USCID NEWSLETTER

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The U.S. society for irrigation and drainage professionals

Cairo, Gooch, Walter Elected to Board

In February balloting, **George J. Cairo**, **Robert S. Gooch** and **Ivan A. Walter** were elected to three-year terms (2006-2008) on the USCID Board of Directors. Cairo and Gooch were elected to their first terms, and Walter to his second. Other candidates for the Board were **Michael C. Archer**, **Vic DeGrande** and **Reed R. Murray**. Retiring from the Board were **Joseph I. Burns** and **Maury Roos**. A total of 170 ballots were counted by a Tellers Committee of Gerald A. Gibbens, Thomas E. Mitchell and Larry D. Stephens.

George J. Cairo is President and Principal Engineer, Davey-Cairo Engineering, Inc., Tempe, Arizona.

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Boise, Indianapolis

Two Meetings Set for Fall 2006

Plan now to attend two important meetings this fall. USCID is organizing ***Ground Water and Surface Water Under Stress: Competition, Interaction, Solutions***, to be held October 25-28, in Boise, Idaho. The Rivers Institute at Hanover College, with the collaboration of USCID and the Nature Conservancy, will organize a meeting in Indianapolis, November 28-30, ***Innovations in Reducing Nonpoint Source Pollution: Methods, Policies, Programs, and Measurement***.

Boise Conference Chairman **Dennis Wichelns** reports that more than 50 papers will be presented during oral and interactive visual (poster) presentations.

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USCID Board of Directors meet at Summers Engineering, Hanford, California. From left, David Cone, Mark Svendsen, Jim Ayars, Joe McGahan, Bob Gooch, George Cairo, Larry Stephens, Bruce Moore, Maury Roos.

Prez

I write this from Islamabad, Pakistan, where a number of our veteran USCID members had experience in the 1970s during the "CSU period" of on-farm water management research and improvement. Pakistan has changed a great deal since that time, but the fundamental challenges of managing the country's two major storage reservoirs, 43 independent canal commands, and 125,000 watercourses across 40 million acres of irrigated land remain.

The USCID Board met in early March at the Summers Engineering office in Hanford, California, hosted by **Joe McGahan**. At that meeting we welcomed new board members **George Cairo** and **Bob Gooch**, who were recently elected. Current member **Ivan Walter** was re-elected at the same time. At that meeting, the Board decided to follow up the very successful SCADA conference in Portland last fall with a similar meeting in the spring of 2007. **George Cairo** will chair the planning committee.

Plans for our IEC meeting/international conference in Sacramento in the fall of

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Inside . . .

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The United States Committee on Irrigation and Drainage is a National Committee of the International Commission on Irrigation and Drainage.

Mission Statement

The Mission of the United States Committee on Irrigation and Drainage is to foster sustainable, socially acceptable and environmentally responsible irrigation, drainage and flood control systems and practices for providing food, clothing and shelter to the people of the United States and the World.

USCID Newsletter and Membership

The *USCID Newsletter* is published in Winter, Spring and Fall for USCID Members. News items and technical articles of interest to the irrigation community are invited. Contact USCID for advertising rates and media information. Membership information is available on the USCID website.

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Environmental Impacts of Irrigation, Drainage and Flood Control	Dennis Wichelns
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Irrigated Agriculture Under Drought and Water Scarcity	Robert H. Edwards
Socio-Economic Impacts and Policy Issues	Anisa J. Divine
Urban Irrigation and Recycled Water	
Application of GIS in Irrigation Projects	Guy Fipps
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ICID News and Activities

ICID·CIID

Sacramento Conference Plenary Session to Feature Abu Zeid, Limbaugh, Mills

A Plenary Session featuring an outstanding slate of speakers will kick off the USCID **Fourth International Conference on Irrigation and Drainage**. Mohammed Abu Zeid, Minister of Water Resources and Irrigation in Egypt; **Mark Limbaugh**, Assistant Secretary for Water and Science, U.S. Department of the Interior; and Stephen Mills, Chairman of the Australian ICID National Committee, will give their unique perspectives on key issues affecting irrigation and drainage.

The Conference will be held in conjunction with the ICID **58th International Executive Council Meeting**, to be held in Sacramento, California, from September 30 - October 5, 2007. Other activities during the IEC week will include ICID work body meetings, workshops, a two-day exhibition, technical and cultural tours, social events, an accompanying persons program, and several post-meeting study tours.

The Second Announcement and Call for Papers has been issued by USCID. The theme of the Fourth Conference is *The Role of Irrigation and Drainage in a Sustainable Future*, and abstracts for papers are invited by November 1, 2006, on the following topics:

- ***Developing Sustainable Irrigation and Drainage Systems***
- ***Using Technology to Improve Irrigation and Drainage Systems***
- ***Improving the Interaction of Irrigation and Drainage Systems with the Wider Society***

A list of Gold Sponsors and Cooperating Organizations is found on page 19.

For more information about the Sacramento meetings, visit www.uscid.org.¤

Regional Conference Set for Pavia, Italy

The **22nd European Regional Conference** will be held in the northern Italian city of Pavia during September 2007.

The European Union countries are facing new and original challenges, including increased competition for scarce water supplies, expanding demand for food, implications of global climate change and energy shortages.

Recognizing these challenges, the Conference will address the theme ***Water Resources Management, and Irrigation and Drainage Systems Development in the European Environment***. Four topics will be addressed:

- Impacts of Extreme Hydrological Events on Irrigation and Drainage Systems
- Energy Saving Technology in Advanced Irrigation Systems
- Conjunctive Use of Surface and Groundwater
- Participatory Management and Economic Policies for Irrigation and Drainage Development

Authors who wish to give a presentation (oral or poster) are invited to submit an abstract no later than May 31, 2006. Instructions for submitting an abstract may be found at the conference website: www.italicid.org/erc.2007.

A one-day technical tour to nearby water facilities will supplement Conference sessions.¤

Kuala Lumpur Workshops

Several ICID work bodies will organize workshops during the upcoming 57th IEC Meeting, to be held in Kuala Lumpur, Malaysia, during September. Recently announced workshops include:

Workshop on Modernization of Irrigation Service Delivery, organized by the Working Group on Development and Management of Irrigation Systems, September 12, 2006. The workshop will coincide with the conclusion of the Working Group activities and creation of a new successor Working Group to focus on Modernization of Irrigation System Delivery. The main objective of the Workshop is to discuss the state-of-the-art in irrigation system modernization with a view to defining the agenda and scope of the new Working Group. To submit a paper, contact the WG Chair, Hector Malano, h.malano@civenv.unimelb.edu.au.

International Workshop on Water Saving Technologies in Tropical Regions of Asia, organized by the Working Group on Water Saving for Agriculture, September 14, 2006. Three sub-themes will be featured:

- Improved water saving through pressurized irrigation
- Evaporation control measures for water conservation
- Policy and institutional aspects of water savings

Workshop on Monitoring and Evaluation of Capacity Development Programs, organized by the Working Group on Capacity Building, Training and Education and IPTRID/FAO, September 14. Authors are invited to submit 100-word abstracts to Virginie Gillet, virginie.gillet@fao.org.

Additional information about the Kuala Lumpur meeting can be found at www.icid2006.org.¤

Global Warming's Possible Impact on California's Water Resources

*Editor's note: The Fall 2005 issue of **DWR News/People**, published by the California Department of Water Resources, featured an article by **Maurice Roos**, whose work in recent years has focused on climate change and its potential impact on water resources in California and globally. Excerpts from the article follow.*

In recent years, evidence has continued to accumulate that global climate change will have significant effects on California's water resources. Global warming has the potential of affecting a wide variety of water resources elements. These include water supply, hydroelectric power, sea level rise, more intense precipitation and flood events, water use and water temperature changes. Causes can be natural or of human origin.

Some of these changes appear to be happening. The fraction of water year runoff coming during the April through July traditional snowmelt season, although highly variable from year to year, seems to have been decreasing during the past 50 years. This effect is more noticeable in the lower elevation northern Sierra than the higher elevation southern Sierra. This current water year, 2005, has bucked the trend with a 51 percent fraction based on current late season forecasts. This shift, if it continues, will make it more difficult to fill our major foothill reservoirs because of less snowmelt in the late spring. Lower reservoir levels could reduce dry season water supply and, because of lower head, reduce hydroelectric power production.

A second major impact is sea level rise, which would affect many low areas along the coast. But the major water systems impact would be in the Delta. There the problem would be two-fold: (1) problems with the levees protecting the low lying land, much already below sea level; and (2) increase salinity intrusion from the ocean, which would degrade fresh water transfer supplies pumped at the southern edge of the Delta or require more fresh water releases to repel ocean salinity. During the past 75 years or so, the measured rate of rise at the Golden Gate tide gage has been about 0.7 feet per century. Much of this is believed to be from melting temperate zone glaciers, particularly in southern Alaska.

It is possible that tectonic earth movements may be influencing the gage, although the 20th century increase is in line with other world tide gages.

More extreme precipitation events generally go along with increasing temperatures. This is the kind of information in the form of statistics on rainfall depth, duration and frequency that go into storm drainage design. The problem may be compounded in the high elevation river watersheds of the Sierra Nevada. Here, with higher storm snow lines, a greater fraction of the watershed could be producing direct rain runoff, with larger flood volume.

There are likely to be changes in water use as well as water supply. Water consumption changes are likely to be small, but because so much land is involved, amounts could be very significant. Generally, a slightly warmer climate with less frost and a higher atmospheric concentration of carbon dioxide is regarded as beneficial to many food crops. As a rule, plant evapotranspiration increases with temperature. Higher carbon dioxide levels, however, reduce water consumption (at least in laboratory tests), and seem to increase yield on some crops. Some weeds, including water weeds, may thrive better too. Most likely, the higher water consumption due to warmer temperatures will only be partly offset by the carbon dioxide-based reductions. Thus, the net effect could be slightly higher agricultural and landscape water requirements. For some annual crops, it may be possible to change the planting season a few weeks which may result in no net change for that crop.

Warmer water temperatures could be of considerable concern in managing salmon and steelhead fisheries. Warmer air temperatures will make it more difficult to maintain rivers cold enough for cold water fish, including anadromous fish. With reduced snowmelt, existing cold water pools behind major foothill dams are likely to shrink. As a result, river water temperatures could warm beyond the point tolerable for salmon and steelhead that currently stay in these rivers during the summer and early fall. Some reservoirs have multi-level outlets to help control water temperatures. These kinds of outlets may have to be installed on other structures.

These are five of the potential major effects of global warming on water resources in California. There are undoubtedly others, such as a longer fire season in the mountains. Impacts on the Colorado River are of concern to California as well. That basin is not so vulnerable to changing runoff patterns with less snowmelt because of ample storage on the main stem. However, its total runoff is quite sensitive to small changes in average precipitation. One would expect warmer temperatures to dry out the water-producing region of its vast watershed somewhat sooner than today.¤

Maury Roos, Hydrologist

Maury Roos, a DWR retiree since 2000 with 43 years of service, is currently Chief Hydrologist (part time) with the DWR Division of Flood Management in Sacramento.

He provides advice on flood forecasting, hydrology, water supply and snowmelt forecasting and staff meteorology. Related topics include floods and droughts, global warming and weather modification. For years, he has been attempting to track climate change issues, as well, especially as they relate to water supply in California.

Roos presented a workshop paper on Northern California flood management during the recent ICID Congress in Beijing, China. He has been active in USCID for many years and recently completed a six-year term on the Board of Directors.

Keys Announces Retirement

John W. Keys III recently announced his resignation as Commissioner of the **Bureau of Reclamation**. Interior Secretary Gale A. Norton lauded Keys' service to the nation and his success in handling water issues associated with the worst five years of drought in the past five centuries.

"As Commissioner, John led the way in developing the Water 2025 Initiative that is helping to avoid future water crises in the West," Secretary Norton said. "He and the rest of the Interior water team were crucial in resolving a nearly 75-year dispute when California water users reached agreement with the federal government and six other states on a multi-decade agreement for sharing and using water in the Colorado River."

Among Keys' accomplishments was development of the Lower Colorado River Multi-Species Conservation Program, a coordinated, comprehensive, long-term multi-agency effort to conserve and work toward the recovery of endangered species and protect and maintain wildlife habitat on the Lower Colorado River.

"I love the Bureau of Reclamation," Keys said. "I believe in what we do. I am proud of our part in the water development and management that has made it possible for us to live in the arid West. I believe that the Bureau and our Department are ready for the water challenges of the 21st century. It is a bittersweet time to leave Reclamation again."

After serving nearly 40 years with Reclamation, Keys intends to spend time with his family. Keys spent 34 years as a career employee with Reclamation, first as a civil and hydraulic engineer and later as the Pacific Northwest Regional Director.¤

Missouri Report

While the mountain snowpack remains at near normal levels, dry conditions persist over much of the Missouri River basin.

The amount of water currently stored in the reservoirs is 19 million acre-feet below normal. Runoff for the year is forecasted to be 19.5 MAF, 77 percent of normal.

The total reservoir storage on March 1 was not sufficient for the Corps of Engineers to conduct the March spring pulse. Another storage check will be taken on May 1 to determine if there is enough water in the reservoirs to conduct the May pulse.

Support for the 2006 navigation season began April 1 at the mouth near St. Louis. The season length is expected to be shortened by 32 to 61 days, depending on runoff in coming months.

The six main stem power plants generated 489 million kilowatt hours of electricity in March, only 73 percent of normal.¤

Landscape Irrigation with Recycled Water in California

by Kenneth K. Tanji, University of California, Davis, Davis, California (kktanji@ucdavis.edu)

The urban population has been steadily increasing in California and the rest of the world, too. Potable water demand is beginning to outstrip available water resources in many communities in California, since new supplies are nearly nonexistent or very costly to develop. Water marketing of agricultural water supplies to urban sectors is growing. This state will need to improve its water use efficiency, both in the agricultural and urban sectors, to meet its water needs by 2030. California's State Water Plan suggest that water purveyors will find it necessary to recycle more water than they currently do, especially treated municipal waste waters. Recycled water from water treated to a fairly high level to meet the state's waste discharge requirements can be used for many non-potable water uses and therefore can help reduce the overall demand for fresh water. Hence, scarce water resources should be stretched to the limits, including the wise use of recycled water.

Current Uses of Recycled Water in California

Currently, about 654 million m^3 per year of reclaimed municipal waste waters is used. About 46 percent of this recycled water is used for agricultural crop irrigation, 21 percent for landscape irrigation, 9 percent for groundwater recharge, 8 percent for recreational impoundments, and 5 percent for barriers to seawater intrusion along coastal areas. The rest, 11 percent, goes to various uses such as cooling water for refineries and power plants as well as environmental enhancement, such as wetlands. In urban areas, recycled water is often used to irrigate golf courses, parks and green belts, schoolyards and playgrounds, commercial and residential landscapes, highway medians and nurseries for plants, as well as water ponds and wetlands.

By the year 2030, an additional 1.6 billion m^3 of recycled water will be available. That water, if reused, could free up enough fresh water to meet the household water needs for 30 to 50 percent of the additional 17 million additional people who will call California home. The expanded use of recycled water for landscape irrigation is of especially high priority in the semi-arid Los Angeles to San Diego corridor (Figure 1), where about half of the state's 37 million residents reside, in order to help alleviate current and future shortfalls of potable water.

Figure 1. Imported water delivered to the Los Angeles to San Diego corridor through the Colorado River (1), Los Angeles (2) and California (3) Aqueducts.

Though many opportunities for using recycled waters in California's urban areas exist and such use is encouraged by the state, some landscape irrigators are reluctant to use treated municipal sewage effluents. Some are not fully aware that California's "Title 22 Recycled Water" is reasonably safe for irrigating landscapes. Some believe that recycled water may be excessively saline and therefore harmful to landscape plants. To help foster a broader acceptance of recycled water uses, the state of California, municipal water purveyors and various other institutions have begun to inform the public and members of the landscape industry about the utility of recycled water.

Regulations on Use of Recycled Water in California

California's regulations regarding the use of recycled water are outlined in Title 22, Code of Regulations on Water Recycling Criteria of the California Administrative Code. According to these regulations, using a potable source of water when non-potable waters could be used, as in landscape irrigation, is a wasteful or unreasonable use of water if reclaimed water is available that meets certain conditions. Before recycled water can be used to irrigate a landscape, the wastewater must be treated to certain secondary and tertiary treatment levels. Table 1 identifies the treatment levels required for allowable uses of recycled waters for various types of landscape irrigation.

All recycled water used for landscape irrigation must be disinfected. To irrigate cemeteries, freeway medians, sod farms and other such places where public contact with irrigation water is quite unlikely, the requirements for treatment levels are less stringent than those for irrigating public-use landscapes such as parks, playgrounds, residential landscape and restricted access golf courses.

Water Quality Characteristics of Recycled Water

Recycled water contains dissolved mineral salts (major cations and anions), nutrients, and residues of disinfection agents and wastewater treatment chemicals. Though all water supplies contain dissolved mineral salts, the salt content of recycled waters primarily depends on the quality of the source water supply and the incidental addition of small concentration of salts; typically about 140 to 400 mg/L from the water's use for municipal and industrial purposes. Larger concentrations of salts are present in recycled water if water softeners using table salt are used extensively in the communities that contribute to the wastewater treatment plant. Recycled water also contains nutrients, nitrogen and smaller concentrations of phosphorus. The principal N forms found are dissolved ammonia and ammonium ions, as well as nitrate.

The principal constituents of concern with regard to the quality of recycled water for irrigation are salinity (electrical conductivity, or Total Dissolved Solids) which contributes to

Table 1. Recycled water uses allowed in California for irrigation of landscapes (compiled by WateReuse Foundation, 2003).

Landscape irrigation	Disinfected tertiary recycled water	Disinfected secondary-2.2* recycled water	Disinfected secondary-23* recycled water	Undisinfected secondary recycled water
Parks and playgrounds	Allowed	Not allowed	Not allowed	Not allowed
School yards	Allowed	Not allowed	Not allowed	Not allowed
Residential landscaping	Allowed	Not allowed	Not allowed	Not allowed
Unrestricted access golf courses	Allowed	Not allowed	Not allowed	Not allowed
Cemeteries	Allowed	Allowed	Allowed	Not allowed
Freeway landscaping	Allowed	Allowed	Allowed	Not allowed
Restricted access golf courses	Allowed	Allowed	Allowed	Not allowed
Ornamental nurseries and sod farms	Allowed	Allowed	Allowed	Not allowed

*Refers to 7-day median counts of total coliform bacteria per 100 ml of water

osmotic effects that affect the availability of soil water to plants; specific ions toxic to sensitive plants such sodium, chloride and boron; and the combined effects of sodicity (Sodium Adsorption Ratio or SAR) and salinity, which affects the rate of water infiltration into the soil surface and the permeability of the soil profile. Other constituents of concern include N, carbonate ions, residual chlorine, and constituents (e.g., suspended solids and chemical constituents that form precipitates of iron and manganese sulfides or hydroxides) that may clog the small orifices in emitters of drip irrigation systems and sprinkler nozzles.

Representative Composition of Recycled Waters in California

Table 2 (page 8) contains representative composition of Title 22 recycled waters in California. The chemical analyses of the recycled waters for Torrey Pines, Whispering Palms and Monterrey Wastewater Reclamation represent monthly values. For the recycled water from the West Basin Water Recycling Facility, residual chlorine and turbidity were monitored continuously, pH and EC are either monitored continuously or daily, suspended solids monitored weekly, dissolved mineral salts monitored monthly, and ammonia and nitrate monitored quarterly.

The recycled waters from Torrey Pines and Whispering Palms are mainly used to irrigate golf courses and parks. The water from the West Basin Water Recycling Facility is used to irrigate golf courses, turfgrasses in a sports field and landscapes (turf, trees and shrubs) surrounding commercial buildings. The water from the Monterrey Wastewater Reclamation Study for Agriculture was successfully used to irrigate artichokes, broccoli, cauliflower, lettuce and celery without any public health impacts.

Guidelines to Evaluate Recycled Water for Landscape Irrigation

Evaluating the suitability of waters for irrigation requires a broad understanding of water quality characteristics and interactions with plant, soil and irrigation management systems. Water quality assessment and management in irrigated agriculture is much more established than in landscape irrigation, except for turf irrigation. A major difference exists, however, in that water quality guidelines for crop irrigation is based on harvested crop yield, while landscape irrigation is based on aesthetic quality or appearance. Nevertheless, attempts are being made to apply a significant portion of guidelines for crop irrigation to landscape irrigation because the effects on plants, soils and irrigation management systems are somewhat similar.

The *FAO Water Quality Guidelines* (Irrigation and Drainage Paper 21 rev.) is the best known and most widely used water quality guideline in irrigated agriculture. Table 3 (page 9) presents the FAO guidelines with three categories on use restrictions that are somewhat arbitrary, due to lack of clear-cut specific boundary and gradual occurrence of changes, but they are based on numerous studies, observations and experiences in the field. Caveats and assumptions in the use of this guideline are indicated in this publication. The FAO guidelines could be used as an initial effort to evaluate suitability of recycled water for landscape irrigation taking into account local conditions. As landscape professionals gain experience, they may need to consider additional constraints or modifications.

Application of FAO Guidelines and Alternative Management Options

The four representative compositions of recycled waters presented in Table 2 are evaluated by the FAO water quality guidelines presented in Table 3. The results are given in Table 4 (pages 10 and 11). The recycled water from the West Basin Water Recycling Facility

Table 2. Representative composition of recycled waters compiled from various sources.

Description	**Torrey Pines** San Diego County 1992-94 (mean and sd, n=31) Shaw et al., 1995	**Whispering Palms** San Diego County 1993-94 (mean and sd, n=30) Shaw et al., 1995	**WBWRF** Los Angeles County 2001-03 (mean n=36) WBMWD, 2004	**MWRSA** Monterrey County 1980-85 (median, n=91) Sheikh et al., 1990
pH	7.2±0.6	7.3±0.3	7.0	7.2
EC, dS/m	1.55±0.23	1.41±0.13	1.03	1.26
TDS, mg/L	989±58	900±83	671	778
Na, mg/L	179±17	185±12	157	166
Ca, mg/L	80±19	63±11	47	52
Mg, mg/L	34±8	26±5	20	21
K, mg/L	14±2	17±4	17	15
Cl, mg/L	226±67	198±52	188	221
SO4, mg/L	92±21	85±13	110	107
HCO3, mg/L	90±59	161±32	159	97
Alk., mg/L as CaCO3	148	264	261	159
SAR, meq/L$^{0.5}$	4.2±1.0	4.8±1.0	3.4	4.9
Adj. SAR, meq/L$^{0.5}$	4.5	5.3	4.5	5.1
RSC, meq/L	<0.0	<0.0	1.7	<0.0
B, mg/L	0.4±0.1	0.5±0.07	0.6	0.4
NH3, mg/L as N	0.24±0.26	0.18±0.23	31.3	1.2
NO3, mg/L as N	13.9±5.7	11.7±6.2	0.83	8.0
NO2, mg/L as N			0.23	
Total P, mg/L			6.2*	2.7
TSS, mg/L			6.0	
Turbidity, JTU			2.2	
Residual Cl2, mg/L			5.6	
Sulfide, mg/L			<0.1*	
Iron, mg/L			0.43*	

WBWRF = West Basin Water Recycling Facility

MWRSA = Monterrey Wastewater Reclamation Study for Agriculture

* average for only 2003

falls into the categories of severe restrictions on use for excess residual chlorine and excess nitrogen. It is expected that the 5.6 mg/L of residual chlorine will tend to be dissipated within the distribution system and to be rapidly dissipated at the time of water application. The excess N is more problematical if normal fertilization rates are practiced using this water. The 32.4 mg/L of N in this water contains 88 lbs per ac-ft of water. If the seasonal water application rate is 12,188 m^3 per ha, then about 390 kg per ha of N would be applied that fulfills the N requirement of most plants, and no N fertilization would be required.

Slight to moderate restrictions in use are expected for each of the four recycled waters, depending on the plant species, soil types and water management practice among others. First, the EC of these waters range from 1.0 to 1.6 mmhos/cm, and may be too salty for the more salt-sensitive plants while having little or no osmotic effect on the more salt tolerant plants. A moderate leaching fraction (ratio of rootzone drainage to applied water) such as 0.3 to 0.4 could control soil salinity so that osmotic effects are reduced. Opportunities exist to replace salt sensitive plants with more salt tolerant plants. Turfgrasses that are salt sensitive include Annual Bluegrass and Kentucky Bluegrass while moderately salt tolerant to tolerant grasses include Annual Ryegrass and Bermudagrass. Landscape trees that are salt sensitive include Red Maple and Coast Redwood while more salt tolerant ones include Red Gum Eucalyptus and Italian Stone Pine. Shrubs that are salt sensitive include Abelia and Rose while more salt tolerant ones include Pittosporum and Italian Jasmine.

Second, the combined effects of EC and SAR of the recycled water from the West Basin Recycling Facility may reduce soil permeability for soils that swell upon wetting and shrink upon drying. Reduced water infiltration rates and soil permeability may be partially overcome by adding calcium into the water or into the soil surface using amendments like gypsum ($CaSO_4.2H_2O$).

Third, the West Basin recycled water has a Residual Sodium Carbonate of

Table 3. Guidelines for interpretation of water quality for irrigation (Ayers and Westcot, 1985)

Potential Irrigated Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Salinity (affects crop water availability)				
ECw	dS/m	<0.7	0.7-3.0	>3.0
TDS	mg/L	<450	450-2,000	>2,000
Infiltration (affects infiltration rate of water into the soil)				
SAR* = 0-3, and ECw =	*$(meq/L)^{0.5}$	>0.7	0.7-0.2	<0.2
SAR = 3-6, and ECw =		>1.2	1.2-0.3	<0.3
SAR = 6-12, and ECw =		>1.9	1.9-0.5	<0.5
SAR = 12-20, and ECw =		>2.9	2.9-1.3	<1.3
SAR = 20-40, and ECw =		>5.0	5.0-2.9	<2.9
Specific Ion Toxicity (affects sensitive crops)				
Sodium (Na)				
Surface irrigation, SAR	$(meq/L)^{0.5}$	<3	3-9	>9
Sprinkler irrigation, Na^+	mg/L	69	>69	
Chloride (Cl)				
Surface irrigation, Cl^-	mg/L	<142	142-355	>355
Sprinkler irrigation, Cl^-	mg/L	<106	>106	
Boron (B)	mg/L	<0.7	0.7-3.0	>3.0
Miscellaneous Effects (affects susceptible crops)				
Nitrogen, NO_3-N	mg/L	<5	5-30	>30
Bicarbonate (HCO_3)	mg/L	92	92-518	>518
pH	No problems expected with normal pH range of 6.5 - 8.4			
Residual Chlorine* (overhead sprinkling only)	mg/L	<1	1-5	>5

* Added by Pettygrove and Asano (1985)

Table 4. Evaluation of representative recycled waters based on the FAO Water Quality Guidelines (TP = Torrey Pines, WP = Whispering Palms, WRF = WBWRF, MRS = MWRSA).

Potential problem	Degree of restriction on use		
	None	Slight to moderate	Severe
1. Affects availability of soil water to plants			
ECw, dS/m	<0.7	0.7-3.0	>3.0
Recycled waters		WRF, MRS, WP, TP	
2. Affects soil hydraulic conductivity			
SAR=3-6, and ECw in dS/m =	>1.2	1.2-0.3	<0.3
Recycled waters	MRS, TP, WP	WRF	
3. Dispersion of soil organic matter and reduced water intake rates			
RSC, meq/L	<1.25	1.25-2.5	>2.5
Recycled waters	TP, WP, MRS	WRF	
4. Specific ion toxicity hazard of Na for surface irrigation			
SAR, meq/L$^{0.5}$	<3	3-9	>9
Recycled waters		WRF, TP, MRS, WP	
5. Specific ion toxicity hazard of Na for sprinkler irrigation			
Na, mg/L	69	>69	
Recycled waters		WRF, MRS, TP, EL	
6. Specific ion toxicity hazard of Cl for surface irrigation			
Cl, mg/L	<142	142-355	>355
Recycled waters		WRF, MRS, TP, WP	
7. Specific ion toxicity hazard of Cl for sprinkler irrigation			
Cl, mg/L	<106	>106	
Recycled waters		WRF, MRS, TP, WP	
8. Specific ion toxicity hazard of boron			
B, mg/L	<0.7	0.7-3.0	>3.0
Recycled waters	TP, MRS, WRF, WP		

Note: Table 4 continues on page 11.

1.7 meq/L and may disperse soil organic matter forming an unsightly dark gray mat on turf and reduce water infiltration rates as noted at the Victoria Golf Course. This golf course injects acids into the recycled water to ameliorate soil dispersion and slow water penetration rates.

Fourth, all waters are judged to have slight to moderate restrictions on use because of their Na and Cl concentrations that may lead to specific ion toxicity effects, especially when the foliage are wetted by sprinkler irrigation. Plants sensitive to these ions could be replaced by more tolerant ones. For instance, specific-ion sensitive tree such as Red Maple could be replaced by Norfolk Island Pine, and salt sensitive Camellia shrub could be replaced by Japanese Boxwood.

Fifth, the recycled waters at Monterrey Wastewater Reclamation Study, Torrey Pines and Whispering Palms contain 9 to 32 mg/L of total N, and may have slight to moderate restrictions on use. Since these waters contain from 27 to 88 lbs N per ac-ft of water, N fertilization rates on landscape plants should be adjusted depending on their N requirements. Shaw et al. From the University of California conducted field trials comparing the recycled water from Whispering Palms to potable water for irrigation of turfgrasses. Table 5 (page 11) summarizes their findings. The potable water had a total N concentration of 0.3 mg/L and the recycled water, 11.4 mg/L, and all plots received 609 kg per ha of N fertilizer. In spite of these high N loadings, the drainage water below the root zone with leaching fraction of about 0.5 contained only 8 to 13 percent of the N loading. This indicates that turfgrasses are heavy feeders of N, and the N in the Whispering Palms recycled water was beneficially used by the turfgrasses.

Summary

Opportunities to beneficially utilize recycled waters for irrigation of landscape plants are being evaluated in the Los Angeles to San Diego corridor in Southern California. The source water for this region is typically a mix of pumped groundwater containing 300 to 1,500 mg/L TDS, 750 mg/L imported

Table 4, continued. Evaluation of representative recycled waters based on the FAO Water Quality Guidelines

Potential problem	Degree of restriction on use		
	None	Slight to moderate	Severe
9. Excess nitrogen for susceptible plants			
NH3+NO3, mg/L as N	<5	5-30	>30
Recycled waters		MRS, TP, WP	WRF
10. Carbonate deposition on foliage, flowers and fruit			
HCO3+CO3, mg/L	92	92-518	>518
Recycled waters	TP	MRS, WRF, WP	
11. Potential toxicity of chlorine residual			
Chlorine residual for overhead sprinklers, mg/L	<1	1-5	>5
Recycled waters			WRF*

*Chlorine residual is expected to be dissipated in transit by the time the water is applied.

Colorado River water, and 450 mg/L imported Northern California water (Fig.1). The recycled waters in this region typically have TDS ranging from 700 to 1,200 mg/L. Landscape professionals are concerned that the salinity of the recycled water may adversely impact landscape plants grown in this region. FAO water quality guidelines for crop irrigation were applied to evaluate the suitability of recycled waters for landscape irrigation.

Table 5. Estimated mass loading of nitrates from the rootzone into the vadose zone at the Whispering Palms study (after Shaw et al., 1995).

	Bermudagrass Potable water	Bermudagrass Recycled water	Kikuyugrass Potable water	Recycled water
Applied N fertilizer, lbs/ac (kg/ha)	544 (609)	544 (609)	544 (609)	544 (609)
N content in water, lbs/ac (kg/ha)	4 (4.5)	225 (252)	4 (4.5)	225 (252)
Total N applied, lbs/ac (kg/ha)	548 (614)	769 (861)	548 (614)	769 (861)
NO3-N in drainage, mg/L	2.1	3.1	3.2	2.2
Leaching Fraction	0.48	0.52	0.48	0.52
N in drainage, lbs/ac (kg/ha)	47 (53)	84 (94)	72 (81)	59 (66)
N drained, percent	8.6	10.9	13.2	7.8

Although there may be some constituents of concern in recycled waters including salinity and sodicity, selection of more tolerant turfgrasses, trees and shrubs, as well as appropriate management practices could result in aesthetically pleasing landscapes. Increases in recycled water use for landscape irrigation instead of potable water will help in meeting current and future water shortfalls in urban water supplies, especially in Southern California.

Acknowledgments

The author is leading a study team consisting of personnel from the University of California (S. Grattan, A. Harivandi, D. Shaw and L. Wu), U.S. Salinity Laboratory (C. Grieve), a water reuse consultant (B. Sheikh), and a documentation specialist (L. Rollins). We are preparing a comprehensive literature review and an interactive CD-Rom as a salinity guide for landscape irrigation. This ongoing study is financially supported by the WateReuse Foundation, Central Basin Municipal Water District, West Basin Municipal Water District, California Department of Water Resources, the city of El Cerritos, Los Angeles Department of Water and Power, Ground Water Replenishment District of Southern California, National Water Research Institute, and Southern California Salinity Coalition.¤

Necrology

Brice Bledsoe, a Member of USCID from 1987 to 1996, died November 21, 2005. He was the former General Manager of the Solano Irrigation District in California.

ICID Addresses Global Climate Change

by Mark Svendsen, Water Resources Consultant, Philomath, Oregon (marksvendsen@aol.com)

Global Climate Change and Irrigation and Drainage

The average global temperature has increased by about 0.5 degrees Celsius during the past 100 years in a continuing trend toward a warmer planet. Convincing evidence shows that this is the highest average global temperature in the past 600 years and evidence from tree rings and glacial ice cores suggests that the increase is unique during the last 10,000 years.

The heating resulting from climate change is not uniform. Temperature increases in the North American arctic have been as high as 5 degrees Celsius, and land surface temperatures have generally increased more than the global average because of the oceans' buffering effect. In addition, because winds and ocean currents redistribute the earth's heat energy and water vapor, temperature changes vary among regions. The strongest effects occur at mid and high latitudes in the northern hemisphere. Winter and spring temperatures are rising more rapidly than summer temperatures and nighttime temperatures are increasing more rapidly than daytime ones.

This warming is closely associated with rising levels of CO_2 in the atmosphere, which have increased by about 30 percent during the past 200 years. Increases in CO_2 levels are, is turn, associated with human activities, principally the burning of fossil fuels (coal, oil and natural gas) and deforestation — the famous "greenhouse effect." The greenhouse effect is the result of atmospheric gasses — principally CO_2, methane, nitrous oxide and water vapor — that trap solar energy under the mantle of the earth's atmosphere.

If it weren't for a naturally-occurring greenhouse effect, the earth's temperature would be about 34 degrees Celsius lower that it is — well below the freezing point. However, in the absence of human activity, the naturally produced greenhouse gases are almost exactly balanced by other natural processes which form "carbon sinks" and sequester the greenhouse gasses — principally as biomass or dissolved in seawater. The problem comes when human activity increases the production of these gasses while sequestration processes remain static. The result is increased concentrations of these gasses in the atmosphere and increased retention of incoming solar radiation, i.e., rising global temperatures. The burning of fossil fuels accounts for 80 to 85 percent of human-caused CO_2 emissions, while land use changes account for 15 to 20 percent.

The reports of the Intergovernmental Panel on Climate Change[1] allow little doubt as to the cause and effect relationship between human-induced increases in atmospheric CO_2 and the rise in global temperatures. And the persistence of CO_2 in the atmosphere means that even if anthropogenic CO_2 emissions were to cease tomorrow, global temperatures would continue to rise for centuries.

In addition to its direct effects, rising global temperatures set in motion a series of other events that will be unevenly distributed across the globe. Of particular interest to irrigation and drainage professionals are those which affect precipitation, soil moisture status, river hydrology, droughts, flooding and agricultural crop growth. Some of these are the following.

Changes in precipitation patterns. In general, rising temperatures lead to increased evaporation and increase the moisture-holding capacity of the atmosphere, which in turn should lead to increased precipitation. Precipitation will be unevenly distributed though, and some areas will receive more precipitation than at present and others less. In mid and upper latitudes, there will be changes in the mix of snow and rain, with more precipitation falling as rain as temperatures rise. Models also predict increased variability in precipitation, and more extreme events — increased flooding and more intense droughts.

Increased storage losses. Water stored in lakes and reservoirs will suffer increased losses due to evaporation, reducing the water available for irrigation, municipal supplies and all other uses. Moreover, more intense precipitation events may enhance erosion in watersheds above reservoirs, increasing sediment deposition and reducing storage capacity.

Reduced storage of precipitation as snow. Higher temperatures at elevations where snow accumulates as snowpack to be released during spring and summer

Projected Consequences of Climate Change to 2100

✓ Global temperature rises by a further 1.0 to 3.5 degrees Celsius.

✓ Incidence of infectious diseases increases, with malaria and other vector-borne diseases spreading into temperate regions.

✓ Number of people affected by coastal flooding doubles from 46 million to 92 million (more if future population increases are figured in).

✓ Market-oriented production of rainfed food grains shifts to higher latitudes.

✓ Agricultural pests and diseases spread and prevalence increases.

✓ Sea level rises by an additional 50 centimeters or more.

✓ Continental glaciers retreat and many disappear.

months will mean that runoff occurs earlier, either during the precipitation events themselves, or sooner in the melting period. This can exacerbate winter and spring flooding and reduce river flows during times of peak water demand. This is an important issue in temperate region countries like Chile, Australia, the United States and Canada, and also in nations watered by major rivers originating in the Himalayas, such as India, Pakistan, Nepal, Bangladesh, Burma and China.

Increased crop water demands. Higher temperatures will increase transpiration from vegetation, boosting water requirements for both rainfed and irrigated crops. At the same time, increased biomass production due to higher temperatures and elevated CO_2 levels in the atmosphere will tend to increase yields. These factors will interact in complex ways.

Rising sea levels. The melting of polar glaciers and thermal expansion of seawater in response to rising temperatures are increasing the volume of oceans, raising sea levels. Since the end of the 19th century, measured sea level increases have averaged 1 to 2 mm/year and now total 10 to 25 cm. As temperatures, and sea levels, continue to rise, this effect will inundate low-lying coastal areas, increase coastal damage due to storm surges, and increase the saline water intrusion into vulnerable fresh water aquifers along the coast. The overall effect will be to reduce the extent of coastal agricultural lands, especially paddy lands, force some coastal populations to migrate inland onto currently cultivated land, and reduce fresh groundwater availability.

These consequences of GCC suggest some important and interesting questions for irrigation and drainage professionals. Among them:

- How can reservoir operations be modified to account for higher storage losses, more extreme events and other expected changes?
- How will higher temperatures, increased CO_2 concentrations, and reduced soil moisture levels combine to affect crop yields and crop water requirements?
- What is the scope for stabilizing rainfed yields through supplemental irrigation in areas where precipitation declines and becomes more variable?
- What is the likely impact of particular shifts in precipitation patterns on groundwater recharge and availability?
- How can new and remodeled infrastructure help to adapt irrigation systems to the disruptions caused by GCC?
- What are policy and institutional requirements for management strategies that cope successfully with GCC-induced changes?

These and other questions are ones that can be addressed by a newly-formed ICID Working Group.

Working Group on Global Climate Change

During its September 2005 meeting in Beijing, the IEC accepted the recommendation of the Technical Activities Committee to establish a Working Group on Global Climate Change (WG-Climate). Vice President **Mark Svendsen** (USA) was named acting chairman of the working group. To date eight national committees (Egypt, India, Italy, Japan, Netherlands, the Philippines, South Africa and the United States) have named representatives to the WG, and three international organizations (IFPRI, IWMI, and the WMO) have named observers to participate.

The purpose of WG-Climate is to:

1. Raise awareness and stimulate discussion among national committees, policy makers, and the general public on the implications of GCC for irrigation, drainage and flood control.

2. Share and collect experience with GCC and its water-related implications

3. Position ICID to play a role in ongoing discussions of GCC effects related to irrigation, drainage and flood control.

The work of the WG will center around annual seminars where information on GCC and its implications will be shared and discussed. These will take place during the annual IEC meetings and their associated conferences — Kuala Lumpur in 2006, Sacramento in 2007, and Lahore in 2008. The WG will aim to accomplish its purpose, as stated above, by 2008, and will decide at that time if the group should continue to work for an additional three-year period.

The meetings of the WG will comprise a brief business meeting to confirm membership and select leaders and a seminar consisting of paper presentations and discussions. Seminars will be open to all interested participants. Presentations will consist of both invited and contributed papers from both national representatives and observers. A half-day meeting/seminar is tentatively planned for Kuala Lumpur, with the possibility of full-day seminars

Climate Change in South Africa

According to South Africa's *National Climate Change Response Strategy*, global climate change is a threat to sustainable development, especially in developing countries. The year 2005 was the warmest year on record in South Africa, and this is bad news for a country which already has a high-risk hydroclimatic environment, with low rainfall-to-runoff conversion and a high inter-annual variability of climate. The country anticipates that it may even face the need to re-negotiate its international water agreements with its neighbors, with whom it shares 70 percent of its water resources.

Of particular concern is the impact of GCC on the most vulnerable communities, as these are invariably the least well-equipped to deal with such widespread change. As Minister of Agriculture Thoko Didiza puts it, "Climate change is a serious risk to poverty reduction and threatens to undo decades of development effects."

The Water Wheel, Jan/Feb 2006

in subsequent years, depending on interest.

Outputs from the WG will include a website, on which all contributed papers will be posted, together with links to the extensive set of resource materials available on other sites. During the second annual meeting in Sacramento, the WG will consider what other outputs may be warranted and useful.

USCID GCC Committee

The USCID Board of Directors recently established a USCID Committee on Global Climate Change, with Mark Svendsen as chairman. The Committee will support the work of the ICID Working Group, and examine relevant issues in the U.S. USCID Members interested in joining the Committee should contact Svendsen at marksvendsen@aol.com.

Endnote

[1]An intergovernmental scientific panel of more than 2,000 scientists, established in 1988 by the United Nations Environmental Program (UNEP) and the World Meteorological Organization (WMO).¤

Loan Reports

The following publications are available on loan from the USCID Denver Office.

Irrigation Sector Reform in Central and Eastern European Countries (CD-ROM), 2006. ICID.

UNESCO-IHE Update, March 2006. Special Edition: 4th World Water Forum. UNESCO-IHE Institute for Water Education.

ICID Annual Report, 2004-2005. International Commission on Irrigation and Drainage.

San Joaquin Valley Drainage Monitoring Program 2001, November 2005. California Department of Water Resources.

Water International, December 2005. International Water Resources Association.

Flood Risks and Safety in the Netherlands, Interim Report, 2006. Government of The Netherlands.¤

Ochs Receives USCID Award

In a ceremony recently held in Washington, DC, **Walter Ochs** was presented the 2004 USCID Service to the Profession Award. He was honored for his leadership in international drainage and for his influence in the improvement of drainage in developing countries.

Ochs served as drainage advisor to the World Bank from 1986 to 1996. Prior to the World Bank, he was employed by the Soil Conservation Service (now NRCS), where as national drainage engineer, he was responsible for technical leadership and guidance in all aspects of drainage for the SCS both within and outside the United States.

During his 40 years of experience with SCS, the World Bank and as an independent consultant, Ochs has participated in drainage, irrigation, flood control and erosion control projects in more than 30 countries.

He has authored more than 45 technical publications, papers and reports related to irrigation and drainage. He has served in leadership position in both the American Society of Civil Engineers and the American Society of Agricultural Engineers. In recognition of his outstanding international achievements in drainage, Ochs was inducted into the International Drainage Hall of Fame in 1996.¤

2005 USCID Scholarship Awarded

The 2005 Summers Engineering/USCID Scholarship was awarded to **Clinton Powell**, an undergraduate student at South Dakota State University in Brookings. He is a senior enrolled in the Agricultural and Biosystems Engineering Department, with an emphasis in water and natural resources. Powell served as an summer intern in Billings, Montana, for the **Bureau of Reclamation**, where he worked on irrigation systems and a study of environmental changes in the Beaverhead Valley. During a second internship with Reclamation in Bismarck, he worked on an irrigation delivery study and other issues related to the Garrison Diversion Project.

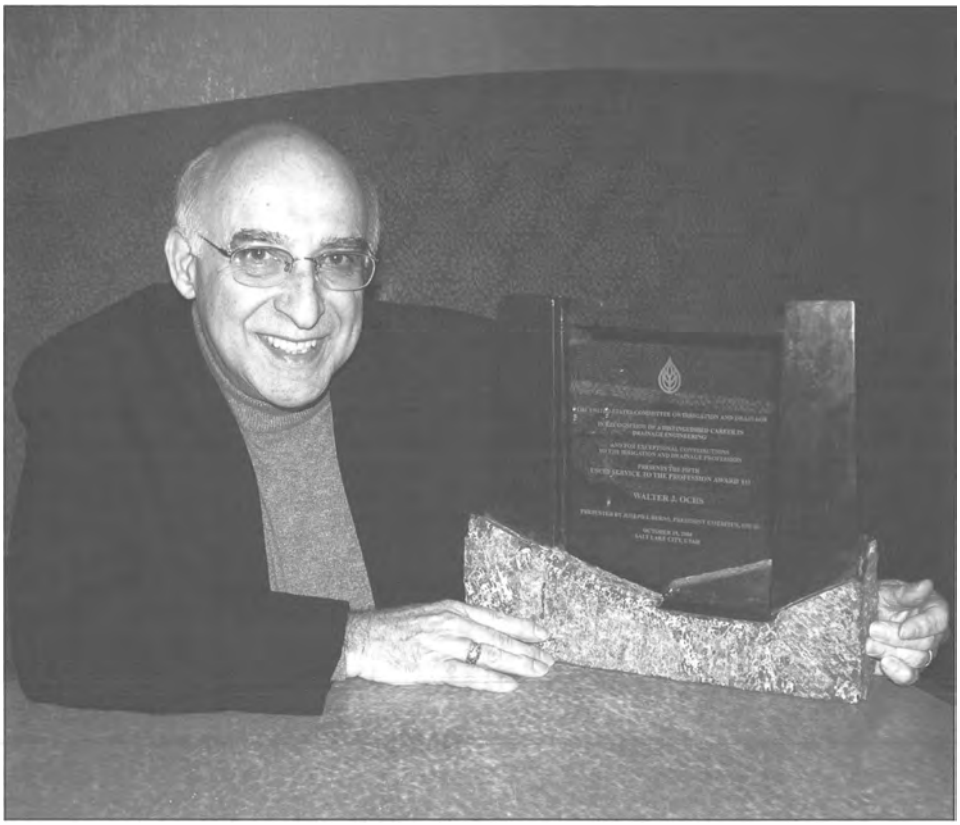
The Summers Engineering/USCID Scholarship is funded by an endowment established by **Joseph B. Summers**, Hanford, California. Donations are invited to help support the scholarship.¤

Scholarship Applications and Award Nominations Invited

Applications are now being accepted for the **2006 Summers Engineering/ USCID Scholarship**.

Nominations are also being accepted for two USCID Awards. The **USCID Service to the Profession Award** recognizes service to the irrigation, drainage, flood control or water resources management profession.

The **USCID Merriam Improved Irrigation Award** goes to a Member of USCID who has made meritorious contributions to the advancement, understanding or attainment of the goals and objectives of USCID, ICID and/or the Fund For Furthering Flexible



Wally Ochs receives USCID Service to the Profession Award.

Conservation Society Meeting Set for July

The Soil and Water Conservation Society will hold its 61st Annual Conference in Keystone, Colorado, July 22-26, 2006. Areas of special emphasis for the Conference include:

- Water use and management — learning to live with limits
- The science of targeting — getting the right practices implemented in the right places and at the right time
- Conservation and the 2007 farm bill — presentations highlighting key issues and recommendations for reform regarding the conservation provisions of the U.S. Farm bill.

In addition to two plenary sessions, the Conference will feature workshops, exhibits, poster presentations, breakfast roundtables, concurrent educational sessions and "outdoor classroom" technical tours. Several social events will round out the program.

For more information, visit www.swcs.org.¤

Prez (continued)

2007 are also proceeding under the able leadership of **Bert Clemmens**. Plenary Session speakers expected at the Conference include Mohammed Abu Zeid, Minister of Water Resources and Irrigation in Egypt; **Mark Limbaugh**, Assistant Secretary for Water and Science, U.S. Department of the Interior; and Stephen Mills, Chairman of the Australian ICID National Committee. An excellent technical program and a stunning set of tours are also in the works. Our next conference will be held in Boise this October and will focus on ground and surface water interactions and conjunctive management. This shapes up to be a most interesting meeting, as well.

USCID will co-sponsor a conference November 28-30 in Indianapolis with the Rivers Institute at Hanover College on reducing nonpoint source pollution. Dennis Wichelns, advisor to the USCID Board, serves as Executive Director of the Rivers Institute. The Institute is generously covering our costs in helping to organize the conference and operating an exhibit there. It should offer the opportunity for some of our Members who are experienced with TDMLs in the West to share that experience with mid-western farmers and drainage managers.

Mark Svendsen
President, USCID¤

USCID Supports Landsat Program

USCID recently sent letters to key government officials at USGS, NASA and the Office of Science and Technology Policy, urging the continued availability of high resolution imagery provided by Landsat satellites. The USCID Board of Directors authorized the letters in response to a request from **Richard G. Allen**, who uses the technology for his work in evapotranspiration.

Following is the information provided in the letter:

Remote sensing is a critically important technology for improving our management of water resources in the United States and abroad over the coming quarter century. Facing unprecedented stress on those resources, irrigated agriculture is being asked to grow more food and fibre with less water, freeing resources for expanding urban and environmental uses. Essential to the application of this technology to irrigation water management is the availability of high resolution imagery in the visible, near infrared, and thermal infrared bands. Such imagery is currently available from the Landsat series of satellites.

Unfortunately the continued availability of such imagery is threatened by reduced functionality of Landsats 5 and 7. Of even greater concern is the prospect that the new generation Landsat satellites may eliminate the thermal imager from its design. This would fatally compromise the utility of these satellites in estimating evapotranspiration (ET) from crops and native vegetation using the SEBAL and METRIC energy balance algorithms. These are the most commonly used and most effective programs for this purpose and rely on the existence of contemporaneous information from all three of these bands to operate.

Although thermal infrared imagery is available from other satellites such as MODIS, the 1 kilometer resolution of these images is too coarse for use in isolating ET from individual fields. Needed is imagery with the following characteristics.

- *Contemporaneous images from visible, near IR and thermal IR bands*
- *Resolution of 60 meters or less for the thermal imager*
- *A repeat coverage interval of 7 to 10 days*

The Landsat satellites fulfill this need admirably and the prospect of losing this capability, because of the lack of a thermal imager on future satellites, is deeply disturbing.

The letter concluded:

. . . we are aware of the need to produce more with less water, both here and abroad, and the promise of remote sensing technology to help us do that. I hope that you will give careful consideration to the needs of water users across the spectrum for this vital technology in considering the capabilities of the Landsat Data Continuity Mission and urge you to support the inclusion of the high resolution short-wave and thermal capability outlined above in future missions.

USCID Members wishing to support this effort are encouraged to contact Allen (rallen@kimberly.uidaho.edu).¤

Meetings, continued

The Conference will open with a Plenary Session on Wednesday afternoon, followed by the Interactive Visual Presentations session that evening. Concurrent Technical Sessions will be featured on Thursday and Friday morning, followed by a closing Plenary Session Friday afternoon. Concurrent sessions will include one track with an emphasis on policy and management issues and one track addressing technical issues. The concurrent sessions will feature the following topics:

- River Basin Compacts
- Remote Sensing and Crop Changes
- Urban/Agriculture Interface
- Flow Management and Consumptive Use
- Resolving Competition and Ground Water/Surface Water Interactions
- Planning and Management and Water Quality Issues

An Exhibition will be held during the Conference. A half-day study tour Wednesday morning and a full-day study tour on Saturday will allow participants to view water resources activities in the area.

The Preliminary Program for the Boise Conference is online. The Final Program and Registration Form will be online this summer; copies will be mailed to USCID Members.

Discussions during the November Conference in Indianapolis, ***Innovations in Reducing Nonpoint Source Pollution: Methods, Policies, Programs, and Measurement***, will focus on the challenges, struggles and successes experienced by farmers, researchers, field technicians, resource agency personnel, public officials and others in reducing nonpoint source pollution. Speakers will present new information regarding successful programs, some of which have been implemented for several years, and others that are relatively new. Special invited speakers will describe historical efforts to reduce nonpoint source pollution and recommend innovative approaches.

Conference Topics include:

- Innovative Methods
- Innovative Policies and Institutions
- Innovative Programs
- Innovative Monitoring and Assessment
- Comprehensive Analysis

Dennis Wichelns, Advisor to the USCID Board of Directors, is Executive Director of the Rivers Institute at Hanover College. The Rivers Institute enhances the understanding of the culture, economics and science of river systems by producing conferences and workshops, providing consulting services and developing educational resources. For more information on the Conference and the Rivers Institute, visit www.riversinstitute.org.¤

58th IEC/Fourth International Conference

USCID acknowledges with appreciation the support of the following organizations.

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www.sontek.com

Sponsorships are still available. To be included, contact Larry Stephens at 303-628-5430, stephens@uscid.org.

Hoover Dam Tours Expanded

The **Bureau of Reclamation** recently expanded the tour route at Hoover Dam to include the Nevada penstock viewing platform, enabling visitors to view a portion of the dam that has been closed for nearly five years. Also, the exhibit gallery in the dam's visitor center, closed since September 2005 while new exhibits were being installed, has re-opened.

The new exhibits include interactive and static science displays, detailed dioramas, and an almost full-size cutaway display of a hydroelectric turbine generator that visitors can walk through to learn about the internal components and workings of these units.

The lobby of the dam's original exhibit building, located across the street from the visitor center, has also been renovated.¤

Cal Poly Receives Conservation Award

The Irrigation Training and Research Center at California Polytechnic State University was recognized by the **Bureau of Reclamation** for helping to improve and promote water conservation and reclamation throughout the Bureau's Mid-Pacific Region.

The Commissioner's Water Conservation Award was presented to ITRC Director **Stuart Styles** in January. The award recognized the ITRC for providing technical assistance and formal training classes to the Bureau and the Region during the past 10 years. The ITRC has provided training classes and consulting services to more than 100 water districts and contract water providers.

The ITRC was founded in 1989 by ITRC Chairman **Charles M. Burt**. The Center has provided consulting on international irrigation modernization to agencies in China, the Philippines, Vietnam, Kyrgyzstan, Azerbaijan, India, Pakistan and Mexico. For more information, visit www.itrc.org.¤

Reclamation History, Volume 1, Published

The **Bureau of Reclamation** has published the first of two volumes documenting its history, innovations, and role in the development of the American West.

Volume 1 tells the story of Reclamation from its beginnings to the end of World War II. The book begins by highlighting important projects, events and personalities that run the gamut of Reclamation's history in the 20th century. The book then continues through a more detailed and chronologically organized progression.

The book was written by William D. Rowley, the Grace A. Griffen Chair in Nevada and the West in the History Department at the University of Nevada, Reno. Rowley received assistance from Donald J. Pisani, a professor of history and occupant of the Merrick Chair of Western American History at the University of Oklahoma, and Donald C. Jackson, a professor of history at Lafayette College.

The book is available for purchase from the Government Printing Office at http://bookstore.gpo.gov.¤

ARS Closes U.S. Water Lab, Creates Arid-Land Research Center

The Phoenix-based U.S. Water Conservation Research Laboratory and the Western Cotton Research Laboratory have been combined and moved to new facilities in Maricopa, Arizona, south of Phoenix.

The U.S. Arid-Land Research Center, USDA-ARS, is structured into three main research units: Water Management and Conservation, Pest Management and Biocontrol, and Plant Physiology and Genetics.

The mission of the USALARC is to develop sustainable agricultural systems by investigating the multiple interactions within a changing agricultural environment and leveraging the unique characteristics of its location. Issues to be addressed through interdisciplinary research include the complex relationships among cropping systems, water management, and the environment, including the agriculture-urban interface.

The address of the U.S. Arid-Land Research Center is 21881 North Cardon Lane, Maricopa, AZ 85239. The main telephone number is 520-316-6300.¤

Election (continued)

He received an A.S. Degree in Engineering Sciences from Pima College, and B.S. and M.S. Degrees in Agricultural and Biosystems Engineering from the University of Arizona. He is co-founder of Davey-Cairo Engineering, Inc. (DCE), a consulting civil and agricultural engineering firm specializing in water resources and irrigation engineering. He is responsible for the daily operations of the DCE Central Arizona Office and Imperial Valley Office, as well as providing project and design management, QA/QC, and leading the firm's marketing and business development activities. His early professional experience was related to soil and water conservation planning, on-farm irrigation water management, erosion control practices, on-farm best management practices and tile drainage design. Prior to founding DCE, he worked for CH2M Hill, where he served as a Project Manager and Design Manager of irrigation and conveyance projects in California, Arizona and other areas of the southwestern United States. He has consulted to numerous irrigation districts and Native American clients. Currently he is leading urbanization mitigation programs for several irrigation districts working to minimize impacts to their operations and maintenance. He is a Registered Professional Engineer in Arizona, a Member of USCID and a past ASAE Arizona State Section Chair. He is a member of the Southwest Indian Agricultural Association Board of Directors, the Fraternal Order of the Engineer and the Alpha Epsilon Agricultural Engineering Honorary. He is also a member of the University of Arizona Ag & Biosystems Engineering Advisory Committee and Scholarship Committee. He has co-authored several publications on agricultural engineering, irrigation and water resources.

Robert S. Gooch is Principal Engineer, Salt River Project, Phoenix, Arizona. He received a B.S. Degree from the University of Arizona and an M.S. Degree from Arizona State University. He has worked 31 years in various fields of Civil Engineering with an emphasis in water resources and irrigation systems. Much of his work at SRP involves operational and planning studies and modeling, including hydraulic modeling, water quality modeling, canal automation, land use and water demand forecasting, irrigation distribution studies and reservoir operations modeling. He also acts as liaison for SRP for several multi-agency projects. Prior to his work at Salt River Project, he worked with the Central Arizona Project developing the canal automation system and performing various hydraulic modeling tasks. He is a registered professional engineer in Arizona, a Diplomate of the American Academy of Water Resources Engineers, and a member of USCID and the Environmental & Water Resources Institute (associated with the American Society of Civil Engineers). He was an active member of the joint USCID Committee for Rehabilitation, Modernization, and Maintenance of Irrigation and Drainage Systems While in Service, and is a member and past-chair of EWRI's Technical Committee on Irrigation Delivery and Drainage Systems, and vice-chair of EWRI's Task Committee on Flow Measurement at Canal Gates. He has also been involved with conference planning committees for USCID and with several other task committees for ASCE and EWRI. He has authored and presented papers at several USCID and EWRI/ASCE conferences.

Ivan A. Walter is President, Ivan's Engineering, Inc., Centennial, Colorado. He received a B.S. Degree from California Polytechnic State University, San Luis Obispo, in 1976, and in 1979, an M.S. Degree from Utah State University. He has worked 22 years as a private consultant and has extensive experience in water resources, water rights, irrigation engineering and hydrology. He has engineered projects that involve surface and groundwater hydrology, water supply planning and development, irrigation engineering, water rights analysis and expert witness testimony. This involvement has included the investigation and analysis of evapotranspiration by agricultural crops and native vegetation, the investigation and analysis of water use on farms, ranches and in wildlife refuges, hydrologic studies and modeling of river basins, analysis of groundwater pumping on streamflow, the investigation and analysis of water rights, development of water supplies for industrial, agricultural, municipal and wildlife purposes, computer modeling of surface water and groundwater hydrologic systems, preparation of studies for water court testimony, and water court expert testimony. His clientele includes agricultural and municipal well associations, water conservation districts, state and federal government wildlife agencies, irrigation and reservoir companies, municipalities, electrical power companies, and mining corporations. He is a Registered Professional Engineer in Colorado, a Member of USCID, American Society of Civil Engineers and American Society of Agricultural Engineers. Since 1983, he has been a member of the ASCE Committee on Evapotranspiration in Irrigation and Hydrology. He is currently the chairman of the ASCE Task Committee for Standardization of Reference Evapotranspiration. He has presented papers at several USCID and ASCE conferences.□

USBR Offers Training Course

The **Bureau of Reclamation** has announced an upcoming international training program, **Modern Methods in Canal Operation and Control**, April 2007 (dates to be determined). The 4th International Technical Workshop and Study Tour will cover modern methods to upgrade the operations of existing canals, including canal automation techniques and equipment. The course includes a combination of classroom discussions, equipment demonstrations and laboratory workshops that target canal operators, water masters, engineers and other technical staff.

The Workshop will begin in Denver, Colorado, followed by a Study Tour. A model canal facility in Reclamation's hydraulics laboratory in Denver is the core of the training course. The Study Tour will include visits to canal automation sites in Utah and Arizona.

For more information about Reclamation's international training programs, contact Leanna Principe, lprincipe@do.usbr.gov, or visit www.usbr.gov.¤

I&D Journal Seeks Papers

M.G. Bos, Editor and Chief of the well known international journal, *Irrigation and Drainage Systems*, has announced that a Special Issue of the Journal addressing the theme *Sustainable Use of Limited Water Resources*, will be published in 2007.

Among topics to be addressed in the Special Issue are small river basins, geo-information applications, water use and consumption, effects of water scarcity and water allocations.

Contributions of about 15 pages are due by June 30, 2006. Refer to http://www.springeronline.com/sgw/cda/frontpage/0,11855,5-40109-70-35593455-0,00.html for detailed author instructions.

For further information, e-mail Bos at bos@itc.nl.

News of Members

Coachella Valley Water District recently commemorated a significant milestone with the ceremonial installation of its 100,000th domestic water meter.

Vic DeGrande is a sales engineer for Ameron International Corporation.

Andres Jaramillo, recipient of the 2004 USCID/Summers Engineering Scholarship, is a post-graduate student at the University of Canterbury, Christchurch, New Zealand.

Steven C. Macaulay is affiliated with West Yost & Associates, Davis, California. He is also Executive Director of the California Urban Water Agencies.

Reed R. Murray has been named Program Director for the Central Utah Project Completion Act Office, U.S. Department of the Interior. He replaces **J. Ronald Johnston**, who recently retired.

William A. Price has moved from Silverthorne, Colorado, to El Paso, Texas.

John A. Replogle was named the Irrigation Association 2005 Person of the Year. He is retired after a 40-year career with the Agricultural Research Service, USDA, and now is a collaborator with the agency.

Samuel W. Schaefer, Santa Barbara, California, is now affiliated with Bookman-Edmonston, a Division of GEI Consultants, Inc.

Thomas L. Spofford has retired from the Natural Resources Conservation Service and now resides in Soap Lake, Washington.

Gene T. Thompson now resides in Clarkston, Washington.

Thomas J. Trout, Agricultural Research Service, USDA, has transferred to the ARS water laboratory in Fort Collins, Colorado. He replaces **Dale F. Heerman**, who recently retired.¤

New Members

The following have joined USCID since publication of the last Newsletter:

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USCID Notes

by Executive Vice President Larry Stephens

Certainly one of the strengths of USCID is our ability to attract outstanding irrigation and drainage professionals to serve on committees and on the Board of Directors. Board Members are elected by the membership for three-year terms and can be re-elected only once. Recently, the second terms of two Board Members ended — **Joe Burns** and **Maury Roos** were the retiring Board Members. Joe's service included two years as President. Their leadership and support will be missed! But, as I say, we continue to attract outstanding Members who are willing to serve the society. In this year's Board election, **Ivan Walter** was elected to serve his second Board term, and **George Cairo** and **Bob Gooch** were elected to their first terms. I look forward to working with them and I'm confident that they will meet the standard of excellence set by Joe and Maury! When you consider that **Mike Archer**, **Vic DeGrande** and **Reed Murray** are the Members who were **not** elected, you get another measure of the quality of our membership! To Mike, Vic and Reed I say thanks for being candidates!

The Board of Directors, noting the success of the SCADA Conference USCID organized in Vancouver, Washington, last fall, has decided that this topic warrants further attention by USCID. We are in the formative stages of planning the second SCADA conference, to be held about a year from now. The Planning Committee will be chaired by **George Cairo** and additional Committee Members are needed. If you would be willing to help USCID and George organize the 2007 USCID SCADA Conference, please let me know (stephens@uscid.org). Serving on a conference planning committee is an excellent way to begin USCID involvement and to network and make contacts. Please join us in this effort if you can.

As you've heard before, USCID is hosting the ICID International Executive Council Meeting next year in Sacramento. Associated with the IEC Meeting will be USCID's ***Fourth International Conference on Irrigation and Drainage***. Hosting an ICID event is a major event and commitment for USCID. Please get involved — submit an abstract for the Conference, volunteer to serve on the Planning Committee (being chaired by **Bert Clemmens**), and/or encourage your organization to support us by becoming a Gold Sponsor. We expect that several hundred irrigation professionals from the ICID family, representing at least 50 countries, will join us in Sacramento. I hope that most USCID Members will take advantage of this unique opportunity to network and exchange professional information with their international counterparts!

A special thanks goes to **Ken Tanji** for the excellent technical article, *Landscape Irrigation with Recycled Water in California*, he wrote for this *USCID Newsletter*. Our goal is to have at least one technical article in each issue of the Newsletter. Please consider submitting an article for an upcoming issue. To get more information about preparing an article, please contact Ken, the Chairman of the Publications Committee, at kktanji@ucdavis.edu. *Irrigation and Drainage*, the Journal of ICID, represents another way to share your professional work and expertise. I urge you to consider offering a paper for the journal.¤

USCID Meetings

October 24-29, 2006, Boise, Idaho. Ground Water and Surface Water Under Stress: Competition, Interaction, Solutions.

ICID Meetings

September 10-17, 2006, Kuala Lumpur, Malaysia. 57th IEC Meeting and 7th Micro Irrigation Congress.

May 2-5, 2007, Tehran, Iran. 4th Asian Regional Conference.

September 30 - October 5, 2007, Sacramento, California. 58th IEC Meeting, and Fourth USCID International Conference on Irrigation and Drainage.

October 2008, Lahore, Pakistan. 59th IEC Meeting and 20th Congress.

2009, Abuja, Nigeria. 60th IEC Meeting.