiveness measures for the project will be improvements in irrigation practices that improve water use efficiency. The reduction in water waste through over-watering, the ability for growers to more precisely schedule irrigation to match crop demand, and improving grower confidence in automated systems are all means to that end. The project's success in each of these areas will be assessed separately, as discussed below. However, all measures of effectiveness are dependent on establishing baseline conditions that are present before any project actions are taken that affect water use or crop yield. Pre-project conditions will be determined by using all existing and readily available data from the growers and historical weather data from nearby weather stations. Monitoring will focus on documenting data from instrumentation during the project, the actions recommended for crop irrigation as a result of these data, and the actual actions taken by the growers in response to the recommendations. It is possible, for example, for field instrumentation to indicate that a grove is receiving sufficient water, but the grower, based on experience and past practice, may wish to irrigate further. The difference in outcomes, comparing the area with controlled irrigation with that under manual control will be assessed; but it is also important to assess *why* the grower believed that decision was incorrect *at the time the decision was made*. Only after gaining the grower's confidence can it be possible to implement widespread reliance on an automated irrigation scheduling system, and only through actual demonstration that the automated system makes good decisions can that confidence be gained.

There are many different variables that can affect water demand and crop yield in agriculture. In this project, the grove selection process will attempt to minimize differences between test and control areas. In the selected groves, the available baseline data on tree age, crop production, sun exposure, water use, and soil quality will be obtained and recorded for comparison with similar data collected during the project's test period. Variations in water demand or crop performance that can be explained by external, uncontrolled variables (such as pest infestation or wind damage to a particular section of a grove) will be documented to permit the data to be interpreted in an appropriate manner at project completion. The amount of reduction in water waste will be demonstrated from the field data after accounting for such external events, and comparing soil

conditions in the managed areas versus the baseline groves, and assessing the crop performance that result from the altered management practices.

Automated data acquisition will be essential in this task, since conditions change throughout the day and within the different microclimates of the groves. Not only will these automated systems provide full-time data acquisition, but the data collected will not be biased by the use of different observers or field techniques at different times. Since the automated data acquisition methods are completely amenable to electronic data storage, the entire data set will be available at the end of the project for additional research and review, and will be submitted to DWR at the end of the project on CD as part of the project report.

The monitoring and data collection tasks comprise the bulk of the project budget, as shown in the attached budget breakdown (Table C-1, Appendix A). After field installation, shakedown, and testing, weekly site visits will be conducted to identify variance from expected performance, and to assure that accurate data is being collected and transmitted through the data collection system.

Section 4: Qualifications of Applicants and Cooperators

The California Avocado Commission is a corporate body organized under the provisions of Division 22, Chapter 5, beginning with Section 67001 of the Food and Agricultural Code. It is a "state body" as defined by Government Code Section 11121, and has been in existence since 1978. The Commission derives all of its funds from legislated grower assessments pursuant to authority granted by the State of California in Food and Agricultural Code Section 67101, et seq. The Commission is broadly responsible for marketing and promotion, issues management, production research and communications for the benefit of the state's 6,500 avocado growers. It operates with an annual budget of approximately $15 million. For over a decade, the Commission has invested over $250,000 annually in program activities related to water. Its Water Program is actively focused on water quality, reliability and affordability issues affecting California avocado growers. The Commission will be accountable for the proper expenditure of grant funds and for the implementation of the grant program. All grant funds will be administered through the Commission and the Commission will be solely responsible for the work product. All other project participants will be under contract to the Commission. Commitment letters and letters of support are included in Appendix B.

The Commission has identified the following entities that will be project participants in that they will perform tasks under the Commission’s direction:

McGuire Environmental Consultants, Inc. – Project management and implementation tasks.

University of California Cooperative Extension (Dr. Ben Faber and Dr. Gary Bender)

Qualifications of the project managers are found in Appendix C. The project team is depicted in the project organization chart below (Figure 2).

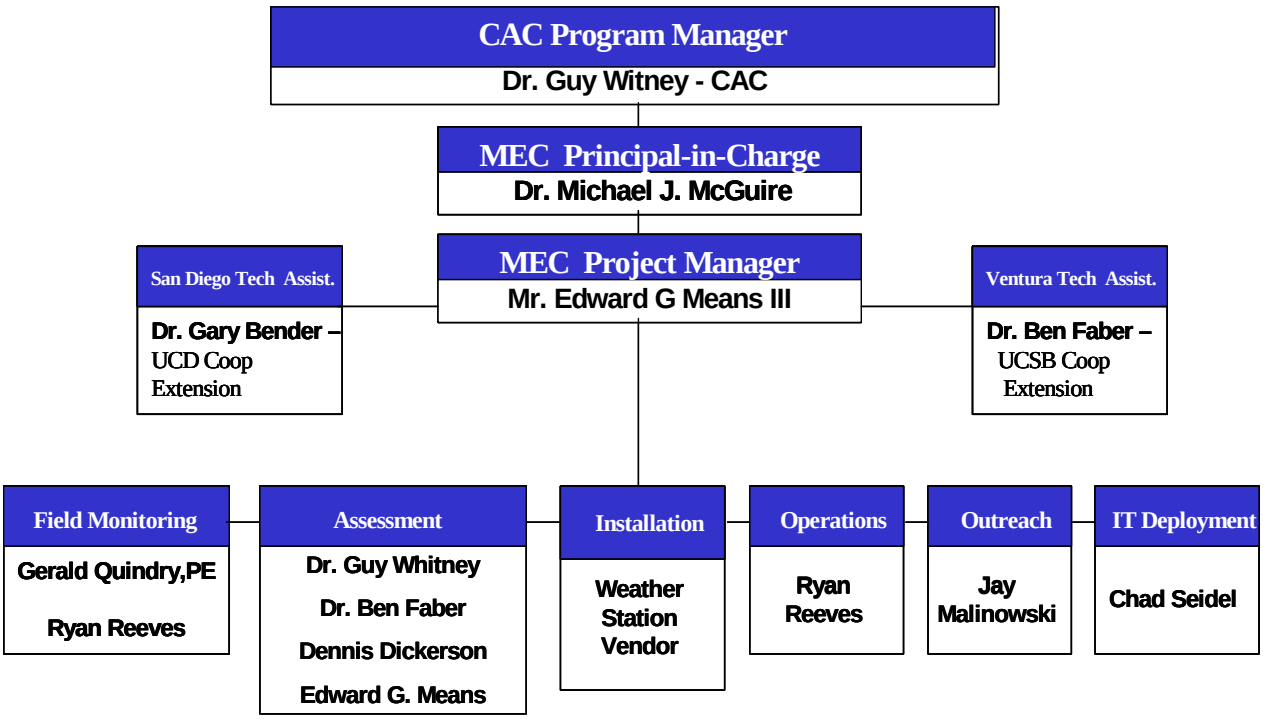


Figure 2: Project Organization Chart

Section 5: Outreach, Community Involvement and Acceptance:

Education

The work product will consist of several components including creation of a webpage for Avocado irrigation management within the Commission's Southern California Agricultural Water Team (SCAWT) Website, conducting two workshops for growers, and development of a videotape (30 minutes) to educate avocado and other agricultural interests in California.

The webpage will build on efforts underway by the Commission to impart a better understanding of irrigation management. The webpage will provide a home for information on weather based irrigation controllers, the progress of the grant implementation measures, and monitoring data collected during the study. The webpage will be updated monthly over the term of the grant.

Two workshops will be conducted for avocado growers (and any other members of the agricultural community) to demonstrate the irrigation technology. The workshops will be 3-4 hours long and will take place on a grove where the irrigation controllers are installed. Each workshop will present information on evapotranspiration and the use of weather based irrigation controllers. The workshops will educate growers regarding the positive financial aspects of reducing water use. The workshops will be conducted in Ventura and San Diego to allow

avocado growers in these and neighboring locations to participate. The University of California Cooperative Extension will be involved in creating the curriculum for the workshops.

A videotape/DVD will be developed (30 minute) that will be widely distributed to avocado growers throughout the state. The video will be distributed free to growers and will be narrated by a recognizable, professional narrator. The program will be based, in part, on the curriculum developed for the workshops and will provide a close look at water savings provided by weather based irrigation controllers. The video program will emphasize the need and obligation for each avocado grower to actively adopt best management practices to control irrigation. The program will clearly identify a set of readily available irrigation controllers and will provide examples of their operation, as well as cost and benefits. The video will be available to growers throughout California.

The Commission already has significant expertise in the development and dissemination of industry information and the conduct of education outreach programs. As the industry authority, the Commission has well-established communication channels with its 6,500 grower constituents, and will use these channels to involve the growers and gain their support in implementing this project.

Section 6: Innovation

ET calculations and irrigation management decisions based on climatic data and other ET parameters is in itself not innovative. This project is innovative in the sense that it combines data resources and accepted agricultural science into a powerful tool and with advanced communications technology places this tool in the hands of individual growers. That tool is referred to as the Irrigation Management System, which will collect applicable regional climatic data from the CIMIS website and combine it with locally collected climatic data, this data will be used in ET calculations and the development of a site specific irrigation schedule specific to an individual grower. This analysis will be directly transmitted to the grower via a convenient form of communication, or directly to an on-site automatic irrigation controller. The successful implementation of this project will achieve several things: 1) increase the usability of the existing CIMIS data network; 2) eliminate sometimes difficult data access and irrigation calculations for the individual growers, 3) demonstrate the potential for significant irrigation water savings that has specific benefit to the Bay-Delta, 4) test the feasibility of combining irrigation scheduling for water conservation with peak demand management strategies through the use of automatic irrigation controllers, 5) test the feasibility of making this system available to growers region-wide and 6) communicate those benefits to the grower community through the California Avocado Commissions existing relationships.

Section 7: Benefits and Costs

Labor Costs

Total labor costs for the project are estimated at $661,380. This includes costs for consultant project management (McGuire Environmental Consultants, Inc.) and general staffing including solicitation of grower participation, weekly visits to 12 test groves, quality assurance planning, test plan development, meetings, data base development, communications (telemetry), data analysis, report writing and outreach.

Direct costs include ET controller costs, weather stations, plumbing, telemetry, a dedicated computer server, and travel costs for staff visits to the 12 groves weekly (more frequently initially).

Cost Sharing

Substantial in-kind costs are being contributed in the project. This is estimated to require 15 hours per month (including grove walk-through), weekly visits, data collection and record keeping or 200 hrs for one year. We estimate that approximately 40 hours of time will be required for initial coordination with each grower including installation of the system, instruction, etc. for a total 440 hr commitment per grower for the study duration. Assuming hourly rates of $50/hr this in-kind portion amounts to 440 x 12 x $50/hr = $264,000 of grower labor.

The California Avocado Commission staff will provide the in-kind services of Dr. Guy Witney as the Project Officer. Dr. Witney is expected to spend a total of 580 hours over a two year period involved in the project.

The total in-kind commitment is therefore, $264,000.

We also believe we may be able to secure discounts on the ET controller equipment that are material but are not able to provide a firm commitment at this time. We have, accordingly, budgeted the estimated unsubsidized cost.

Potential benefits and Water Use and Efficiency Information To Be Disseminated

The demonstration of this technology and dissemination of the information has significant potential benefits. Growers will be able to make clear business case decisions regarding the payback for this investment. Current water costs in some areas of Southern California range as high as $1000 per acre-foot. Growers generally apply between 3 and 5 acre-feet of water per acre for avocado production. According to Mission Resource Conservation District, this application rate varies across the San Diego County area. Assuming average water savings are only ½ acre-foot per acre per year (see the earlier “water savings” section) and this technology

can be implemented on ½ of the irrigated agriculture in San Diego County alone or approximately on 25,000 acres (excluding the savings that could be recognized in Ventura County), the annual water savings would be on the order of 12,500 acre-feet per year while maintaining agricultural production. The avoided cost of the supply to the growers would be approximately $9.4 million per year (or $750 per AF x 12,500 AF). This level of savings would amount to approximately 5 acre-feet of water per year per 10-acre grove (which is about the average size of groves in San Diego County) or annual savings to an individual grove of approximately $3,750. This savings would be sufficient to finance and drive significant adoption of this technology *if it can be demonstrated to the growers through this project*. Importantly, the water savings would reduce proportionately, the required importation of supplies from the Bay-Delta and the Colorado River.

Project Budget

The project budget is estimated at $1,152,918 including contingency dollars. The tables in Appendix A depict the budget, schedule and deliverables in the format as required by DWR.

2004 Water Use Efficiency Proposal Solicitation Package

APPENDIX A: Project Budget Tables

Applicant: California Avocado Commission

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Section A projects must complete Life of investment, column VII and Capital Recovery Factor Column VIII. Do not use 0.

Table C-1: Project Costs (Budget) in Dollars)

	Category	Project Costs $	Contingency % (ex. 5 or 10)	Project Cost + Contingency $	Applicant Share $	State Share Grant $	Life of investment (years)	Capital Recovery Factor	Annualized Costs $
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII	(VIII)	(IX)
	Administration[1]								
	Salaries, wages	$0	0	$0	$0	$0	0	0.0000	$0
	Fringe benefits	$0	0	$0	$0	$0	0	0.0000	$0
	Supplies	$0	0	$0	$0	$0	0	0.0000	$0
	Equipment	$0	0	$0	$0	$0	0	0.0000	$0
	Consulting services	$58,500	5	$61,425	$0	$61,425	0	0.0000	$0
	Travel	$0	0	$0	$0	$0	0	0.0000	$0
	Other	$0	0	$0	$0	$0	0	0.0000	$0
(a)	Total Administration Costs	$58,500		$61,425	$0	$61,425			$0
(b)	Planning/Design/Engineering	$38,900	0	$38,900	$0	$38,900	0	0.0000	$0
(c)	Equipment Purchases/Rentals/Rebates/Vouchers	$150,000	20	$180,000	$0	$180,000	10	0.0000	$0
(d)	Materials/Installation/Implementation	$91,640	20	$109,968	$0	$109,968	0	0.0000	$0
(e)	Implementation Verification	$39,680	0	$39,680	$0	$39,680	0	0.0000	$0
(f)	Project Legal/License Fees	$0	0	$0	$0	$0	0	0.0000	$0
(g)	Structures	$0	0	$0	$0	$0	0	0.0000	$0
(h)	Land Purchase/Easement	$0	0	$0	$0	$0	0	0.0000	$0
(i)	Environmental Compliance/Mitigation/Enhancement	$0	0	$0	$0	$0	0	0.0000	$0
(j)	Construction	$0	0	$0	$0	$0	0	0.0000	$0
(k)	Other (Specify)	$22,000	0	$22,000	$0	$22,000	0	0.0000	$0
(l)	Monitoring and Assessment	$346,960	0	$610,960	$264,000	$346,960	0	0.0000	$0
(m)	Report Preparation	$85,700	5	$89,985	$0	$89,985	0	0.0000	$0
(n)	**TOTAL**	$833,380		$1,152,918	$264,000	$888,918			$0
(o)	Cost Share -Percentage				23	77			

1- excludes administration O&M.

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Table C-2: Annual Operations and Maintenance Costs

Operations (1) (I)	Maintenance (II)	Other (III)	Total (IV) (I + II + II)
$0	$0	$0	$0

(1) Include annual O & M administration costs here.

Table C-3: Total Annual Project Costs

Annual Project Costs (1) (I)	Annual O&M Costs (2) (II)	Total Annual Project Costs (III) (I + II)
$0	$0	$0

(1) From Table C-1, row (n) column (IX)
(2) From Table C-2, column (IV)

Applicant: **California Avocado Commission**

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Table C-5 Project Annual Physical Benefits (Quantitative and Qualitative Description of Benefits)

	Qualitative Description - Required of all applicants[1]				**Quantitative Benefits - where data are available [2]**
	Description of physical benefits (in-stream flow and timing, water quantity and water quality) for:	Time pattern and Location of Benefit	Project Life: Duration of Benefits	State Why Project Bay Delta benefit is Direct[3] Indirect [4] or Both	Quantified Benefits (in-stream flow and timing, water quantity and water quality)
Bay Delta	The proposed project is located in the service area of the Metropolitan Water District of Southern California. The project is designed to demonstrate and convey the value of ET controller technology to agricultural water users in the Metropolitan service area there by expanding the use of this technology and saving water that would otherwise be required to be imported through the State Water Project or Colorado River Aqueduct. The program directly benefits the Bay-Delta through the initial demonstration project saved water volumes but has maximum impact through the outreach and broader adoption of this technology in the Metropolitan service area. The California Avocado Commission represents most irrigated grove agriculture in Southern California and, therefore, has the great access to growers. They also have long-standing relationships with the UC Cooperative Extension staff (who also have trusted contacts in the grower community). Two respected staff, Dr. Ben Faber and Dr. Gary Bender of UC Santa Barbara and UC Davis, respectively, are on the project team.	Most water savings would be realized during the warmer periods of the year (from April through November) when irrigation volumes are highest.	The initial demonstration scale benefits would be recognized over a one year period. The equipment would left in the groves and would therefore continue to accrue water savings benefits. The primary value of the project is to accelerate deployment of this technology broadly and permanently.	The benefit is direct in that conservation of water in Metropolitan's service area directly reduces the required need to import water from outside the service area. Cal Fed has three primary objectives: Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species (this is aided by reducing imports); Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system (this is adied by reducing import needs through projects like this one); Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees. Indirect benefits accrue (increasing local water supplies through efforts like conservation can reduce the impact of supply reductions on the agricultural economy).	Assuming 12 10-acre groves are retrofit with this technology, and 1 acre-foot per acre is saved annually, the immediate benefit is a water savings of approximately 10 AF per grove or 120 AF per year for all 12 groves. This, however is only for the demo. The primary objective is to use the demo project to dramatically expand the use of the technology. By example if 1/2 of irrgated groves in San Diego County install this technology, approximately 25,000 AF of water could be saved annually. Importantly, it is possible that the avoided cost of the otherwise purchased water will pay for the technology. This demo is key to prove the technology to local growers and outreach critical to get the information into the hands of growers (which is why CAC has included it in the project and enaged the UC Cooperative Extension).
Local	The local benefits will accrue to the direct participants through lower costs of water for irrigation. Avocado costs are dominated by water costs (approximately 60% of the production cost). Local water agencies will be required to purchase less imported water from Metropolitan. Importantly, in some areas, like San Diego County, important peaking management benefits will accrue during warm summer months when existing water demands exceed local facility capacity. Significant agricultural conservation (like could be realized through this project) will certainly help peaking and potentially forestall capital spending for some facilities.	Most water savings would be realized during the warmer periods of the year (from April through November) when irrigation volumes are highest.	The initial demonstration scale benefits would be recognized over a one year period. The equipment would left in the groves and would therefore continue to accrue water savings benefits. The primary value of the project is to accelerate deployment of this technology broadly and permanently.	The local benefit is direct in that conservation of water in Metropolitan's service area directly reduces the required need to import water from outside the service area. Indirect benefits accrue.	These benefits are essently the same as above.

[1] The qualitative benefits should be provided in a narrative description. Use additional sheet.

[2] Direct benefits are project outcomes that contribute to a CALFED objective within the Bay-Delta system during the life of the project.

[3] Indirect benefits are project outcomes that help to reduce dependency on the Bay-Delta system. Indirect benefits may be realized over time.

[4] The project benefits that can be quantified (i.e. volume of water saved or mass of constituents reduced) should be provided.

Applicant: California Avocado Commission

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Table C-6 Project Annual Local Monetary Benefits

ANNUAL LOCAL BENEFITS*	DEMO ANNUAL QUANTITY (120 AF)	POTENTIAL FULL-SCALE QUANTITY (25,000AF+)	UNIT OF MEASUREMENT	DEMO ANNUAL MONETARY BENEFITS	POTENTIAL FULL-SCALE ANNUAL MONETARY BENEFITS
(a) Avoided Water Supply Costs (Current or Future Source	$250	$250	acre-feet	$30,000	$6,250,000
(b) Avoided Energy Costs	$81	$81	acre-feet	$9,720	$2,025,000
(c) Avoided Waste Water Treatment Costs	$112	$112	acre-feet	$13,440	$2,800,000
(d) Avoided Labor Costs	0	0	acre-feet	$0	$0
(e) Other (approximate local agency markup)	$80	$80	acre-feet	$9,600	$2,000,000
(f) Total [(a) + (b) + (c) + (d) + (e)]	~~$523~~	~~$523~~		$62,760	$13,075,000

*Based upon published MWD water rates

Table C-7 Project Local Monetary Benefits and Project Costs

(a) Total Annual Monetary Benefits [(Table C-6, row (f)]	$62,760		$13,075,000
(b) Total Annual Project Costs (Table C-3, column III)			$0

Table C-8 Applicant's Cost Share and Description

Applicant's cost share %: (from Table C-1, row o, column \	23	100%	**23**
		The cost share is based upon the in-kind services of the California Avocado Commission Staff (Dr. Guy Witney) contributing 580 hrs over the project life and 12 growers contributing 440 hours each at $50/hr over the project life including involvement in grove selection, installation of equipment and weekly monitoring of equipment function (ie walking the test and control plots). Should the demonstration prove successful, broad deployment of the technology is likely and cost-effective with minimal state support. This is an investment by the state up front to gain significant local investment and state-wide water savings later.	

FARM BUREAU SAN DIEGO COUNTY

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December 20, 2004

Mr. Tom Bellamore, Executive Director
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

Subject: Recommendation in Support of an Application by the California Avocado Commission for a Proposition 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

I am writing to express the San Diego County Farm Bureau's support for the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will offer a demonstration of new technologies that are now becoming available that can achieve a substantial savings of water that is used for irrigation.

By demonstrating this new technology in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of this technology. As this technology becomes better known and the value is demonstrated in a scientific manner and by a recognized leader among agricultural support organizations in southern California, the potential to realize substantial savings in water is significant. As water used for irrigation is applied more efficiently, taking advantage of close monitoring of weather and environmental conditions, water applied to avocado groves could be reduced.

As advanced irrigation water supply technologies are more widely used following the successful outcome of this project, water that is now diverted from the California Bay-Delta to the State Water Project could remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the importance of that long-term goal, the potential water savings that could be realized from this proposal should be given serious consideration.

I believe your proposal is of special merit, and I urge the California Department of Water Resources to give this application full and fair consideration.

Sincerely,

Eric Larson
Executive Director

COOPERATIVE EXTENSION **COUNTY OF VENTURA**

Agriculture & Natural Resources
University of California

669 County Square Drive, Suite 100
Ventura, California 93003-5401
(805) 645-1451 Fax: (805) 645-1474
E-mail: ceventura@ucdavis.edu
Website: ceventura.ucdavis.edu

December 17, 2004

Mr. Tom Bellamore, Executive Director
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

Subject: Recommendation in Support of an Application by the California Avocado Commission for a Proposition 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

I am writing to express my strong support for the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will offer a demonstration of new technologies that are now becoming available that can achieve a substantial savings of water that is used for irrigation.

By demonstrating this new technology in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of this technology. As this technology becomes better known and the value is demonstrated in a scientific manner and by a recognized leader among agricultural support organizations in Southern California, the potential to realize substantial savings in water is significant. As water used for irrigation is applied more efficiently, taking advantage of close monitoring of weather and environmental conditions, water applied to avocado orchards could be reduced.

As advanced irrigation water supply technologies are more widely used following the successful outcome of this project, water that is now diverted from the California Bay-Delta to the State Water Project could remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the importance of that long-term goal, the potential water savings that could be realized from this proposal should be given serious consideration.

I believe your proposal is of special merit, and I urge the California Department of Water Resources to give this application full and fair consideration.

Sincerely,

Ben Faber, Farm Advisor

KATHLEEN A. THUNER
AGRICULTURAL COMMISSIONER
SEALER OF WEIGHTS
AND MEASURES

County of San Diego

DEPARTMENT OF AGRICULTURE, WEIGHTS & MEASURES
5555 Overland Ave., Bldg. 3, San Diego, CA 92123-1292

AGRICULTURE
(858) 694-2739
FAX
(858) 565-7046
WEIGHTS & MEASURES
(858) 694-2778

January 4, 2005

Mr. Tom Bellamore, Executive Director
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

Subject: Recommendation in Support of an Application by the California Avocado Commission for a Proposition 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

I am writing to express my strong support for the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will offer a demonstration of emerging technologies that can achieve substantial savings of water that is used for irrigation.

By demonstrating this new technology in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of this technology. Increased awareness of this technology through a science-based demonstration by a recognized leader among agricultural support organizations in Southern California, will significantly increase the potential for its deployment and associated water savings. The proposed project will demonstrate the efficient application of irrigation water through the integration of weather and environmental monitoring technologies.

Deployment of advanced irrigation water supply technologies over a wider geographic area following the successful outcome of this project, will allow water that is now diverted from the California Bay-Delta to the State Water Project to remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the importance of this long-term goal, the potential water savings that could be realized from this proposal deserve serious consideration.

I believe your proposal is of special merit, and I urge the California Department of Water Resources to give this application full and fair consideration.

Sincerely,

KATHLEEN A. THUNER
Agricultural Commissioner/
Sealer Weights and Measures

KAT:pd

STATE CAPITOL
P.O. BOX 942849
SACRAMENTO, CA 94249-0066
(916) 319-2066
FAX (916) 319-2166

DISTRICT OFFICE
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TEMECULA, CA 92591
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Assembly
California Legislature

RAYMOND N. HAYNES
ASSEMBLYMEMBER, SIXTY-SIXTH DISTRICT

COMMITTEES
VICE-CHAIR
HUMAN SERVICES
MEMBER
APPROPRIATIONS
BUDGET
NATURAL RESOURCES

December 21, 2004

Mr. Tom Bellamore, Executive Director
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

Subject: Recommendation in Support of an Application by the California Avocado Commission for a Proposition 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

I am writing to express my strong support for the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will offer a demonstration of new technologies that are now becoming available that can achieve a substantial savings of water that is used for irrigation.

By demonstrating this new technology in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of this technology. As this technology becomes better known and the value is demonstrated in a scientific manner and by a recognized leader among agricultural support organizations in Southern California, the potential to realize substantial savings in water is significant. As water used for irrigation is applied more efficiently, taking advantage of close monitoring of weather and environmental conditions, water applied to avocado orchards could be reduced.

As advanced irrigation water supply technologies are more widely used following the successful outcome of this project, water that is now diverted from the California Bay-Delta to the State Water Project could remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the importance of that long-term goal, the potential water savings that could be realized from this proposal should be given serious consideration.

I believe your proposal is of special merit, and I urge the California Department of Water Resources to give this application full and fair consideration.

Very truly yours,

Ray Haynes

RAYMOND N. HAYNES

DARRELL E. ISSA
49TH DISTRICT, CALIFORNIA

COMMITTEE ON
ENERGY AND COMMERCE
SUBCOMMITTEES:
COMMERCE, TRADE AND CONSUMER PROTECTION
ENERGY AND AIR QUALITY
ENVIRONMENT AND HAZARDOUS MATERIALS

HOUSE POLICY COMMITTEE

Congress of the United States
House of Representatives
Washington, DC 20515–0549

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SOUTHWEST RIVERSIDE COUNTY
(909) 693-2447
www.issa.house.gov

January 4, 2005

Mr. Lester A. Snow
Director
California Department of Water Resources
PO Box 942836
Sacramento, CA 95814

Dear Mr. Snow:

I write to express my strong support for the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will offer a demonstration of new technologies that are now becoming available that can achieve a substantial savings of water that is used for irrigation.

By demonstrating this new technology in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of this technology. As this technology becomes better known and the value is demonstrated in a scientific manner and by a recognized leader among agricultural support organizations in Southern California, the potential to realize substantial savings in water is significant. As water used for irrigation is applied more efficiently, taking advantage of close monitoring of weather and environmental conditions, water applied to avocado orchards could be reduced.

As advanced irrigation water supply technologies are more widely used following the successful outcome of this project, water that is now diverted from the California Bay-Delta to the State Water Project could remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the importance of that long-term goal, the potential water savings that could be realized from this proposal should be given serious consideration.

I believe this proposal is of special merit, and I urge the Department of Water Resources to give this application full and fair consideration.

Sincerely,

Darrell E. Issa
Member of Congress

San Diego County Water Authority
4677 Overland Avenue • San Diego, California 92123-1233
(858) 522-6600 FAX (858) 522-6568 www.sdcwa.org

January 4, 2005

Mr. Tom Bellamore
Executive Director
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

RE: Recommendation in Support of an Application by the California Avocado Commission for a Proposition 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

The San Diego County Water Authority strongly supports the California Avocado Commission's application for a Proposition 50 grant for agricultural water use efficiency. The proposed project will demonstrate new technologies that can achieve a substantial savings of water that is used for irrigation.

By demonstrating these new technologies in field conditions and disseminating information on the project's value in saving water, the Commission can help to foster the expanded use of the technologies. As the technologies become better known and the value is demonstrated in a scientific manner by a recognized leader among agricultural support organizations in Southern California, the potential for substantial water savings is significant. When water used for irrigation is applied more efficiently, taking advantage of close monitoring of weather and environmental conditions, water applied to avocado orchards could be reduced.

As advanced irrigation water supply technologies are more widely used following the successful outcome of this project, water that is now diverted from the California Bay-Delta to the State Water Project could remain in the Bay-Delta to meet urgent needs that are being developed by the Bay-Delta Authority. Given the important of that long-term goal, the potential water savings that could be realized from this proposal should be given serious consideration.

Sincerely,

Maureen A. Stapleton
General Manager

I:\CINDY\Prop 50 letters of support\CA Avocado Commission.doc

A public agency providing a safe and reliable water supply to the San Diego region

January 6, 2004

Mr. Tom Bellamore
Senior Vice President & Corporate Counsel
38 Discovery, Suite 150
Irvine, CA 92618

RE: Commitment to Participate in an Application by the California Avocado Commission for a Prop 50 Grant for Water Use Efficiency

Dear Mr. Bellamore:

McGuire Environmental Consultants, Inc. is pleased to write this letter of commitment to the California Avocado Commission regarding your pending application for a grant under Proposition 50 for Water Use Efficiency. The proposed project for which you are seeking grant funding will provide information that will be helpful to the community, the region and the water industry, by helping to reduce agricultural water use by using evapotranspiration (ET) controllers. McGuire Environmental Consultants, Inc. is pleased to be included on the project team and will provide project management, field monitoring, assessment, operations, outreach, and IT deployment.

Sincerely,

Edward G. Means III
Sr. Vice President
McGuire Environmental Consultants, Inc.

2004 Water Use Efficiency Proposal Solicitation Package

APPENDIX C: Project Team Managers Resumes

Guy W. Witney, Ph.D
California Avocado Commission
38 Discovery, Suite 150
Irvine, CA 92618

Telephone: 949-341-1955
Fax: 949-341-1970
E-mail: Gwitney@avocado.org

Education:

University of Natal, Pietermaritzburg: Batchelor of Science; B.Sc. 1982
University of Natal, Pietermaritzburg: Master of Science in Ag; M.Sc. 1986
Virginia Tech: Doctorate, Plant Physiology; Ph.D. 1989

Professional Experience:

2003 to present Director of Industry Affairs, California Avocado Commission
1999 to 2003 Production Research Program Manager, California Avocado Commission
1996 to 1999 Area Tree Fruit Horticulture Extension Faculty, Washington State University, Wenatchee, WA
1989 to 1996 Subtropical Horticulture and Citrus Management Specialist, University of California, Riverside

Primary Responsibilities in Current Position:

Grower relations, communication and education; crop estimation and shipment projections; production research program management.

Relevant Publications:

Witney, Guy W., Wolstenholme, B. Nigel, Hofman, P.J. 1986. Calcium Accumulation In Avocado Fruits: Effect of Cultivar and Tree Vigor. South African Avocado Growers' Association Yearbook 1986. 9:35-38.

Arpaia, Mary Lu, Bender, Gary S., Meyer, Jewell L., Stottlemyer, David E., Takele, Etaferahu, Witney, Guy W., Yates, Marylynn V. 1992. Irrigation and Fertilization Management of Avocados. Proc. of Second World Avocado Congress 1992 pp. 281-288.

Arpaia, Mary Lu, Bender, Gary S., Meyer, Jewell L., Stottlemyer, David E., Takele, Etaferahu, Witney, Guy W., Yates, Marylynn V. 1992. Irrigation and Fertilization Management of Avocados: Economic Analysis Progress Report. Proc. of Second World Avocado Congress. 1992. pp. 579-583.

Bender, Gary S., Witney, Guy W. Water Conservation Strategies for California Groves. Proc. of Second World Avocado Congress 1992. pp. 349-355.

Martin, Gray E., Witney, Guy W. 1995. Taking the California Avocado Breeding Program into the Next Century. Proceedings of the World Avocado Congress III, 1995. pp. 114 - 118.

Additional references are available upon request.

Edward G. Means
Senior Vice President and Principal
McGuire Environmental Consultants, Inc.
Phone: 949/723-8830 Fax: 949/723-8831
3471 Via Lido, Suite 207, Newport Beach, CA 92663-3929

Areas of Qualification

Edward G. Means III is a Senior Vice President with the firm. Mr. Means has over 25 years of experience, including 18 years with the Metropolitan Water District of Southern California, culminating in 2-1/2 years as Deputy General Manager and Chief Operating Officer. He also provided general management services to the utility for several months upon joining McGuire Environmental Consultants, Inc. At Metropolitan, his roles also included stints as Water Quality Laboratory Manager, Director of Water Quality, Director of Resources, and Chief of Operation. Between 1992 and 1997, he represented the National Water Resources Association (NWRA), and then the American Water Works Association (AWWA), on the Federal Advisory Committee negotiating the Disinfectants/ Disinfect ion By-Products Rule.

Relevant Professional Experience

Utility long-range management stratifies including competitiveness; work-force strategies and policies reengineering and benchmarking; Utility operations audits; Regulatory development and compliance implementation; Water quality studies and investigations in source waters, treatment plants, and distribution systems; Project management; Laboratory management; Water resources management and rates.

Projects

Examples of projects Mr. Means has managed for the firm over the last 6 years include:

- Project Manager for water treatment plant regulatory assessments.
- Principal in Charge for 2 Sanitary Survey
- Project Manager for Science and TechnologyAssessment/American Assembly tasks associated with re-visit of the City of San Diego's North City Water Reclamation Plant indirect reuse project
- Project Manager for the AwwaRF Strategic Assessment 2 project assessing strategic trends affecting the U.S. water utilities
- Principal-in-charge for the City of Escondido Water Quality Laboratory Resources Evaluation
- Principal-in-charge of chlorine dioxide/nitrification control full-scale test program for the City of Carlsbad
- Project Manager for AwwaRF Tailored Collaboration Project "Water Quality Implications of Large-Scale Application of Seawater Desalination"
- Principal Investigator for AwwaRF 2816, "Water Quality Management: How to Structure it in a Utility"
- Principal Investigator for AwwaRF 2604 "A Strategic Assessment of the Future of Water Utilities". Published book "Watercourse: Charting Your Utility's Future"
- Treatment Plant, Santa Barbara, California
- Conducted SDWA compliance audits of City of Fullerton
- Managed the conduct of bromate control strategy assessment for Mesa Consolidated Water District, Costa Mesa, California.
- Principal in Charge for a pilot scale ozone/magnetic ion exchange resin investigation of bromate control strategies.
- Conducted nationwide DBP Rule training for AWWA
- Conducted water quality regulation compliance audit for Contra Costa Water District, Contra Costa, California

Education

Professional Management Program, University of Southern California, Los Angeles, CA, 1987.

Master of Arts, Social Ecology, University of Southern California, Los Angeles, CA, 1980.

Bachelor of Arts, Social Ecology (Honors), University of California, Irvine, CA, 1977.

2004 Water Use Efficiency Proposal Solicitation Package

APPENDIX D: References

1. Allen, R. G., L. S. Pereira, D. Raes and M. Smith- FAO - Food and Agriculture Organization of the United Nations. *Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements.*1998. (http://www.fao.org/docrep/X0490E/X0490E00.htm)

2. Aquacraft, Performance Evaluation of WeatherTrak Irrigation Controllers in Colorado, 2001 and 2002, (http://www.aquacraft.com)

3. CAC-California Avocado Commission. (http://www.avocado.org/static/growerres/cimiscalculator.php)

4. CDFA- Californial Department of Food and Agriculture. California Agricultural Statistics 2003.2004. (http://www.cdfa.ca.gov/card/card_new03.htm)

5. CIMIS-California Irrigation Management Information System. http://wwwcimis.water.ca.gov/cimis/welcome.jsp

6. Hunt, T., Lessick, D., Berg, J., Wiedman, J., Ash, T., Pagano, D. Marian, M., and Bamezai, A., *Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller*" Study, 2001

7. Jordan, A., Lang, R., and Gonzalez, M., *High Tech World Meets the Irrigation Controller to Save Water in Santa Barbara County*, 2004 (forthcoming in AWWA conference proceedings)

8. Metropolitan Water District of Southern California, *Weather Based Controller Bench Test Report*, 2004

9. TPLA-The Port of Los Angeles. (http://www.portoflosangeles.org/index.htm)

10. Smith, M. (1995). *Summary Report, Conclusions and Recommendations*. Proceedings of the ICID/FAO Workshop on Irrigation Scheduling, Rome, Italy, Sept. 12-13. (http://www.fao.org/docrep/W4367E/W4367E00.htm)