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Statement of Work:
Section One: Relevance and Importance

The efficient use of California's limited water supplies is a critical local, regional and statewide issue. The Bay-Delta supplies 22 million people in the state with water. However, there is a mis-match between the available supplies and beneficial uses of the Bay-Delta system. Water use efficiency is one of the strategies that will help to meet this objective, as stated in CALFED's Record of Decision (ROD).

CALFED has estimated the potential for urban water conservation at almost 2 million acre-feet per year. CALFED estimates that landscaping statewide is irrigated at 1.2 times the ETo , thus landscape irrigation is one urban use that offers significant opportunities for savings, as well as other benefits. , which suggests that over-watering is a major cause of water waste. Water waste from over-watering occurs as a result of improper irrigation scheduling and/or irrigation system inefficiency.

Irvine Ranch Water District (IRWD) has taken a leadership role in researching irrigation technologies that will provide water savings and reduce urban runoff. To date, IRWD has conducted two studies of evapotranspiration (ET) -based irrigation management systems, the Westpark Study and the Residential Runoff Reduction Study (R3 Study). The first study of residential ET-based systems resulted in average water savings of 37 gallons per day (gpd). The R3 Study showed, on average, 41 gpd water savings for single-family homes, along with a run-off reduction of up to 70 percent. The R3 Study also included a small sample of commercial sites (small and medium-sized landscapes). The average water savings a commercial site were 545 gpd. IRWD has also implemented ET-based water budgets combined with an aggressive tiered rate structure.

As a result of the studies by IRWD and others, many agencies are beginning large-scale ET-based irrigation control implementation programs. However, it is important to recognize that although irrigation scheduling is a critical element of landscape water use, it is only one part of the equation. Irrigation system efficiency is the other factor that affects landscape water use and waste. Most irrigation controllers, including ET controllers, assume a certain minimum level of irrigation system efficiency. AB 325 sets a standard of 62.5%. However, the reality in the field is that irrigation systems often operate with efficiencies as low as 40% and 50%. IRWD staff observed during the ET controller studies conducted by the District, that sites operating with inefficient systems did not work as well with the new ET controller technologies. This is because ET controllers are designed to apply the correct amount of water for the site, and the automatic schedules do not overcompensate for irrigation system problems by applying additional water.

IRWD is proposing to study the impact of retrofitting spray heads on existing irrigation systems with new state-of-the-art low volume rotary nozzles to improve the irrigation system efficiency, and the water use efficiency at the site. Although irrigation system efficiency is a key factor in landscape water use efficiency, it has been difficult to design and implement cost-effective programs due to the uniqueness of each site and design

differences. However, the new rotary nozzle shows promise in terms of providing a cost-effective method to improve system efficiency, and as a result improve landscape water use efficiency. Improved landscape water use efficiency has a number of benefits. Local benefits are summarized below, however the benefits would be readily transferable throughout the state:

- Water savings - reduces demand on Metropolitan Water District of Southern California's imported supplies, which include the Bay-Delta system and Colorado River;

- Reduces urban runoff into streams, ocean and groundwater basins, which transport pollutants to those receiving waters;

- Reduces summer peaking demands; and

- Reduces pumping and related energy costs.

Improving landscape water use efficiency is a statewide objective, as noted above. It is also a key component in the Integrated Regional Plan of the Metropolitan Water District of Southern California (Metropolitan) and the Municipal Water District of Orange County, IRWD's regional wholesale agencies. Both of those agencies are planning large-scale ET controller programs as a means of addressing landscape water use efficiency. Metropolitan received a Prop 13 Water Use Efficiency grant for ET-based irrigation controllers, and MWDOC was awarded a Prop 13 Watershed Management grant for $774,000, also for ET controllers. The ET-based irrigation controllers will address many of the problems associated with improper irrigation scheduling, but they will not address water waste that results from irrigation system inefficiencies. This project is designed to assess the water savings from irrigation system efficiency improvements on landscape water use efficiency and evaluate the effectiveness of the pilot program design.

Statement of Work:
Section Two: Technical/Scientific Merit, Feasibility

IRWD is proposing to study the effectiveness of making relatively low-cost irrigation system efficiency improvements, using new state-of-the-art rotary nozzles to retrofit typical spray heads. The key objectives of the project are as follows:

- Evaluate the water savings resulting from irrigation system efficiency improvements by retrofitting spray heads with rotary nozzle heads.
- Design and evaluate a proposed cost-effective method to improve irrigation system efficiency and maximize associated water savings.

Efficient landscape water use depends on two variables; ET-based irrigation scheduling and irrigation system efficiency. New weather-based or ET-based irrigation controllers are being designed and many water agencies are already operating pilot programs or full-scale implementation programs, based on studies conducted by IRWD and others. The other variable, irrigation system efficiency, has traditionally been much more difficult to address. Landscape irrigation retrofits tend to be time consuming and very costly because many times entire zones have to be redesigned and completely new irrigation heads installed. Irrigation retrofits can range from $5,000 at the low end to upwards of $20,000 per site. Furthermore, each site is different and cannot be managed with a "cookie cutter" approach. As a result, irrigation retrofits and system efficiency improvement programs have been difficult to administer and fund on a cost-effective basis.

One of the most common components used in typical landscape irrigation systems, the spray nozzle, is responsible for a significant amount of waste in the use of water for landscape irrigation. The problems are in the design of the nozzle opening. With only one opening, the water comes out of the nozzle in a consistent pattern. Within the area that is being watered by the nozzle some areas get more water than others. Distribution uniformity (DU) is a concept that describes the ability of a nozzle to apply water evenly over a given area. 100% DU would mean that every part of a given area is getting the same amount of water. Imagine putting your thumb over the end of a garden hose. If you keep your thumb in the same position, the water comes out in one pattern and in this pattern some areas will get more water than others, But, if you move your thumb around you can change the pattern and get more water to those areas that aren't getting enough. Typically, spray heads are rated at 70% DU. However, those ratings are generally calculated under very controlled conditions. Real world situations, factoring in system design, installation and maintenance reduce DU to 50%-60% or less. At 50% DU, one would have to water twice as long to ensure that all areas received adequate water. Of course, that would mean that some areas receive much more water than they need.

Another problem is the rate at which the water comes out of the nozzle. This rate, precipitation rate (PR), describes the amount of water applied to a given area over a period of time (inches/hour). Typical spray heads are rated anywhere from 1.5 inches per hour. to 2.5 inches per hour. This means that a lot of water is applied in a short amount of time. This

causes problems when irrigating slopes and/or clay soils. If the water is applied faster than the soil can accept it, the result is water waste and urban runoff.

Spray heads are designed to operate optimally at relatively low pressures, in the 25 psi to 35 psi range. At higher pressure the droplet size of the water is reduced and often results in misting. As much as 30% of the water being applied can be lost in windy conditions.

A relatively new landscape irrigation component shows promise in helping reduce some of these problems associated with the spray nozzle. These nozzles, called rotary nozzles, have variously cut nozzle openings that rotate during use to distribute the water more evenly throughout the watering pattern than spray heads. A limited Cal Poly, Pomona[1] study of one brand of rotary nozzle indicated average DU improvement of 61% compared to similar spray nozzles. This same study showed an average reduction of PR of 53% and average potential water savings of 37%.

Rotary nozzles are designed to be installed on the risers of some of the most commonly used spray heads. They can be easily installed by simply unscrewing the existing spray nozzle and screwing on the rotary nozzle. Nozzle adjustment for radius or arc is a simple screw adjustment. The irrigation schedule can then be adjusted to reflect the lower PR and higher DU. The rotary nozzles offer a low cost opportunity to improve the efficiency of many existing systems, particularly on smaller turf areas (approximately half an acre), which are among the highest water using (and wasting) sites. IRWD is proposing to test the use of retrofitting turf areas of sites with DUs of 50% or less with the rotary nozzles. Since turf is the highest water using plant material in a typical landscape, this project is designed to test the effectiveness of maximizing the water savings potential and runoff reduction at the lowest cost.

If we assume an average of a half an acre of turf per site, and a DU of 50% then it would take 4 acre-feet per year to irrigate the site. This is calculated by using the average 10-year historical demand for coolseason turfgrass in the Irvine area of four acre-feet/acre. Therefore, irrigating one-half acre at 50% efficiency would require four acre-feet of water per acre per year. If we can improve DU by 25% (50% DU to 62.5% DU) through the use of rotary nozzles, then we could potentially achieve 33% water savings that would equal 1.3 acre-feet per site or 2.6 acre feet per acre per year.

Site Selection and Eligibility

- IRWD will target commercial landscape sites with turf areas of less than 1 acre (half acre average) with usage consistently above the ET-based water budget allocation for the site.
- All selected sites will have dedicated irrigation meters so that water usage can easily be tracked.
- Sites must have spray heads that can be retrofitted with rotary nozzle technology.

[1] Landscape Irrigation Water Management – Uniformity & Sprinkler Retrofits, Presented at Turfgrass and Landscape Institute, Dec 15, 2004, by Ramesh Kumar, Chris Curry & Joe Kissinger, Landscape Irrigation Science, Cal Poly, Pomona.

- The irrigation system efficiency (distribution uniformity) at each site will be 50% or less to be eligible for participation. The distribution uniformity of the turf area will be measured with an on-site landscape audit, conducted by a Certified Landscape Irrigation Auditor (CLIA).
- Eligible sites must not have made any significant landscape repairs or improvements in the three years prior to the program, and must not have any plans for renovations for at least one year after participation.

Targeting

Targeted sites will be sent a letter inviting them to participate in the IRWD study. IRWD will follow up with phone calls directly to the customers to encourage participation. Study participants will be divided into two groups of 40:

1. Irrigation efficiency improvements
2. Control group

Participation Process

1. Customers wishing to participate will schedule an on-site irrigation audit.
2. IRWD will schedule a Certified Landscape Irrigation Auditor to conduct an audit that will include documenting the distribution uniformity of the turf areas ,at the site and identifying irrigation system components and upgrades that could improve the distribution uniformity. A copy of the report will be provided to the customer, and a copy retained by IRWD.
3. Customer will submit a proposal to IRWD for irrigation system efficiency improvements with a scope of work including the make, model and quantities of rotary nozzles required for the retrofit.
4. IRWD staff will approve submitted work plans prior to implementation and provide the customer with the requested rotary nozzles.
5. Licensed contractors will conduct the on-site spray nozzle retrofits, using the equipment provided by IRWD. All inventory will be tracked using an inventory tracking sheet and by the IRWD inventory management database system. Customers will be liable for the cost of any uninstalled equipment. Installation costs will be the responsibility of the customer.
6. Customer will submit signed-off work plan and copy of invoice from contractor to IRWD.

Monitoring and Verification

1. IRWD will schedule a post-installation site inspection, verify that all work was completed, and measure post-installation distribution uniformity.
2. Participants will be required to keep a log of any maintenance repairs at the site, during the monitoring period and provide copies to IRWD.
3. IRWD will visit each site during the one-year monitoring year to assess the aesthetics, and note any problems such as brown spots. Monitoring visits will be made monthly during June, July, August and September, and bi-monthly for the balance of the year. A total of 2 hours per site is allocated for this purpose.

4. IRWD will send questionnaires to program participants to provide a qualitative review of the program. IRWD staff will follow-up with non-respondents to try and ensure a high response rate.

Tracking and Reporting

IRWD will develop an access database to track the program. The database will include account and site specific information including:

- Site address and customer information
- Meter number
- Total irrigated acreage
- Turf acreage
- Turf distribution uniformity (pre and post)
- Quantity and types of rotary nozzles provided for each site.
- Landscape maintenance contractor
- Type of irrigation controller

IRWD will also maintain files containing the results of the pre-and post inspection audits, the approved work plan and submitted invoices detailing the completed work. This information can be linked with IRWD's billing database to obtain pre-and post monthly water usage data for evaluation purposes. All inventory will be tracked and managed through IRWD's purchasing and inventory tracking system.

Task List and Schedule

Task	Deliverable	Start Date	End Date	Projected Cost	
				Prop 50	**IRWD**
Contract Negotiations	N/A	6/1/05	12/31/05	Agency salaries excluded	Agency salaries excluded
Contract Executed	Signed contract	1/2/06			
Project Start-Up (80 hrs @ $75/hr)	Final program requirements and procedures Develop tracking database Contact rotary nozzle suppliers, procure inventory	1/2/06	3/1/06		$6,000
Design and Print Project forms (25 hours @ $75/hr) + $750 supplies	Site audit forms (pre and post) Customer participation form Inventory release and tracking form	1/2/06	3/1/06		$2,625
Customer targeting (25 hrs @ $75/hr)	Create target customer database Participation letter	2/1/06	2/28/06		$1,875
Conduct program and issue incentives	20 sites @ average of $1220 per site. *$500 pre & post-audit plus average of $720 equipment per site.*	3/1/06	6/1/06	$12,200	$12,200
Conduct program and issue incentives	20 sites @ average of $1220 per site. *$500 pre & post-audit plus average of $720 equipment per site.*	6/1/06	9/1/06	$12,200	$12,200
Site monitoring (2hrs x 40 sites x $75)	Monitoring	9/1/06	9/1/07		$6,000
Tracking, data collection,	One year post-installation data	9/1/06	9/1/07		$3,000

reporting (1 hr/site x 40 x $75)					
40 site audits at control group $300 per site – turf only	DU data from 40 control sites	6/1/07	9/1/07	$6,000	$6,000
Project Evaluation: Questionnaire design, administration and data compilation. (40 hours @ $75 IRWD plus 20 hours @$200)	Participant questionnaire.	9/1/07	12/1/07	$4,000	$3,000
Project Evaluation Analysis of water savings and program effectiveness. (140 hours @ $200/hr)	Draft project report	9/1/2007	3/1/2008	$28,000	
Finalize Report (30 hrs @ $200/hr)	Final Report and Dissemination	3/1/2008	6/1/2008	$6,000	
			Project Administration		**$4,400**
			Sub-Total Proposed Budget	**$68,400**	**$57,300**
			5% Contingency	**$3,420**	**$2,865**
			Total Proposed Budget	**$71,820**	**$60,165**

Environmental Documentation

The proposed project is not subject to the provisions of CEQA or NEPA.

Statement of Work:
Section Three: Monitoring and Assessment

IRWD is seeking to measure the change in water use by upgrading sprayheads on the turf area of a landscape with newly designed rotator heads that improve the distribution uniformity on a site. Improved uniformity or system efficiency means that water schedules can be better adjusted to apply the correct amount of water, and that additional water does not need to be applied in order to compensate for deficiencies in the irrigation system. In order to conduct the study, IRWD will split study participants into two groups of 40:

1. One group will receive the irrigation retrofits.
2. Control group.

In order to assess the effectiveness of the rotary nozzles, IRWD will work with certified irrigation auditors to audit the sites in the irrigation upgrade and control groups. The irrigation retrofit group will be audited pre-and post retrofit. The pre-upgrade audit will focus primarily on the turf area, although the entire system will be evaluated and problems noted. The audits will include a measure of the distribution uniformity of the turf areas being studied using a standard catch can test. The irrigation audits are expected to take between 1-2 hours per site. The pre-audit will be more comprehensive, while the post-audit will focus primarily of measuring the post-installation distribution uniformity. The pre-audits are budgeted at 40 sites x 3 hours (2 on site, 1 reporting) x $100 per hr = $12,000.

After the irrigation upgrade with rotary nozzles has been completed, IRWD will schedule a post-retrofit audit to verify that the work was completed, and to conduct a catch can test on the turf area to measure the post-installation distribution uniformity. The post-audits are budgeted at 40 sites x 2 hours x $100 per hr = $8,000.

An audit of the control group will also be made, but not until close to the end of the first year monitoring period. This will ensure that no changes or interventions were made to the control sites as a result of awareness of the study by the control group. Control group audits are budgeted at 40 sites x 3 hours (2 on site, 1 reporting) x $100 per hr = $12,000. All of the audits will be conducted by the same certified landscape irrigation auditor in order to ensure consistency in technique and data collection.

IRWD will collect one-year of post-retrofit water usage data for all the sites prior to conducting the initial water savings analysis. IRWD will contract with a qualified consultant to conduct an independent analysis of the water use data. IRWD will provide three years of pre-installation water usage data, and one year of post-installation data for evaluation. In addition, IRWD will provide ET data from its weather stations for the IRWD service area for the entire period being evaluated, so that the data can be weather normalized.

In addition to evaluating the program from a quantitative perspective, IRWD will also obtain qualitative data about the program. IRWD will conduct assessments to evaluate the

aesthetics of the site, as well as note any problems such as brown spots. These assessments will be conducted monthly during peak irrigation season (June – September) and every other month for the balance of the year. Participating customers will be asked to keep maintenance log sheets for the 12-month test period, and note any maintenance needs related to the rotary nozzles. In addition, at the conclusion of the 12-month period, participating customers will be sent a questionnaire requesting qualitative data about the performance of the product, satisfaction with the product and any potential problems or other comments associated with the product or overall program. IRWD staff will develop the questionnaire in conjunction with the evaluation consultant. IRWD will be responsible for mailing out the questionnaires, collecting the responses and tabulating the responses in an Access database. The data from the questionnaires will be compiled and included in the program effectiveness evaluation within the final report. Questionnaire design, administration and data collection is budgeted at $7,000.

Developing the water savings analysis modeling, weather normalizing the data, conducting the analysis, compiling questionnaire data and preparing the draft report is budgeted at $28,000, based on 140 hours at $200/hr. The draft report will be available for review by IRWD and DWR. Any revisions will be incorporated into a final report. The revision process, final report production, copying and dissemination is budgeted at $6,000.

The final report and evaluation will include the costs and benefits from the pilot program, and these are not expected to change significantly over the five years following the conclusion of the program.

Qualifications of the Applicants and Cooperators

Key personnel that will be managing and implementing the proposed project include Mark Tettemer, Fiona Sanchez and Nick Mrvos of Irvine Ranch Water District. Mark Tettemer will be responsible for overall project management and contract administration. Fiona Sanchez will be responsible for project design, database development and coordination of the monitoring and assessment. Nick Mrvos, a certified landscape irrigation auditor, will be responsible for project development, implementation and day-to-day project management. Experience and resume information for the key personnel follows.

Mark Tettemer

6/04 – Present
Irvine Ranch Water District (IRWD), ***Water Resources Manager***

Key Experience:
Develops IRWD water use efficiency and recycled water policy. Oversees conservation and recycled water customer development programs, including the Buck Gully Study (monitoring and reducing runoff from landscape irrigation in Newport Beach), the Wick Irrigation Study (drip irrigation for turf grass), and the Irvine Controller Review (of weather-based irrigation controllers).

Prepares request-for-proposals, proposals and grant applications. Performs financial analyses to determine viability of projects, negotiates agreements and administers contracts.

Works with regulatory community on recycled water projects. Prepares and presents items to IRWD's Board of Directors. Manages staff of nine.

2003 – 6/04
Central & West Basin Municipal Water Districts (CWBWD)
Manager of Customer Development; Principal Project Manager

Key Experience:
Developed policy regarding customer development and participated in regional and statewide efforts for the advancement of recycled water use.

Oversaw $1 million USBR grant funding to expand CWBWD distribution system to provide recycled water to the City of Vernon's Malburg Generating Station.

Performed financial analysis and negotiated agreements resulting in the Toyota/CWBWD joint project to expand Toyota's recycled water distribution system to include the cooling towers, landscape irrigation, toilets and urinals on Toyota's expansive Torrance campus. Toyota agreed to fully capitalize this project, and was reimbursed by CWBWD through water bill credits. Toyota currently uses 100 acre-feet per year of recycled water as a result of this project.

Managed two staff project managers and three customer development consultants, overseeing and supporting the construction of approximately 50 large landscape development sites, including the Goodyear Airfield and Home Depot Center, both in Carson, California.

1990 – 1998
JMTA Costa Mesa, California
Senior Project Manager

Supervised engineers, regulatory specialists, and support staff in implementing civil and environmental projects. Represented and acted on behalf of clients with Federal, State and City representatives on project development and approvals.

Education:
University of Phoenix: Bachelor of Science in Business Administration
University of California, Irvine: Certificate in *Land Use and Environmental Planning*

Fiona M. Sanchez

3/03 – Present
Irvine Ranch Water District (IRWD), Conservation Analyst

Key Experience:
Contributes primary technical analysis and project management for IRWD's conservation department, including water use efficiency research projects such as:

4/03 – Present **Buck Gully Study**
Manages the analysis of collected data on the use of weather-based irrigation controllers to save water and reduce chronic runoff in the Buck Gully watershed.

8/04 – Present **Commercial ER-Based Irrigation Water Savings Study**
Awarded $30,000 USBR grant funding for this Irvine Residential Runoff Reduction Study follow-up, in which IRWD will conduct additional analysis to verify the water savings across a larger sample size of small and medium-sized commercial landscape sites. This research will also analyze the difference, if any, in water savings between sites that are closely monitored under study conditions with sites that rely on the technology and site landscaper without additional intervention.

1/04 – 11/04 **Santa Ana Heights Residential Water Allocation Modeling**
Managed and provided analytical implementation of this study to develop an equitable methodology for sizing landscape and determining water allocation in the Santa Ana Heights service area of IRWD. This study's findings were presented at 2003 and 2004 Irrigation Association convention. Led successful methodology implementation.

3/03 – 8/03 **Demonstration of Water Conservation Opportunities in Urban Supermarkets**
Managed the completion of this grant-funded ($108,000) study conducted by Aquacraft, Inc. for the California Department of Water Resources/USBR CalFed Bay-Delta program. The conclusions of the study supported the use of advanced water treatment in supermarkets.

3/03 – Present **Additional Water Use Efficiency Research**
Participated in the development and analysis of the AWWA National Multi-Family Sub-Metering Study, the AWWARF (grant funded) Salinity Study, IRWD Environmental Partnerships, and the Irvine Weather-Based Irrigation Controllers Preliminary Study.

2002 – 2003
California Urban Water Conservation Council (CUWCC), *Technical Advisor*

Key Experience:
Provided conservation data and technical information, performed cost-benefit analyses, researched data sources and calculated water conservation savings estimates for CUWCC members.

Gave oral presentations and wrote papers related to the technical aspects of water conservation. Served as project manager for the technical resources web page content and CUWCC staff liaison to the landscape and residential committees.

Developed budgets, cash flow analyses and project milestones to ensure successful contract administration for multiple grants as volunteer Treasurer (1997 – 2002) for the CUWCC.

2001 – 2002
ConserVision Consulting, LLC, ***Senior Project Manager***

Key Experience:
Managed MWDOC's water budget website (www.waterbudgets.com) and Landscape Certification Performance Program. Coordinated the development of website and database with the site programmer and functioned as technical liaison for participating member agencies and program participants.

Managed Santa Clara Valley Water District's ($ 1.5 M) Water Wise House Calls residential survey program. Coordinated with SCVWD to effectively market this program, conduct surveys, track data and conduct analysis using custom-designed database.

Managed Alameda County Water District's BMP 5 Landscape Measurement Program.

2001 – 2002
Senior Project Manager
CTSI Corporation

Provided technical management of MWDOC's landscape certification project, which piloted the use of a web-backed database to provide water budget information to property managers, landscapers and participating water agencies.

Led research of new water-efficiency technologies and water savings and development of pilot programs such as ET Controller studies and a water/energy efficient loan program in conjunction with Fannie Mae.

1996 – 2000
Northern California Project Manager
CTSI Corporation

Key experience:
Provided contract negotiation and administration, development and implementation of water conservation programs on behalf of Marin Municipal Water District, East Bay MUD ($2 M), Contra Costa Water District, Alameda County Water District, City of Santa Rosa and the Sonoma County Water Agency.

1991 – 1996
Project Manager
CTSI Corporation

Key experience:
Co-created an award winning community-based conservation program on behalf of the Metropolitan Water District of Southern California (recognized by the U.S. Bureau of Reclamation) that was expanded from a pilot program with a $100,000 budget to a $40 million dollar operation.

Education:
University of California, Irvine: Master of Business Administration
University of California, Riverside: Bachelor of Arts in Economics, Bachelor of Arts in History

Nick Mrvos

2/01 – Present
Irvine Ranch Water District (IRWD), ***Landscape Water Conservation Specialist***

Key experience:
Oversees 5,402 landscape irrigation accounts within IRWD, including site inspections to determine irrigation system efficiency and provide recommendations for improvements. Compiles monthly data identifying high over-use accounts, leading to conservation intervention. Reviews and processes requests for bill adjustments for over-allocation charges incurred, due to landscape irrigation system problems and inefficiencies.
Coordinates with the City of Irvine and Cal Trans to develop and implement landscape water conservation strategies. Organizes *Protector del Aqua* classes for landscape professionals and presents residential landscape workshops for IRWD homeowners.

7/04 – Present Buck Gully Study
Provides landscape irrigation expertise for Buck Gully Study, which is collecting data on the use of weather-based irrigation controllers and runoff reduction in the Buck Gully watershed.

9/04 – Present Wick Irrigation (Surface Flow Study)
Provides technical expertise for a study of the effectiveness of the Wick method of drip irrigation based on an evaluation of turf grass health, water use and runoff resulting from the use of wick irrigation.

7/04 – Present Irvine Controller Review
A comparative study documenting the performance of selected weather-based and non-weather-based irrigation controllers based on water use and runoff at certain landscape sites within the City of Irvine.

7/04 – 12/04 Irvine Weather-Based Irrigation Controllers Preliminary Study
Provided technical on-site expertise in preliminary comparative study of weather-based irrigation controllers used on large and medium-sized landscapes.

7/03 – 7/04 Santa Ana Heights Residential Water Allocation Modeling
Provided on-site commercial irrigation landscape allocation follow-up for a study to develop an equitable methodology for sizing landscape and determining water allocation in the Santa Ana Heights service area of IRWD.

9/01 – 12/03 Residential Runoff Reduction Study (R3 Study)
Participated in the grant-funded MWDOC / IRWD study of the effects of weather-based irrigation controllers and customer education on residential runoff reduction, water conservation and runoff water quality. The R3 Study showed, on average, 41gpd water savings for single-family homes, along with a run-off reduction of up to 70 percent.

7/98 – 10/00 IRWD "Northwood" Study of Weather-Based Irrigation Controllers
Participated in the initial IRWD, MWDOC and MWD collaborative study of the effectiveness of weather-based remote-controlled residential irrigation technology.

Education:
Certified Landscape Irrigation Auditor
Certified Master Gardener

External Cooperators

Data Analysis and Reporting Consultant
IRWD will contract with an industry-recognized statistical analysis expert to evaluate and report on the average water-savings from participating sites in the study and on overall program effectiveness.

Rotary Nozzle Supplier(s)

To maximize the cost-effectiveness of irrigation system upgrading via nozzle replacement, state-of-the-art rotary nozzles will be purchased in quantity at wholesale rates. Selected supplier(s) will also be accountable for the quality and reliability of any irrigation hardware or products provided, throughout a reasonable warranty period, to include the life of this project.

To date, Rain Bird and Walla Walla Sprinkler Company are the only known suppliers of a multi-trajectory rotor the size of a spray nozzle.

Landscape Contractors

IRWD has already developed well-established relationships with many of the landscape contractors, property management companies and large landscape customers within its service area. IRWD offers regularly scheduled training sessions, as well as providing ongoing assistance. Nick Mrvos, of IRWD, has worked with many of these customers on previous irrigation projects, and anticipate having their support and cooperation for the proposed project.

Outreach, Community Involvement, Acceptance

IRWD will work together with landscape customers, local landscape contractors, certified irrigation auditors and irrigation equipment manufacturers. IRWD already has well-established relationships with all of these groups. IRWD is not aware of any opposition to the proposed study.

IRWD will provide the information on water savings to regional wholesalers, including the Municipal Water District of Orange County (MWDOC) and the Metropolitan Water District of Southern California. Copies of the report can be made available in pdf format to be posted on conservation websites. The information from the proposed study could be disseminated statewide through the California Urban Water Conservation Council (CUWCC). The information can also be presented at Irrigation Association conferences, AWWA conferences and through other organizations and conferences targeting landscape professionals and urban water conservation managers.

Innovation

The proposed project is innovative in several ways:

1. It addresses a source of landscape water waste in a way that may prove to be simple and cost-effective for agencies to implement. Landscape water waste results from irrigation system inefficiencies and improper irrigation scheduling. New ET controller technology is already being used by agencies to address scheduling issues. However, ET controllers cannot address system inefficiencies, and in fact may exacerbate them, since the improved scheduling doesn't overcompensate for the inefficiencies of the system. IRWD's proposed project will test a new program design and evaluate whether improving irrigation system inefficiency can generate landscape water savings in a cost-effective way.
2. The proposed project tests the effectiveness of a relatively new technology that shows promise in addressing many of the typical problems associated with traditional sprayheads that result in over-watering and water waste. The rotary nozzles are essentially multi-trajectory rotors at the size of a spray nozzle. They fit most conventional spray heads, transforming each into a high uniformity, low application rate sprinkler with matched precipitation, even after arc and radius adjustment. The rotary nozzle's low application rate helps to significantly control runoff on slopes and tight soils. The multi-trajectory, wind-resistant, rotating streams provide high uniformity and outstanding close-in watering, preventing the need for lengthened irrigation cycles to compensate for brown spots. The limited Cal Poly Pomona study showed 37% savings. This project will build upon that data and through the water use data analysis, quantify the water savings and associated irrigation system efficiency improvements.
3. The program design is innovative in focusing only on turf grass areas irrigated with spray heads. Turf grass is the highest water using plant in a typical landscape, and spray heads are often the source of significant inefficiency and water waste. Therefore, the program design is limited to improvements in those areas. Other irrigation system design programs have not restricted the type of landscape or type of improvement that is to be made. As a result, the costs of the project, especially those involving a redesign have usually far outweighed the benefits, and therefore widespread implementation has been limited.

Benefits and Costs

Labor Costs

Task	Description	Quantity	Rate/Hr	Total	IRWD	Grant Funded
Adminstration	Project management, oversight and reporting	40 hours	$110	$4,400	$4,400	
Project Start Up	Finalize program requirements and procedures Develop tracking database Contact rotary nozzle supplies, negotiate purchase	80 hours	$75	$6,000	$6,000	
Design Project Forms	Site audit forms Participation forms Inventory tracking forms	25 hours	$75	$1,875	$1,875	
Customer targeting.	Create target database, mail merge. Develop participation letter.	25 hours	$75	$1,875	$1,875	
Pre-participation site audits	3 hours per site	40 sites	$100	$12,000	$6,000	$6,000
Post-participation site audits	2 hours per site	40 hours	$100	$8,000	$4,000	$4,000
Site monitoring	2 visits per site @ 1 hr per visit	2 x 40	$75	$6,000	$6,000	
Tracking, data collection, reporting	1 hr per site	40 hours	$75	$3,000	$3,000	
Control group audits	3 hours per site	40 sites	$100	$12,000	$6,000	$6,000
Questionnaire design, administration and data compilation	IRWD	40 hours	$75	$3,000	$3,000	

Questionnaire design and oversight	Independent Consultant	20 hours	$200	$4,000		$4,000
Project Evaluation	Water savings and program effectiveness	140 hours	$200	$28,000		$28,000
Final Project Report and Dissemination		30 hours	$200	$6,000		$6,000
Sub-Total Labor Cost				**$96,150**	**$42,150**	**$54,000**
5% Contingency				**$4,807**	**$2,107**	**$2,700**
Total Labor Cost				**$100,957**	**$44,257**	**$56,700**

Equipment Costs

Equipment consists of the rotary nozzles that will be replaced at each site. The installation cost will be the cost of the participant. Rotary nozzles have a radius of at least 13' ranging up to 20'. In order to effectively cover half an acre, you would need a maximum of 120 nozzles to obtain head to head coverage. This calculation is based on a 150' x 150' site with heads at 15' square spacing. This design would require 40-180° nozzles around the perimeter and 81-360° in the interior of the site. Most commercial and common area landscapes incorporate a significant percentage of shrubs, groundcover and other non-turf plant material, so the actual number of nozzles per site will probably be fewer. For purposes of the proposal, IRWD is estimating an average site of half an acre with 120 nozzles per site. Therefore equipment costs are as follows, with costs split between IRWD and the grant funding.

Description	Average Quantity Per Site	# of Sites	Unit Cost	Total Cost	IRWD	Grant Funding
Rotary Nozzles	120	40	$6	$28,800	$14,400	$14,400
Sub-Total Equipment Cost				**$28,800**	**$14,400**	**$14,400**
5% Contingency				**$1,440**	**$720**	**$720**
Total Equipment Cost				**$30,240**	**$15,120**	**$15,120**

Supplies

Supplies include program forms, catch cans for distribution uniformity tests, and other general office supplies. IRWD already has catch cans available for use on this project. IRWD will print program forms and provide miscellaneous supplies as needed. The estimated cost is $750, plus a 5% contingency gives a total budget of $788.

Travel

No travel is anticipated for this project, beyond the scope of visiting participating sites within IRWD's service area.

Potential Benefits and Information

The potential benefits include a pilot program design and evaluation of a low cost irrigation efficiency upgrade program. Most irrigation system efficiency upgrades range from a low of $2500 to upwards of $20,000 depending on the specifics of the site. As a result, landscape water use efficiency programs have focused more on addressing irrigation scheduling, particularly with ET controllers. However, this still leaves additional potential water savings that can be achieved through efficiency improvements. IRWD is proposing to evaluate the water savings resulting from the change in irrigation system efficiency from retrofitting spray heads with rotary nozzles. The program will also evaluate the effectiveness and success of the pilot program design and calculate the cost-effectiveness of an implementation program. IRWD estimates the potential water savings at 2.6 acre-feet per acre per year. This is based on the following assumptions:

- With an average of a half an acre of turf per site, and a DU of 50% then it would take 4 acre-feet per year to irrigate the site.

- This is calculated by using the average 10-year historical demand for a turfgrass site in the Irvine area of four acre-feet/acre.

Therefore, irrigating one-half acre at 50% efficiency would require four acre-feet of water per acre per year. If we can improve DU by 25% (50% DU to 62.5% DU) through the use of rotary nozzles, then we could potentially achieve 33% water savings that would equal 1.3 acre-feet per site or 2.6 acre feet per acre per year. The limited Cal Poly, Pomona study (referenced earlier) of this same technology achieved average water savings of 37%. Water savings would improve reliability of local water supplies, and reduce need for imported water through the Bay-Delta system.

Reduced demands would also lead to lower pumping and related energy costs, and would help reduce summer peaking demands. Landscape over-watering is a major component of urban runoff, and so by improving the application and efficiency of landscape water, the program has the added benefit of helping to reduce urban runoff.

Potential Benefits and Anticipated Costs

The total proposed project budget is $131,985, which incorporates a 5% contingency. IRWD is requesting grant funds of $71,819. IRWD will provide $60,166 in funding and in-kind services, a match of 46%.

With projected water savings of 2.6 acre-feet per acre and avoided cost of water for IRWD at $450 per acre-foot, the potential benefits to IRWD per acre = $450 x 2.6 = $1170 per acre, or $585 per half acre site. Depending on the findings from the pilot program and evaluation, a cost-effective full-scale implementation program could be designed, based on the level of estimated water savings. An implementation program would not necessarily require the full-scale pre-and post irrigation audits that are being used for evaluation purposes in this proposed project. Manufacturers have indicated that pricing for the rotary nozzles could be negotiated based on larger volumes, and so actual implementation costs could be reduced from those proposed in the pilot.

Landscape water use (not including residential) accounts for approximately 28% of total water use in IRWD's service area, and represents the sector with the most conservation potential at the lowest cost. Residential plumbing retrofit programs have addressed many of the conservation opportunities within the residential sector. Commercial, industrial and institutional (CII) customers are much more difficult to reach and solutions are typically site specific, more complex and have long decision-making time frames. Many other agencies throughout the state have similar circumstances. A cost-effective program that can improve irrigation efficiency and provide landscape water use savings is broadly transferable throughout the state. Improvements to landscape water use efficiency produces multiple benefits including reduction of demand for imports from the Bay-Delta, a reduction of non-point source pollution and reduction of summer peaking problems (peak irrigation season).

2004 Water Use Efficiency Proposal Solicitation Package

APPENDIX A: Project Information Form

Applying for: ✓ Urban ☐ Agricultural

1. (Section A) **Urban or Agricultural Water Use Efficiency Implementation Project**
   - ☐ (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): Irvine Ranch Water District

4. Project Title: Rotary Nozzle Retrofit Study

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

Name, title	Paul Jones II General Manager
Mailing address	P.O. Box 57000
	Irvine, CA 92619-7000
Telephone	949 453-5010
Fax.	949 453-1228
E-mail	jones@irwd.com

6. Contact person (if different):	Name, title.	Fiona Sanchez Conservation Analyst
	Mailing address.	P.O. Box 57000
		Irvine CA 91619-7000
	Telephone	949 453-5325
	Fax.	949 453-5354
	E-mail	sanchezf@irwd.com
7. Grant funds requested (dollar amount): *(from Table C-1, column VI)*		$71,819
8. Applicant funds pledged (dollar amount):		$60,166
9.Total project costs (dollar amount): *(from Table C-1, column IV, row n)*		$131,985
10. Percent of State share requested (%) *(from Table C-1)*		54%
11. Percent of local share as match (%) *(from Table C-1)*		46%
12. Is your project locally cost effective? *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.)*		❑ (a) yes ✓ (b) no
11. Is your project required by regulation, law or contract? If no, your project is eligible. 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.*		❑ (a) yes ✓ (b) no

12. Duration of project (month/year to month/year): 1/06 – 6/08

13. State Assembly District where the project is to be conducted: 70

14. State Senate District where the project is to be conducted: 35, 33

15. Congressional district(s) where the project is to be conducted: 48

16. County where the project is to be conducted: Orange

17. Location of project (longitude and latitude) Throughout IRWD's service area.

18. How many service connections in your service area (urban)? 86,660

19. How many acre-feet of water per year does your agency serve? 86,267

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

2004 Water Use Efficiency Proposal Solicitation Package
APPENDIX B: 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.

	Paul Jones II, General Manager	1/6/05
_____	_____	_____
Signature	Name and title	Date

Applicant: Irvine Ranch Water District

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 (I)	Project Costs $ (II)	Contingency % (ex. 5 or 10) (III)	Project Cost + Contingency $ (IV)	Applicant Share $ (V)	State Share Grant $ (VI)	Life of investment (years) (VII	Capital Recovery Factor (VIII)	Annualized Costs $ (IX)
	Administration[1]								
	Salaries, wages	$4,400	5	$4,620	$4,620	$0	0	0.0000	$0
	Fringe benefits	$0	0	$0	$0	$0	0	0.0000	$0
	Supplies	$750	5	$788	$788	-$1	0	0.0000	$0
	Equipment	$0		$0	$0	$0	0	0.0000	$0
	Consulting services	$0		$0	$0	$0	0	0.0000	$0
	Travel	$0		$0	$0	$0	0	0.0000	$0
	Other	$0		$0	$0	$0	0	0.0000	$0
(a)	Total Administration Costs	$5,150		$5,408	$5,408	-$1			$0
(b)	Planning/Design/Engineering	$9,750	5	$10,238	$10,238	-$1	0	0.0000	$0
(c)	Equipment Purchases/Rentals/Rebates/Vouchers	$28,800	5	$30,240	$15,120	$15,120	10	0.0000	$0
(d)	Materials/Installation/Implementation	$21,000	5	$22,050	$15,750	$6,300	0	0.0000	$0
(e)	Implementation Verification	$8,000	5	$8,400	$4,200	$4,200	0	0.0000	$0
(f)	Project Legal/License Fees	$0	5	$0	$0	$0	0	0.0000	$0
(g)	Structures	$0	5	$0	$0	$0	0	0.0000	$0
(h)	Land Purchase/Easement	$0	5	$0	$0	$0	0	0.0000	$0
(i)	Environmental Compliance/Mitigation/Enhancement	$0	5	$0	$0	$0	0	0.0000	$0
(j)	Construction	$0	5	$0	$0	$0	0	0.0000	$0
(k)	Other (Specify)	$0	5	$0	$0	$0	0	0.0000	$0
(l)	Monitoring and Assessment	$42,000	5	$44,100	$9,450	$34,650	0	0.0000	$0
(m)	Report Preparation	$11,000	5	$11,550	$0	$11,550	0	0.0000	$0
(n)	**TOTAL**	$125,700		$131,985	$60,166	$71,819			$0
(o)	Cost Share -Percentage				46	54			

1- excludes administration O&M.

Applicant:

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)

Table C- 4: Capital Recovery Table (1)

Life of Project (in years)	Capital Recovery Factor
1	1.0600
2	0.5454
3	0.3741
4	0.2886
5	0.2374
6	0.2034
7	0.1791
8	0.1610
9	0.1470
10	0.1359
11	0.1268
12	0.1193
13	0.1130
14	0.1076
15	0.1030
16	0.0990
17	0.0954
18	0.0924
19	0.0896
20	0.0872
21	0.0850
22	0.0830
23	0.0813
24	0.0797
25	0.0782
26	0.0769
27	0.0757
28	0.0746
29	0.0736
30	0.0726
31	0.0718
32	0.0710
33	0.0703
34	0.0696
35	0.0690
36	0.0684
37	0.0679
38	0.0674
39	0.0669
40	0.0665
41	0.0661
42	0.0657
43	0.0653
44	0.0650
45	0.0647
46	0.0644
47	0.0641
48	0.0639
49	0.0637
50	0.0634

(1) Based on 6% discount rate.

Applicant:

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					0
Local				**Not applicable.**	

[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.