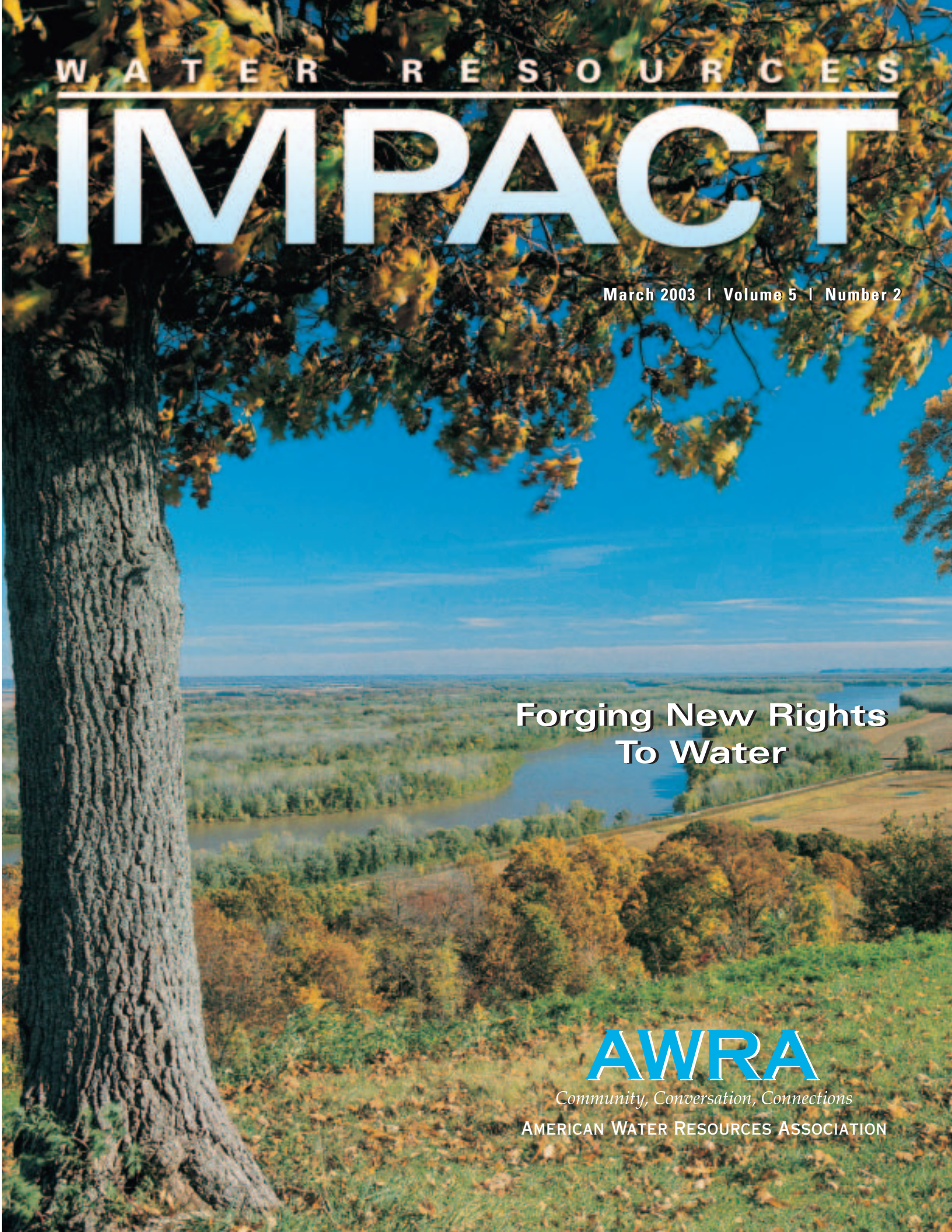

WATER RESOURCES

IMPACT

March 2003 | Volume 5 | Number 2

Forging New Rights To Water

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WATER

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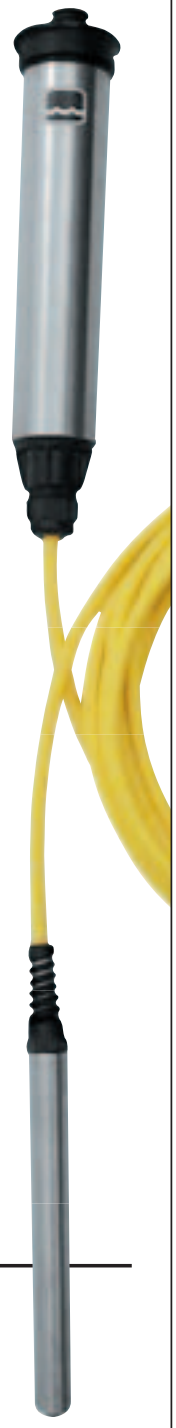

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FORGING NEW RIGHTS TO WATER

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This issue of *IMPACT* is devoted to exploring the opportunities and challenges of forging new rights to water. It looks at the challenges and problems associated with poorly defined water rights. Not stopping short with problems, the issue also provides ideas and recommendations for transitioning from water right structures that are failing to meet societies' needs to new systems that recognize the complex array of cultural, religious, economic, and environmental needs.

OVERVIEW

FEATURE ARTICLES

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[Cover Photo: Digital Vision "North American Scenics," No. 030509 – The Mississippi River Near Hannibal, Missouri)

WATER RESOURCES IMPACT

OVERVIEW
FORGING NEW RIGHTS TO WATER

Clay J. Landry and Laurel E. Phoenix

"Call 911, some sucker stole my water," reads a home made sign posted prominently along the highway just shy of the Oregon-California border in the Klamath Basin. A local landowner hastily crafted the sign in 2001 after federal regulators shut off water to local area farms to provide river flows for several endangered species – including the Lost River and shortnose suckerfish. The controversial decision set off a political firestorm between the federal managers, farmers, tribes, and environmentalists. At one point, tension between the groups was so heated that armed federal marshals were brought in to guard the head gates once used to divert irrigation water.

In the Klamath case, farmers, tribes, and environmentalists have competing water right claims. Area farmers contend that they hold water rights that entitle them to divert water even during dry years. Local Native American tribes assert that they hold water rights that supercede all others, including the irrigators' rights. Muddying the ownership waters even further are environmental claims that maintain that the Endangered Species Act trumps all existing water rights.

Disputes such as the Klamath have been brewing for many years in river basins throughout the United States and the world. And these disputes are only now starting to surface as the competition for water becomes fiercer in recent years. The battles ultimately come down to ownership and the right to water.

No resource is more important than water for food production, human health, local livelihoods, and for the health of the environment. Yet rising populations and economic growth are driving demands for water from all sectors. Traditional demands such as agriculture, industry, and domestic water supplies, are clearly on the rise. And new to the demand equation are environmental uses. In fact, never before has the demand for water for environmental uses been so great. People all across the globe are clamoring for improved river flows and cleaner, safer water.

Water rights are fundamental to the outcome of increasing global competition for water. Surprisingly though, water rights even in countries like the United States are poorly defined, and in many cases, are ambiguous at best. The lack of well defined water rights is creating all sorts of social, economic, and environmental problems. In some parts of the world, we are overtapping our ground water resources. In other areas, rivers run dry because instream flow rights were never contemplated. And in nearly every corner of the globe, we are facing water quality problems because water rights have only focused on quantity and not quality.

Despite these problems, there is a broad recognition and understanding among researchers and policy makers that well defined property rights to resources such as water are fundamental to giving people the proper incentives for sustainable management. However, the legal, cultural, and technical development of water rights is far behind that of other resources such as land, forest, and energy resources.

Some blame poor development of water rights on the technical difficulty of defining rights to a mobile resource such as water. In fact, legal doctrines for water rights around the world are rudimentary and were developed in an era with fewer water demands. At the time, the rules to water ownership were kept simple out of necessity and scarcity. However, more intricate legal systems developed in areas where water was scarce and the need was greater. Arguably, the riparian doctrine that dictates water rights in the eastern United States tends to be more straightforward and transparent than the prior appropriation doctrine of the western United States, which allocates water based on a complex array of priority dates and quantities.

Regardless, the world today is far more complex and the demands for water are far greater than during the time when water right doctrines were first developed. Consequently, the rules concerning water rights are showing their age. The increasing number of disputes like that in the Klamath, reaffirms our need to devote more effort toward forging new and better rights to water.

This issue of *IMPACT* is devoted to exploring the opportunities and challenges of forging new rights to water. The issue begins with an article by George Sherk that examines the changes that have occurred in the past ten years in the two dominant and competing water right doctrines of the United States. He describes how the distinctions that continue to exist between the two doctrines are more a function of culture and history than of geography.

Moving further afield, an article by Elinor Ostrom, Paul Stern, and Thomas Dietz looks at the challenges of developing water rights in the commons. They argue that two common solutions frequently proposed – government control or privatization – only serve to polarize the debate of water rights and that a more localized understanding is necessary to find the best system for governing natural resources. The researchers draw upon years of experience and numerous water management examples from around the globe to develop six lessons for developing water rights in a complex world.

The next two articles focus on issues closer to home. Robert Glennon examines the race to the pump house that has been created by poorly defined ground water rights. He provides example after example of how ground water is being pumped at alarming rates that is causing untold environmental and economic damages. Todd Smith navigates us through the murky and unfamiliar

area of Indian water rights. It is only now that Indian water rights are starting to be recognized. He explains why these rights are being recognized and how they are defined and quantified.

Jeffrey Rothfeder provides us a glimpse of the darker side of when governments ignore the custom and cultural association with water. He recounts the tragic events of Cochabamba, where citizens rioted after the Bolivian government handed over control of large water resources to a subsidiary of Bechtel without considering the needs of local area residents. The Bolivian government agreed to a couple of provisions that virtually assured that Cochabamba residents would have to pay a lot more for water than before. Bloodshed ensued all because of unchecked corporate and governmental greed.

Finally, we end with an article by the authors that were the inspiration for this issue. Ruth S. Meinzen-Dick and Bryan Randolph Bruns explore a way of forging new water rights through negotiations. They provide a comprehensive approach for transitioning from existing water right structures that are failing to meet societies' needs to new types of water rights that recognize the broad array of cultural, religious, economic, and environmental needs.

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WATER RESOURCES IMPACT

EAST MEETS WEST: A TALE OF TWO WATER DOCTRINES

George William Sherk

A little over ten years ago, I wrote an article for *Natural Resources and Environment* entitled "Meetings of Waters: The Conceptual Confluence of Water Law in the Eastern and Western States" (Sherk, 1991). The article began at the confluence of the Missouri and Mississippi Rivers and compared the "conceptual confluence" of state water laws with the actual confluence of the two great rivers.

I noted at the time that the two rivers shared the same riverbed below the point of confluence but that they remained separate and distinct with the Mississippi flowing along the eastern shore and the "Big Muddy" flowing beside it along the western shore. I also noted that the two rivers did not truly become one river until well below the actual confluence and speculated as to the changes that might occur as we moved further downstream.

The decade just past has seen continued changes in the water law systems of both the eastern and western states. The conceptual confluence is now far behind us as we, like Huck and Jim, follow the river downstream.

The present article looks at some of the changes that have occurred in the past ten years in both the eastern and the western states. I have used the Mississippi River as the dividing line between the eastern and western states. This is an entirely artificial distinction, of course. Missouri is no more a western state than Illinois is an eastern state, but given the extent to which distinctions between the two regions are eroding, the "eastern" or "western" label is becoming progressively more irrelevant. Nonetheless, if only for historic reasons, I have continued to divide the states as eastern and western.

In general, the western states are prior appropriation doctrine states. The basic doctrinal principle, that "first-in-time" is "first-in-right," reflects the scarcity of water in the western states and provides certainty in times of shortage. The prior appropriation doctrine has been criticized for being exceptionally rigid, particularly regarding new water uses having junior priorities. With regard to instream flows, for example, the doctrine has also been criticized for its inability to protect water uses that do not have easily quantifiable economic benefits.

The eastern states, where water was relatively abundant, kept the riparian water rights doctrine of the English common law. Under the riparian doctrine, use of water was required to be "reasonable" and was limited to lands adjoining or overlying the water resource. In the event of a shortage, the riparian doctrine generally required a *pro rata* sharing of available water supplies.

... perhaps the greatest weakness of the riparian doctrine is the fundamental assumption that the eastern states have abundant supplies of water

In terms of managing and allocating water resources, the riparian doctrine has been subject to greater criticism than the prior appropriation doctrine, in part because of the inherent vagueness in defining rights to use water. With certain limited exceptions, the riparian doctrine does not provide a means by which specific water uses may be either protected or regulated. Furthermore, the doctrine neither allows water to be moved to higher valued uses nor protects environmental values. Perhaps the greatest weakness of the riparian doctrine is the fundamental assumption that the eastern states have abundant supplies of water. As Abrams (1989) has noted, because of increasing instream flow requirements, contamination of existing supplies, and gradual climate change, the eastern states may not have the supplies of water that were assumed to be available.

In essence, the inadequacies of the riparian water rights doctrine have motivated a number of eastern states to either abandon it or to modify it significantly. Ten years ago, I enumerated the numbers of states that had made specific changes to their state water laws. In the years since, a new development has occurred that precludes the need for such an approach.

About the time that I was writing the first article, the American Society of Civil Engineers (ASCE) was establishing a Task Committee to draft a new model state water code. There have been several model water codes, but all were outdated and did not provide adequate models for new state legislation. To address this deficiency, the ASCE Task Committee began the preparation of two model codes, one for use in prior appropriation doctrine states and one for use in riparian doctrine states. The model code for use in riparian doctrine states was completed first and was published as *The Regulated Riparian Model Water Code* (Dellapenna, 1997). In addition to being an invaluable resource, the *Model Code* is an excellent summary of the water law changes that have occurred in the eastern states. I have chosen to use the *Model Code* as the basis to examine a number of areas in which the conceptual confluence of eastern and western water laws has continued.

QUANTIFICATION OF WATER RIGHTS

The critical question confronting the states was how to determine the quantity of water to which any individual might be entitled. In prior appropriation doctrine states, "beneficial use" defines the basis, measure, and limit of a water right. This means, in essence, that rights to water are quite specific in terms of quantity, allowable use, point of diversion, and timing of availability. Essentially the same level of specificity is mandated by the *Model Code,* which requires that water be put to a "reasonable use" defined as "the use of water, whether in

place or through withdrawal, in such quantity and manner as is necessary for economic and efficient utilization without waste of water, without unreasonable injury to other water right holders, and consistent with the public interest and sustainable development" (§2R-2-20). Similar requirements have been enacted in at least seven eastern states.

The movement toward quantification of water rights in the eastern states has been motivated in part by the growing interest in using market mechanisms as a means of reallocating water supplies. The eastern states are learning what the western states deemed obvious: A quantification process is essential to determining the amount of water that a permit holder can transfer.

ESTABLISHMENT OF PRIORITIES AND PROTECTION OF THE PUBLIC INTEREST

When water supplies are inadequate, how should available supplies be allocated? Under the prior appropriation doctrine, temporal priority controlled with the highest priority going to the most senior water user. The concept of temporal priority has been utilized in eastern states, but not as the sole determinant of priority in times of shortage. The emerging eastern approach as seen in the *Model Code* has been to list a series of factors that should be considered in determining whether a permit should be issued. The *Model Code* allows a water use permit to be issued "only upon determining that: (a) the proposed use is reasonable; (b) the proposed withdrawal, in combination with other relevant withdrawals, will not exceed the safe yield of the water source; (c) the proposed withdrawal and use are consistent with any applicable comprehensive water allocation plan and drought management strategies; (d) both the applicant's existing water withdrawals and use, if any, and the proposed withdrawal and use incorporate a reasonable plan for conservation; and (e) the proposed withdrawal and use will be consistent with the provisions of this Code and any order, permit term or condition, and regulation made pursuant to this Code or any other statute pertaining to the use of water" (§6R-3-01). The factors to be considered in determining whether a use is "reasonable" include impacts on both existing water users and on the public interest (§6R-3-02). In times of shortage, the first priority goes to "direct human consumption or sanitation," the second priority going to agriculture, and the third priority going to "other uses in such a manner as to maximize employment and economic benefits within the overall goal of sustainable development" (§6R-3-4). Similar legislation has been enacted in at least 12 eastern states.

As eastern states move toward a balance between temporal priority and the public interest, the western states, either by statute or case law, are moving in the same direction. Virtually all of the western states now require consideration of the public interest when an appropriation is initiated (Johnson and DuMars, 1989).

In essence, eastern and western states are moving toward a concept of "equitable priority" that balances impacts on existing water users (temporal priority) with public interest consideration.

PROTECTION OF INSTREAM FLOWS

Should state laws protect instream flows? Many of the prior appropriation doctrine states answered this question in the negative, requiring a diversion of water from a watercourse before a right to the water could be established. In the historically riparian doctrine states, the English common law concept of "natural flow" was replaced by the "reasonable use" requirement in order to encourage economic development. Absent state legislation, however, the definition of "reasonable use" did not include instream uses.

There has been increasing recognition in both eastern and western states of the importance of protecting instream flows. Navigation, public water supply, sanitation, and fish/wildlife purposes have been recognized as requiring minimum streamflows. Recreational, aesthetic, and ecological uses now are being recognized as equally important water uses. In the prior appropriation doctrine states, for example, Colorado, Idaho, and Arizona have eliminated the diversion requirement. Instream flows have been protected by case law or statute in Washington, Wyoming, North Dakota, and Nevada. Legislation authorizing the reservation of water (or the withdrawal of water from appropriation) to protect instream flows has been enacted in Alaska, Oregon, Montana, and Utah.

The reservation of water approach is reflected in the *Model Code*. As noted above, a proposed withdrawal will be permitted only if it "will not exceed the safe yield of the water source." "Safe yield" is defined as "the amount of water available for withdrawal without impairing the long-term social utility of the water source, including the maintenance of the protected biological, chemical, and physical integrity of the source" (§2R-2-21). Biological integrity is "the maintenance of water in the source in the volume and at the times necessary to support and maintain wetlands and wildlife (including fish, flora, and fauna) in so far as protection of either is required by federal or State laws or regulations" (§ 2R-2-02). Chemical integrity is "the maintenance of water in the source in the volume and at the times necessary to enable a water source to achieve the water quality standards prescribed for the water source by federal or State laws or regulations in light of authorized effluent discharges and other expected impacts on the water source" (§2R-2-03). Physical integrity means "the volume of water necessary to: (a) support commercial navigation of the water source as required by federal or State law or regulation; (b) preserve natural, cultural, or historic resources as determined by or as required by federal and State law or regulation; (c) provide adequate recreational opportunities to the people of the State; and prevent serious depletion or exhaustion of the water source" (§2R-2-16). Versions of such requirements, which protect instream flows by restricting the amount of water available for diversion, have been enacted in at least 16 eastern states.

TRANSBASIN DIVERSIONS OF WATER

Diversions of water from the basin-of-origin, which may be required by growth of demand in water-short areas, have been extremely politically unpopular in areas from which water had been diverted. In practical effect, a transbasin diversion of water is a transbasin diversion of wealth. To address this conflict, a number of states have enacted legislation regulating transbasin diversions. These legislative responses have fallen into four categories: (1) prohibitions, (2) general permit requirements, (3) permit conditions mandating water conservation, and (4) permit conditions mandating the payment of compensation.

Prohibitions

While most of the western states have allowed transbasin diversions, a number of prohibitions have been enacted. California, for example, prohibits diversions that would impair existing or future uses of water in the area of origin. Similar legislation has been enacted in Texas and Colorado. In Nebraska, diversions from "minor" streams are prohibited as are diversions from other streams in excess of 75 percent of the flow of the stream.

General Permit Requirements

Among the western states imposing general permit requirements, one of three approaches is implemented: (1) establishment of rights of recapture or priority rights for areas of origin (enacted in Oklahoma and California), (2) reservation of water for areas of origin (enacted in New Mexico), or (3) establishment of standards with which to evaluate proposed diversions (enacted in Montana).

Conservation

One of the factors usually considered in those states that have enacted general permit requirements is water conservation. Transbasin diversions are generally not permitted absent water conservation programs in areas receiving such diversions.

Compensation

At least three prior appropriation doctrine states have enacted legislation providing some form of compensation for areas of origin. Oregon allows transbasin diversions by irrigation districts upon payment of adequate compensation. In Colorado, compensatory storage may be required to protect future consumptive uses in the area of origin. Other forms of compensation, such as the construction of facilities to conserve or develop remaining supplies, may be required in California.

Very similar provisions are found in the *Model Code.* In addition to the general provisions applicable to all proposed water withdrawal permits noted above, specific provisions apply to transbasin diversions. Prior to issuance of a permit for such a diversion, the state is required to address "any foreseeable adverse impacts that would impair the sustainable development of the water basin of origin" (§6R-3-06(1)). The state is also required to consider "(a) the supply of water available to users in the basin of origin and available to the applicant within the basin in which the water is proposed to be used; (b) the overall water demand in this basin of origin and in the basin in which the water is proposed to be used; and (c) the probable impact of the proposed transportation and use of water out of the basin of origin on existing or foreseeable shortages in the basin of origin and in the basin in which the water is proposed to be used" (6R-3-06(2)). Finally, the *Model Code* provides for compensation for the basin of origin: "When authorizing an interbasin transfer notwithstanding probable impairment to the existing or future uses of water in the basin of origin, the [state] shall assess a compensation fee to be paid into the Interbasin Compensation Fund by the person granted a permit for the interbasin transfer in so far as is necessary to compensate the basin of origin for generalized losses not attributable to injuries to particular holders of water rights in the basin of origin" (§6R-3-06(3)). Similar legislation has been enacted in at least seven eastern states.

THE NEED TO CONSERVE AVAILABLE SUPPLIES OF WATER

Should water conservation be encouraged? If so, how? To answer these questions, it is important to understand that the term "water conservation" means different things to different people. In the western states, "water conservation" meant conservation of seasonally available resources through the construction of dams and reservoirs. In the eastern states, "water conservation" has meant those means by which the demand for water might be reduced. Given supply limitations and growing demands, however, the term is rapidly coming to have both definitions in both regions.

Strictly implemented, the prior appropriation doctrine has the effect of discouraging water conservation because water rights are limited to the quantity of water that is diverted and put to beneficial use. While waste is prohibited, the owner of a water right has no incentive to reduce consumption through alternative or more efficient processes. Several western states have moved to correct this situation. Oregon and California, for example, have granted rights to conserved water to the person implementing the conservation measures. Court decisions in Utah and Colorado have reached similar results. Water conservation must be considered in Texas when granting permits for proposed water uses.

As noted above, the *Model Code* addresses water conservation by requiring any proposed withdrawal or transbasin diversion to "incorporate a reasonable plan for conservation" defined as "a detailed plan describing and quantifying the amount and use of water to be developed by conservation measures in the exercise of a water right" (§2R-2-17). "Conservation measures" are defined as "any measures adopted by a water right holder . . . to reduce

the withdrawals or consumptive uses, or both, associated with the exercise of a water right, including, but not limited to: (a) improvements in water transmission and water use efficiency; (b) reduction in water use; (c) enhancement of return flows; and (d) reuse of return flows" (§2R-2-05). In addition, one of the factors to be considered in determining whether a proposed use is reasonable is the extent to which it "will avoid or minimize the waste of water" (§6R-3-02(f)). Similar measures have been enacted in at least nine eastern states.

In the final analysis, the distinctions that continue to exist between state water law systems are not as much a function of geography as they are of history. As the eastern states have moved away from the vagueness and uncertainty of the riparian doctrine, so have the western states tamed the harshness of the prior appropriation doctrine. As noted above, the result has been the emergence of a rule of equitable priority that varies by state, not by region. Though there are many side channels, oxbows and shoals, it is now one river.

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"Agricultural Hydrology and Water Quality"

JUNE 30-JULY 2, 2003
NEW YORK, NEW YORK
AWRA'S SUMMER SPECIALTY CONFERENCE
"Second International Congress on Watershed Management for Water Supply Systems"

NOVEMBER 3-6, 2003
SAN DIEGO, CALIFORNIA
AWRA's ANNUAL
WATER RESOURCES CONFERENCE

2004 MEETINGS

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NASHVILLE, TENNESSEE
AWRA'S SPRING SPECIALTY CONFERENCE
"GIS and Water Resources-III"

JUNE 28-30, 2004
OLYMPIC VALLEY, CALIFORNIA
AWRA'S SUMMER SPECIALTY CONFERENCE
"Riparian Ecology – Buffer Zone"

NOVEMBER 1-4, 2004
ORLANDO, FLORIDA
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WATER RESOURCES IMPACT

WATER RIGHTS IN THE COMMONS

Elinor Ostrom, Paul C. Stern, and Thomas Dietz

Scarcities of usable, fresh water resulting from demographic change, industrialization, and agricultural expansion elevate water to the rank of major resource policy issue of the 21st century for both developing and developed countries (Shirley, 2002; Blomquist *et al.*, forthcoming). Policymakers in many countries are trying to understand how best to cope with increasing water scarcity. Two "solutions" are frequently proposed – giving responsibility to government agencies to act on behalf of all citizens or privatizing water so as to utilize market systems for allocation. Decades of research and public policy experience have shown the limits of making a strict distinction between government and the market and have led to a more nuanced understanding of the possibilities for effective management of water and other natural resources (Saleth and Dinar, 1999). Much of this research has been brought together in a new book from the National Research Council, *The Drama of the Commons* (NRC, 2002). Drawing on an earlier report by Stern *et al.* (2002), we highlight some of these major lessons.

LESSON 1
There Is No One Best System For Governing Water Resources

Researchers usually distinguish four basic types of governance systems, defined in terms of who controls access to resources: private property, government property, common property, and open access (i.e., no one's property). Research has consistently shown the inefficient outcomes of open access since open access almost always leads to destruction of any resource that is in great demand. This is the problem identified in Hardin's (1968) famous essay, although he called open access "commons," which led to substantial subsequent confusion. The other three systems, however, have mixed records in terms of sustaining water resources, including both great successes and massive failures. Thus, the ability of a type of ownership to enhance sustainable resource management depends on a number of other factors discussed below.

LESSON 2
Many More Viable Options Exist for Resource Management Than Envisioned in Much of the Policy Literature

Successful community resource management is not only possible but commonplace. Contrary to the presumption that only external coercion constrains individual selfish appetites, throughout history communities have used informal social controls, often complementing them through modest use of formal enforcement, to manage their water (see, for example, Lubell *et al.,* 2002). Among the most important is the use of indigenous knowledge of the characteristics of the resource system and culturally acceptable ways of restricting the use of commonly held assets. Such commons management has often achieved long-term sustainability. Irrigation systems around the world have been built, maintained, and used by farmer associations for centuries (Lam, 1998). In the contemporary U.S., farmers create special districts to manage irrigation and drainage. Many disasters of resource management during the 20th century have been caused by replacing effective community management with ineffective or corrupt government management.

A substantial body of research shows that a variety of governance systems – many of them hybrids of the basic types – can be effective. For example, in southern California, water users developed tradable rights to ground water through a series of court decisions (see Blomquist, 1992). But the development of rights to ground water does not turn the ground water basin into a privately owned resource. Instead, the total allowable withdrawals were determined by a state court and are monitored by a watermaster appointed by the court. Further, southern California water users have created multiple special districts to manage a series of injection wells along the coast (effectively building a "dam" against saltwater intrusion). These districts levy substantial pump charges on all ground water extractors in a basin to pay for replenishing the basin. The resulting water-rights system cannot be classified as purely private or government management. It is a unique system that has been in operation for almost 50 years and has protected a series of ground water basins underlying the Los Angeles metropolitan area. The tradable water rights system combines features of private and government property in novel and effective ways. Such hybrids are appealing on theoretical grounds and are sometimes, though not always, highly successful (Tietenberg, 2002). Further, multiple ways exist to establish such systems. For example, Arizona has adopted a policy of specifying ground water rights as a matter of state policy, thus reducing many of the transaction costs faced in the basin-by-basin adjudication system adopted in southern California (Blomquist *et al.,* forthcoming).

Many disasters of resource management during the 20th century have been caused by replacing effective community management with ineffective or corrupt government management

Current knowledge provides more subtle and nuanced insights into sustainable management than the simple models of pure government, market, commons, or

open access. We are moving toward an approach to resource management that resembles medical practice. Diagnosis and treatment are based on hard science as well as many individual case histories and meta-analyses of accumulated evidence from cases. However, because every case has unique aspects, an effective practitioner draws both on established principles and on knowledge of the specific case in facing the challenges of diagnosing problems and prescribing courses of action.

LESSON 3
It Helps To Think of Resource Management as a Problem of Designing a Management System to Meet a Set of Ongoing Challenges

From this perspective, the best system of control is one that meets the most critical challenges of the situation at hand. The reason each type of control system sometimes succeeds and sometimes fails is that the challenges of resource management vary with the type of resource; characteristics of the resource users; and the environmental, social, economic, and political context of resource use – most of which change over time. Water managers can use current research to diagnose their situations and find the most likely set of management strategies for meeting particular challenges.

In its concluding chapter, *The Drama of the Commons* (NRC, 2002) identifies seven key challenges of resource management (see right side of Figure 1). These are: (1) monitoring the resource and resource use, (2) low cost enforcement of rules, (3) reconciling conflicts, (4) coping with imperfect knowledge of the resource system, (5) establishing linkages across space and scale, (6) addressing externalities to other resources, and (7) adapting to change. These challenges are not equally important in all situations. For example, monitoring the resource is a more difficult challenge for rivers than for lakes. Reconciling conflicts is a bigger challenge when the resource users live far away from each other (e.g., when water users live hundreds of miles away from the source of their water supply, like Los Angeles, San Francisco, Boston, and New York City) than when they all live in the same community and interact on a regular basis.

How should management systems be designed to meet these challenges? Some researchers have proposed sets of design principles for resource management systems (one set, from Ostrom, 1990, is listed in the left half of Figure 1). The hope is that the use of these will increase the chances of success. The principles are based on empirical and theoretical evidence about what works under different circumstances (Agrawal, 2002). Although most of the emerging design principles probably constitute good general advice, they do not constitute a rigid blueprint. Examples of sustainably managed resources exist that deviate in some ways from the suggested principles. Practitioners will still need to exercise judgment to place a particular situation into its appropriate category.

It is worth noting that each design principle addresses only a subset of the challenges, as suggested by the arrows in Figure 1. Thus, in situations where a particular challenge is especially critical (for example, linking authorities at different levels or in different jurisdictions), some design principles may offer little help while others are especially worth trying to apply (such as using nested layers of organization).

It is also the case that some of the challenges are closely interlinked in many situations: Conditions that make one of them problematic tend to have a similar effect on others. Further, interventions that help with one challenge often also help with others. Monitoring, enforcement, and conflict resolution, for example, are linked in several ways. Small, stable, isolated groups that subsist on local resources (a small lake or river) often share a number of characteristics that make it possible for groups of resource users to solve problems at low cost. They are collectively dependent on a clearly defined resource base, and they have strong incentives to maintain it. In addition, they often have well established community norms and procedures of conflict management that operate in many areas of local life.

These social characteristics, sometimes described as strength of community or social capital, greatly reduce the incremental costs of monitoring, rule enforcement, and conflict resolution because much of the necessary activity is already going on. Where resource users do not constitute strong communities, the challenges of monitoring, enforcement, and conflict resolution may also be linked in the sense that it may be possible to design mechanisms, perhaps learning from those of small, stable communities, that meet all the challenges together. For example, participatory processes for decision making and monitoring have been suggested as a promising strategy for meeting several challenges and also for building the capacity (or social capital) needed for effective resource management in groups that are not already strong communities. In a review of World Bank water projects, for example, Watson and Jagannathan (1995) found that projects where participation had been built into the design of the project, made more efficient investment decisions and water use was monitored more closely.

LESSON 4
Complexity, Uncertainty, and Conflict Are Inherent Attributes of Many Water Management Systems

Many water resources are complex systems not adequately described by simple deterministic models, but neither are they wholly chaotic or unpredictable. As a result, outcomes of particular use strategies can be projected only with considerable uncertainty. Using uncertain projections of rainfall or other resource characteristics without highlighting the likelihood of error often leads to resource collapse, especially as uncertainty interacts with political and economic pressures to produce unsustainable levels of resource extraction – the most optimistic forecasts are often chosen to meet immediate needs and reduce short term conflict (Wilson, 2002). Since projections of resource availability at the high end

of the uncertainty range will be wrong more often than they are right, such politically motivated optimism can easily lead to systematic overexploitation of resources.

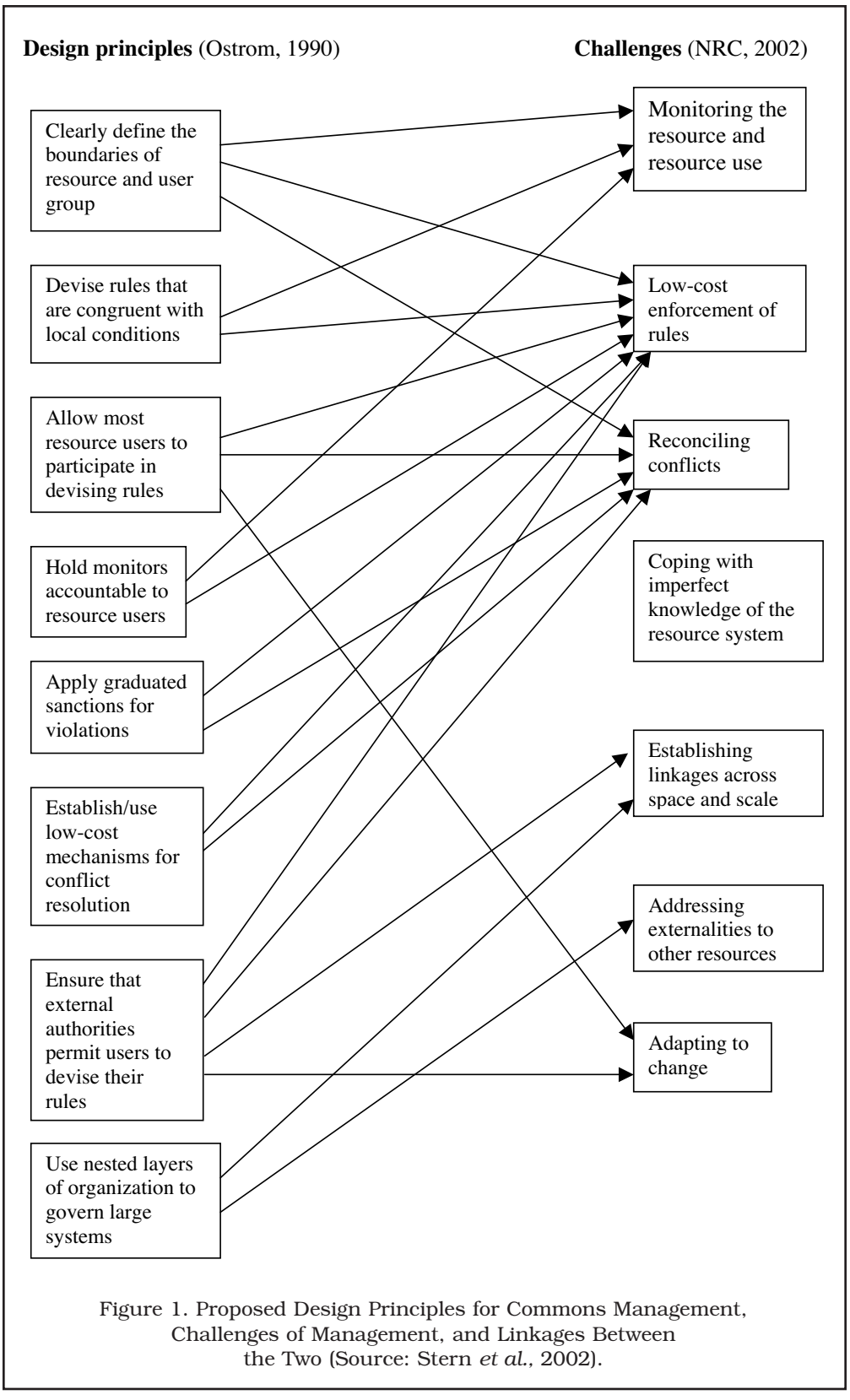

Figure 1. Proposed Design Principles for Commons Management, Challenges of Management, and Linkages Between the Two (Source: Stern *et al.,* 2002).

This combination of scientific uncertainty and the resulting political dynamics ensures that resource management is typically conflictual. In any social arrangement in which there is some play for politics, conflict will arise around water management. Rather than seeing conflict as a pathology to be avoided, it may be better to see it as an inevitable feature of human use of resources and to build institutions to manage conflict as well as manage the resources. Indeed, sometimes conflict over resource management is just one manifestation of broader and deeper conflicts.

LESSON 5
Water Management, Notwithstanding Its Technical Aspects, Is Largely a Problem of Governance

Research on conflict in resource management is still emerging, but at least one lesson seems to hold across many types of environmental policy. In democratic societies, conflict about the commons is best managed via effective deliberative processes (Dietz and Stern, 1998). Such processes not only suggest compromises around immediate issues but also build cultures of understanding and trust that can be critical to devising management systems that can change as conditions change. This is the essence of adaptive management. Research shows that adaptive management is as much about broad discourse among all those affected by resources as it is about understanding resource dynamics.

LESSON 6
Successful Resource Management Depends on Integrating the Human Sciences

Many water resource managers are trained in the basic natural sciences or engineering. Managers know that they must rely on approximations and experience on a day-to-day basis,

but those trained in the physical and biological sciences take pride that management integrates good science with practical constraints in the field. We suggest that exactly the same approach is required for understanding the human and institutional dynamics – the governance problems – of water resource management. Resource managers should learn enough of the basic ideas and methods of research on resource management institutions to be active and skeptical readers of this literature as well. One goal of *The Drama of the Commons* is to provide a starting place for obtaining that literacy, which is at least as important to sustainable resource management as literacy in hydrology, ecology, or the other relevant natural sciences.

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WATER RESOURCES
IMPACT

THE ENVIRONMENTAL CONSEQUENCES OF GROUND WATER PUMPING

Robert Glennon

To water management professionals searching for new water supplies in the United States, ground water seems like the ideal solution. It is available throughout the year and it exists beneath almost the entire country. In most states, the legal system is generous toward those who would like to drill ground water wells, even as it is stingy toward those who would like to divert water from rivers and streams. As a result, well drilling businesses did a land office business during the recent drought as farms, mines, cities, and homeowners tapped into underground aquifers.

The ground water we are now pumping accumulated slowly over millennia, but we have sucked much of it out in mere decades. In 1995, the most recent year for which data is available, we pumped over 27 trillion gallons of ground water (Solley *et al.,* 1998). In addition, ground water provides more than half of the country's population with its drinking water supply. Ground water withdrawals actually exceeded surface water diversions in Florida, Kansas, Nebraska, and Mississippi.

There are enormous environmental costs associated with ground water pumping. Some of these are well known, including overdrafting or "mining" ground water that may eventually deplete the resource completely. Mining water increases the costs for energy to pump water from lower depths and may cause the earth to subside or salt water to intrude into aquifers beneath coastal areas.

A largely ignored problem is the impact of ground water pumping on surface waters, including rivers, creeks, springs, lakes, wetlands, and estuaries. Ground water, we know from the science of hydrology, is part of the hydrologic cycle that provides fresh water for lakes, rivers, and streams. Ground water pumping disrupts this cycle. It steals water from our rivers and lakes, but because it does so very slowly, we do not notice the effects until they are disastrous. In Arizona, verdant rivers, such as the Santa Cruz in Tucson, have become desiccated sandboxes due to ground water pumping by the city, the mines, and the farmers. Ground water pumping has dried up or degraded 90 percent of Arizona's once perennial desert streams, rivers, and riparian habitats (Glennon and Maddock, 1994). But the impact of ground water pumping on the surface waters is not just a western or an arid lands problem.

In Florida, one of the wettest states in the country, pumping in the Tampa Bay region has dried up lakes and ponds, turning them from fishing holes into mud flats (Alley *et al.,* 1999). Pumping also has led to the toppling of thousands of centuries-old cypress trees as the life sustaining wetlands gradually disappeared. The withdrawal of ground water has created immense sinkholes that have cracked the foundations of homes and other buildings (Browning, 1998).

In Massachusetts, which receives on average 45 inches of rain a year (or more rain than Seattle), the Ipswich River just north of Boston dried up in 2002 – for the fourth time in eight years (USGS, 2002). The culprit? Ground water pumping to support suburban sprawl of trophy homes, with rolling lawns, sprinkler systems, and swimming pools. In Minnesota and Wisconsin, pumping by potato farmers for fast-food french fries and by bottled water companies has threatened blue-ribbon trout streams. And in Georgia, pumping by farmers and diversions in the metropolitan Atlanta area endangers the health of Apalachicola Bay – Florida's premier oyster fishery (USGS, 1989).

These examples illustrate what the future holds. Because ground water moves slowly, it may take years or decades before the effects of ground water pumping to rivers, streams, creeks, springs, wetlands, lakes, and estuaries become apparent. The hidden tragedy and irremediable fact is that ground water pumping that has already occurred will cause environmental damage in the future.

The devastating impact on the environment caused by ground water pumping epitomizes what biologist Garrett Harden called "the tragedy of the commons." When the legal system permits limitless access to common pool resources – those not owned by individuals, such as air, water, and the oceans – individuals will rationally act to maximize their individual welfare, but that unfortunately reduces total social welfare. That has happened with ground water as the legal system in most states permits essentially unlimited pumping. There is an overwhelming incentive to use the resource in an unsustainable fashion.

Instead of eliminating the gap between law and science, we have demonstrated limitless ingenuity in devising technological fixes for water supply problems ...

The problem comes from a disconnect between law and science. Principles of hydrology explain how ground water pumping dries up rivers and lakes. Ground water and surface water are not separate categories of water any more than liquid water and ice are truly separate. The designations ground water and surface water merely describe the physical location of water in the hydrologic cycle (Winter *et al.,* 1999). In many areas of the country, stream flow originated as ground water that seeped from the subsurface into the watercourse. If this seems perplexing, consider the following puzzle. If it has not rained in a while, where does water in a river come from? It has

seeped from the aquifer into the river in what hydrologists call base flow.

But the legal system in most states governs ground water and surface water by different legal doctrines. For surface water, either riparian water rights or the prior appropriation doctrine regulate diversions from rivers and lakes. Riparianism, which applies in most eastern states, permits owners of land that abut watercourses to make use of water in the river or lake. This right is correlative: it depends on what other riparians may be doing. In the West, the prior appropriation doctrine assigns specific rights to those who divert from rivers based on the date of the diversion. Junior diverters can only take water subject to senior rights. In short, the legal system restricts rights to divert surface water.

In contrast, the legal rules concerning ground water are quite different and permissive. Most states embrace either the doctrine of capture – an absolute right to limitless quantities – or the reasonable use doctrine, which is only slightly more restrictive. A landowner may pump essentially as much ground water as he or she pleases so long as it is for a "beneficial" use, and the law deems "beneficial" almost any conceivable use.

The disconnect between law and science arose because ground water law was developed in the 19th century, when the science of hydrology was in its infancy and the movement of ground water was not well understood. As a consequence, the judges decided that there could be no sensible legal rules because ground water moved according to scientific principles that were unknown. Since then, the science of hydrology has matured, but the legal system has failed to keep pace. As a result, we have bifurcated legal doctrines that are completely inconsistent with the underlying physical reality. Instead of eliminating the gap between law and science, we have demonstrated limitless ingenuity in devising technological fixes for water supply problems.

How shall we reform the system? Although a cure will not come quickly or easily, nature has enormous regenerative capacity. The solution involves charting a new course for the future based on wise policies, then making a commitment to stay the course. In the process, state and local governments must play a critical role.

To control the impact of ground water pumping on the environment, we must combine a command-and-control model of government rules and regulations with the market forces of transferable rights and price incentives. Meaningful reform must do two essential things: first, it must protect the rights of existing users by creating quantified water rights that are transferable, and therefore valuable; and, second, it must break free of the relentless cycle of increasing use by placing restrictions on individual freedom to pump ground water.

In the United States, we use enormous quantities of water to grow extremely low value crops, such as cotton or alfalfa. State law must facilitate the movement of water from these uses to higher value ones by encouraging a market in water rights. Essential to the development of a market is the easy transferability of rights from existing users to newcomers.

But government should not rely solely on market forces, which are notoriously inefficient in failing to consider environmental values. Government rules and regulations deserve a prominent place in any reform effort. States have available a menu of reforms that would restrict ground water pumping in order to protect the environment. For one, water conservation standards deserve careful consideration. However, a problem with conservation standards, as many western states have found, is that government attempts to impose conservation standards have sometimes been unsuccessful. If the states attempt to impose elaborate and detailed conservation standards, the regulated community will fight tooth and nail over every sentence in the proposed regulation. We have seen this battle rage in Arizona over proposed "assured water supply" provisions in the Arizona Groundwater Management Act.

Fights over conservation standards may consume enormous amounts of time, energy, and money. The lesson of these battles is that it is better for states to embrace simple conservation standards that are easy to administer and implement. Not only are they most likely to actually save water, they will also avoid prolonged political struggles. In other words, the states should pick the low hanging fruit.

On another front, states should establish minimum flows for rivers, streams, and lakes and protect those flows from pumping of hydrologically connected ground water. The state of Washington has such a system that other states might imitate.

Perhaps the simplest and most obvious thing for states to do is to prohibit the drilling of new wells in areas that are hydrologically connected to surface flows. These wells have the most devastating impact on the environment. Another option available to the states is to impose an extraction tax on water pumped from any well within a certain distance of a river, spring, or lake. Such a tax would have two benefits. First, it would encourage existing pumpers to conserve water. Second, it would create an incentive for new pumpers to locate wells farther away from water courses.

Finally, we need to rethink the economic structure by which we value (and usually undervalue) our water resources. Quite simply, we are not paying the true cost of water. When homeowners or businesses receive a monthly water bill from the private utility or municipal water department, that bill normally includes only the extraction cost of drilling the wells, the energy cost of pumping the water, the infrastructure cost of a distribution and storage system, and the administrative cost to the water department or company. In other words, water rates, with rare exceptions, do not include a commodity charge for the water itself. The water is free.

Even though water is clearly a scarce commodity, most Americans have not yet faced the condition that economists call scarcity, which occurs when people alter their consumption patterns in response to price increases. Our water use habits will not change until the cost of water rises sufficiently to force an alteration. Water rates must increase so that all users pay the replacement value

of the water, which includes not just the cost of drilling a new well but also the cost of retiring an existing user's well.

Economists agree that significant price increases would create incentives for all users to conserve. Each farmer, homeowner, business, or industrial user could then decide which uses of water to continue and which to curtail. Rate increases would encourage the elimination of marginal economic activities and the movement of water toward more productive uses.

In conclusion, the impact of ground water pumping on the environment is enormous, and it is getting worse. As drought gripped the country in 2002, the media paid remarkable attention to water issues. Yet, not a single story mentioned that ground water pumping has environmental consequences. It is time to recognize this serious problem and to act to protect our environment.

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WATER RESOURCES IMPACT

NATIVE AMERICAN WATER RIGHTS

Tod J. Smith

The doctrine of prior appropriation, applied in its disparate forms throughout the West, is founded upon the principle of "first in time, first in right." Those who first exercise the right to use water, hold the senior water rights which are satisfied first in times of shortage, before those with junior water rights can exercise their right to use water. The use of water rights can be changed, for example from agricultural to municipal use or from one place of use to another, so long as the change does not injure other water users. And, water rights can be lost as a result of non-use or forfeiture. All of us who work in any field that involves the use of water in the West are familiar with these fundamentals of western water law. We are not so familiar, however, with the other water law-doctrine applied throughout the West – the doctrine of federal reserved water rights, specifically, the doctrine of Indian reserved water rights.

Our unfamiliarity with the history and development of Indian reserved water rights often breeds confusion, fear, and mistrust, leading in too many instances to long, drawn out and expensive conflicts between the states and their appropriators on the one hand and Indian tribes and the federal government on the other. This short article, only introduces the fundamental principles underlying Indian water rights that have developed over the past 100 years and outlines some of the issues that continue to permeate the determination of the extent and nature of the water rights reserved to Indian tribes. The broader hope is that familiarity will engender cooperation and recognition that the quantification and development of Indian water rights will better serve Indian reservations, the surrounding community, the state, the river basin, and ultimately the West, than the uncertainty that accompanies long drawn out legal battles. In fact, many of the issues highlighted below have been addressed through settlement of Indian reserved water rights, and the too often disparately viewed water rights doctrines have been melded into a cooperatively managed and regulated system that works for the benefit of all.

The fundamental principles of Indian reserved water rights were first established by the U.S. Supreme Court in 1908 in *Winters v. United States*, 207 U.S. 564. A *Winters* right,"[1] as it is commonly referred to, includes:

1. An implicit reservation of a sufficient amount of water necessary to fulfill the purposes of the Indian reservation, which the *Winters*' Court described as "a permanent home and abiding place," *Winters,* 207 U.S. at 565.
2. A right created and defined by federal, not state law.
3. A right created and vested, at the latest, as of the date the reservation was established. That date is the priority date of the water right.
4. A right that cannot be lost by non-use.

The response to *Winters* was to ignore it. For the next 50 years, growth in the West, the expansion of agriculture, and the development of water projects proceeded at an unprecedented pace. The western states and their appropriators, with massive assistance from the federal government, claimed, divided, and developed much of the water flowing throughout the West. *Winters* rights received scant attention and Indian tribes, generally holding the senior water rights, were left out of the process and left behind in the development. Over 50 years after *Winters*, only after much of the water resources in the West had ostensibly been divided and distributed, did the Supreme Court again address the tribes' right to water within the context of a dispute between Arizona and California over the quantification of water available to each from the Colorado River. In *Arizona v. California*, 373 U.S. 546 (1963), the Court reaffirmed the fundamental principles established in *Winters*, and proceeded to quantify the rights that had been reserved for five Lower Basin Indian tribes whose reservations were adjacent to the Colorado River. Confronted with a revitalized *Winters* rights doctrine which they could no longer ignore, the States sought to limit the impact of those rights on a resource they believed had already been, for the most part, allocated to support existing and developing economies. They argued that the amount of water reserved should be limited to that amount likely to be needed by relatively sparse Indian populations in the foreseeable future. Instead, the Court, as directed by *Winters*, looked to the purposes of the five reservations which, it determined, was to provide the Indians with a "liveable" permanent homeland based upon agriculture. In light of that purpose, the Court held that the quantity of water reserved to the tribes was that amount necessary to irrigate all the practicably irrigable acreage on the five reservations, nearly one million acre-feet.

because tribes were left out during the era of water projects, they lag in the development of their water rights

"Practicably irrigable acreage" – PIA – has become the standard upon which most *Winters* rights have been quantified and has, in fact, supported recognition of substantial quantities of water reserved for Indian tribes. In nearly all of the over 20 settlements of Indian tribes' *Winters* rights, PIA has been the principal methodology for quantifying the right in varying amounts from 4,000 to over 600,000 acre feet. Whether PIA is the only applicable methodology remains an open question. In Wyoming, the United States and the Shoshone and Arapaho Tribes claimed that the quantity of water reserved to make the Wind River Reservation a permanent homeland included water for mining and other industrial purposes, fish and wildlife, and municipal uses, in addition to agriculture

and its related uses. The Wyoming Supreme Court rejected those claims holding that water was reserved only for agriculture, which, the Court held was the primary purpose for establishing the Reservation. The total quantity of water available to the Tribes for agriculture, in excess of 500,000 acre feet, was measured by the PIA within the boundaries of the Reservation [see *In re Rights to Use Water in the Big Horn River,* 753 P.2d 76 (Wyo. 1988)]. The U.S. Supreme Court, divided four to four without Justice O'Connor's participation, affirmed that decision without issuing an opinion. Recently, the Arizona Supreme Court broadly construed the purpose of creating a permanent homeland holding that water may have been reserved for purposes other than agriculture [*In re General Adjudication of All Rights to Use Water in the Gila River System and Source,* 33 P.3d 68 (Ariz. 2001)]. The court's broader view of reservation purposes, which may result in the recognition of additional water rights for tribes, is tempered by the court's recognition that certain subjective factors may also be taken into consideration. Factors such as the tribes' current economic situation and infrastructure, past water use, the appropriateness of proposed water use projects, projected future populations, and sensitivity toward existing state water uses may be considered. Whether such subjective factors may be utilized in determining the quantity of water reserved at the time an Indian reservation was established will ultimately have to be addressed by the United States Supreme Court.[2]

Additionally, the Supreme Court will ultimately have to address whether the Winters doctrine extends to ground water. While recognizing that the "logic which supports a reservation of surface water to fulfill the purpose of the reservation also supports reservation of ground water," *Big Horn,* 753 P.2d at 99, the Wyoming court found that the "district court did not err in deciding there was no reserved groundwater right" (*Id.* at 100). In *Big Horn,* however, the surface supply was sufficient to meet the quantity of water necessary to fulfill the Reservation's agricultural purpose. When that same issue was addressed by the Arizona Supreme Court, where surface supplies are scarce, the court held that, "a reserved water right to groundwater may only be found where other waters are inadequate to accomplish the purpose of the reservation" [*In re General Adjudication of All Rights to Use Water in the Gila River System and Source,* 989 P.2d 739, 748 (Ariz. 1999)] [see also *New Mexico ex rel Reynolds v. Ammodt.* 618 F.Supp. 993 (D.N.M. 1985)] (recognizing a reserved right to interrelated ground water).

While disputes over the purposes of the reservations, the quantity of water reserved to meet those purposes, and the types of water available to satisfy the quantity required continue in many river basins throughout the West, Indian tribes also have been forced to defend against numerous challenges to their use of water. Just as being the last to quantify their water rights has led to strong resistance by states and appropriators who thought they had already divided and distributed the available water supply, being the last to actually develop and use those rights has presented equally daunting hurdles for tribes. A few of those hurdles are mentioned for the readers' information.

In *Arizona v. California*, the Court recognized that quantifying the tribes' *Winters* rights based upon PIA did not limit how the water may be used [429 U.S. 419, 421-22 (1979) (Supplemental Decree)]. Other courts have recognized that tribes are entitled to use their water rights for any lawful purpose [see, e.g,, *United States v. Anderson*, 736 F.2d 1358, 1365 (9th Cir. 1984); *State ex rel Greeley v. Confederated Salish and Kootenai Tribes,* 712 P.2d 754 (Mont. 1985)]. However, in a subsequent *Big Horn* decision, the Wyoming Supreme Court ignored the guidance of these other courts and held that a water right quantified under the PIA standard must be put to agricultural use before it can be used for another purpose [835 P.2d 273 (Wyo. 1992)]. While such a result appears absurd from almost any perspective, it assures that for the time being, the Tribes' unused water will continue to flow to State appropriators providing the Tribes with no benefits and no economic return.

Tribes seeking to market their water off reservation have been confronted with the claim that *Winters* rights are limited to on reservation use. Thus, a tribe which cannot presently put all its water to use due to the lack of infrastructure, lack of a viable economic return from agricultural production, lack of industrial or municipal development, or lack of a current demand, would not be able to lease that water to users outside the reservation who have a present need. Again, such a limitation contradicts the Supreme Court's reasoning in *Arizona v. California* [see *Meyers, The Colorado River,* 19 Stan. L.R. 1 (1966)], and any reasonable view of the proper use of a scarce resource; but until the challenge is overcome, it serves to assure that tribal water continues to flow to the benefit of State appropriators with no benefit to the tribes.

Finally, because tribes were left out during the era of water projects, they lag in the development of their water resources. Their water constitutes much of the supply left in the stream, which environmentalists argue is essential to preserve riverine habitat and various species. Any attempt to put that water to use, on or off the reservation, is subject to scrutiny under the National Environmental Policy Act (NEPA) and, almost always, the Endangered Species Act (ESA). Having failed to include the entirety of a tribe's reserved water right in the analysis under the ESA, a tribe's subsequent attempt to use its water is often subject to a "jeopardy opinion." As a result, a tribe's heretofore senior water right is relegated to a junior priority.

These are just a few of the legal hurdles that Indian tribes must overcome after they have successfully quantified their *Winters* right. Fortunately, tribal and state leaders have had the foresight to address many of these issues within the context of settlements. They have developed a variety of cooperative systems to regulate and manage a shared resource in a way that assures the development of viable, liveable, homelands as originally envisioned by the Supreme Court in *Winters*, without

threatening the viability of the surrounding communities and states. This goal, rather than thwarting Indian water development, will best serve us all.

ENDNOTES

[1]There are two other types of Indian reserved water rights, those held by Pueblos in New Mexico with priority dates based upon Spanish land grants, and aboriginal water rights held, for example, by tribes in the Northwest who used their land and rivers for fishing since time immemorial and continued to do so following establishment of their reservations [see, e.g,, *United States v. Adair,* 723 F.2d 1394 (9th Cir.); *cert. denied*, 467 U.S. 1252 (1983)]. This article focuses on *Winters* rights.

[2]States can include the quantification of *Winters* rights in a general stream adjudication [see *Arizona v. San Carlos Apache Tribe*, 463 U.S. 545 (1983)]. The right must be determined in accordance with federal, not state law, and is subject to exacting scrutiny upon review by the Supreme Court.

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WATER RESOURCES IMPACT

WATER RIGHTS, CONFLICT, AND CULTURE

Jeffrey Rothfeder

Blood on the streets was probably the last thing anyone would link to privatization of a water system. But three years ago in a small Bolivian town the perceived water related needs and rights of local citizens collided with the interests of a multinational company and open warfare broke out. Before it was over, an unarmed 17 year old boy was shot in the face and murdered by the Bolivian army – he was just one of a number of victims – and the Bechtel subsidiary, the company managing the water supply, had packed up its gear and left.

This was a telling incident, one that lay bare the pitfalls of private water resource projects in undeveloped regions, where cultural and social isolation and the desire for at least the most basic quality of life to raise children and protect the health of the community reside close to the bone in day-to-day existence. Because an adequate amount of clean water is the very essence of life – vital for cooking, cleaning, hygiene, and subsistence – any attempt to tamper with the supply feels dangerously like a threat to survival for people in disadvantaged areas. Consequently, water privatization and major water projects like hydroelectric dams, with all the good intentions, cannot succeed without understanding the deep seated concerns and basic needs of affected local communities. In Bolivia, at least as far as the people could tell, those were the last things on anyone's mind.

The episode took place in Cochabamba, a town tucked in central Bolivia at the very edge of the Andes on the Rocha River, about 60 miles east of the capital La Paz (it is fed by a web of tiny crystalline streams pouring off the mountains). Until just a couple of decades ago, tin mining made up more than half of the city's gross domestic product and there were ample jobs, many of them with wages approaching middle class. But tin prices collapsed in the 1980s, taking Cochabamba down with them. Now, in Cochabamba there is a beer and shoe factory and El Cristo de la Concordia – an immense statue of Jesus Christ overlooking the town – and little else.

It is impossible to fully tap the potential profits from water projects without being sensitive about local cultural mores, social and property rights, and water related needs

As the town slipped backwards and many of the tin entrepreneurs exited with much of the money that had supported Cochabamba, the water system was neglected and quickly fell into disrepair. By the late 1990s, it was in such bad shape that 50 to 60 percent of Cochabamba's water supply was wasted, seeping out through rusted holes in unmaintained pipes before it reached anyone. Water quality was barely monitored, and thousands of liters a day of the scant available clean water was siphoned off under the counter at discount prices to wealthier residents who had paid off the local water authorities.

Facing such conditions, most of the residents of Cochabamba were actually buoyed by the news in mid-1999 that the Bolivian government had sold the city's public water system to a subsidiary of Bechtel known as Aguas de Tunari and a group of British-led investors. Under the terms of the 40-year privatization deal, Bechtel promised to pour millions of dollars into expansion and improvement of the water supply. There was at least the hope that under this private corporate regime, the dismal water situation would improve.

What the Cochabambinos did not know was that Bechtel had negotiated a couple of sweetheart clauses in the deal. For one, Bechtel would be allowed to raise water rates each year to match the increase in the U.S. consumer price index. Additionally, the contract guaranteed the company an average 16 percent annual return on its investment. Both of these clauses virtually assured that Cochabamba residents would have to pay a lot more for water than before. The Bolivian government was in no financial position to subsidize the yearly profits that Bechtel was promised in its contract. So, in January 2000, about a half a year after Bechtel took over Cochabamba's water operations and the same week that Aguas de Tunari finally hung its shingle on the city's water facilities, water rates for Cochabamba residents were increased significantly. For some, the monthly bill was doubled and others would pay three times as much as they had been charged. Under this new structure, many people in Cochabamba would have to pay more than 20 percent of their salaries for water.

Shocked into action, in mid-January 2000 Cochabambinos took to the streets to protest the water price hikes. That kicked off four months of protests, riots, and police actions that resulted in scores of injuries and eventually the murder of young Victor Hugo Daza, which marked the end of the city's water war. The anger on all sides seemed to dissipate instantly in Cochabamba as the mood turned to sorrow. With the youth's death, sadness replaced truculence and nobody seemed to have the energy anymore to fight. Daza's killing finally drove home the point that this was indeed a civil war over water and it was getting out of hand. Cochabamba was too fragile – the thread of its society too frayed – to survive continued fighting.

On April 10, pressured by Cochabamba's authorities as well as international diplomats who had ignored the crisis until Daza's death, the Bolivian government cancelled its deal with Bechtel. The water system was returned to Cochabamba and an onerous national law that led to the privatization of the water supply was

overturned. In so doing, future water management and development decisions throughout the country were put back in the hands of local communities with the requirement that residents be included in the discussions. In addition, Bolivia agreed to give financial compensation to the families of people killed and injured during the water war.

Similar ham-handed – insensitive to local cultural, social, and economic needs – attempts to privatize water supplies or construct large water projects have occurred in many other places around the world as well. In many of the other incidents, individual water rights and property rights – not the price of water – are at the heart of the matter.

A vivid and typical example is the so-called Narmada project. In 1985, the World Bank approved a $450 million loan to build the Sardar Sarovar Dam and create a giant reservoir and hydroelectric facility on the Narmada River in central India. Major water resource and construction companies – including U.S. outfits Ogden and Harza; German firms Bayernwerk, VEW Energie, and Siemens; ABB of Switzerland; and Alstrom of France – were awarded lucrative pieces of the project, which was originally intended to provide electricity for industry and supply water to as many as 40 million people in water-scarce Indian provinces.

Completely neglected when the World Bank funded the project was that literally millions of people would have to be uprooted from their homes and moved into refugee camps, at least temporarily, or they would be flooded by lakes created by Sardar Sarovar. Equally inexcusable was that the money needed for the pipes and pumps to supply water to the thirsty in India was not even included in the funding for this project. And then there was the environmental damage. Thousands and thousands of acres of forest would be drowned and the runoff from this would pollute the rivers downstream. That means, of course, that the Indian water supply would actually be diminished by this project, not increased. Simply put, as far as the local populace could tell, there were only two beneficiaries of Sardar Sarovar – the industries that would get cheap hydroelectricity and the construction companies contracted to build the project.

Construction began in the early 1990s and tens of thousands of Indian people, in what became known as the Black March, were, indeed, uprooted from their homes and land – in many cases, they were farmers and they lost their livelihood with their property.

From the mid-1980s on, social activists and environmentalists lobbied U.S. lawmakers and World Bank members to have Sardar Sarovar stopped. They produced first-hand accounts of the forced displacement and refugee conditions in India that resulted from the construction of the dam, describing it as a calamity as bad as any civil war in the world. And they offered evidence of the polluted waters and deforestation that was occurring as well. Finally, in 1993, under pressure from Congress, the World Bank told India that it was pulling out of the project and would not send the final loan installment of about $70 million. By this point, almost all of the large multinational companies that were initially involved in the construction of the dam had already dropped out.

All of this, as it turned out, was only a small victory for Narmada opponents. With the initial outlays from the World Bank and funding from friendly countries (like the Soviet Union before it broke apart), the dams on the Narmada are still being built, creating tens of thousands of new refugees a year and a dirtier and diminished water supply in a country whose residents already have to survive on an average of only 31 liters of water per day. And with the Indian economy sputtering – the country pays more money in interest to the World Bank for loans relating to Sardar Sarovar and other infrastructure projects than it takes in from taxes and investments – the scant additional hydropower produced by the Narmada dams is mostly going to waste. There is not enough new industry to support the potential increase in electricity.

More than anything, though, the lesson for water resource companies from the Bolivian water war and the Narmada forced property evacuation – and other incidents like them around the world – is that it is impossible to fully tap the potential profits from water projects without being sensitive about local cultural mores, social and property rights, and water related needs. The expense, ill will, and long delays that result from fighting litigation or vocal opposition to a project that has been mishandled can easily overwhelm the value of the water development or privatization effort itself.

The irony is, though, that private water supply projects are essential to deliver clean water to hundreds of millions of people around the world who are living without it now. Especially in poor areas, governments do not have enough money or are so infected with cronyism and kickbacks that they are unable or unwilling to supply adequate water to local residents. Because companies are more skilled at managing a water supply than the local government – and more motivated by hoped for profits to succeed – many are beginning to realize that water privatization can actually improve the lives of a developing country's population.

But particularly because of Cochabamba and Narmada, enlightened water privatization proponents have learned that to succeed they must not appear callous and uncaring about local rules, mores, aspirations, and needs. Moreover, some governments have begun to realize that while privatizing water systems may be a desirable course for maintaining the water supply at a peak level and distributing cleaner water to more residents, they cannot abdicate their essential responsibility to protect the needs of their populations. They are beginning to recognize that it is dangerous to simply hand over water systems to private companies and then turn a blind eye to their activities. Instead, they are taking a stronger role in overseeing the operations of the water companies, demanding certain standards of performance and environmental protection, and ensuring that consumers are able to afford the price of water.

Not surprisingly, a developed nation, the United Kingdom, has become a model for how this can work. In 1989, much of the British water supply, in dismal shape at the time, was privatized. Under the plan, private

companies were given carte blanche to run the water systems, with no oversight. To Tory Prime Minister Thatcher it was a perfect supply side solution – turning the power of the free market to the public good. It failed miserably. Financial mismanagement of the water systems was rampant, water rates skyrocketed, company executives gave themselves generous compensation packages from the water contracts, and water quality deteriorated. In 1999, with Labour's Tony Blair in power, the privatization plan was amended. While private companies would continue to manage the nation's water systems, the Office of Water Services (OFWAT) was instructed to oversee and regulate the companies. OFWAT imposed rate reductions of as much as 12 percent and mandated certain required infrastructure improvements if the companies wanted to continue to do business in the U.K. Taking the hard line was a quick success. In 2001, an impressive 99.8 percent of drinking water samples in the U.K. passed rigorous pollution tests compared to only about 85 percent in the mid-1990s; pipe leakage, which wasted significant amounts of water, has been cut by a third since it reached peak levels in 1995; and companies have promised to invest $72 billion over the next five years to ensure supply meets growing demand.

The British approach – strict oversight of the free water market, while still leaving it unrestricted enough that there are sufficient profit incentives to motivate private corporations – has opened a lot of eyes, offering a model for how governments can control the potential negative impact of water privatization and water resource projects on their populations. Consequently, even some of the poorest regions of the world – parts of India, Mozambique, and Manila, for instance – are adding clauses to private water resource contracts that limit rate hikes, set predetermined investment levels, protect local property and water rights, minimize environmental damage, and establish performance benchmarks. In addition, these and other countries are requiring an open accounting of the activities of the private companies so local citizens can be involved in regulating them. Not surprisingly, none of this is dissuading private companies from bidding on water projects around the world or slowing down so called water globalization. Water is a commodity that is too potentially lucrative for private companies to ignore.

Which could be the true – and unwitting – consequence of Cochabamba. A war fought against water privatization may have been the seminal incident that eventually allows water globalization to fulfill its promise.

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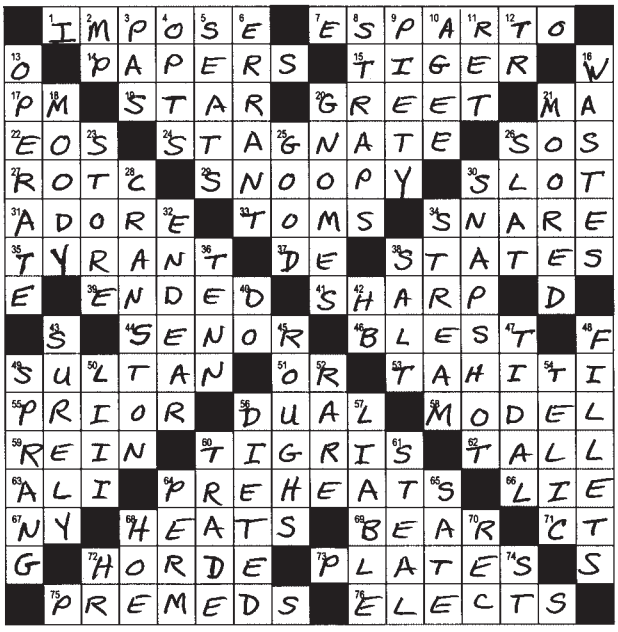
Solution to Puzzle on pg. 25



WATER RESOURCES IMPACT

NEGOTIATING TRANSITIONS IN WATER RIGHTS

Ruth S. Meinzen-Dick and Bryan Randolph Bruns

WATER RIGHTS TRANSITIONS

As we look around the world, we find that water rights can be as fluid as the resource itself. Water moving through the landscape shifts from being public property to community managed to privately controlled and back again. Even in a single location, the relevant rights to water often vary according to the intended use and user. Rules governing entitlements to water vary by season, and even depend on who is talking. As competition for water grows, locally and within river basins, different principles for determining access to water come into increasing contact and conflict.

In many countries women may wash clothes next to an irrigation canal. Livestock owners bring animals to drink and bathe in the canal, which may also be used for waste disposal where it flows through villages. Irrigation systems such as this often overlay smaller schemes earlier built and managed by farmers, with their own patterns of customary rights. As the use of small pumps has proliferated in Asia, farmers have not just irrigated lands within current irrigation command areas, pumping from canals and from aquifers (replenished by the water imported through canals), but also have pumped from canals and ground water to irrigate adjoining lands that were not part of the area planned during design. Such changes raise new questions about who will be included or excluded from access to water, and how rights to water are made and enforced. On a larger scale, growing water demand from cities and industry brings pressures to restrict diversions by irrigation schemes, and to shift water from agriculture to other uses. Water users in schemes such as this are increasingly exposed to demands from distant users, and governments are stimulated to improve water allocation institutions.

LEGAL PLURALISM

How can we make sense of changing, overlapping types of water rights? A promising approach is to start with the perspective of people's experience with water access and control, in which individuals and groups draw upon a range of strategies for claiming and obtaining water. From this standpoint, we see that claims to water are not based only on state law, but may also be based on religious law, local or "customary" law, water project regulations, and other norms and practices. In many cases government has a much more limited influence than other institutions involved in allocating water. Thus negotiation about water rights occurs not just within a single framework of state law, but across multiple frameworks (Bruns and Meinzen-Dick, 2000).

The existence of and interaction between multiple legal orders is referred to as legal pluralism. In most cases rights to water are not derived only from the formal statutes of state law, but also have important sources in other patterns of social order. Webs of social relationships link friends and neighbors who share a common water source, social capital at the local level that helps to coordinate action and resolve most disputes long before they come to the attention of any outsider (Boelens and Davila, 1998). Disputants may seek advice from religious leaders and appeal to religious principles concerning rights to water, fairness, and other values. Viewing things from the perspective of legal pluralism helps us to understand water rights in practice. People will base their claims to water on one or another of these different legal frameworks, depending on how they see the world and on what they feel best suits their specific conditions. Within a context of legal pluralism, people may act strategically, based on what might offer them the most favorable outcome in resolving a dispute – a process referred to as "forum shopping."

In one area of Sri Lanka, government regulations restrict the use of domestic water supplies from each standpipe to a group of 10 families. They are only allowed to take water away in pots for their drinking and cooking needs. No bathing or other water use is allowed. However, those families will allow busloads of pilgrims going to a nearby temple to take water, because of religious principles that it is meritorious to give water to pilgrims. They also allow people to use water for other purposes based on local norms of when it is needed (Meinzen-Dick and Bakker, 2001). These people may be "breaking" the state law, but if we want to understand their behavior, it may be useful to look at how they are choosing to follow different laws, based on religion, local customs, and other sources.

... local law systems often draw on a rich, inconsistent mix of community norms, religious ideas, and concepts from formal law

Research on legal pluralism has challenged stereotypes and misconceptions regarding folk law and customary rights (Pradhan *et al.*, 1996). Local law systems commonly are dynamic, diverse, and co-evolve with state law. Rather than a fixed tradition, ideas about rights and how to conduct disputes change with circumstances. Rather than a monolithic consensus, local law systems often draw on a rich, inconsistent mix of community norms, religious ideas, and concepts from formal law, with conflicts between different principles left ambiguous or unresolved except perhaps where they clash in particular disputes. State law does not necessarily erase or supersede local law. Rather, statutes, courts, and state agencies become yet another option for those engaged in disputes, such as water conflicts.

Pluralism can be seen as a problem – a source of confusion and difficulty. However it may also contain strengths that are worth protecting and enhancing – embodying local values and offering additional avenues to voice concerns, search for solutions, and resolve conflicts. Misguided attempts to erase or suppress local ideas and institutions concerning rights to water risk creating confusion or even backfiring, increasing uncertainty and conflict. Whatever one's views about its merits, legal pluralism first needs to be recognized as a reality on the ground.

AVOIDING CADASTRE DISASTERS

A major reason for emphasizing the negotiation of water rights is to avoid a common fallacy that all that is needed is "simply" to record rights in a water cadastre (central registry listing owners and details of their water right). In many river basins around the world such formal registration is not the first priority for improving water allocation institutions. Premature formalization may be unnecessary or even counterproductive. As with land cadastres, such systems are often difficult for those with less education and contacts to access, while quite vulnerable to manipulation and abuse by elites. They can also distort existing principles or increase confusion and ambiguity when new rules about water rights are issued but not enforced.

This is not to say that state definitions of water rights and their implementation are unimportant. Government recognition of a range of customary water rights can provide protection, especially for those water users who are socially or economically less powerful. Recognition of jointly held water rights can reinforce collective action within a community. Security of water rights provides important incentives for managing the water. However, government actions to improve water allocation institutions need to be concerned with the processes by which local law works, and the impacts of changes in the water rights established by formal statutes and implemented by government agencies.

FORMING FORUMS

Instead of seeking comprehensive registration and government control of water rights, we suggest that it is more important to strengthen the forums for negotiation, whether *ad hoc* negotiations to deal with specific allocation problems, or more structured bodies such as basin committees and water parliaments. Negotiation also becomes more important as more countries try to put into practice ideas about participation and decentralization, rather than assuming that water can just be allocated by bureaucratic command and control. A government legal framework can enable collective action among users and user organizations. Government may be well placed to provide services, such as technical analysis and dispute resolution through facilitation, mediation, arbitration and courts (Blomquist, 1992). Negotiation becomes central to the process of establishing institutions for making collective decisions about water rights, designing suitable rules, and putting them into operation.

NEGOTIATING WATER RIGHTS

Even where governments have sought to formalize rights through permits, licenses, and other instruments, asserting rights typically involves negotiation. It depends not just on formal law but also on local understandings and power relationships. Where formal legal frameworks are absent, or, as in many developing countries, assert government authority over water but do little to further specify how rights are allocated, then customary practices and sources of water rights become even more important. If courts are distant, weak, or distrusted, then negotiation – perhaps mediated by administrative officials – become a major option available for seeking to peacefully resolve disputes (see, for example, Boelens and Hoogendam, 2002).

Even within an apparently well worked out framework of laws, courts, and other institutions, putting water rights into practice still includes large elements of negotiation. A key force driving negotiation is usually agreement by all parties that it is better to avoid the risk of having a court or administrative agency impose a very unsatisfactory outcome, and so instead to formulate an agreement among themselves. Such negotiations may occur "in the shadow of the law," influenced by statutes and legal precedents but still with ample scope for diverse interpretations and negotiation among the parties involved.

A negotiated approach that recognizes a range of customary water rights is not necessarily rigid and locked in the past, but can respond to changing priorities and concerns. Growing scarcity within basins stimulates efforts to more clearly and precisely define water rights. Pressures to renegotiate rights can also come from concern about environmental needs, redefinition of government roles, entry of new stakeholders, or other changes in policy and regulations, as well as being part of specific water resources development projects.

TRANSITIONS FROM FARMS TO CITIES

By 2025 over half the world's population will be living in cities. Continued growth of cities and industry brings increasing demands to shift water from agriculture to other uses. A key question is whether this will be a process of imposed expropriation, or a negotiated transition. If reallocation is imposed without due consideration for the impact on farmers, then that transition is likely to meet increasing resistance and opposition. Conversely, if the rights of existing users are respected, then solutions can be negotiated that offer adequate compensation for affected water users. Such negotiation can take place either in the context of water allocation administered by government agencies or user organizations or through water markets. In the case of markets, measures to avoid or mitigate impacts on third parties may also be an important part of the process.

CONCLUSIONS

The social institutions that shape how claims to water are recognized and enforced will continue to change. The challenge, as water grows increasingly scarce around the world, is how to best navigate the process of change, identifying opportunities to shift towards more equitable, productive, and sustainable use of water – resolving conflicts over water peacefully and fairly. Water rights flow from customary laws, local practices, and religious values, as well as government statutes, regulations, and bureaucratic procedures. A clearer recognition of the multiple sources of water rights offers both a better, more realistic understanding of how people establish and defend their access to water, and insight into the scope for and importance of negotiation of water allocation. Where water rights become more precisely defined, and even transferable, this is likely to increase, not reduce, the extent of negotiation, decentralizing it among dispersed users responding to their local conditions. Once the importance of negotiation is better understood, then it becomes apparent that a first priority in improving water allocation institutions lies not in imposing immediate, comprehensive registration, but in strengthening forums for negotiation, and improving the services for technical analysis and dispute resolution that can support the participation of users in improving water governance.

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Ruth Meinzen-Dick is a Senior Research Fellow at the International Food Policy Research Institute, conducting research on water policy, local organizations, collective action, property rights, and the impact of agricultural research on poverty. She is a Development Sociologist who received her PhD from Cornell University. Much of her work has been interdisciplinary research, with field work in India, Zimbabwe, Pakistan, Nepal, and Sri Lanka. Among many journal and book publications, she has co-edited *Negotiating Water Rights* with Bryan Bruns.

Bryan Bruns is a consulting sociologist with an independent practice specializing in improving participation in irrigation and water resources management. Other areas of interest include the role of information and communication technologies in international development, intellectual property institutions, and participatory processes in research and development of emerging technologies. He holds a Ph.D. in Development Sociology from Cornell University. Additional information available at www.BryanBruns.com.

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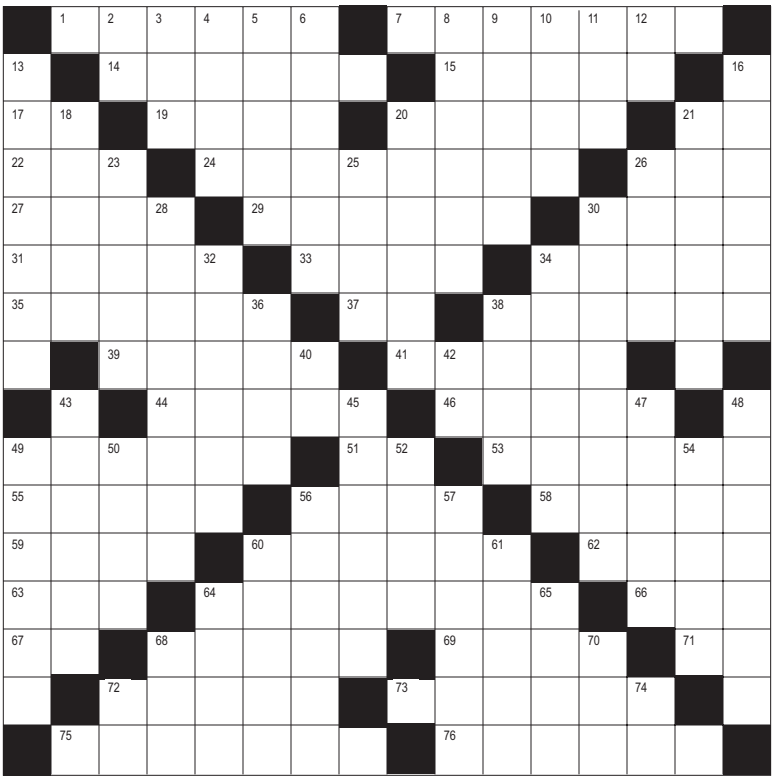
▲ Water Resources Puzzler (answers on pg. 21)



ACROSS
1 to levy
7 a type of grass
14 the Watergate _____
15 shark or lily
17 after noontime
19 follows movie or shooting
20 to welcome
21 loc. of Concord R.
22 goddess of the dawn
24 to lie inactive
26 . . . - - - - . . .
27 campus org.
29 Lucy's friend
30 type of machine
31 to worship
33 Mix and Jones
34 trap
35 an oppressor
37 St. bird: Blue Hen
38 followed by rights or evidence
39 finished
41 followed by eyed or shooter
44 mister in Veracruz
46 santified
49 Moslem ruler
51 loc. of Rogue R.
53 South Pacific island
55 abbot's subordinate
56 twofold
58 Twiggy or Tyra
59 part of a harness
60 river of SW Asia
62 NBA players
63 boxing champ
64 warms up
66 to deceive
67 loc. of Mad R.
68 race divisions
69 black or brown
71 loc. of Shepaug R.
72 a nomadic group
73 license and dinner
75 ER workers
76 votes into office

DOWN
2 armed forces cop
3 ballet step
4 chooses
5 county and padded
6 straying
8 belts
9 religious devotion
10 Mets Tommie
11 to soak
12 25th Vice Pres.
13 to perform surgery
16 squanders
18 Boone's "_____ River"
20 shriveled old men
21 secured a vessel
23 candy or grocery follower
25 before Friday or looks
26 Venetian blind part
28 the Shadow
30 picture album entry
32 make beloved
34 body of running water
36 neighbor of KY
38 followed by Lake or cake
40 _____ or die
42 football pos.
43 unhesitatingly
45 golf course hazards
47 followed by Tidal or wave
48 strips of fish
49 jumped abruptly
50 XC minus XXXVII
52 unusual
54 purposeful
56 consumed less
57 legally obligated
60 wind or barrier
61 Rickey Henderson's specialty
64 long-lasting hair setting (abbr)
65 glut
68 garden tool
70 popular rm.
72 3600 sec.
74 Louis or Patrick

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WATER ON WALL STREET

Clay J. Landry and Rachel Cardone

The Suez Soap Opera

Suez suffered a major setback in January when its subsidiary United Water Atlanta lost a 20-year O&M contract to provide drinking water to the two million people in the City of Atlanta. The contract, signed in 1999, was worth an estimated $430 million ($21 million annually). At the time of signing, the deal represented the largest public-private partnership for water operations in the United States.

The City of Atlanta terminated its contract with United Water citing rusty water, water shutoffs, late payments, and a bill collection rate lower than it had been under public management. Itself dissatisfied, United Water claimed that the city's infrastructure was in worse than expected condition, necessitating unforeseen capital expenditures. Conflicting claims of nonperformance to the contract's terms have been settled, with United Water agreeing to pay the City of Atlanta $6 million and the City of Atlanta will pay United Water $1 million.

The transition back to city ownership could be costly for Atlanta. Public or private, the water system infrastructure still needs upgrading and city officials are already planning an $800 million capital program for needed improvements. In addition, operating the system with city employees could cost up to $8 million more a year than what was spent during an average year with United Water services. Even starting up public management again is expected to cost up to $10 million. Replacing, or luring back, 200 former city workers who stayed with United Water could add up to $4 million in extra costs.

The fallout between Atlanta and United Water has been well publicized as a major failure of public-private partnerships and provides powerful ammunition to those opposed to a private sector role in water. The story of Atlanta and United Water adds another anecdote to a growing list that already includes cholera epidemics in South Africa and corrupt contracts in Bolivia. Momentum is building in the press in support of this resistance. Every month a new indictment of private water suppliers trots out these same few examples, usually without mentioning the chronic failure of developing nation governments to provide clean water publicly.

While events in Atlanta unfolded, an RWE partnership nailed down a similar, but even larger deal. The City Council of Stockton, California, approved a 20-year, $600 million contract with OMI-Thames Water for operation and maintenance of that city's water, wastewater, and storm water utilities.

According to a news release issued by Thames, OMI-Thames Water will serve 250,000 Stockton residents and make major physical plant improvements to the city's wastewater facilities. The release goes on to claim that the partnership with OMI-Thames Water will save Stockton $175 million over the life of the contract. Stockton will retain ownership of the utility system, and the council will continue to set rates.

Cadiz Update

Much publicized water resource developer Cadiz is still fighting to shrug off financial troubles stemming from its mothballed Mojave Desert ground water project. At the end of January, Sun World, a wholly owned Cadiz subsidiary voluntarily filed for Chapter 11 bankruptcy to protect itself from creditors. Cadiz itself was not named in the filing, but the voluntary move for Chapter 11 allows Sun World to secure $40 million in previously unavailable financing. Before Chapter 11, that $40 million would have come from Cadiz, which is now free from the obligation.

Cadiz also announced this month that it will ask shareholders to approve an ambitious reverse stock split of between 1-for-4 and 1-for-25. The goal is to buoy up share price to around $3 and eliminate the danger of being de-listed from the NASDAQ. Cadiz bet the farm on the Mojave project and can ill afford to write it off. Who knows, given Cadiz's connections in California government, they may yet come out on top.

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Rachel Cardone
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HAVE SOME COMMENTS ABOUT THIS ISSUE? . . . SEND US YOUR FEEDBACK

(COMMENTS ON PREVIOUS ISSUES ARE ALSO WELCOME)

Water Resources IMPACT is starting its fifth year in publication and we have explored a lot of ideas. We hope we've raised some questions for you to contemplate. "Feedback" is your opportunity to reflect and respond. We want to give you an opportunity to let your colleagues know your opinions . . . we want to moderate a debate . . . we want to know how we're doing. Send your letters by land-mail or e-mail to Clay Landry or Laurel Phoenix (for this issue), or to Earl Spangenberg (Editor-In-Chief). Either way, please share your opinions and ideas. Please limit your comments to approximately 350 to 400 words. Your comments may be edited for length or space requirements.

Water Industry Market Watch

Company	Ticker	Share Price	% Change	Exchange	52-Week High	52-Week Low	Yield	P/E	Revenues* Last Reported	Revenues* Year Ago	Dec. 10 close
American States Water	AWR	$ 22.51	-5.6%	NYSE	29.01	20.25	3.93	18.83	258.7	243.0	$23.85
Artesian Resources	ARTNA	$ 32.00	10.2%	NASDAQ	34.60	24.75	3.78	18.42	25.9	23.9	$29.03
Birmingham Utilities	BIW	$ 18.12	0.6%	American	20.75	16.00	3.31	5.21	3.4	3.5	$18.02
California Water Services	CWT	$ 24.99	1.8%	NYSE	26.89	20.45	4.64	19.37	202.2	190.3	$24.55
Connecticut Water	CTWS	$ 25.44	-1.6%	NASDAQ	31.09	20.35	3.28	22.33	34.8	34.7	$25.84
Consolidated Water	CWCO	$ 14.51	5.5%	NASDAQ	2.91	21.57	3.12	20.12	9.1	8.5	$13.75
Middlesex Water Co.	MSEX	$ 23.02	8.8%	NASDAQ	26.72	18.30	3.84	23.07	46.8	34.0	$21.15
Pennichuck Corp.	PNNW	$ 22.60	-20.4%	NASDAQ	32.40	22.39	3.43	22.09	18.5	15.6	$28.40
Philadelphia Suburban	PSC	$ 20.80	1.2%	NYSE	25.00	16.02	2.67	24.11	240.2	232.2	$20.55
Suez	SZE	$ 16.83	-3.6%	NYSE	30.30	13.18	3.71	18.97	7281.4	7349.1	$17.45
Southwest Water	SWWC	$ 13.06	-6.7%	NASDAQ	18.19	11.24	1.79	20.65	95.5	83.1	$13.99
York Water Co.	YORW	$ 16.01	-5.5%	NASDAQ	20.17	12.30	3.43	25.79	14.8	14.4	$16.95
Vivendi Environnement	VE	$ 19.80	-14.1%	NYSE	34.20	17.52	9.52	19.21	8372.9	7905.7	$23.05
Calgon Carbon Corp	CCC	$ 5.74	15.3%	NYSE	9.89	4.00	2.29	47.73	195.5	206.6	$4.98
Ionics Inc.	ION	$ 21.23	-8.1%	NYSE	32.77	17.64	-	10.02	246.5	354.9	$23.11
Millipore Corp.	MIL	$ 33.28	-5.8%	NYSE	58.27	27.25	-	19.43	518.4	488.1	$35.32
Osmonics Inc.	OSM	$ 17.60	4.4%	NYSE	17.50	10.00	-	29.84	156.9	153.4	$16.86
Pall Corp.	PLL	$ 16.43	-1.9%	NYSE	23.90	14.68	2.23	67.13	654.8	591.1	$16.75
Cadiz Inc.	CLCI	$ 0.16	-72.3%	NASDAQ	11.00	0.14	-	-	95.0	84.0	$0.57
Intergrated Water Resources	IWRI	$ 0.25	-28.6%	OTC	-	-	-	-	-	-	$0.35
Layne Christensen Co.	LAYN	$ 8.20	-2.4%	NASDAQ	10.8	5.47	-	138.33	214.2	236.1	$8.40
Pico Holdings Inc.	PICO	$ 12.19	-1.1%	NASDAQ	17.86	8.05	-	13.29	60.0	52.0	$12.32
Southwestern Water Exploration	SWWE	$ 0.38	-50.0%	OTC	-	-	-	-	-	-	$0.76
Western Water Co.	WWTR	$ 0.29	-9.4%	OTC	1.26	0.17	-	-	0.9	0.8	$0.32

* Revenues presented are in $ millions and reflect cumulative third quarter revenues ended Sept 30

PLL reports full year end Aug 1, 2002. Suez reflects Ondeo cumulative revenues, VE reflects Vivendi Water cumulative revenues.

▲ Editorial . . . Richard A. Engberg, Technical Specialist, AWRA

The following is a slightly abridged editorial written by Tim Cohn and published in the December 3, 2002, issue of *EOS*. I believe that it should be required reading for all AWRA members. It is printed here, not as an editorial for AGU, but rather because of its relevance to the multidisciplinary science backgrounds of AWRA members. Interestingly, the National Water Resources Policy Dialogue, which AWRA convened in September 2002, was a major step toward communicating water resources science related needs to policy makers. (*This editorial is printed with the permission of the author. The emphasized sentences or phrases are mine.*)

THE UNEASY COURTSHIP OF SCIENCE AND POLITICS

Timothy A. Cohn, Chair, AGU Committee on Public Affairs

AGU's Committee on Public Affairs (COPA) exists to serve the AGU community by raising awareness of political issues that affect science and by helping members communicate with their elected representatives. COPA's goal is to reach the entire AGU membership, but its efforts sometimes involve one member at a time. In particular, each year COPA sponsors one scientist to learn about politics while providing scientific expertise to Capitol Hill as part of the AAAS Congressional Science Fellows Program.

In 1995, I was chosen as AGU's Congressional Science Fellow and I spent a year working as a legislative assistant in the office of Senator Bill Bradley (D-NJ). I arrived with great confidence in science and with serious doubts about our political system. A year later my perspective had changed. As my confidence in our democratic processes grew, so did my recognition that **scientists, almost alone among groups affected by government policies, were not playing their appropriate part in our system.**

Senator Bradley was repeatedly visited by almost every interest group imaginable. The surf-clammers showed up monthly. I talked with dozens of ranchers who graze livestock on federal lands. New Jersey's fumigators – who, I come to understand, provide the first line of defense against invasive species – called at least once each week. The florists, the nuclear power industry, wool garment makers (accompanied by six memorable fashion models), Indian tribes, garden clubs, candy manufactures, loggers and environmentalists (does every Oregon tree have its own lobbyist?), proponents and opponents of beach renourishment, and countless others also visited regularly. They came intent on sharing their concerns and hopes, full of ideas about what the senator should do.

These people understood something essential about the process of representative democracy: They knew to show up (on time), to make a (succinct) case, to listen, to learn, to understand the senator's position on each issue – what's carved in stone and what's open for discussion, to link their issue to other issues that the senator cared about, and to explain why their request was consistent with the senator's policies and previous statements and votes.

Scientists, however, were notable mostly for their absence. Those few scientists who did visit seemed unsure about how to ask for help, or even how to relate to a Hill staffer or a member of Congress. They usually retreated to simply explaining their research, perhaps believing that the staffer would immediately grasp its significance and recognize how it served the public. However, despite my scientific background and desire to support their requests, I often had a hard time understanding the connections. My sense is that the scientists left frustrated, none returned for a second round.

Why do cowboys and clammers run circles around scientists on the Hill?

At one level, it likely has to do with scientific training and cultural values. (For one thing, scientists are supposed to be objective, and politics is inherently subjective.) But I think there is also something else.

I once heard the comment that scientists' approach to the political environment was analogous to the foreign traveler who, unable to speak the local language, cannot successfully order a drink and then doubts the natives' intelligence. That isn't quite right, of course.

For one thing, communication problems on the Hill are not so easily diagnosed. Also, the world really would be better if all our representatives understood more about geology, physics, and biology, and could communicate in the language of science. But that isn't going to happen. **The best way for us scientists to become more effective in serving our society is to learn to communicate in the world of politics.**

COPA is Dedicated to This Task
We Want Your Help

Science is now inextricably linked to the political process, for better or for worse. The time is long overdue to forge a better relationship between science and politics, for the health of both our science and our world. We know this is possible because it has happened in a number of specific cases, from geologic mapping to water quality, to seismology, with enduring benefits to both science and the nation.

There are many ways to participate at the federal, state, and local levels. Here are some things you can do to get started:

- Sign up for ASLA, AGU's Science and Legislative Alerts, which provide brief descriptions of legislation or other news at the national, state, and local level affecting the geophysical sciences.

cont'd. on pg. 29

▲ President's Message . . . Jane L. Valentine, AWRA President, 2003

In the early 1960s Dr. Sander C. Csallany, a civil engineer and hydrologist, and Dr. Icko Iben, a librarian, had a vision of an Association that would increase communication and knowledge in the field of water resources. This vision became a reality when they formed the American Water Resources Association (AWRA) in 1964 with a major objective of fostering a program of information exchange between professionals in water related disciplines.

Today that vision is very much alive! We will witness this in 2003 in several conferences, including the "Water Information Day of the Third World Water Forum" to be held in Japan this month. The Forum will continue the vision of Drs. Csallany and Iben in providing a dialog for water information exchange in Japan. Topics scheduled are: Case Studies of Water Information Systems and Principles; Does Information Matter? Legal, Economic, Scientific, and Cultural Perspectives; Building and Sustaining Knowledge Networks; and Water Portal of the Americas.

The current Board of AWRA, consisting of 11 members, has been participating in strategic thinking on issues to enhance and continue the vision of Csallany and Iben. Some of the issues discussed at our two-day Board meeting this past January are highlighted here, along with the outcomes of the discussions.

Should AWRA do more to directly influence the water resources agenda?

While this was not directly addressed in the retreat, AWRA's policy was reiterated in the board meeting. AWRA's role is to encourage and facilitate full discussions about water policy among the wide range of key players, such as was done in the Water Policy Dialogue last year.

How do we develop a community with related associations?

It was suggested that AWRA headquarters track the meetings of related associations, web sites be linked to each other, and that membership dues and topical committees for those associations be researched. A side conversation suggested a task force explore this further.

How do we attract and maintain the 'generalist' water resources professional and continue to attract and maintain the highly technical scientific community?

Market multidisciplinary nature of profession to related groups, use conference sessions to emphasize, and assess corporate memberships for support.

How do we assure the current financial support and future security of the AWRA?

A task force (Earl Spangenberg, Mike Kowalski, Dick Engberg) was appointed to flesh out recommendations for building an endowment fund for initiatives. Ken Reid will ask a couple of people who have expertise in development to join this group.

How do we attract the top water research to JAWRA?

John Warwick has a list of ideas from the small circle session to implement regarding the recruitment of papers and reviewers for the *Journal*.

What might be our role in educating young people (K-12) in the future?

It was suggested that the state sections consider adopting this role at the local level.

We still have hopes of communicating with each of you in order to better position AWRA in this 21st century. As we reach our 50th anniversary of existence in 2014 we hope to see the Csallany-Iben vision going strong with an Association in which we have been and continue to be immensely proud.

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Editorial . . . cont'd. from pg. 28

- Visit the AGU Science and Policy Web site.
- Get to know your Congressional delegation.
- Make friends with your university federal relations director
- Participate in Congressional Visits Days.
- Become a Congressional Science Fellow.
- Volunteer to serve on COPA!

This concludes Mr. Cohns' editorial. I might add that AWRA members can participate individually in the following ways to ultimately raise the level of scientific communication with the world of politics:

- *Support future AWRA water resources policy dialogues whether on the federal or regional level.*
- *Join a rejuvenated AWRA Policy Technical Committee.*
- *Get involved (separately from your day job) with water-related issues at your local or state level.*
- *Subscribe to the policy that "brief is better" in any communications with Congress or Hill staff.*

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▲ Water Resources Continuing Education Opportunities

MEETINGS, WORKSHOPS, SHORT COURSES

APRIL 2003

23-24/Water, Science, & Decision Making – Red River Basin Inst. **Contact** (w: www.ndsu.ed/tricollege/watershed)

22-25/Developing & Implementing TMDLs for Lakes and Reservoirs – 16th Annual State Lakes Mgmt. Prog. Conf. Chicago, IL. **Contact** Bob Kirschner, Chicago Botanic Garden, 1000 Lake Cook Rd., Glencoe, IL 60022 (e: bkirschn@chicagobotanic.org)

MAY 2003

12-14/AWRA's Spring Specialty Conf. "Agricultural Hydrology & Water Quality." Kansas City, MO. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org) (see pgs. 31-32)

12-15/Water for a Sustainable World – Limited Supplies & Expanding Demand (2nd Intn'l. Conf. on Irrigation & Drainage. Phoenix, AZ. **Contact** (e: stephens@uscid.org; w: www.uscid.org)

13-15/Using Science to Assess Environmental Vulnerabilities. King of Prussia, PA. **Contact** Conf. Coor. Storm Tech. Planning & Mgmt. Corp., Mill Wharf Plaza, Ste. 208, Scituate, MA 02066 (718/544-0423; f: 781-544-3086; e: congerence@tpmc.com)

27-30/8th Annual Workshop on Use of Constructed Wetlands for Water Quality Mgmt. Humboldt State Univ., Arcata, CA. **Contact** B. Smith (707/826-3619; e: smith@humboldt.edu; w: www.olawai.org)

JUNE 2003

8-13/Society of Wetland Scientists (24th Ann. Meet.). New Orleans, LA. **Contact** D. Meffert (e: dmeffert@tulane.edu) or R. Twilley (e: ceet@louisiana.edu)

11-13/Canadian Water Res. Assn 56th Ann. Conf. Vancouver, BC, Canada. **Contact** David Sellars (604/273-6299; e: dsellars@watermc.com; w: www.cwra.org)

19-21/Hydraulics of Ice Covered Rivers. Edmonton, Alberta, Canada. **Contact** Fay Hicks (780/492-7170; f: 780/492-0249; e: fehicks@civil.ualberta.ca)

29-July 2/AWRA's Summer Specialty Conf. Intn'l. Congress on "Watershed Mgmt. for Water Supply Systems." New York, NY. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org) (Prem. Prog. coming in March)

JULY 2003

26-30/The Columbia: Conserving a Legacy of Life – SWCS Annual Conf. Spokane, WA. **Contact** Deb Happe, Soil & Water Cons. Soc., 7515 NE Ankeny Rd., Ankeny, IA 50021-9764 (515/289-2331; f: 515/289-1227; e: seb@swcs.org)

28-31/StormCon '03. San Antonio, TX. **Contact** Janice Kaspersen (www.stormcon.com)

30-August 1/Joint UCOWR/NIWR/ASCE-EWRI Conf.-Water Security in the 21st Century. Washington, D.C. **Contact** Margaret Skerly, UCOWR, 4543 Faner Hall, SIU, Carbondale, IL 62901-4529 (e: mskerly@siu.edu; w: ucowr@siu.edu)

AUGUST 2003

10-14/American Fisheries Society 133rd Annual Meeting. Quebec City, Quebec, Canada. **Contact** Betsy Fritz (301/897-8616, x212; e: bfritz@fisheries.org)

11-14/13th Stockholm Water Sym. – Drainage Basin Security. Stockholm, Sweden. **Contact** Stockholm Intn'l. Water Inst., Stockholm Water Sym., Hantverkargatan 5, Hus 6, SE-112 21 Stockholm, Sweden (+46 8 522 139 61; e: sympos@siwi.org)

SEPTEMBER 2003

10-13/Drainage for a Secure Environ. & Food Supply – ICID 9th Intn'l. Workshop. Utrecht, The Netherlands. **Contact** W.F. Voltman (e: drainage2003@ilri.agro.nl; w: www.ilri.nl/workshop

OCTOBER 2003

19-22/2003 AIH Annual Meeting & Conf. Atlanta, GA. **Contact** AIH, 2499 Rice St., Ste. 135, St. Paul, MN 55113 (651/484-8169; f: 651/484-8357; e: AIHydro@aol.com)

NOVEMBER 2003

2-5/AWRA's Annual Water Resources Conf. San Diego, CA. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org) (Call for papers will be published in early March - check out AWRA's website for exact due dates)

7-10/Dam Safety 2003. Minneapolis, MN. **Contact** ASDSO, 450 Old Vine St., Lexington, KY 40507 (859/257-5140; f: 859/323-1958; e: info@damsafety.org)

(Check Out AWRA's 2004 Meetings on pg. 8)

FEBRUARY 2004

2-4/6th Intn'l. Sym. on Hydrological Applications of Weather Radar. Melbourne, Australia. **Contact** Dr. Alan Seed, Bur. of Meteor. Res. Ctr., GPO Box 1289K, Melbourne, Australia (e: hawr2004@bom.gov.au; w: www.bom.gov.au/announcements/conferences/hawr2004/)

CALLS FOR ABSTRACTS

MARCH 28, 2003 (Abstracts Due) – TMDL 2003. Nov. 16-18, 2003, Chicago, IL. **Contact** (w: http://www.wef.org/TMDL03Call.pdf)

APRIL 30, 2003 (Abstracts Due) – N. American Lake Mgmt. Soc.-Ann. Sym. Nov. 3-7, 2003. Mashantucket, CT. **Contact** (w: http://www.nalms.org)

MAY 9, 2003 (Abstracts Due) – AWRA's Annual Water Resources Conf. November 2-5, 2003. San Diego, CA. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

MAY 15, 2003 (Abstracts Due) – FAME (Frontiers in Assessment Methods for the Environment). August 10-13, 2003. Minneapolis, MN. **Contact** (w: http://www.aeesp.org or http://wrc.coafes.umn.edu/FAME)

AUGUST 1, 2003 (Abstracts Due) – Watershed 2004. July 11-14, 2004. Dearborn, MI. **Contact** (w: http://www.wef.org/pdffiles/Watershed04Call.pdf)

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▲ February 2003 JAWRA Papers (Vol. 39, No. 1)

DIALOGUE ON WATER ISSUES

- Integrating Service-Learning Into Watershed Management Programs: Opportunities and Challenges
- Overcoming the Nation's Best Landscaped Sewer: Recreators' Perceptions of the Connecticut River

TECHNICAL PAPERS

- Observation Well Network Design for Pumping Tests in Unconfined Aquifers
- Implications of Climatic Variability for Regulatory Low Flows in the South Platte River Basin, Colorado
- Stochastic Flow Duration Curves for Evaluation of Flow Regimes in Rivers
- Comparative Study of Optimization Techniques for Irrigation Project Planning
- Modeling Runoff From Variable Source Areas in Humid, Shallow Water Table Environments
- Septage Quality and Its Effect on Field Life for Land Applications
- Static Water Level Mapping in East Central Michigan
- The Need for High Resolution Time Series Data to Characterize Hawaiian Streams
- Predictive Real Time Control of Surcharged Interceptors: Impact of Several Control Parameters
- Simulated Impacts of El Niño/Southern Oscillation on United States Water Resources
- Potential Effects of Climate Change on Ground Water in Lansing, Michigan
- Watershed Weighting of Export Coefficients to Map Critical Phosphorus Loading Areas
- Use of the Delphi Method in Resolving Complex Water Resources Issues
- Watershed and Instream Impacts on the Fish Population in the South Fork of the Clearwater River, Idaho
- Evaluation of Hydrologic Benefits of Infiltration Based Urban Storm Water Management
- Geological and Climatic Controls on Streamflows in the Nebraska Sand Hills

▲ AWRA's Spring Specialty Conference ... See Pg. 32 for Registration Form

"Agricultural Hydrology and Water Quality"
May 12-14, 2003 • Kansas City, Missouri

This conference will bring together researchers, engineers, policy makers, modelers, state and federal agency program managers, and producers to discuss/debate issues related to agricultural hydrology and the impact on water quality by nutrients, pesticides, bacteria, and sediment discharged from agricultural systems. This specialty conference will be a forum for dialogue, and presentations will be made by national and international leaders in research and policy. A total of 32 sessions composed of 125 oral presentations and 68 poster presentations are scheduled to address the following topics:

- Nutrients Standards and Manure Management, TMDLs, and Water Quality Issues
- CAFOs and Microbial and Antibiotics in Water
- CAFOs and Manure Management/Water Quality Research
- CAFOs and Lagoon Seepage Research
- Pesticide Fate, Transport and Water Pollution
- BMPs for Water Quality Mitigation/Water Resource Protection
- Riparian Buffers and Water Quality
- Policy Issues Related to Water Quality Management
- SWAT and HSPF Modeling Applications

Presenters coming from Asia, Europe, Canada, and the United States will bring international experience to the discussions. We have planned two outstanding pre-conference technical tours for the participants. These tours will bring participants close to real water quality problems of the Clinton Reservoir in Douglas County and the Hillsdale Reservoir in Miami County in Kansas and learn how TMDLs and BMPs are being developed to protect these water bodies from the incoming discharge from CAFOs and crop lands.

All professionals, producers, policy makers, and citizens interested in water quality issues are invited to attend the 2003 specialty conference in one of the Midwest's best cities, Kansas City, and get one of the best learning and rewarding experiences.

Complete Preliminary Program and Information on Registration
Can Be Found On AWRA's Website At info@awra.org

"Agricultural Hydrology & Water Quality" Conference Registration Form

Mail OR Fax Registration Form & Fees To: AWRA • 4 West Federal St. • P.O. Box 1626 • Middleburg, VA 20118-1626
(540) 687-8390 / Fax: (540) 687-8395 / E-Mail Address: info@awra.org

		Early Bird Registration postmarked by April 28, 2003	On Site Registration Postmarked AFTER April 28, 2003	TOTAL $
FULL Registration	AWRA MEMBER	$390	$450	$ _____
	Non-AWRA MEMBER	$490	$540	$ _____
STUDENT Registration	AWRA MEMBER	$70	$110	$ _____
	Non-AWRA MEMBER	$90	$130	$ _____
ONE-DAY Registration	AWRA MEMBER	$150	$175	$ _____
	Non-AWRA MEMBER	$175	$200	$ _____

(one-day registrants please circle day of attendance →) MON TUES WED

★ The following events ARE INCLUDED in the above registration fees. If you would like to bring a guest, please order extra tickets below tickets may be purchased on-site. REFUNDS WILL NOT BE GIVEN for tickets ordered in error.

Opening Reception	MONDAY	May 12	5:00 PM-6:30 PM	$15	x ____ =	$ _____
Conference Luncheon	WEDNESDAY	May 14	12:00 NN-1:15 PM	$25	x ____ =	$ _____

★ The following events ARE NOT INCLUDED in the registration fees and are extra

CEU Credit (1.2 CEUs will be offered, representing 12 hours of attendance) (see inside front cover for details)	Member	$10	Non-Member	$12		$ _____
Field trip #1 (Hillside Lake Watershed / You must register by April 28)	SUNDAY	May 11	8:00 AM-5:00 PM	$70	x ____ =	$ _____
Field trip #2 (Clinton Lake/Reservoir / You must register by April 28)	SUNDAY	May 11	8:00 AM-5:00 PM	$70	x ____ =	$ _____
Workshop #1 (WEPP Training / You must register by April 28)	SUNDAY	May 11	8:00 AM-5:00 PM	$50	x ____ =	$ _____
Workshop #2 (SWAT Training / You must register by April 28)	SUNDAY	May 11	9:00 AM-5:00 PM	$50	x ____ =	$ _____
Additional Conference CD Proceedings (One CD is included with your registration fee. Additional CDs may be purchased only by attendees at this price.)				$10	x ____ =	$ _____

GRAND TOTAL $ _____

INSTRUCTIONS

1. One form per person. Please photocopy.
2. To receive discounts, form and **fee** must be postmarked by due dates indicated above. Do not send/fax a registration without payment or PO. It will be returned.
3. To receive the AWRA member discount you must be a current 2003 National AWRA member at the time of registration. Membership will be verified. To qualify for the Student Registration fee, students **must submit a school ID, showing FULL TIME status, with the registration form.** Students who are employed full time, within the profession, should pay the Full Registration Rate.
4. All balance-due invoices must be paid before meeting credentials will be issued.
5. All payments must be in U.S. currency.
6. All registrations received by May 2, 2003, will be confirmed in writing. The confirmation will be the official receipt of payment.
7. If you register via fax, do not also mail it. This will avoid duplication. A cover sheet is not needed. A credit card # or PO must accompany the fax.
8. Hotel reservations should be forwarded to the hotel and **not** AWRA.
9. Questions? . . . Give us a call or send us an e-mail.

REGISTRATION INFORMATION

NAME _____

'NICK NAME' FOR BADGE _____

COMPANY OR AGENCY _____

ADDRESS _____

CITY _____ STATE _____ ZIP+4 _____ COUNTRY _____

BUSINESS PHONE # _____ FAX # _____

E-MAIL ADDRESS _____

ARE YOU A CURRENT AWRA NATIONAL MEMBER? ❑ YES / MEMBERSHIP # _____ ❑ NO
(TAKE ADVANTAGE OF MEMBER RATES . . . SEE THE AWRA MEMBERSHIP APPLICATION)

❑ SPECIAL DISABILITIES: CHECK IF YOU REQUIRE SPECIAL ASSISTANCE OR SERVICES. (PLEASE INCLUDE A WRITTEN DESCRIPTION OF THE SPECIAL SERVICES REQUIRED.)

PAYMENT INFORMATION

FULL PAYMENT MUST ACCOMPANY REGISTRATION FORM. AWRA'S FEDERAL IDENTIFICATION NUMBER IS 37-6076418) PAYMENT MUST BE MADE BY ONE OF THE FOLLOWING:

❑ Check (in U.S. dollars only) payable to AWRA.

❑ Gov't. Purchase Order – the PO must accompany the registration form in order to be processed. All purchase orders must be received by April 28. POs will not be accepted on site. Incomplete POs or registrations will be returned.

❑ Credit Card (circle one)
Visa MasterCard Diners Club Amex Discover

Card # _____ EXP DATE _____

CARDHOLDER NAME _____

SIGNATURE (REQUIRED) _____

CANCELLATION POLICY: CANCELLATIONS MUST BE MADE IN WRITING. THOSE RECEIVED BY **April 28, 2003**, WILL BE SUBJECT TO A PENALTY OF 25% OF TOTAL FEES. NO REFUNDS WILL BE GIVEN AFTER April 28, 2003. **NO EXCEPTIONS!**

AMERICAN WATER RESOURCES ASSOCIATION MEMBERSHIP APPLICATION – 2003

MAIL THIS FORM TO . . . AWRA • 4 West Federal St. • P.O. Box 1626 • Middleburg, VA 20118-1626
FOR FASTEST SERVICE . . . FAX this form (credit card or P.O. orders only) to (540) 687-8395
QUESTIONS? . . . CALL AWRA HQ at (540) 687-8390 or E-MAIL at info@awra.org

➤ Complete All Sections (please print)

LAST NAME FIRST MIDDLE INITIAL

TITLE

COMPANY NAME

MAILING ADDRESS

CITY STATE ZIP+4 COUNTRY

IS THIS YOUR ❑ HOME OR ❑ BUSINESS ADDRESS?

PHONE NUMBER FAX NUMBER

E-MAIL ADDRESS

RECOMMENDED BY (NAME) AWRA MEMBERSHIP #

➤ Student Members Must Be Full-Time And The Application Must Be Endorsed By A Faculty Member.

PRINT NAME SIGNATURE

ANTICIPATED GRADUATION DATE (MONTH/YEAR): _____

➤ Key For Membership Categories:

JAWRA – Journal of the AWRA (bi-monthly journal)
IMPACT – IMPACT (bi-monthly magazine)
PROC. – 1 copy of AWRA's annual symposium proceedings

ENCLOSED IS PAYMENT FOR MEMBERSHIP (PLEASE CHECK ONE)

❑ FULL YEAR ❑ HALF YEAR

- ❑ Regular Member (JAWRA & IMPACT) $130.00
- ❑ Student Member (IMPACT) FULL YEAR ONLY.....$25.00
- ❑ Institutional Member (JAWRA, IMPACT, & PROC.).....$275.00
- ❑ Corporate Member (JAWRA, IMPACT, & PROC.).....$375.00
- ❑ AWRA Membership Certificate $6.00

➤ Foreign Airmail Options: Contact AWRA for pricing.

➤ Please Note

* Membership is based on a calendar-year; after July 1st regular, institutional, or corporate members may elect a 6-month membership for one-half of the annual dues.
* Students do not qualify for half-year membership.
* Remittance must be made in U.S. dollars drawn on a U.S. bank.

➤ Payment Must Accompany Application

PAYMENT MUST BE MADE BY CHECK OR ONE OF THE FOLLOWING CREDIT CARDS:

❑ VISA ❑ MASTERCARD ❑ DINERS CLUB ❑ AMEX ❑ DISCOVER

CARDHOLDER'S NAME _____

CARD NUMBER _____ EXPIRATION DATE _____

SIGNATURE (REQUIRED) _____

➤ Your Primary Reason For Joining? (check one)

- ❑ To Receive Information Through JAWRA and IMPACT
- ❑ Networking Opportunities
- ❑ Technical Committee Interactions
- ❑ Conference Discount
- ❑ Employment Opportunities
- ❑ Other: _____

➤ How Did You Learn Of AWRA? (check one)

- ❑ Promotional Mailing
- ❑ Internet Search
- ❑ Journal (JAWRA)
- ❑ IMPACT
- ❑ Boss/Friend/Colleague
- ❑ Email Received
- ❑ Other: _____

AWRA
Community, Conversation, Connections

DEMOGRAPHIC CODES

(PLEASE LIMIT YOUR CHOICE TO ONE IN EACH CATEGORY)

JOB TITLE CODES

JT1	Management (Pres., VP, Div. Head, Section Head, Manager, Chief Engineer)
JT2	Engineering (non-mgmt.; i.e., civil, mechanical, planning, systems designer)
JT3	Scientific (non-mgmt.; i.e., chemist, biologist, hydrologist, analyst, geologist, hydrogeologist)
JT4	Marketing/Sales (non-mgmt.)
JT5	Faculty
JT6	Student
JT7	Attorney
JT8	Retired
JT9	Computer Scientist (GIS, modeling, data mgmt., etc.)
JT10	Elected/Appointed Official
JT11	Volunteer/Interested Citizen
JT12	Non-Profit
JT13	Other _____

EMPLOYER CODES

CF	Consulting Firm
EI	Educational Institution (faculty/staff)
ES	Educational Institution (student)
LR	Local/Regional Gov't. Agency
SI	State/Interstate Gov't. Agency
IN	Industry
LF	Law Firm
FG	Federal Government
RE	Retired
NP	Non-Profit Organization
TG	Tribal Government
OT	Other _____

EDUCATION CODES

HS	High School
AA	Associates
BA	Bachelor of Arts
BS	Bachelor of Science
MA	Master of Arts
MS	Master of Science
JD	Juris Doctor
PhD	Doctorate
OT	Other _____

WATER RESOURCES DISCIPLINE CODES

AG	Agronomy	GI	Geographic Information Systems
BI	Biology	HY	Hydrology
CH	Chemistry	LA	Law
EY	Ecology	LM	Limnology
EC	Economics	OE	Oceanography
ED	Education	PS	Political Science
EG	Engineering	OT	Other _____
FO	Forestry		
GR	Geography		
GE	Geology		

PLEASE NOTE YOUR SELECTED CODE NUMBERS FROM ABOVE

JOB TITLE CODE .....
EMPLOYER CODE .....
WATER RESOURCES DISCIPLINE CODE.....
EDUCATION CODE .....

SUBSCRIPTION RATES • WATER RESOURCES IMPACT

DOMESTIC $50.00
FOREIGN $60.00
FOREIGN AIRMAIL OPTION $30.00

CONTACT THE AWRA HQ OFFICE FOR ADDITIONAL INFORMATION OR TO SUBSCRIBE

Questions??? • Contact AWRA HQ
By Phone • (540) 687-8390
By Fax • (540) 687-8395
By E-Mail • info@awra.org
Check Out Our Home Page At www.awra.org

DATED MATERIAL ENCLOSED

AMERICAN WATER RESOURCES ASSOCIATION
4 West Federal St., P.O. Box 1626
Middleburg, VA 20118-1626 USA
Telephone: (540) 687-8390

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