The Water Report™

Water Rights, Water Quality & Water Solutions in the West

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# NEW WESTERN WATER AGENDA

**OPPORTUNITIES FOR ACTION IN AN ERA OF GROWTH AND CLIMATE CHANGE**

by Lawrence J. MacDonnell (Boulder, CO) and Denise D. Fort (Albuquerque, NM)

### Introduction

The Rocky Mountain West is a region of great contrasts — from alpine tundra to arid deserts, from red rock canyons to high plains prairies, from mountain forests to piñon-juniper woodlands. It contains the headwaters of many major rivers, including the Snake, the Green, the Colorado, the Arkansas and the Rio Grande. Yet it is largely semi-arid, with little rain; its moisture comes primarily as snow. Both stream flow and groundwater recharge rely heavily on runoff from snowmelt. This constrained distribution of water and the variability of its supply give inordinate importance to water use decisions.

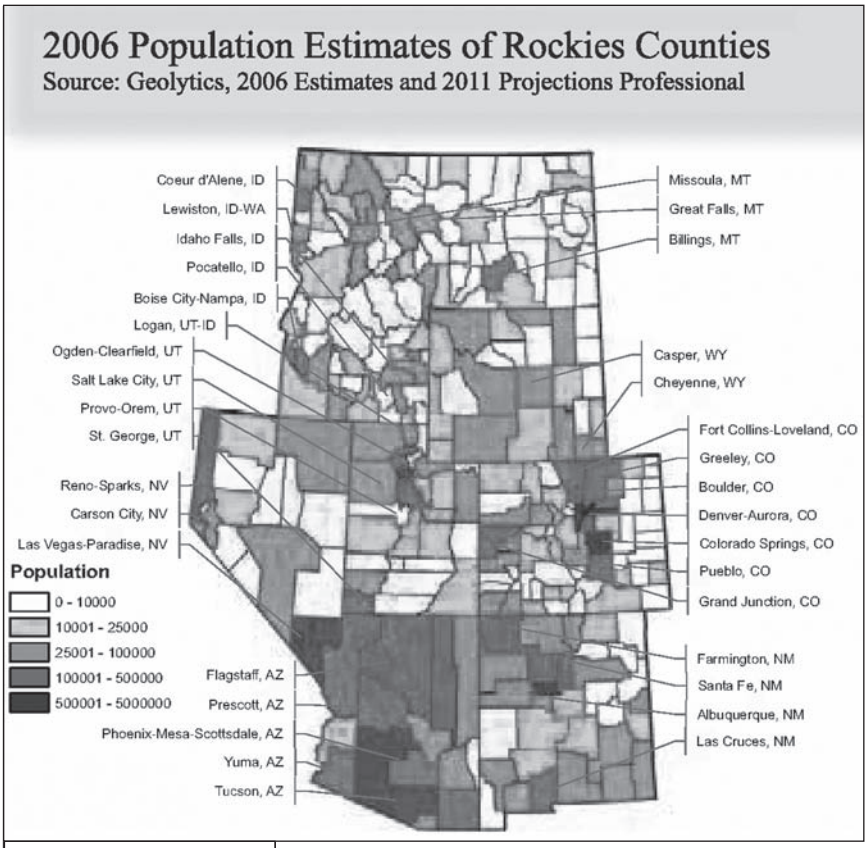
Human habitation of this region has always been tied to water. The Hohokam civilization, located in what is now central Arizona, developed highly sophisticated water collection systems to support its growth more than a thousand years ago. Settlement of this region as part of the US depended heavily on diversion of water for irrigated agriculture. Construction of large dams enabled storage and control of additional water. Conveyance systems involving large canals, pumps, tunnels and other structures allowed transport of water long distances, even between basins. Improved pumps made it possible to tap into groundwater aquifers, sometimes at considerable depth.

People in the American West are heavily concentrated in urban areas, in part because such areas have developed extensive systems of water supply to support local populations and economies. Given a big boost by war-related activities during the 1940s, the West has continued to grow at rates faster than other regions of the US. Forecasts suggest a continuation of this trend. This growing population will require more usable water.

Until relatively recently, it has been possible to identify sources of water not yet committed to other, legally-protected uses and develop these sources to meet new demands. Spring runoff could be stored and not interfere with summertime direct flow diversions. Groundwater could be withdrawn without impairing surface water uses or other groundwater uses.

It is increasingly difficult to find water sources that are not already committed to another use. Most rivers have been dammed to capture high flows and to recapture water for subsequent use. Groundwater has been tapped at rates well beyond the ability of aquifers to recharge, so water levels have dropped and associated surface water has declined. Alteration of aquatic systems for water development has caused extinction of species of fish, and others are in jeopardy.

Further complicating this picture is a changing global climate that is bringing warmer temperatures and is predicted to measurably change historical hydrologic patterns in the Rocky Mountain West. One likely consequence of global warming for the Rocky Mountain West is a reduction in the mountain snowpack that has been such an important source of water supply in this region. Another likely consequence is increased evaporation from land and water surfaces. (See International Panel on Climate Change (IPCC), *Climate Change 2007—Impacts, Adaptation and Vulnerability*). Almost certainly, the region needs to anticipate a net reduction in usable water supplies in the foreseeable future.




**Map Source:**
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260 North Polk Street,
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**Editors:** David Light
David Moon

**Phone:** 541/ 343-8504
**Cellular:** 541/ 517-5608
**Fax:** 541/ 683-8279
**email:**
thewaterreport@hotmail.com
**website:**
www.TheWaterReport.com

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Without doubt, the biggest water-related challenge facing the Rocky Mountain West is how to meet increasing water demands associated with a growing population with a fully committed but less secure water supply. Responding to this challenge will require careful management and use of this water supply. It also calls for a reconsideration of existing laws and institutions that guide and direct human uses of water. This article sets out a brief overview of the existing water policy framework, explores the changing role of water in the West and identifies key issues for action.

**The Legal, Institutional and Policy Framework**

To help make the region's limited surface water supplies securely available for particular human uses, customary rules developed in regard to water use. These rules recognized that actions taken to capture (or "appropriate") water and apply it to beneficial uses established a legally protected right to continue that use. Newly formed states in the West often embedded these basic rules, known as the Prior Appropriation Doctrine, into their constitutions as well as their laws.

Importantly, private rights to use water are not the same as ownership of the water itself. Every western state constitution includes a statement confirming that water is a public resource (similar to wildlife), and that the state is responsible for managing water on behalf of all citizens. When private water rights are established, they encompass the right to use water under particular conditions, most importantly the rule that one's use not harm other senior water right holders (a "senior right" is a right established by earlier beneficial use).

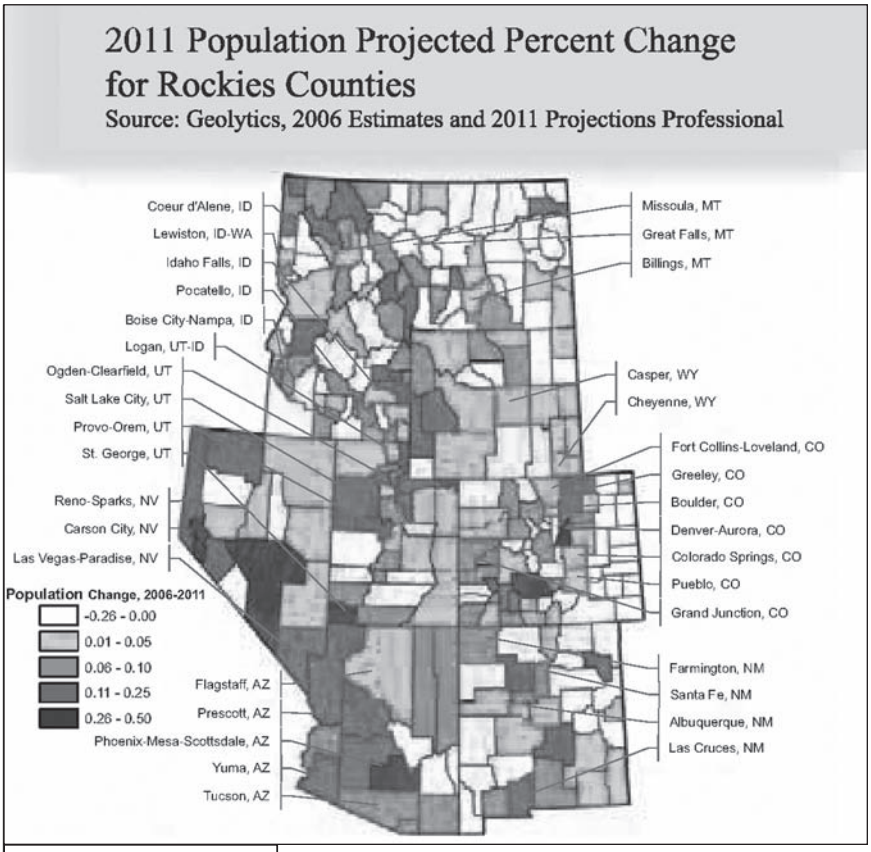
Led by Wyoming, states developed unique administrative and judicial systems to clarify rights to use water, to help sort out conflicts between users, and to enable consideration of broader interests. The earliest to put water from a particular source to use are given a priority over subsequent users (a doctrine referred to in shorthand as "first in time, first in right"). Only that amount of water reasonably necessary to accomplish the particular use is protected as a legally recognized "beneficial use." The use must continue on a regular basis to retain that protection — "use it or lose it" — but, so long as it does, the use may continue indefinitely with full legal protection according to its priority (date of first use). A use may be changed, but only after public review to ensure that other uses are not impaired by the change ( "no injury rule").

Rules governing use of groundwater developed independently of rules for surface water. In states such as Arizona, California, Nebraska and Texas, the right to pump groundwater depends on one's land ownership. Most other states in the region follow some form of prior appropriation under which the right is established by use, not by land ownership. Often, areas of intensive groundwater development are subject to special management rules to help manage conflicts between users.

Congressional and executive reservations of federal lands, such as for Indian reservations and national forests, are regarded as having an implied reservation of water necessary to accomplish the purposes of the reservation. These "reserved" water rights date from the creation of the reservation and exist outside of state law. Once quantified and put to use, they are administered in the same manner as other water rights. Other water-related needs for the federal public lands are addressed under state water law or through land management decisions.

Thus, with the exception of reserved water rights for tribes and federal lands, allocation of water for particular uses is governed under state law. The primary objective of state law has been to encourage water development. It is the users and their representative organizations such as mutual ditch companies, conservancy districts, and city water utilities that have done the developing. Collectively, they hold millions of individual water rights that determine how much water is stored behind dams and when that water is released, how much water is diverted from streams and where, and how much water is withdrawn from aquifers and when.




**Map Source:**
**State of the Rockies**
Website: www.coloradocollge.edu

The national role related to water in the American West historically concerned support for water development. Thus, under the Newlands Reclamation Act of 1902, the US Bureau of Reclamation (Reclamation) constructed large dams on many western rivers to store water to be used primarily for irrigated agriculture. Reclamation also installed hydropower facilities at many of these dams, using the revenues from the sale of electricity to help pay for the dams and other water delivery facilities. The US Army Corps of Engineers also constructed dams in the region, primarily for flood control purposes.

The national role has shifted from construction of new facilities to management of existing facilities. It has expanded into the areas of water quality regulation, wetlands management, and endangered species protection. Thus, the federal Clean Water Act (CWA) established a national-level program that regulates the discharge of pollutants into water from point sources and requires specified levels of treatment before such discharges may occur. States generally implement the program. The regulatory program has been expanded to include stormwater discharges within urban areas. Pollution from more diffuse sources such as agriculture is largely addressed through voluntary programs. CWA Section 404 regulates the development of wetlands that are considered to be waters of the US. The federal Endangered Species Act prohibits federal actions that would jeopardize protected plant and animal species. Thus, water-related activities that affect aquatic habitat used by protected species, which have some kind of federal "nexus," are regulated under this law.

To summarize, state water policy encourages the development and use of available water resources by awarding water rights for the use that are administered and protected under state law. Traditionally, federal water policy also emphasized support for water development but has transitioned to management and implementation of more recent national priorities such as water quality protection.

**Policy Shift**

**A Changing Climate for Water Policy in the West**

**Population Demands**

Political support for large-scale, federally supported development of western rivers peaked in the 1960s. Expansion of irrigated agriculture continued into the 1970s, based largely on development of groundwater resources. While irrigation still accounts for about 80 percent of all water withdrawals from surface and groundwater sources in this region, total withdrawals for this purpose have stabilized and even declined somewhat in recent years. Today, demands for new water supplies come primarily from population growth. In 1920, the population of the western states totaled 8 million. By 2000, the population had grown to 63 million. Additional water development remains an important component of meeting new demands, but that development has become greatly complicated by the reduction in federal funds, the increased attention to environmental concerns, the limited amount of undeveloped water still remaining, and the much more complex array of interests competing for use of this water. As discussed below, climate change adds still another enormous complication.

**Urban Shift**

As the West continues its transition from a largely extraction-based economy with scattered small to medium sized population centers, to a more diverse economy increasingly located in its growing urban areas, the role of its water resources is changing as well. Water once served as a tool to encourage settlement of western lands by making agricultural use of these lands possible. The result was the commitment of much of the region's water to irrigated agriculture. That remains true today. Irrigation is slowly but surely becoming more efficient as on-farm technology and management improve. Irrigated lands are, however, being urbanized. Cities are purchasing irrigation water rights and changing the use of the water. Water historically used to irrigate crops is shifting to supply urban growth and, in some cases, to restore depleted streamflows and wetlands.

## Water Policy

### Urban Distinctions

### Instream Flows

### Climate Change Projections from IPCC's Fourth Assessment

Urban water demands differ in important ways from irrigated agriculture. While watering lawns and gardens is essentially just urban irrigation (and accounts for much of urban water use), that part of urban demand needed to meet direct human needs for such things as drinking, washing, and cooking (household uses) is relatively modest. Water quality, however, is critical for those human needs. Moreover, household uses consume only a small portion of the water that is used (perhaps 10 percent); the rest returns to the system after treatment for other uses. Urban uses are year-round. Urban users generally can afford to pay the sometimes considerable costs associated with obtaining needed water supplies.

Moreover, urban residents are likely to have interests related to water that extend beyond its development for their direct use. They may be interested in recreational uses of rivers and lakes for fishing, boating, and swimming. They may want greenways along rivers that flow through their towns. They are likely to want water to stay in reservoirs during summer months for recreational uses. They may be concerned about restoring impaired waterways.

States have responded to these changing interests in a variety of ways. To address growing interest in maintaining flowing streams, most states have established instream flow protection programs. Typically, a state agency is charged with identifying river segments in which remaining flows still support a valuable fishery or other important public values. Some portion of these flows is then reserved from future appropriation and development to retain this public value. These programs do not affect pre-existing appropriations and uses of water from these rivers, but they can limit future water development.

At the national level, Congress enacted the Wild and Scenic Rivers Act in 1968, enabling designation of river segments that should not be dammed so that they can maintain their wild, scenic and recreational values. The 1973 Endangered Species Act also has had the effect of requiring maintenance of aquatic habitat essential for the survival of protected species.

The process of allowing water to shift from agricultural to urban use involves the voluntary purchase of the water rights and then state review of the proposed new use of the water to ensure no existing water rights are harmed. While the quantity of water moving from irrigation to urban uses is gradually increasing, the process has been slower than might be expected based solely on the comparative economic value of water in the two types of uses. In part, this can be explained by the technical complexities and costs of demonstrating "no harm" to other water rights. Perhaps more important is the reluctance of many irrigators and other rural residents to see water leave agriculture, especially given the sometimes limited economic alternatives in a rural agricultural area.

Urban water suppliers, faced with interests in preserving instream flows and challenges to moving agricultural water, have turned to groundwater development for new supplies and to water conservation as a means of reducing demand. Groundwater in most parts of the West is not a renewable source of supply. Large-scale pumping lowers the water table, making pumping more expensive, affecting other uses, and sometimes causing land subsidence.

Conservation, on the other hand, has proven to be an important means to reduce the need for additional water. Cities have had considerable success with voluntary programs that encourage household and commercial water use efficiency. (See Western Resource Advocates, *Smart Water*, 2003). Programs range from providing low water using fixtures (e.g., showerheads, toilets), metering water use and using rate structures that encourage conservation, and encouraging landscaping using native vegetation. (See Wolff & Hallstein, TWR #27 and Little & Gallup, TWR #30).

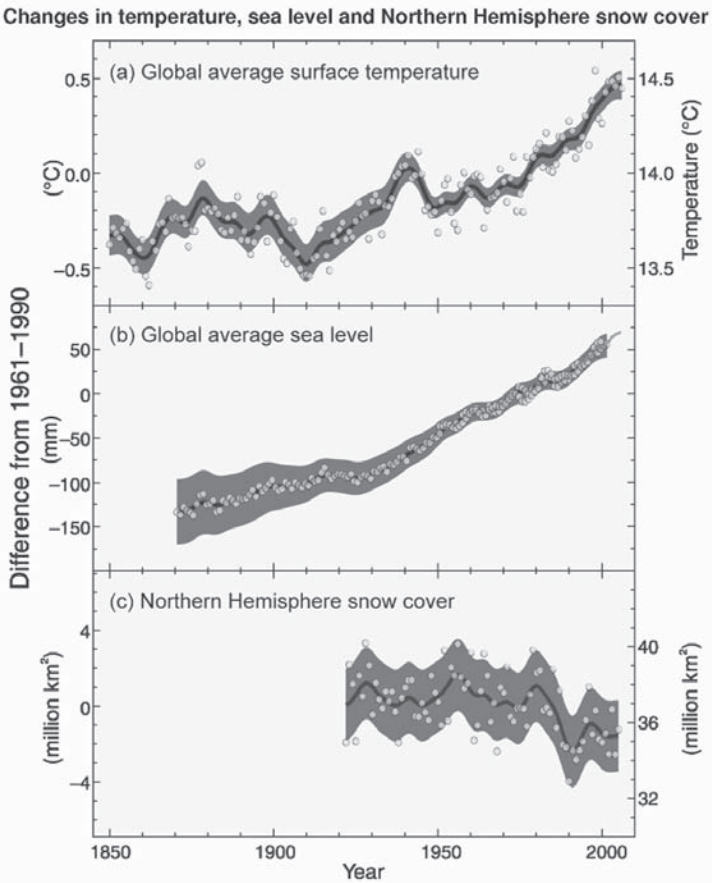



**Figure 1.1.** Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All differences are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c). {WGI FAQ 3.1 Figure 1, Figure 4.2 and Figure 5.13, Figure SPM.3}

## Water Policy

### Global Warming

### Impacts

### Reduced Supply

### New Realities

**The Challenges Ahead**

Heading the list of challenges is a relative newcomer: the likelihood of a reduced water supply in at least some parts of the region caused by global warming. The international scientific community has now agreed that the average temperature of the earth's surface is increasing. The rate of increase appears to be accelerating. Observed temperature increases in parts of the West are greater than for other parts of the country. Regional climate models suggest average temperature increases in this region of as little as 4º Fahrenheit or as much as 13º F by 2100.

At a minimum, such temperature increases will change some winter snows to rain, reducing the mountain snowpack. Temperature increases will cause snow to melt earlier in the spring. They will increase evaporation of water from land and water surfaces. Hydrologic patterns will change. Moisture may come more often in the form of intense storms that produce flooding than in winter snows. Regional climate models predict substantial reductions of water availability — potentially from 20 to 50 percent. (See, e.g., the *National Research Council* 2007 report on climate change impacts in the Colorado River Basin).

Water managers generally look to historic hydrological records to determine expected future water supplies. Tree ring analysis, which extends many centuries farther back in time, demonstrates a much greater amount of variability in water availability than historic records. Climate models are warning us to prepare for at least this amount of variability, including prolonged periods of what we would term severe drought.

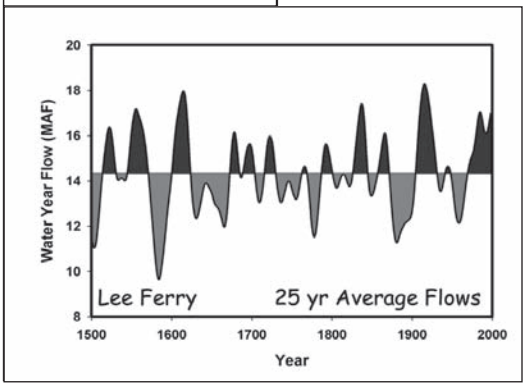
The implications of a reduced water supply in a region whose limited water resources already are overallocated are profound. We have been accustomed to meeting new demands by increasing supply. Water development has moved from source to source, taking control of previously unappropriated water to serve new uses. Public support of such development has often been necessary to keep the costs to users affordable. In the priority-based system of the West, the newest appropriations are the first to be curtailed in the event of shortage. Thus, the prospect of declining or even highly variable water availability places the reliability of new water development at risk. Yet population growth and its associated water demands are certain to continue.

Indeed, it is this heightened sense of scarcity during the past several decades that has elevated public attention of water policy and contributed to the splintering of the long-standing political consensus based on publicly supported water development to meet all demands. A new policy is needed that better reflects the realities of a changing West — with limited water development opportunities and growing water demands. There is concern about the future of those areas heavily dependent on irrigated agriculture as water inevitably moves to meet new demands. In addition, one must recognize the growing importance of economies drawing value from the scenic and recreational uses of rivers and their water. Another struggle comes from the water demands associated with the region's current and projected energy boom, including the production of large quantities of unwanted water associated with coalbed methane development (see Darin, TWR #3) and the significant amounts of water demanded for new coal-fired power plants. Finally, water policymakers are beginning to grapple with the implications of global warming for our water future. It's a complicated map, with no certain guideposts marking the path forward.

Consideration of the resource itself is a good place to begin. Western rivers and aquifers are important not only as a source from which to extract water for human use but for the many other valuable functions they serve. It is necessary to remove large quantities of water to support human activities, but healthy rivers that provide recreational benefits and support aquatic life are also desirable. Thus, a major thrust of water policy in recent decades has been to better integrate our water development activities with other hydrologic and ecologic functions.

These efforts represent a critical testing ground for our experiments with achieving sustainable uses of our natural resources. In moving ahead, it is important to have the active engagement of those holders of water rights in the source because their uses have such a substantial influence on what can be accomplished. Further, the science of river restoration has made great strides in recent years. Some of these efforts are driven by meeting the requirements of the Endangered Species Act. It should be noted that in those situations in which the water development community has been an active participant in developing measures to meet species needs, solutions have been found that have had little or no effect on existing water uses. Collaborative processes such as the *Upper Colorado Recovery Program* illustrate the potential for smarter river management to better accommodate our water use and river health interests (see Sibley, TWR #42).

**Variability of Streamflow at Lees Ferry (Colorado River)**
**Source: Woodhouse, C.A., S.T. Gray, and D.M. Meko. 2006**



## Water Policy

### Competing Interests

Decisions respecting uses of water are made in the first instance by water users and suppliers. State involvement has generally concerned protection of existing water uses. Today, government plays a more active role in water use decisions. With very limited amounts of unclaimed water still available, competing interests are greater. Public concerns beyond those represented by water rights holders are more likely to be involved, forcing broader consideration of proposed new or changed uses. In addition to the traditional state-level water allocation determination, water development may implicate local, state, and federal land use decisions as well as National Environmental Policy Act (NEPA) and other federal regulatory requirements.

**RECOMMENDATIONS**
**Western Water Policy for the 21st Century**

Future water needs can be met while achieving the long-term goal of maintaining viable streams and rivers in the region. The following recommendations suggest a reform agenda to achieve sustainable water management in the West.

**Strengthen and Expand Water Conservation and Efficiency**

### Conservation Expands

Water conservation is now widely accepted as a smart, cost-effective way of reducing the amount of water that would otherwise be needed to meet new demands. Many urban water providers are now leading the way forward in promoting conservation of water. As awareness of the region's water situation grows, users are demonstrating an increased willingness to be more careful in their own water uses. States have not yet evidenced much interest in getting involved in water conservation, aside from providing limited funding support and encouraging water utilities to pursue conservation. It seems likely this will change as water supplies become increasingly scarce. Agricultural conservation measures are an important component of this approach, but require a mixture of incentives and regulation to be accepted and effective.

**Integrate Water Planning with Growth Management and Land Use Planning**

### Sustainable Future

The 2006 Western Governors' Association report, *Water Needs and Strategies for a Sustainable Future,* stated:

> In the future, we may not be able to sustain unlimited growth and still maintain our current quality of life. Difficult political choices will be necessary regarding future economic and environmental uses of water and the best way to encourage the orderly transition to a new equilibrium. Among other things, these new realities require an evaluation of the relationship between water policies and growth.

### Water Planning

States have increasingly been using public water planning processes to address difficult questions of future water uses. A good example is the ten-year regional planning process used by Texas to develop a statewide water plan (see www.twdb.state.tx.us). Such processes can be used to develop better public information respecting existing water uses including instream flows and claims for future uses, the availability of water for additional development, and local, regional, and state interests respecting this water. Stakeholder involvement is used to educate the interested public and to search for areas of agreement. While cumbersome and time-consuming, such processes respond to contemporary demands for open public engagement in water matters.

States and political subdivisions should develop approaches to growth management planning that include adequate consideration of alternative sources of water to meet projected demands, plus the environmental and other impacts of obtaining this water. See Tarlock and Bates, TWR #43.

**Adopt Integrated Strategies at the Federal Level**

### Reclamation Role

Although this discussion focuses most directly on state water policy, the federal Bureau of Reclamation (Reclamation) will continue to be a key actor in the future of western water policy. While Reclamation has made considerable progress in making its projects more water-use efficient and more river friendly, either voluntarily in response to local interests or to bring project operations into compliance with legal obligations, many opportunities for improvement still remain.

### Operational Changes

In fact, the US Army Corps of Engineers has joined with The Nature Conservancy in a "sustainable rivers" initiative under which the Corps is changing the operation of many of its dams to achieve a more environmentally oriented flow regime. Congress should give Reclamation the legal authority (and the

## Water Policy

**Open Process**

funding) to participate in this initiative as well. The US Environmental Protection Agency, meanwhile, has supported watershed restoration across the western states.

In general, federal agencies can play a positive role in basins and watersheds when they facilitate cooperative management. Opening up decision-making processes will lessen tensions across governmental lines and draw on the strengths of each level of government.

**Improve the Process for Transferring Water from Agricultural to Urban and Environmental Uses**

**Transfers to Urban Use**

The influx of people into the Rocky Mountain West seems likely to continue. The region offers a quality of life unmatched in other parts of the country. The rates of growth have been greatest in the warmer, more arid parts of the region where water resources are more limited and where global warming appears most likely to further reduce water availability. These areas in particular face difficult challenges with maintaining their attractive qualities of life while accommodating increasing numbers of people.

**Colorado Conditions**

It is instructive to consider developments in Colorado law relating to transfers of water from agriculture to new uses. The intent of these provisions has been to establish statewide requirements representing the conditions under which such transfers would be allowed. Thus, approval of such transfers must include conditions requiring revegetation of the former cropland and control of noxious weeds (Colo. Rev. Stat. §37-92-305 (4.5)). A "transition mitigation payment" to local governments may be required to offset losses of property tax revenues for up to 30 years. If the transfer would result in a change of water quality exceeding legal limits, requirements for offsetting this negative effect would be imposed. As usual, the transfer must not impair other water rights.

**Tax Mitigation**

**Colorado Model**

Water transfers are common in Colorado but often controversial, especially if they involve large quantities of water. Through the legislative process, rules have been established that determine the conditions under which such transfers are permitted. Such clear guidance may also be useful for proposed new development involving large quantities of water. The Colorado approach provides a model for other states to consider in addressing the impacts of water transfers from agricultural to other uses.

**Agriculture Alternatives**

With millions of acre-feet of the region's water now used in irrigated agriculture, the trend towards transferring a portion of this water to new uses is certain to continue. Irrigated agriculture in the Rocky Mountain region remains important but, in many places, it is struggling to compete in an increasingly global agricultural economy. The water rights upon which this agriculture depends are very often the farmer's most valuable asset. National farm policies, the aging of those in the business, and changes in climate will make transitions away from farming the best alternative for some. However, alternatives to selling out and shutting down farming exist. They include making water rights available to other users only in dry years, temporarily leasing water rights and rotating lands irrigated to make portions of water rights available. Again, Colorado has now established special statutory rules enabling such arrangements (Colo. Rev. Stat. § 37-92-309; 37-92-305(3)).

**Expand and Enhance State Instream Flow Programs**

**Instream Restoration**

Most of the work to modernize our western water policy rests at the state level. For example, state instream flow programs have filled a critical gap in the prior appropriation system by providing a means of retaining some portion of the remaining unappropriated water instream. States vary widely in the extent to which they have used these programs to protect instream flows. Typically, a single rate of flow is protected — usually the minimum necessary to maintain a particular fishery. It is now time for these programs to take the next step and expand into restoration of rivers identified to be of state importance. In this capacity, they would not only work to protect existing waters with high public values, they would also seek to enhance and restore lost values in other important waters. Again, such efforts can only succeed with the participation and support of the water development community. Collaborative efforts are essential. Rocky Mountain state governors and legislatures should redouble their efforts to develop expanded stream protection programs.

**Promote Local Watershed Efforts**

**Watershed Entities**

Local watershed restoration efforts have become increasingly important in recent years. Typically, these are ad hoc processes that emerge in response to some identified local concern such as water quality impairment caused by abandoned mine wastes. While local, state and even federal agencies may be involved, these processes generally include a wide range of interested parties who often provide important leadership. Their emergence suggests there is a gap in existing institutions concerned with local watershed health. States should authorize formation of appropriate local watershed districts or similar entities to fill this gap.

## Water Policy

### Statutory Innovations

**Establish and Strengthen Statewide and Local Water Trusts**

It is also important to note the emergence of nonprofit "water trusts" and the development of programs by existing entities such as Trout Unlimited aimed at acquiring existing water rights and changing these rights to allow the associated water to remain in the stream. A few states have authorized a state agency to acquire water rights for this purpose as well. Current voluntary efforts to restore aquatic ecosystems deserve increased support and other states should be encouraged to establish such programs. While it may be possible to obtain water rights in some instances by donation if tax incentives are made available in a manner akin to those available for the donation of a conservation easement, funding for acquisition will ordinarily be required. States should encourage such efforts by nonprofits as well by allowing them to directly hold the donated or acquired water rights, rather than requiring these rights to be given to the state. [Editor's Note: The Oregon Water Trust is finding innovative ways to work with the agricultural community to restore instream flows. See Paulus, TWR #43].

If, as forecast, the future brings less water to this region, the pressure to forgo water for the environment will grow. In the past, water development decisions were made without consideration of the effects on physical and ecological values of rivers and aquifers. Now, these impacts are better understood and often conscious efforts are made (or required) to mitigate adverse effects. In some cases, actions have been taken that even reversed or reduced some of these effects to regain desired improvements.

### Supplemental Source

**Improve Groundwater Management Strategies**

Considering the supply uncertainties due to global warming, multiple approaches are clearly necessary to meet new water demands. Groundwater seems best suited to play a role where this source can be used primarily to supplement surface supplies in drought years or where withdrawals can be adequately replaced by recharge. States have struggled with administration of this critical resource, stymied in part by inadequate information about aquifer function, recharge and discharge, and the effects of pumping. Basing substantial new development on groundwater alone is not sustainable. Used wisely in conjunction with renewable surface water supplies, however, groundwater can provide an important part of the water supply mix.

**Summary and Concluding Thoughts**

Ongoing discussions of water matters in the Rocky Mountain region are occurring at a time in which rapid growth and a diversifying economy are redefining the region's needs and interests. The region's aridity has always been a defining characteristic. Slowly, the region is shifting its views about its water resources from one committed to maximum development to meet all demands to one supporting sustainable development that provides for changing human uses while maintaining functioning hydrologic systems wherever manageable. A marked conservation ethic is emerging. Urban water needs now dominate new demands for water supplies. Urban water providers increasingly have demonstrated their ability to meet these demands in a manner that is responsive to local economic concerns in the areas from which water is taken and to environmental concerns as well. The uncertainties about the effects of global warming on regional water resources add a whole new dimension to these changes.

### Key Strategies

KEY WATER SUPPLY AND MANAGEMENT STRATEGIES INCLUDE:

- SUSTAINABILITY: Support and promote ongoing efforts to make water development for direct human benefits more compatible with river health to help achieve the goal of sustainable water use
- EFFICIENCY: Encourage more efficient uses of water to help reduce the burden on our limited water sources
- FLEXIBILITY: Support the gradual voluntary reallocation of agricultural water to new urban and environmental uses in a manner that benefits the landscapes and communities from which the water is moved
- COLLABORATION: Encourage use of public processes at the watershed level that develop better information about present and desired future uses of water resources and that help inform decisions about water uses

Change does not come easily or quickly in water policy in the West. The literature is filled with proposals for reform. While in some form many of these proposals have gradually worked their way into federal and state policies, others have not. It is probably fair to say that none have found instant acclaim or quick adoption. The best means to achieve objectives in water vary from state to state, according to differences in law and institutions, and the relative availability of water in relation to demands and local politics.

There is an inherent conservatism in western water policy that reflects a preference for what exists despite enormous social and economic changes. The system works well for those who are its major

## Water Policy

### Resistance to Change

### Adaptation Required

beneficiaries — the owners of senior water rights. Understandably, they resist changes with unknown outcomes. Moreover the region's water resources are already committed to particular uses, and these use patterns are firmly established. Complicated relationships among users from the same source exist based on these uses. Even when agreement is reached on new policies on-the-ground change is often slow. New policies take time to work their way into the complex web established in relation to millions of individual water rights.

Nevertheless, policies must adapt to conditions or risk becoming obsolete. The West is a place undergoing dramatic change. Societal needs and interests related to water are markedly different than they were when the region was being settled. The West is the country's fastest growing region, contains most of the country's fastest growing cities, and now hosts more than 22 percent of the country's population. It faces the prospect of having less water when its resources are already fully allocated and demands are increasing. The status quo simply won't work.

**For Additional Information:** Lawrence J. MacDonnell, 303/ 440-0180 or email: L.MacDonnell@comcast.net; Denise Fort, 505/ 277-1094 or email: fort@law.unm.edu

**Lawrence J. MacDonnell** is an attorney and consultant in Boulder, Colorado. His practice focuses primarily on water resources and on ways to make development more environmentally compatible. He helped found the Colorado Watershed Network, the Colorado Watershed Assembly, and the Colorado Water Trust. He was the first director of the Natural Resources Law Center at the University of Colorado School of Law, a position he held for 11 years. MacDonnell's publications include books, law review articles, other journal articles, and research reports. He has given over 200 invited presentations and serves on several boards and committees related to water law.

**Denise Fort** has an extensive background in environmental and natural resources law based on her 25 years of practice, politics, and writing about policies. In 1995, she chaired the Western Water Policy Review Advisory Commission, a presidential panel appointed to review the role of the federal government in western water issues. She has also been active in the National Research Council, an arm of the National Academy of Sciences. Fort began her career as an environmental attorney with New Mexico Public Interest Research Group and Southwest Research and Information Center, then became a special assistant attorney general in the state's Taxation and Revenue Department. When she was 31, she was appointed Secretary of the New Mexico Department of Finance and Administration. She moved on to head the state Environmental Improvement Division. In 1987, Fort turned her focus to teaching, spending a year as a research associate at UNM's Institute of Public Policy and the UNM School of Law. She then served as executive director of Citizens for a Better Environment and as a consultant for the Natural Heritage Institute, both in California, before returning to New Mexico. In 1991, she became director of the Water Resources Administration Program at UNM and joined the law school faculty, focusing on environmental law and a broad range of natural resources topics.

### Priority Actions

**Western Progress Water Policy Agenda**

The preceding article was originally prepared as a briefing paper for participants in a western water policy roundtable convened by Western Progress, a non-partisan organization dedicated to advancing progressive solutions in the Rocky Mountain States. The roundtable discussion in October 2007 focused on opportunities for Western Progress to work with partners throughout the region to provide practical research and advocacy promoting sustainable water policies. Based on the roundtable discussion and further consultations, Western Progress has identified the following priority areas for action in the coming year: (1) evaluating and suggesting improvements to state instream flow programs; (2) promoting land use practices that fully integrate water resource considerations; (3) encouraging public and private water conservation and efficiency, including wastewater re-use; (4) advocating fair and complete resolution of Native American reserved water right negotiations; and (5) designing model legislation to facilitate water transfers with appropriate mitigation measures.

For more information on the Western Progress water policy agenda, contact:
Sarah Bates, Deputy Director for Policy & Outreach: 406-829-6608 or sbates@westernprogress.org

**Water Supply**

**Informed Decisions**

**Groundwater Planning**

# WATER RESOURCES SUPPLY

**DECISION SUPPORT SYSTEM DEVELOPMENT**

by David Jordan, PE; Cynthia Ardito, CGWP; Van Kelley, PG; (INTERA, Incorporated)

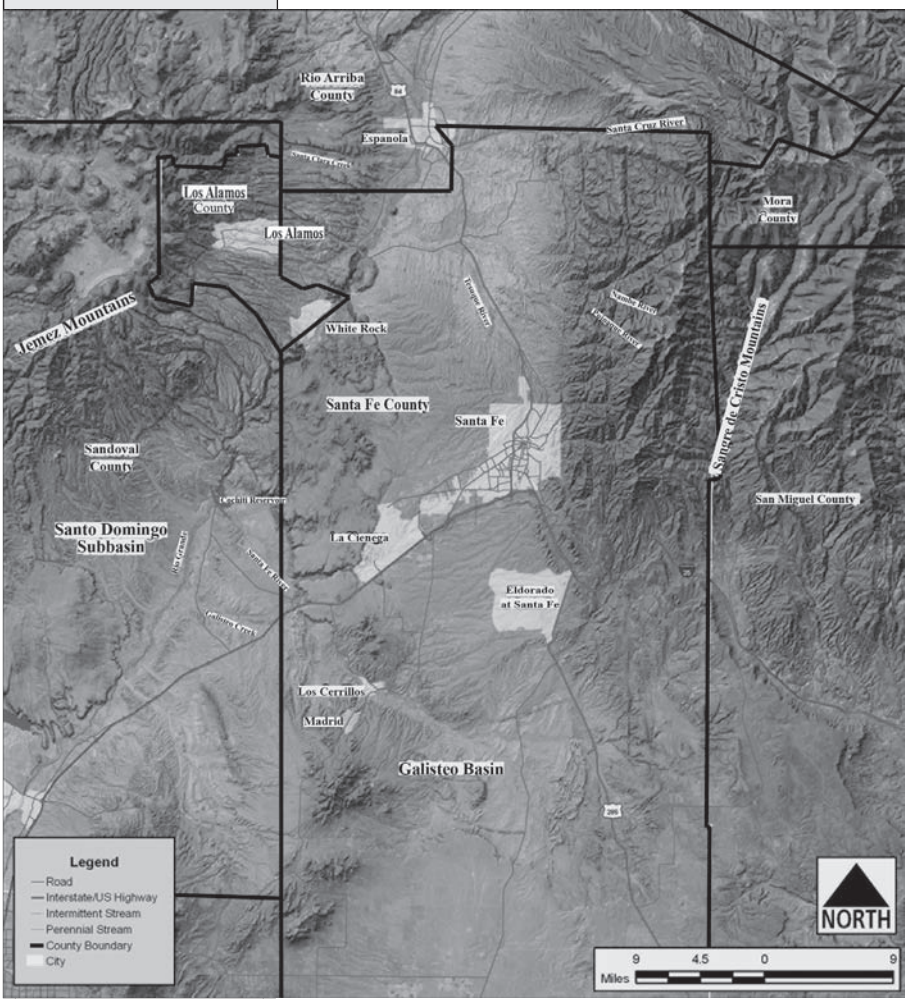
## Introduction

As is true for much of the American West, population growth in northern New Mexico continues to exceed the national average. With continued growth comes the need for additional sources of water supply. At this stage of development, reliable methods of determining what water sources are most available, appropriate, and sustainable are a necessary component of informed decision making. Given the ever-increasing level of pubic involvement, the ability to communicate this information in a readily understandable manner to diverse stakeholders is also of prime importance.

Santa Fe County, New Mexico (County) is experiencing rapid growth, particularly in the areas adjacent to the City of Santa Fe (City) — as development occurs on the City's outskirts. Currently, much of the County's water supply is purchased from the City and transported across the City's infrastructure to the County's distribution system. The County is seeking to expand its water supply portfolio through the sustainable development of groundwater resources. In order to strategically develop these resources in relation to existing infrastructure and groundwater availability — while also posing the least threat of adverse impact to existing water right holders, streams, and springs — the County has undertaken a comprehensive planning process.

INTERA's approach to developing its contribution to the County's groundwater development plan consisted of three phases. First, a detailed, three-dimensional geologic model was developed, in order to allow for a detailed understanding of the geologic and hydrogeologic features controlling water availability. Second, the geologic model, in conjunction with a variety of other hydrologic data, was used to develop a groundwater flow model using the United States Geologic Survey (USGS) MODFLOW code. Finally, a **g**eographic **i**nformation **s**ystem (GIS) based Decision Support System was developed which integrated information from a variety of sources, including the geologic model, to select potentially promising locations for supply wells. The selected potential well locations were simulated using the MODFLOW model and evaluated with respect to impacts on nearby wells, streams, and springs.

**Figure 1:**
**Santa Fe County & Española Basin**




Decision Support Systems (DSS) are very useful tools for evaluating water supply and water-resources issues. The need for such tools has become apparent as water resources managers try to balance the sometimes competing demands of numerous stakeholders and supply issues. Stakeholder issues range from developers needing additional supply for new housing developments, to endangered species that require minimum river or spring flows for their continued survival. Supply issues range widely, from basic issues such as groundwater availability to economic issues such as the infrastructure costs to bring water from a distant supply to the population that needs it. All of these issues, and many more, must be weighed against each other in order to develop water supply portfolios that maximize supply while minimizing adverse impacts to stakeholders and the environment. DSS provides a tool with which to evaluate these complex systems, perform "what-if" scenario analyses, and aid in the decision-making process to select an appropriate supply portfolio. DSS can also provide a way to resolve competing objectives, and apply weighting schemes to decision attributes so that stakeholders can select which decision attributes are most important to them.

**Water Supply**

The DSS developed for Santa Fe County is the primary focus of this article. However, the geologic and hydrogeologic setting as well as the development of an associated numerical model will also be briefly discussed.

**Geologic and Hydrogeologic Setting**

**Complex Geology**

Santa Fe County resides predominantly within the Española Basin, a tectonic basin filled with several thousand feet of alluvial fan deposits and some interbedded basalt and ash beds (see **Figure 1**). The Española Basin is bounded on the east and west by the Sangre de Cristo and Jemez Mountains, respectively. The northern boundary of this Basin nearly coincides with the northern boundary of the County with a narrow connection to the Northern San Louis Basin through the Embudo Channel. To the south the Española Basin's tertiary basin-fill sediments become thin and the Basin is bounded by the Cerrillos Intrusion. Also in the southern part of this Basin, a series of faults have uplifted this area relative to the Santo Domingo Basin to the south. The complex geology in the southern portion of the Española Basin led to numerous challenges in developing the geologic and groundwater flow models.

The Española Basin's fill deposits are composed primarily of the Santa Fe Group. The Santa Fe Group is comprised of the Tesuque, Ancha and Puye Formations. The Santa Fe Group sediments are considered to be in hydraulic connection with the underlying sedimentary units and volcanic units in the northern part of the Española Basin.

**Aquifer Recharge**

The Española Basin's tertiary aquifers generally receive recharge from the eastern Precambrian uplift (Sangre de Cristo Mountains) and to a lesser degree from the western Jemez volcanic uplift. Additional recharge may occur in higher elevation streams and arroyos and in areas of stream capture. Inflow to the Española Basin also occurs from the Embudo constriction and Chama Basin to the north. Some discharge occurs as underflow to the Santo Domingo Basin to the south, with the dominant discharge occurring to the Rio Grande and to ephemeral streams within the Basin. Stream depletions may occur as a result of groundwater withdrawal in the Basin and are an important metric to consider with respect to any new groundwater development in the region.

**Surface Flow Impacts**

**Structural Development of the Numerical Model**

The complexity of the geology within the model domain precludes a layer-aquifer approach to model layering. That is, it was not possible to represent each geologic layer as a discrete model layer. As a result, hydrologic model layers were developed to be of uniform thickness. The hydrologic model layers were tied to the pre-development water table surface (rather than the ground surface) in an attempt to avoid significant wet-dry oscillations during model convergence.

**Hydrologic Model Layers**

Layering thicknesses were based on a review of existing models of the region that had been previously developed by others. The model contains nine layers, with layer thicknesses (from top to bottom) of 100, 100, 275, 325, 475, 725, 1,000, 1,200, and 1,400 feet. Specifically, the top of layer 1 was based on the USGS **d**igital **e**levation **m**odel (DEM) elevation averaged within each model cell and the base of layer 1 was set at 100 feet beneath the pre-development surface. This resulted in model layer 1 having variable thickness but an initial (pre-development) saturated thickness of 100 feet.

**Model Grid**

The model grid was designed to have a grid size dimension ranging from one mile down to one-quarter mile. Consistent with the requirements of MODFLOW, the grids are rectilinear. The smallest grid size of one-quarter miles was selected based upon maintaining a reasonable size simulation grid. The smallest grid dimensions were applied in and around large pumping centers, such as the Buckman well field and the Santa Fe well field, and in areas of the model where improved resolution was desired. The model grid has 313,956 grid cells (9 layers, 228 rows, and 153 columns). The number of active grid cells is 286,308.

**Geologic Model Development**

**GIS-Based Methodology**

Geologic controls on the nature and extent of the principal aquifers within the Española Basin play an important role in the assessment of water resources. The primary focus for the development of the geologic model was to provide a rationale for assigning hydrologic properties to each model grid cell. Depositional environments and volcanic events provided the basis for selecting the **h**ydro**s**tratigraphic **u**nits (HSUs) included in a representative geologic column. This common geologic column of HSUs was used as the basis for defining the three-dimensional geologic model developed in the Groundwater Modeling System (GMS) software environment through the use of surface geology, available regional cross-sections, aeromagnetic data, and other geologic work in the region connecting the Española and Santa Domingo Basins. Using a GIS-based methodology to integrate the wide variety of geologic data, the previously-defined model grid and layering was then superimposed on the geologic model to begin the process of assigning the hydraulic parameters within the hydrologic model grid.

**Water Supply**

**Calibration**

**Predevelopment Model**

**DSS Attributes**

**Site Suitability**

**General Criteria**

**Specific Criteria**

**DSS Options**

**Calibration of the Numerical Model**

An accepted approach to calibration for groundwater modeling involves the process of producing agreement between water levels and aquifer discharge simulated in the model, and water levels and aquifer discharge measured in the field, through the adjustment of independent variables (typically hydraulic conductivity, storativity, and recharge). This approach usually includes performance of a sensitivity analysis, which entails re-simulating aquifer conditions under systematically varied calibrated parameters and stresses. Parameters that strongly change the simulated aquifer heads and discharges are viewed as important parameters to the calibration. The model calibration process was automated by using PEST, a calibration software package. Manual calibration was also performed to improve model fit to stream and spring discharge measurements.

The model was calibrated through a range of hydrological conditions. The steady-state predevelopment model represents a period of equilibrium where recharge and aquifer discharge through streams and cross-formational flow are in balance. Under these conditions, the amount of recharge to the aquifers is in equilibrium with the amount of discharge from the aquifer. The transient calibration period (1947 through 2004) represents a period of development when portions of the aquifers have been developed resulting in loss of storage, declining heads, and capture of discharge. Some of the aquifer discharge observed under steady-state predevelopment conditions is captured as a result of reduced base flow, decreased cross-formational flow, and decreased evapotranspiration.

A sensitivity analysis was performed on the steady-state calibrated model to determine the impact of changes in a calibrated parameter on the predictions of the calibrated model. A standard "one-off" sensitivity analysis was performed. This means that hydraulic parameters or stresses were adjusted from their calibrated "base case" values one by one while all other hydraulic parameters were unperturbed.

**Development of the Decision Support System**

For this project, INTERA developed a DSS to determine the best potential supply well locations based on attributes which define desirable locations for these wells. The DSS was programmed into a GIS and thus provided a structured and reproducible decision framework that could be readily explained to stakeholders and justified by County decision-makers. The DSS was used in conjunction with the regional groundwater availability model to quantitatively evaluate the potential supply-well locations identified during the DSS screening.

The DSS was based on a site-suitability analysis to identify promising areas for supply-well locations based on a variety of criteria such as the locations of existing supply wells, streams, springs, existing infrastructure, and population centers, as well as areas of favorable geology. Land ownership was also considered in the analysis, because there are a number of areas such as tribal lands, National Park Service (NPS) property, and US Department of Energy property (DOE) where it is not possible to site wells.

The DSS was based on four general decision criteria, including:

- Development of a sustainable water supply
- Minimizing impact to existing users
- Minimizing impact to streams and springs
- Cost

Each of the general decision criteria was then broken down into specific decision criteria that were used to build the DSS.

The DSS specific criteria included:

- Areas of favorable hydrogeology (high transmissivity)
- Proximity to existing population (close proximity is desirable)
- Proximity to existing and proposed water conveyance infrastructure (close proximity is desirable)
- Proximity to existing supply wells and large water right holders (close proximity is not desirable)
- Proximity to existing domestic wells (close proximity is not desirable)
- Proximity to streams (close proximity is not desirable)
- Proximity to springs (close proximity is not desirable)
- Proximity to areas of existing groundwater contamination (close proximity is not desirable)
- Property ownership

Each decision criterion was represented as a grid, or matrix, of suitability scores that covered the study area. At each grid cell, a normalized suitability score between 0 and 100 was assigned, with 100 indicating the most suitable areas based on the specific suitability criterion of interest.

For this study a "neutral" weighting scheme was used — i.e. all of the site suitability criteria were treated equally. The DSS, however, may be re-run using alternative weighting schemes in order to evaluate different perspectives and scenarios. The DSS combined with the regional model provides the County with a solid set of decision-making tools for analyzing and managing future water supply alternatives.

**Water Supply**

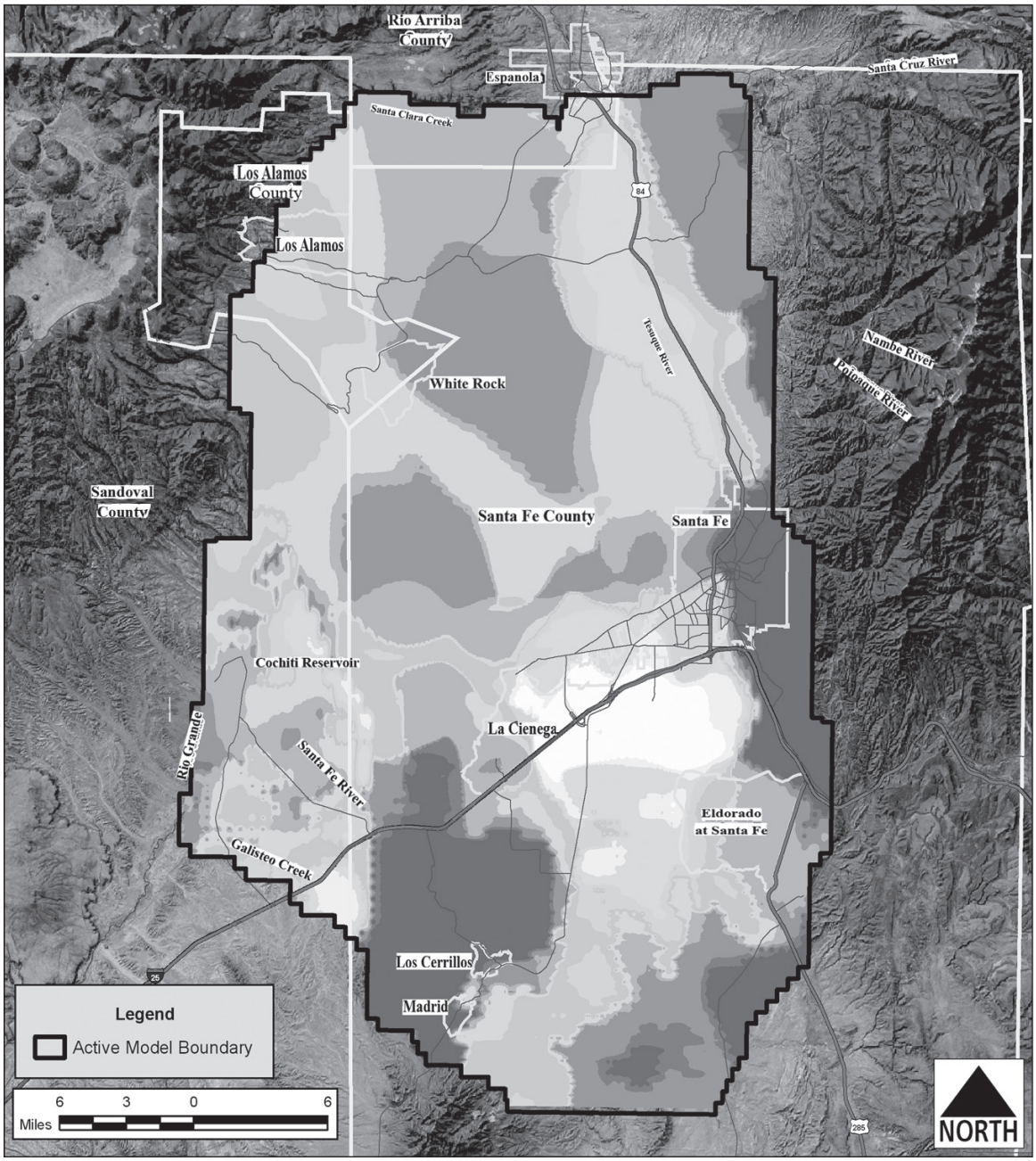



**Figure 2: Areas of Favorable Hydrogeology**

**Aquifer Thickness**

**Areas of Favorable Hydrogeology**

Areas of favorable hydrogeology were identified in four target aquifers: the Ancha, Espinaso, Galisteo, and Tesuque. The geologic model developed for this project was used to develop a grid of aquifer thickness for each target aquifer. Multiplying the thickness of the aquifer at each grid cell by the target aquifer's hydraulic conductivity (an average was assumed for each aquifer) provided transmissivity grids. The transmissivity grids for each aquifer were weighted with respect to relative depth. The deepest portions of any aquifer (relative to the depth of the tops of all four aquifers) were assigned a 0 weighting, and the shallowest portions were assigned a weighting of 1. The intervening portions were assigned a value in between. The logarithm of the depth-weighted transmissivity score at each grid cell was then calculated to compress the values into a smaller range of values, since the depth-weighted transmissivity varied over several orders of magnitude. Finally, the log depth-weighted transmissivities of all four target aquifers were summed together to produce a matrix of composite depth-weighted transmissivities. The composite normalized values are presented in **Figure 2**. Colors in this map's original grids represented relative thickness, ranging from red (dark), indicating the absence of the aquifer, to green (light), indicating the presence of the aquifer at its thickest. [Editor's note: These colors have been greyscaled from dark-to-light for TWR publication; some distortion has occurred.]

## Water Supply

### Population

**Proximity to Existing Population**

Population data were derived from United States Census Bureau block group data for 2004. Blocks were selected which had a 2004 population greater than 300 people/square mile. These areas were used to represent the most densely-populated areas in Santa Fe County. The shortest distance to any block group was calculated using a GIS-based method for each grid cell. The values were then normalized to a suitability score from 0 (farthest) to 100 (closest), since from a cost perspective it is desirable to develop water supplies that are as near as possible to existing populated areas.

### Infrastructure Proximity

**Proximity to Existing and Proposed County Water Service Areas**

This suitability score for infrastructure was developed to evaluate proximity to existing and proposed infrastructure that could be used to convey water from County supply wells. Areas that are closest to existing or proposed County infrastructure received the highest score since proximity to infrastructure minimizes the cost of building, operating, and maintaining additional conveyance infrastructure.

The suitability score for infrastructure was calculated based on the normalized distance to infrastructure. Using a scale of 0 through 100, areas that are closer to infrastructure were assigned a higher score (less costly and hence more suitable), while areas that are farther away from infrastructure were assigned a lower score (more costly and hence less suitable).

### Supply Wells

**Proximity to Existing Supply Wells and Large Water Right Holders**

The proximity to existing supply wells and large water right holders was evaluated in order to maximize the distance to any of these features when selecting proposed locations for County supply wells. It is desirable to maximize the distance to other existing supply wells and large water right holders in order to minimize the potential for impairment or perceived impairment of these wells.

The wells selected for this portion of the analysis included:

- Municipal supply wells
- Community water systems
- Large irrigation wells (with water rights equal or greater than 10 acre-feet/year)

Areas close to existing supply wells and large water right holders were assigned a low score, while areas farthest from existing supply wells and water right holders were assigned the highest score.

### Domestic Wells

**Proximity to Existing Domestic Wells**

Data on existing domestic wells was taken from the New Mexico Office of the State Engineer WATERS database, which is a database of known water rights within New Mexico. While the WATERS database is far from complete, it provides the best available data set with which to identify the locations of domestic wells. Suitability scoring for this criterion is based on proximity to domestic wells — it is desirable to be as far as possible from any domestic wells when siting a production well location. As **Figure 3** shows, areas close to domestic wells were assigned a low suitability score, while areas distant from domestic wells were assigned a high suitability score.

### Stream Depletion

**Proximity to Streams**

The main perennial streams in the study area were used to develop a proximity-based suitability score based on distance to the nearest stream. The streams that were considered were the Rio Grande, the Santa Fe River, the Pojoaque River, the Tesuque River, the Nambe River, Santa Clara Creek, and Galisteo Creek. The suitability score for proximity to streams was developed based on the desirability of installing any production well as far as possible from any stream in order to minimize the risk of stream depletion. Thus, a normalized suitability score was developed based on proximity to any stream, with proximal areas scoring low, and distal areas scoring high.

### Springs

**Proximity to Springs**

Similar to the suitability scoring for streams, the suitability scoring for springs was assigned to score highly those potential well sites that are as far as possible from any known springs so as to minimize spring depletions. For site suitability, low scores were assigned to areas near springs, and high scores assigned to those areas that are as far as possible away from any existing springs.

### Groundwater Contamination

**Proximity to Areas of Existing Groundwater Contamination**

Locations for known groundwater contamination sites were taken from a previous study, which presented locations throughout Santa Fe County where known contaminant releases to groundwater had occurred. These were typically leaking underground storage tank and other similar sites. Areas close to known ground water contamination sites were scored low, while areas farthest from groundwater contamination sites were scored the highest. While this study did not consider them due to lack of data, the same methodology could be used to evaluate naturally-occurring groundwater constituents of concern, such as arsenic.

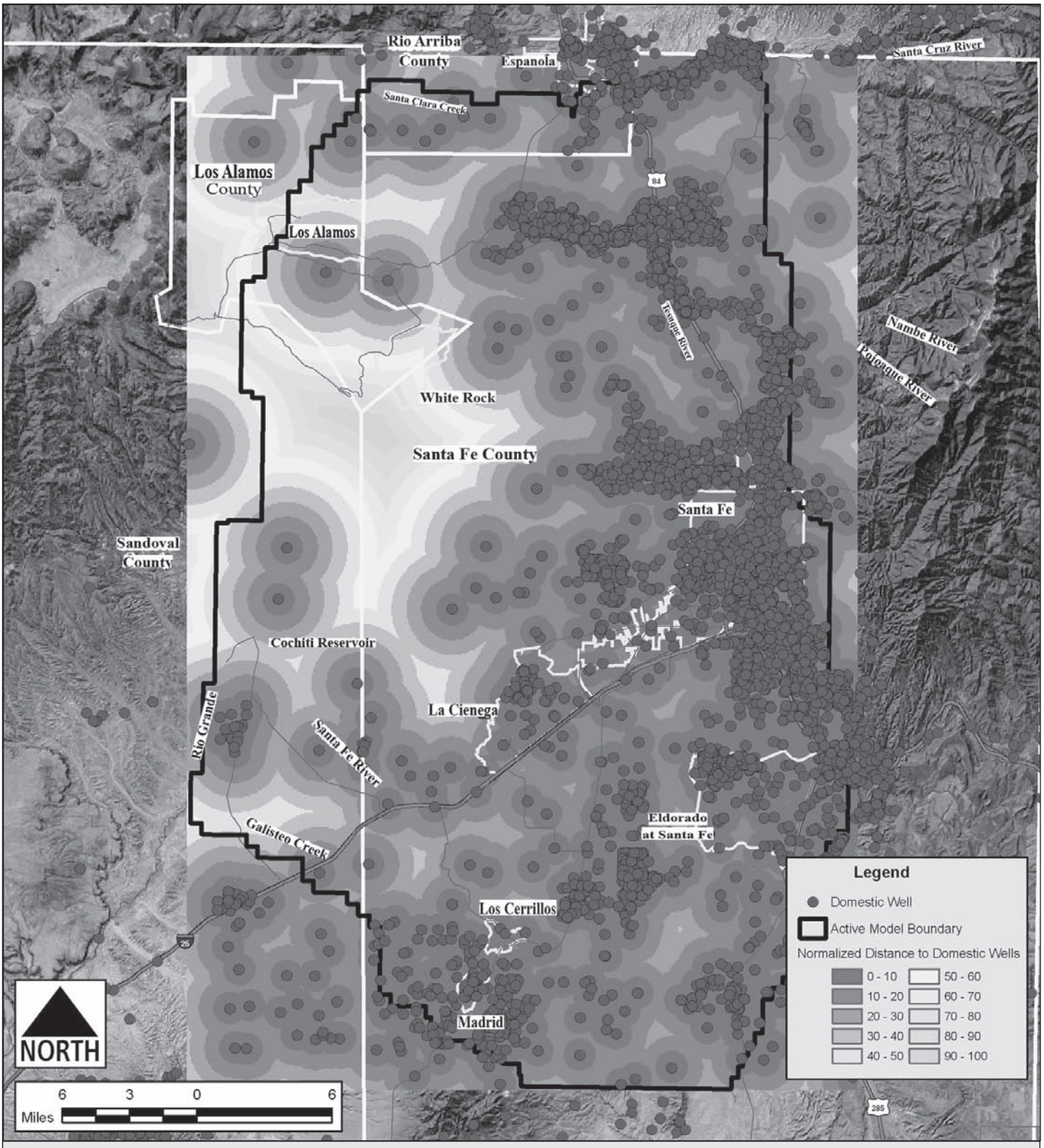



**Figure 3: Proximity to Existing Domestic Wells & Suitability Scores**

**Development of Final DSS Suitability Map**

The final suitability scoring map was developed by combining DSS layers 1 through 8 (property ownership was considered separately, as discussed below), giving each an equal weighting. At each grid cell on the map, the site suitability scores for layers 1 through 8 were averaged. Due to the averaging process, the range of the suitability scores was diminished, from a possible range of 0 through 100, to a range of approximately 35 through 100. The final combined result is presented in **Figure 4 (page 17)**.

## Water Supply

### Suitability Threshold

For the purpose of identifying promising potential well sites, a site suitability score threshold of 75 or greater was selected to indicate areas of good potential based on the DSS suitability criteria. These areas were then compared against property ownership. DOE, NPS, and tribal lands were removed from further consideration. Finally, four potential well locations were sited in the approximate centroid of each of the four areas that were identified as a result of the screening process. These locations are also presented on Figure 4.

As noted, while this study weighted all of the site suitability criteria equally, the DSS may be re-run using alternative weighting schemes in order to evaluate different stakeholder perspectives.

### Evaluation of Impacts

**Evaluation of Potential Locations Using the MODFLOW Model**

Once four potential well locations were selected based on the DSS suitability analysis, the groundwater flow model was used to simulate a pumping well at each location. Each hypothetical well was pumped at 100 acre-feet/year (approximately 60 gallons per minute) continuously for 40 years, and the potential pumping effect was evaluated against three metrics: (1) drawdown at the nearest supply well; (2) spring depletion; and (3) stream depletion. The results of the simulated pumping allowed relative ranking of the proposed locations with respect to potential impacts to other wells and surface water. In addition, an engineering analysis of relative infrastructure costs for the four proposed locations was also completed, and this information was also available to assist the County in its ranking process.

### DSS Benefits

**Stakeholder Outreach**

Once completed, the results of the DSS and the groundwater modeling were presented in a series of public meetings held throughout the County. The approach was well-accepted by stakeholders because they could understand and appreciate both that all of the available data had been used in the decision-making process, as well as the fact that the decision-making process itself (the DSS) was scientifically-based, transparent, and unbiased. In addition, the graphical natural of the DSS site suitability scoring, and the fact that it was based primarily on proximity, was straightforward for the lay audience to understand. In the end, the County was able to successfully communicate to the stakeholders that the potential supply-well locations selected during this process were, indeed, good candidate sites that had been selected based on careful and equitable consideration of all of the available data.

**For Additional Information:** David Jordan, 505/ 246-1600 x1240 or email: djordan@intera.com

**Santa Fe County website:** Additional information regarding the DSS, including original color maps, is available on the Santa Fe County website: www.santafecounty.org (select “Departments” >> “Water” (flow chart) “Intera Hydrologic Model - ‘PowerPoint Presentation’ ”

**David Jordan** is a Senior Hydrogelogist with INTERA in Albuquerque with over 18 years of experience in environmental and water resources consulting. He holds a BS degree in Geophysics from Virginia Tech, and an MS degree in geophysics from New Mexico Tech. He is also a registered Professional Engineer in New Mexico. For INTERA, Mr. Jordan applies quantitative analytical tools such as numerical models, GIS, and remote sensing to solve regional water-resources problems. He has applied GIS to numerous groundwater modeling studies, water quality modeling studies, and water availability studies for the purpose of data management and analysis. His recent work includes the use of Landsat imagery to evaluate historical and present-day irrigated acreages in New Mexico, as well as to estimate crop consumptive water use.

**Van Kelley, P.G.,** has 22 years of experience in the fields of geology and hydrogeology specializing in fluid flow and transport modeling, regulatory review, and project management. Since 2000, he has focused on the water resources market. He has managed and/or provided senior technical guidance on projects involving the development and application of groundwater availability models for major and minor aquifers across Texas. He has also developed water availability models to support water resource planning and management in the Lower Colorado River Basin of Texas and the Espanola Basin of New Mexico. Over the last 15 years, Mr. Kelley has served as Project Manager for several large flow and transport modeling projects, including groundwater modeling contracts to support environmental restoration activities at US Department of Energy facilities and work involving fluid flow analyses to design shaft seal systems for a deep geologic repository for radioactive waste. Mr. Kelley also serves as INTERA’s Water Resource Division Manager focused on the Texas and southwestern US market and is responsible for a staff of 24 geoscientists and engineers.

**Cynthia Ardito’s** professional experience includes 23 years of water quality and water resource evaluations, environmental investigations, and environmental remediations. She has an MS degree from New Mexico Tech where she focused on ground water chemistry and hydrology. She has worked on surface water and groundwater issues in New Mexico since 1984. One of her technical focus areas is water quality evaluations to determine the nature and extent of ground water contamination, particularly at sites that have been contaminated by chlorinated solvents and petroleum products. She has worked throughout New Mexico at Brownfields, hazardous waste and superfund sites, leaking underground storage tank sites, mine tailings disposal sites, heap leach facilities, industrial waste lagoons, and landfills where she has been the technical lead for designing field investigations and remedial action systems. Another focus for Ms. Ardito is water resource evaluations, where she has provided expert support in the areas of hydrogeologic conceptual model development, aquifer test design and evaluations of potential water resource impacts of groundwater pumping.

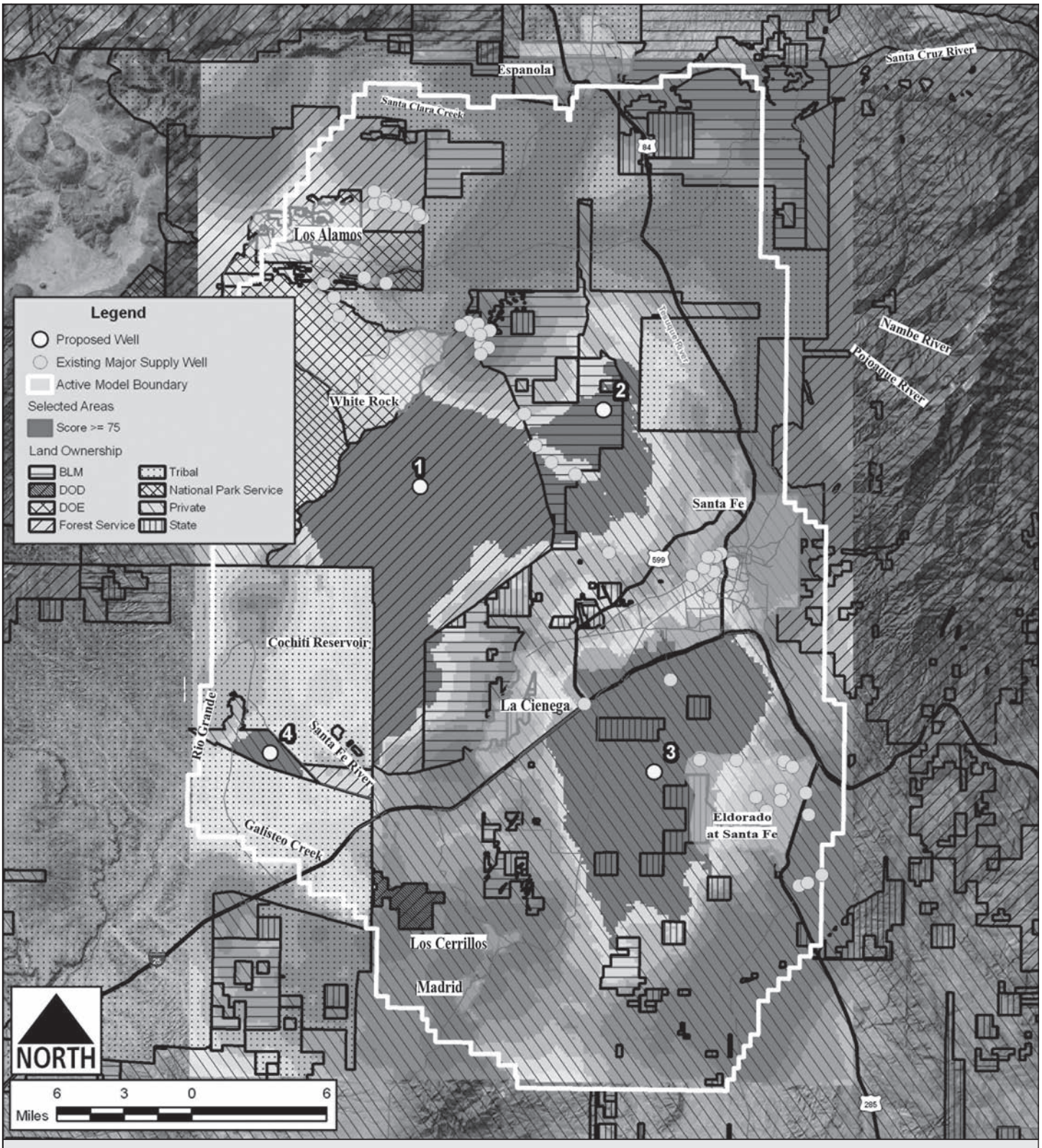



**Figure 4: Final Decision Support System Suitability Map**

Urban/Rural Water

Conflicts in Use

Groundwater "Mining"

# URBAN & RURAL WATER SUPPLIES

**COLORADO RESEARCH PURSUES WIN-WIN SCENARIO**

by Bruce A. Lytle, P.E., President, Lytle Water Solutions, LLC
Neil Hansen, Ph.D., Associate Professor of Soil Science, Colorado State University
Frank P. Jaeger, District Manager, Parker Water and Sanitation District
Jim Nikkel, P.E., Assistant District Manager, Parker Water and Sanitation District

## INTRODUCTION

Major areas of population along the Front Range of Colorado are primarily located in the South Platte River drainage basin, including the Denver area north to Fort Collins. The South Platte River basin downstream of Denver is also a major agricultural area, with approximately 1,000,000 acres (ac) currently in irrigated farming. Here, as elsewhere in the West, the conflict between agricultural water use and municipal water demands is demanding attention. While most of Colorado's population lives in urban areas, agricultural water use accounts for approximately 85 percent of total water use in the state. It is evident that changes from current water use and allocation will be necessary to accommodate changing water demands.

According to the 2004 Statewide Water Supply Initiative study (SWSI) the population in the South Platte River Basin is expected to grow by 1.9 million by the year 2030. A substantial portion of recent growth along the Front Range has relied on "mining" (i.e. depleting an aquifer in excess of recharge capabilities) the water resources of the Denver Basin — a large groundwater basin which covers approximately 6,700 square miles and has as much as 200,000,000 **a**cre-**f**eet (AF) of water in storage (Figure 1). Moreover, development of the Denver Basin resources has not been uniform. Most of the development is occurring in the greater Denver metropolitan area. Despite the large storage capacity of Denver Basin aquifers, due to the density of development municipal water suppliers are experiencing significant water level declines at their wells. This has led to decreased well productivity. As a result, municipal water suppliers are in need of replacement water supplies to meet existing demands in addition to securing water to provide for future growth.

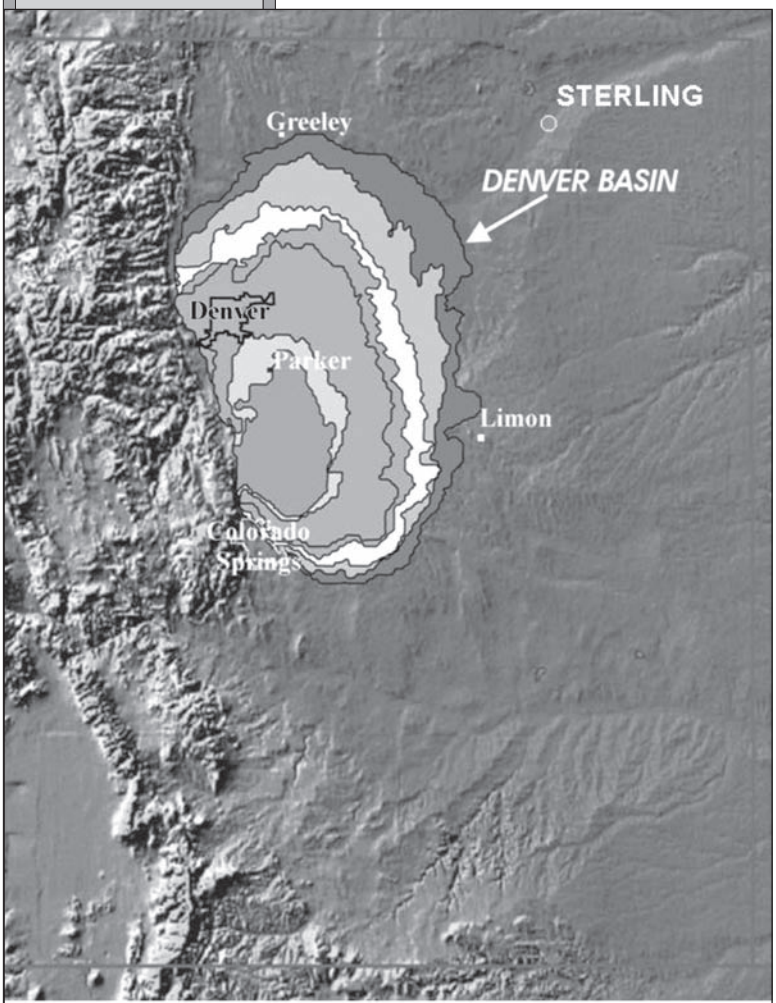



Fig. 1 - Denver Basin and Project Research Locations

Based on its population growth projections, the SWSI identified potential water supply shortfalls by the year 2030. One of the alternatives identified to address these shortfalls was the retirement of irrigated agricultural lands. In the South Platte River basin alone, SWSI estimated that approximately 130,000 to 260,000 acres of irrigated land would need to be retired to help meet projected water demands due to growth. This estimation was based on the traditional "buy and dry" water transfer concept, whereby municipalities purchase the water from the agricultural lands and all farming dependent on that water ceases.

The Parker Water and Sanitation District (PWSD), one of the Denver metropolitan area water suppliers that is primarily dependent on Denver Basin aquifer water, wishes to determine whether there are viable alternatives to the agricultural dry-up approach. PWSD is interested in alternatives which would benefit urban interests by providing much-needed water supplies while also maintaining the rural economies on the eastern plains of Colorado. To this end, PWSD approached Colorado State University (CSU), the agricultural land grant university in Colorado. The result of this initiative is a collaborative three-year research program, the *Lower South Platte River Irrigation and Research Project* (Project), which commenced in 2007 and will continue through 2009 with current funding. This article briefly describes this Project and its initial findings.

Urban/Rural Water

Project Components

"Buy and Dry"

Negative Impacts

Management Techniques

Optimize Crop Yields

On-Farm Research

Salinity

## INNOVATIVE ALTERNATIVES TO AGRICULTURAL DRY-UP

There are two major components to the Project: 1) research related to crop irrigation management; and 2) institutional issues associated with developing a structure by which these types of crop irrigation management techniques can be employed within the Colorado water rights system. In conjunction with the crop research described below, the Project will propose administrative procedures and/or draft legislation appropriate to promote this win-win scenario for rural and urban interests.

Agricultural-to-municipal water transfer has historically followed the "buy and dry" model. There are two principal reasons why the "buy and dry" concept has been used almost exclusively. First, farmers have been willing to sell all of the water rights used to irrigate their land and totally cease farming. Second, the dry-up of lands is the simplest way to administer a change in water rights. State water rights administrators can simply observe that the land is no longer being irrigated and, therefore, this water is available for transfer to municipal interests.

However, history has also shown that "buy and dry" creates environmental issues, e.g., proliferation of noxious weeds, erosion, and wind-blown sediments. In addition, there are negative economic impacts to rural communities when large tracts of farmland are taken out of production. Associated effects include the loss of business to farm implement dealers, seed dealers, fertilizer dealers, and other local businesses. Because of these factors, PWSD and CSU looked for alternatives that would make water available for transfer while also maintaining agriculture and rural economies.

Three crop irrigation management techniques are being evaluated:

- limited irrigation, where irrigation is applied in lesser amounts than full **e**vapo**t**ranspiration (ET) demand by timing irrigations to critical crop growth stages and managing crop water stress
- partial season irrigation, where perennial forage crops receive a full water supply for part of the season, then irrigation ceases
- rotational fallowing, whereby lands are alternatively taken out of, and then put into, production on either a 2-year or a 3-year rotation

Crop irrigation management and rotational fallowing are hardly new concepts. However, the unique strategy of this research-oriented approach is to optimize crop yields (and therefore value) while also optimizing water savings. The Project is also working with farmers to insure that the techniques developed are practical and capable of large-scale application as well as theoretically defensible.

## RESEARCH PROJECT

The first year of the Project was completed during the 2007 irrigation season. There have been two distinct areas of research set up by CSU: 1) three field-scale farm demonstrations conducted in cooperation with the farmers on their lands; and 2) a plot-scale irrigation research farm. At the plot-scale site, farmland has been broken up into numerous small irrigation plots which are operated by CSU personnel.

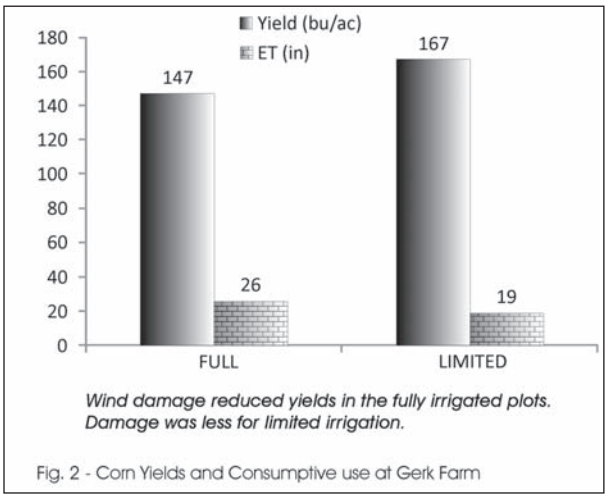
As noted, the techniques being developed by CSU are intended to be implemented by farmers on a large-scale basis. For this reason, while CSU directed irrigation practices at the field-scale farm demonstrations, the farmers actually implemented the techniques. The Project recognizes that these innovative techniques must prove practical to insure that the farmers can, and will, implement them on a long-term basis.

The three 2007 on-farm demonstrations include:

Rafaelli Farm — Gypsum amendments to soil to address salinity issues. As a result of high water tables and marginal irrigation water quality, some soils in the South Platte River basin are affected by soil salinity. Soil salinity reduces crop productivity and water use efficiency. In addition, sodicity (i.e., the amount of sodium in the irrigation water) can reduce water infiltration and degrade soil structure. If salinity and sodicity issues can be minimized, crop yields and water use efficiency can be improved. A common method for reducing sodicity is applying gypsum to the soil in combination with leaching. The calcium cations from the gypsum replace sodium cations on the soil, which then need to be leached from the root zone. For this study, soils on the Rafaelli farm were tested and found to have a moderate salinity level typical of a moderately sodium-affected soil. Two application rates of gypsum were added to the soils at the Rafaelli Farm to evaluate if gypsum was increasing the permeability of the soil and, therefore, reducing the effects of salinity. The preliminary results from the 2007 irrigation season indicate that crop yields were not materially affected by these gypsum amendments. It is expected that this study will continue in the 2008 irrigation season to assess the potential delayed effects of the gypsum amendments.

## Urban/Rural Water




*Wind damage reduced yields in the fully irrigated plots. Damage was less for limited irrigation.*

Fig. 2 - Corn Yields and Consumptive use at Gerk Farm

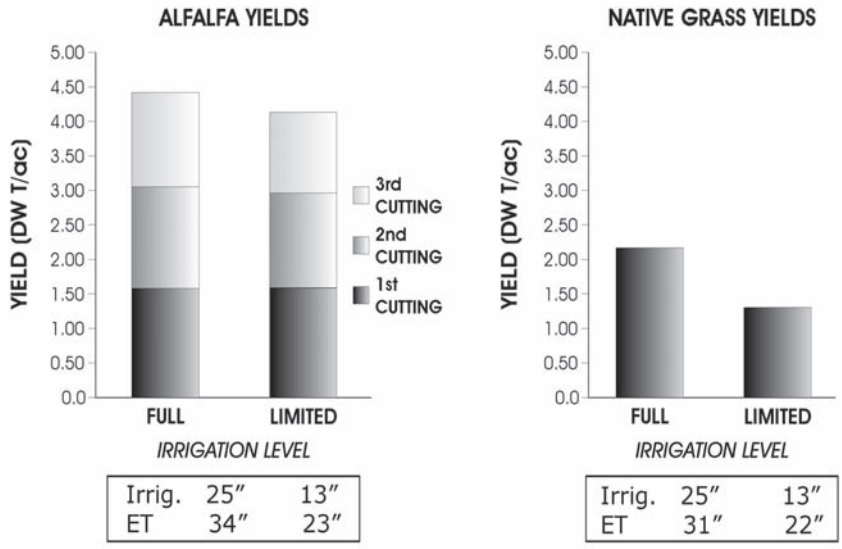



Fig. 3 - Alfalfa and Native Grass Hay Yields and Consumptive Use with Full and Partial Season Irrigation

Fig. 4 - Water Supply for Linear Sprinkler

### Gerk Farm

LIMITED CORN IRRIGATION — CENTER PIVOT

The Gerk Farm operated a wiper pivot sprinkler placed in the cornfield as part of its normal operations. To evaluate the effects of limited irrigation, part of the pivot continued with full irrigation of the corn, while a portion of the pivot had water shut off during three irrigation events that occurred during vegetative corn growth periods prior to the corn's tasselling. Results from the 2007 irrigation season were somewhat inconclusive, as significant windstorm damage just prior to harvest affected the yields on both the fully-irrigated corn and the limited-irrigation corn. Yields were actually higher on the limited-irrigation corn because the stalks were of lower stature and experienced less yield loss associated with the late season wind, as shown in Figure 2. However, visual estimates of yields suggest that the limited irrigation corn would yield competitively with a fully irrigated crop. The study evaluates crop consumptive use with a water balance method that accounts for differences in water used from the soil profile. The limited irrigation corn reduced ET by 7 acre-inches relative to the fully irrigated corn. CSU plans to continue the limited irrigation corn research on this field during the summer of 2008

### Schuppe Farm

PARTIAL SEASON IRRIGATION OF ALFALFA AND NATIVE GRASS HAY ON A CENTER PIVOT

Both alfalfa and native grass hay have historically been grown on the Schuppe Farm. CSU wanted to evaluate the effect of partial season irrigation on these two crops. CSU compared areas of full irrigation of both the alfalfa and native grass hay with areas of partial season irrigation. For the partial irrigation season, CSU had the Schuppes fully irrigate all of the land through the first cutting of the alfalfa and then completely shut off irrigation to a portion of the alfalfa and native grass hay fields. While there was little loss in yield from the alfalfa with the partial season irrigation, there was a significant change in yield of native grass hay. This indicated that alfalfa may be amenable to partial season irrigation while native grass hay may not (Figure 3). Alfalfa is known to have drought tolerance traits that make it well suited for water savings. When under drought stress, alfalfa goes into dormancy. Although growth ceases, alfalfa stores energy in the crown and is capable of rapid re-growth when water is newly supplied. Alfalfa is also a good candidate for innovative water saving cropping systems because it is a large water user and is grown on a significant amount of land in Eastern Colorado.

Fig. 5 - Instrumented Sprinkler Nozzles

Fig. 6 - Linear Research Field Irrigation

In addition to the on-farm demonstrations, there was also a controlled research farm operated solely by CSU personnel. A research-grade linear sprinkler system was used to irrigate a 35-acre field that is divided into replicated and randomized research plots. The setup and operation of the linear sprinkler is shown in Figures 4 through 6. Figure 4 shows the water supply for the sprinkler, a linear ditch running parallel to the field on the north side and perpendicular to the linear sprinkler. Figure 5 shows the instrumented flow nozzles that are each individually metered to record precise irrigation rates to each section of the field. Figure 6 shows the operation of the linear sprinkler.

A linear sprinkler setup was used to facilitate the development of small plots to evaluate various crop irrigation management techniques. The linear sprinkler is fully instrumented with flow meters at each dropdown nozzle and a computer guidance system controls the irrigation at each nozzle so that a full irrigation water supply can be applied to some plots, a limited irrigation supply to other plots, and no water supply to lands that are being fallowed during that year. The layout of the crop plots for the 2007 research season is shown in Figure 7.

The experimental treatments evaluated in 2007 include full and limited irrigation practices for different crops and crop rotations. Crops being tested include: corn; winter wheat; sunflower; soybean; triticale; and winter canola. The plots are designed to allow these crops to be combined in different rotations with each other and with fallow periods. Limited irrigation practices were found to have potential for corn, sunflower, and soybean crops. Corn yields under limited irrigation only reduced yields by 15 percent relative to a fully irrigated crop. Sunflower yields were reduced 25 percent under limited irrigation practices, with an ET savings of 4 inches compared to fully irrigated sunflower and a savings of 8 inches relative to fully irrigated corn (Figure 8, next page). Soybeans were well suited to limited irrigation practices, with increased yields at slightly lower irrigation (savings of 1.4 inches). Because of the timing of irrigation, the limited irrigation approach resulted in slightly higher grain yield than the fully irrigated treatment, while saving 4 inches of ET relative to fully irrigated corn. Ongoing work will evaluate other crops and cropping practices for potential water savings. It is hoped that the amounts of saved ET will be higher in the 2008 season.

**Test Plots**

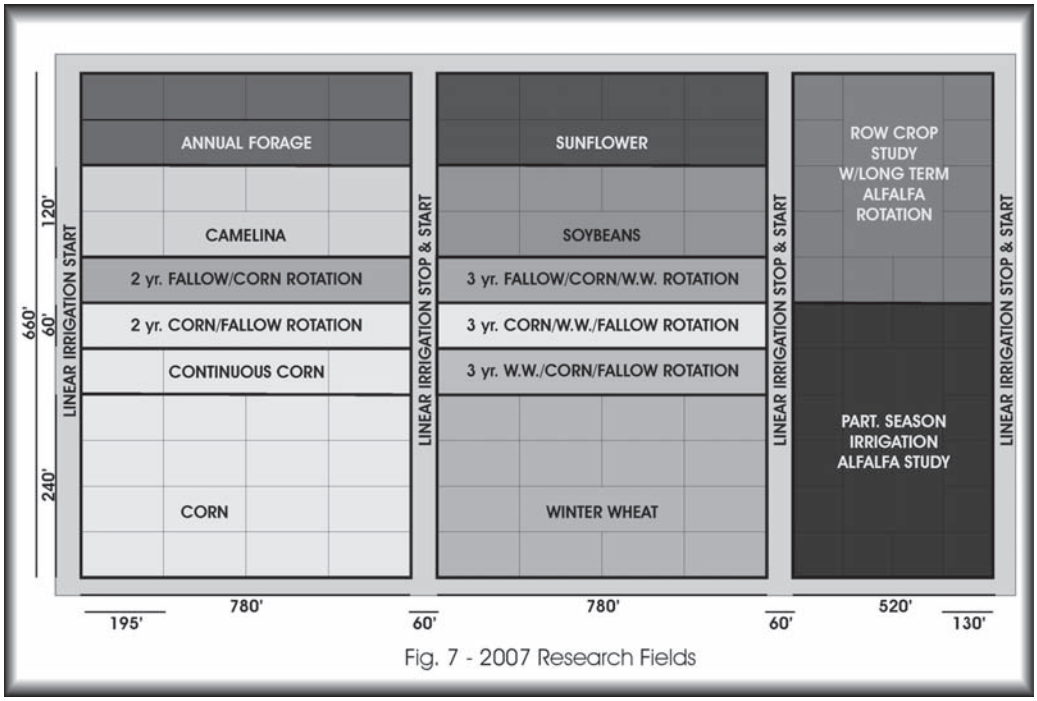



Fig. 7 - 2007 Research Fields

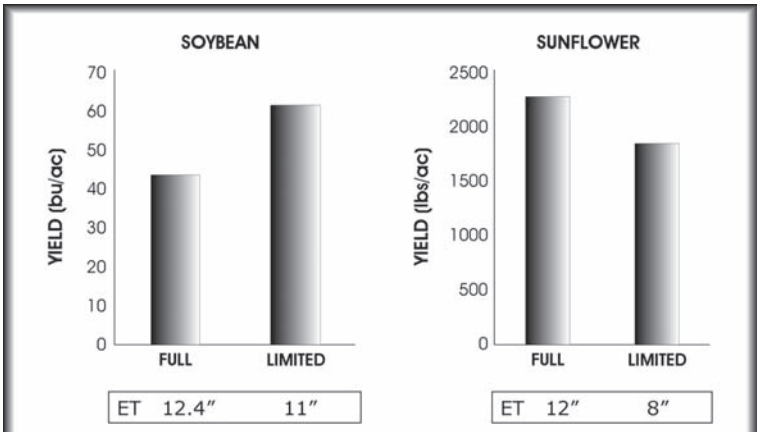



Fig. 8 - Soybean and Sunflower Yields and Consumptive Use at Research Farms

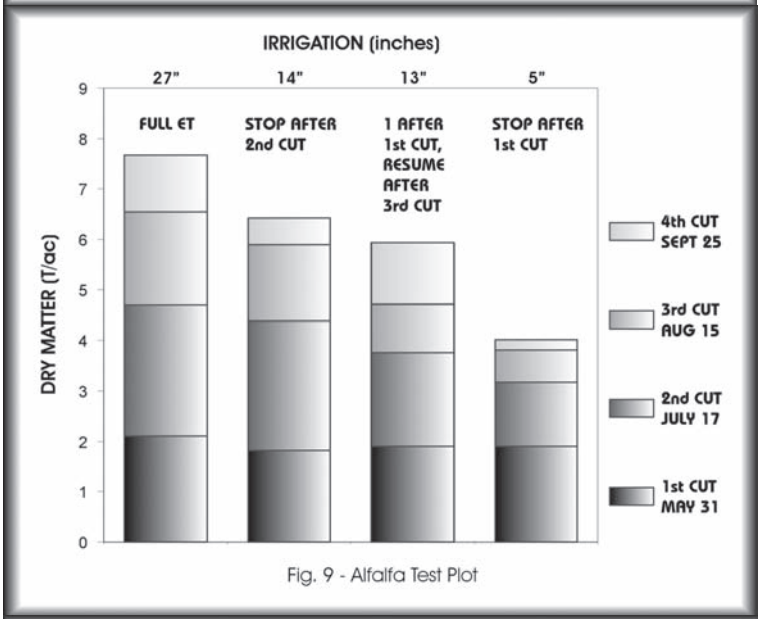



Fig. 9 - Alfalfa Test Plot

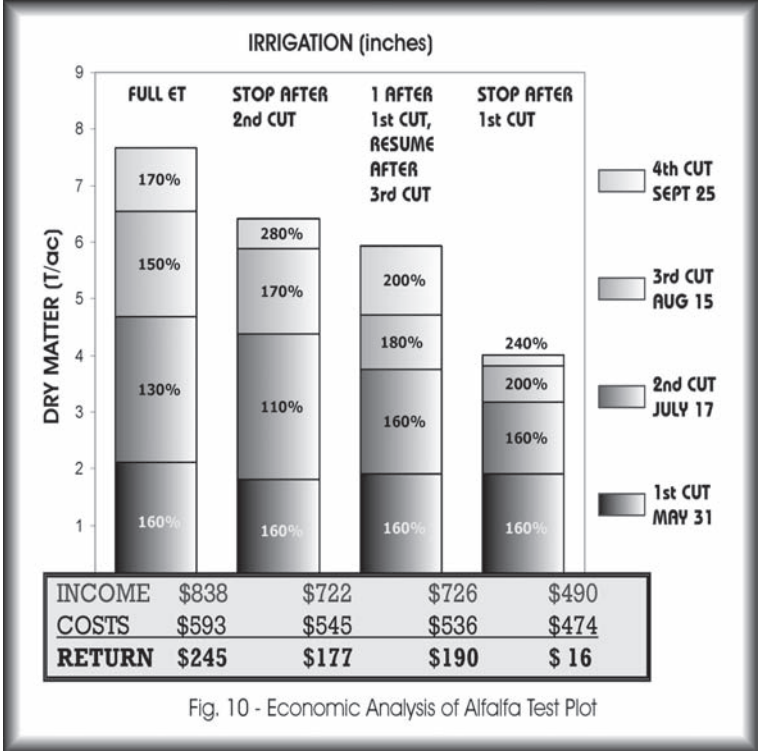



Fig. 10 - Economic Analysis of Alfalfa Test Plot

**URBAN/RURAL ECONONOMICS**

Since urban interests are often both willing and able to pay prices for water far in excess of the current dollar value of water to the farmers, there is often a potential synergy between urban and rural interests when it comes to water supplies. However, this can be both a blessing and a curse — fueling the "buy and dry" concept in agricultural-to-municipal water transfers. However, a scenario now presents itself where the disparate value in water for urban interests versus rural interests can be an unmixed blessing.

CSU has ongoing research at a site in the South Platte River Basin, where it is evaluating the effect of partial season irrigation of alfalfa. CSU has operated four plots, with one plot receiving a full water supply (approximately 27 inches) but the three other plots have received varying amounts of water in a partial season irrigation program, as shown in Figure 9. These fields had four cuttings of hay with variable dry matter yields (Figure 9). CSU agricultural economists then compared the income derived from the yields of these fields to the cost to farm the land. CSU demonstrated that there can be significant water savings while concurrent with only a slight decrease in farmer revenues. CSU economists evaluated the changes in return on the land for these varying irrigation techniques, as illustrated in Figure 10. Figure 10 shows the costs for farming the land per acre, the income obtained from the land per acre, and the difference in value under the varying irrigation techniques. Combining the information represented by the bar graph on the far left with the bar graph second from the right indicates that when water use is cut in half the return on the crop only decreases $55 per acre (the actual value here is dependent upon the somewhat variable costs of inputs and the sale price for hay). Therefore, if one AF of water per acre (of land) could be removed while maintaining this production level, the result would be water costing — at a minimum — $55 per AF. This clearly illustrates the potential win-win scenario whereby farms keep farming and water is still made available to urban interests at a very reasonable rate. Determining whether these types of results can be replicated on a large scale and over a long period of time is one of the primary objectives of the Project's ongoing research.

In a recent survey of farmers in the South Platte River drainage basin conducted by CSU, over 60 percent of the respondents indicated that they would be willing to enter into long-term leases related to the crop irrigation management techniques being researched by CSU. The respondents would generally like to receive approximately $300 to $500 per acre for these leases. This would appear to more than offset any loss of yield on fields where either limited or partial irrigation techniques, or rotational fallowing, were being practiced. In addition, while there was only limited response to the survey (approximately 330 farmers), these respondents indicated that they may have over 30,000 AF of water that they would be willing to lease to urban interests.

While more work needs to be done concerning implementable crop irrigation management techniques and the economics associated with these techniques, the initial results from the first year of Project research are encouraging.

**Urban/Rural Water**

**Change in Use (Transfer)**

**Sub-Irrigation Issues**

**Administration Questions**

**Continuing Research**

**WATER RIGHTS Transfers**

All of the large senior water rights in the Lower South Platte River downstream of Denver are adjudicated for irrigation use only. Therefore, none of this water can be used for municipal purposes without a change of use proceeding in Colorado's Water Court. In a change of use proceeding, it is necessary to demonstrate the components of historic irrigation practices; i.e., the historic consumptive use of the crops grown on the land, the return flow pattern of the water applied in excess of the consumptive use requirement, and to demonstrate that these impacts on the stream system will not change from the transfer of water rights (i.e., the pattern of depletions and accretions to the river). As noted, in a typical change of use proceeding, the lands are dried up and the consumptive use associated with the land can be easily identified as transferable to a municipal entity. However, these new crop irrigation management techniques set up a new paradigm, whereby it is not clear-cut precisely how the consumptive use of a specific crop, at a specific time, at a specific location has been reduced in order to administratively demonstrate that this water is available for transfer.

One of the issues is sub-irrigation of lands, which occurs naturally from a high water table, that is providing some portion of the irrigation supply. Sub-irrigation is not a transferable water right, so quantification of the extent and location of sub-irrigation is very important. A network of monitoring wells throughout the research area has been set up and instrumented to monitor daily water levels in the alluvial aquifer. In addition, CSU has installed access tubes for routine assessment of soil moisture to a depth of eight feet using neutron attenuation methods. All of these data will be used to evaluate sub-irrigation issues.

As part of this research project, CSU has set up an advisory committee to obtain input from local farmers, bankers, and state administrative officials. The Project is currently working with the Colorado State Engineer's Office to evaluate what administrative methods might be acceptable for crop irrigation methodologies that do not completely dry up lands when it can be shown that these crop irrigation management techniques are effective in reducing crop consumptive use while still maintaining farming operations. The two principal issues from an administrative standpoint are: 1) potential sub-irrigation in some areas near the ditch systems which could be affecting the crop consumptive use associated with irrigation; and 2) definitively quantifying the amount of consumptive use reduction if either limited or partial season irrigation is used. These issues may be major hurdles and require legislative change if these techniques are to be employed. Alternatively, CSU is also evaluating rotational fallowing because this may be easier to deal with from an administrative standpoint. With rotational fallowing, specific fields would be dried in certain years and, therefore, it would be readily observable what historic consumptive use is being saved on the specific fields that are fallowed.

Clearly, consideration of administrative issues will be an extremely important adjunct to the research. To be effective, crop irrigation techniques must have a practical application on a large scale. Similarly, as a practical matter, water rights have to be administrable. However, given the escalating conflict between urban and rural water interests, a successful resolution to this dilemma is imperative.
[Editor's Note: Oregon recently instituted a new program that allows for "split season leasing" (similar to the partial season irrigation discussed above (see Water Briefs, TWR #24 and www.wrd.state.or.us)]

**PLANS FOR FUTURE RESEARCH**

The crop irrigation management techniques being evaluated as part of this research study cannot be fully determined during one irrigation season. It is expected that the CSU research will continue to focus on these crop irrigation management techniques and to further develop the techniques and crops which seem the best suited for creating a win-win scenario for both rural and urban interests. As noted, the current study is funded through the 2009 irrigation season. However, it is likely that additional studies will be required to fully develop both the most efficient irrigation methodologies and the procedures that will be necessary to convert available irrigation supplies to municipal use through Colorado's Water Court system. Alternatively, it may become apparent that legislative change is necessary, which likely will also require additional time beyond the scope of the 2009 horizon for the current research project.

**For Additional Information:**
Bruce A. Lytle, Lytle Water Solutions, LLC, 303-350-4090
or email: bruce@lytlewater.com; website: www.lytlewater.com
Neil Hansen, Ph.D., Colorado State University, 970-491-6804 or email: Neil.Hansen@ColoState.edu
Frank P. Jaeger, Parker Water and Sanitation District, 303-841-4627 or email: fjaeger@pwsd.org
Jim Nikkel, Parker Water and Sanitation District, 303-841-4627 or email: jnikkel@pwsd.org

*See Next Page for Authors Information*

**URBAN & RURAL WATER SUPPLIES: AUTHORS**

**Bruce A. Lytle, P.E.**, is a water resources engineer with over three decades of experience in all types of surface water and ground water-related projects throughout the United States. He is currently serving as the Project Manager for the joint Parker Water and Sanitation District/Colorado State University farm research study. Mr. Lytle is the President of Lytle Water Solutions, LLC, a water resources consulting firm in Highlands Ranch, Colorado. Mr. Lytle's primary focus is in the areas of hydrologic impact studies, environmental audits, ground water remediation programs, baseline surface and ground water data collection programs, surface water and ground water supply development, surface water modeling studies, ground water modeling studies, water rights cases, and expert testimony regarding surface water and ground water issues.

**Neil Hansen** is an Assistant Professor of Soil Science at Colorado State University in Fort Collins, Colorado. His focus is on understanding how agricultural management practices affect the quality of soil and water resources and to develop management practices that promote sustainability. Professor Hansen holds a Ph.D. in soil physics from the University of Minnesota and an MS in Agronomy from Brigham State University. For the joint PWSD/CSU farm study, Dr. Hansen is in charge of field activities related to cropping system development and water budget acounting.

**Frank Jaeger** is the District Manager of the Parker Water and Sanitation District (Parker) in Parker, Colorado, a position he has held since 1981. He has guided Parker from a community with 400 taps in 1981 to a growing Denver suburban area with more than 15,000 taps today and an expected buildout population of over 100,000 people. Through Mr. Jaeger's leadership, Parker is currently building Rueter-Hess Reservoir, a 72,000 ac-ft reservoir, and he is taking a leading role in the development of sustainable water supplies for Parker and northeastern Douglas County. Mr. Jaeger developed the concept for the joint PWSD/CSU farm study. In 2005, the El Paso County Commissioners appointed Mr. Jaeger to the Metro Roundtable. Recently, he was appointed by Governor Owens to a three-year term on the Colorado Ground Water Commission.

**Jim Nikkel, P.E.** is the Assistant District Manager at Parker Water and Sanitation District, and has been with PWSD since 1999. Mr. Nikkel is overseeing the construction of Rueter-Hess Reservoir and is managing the operations of the joint PWSD/CSU farm study as it relates to the potential for providing a future water supply to Parker. Mr. Nikkel is responsible for not only the water supplies for PWSD, but the treatment of these water supplies to potable standards, and for the treatment of PWSD's wastewater, which is integrated into a reuse system to maximize the beneficial use of water.

# WATER BRIEFS

## KLAMATH SETTLEMENT: DAMS REMOVAL SOUGHT CA/OR

On January 16, a settlement agreement was announced in the Klamath Basin that includes a proposal to remove four dams on the Klamath River following over two years of negotiations (Iron Gate, J.C. Boyle, Copco 1 and Copco 2 Dams). The "*Proposed Klamath Basin Restoration Agreement*" is designed to rebuild fisheries, sustain agricultural communities, and resolve other longstanding disputes related to the allocation of water resources. Removal of the four dams would open approximately 300 miles of fishery habitat upstream and improve water quality.

The "Klamath Settlement Group" — a diverse collection of government agencies, Indian tribes, farmers, conservation groups and fishermen — crafted the agreement. PacifiCorp, the corporation that owns the dams on the Klamath River that are currently the subject of a relicensing proceeding before the Federal Energy Regulatory Commission (FERC), was not part of the settlement group. Warren Buffett's Mid American Holdings is the owner of PacifiCorp. The Klamath Settlement Group's press release noted that the Group is presently negotiating with PacifiCorp in an effort to reach agreement on the removal of the utility's four lower dams in the Klamath Basin.

Other key provisions of the agreement include: increasing the amount of water in the Klamath River and maintaining water in Upper Klamath Lake by supporting money for an interim water bank program; limiting the amount of water diverted from the river and lake for the federal Klamath Reclamation Project; and establishing a voluntary water rights retirement program for the Wood, Sprague, Sycan and Williamson rivers (designed to secure 30,000 **a**cre **f**eet (AF) of water for additional inflow to Upper Klamath Lake). The parties agreed to a permanent limit on the amount of water diverted from the lake and river for the Klamath Reclamation Project. It was estimated that the limitation would result in the availability of water for irrigation being 100,000 AF *less* than current demand in the driest years, with irrigation water availability increasing on a sliding scale with wet conditions (up to 10,000 AF increase once the four dams are removed or additional storage is available). For irrigators, the agreement will maintain the cost of below-market power at approximately 3 cents per kilowatt-hour.

Provisions affecting Indian tribes in the region include the creation of a 90,000-acre reservation for the Klamath Tribes from private forestland in Klamath County and a budget of $80 million for tribal fisheries. The agreement also dealt with governance by proposing to establish the Klamath Basin Coordinating Council to facilitate coordination, cooperation, collaboration and accountability, plus setting out a process to resolve disputes. The total of estimated costs of the deal is $985 million over 10 years. The state of Oregon would be asked to contribute lottery funds, and California and the US Congress would have to contribute as much as $500 million, with the remainder coming from funds already allocated to the basin by the states and the federal government.

Under the proposal, salmon and steelhead would be reintroduced above Iron Gate Dam, including tributaries to Upper Klamath Lake (excluding the Trinity River watershed above its confluence with the Klamath River). The reintroduction also does not include the Lost River or its tributaries, or the Tule Lake Basin.

The agreement also establishes a process to develop an Off-Project Water Settlement (OPWAS) as part of the ongoing Klamath Basin Water Rights Adjudication in the upper basin (general adjudication by the state of Oregon).

The 140-page settlement agreement was released for public comment before becoming final. Obviously, much remains to be accomplished before the deal can be consummated. PacifiCorp spokesman were quoted as being "surprised" that the deal was announced without contacting them. Opposition remains from Oregon Wild, a Portland-based conservation group, and WaterWatch of Oregon. Negotiators for two parties, the Hoopa Valley Tribe of northern California and the Off-Project Water Users Association, are not prepared to recommend approval.

The Water Report plans to include an extended article in our next issue on the settlement, authored by some of the participants of the Klamath Settlement Group.

**For info, contact:** Greg Addington, Klamath Water Users Association, 541/ 883-6100; Troy Fletcher, Yurok Tribe, 707/ 498-8486, Chuck Bonham, Trout Unlimited, 510/ 528-4164; Settlement document available at: www.edsheets.com/klamathdocs.html

## WATER BRIEFS

### INTERSTATE COMPACT LAWSUIT MT/WY

**US BRIEF FILED**

On January 2, US Solicitor General Paul Clement filed an amicus brief with the US Supreme Court (Court) recommending that the Court accept for review Montana's water rights case against Wyoming involving water use from the Tongue and Powder Rivers. Montana sued Wyoming in February 2007 in an effort to enforce the provisions of the Yellowstone River Compact (Compact). Montana, Wyoming and North Dakota entered into the Compact in December 1950 and following ratification by the state legislatures the US Congress consented to the Compact in October 1951.

Montana asserts that the Compact effected a full equitable division of the waters of the Tongue and Powder Rivers, tributaries of the Yellowstone River. Montana also alleges that recent water use and storage in Wyoming, based on post-1950 water rights issued by Wyoming, results in use in excess of that state's equitable share of water. Montana's complaint asked the court to order Wyoming to deliver more water in the Tongue and Powder Rivers downstream to Montana according to the Compact and award Montana damages, costs and other relief. Wyoming responded that its various uses of water are permissible under the Compact and that Montana failed to state a claim under the Compact or to plead injury with sufficient particularity (Wyoming Brief 14-17). Wyoming also argued that Montana should use the alternative forum for relief — the Yellowstone River Compact Commission (*Id.* at 28-29). Wyoming also maintains that groundwater use is not covered by the Compact.

The Solicitor General's brief states that the controversy relates principally to Compact Article V's operative provisions that "provides for the division of water between Montana and Wyoming according to a three-tiered framework." (Brief at 6). The brief also notes the principal issue at play in the case: "The gravamen of Montana's complaint is that in some recent years, there has been insufficient water available in the Powder and Tongue Rivers to satisfy pre-1950 water rights in Montana under the Compact's first tier, see Br. in Supp. of Compl. 17, and that when Montana's first-tier rights are not satisfied there is no 'unused and unappropriated' water to be allocated between the States pursuant to the Compact's second and third tiers." *Id.* at 8.

The United States, through the Solicitor General's brief, concludes that Montana's case should be heard by the Court. The Solicitor General clearly laid out his rationale for this recommendation: "Montana alleges an interstate dispute of sufficient importance to warrant this Court's exercise of its original jurisdiction, and there is no other forum in which the controversy practicably can be resolved. Wyoming's challenges to the complaint's legal sufficiency turn on the interpretation of the Compact, and therefore should properly be resolved on their merits; at this threshold stage, Montana has adequately pleaded an injury to its sovereign rights, under its interpretation of the Compact." *Id.* at 9-10.

The Solicitor General also suggested in his brief that the Court consider "potentially dispositive legal issues before referring the matter to a Special Master [for fact-finding] or taking other action. The resolution of those legal issues, which could be placed before the Court through a motion to dismiss the complaint [by Wyoming], could significantly facilitate disposition of the controversy." *Id.* at 10. "This course of action is particularly appropriate where, as here, the complaint seeks a definitive interpretation of an interstate compact." *Id.* at 17.

**For info:** Lynn Solomon, Montana AG's office, 406/ 444-0582; Solicitor General's Brief available at: www.doj.mt.gov/news/releases2008/20080102brief.pdf

### CONJUNCTIVE USE ID

**WATER CALL DECISION**

On January 11, former Idaho Supreme Court Chief Justice Schroeder issued a recommended order as a result of the hearing in the Thousand Springs area water call. Schroeder, acting as independent hearing officer, presided over the hearing conducted November 28 through December 13 at Idaho Department of Water Resources (IDWR) headquarters in Boise, Idaho. The hearing was conducted to resolve disputes between groundwater users and two aquaculture businesses that hold senior water rights located in the Thousand Springs area near Hagerman. These businesses use water flowing from the springs to raise trout for sale. The disputes involved objections to orders issued by former IDWR Director Karl Dreher in 2005 in response to water delivery calls made by senior water right holders Blue Lakes Trout Farm and Clear Springs Foods' Snake River Farm. In a detailed 30-page order, the hearings officer determined that "The Director's Orders are supportable and should be enforced." (Order at 27).

A water delivery call is made when the holder of a senior water right experiences a shortfall in the water they are beneficially using and are entitled to receive. The department then issues an order requiring the holders of junior water rights either to mitigate the effects of their diversions or stop diverting water in order to satisfy the senior right.

The provisions of Schroeder's recommended order will not become effective until IDWR Director David Tuthill issues a final order in the matter, which is expected sometime late this winter. With the release of the recommended order, each party who appeared at the hearing may file a petition for reconsideration, briefs and exceptions to the recommended order, and may request oral argument before the IDWR director.

**For info:** Preliminary Order, Audio of the Hearing and related documents are available on the IDWR website: www.idwr.idaho.gov

## WATER BRIEFS

### TRIBAL WATER SALE WA

**RECLAMATION & STATE PARTNERSHIP**

The Spokane Tribe of Indians (Spokane Tribe) recently joined a historic partnership that will provide new water for irrigators and cities in the Columbia River Basin and support stream flows for endangered fish. The partnership consists of the state of Washington, the US Bureau of Reclamation (Reclamation), The Confederated Tribes of the Colville Reservation (Colville Tribes) and the Spokane Tribe. Spokane Tribal leaders signed their agreement on February 4th that will facilitate the delivery of water from Lake Roosevelt on the Columbia River to irrigators of 10,000 acres east of Moses Lake, Washington. Those irrigators now rely on the rapidly diminishing Odessa groundwater aquifer, which has been dropping an average of 7 feet per year for decades. Reclamation manages Lake Roosevelt and will deliver water to the Odessa area using existing infrastructure. Colville Tribal leaders signed their agreement in December.

The agreements, subject to approval by the 2008 Legislature, authorize annual payments to the tribes in exchange for their support of incremental storage releases of up to 132,500 acre feet of water each year from Lake Roosevelt (behind Grand Coulee Dam on the Columbia River). This amount of water will lower lake levels no more than an additional 1.5 feet below current operations. Governor Christine Gregoire is asking the Legislature to approve annual payments of $2.25 million to the Spokane Tribe, and $3.8 million (first year) and $3.6 million in subsequent years to the Colville Tribes. Payments will be adjusted for inflation over time and would come from the State's General Fund. The payments will be used to mitigate damage on fish and wildlife, cultural resources, and recreational activities resulting from the release of water from Lake Roosevelt, and for economic development investments to benefit the local economy. The funding is not for a purchase of water or water rights from the tribes and the agreement does not affect either tribe's water rights or future water right claims.

During drought years, additional water will also be made available to avoid temporary interruption of irrigation water for as many as 379 holders of water rights who can suffer service interruptions of water during droughts. Most of them are farmers who use the water to irrigate. The addition of 33,000 acre-feet (AF) of water for use in dry years will create a "drought insurance" program for these water users.

Instream flows for salmon will also be improved under the agreements by the release of additional water during the critical late-summer period on the river. Each year, 27,500 AF of water will be available for instream flows and an additional 17,000 AF will be available during critical drought years to increase water held instream to benefit endangered salmon and improve the health of the Columbia River.

Cities that have been waiting for years for new water supplies will also gain from the agreement signed by the Spokane Tribe, including many of the 128 applicants (pending) for municipal and industrial water rights who will receive water under the agreements. New water permits for the agricultural, municipal, and industrial water use may be issued as early as spring 2008.

Benefits of the agreements to non-tribal communities include $2 million Governor Gregoire is asking for local governments around Lake Roosevelt to address priority water issues. The State will also benefit by avoiding the purchase of water at current market rates, which would be cost-prohibitive for a quantity similar to that coming from Lake Roosevelt under the agreements.

**For info:** Gerry O'Keefe, Washington Dept. of Ecology, 360/ 407-6640, email: goke461@ecy.wa.gov or website: www.ecy.wa.gov/programs/wr/cwp/cr_lkroos.html

### STORMWATER PLAN US

**EPA GUIDE: CONSTRUCTION SITES**

EPA's "Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites," is an easy-to-read reference for construction site operators who require a National Pollutant Discharge Elimination System (NPDES) permit for their stormwater discharges. The guide explains the basic principles of developing and maintaining an effective stormwater pollution prevention plan (SWPPP) and can be used at most construction sites in any state, territory, or in Indian country. A customizable SWPPP Template, an Inspection Template, two "model or example" SWPPPs, and other stormwater resources are also available. Printed copies of the guide are available from EPA's National Service Center for Environmental Publications, 800/ 490-9198 or email: nscep@bps-lmit.com (document number EPA-833-R-06-004). **For info:** Guide at EPA website: www.epa.gov/npdes/swpppguide; Construction Center website: www.cicacenter.org/swppp.html

### SULFATE CLEANUP AZ

**ADEQ CONSENT ORDER**

On January 25, Arizona Department of Environmental Quality (ADEQ) Director Steve Owens announced that Phelps Dodge Copper Queen mine is taking steps under a Consent Order the company recently signed with ADEQ to address sulfate contamination in drinking water from the mine, in Bisbee (Cochise County). In a press release, Director Owens noted that "Some wells in the area would not be usable for drinking water without taking steps to keep the water safe from sulfate contamination."

The Consent Order, which was entered into with ADEQ last November, requires the company to ensure that drinking water affected by the mine's operations does not exceed a maximum allowable limit of 250 parts-per-million (ppm) for sulfate. That is the toughest sulfate level allowed by ADEQ and mirrors a similar requirement imposed on Phelps Dodge by ADEQ at Phelps Dodge's Sierrita mine near Green Valley. The order also requires Phelps

## WATER BRIEFS

Dodge to provide quarterly status reports to ADEQ and to establish a Community Advisory Group to keep community members informed of the company's activities.

The Order also requires Phelps Dodge to determine the size and direction of the sulfate plume, and to conduct an inventory of wells in the area to ensure that drinking water provided to area residents meets all applicable drinking water standards, including the 250 ppm sulfate limit established in the order. The plume and well reports will take about a year to complete. The order applies to all drinking water in Bisbee and Naco, where two water companies serve about 8,200 customers. Phelps Dodge has been supplying bottled water to some customers of the Naco Water Company in Naco. Other steps Phelps Dodge might take for Bisbee and Naco include treating the water, finding alternative water sources, or mixing or blending water sources so that water intended for drinking meets the specified sulfate level.

Elevated sulfate levels attributable to the Phelps Dodge mine have been identified in groundwater samples collected from wells in the area. Although sulfate is considered a "non-hazardous" substance under federal and state law, ingestion of water containing levels of sulfate exceeding 500 ppm can cause diarrhea and other health problems. A 2006 Consent Order between ADEQ and Phelps Dodge regarding the company's Sierrita mining operations near Green Valley in Pima County represented the first time that ADEQ has ever used its authority under the Water Quality Assurance Revolving Fund to require a party to deal with contamination caused by a "non-hazardous" substance such as sulfate. It was also the first time ADEQ set the sulfate level at 250 ppm.

The Consent Order also includes a stipulated penalty clause that automatically subjects Phelps Dodge to a set monetary penalty per day if Phelps Dodge fails to comply. The Order is available on the ADEQ website.
**For info:** Mark Shaffer, ADEQ, 602/ 771-2215 or ADEQ website: www.azdeq.gov

### WATER QUALITY GRANT OK/TX

**INTER-TRIBAL ENVIRONMENTAL COUNCIL**

The US Environmental Protection Agency (EPA) announced on January 10 that it awarded $200,000 to the Inter-Tribal Environmental Council (ITEC) - Cherokee Nation. These funds will allow ITEC to continue to establish and enhance its Voluntary Cleanup Program and Brownfields Site Assessment Program. Brownfields are vacant, abandoned, or under-used properties where redevelopment may be complicated by the presence or potential presence of environmental contamination. Through these programs, ITEC will inventory, oversee or perform assessments and cleanups of Brownfields properties, and promote the program within and between its consortium of 32 tribes from Oklahoma and Texas. The Cherokee Nation serves as the lead agency for the consortium.

The Cherokee Nation's Office of Environmental Services will create a database and mapping system of solid waste sites and facilities located within jurisdictional boundaries for the ITEC member tribes in Oklahoma and Texas. The database will assist tribes with prioritizing sites in order to secure funding for cleanup, develop tribal solid waste programs and encourage the development of tribal solid waste codes and ordinances.
**For info:** ITEC, 800/ 259-5376, email: itec@cherokee.org or ITEC website: www.itecmembers.org/; EPA website: www.epa.gov/region6/gandf/index.htm

### TRANSBOUNDARY ISSUES US

**SUPREME COURT DENIES PETITION**

On January 7, in the case of *Pakootas, et.al. v. Teck Cominco Metals Ltd*., the US Supreme Court refused to hear an appeal from the Ninth Circuit Court of Appeals to consider whether that appellate court erred in its ruling that Teck Cominco Metals Ltd. (Teck Cominco) could be penalized for dumping mining slag into the Columbia River that ultimately resulted in contamination downriver in the US. Teck Cominco had alleged that the EPA could not unilaterally impose liability on a Canadian company doing business in Canada in compliance with Canadian law under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA is the US law that created EPA's Superfund toxics cleanup program.

The Ninth Circuit, however, found in favor of the Confederated Tribes of the Colville Reservation and the State of Washington and decided that EPA did have jurisdiction to force compliance with an EPA order to study contamination in and around Lake Roosevelt. The Lake is the reservoir created on the Columbia River by Grand Coulee Dam in northeast Washington. A three-member appellate panel of the Ninth Circuit in July 2006 ruled that the Canadian company can be held liable under US environmental law and upheld the lower court's decision to deny Teck Cominco's dismissal request. Du Bey & Clark, TWR #15 and Water Briefs, TWR #37. The Supreme Court did not explain its decision to deny Teck Cominco's petition. The refusal to hear the appeal, however, effectively upholds the Ninth Circuit's decision.

Teck Cominco noted in its press release that the Government of Canada, the Province of British Columbia, and the Chambers of Commerce of both Canada and the United States had all joined Teck Cominco in arguing that diplomatic processes, and not the courts of the United States, are the forum in which to resolve cross-border issues of this nature. The company stated that upon remand to the District Court of Eastern Washington, it "will vigorously defend against the complaints."
Teck Cominco also noted that it will "continue to fulfill its obligations under a settlement agreement reached with the U.S. and the EPA in June 2006 and complete a voluntary Remedial Investigation and Feasibility Study (RI/FS) to determine if any risks to human health and the environment result from past releases from Teck Cominco Metals' refinery at Trail, British Columbia." The RI/FS is scheduled for completion in 2011.
**For info:** Richard Du Bey, Atty. for Tribes, 206/ 682-3333 or email: rdubey@scblaw.com; Dave Godlewski (Teck Cominco), 509/ 747-6111

## WATER BRIEFS

### WATER INFRASTRUCTURE US
**EPA NEEDS ASSESSMENT**

A new report from the EPA estimates $202.5 billion is the nationwide capital investment needed to control wastewater pollution for up to a 20-year period. Delivered to Congress in mid-January, the *2004 Clean Watersheds Needs Survey* summarizes the results of the EPA's 14th national survey on the needs of publicly owned wastewater treatment works. The estimate includes $134.4 billion for wastewater treatment and collection systems, $54.8 billion for combined sewer overflow corrections, and $9.0 billion for stormwater management.

Communities across the country face challenges in sustaining their water infrastructure. EPA is working with states, tribes, utilities, and other partners to reduce the demand on infrastructure through improved asset management, improved technology, water efficiency, and watershed-based decision making, and is working with Congress to enact the Administration's Water Enterprise Bond proposal.

The *Survey* provides information to help the nation make informed decisions about pollution control needs necessary to meet the environmental and human health objectives of the Clean Water Act. The figures represent documented wastewater investment needs, but do not account for expected investment and revenues. Wastewater treatment utilities pay for infrastructure using revenue from rates charged to customers and may finance large projects using loans or bonds. State and federal funding programs, such as EPA's Clean Water State Revolving Fund program, are also available to help communities meet their wastewater pollution control needs. The needs in this *Survey* represent a $16.1 billion (8.6%) increase (in constant 2004 dollars) over the 2000 report. The increase in overall national needs is due to a combination of population growth, more protective water quality standards, and aging infrastructure.
**For info:** Shakeba Carter-Jenkins, EPA, 202/ 564-4355 or email: carter-jenkins.shakeba@epa.gov
EPA website: http://www.epa.gov/cwns/

### GROUNDWATER REPORT OR
**DESCHUTES BASIN**

New permits for groundwater in the Deschutes Basin require mitigation in order to protect streamflow in the Deschutes River Scenic Waterway. The Oregon Water Resources Department (OWRD) is required to evaluate the program to assure that mitigation is resulting in no net reduction of flow in this waterway. OWRD's Deschutes Ground Water Mitigation Program - Five Year Program Evaluation Report covers how this effort is progressing and the preliminary results of the evaluation.
**For info:** Report is available at OWRD's website: http://egov.oregon.gov/OWRD/Deschutes_five_year_eval.shtml

### AG COMPLIANCE US
**EPA WEB PORTAL**

The National Agriculture Compliance Assistance Center (Ag Center) is now the official host to EPA's new "Agriculture" web portal. The conversion created a section highlighting the Ag Center Services. The Agriculture portal provides multi-media information about the environment and agriculture by drawing information from across EPA's programs and activities. Using the Ag Center as host for the Agriculture portal will provide more visibility to program and regional agriculture-related efforts, direct web users to these resources, and help to eliminate duplication and conflicting information on the web.
**For info:** EPA website: www.epa.gov/agriculture/agctr.html

### LOWER PLATTE DECISION NE
**NOT FULLY APPROPRIATED**

The Nebraska Department of Natural Resources (NDNR) has determined that the Missouri Tributary Basins, the Blue River Basins, the Lower Plate River Basin and a portion of the Lower Niobrara Basin are not fully appropriated at this time. This decision was based on the Department's annual report evaluating the river basins of the state and testimony given at a public hearing. The purpose of the annual evaluation is to determine if there is enough surface and groundwater in the river basin to sustain the beneficial uses of existing surface water appropriations or the beneficial purposes of wells constructed in aquifers dependent on recharge from the stream. When a river basin is determined to be fully appropriated, it means the available water supply is just in balance with existing demands — allowing any additional consumptive use of water would cause a decrease in the water supply needed by existing water uses.

With the January 16 decision, NDNR left open the possibility of new water rights for irrigation development. The Nebraska Game and Parks Commission (Commission) had hoped for a different decision since a study from their department showed that threatened and endangered species in the Lower Platte River could disappear if the basin was left open for further appropriation of water. The pallid sturgeon and the least tern (bird species) are endangered. Piping plovers also are a threatened species. Nevertheless, press reports indicated that the Commission did not plan on appealing the decision.
**For info:** Ann Bleed, NDNR Director, 402/ 471-2363
or website: www.dnr.ne.gov/

### GROUNDWATER USE NW
**TNC GUIDE RELEASED**

The Nature Conservancy (TNC), with the support of the Northwest Conservation Fund, has just released *Groundwater and Biodiversity Conservation: A Methods Guide for Integrating Groundwater Needs of Ecosystems and Species into Conservation Plans in the Pacific Northwest.* The peer-reviewed and field-tested manual describes tools and approaches for: understanding groundwater processes in a watershed; identifying key ecosystems and species that are groundwater dependent; and describing the groundwater requirements of these ecosystems and species. It is written for non-hydrogeologists, uses readily available data (so detailed groundwater studies do not need to be completed at your site) and illustrates all steps with examples. The specifics of the methods are for use in the Pacific Northwest but the overall

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framework may be useful in other areas. The Guide is available at the website listed below.

**For info:** Dr. Jenny Brown, email: jfbrown@tnc.org or Dr. Leslie Bach, email: lbach@tnc.org; Guide available at: http://conserveonline.org/docs/2008/01/ (Select "Groundwater Methods Guide TNC Jan08.pdf")

### CALIFORNIA WATER CA

**WATER PLAN UPDATE 2009**

**COMMENTS SOUGHT**

A new report issued by the California Department of Water Resources (CDWR) describes data and information sources to be used in developing the California Water Plan Update 2009. The draft Assumptions and Estimates Report reviews requirements of the plan and discusses data and data sources for major areas of the update, including water portfolios, future scenarios and response packages.

CDWR is required to publish assumptions and estimates for the California Water Plan one year prior to its publication. A final Assumptions and Estimates Report will be published in December 2008. The California Water Plan provides an overview of the State's water picture and a framework for decisions regarding its future.

Comments on the draft report are requested by June 30, 2008.

**For info:** The Draft Water Plan Update can be found at www.waterplan.water.ca.gov/cwpu2009/ae/index.cfm

### RIVER CLEANUP MT

**ARCO SUPERFUND SETTLEMENT**

**$187M - CLARK FORK RIVER**

The State of Montana is a party to settlement and will be the lead government agency conducting the cleanup using the funds secured in the settlement. Decades of mining activity upstream in Butte and Anaconda has contaminated the sediment, banks and floodplain of the Clark Fork with heavy metals that harm plant and animal life in the river and along its shores.

Up to $103.7 million from the settlement will be available to finance various remedial actions along the river between Warm Springs and Missoula, Montana. The work will include extensive revegetation of stream banks and removal of areas devoid of vegetation contaminated with mine tailings. Contingency plans in the settlement provide for additional funds if necessary. An additional $7.6 million from the settlement will reimburse the federal government for past response costs, and $3.35 million will compensate for natural resource damages at the historic Grant Kohrs Ranch managed by the National Park Service.

"This settlement brings to a close prolonged litigation over these large Superfund Sites in the Clark Fork Basin," said Ronald J. Tenpas, Assistant Attorney General for the US Justice Department's Environment and Natural Resources Division. "All parties can now focus on finalizing settlements and completing the Basin cleanup as quickly as possible."

"This is an excellent example of a federal and state partnership working toward our common goal of a clean and healthy Montana," said Kurt Alme, First Assistant U.S. Attorney for the District of Montana.

"The environmental benefits will go directly to local landowners with improved soil, and extend to all Montanans through cleaner water and improved fisheries," said Robbie Roberts, EPA's Regional Administrator from Denver.

As part of the settlement, the State of Montana is resolving its natural resource damage claims against ARCO at the Clark Fork River Site as well as sites in Butte and Anaconda for a payment of $72.5 million, which the State will use to finance additional natural resource restoration activities along and upstream of the river.

The consent decree filed on February 7, 2008 in US District Court in Butte, Mont., is subject to a 60-day public comment period and approval by the federal court. A copy of the consent decree is available on the Department of Justice Web site at: http://www.usdoj.gov/enrd/Consent_Decrees.html.

**For info:** John Wardell, EPA, 406/ 457-5030; US DOJ 202/ 514-2007

EPA Clark Fork River Superfund website: http://epa.gov/region8/superfund/mt/milltowncfr/cfr/

### PUGET SOUND POLLUTION WA

**STORMWATER PROJECTS - WATER REUSE**

The Washington State Department of Ecology (Ecology) is providing grants worth more than $25 million to help communities restore Puget Sound.

The initiative is a collaborative effort by local, tribal, state and federal governments, business, agricultural, environmental interests and the public. The 2007 State Legislature approved the spending for the State's 2008 fiscal year.

Of the $25.1 million, Ecology will send $19.7 million to local efforts to prevent pollution from stormwater runoff. It is awarding $5.4 million for projects in the Puget Sound region to re-use highly treated wastewater.

Ecology is funding a total of 46 projects, 36 of which aim to help restore Puget Sound. The funding comes from Ecology's Stormwater Management Implementation Grants Program and its Reclaimed Water Grants Program.

Ecology's stormwater management program funds municipal stormwater projects that prevent polluted stormwater from reaching downstream waters. A November 2007 Ecology preliminary report found that surface-water runoff from land is generally the largest contributor of toxic chemicals entering the Sound. The program pays for low-impact development stormwater projects, which use techniques that mimic and preserve natural drainage systems. It also pays for projects that remove unlawful, pollutant discharges from storm sewer systems, and retrofit projects that correct old-fashioned stormwater systems that send polluted runoff into downstream waters.

Ecology's Reclaimed Water Grants Program funds projects in water-short areas and locations where reclaimed water will restore important ecosystem functions in Puget Sound. Reclaiming, or reusing highly treated wastewater means using human-engineered treatment systems to speed up nature's restoration of water quality.

**For info:** Sandy Howard, Ecology, 360/ 407-6408 or email: srud461@ecy.wa.gov

Ecology website: www.ecy.wa.gov/programs/wq/funding/indexfunding.html

# CALENDAR

**February 15 MT**
**Water Law for General Practitioners: 20th Annual Real Estate CLE Seminar, Anaconda.** Fairmount Hot Springs. For info: CLE Institute (MT State BAR), 406/ 447-2206, email: gdunfee@montanabar.org or website: www.montanabar.org/

**February 16 WA**
**2008 Water Quality Assessment Workshop, Bellevue.** Ecology Northwest Regional Office, 3190 - 160th Ave SE, 6:30pm - 8:30pm. Ecology Workshop. For info: Becca Conklin, Ecology, 360/ 407-6413, email: 303d@ecy.wa.gov, or website: www.ecy.wa.gov

**February 19-21 OR**
**Northwest Hydroelectric Association Conference, Portland.** Marriott Hotel. For info: NWHA, 541/ 610-3311 or website: www.nwhydro.org

**February 19 CA**
**California State Water Board Meeting, Sacramento.** Cal/EPA Bldg., 1001 I Street. For info: Jeanine Townsend, CSWB, 916/ 341-5600 or email: jtownsend@waterboards.ca.gov

**February 19-20 MT**
**Montana Water Policy Interim Committee Meeting, TBA.** For info: Krista Lee Evans, Lead Staff, 406/ 444-1640; Committee website: leg.mt.gov

**February 19-21 NV**
**Power-Gen 2008 Conference, Las Vegas.** The Rio Hotel and Casino. National trade show for the renewable energy industry. For info: Conference website: pgre08.events.pennnet.com/fl//index.cfm

**February 20 WA**
**Washington Forest Practices Adaptive Management Annual Science Conference, Olympia.** For info: Linda Heckel, WDNR, email: linda.heckel@dnr.wa.gov or website: www.dnr.wa.gov

**February 20-22 CA**
**2008 Environmental Industry Summit, San Diego.** Coronado Island Marriott Resort. For info: Summit website: www.ebiusa.com/Summit2007/

**February 20-22 NM**
**Western Coalition of Arid States Winter Conference, Albuquerque.** Embassy Suites. RE: Water Resources Planning for Climate Change in the Arid West. For info: WESTCAS, 202/ 966-2190 or website: www.westcas.org

**February 21 CO**
**Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) Workshop, Denver.** RE: Clean Water Act, Scope of the NPDES Program, Water Regulations (e.g., SPCC, Wetlands), Case Studies & More. For info: Trinity Consultants, 800/ 613-4473 or website: www.trinityconsultants.com

**February 21-22 GA**
**Southeast & Georgia Wetlands & Water Law Update Conference, Atlanta.** Hyatt Regency. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

**February 21-22 OR**
**Oregon Environmental Quality Commission Meeting, Portland.** For info: Wendy Simons, DEQ, 503/ 229-5301 or website: www.deq.state.or.us

**February 21-22 CA**
**26th Annual Water Law Conference (American Bar Association), San Diego, Hotel del Coronado.** For info: ABA website: www.abanet.org

**February 21-24 NM**
**13th Water Conservation/Xeriscape Conference and Expo, Albuquerque.** Marriott Pyramid Hotel. For info: Scott Varner, Xeriscape Council of New Mexico, 505/ 468-1021, email: scott@xeriscapenm.com or website: www.xeriscapenm.com

**February 25-26 DC**
**Ground Water Industry Legislative Conference, Washington D.C..** For info: National Ground Water Association, 800/ 551-7379 or website: www.ngwa.org

**February 26-28 DC**
**2008 Association of California Water Agencies Washington DC Conference, Washington DC.** Washington Court Hotel. For info: ACWA website: www.acwa.com

**February 27 OR**
**Environmental Entrepreneurship Workshop, Eugene.** University of Oregon, Many Nations Longhouse. For info: Christina Davis, ENR, 541/ 346-1395, email: cdavis6@uoregonl.edu, or website: www.law.uoregon.edu/org/jell/climate.php

**February 28 OR**
**Aquifer Storage and Recovery and Artificial Recharge Conference, Corvallis.** Oregon State University (LaSells Stewart Center). For info: Michael Campana, Institute for Water & Watersheds, 541/ 737-2413 or email: aquadoc@oregonstate.edu

**February 28-29 OR**
**Oregon Water Resources Commission Meeting, Salem.** For info: Cindy Smith, WRD, 503/ 986-0876 or website: www.wrd.state.or.us

**February 28-29 OR**
**Pacific Northwest Timberlands: A Changing Industry Seminar, Portland.** For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

**February 28-29 NV**
**Family Farm Alliance 20th Annual Meeting & Conference, Las Vegas.** Monte Carlo Resort & Casino. For info: Dan Keppen, FFA, 541/ 850-9007, email: DanKeppen@clearwire.net or website: www.familyfarmalliance.org

**February 28-29 OR**
**Oregon Water Resources Commission Meeting, Corvallis.** For info: Cindy Smith, WRD, 503/ 986-0876 or website: www.wrd.state.or.us

**March 4-6 WA**
**Sound Management: Mountain to the Sea Conference, Bellingham.** Sponsored by American Fisheries Society North Pacific Int'l Chapter. For info: Larry Dominguez, Program Chair, 360/ 902-1718, email: larry.dominguez@dnr.wa.gov, or website: www.npic-afs.org/

**March 4-7 VA**
**Washington Roundtable: Water Policy Seminar and 156th Council Meeting, Arlington.** Doubletree Hotel Crystal City. Sponsored by the Western States Water Council. For info: Cheryl Redding, WSWC, 801/ 561-5300 or email: credding@wswc.state.ut.us

**March 6-9 OR**
**Public Interest Environmental Law Conference, Eugene.** University of Oregon. For info: PIELC website: www.pielc.org

**March 6-7 CA**
**Alternative Water Sources for California Seminar, Sacramento.** Hyatt Regency. Regulatory, Permitting, Engineering, Cost & Financing. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

**March 6-7 CA**
**National Environmental Policy Act SuperConference, San Francisco.** The Fairmount. For info: CLE International, 800/ 873-7130 or website: www.cle.com

**March 7 AZ**
**National Environmental Policy Act & Environmental Impact Statement Seminar, Phoenix.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**March 7-8 UT**
**Alternative Energy: Seeking Climate Change Solutions Symposium, Salt Lake City.** Marriott University Park. Stegner Center 13th Annual Symposium. For info: Wallace Stegner Center, 801/ 585-3440 or website: www.law.utah.edu/stegner/

**March 12 TX**
**Implementing Sustainable Development Programs Workshop, Houston.** RE: How Companies Can Achieve Competitive Business Advantage Through Sustainable Business Approaches; Successful Programs Presented & Discussed. For info: Trinity Consultants, 800/ 613-4473 or website: www.trinityconsultants.com

**March 12-14 Canada**
**GLOBE International Conference & Trade Fair on Business and the Environment, Vancouver, B.C..** Major international marketplace for innovative environmental technologies, products, and services.. For info: Conference website: www.globe2008.ca

**March 13 WA**
**Water Rights Transfers: Participating in the Water Market in Washington State Seminar, Seattle.** For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net/

**March 13-14 CO**
**Colorado Water Law SuperConference, Denver.** Athletic Club. For info: CLE International, 800/ 873-7130 or website: www.cle.com

**March 13-15 OR**
**7th Biennial Conference on University Education in Natural Resources, Corvallis.** Oregon State University. For info: Andrea Wirth, OSU 541/ 737-9903, email: andrea.wirth@oregonstate.edu, or website: http://uenr.forestry.oregonstate.edu/

**March 13-15 TX**
**Waterways 2007 Conference, Denton.** Sponsored by the Philosophy of Water Project. For info: Prof. Irene Klaver, UNT, 940/ 565-3331 or website: www.water.unt.edu/

## CALENDAR

**March 13-16 CO**
**Environmental Law 37th Annual ABA Conference, Keystone.** For info: ABA website: www.abanet.org

**March 14 CA**
**Common Grounds, Common Waters: Towards a Water Ethic, Santa Clara Journal of International Law Symposium, Santa Clara.** Santa Clara University, Benson Memorial Center. RE: Compromise, Cooperation & Sound Management. For info: Monica Davis, SCJIL, email: monicaelisedavis@gmail.com or website: http://scjil.wordpress.com/program-description/

**March 17-18 CA**
**National Environmental Policy Act SuperConference, Los Angeles.** The Millennium Biltmore Hotel. For info: CLE International, 800/ 873-7130 or website: www.cle.com

**March 17-19 CA**
**American Water Resources Association "GIS & Water Resources V" Conference, San Mateo.** Marriott Hotel. For info: AWRA, 540/ 687-8390 or website: www.awra.org

**March 21 WA**
**Defining Sustainability in Practice, Policy, and Law Seminar, Seattle.** Northwest Environmental Training Center Course. For info: NWETC website: www.nwetc.org/

**March 24-26 CA**
**California's Recycled Water: Water ReUse Cal Section Annual Conference, Newport Beach.** Marriott Newport Beach. For info: Courtney Tharpe, Water ReUse, email: ctharpe@watereuse.org or website: www.watereuse.org

**March 25-28 CA**
**Joint 2008 Ntl. Association of Environmental Professionals/ California AEP Annual Conference, San Diego.** Omni Hotel. For info: Website: www.califaep.org or www.naep.org

**March 26 WA**
**Redevelopment of Contaminated Property Seminar, Seattle.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**March 26 WA**
**South Sound Science Symposium, Lacey.** Community Center, 6729 Pacific Ave. SE. Water Quality, Stormwater Impacts & More. For info: Mindy Roberts, Ecology, 360/ 407-6804, email: mrob461@ecy.wa.gov or website: www.ecy.wa.gov

**March 26 CA**
**ACWA's Legislative Symposium, Sacramento.** Sheraton Grand. Association of California Water Agencies. For info: ACWA, 916/ 441-4545 or website: www.acwa.com

**March 27 WA**
**Managing Stormwater in Washington, Tukwila.** Embassy Suites Hotel. Sponsored by Northwest Environmental Business Council. For info: NEBC, 800/ 985-6322, email: sue@nebc.org or website: www.nebc.org

**March 27 WA**
**Northwest Environmental Business Council Conference "Managing Stormwater in Washington: Solutions to New Compliance Regulations", Seattle.** For info: NEBC website: www.nebc.org or Sue Moir, 503/ 227-6361, email: sue@nebc.org

**March 27-28 NV**
**National Environmental Policy Act Seminar, Reno.** Grand Sierra. For info: CLE International, 800/ 873-7130 or website: www.cle.com

**March 30-April 2 MI**
**AWWA/WEF Information Management & Technology Conference, Detroit.** Marriott Renaissance Center. For info: AWWA website: www.awwa.org

**March 30-April 3 TN**
**Ground Water Summit, Memphis.** For info: National Ground Water Association, 800/ 551-7379 or website: www.ngwa.org

**April 1-4 WA**
**American Public Works Association Spring Conference, Ocean Shores.** Convention Center. RE: Practical Innovation in the Field of Public Works. For info: Mike Terrell, 206/ 684-3078 or email: michael.terrell@seattle.gov

**April 2 UT**
**Solving the Conservation Easements Puzzle Lecture, Salt Lake City.** S.J. Quinney School of Law. For info: Elizabeth Seeley, Wallace Stegner Center, 801/ 585-3440 or website: www.law.utah.edu/stegner/

**April 6 PA**
**21st Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP 2008) Conference, Philadelphia.** RE: Abandoned Mines, Future of Geophysical Technology, Unique Developments in Electrical Resistivity, Marine and Beach Geophysics, Special Challenges in Surface Wave Processing, more. For info: Conference website: www.eegs.org/sageep/index.html

**April 7-8 CO**
**State of the Rockies Conference, Colorado Springs.** Colorado College, Amstrong Hall. For info: CC website: www.coloradocollege.edu

**April 10-11 AZ**
**Climate Change and the Natural Resources Industry Conference, Phoenix.** For info: AWWA, 800/ 926-7337 or website: www.awwa.org/

**April 10-11 WA**
**Washington Water Law Seminar, Seattle.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**April 13-16 DC**
**National Hydropower Association 2008 Annual Meeting, Washington D.C..** For info: NHA website: www.hydro.org/

**April 15-16 MT**
**Montana Water Policy Interim Committee Meeting, TBA.** For info: Krista Lee Evans, Lead Staff, 406/ 444-1640; Committee website: leg.mt.gov

**April 15-18 Australia**
**Water Down Under 2008 Conference, Adelaide.** RE: Hydrology, Water Resources & the Environment. For info: Water Down Under website: www.waterdownunder2008.com/welcome.htm

**April 17-18 OR**
**Oregon Wetlands Seminar, Portland.** For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

**April 24 OR**
**Northwest Environmental Business Council Conference "Making Renewable Energy Projects Happen", Portland.** For info: NEBC website: www.nebc.org or Sue Moir, 503/ 227-6361, email: sue@nebc.org

**April 24-25 WY**
**Wyoming Water Law Seminar, Cheyenne.** For info: CLE International, 800/ 873-7130 or website: www.cle.com

**April 28-29 OR**
**28th United States Society on Dams Annual Meeting and Conference, Portland.** RE: The Sustainability of Experience - Investing in the Human Factor. For info: USSD website: www.ussdams.org

**May 1-2 NM**
**Strategic Risk Management in the Natural Resources Industry Conference, Santa Fe.** Sponsored by the Rocky Mt. Mineral Law Foundation. For info: RMMLF, 303/ 321-8100, email: info@rmmlf.org, or website: www.rmmlf.org

**May 2 OR**
**Oregon Wetlands Seminar, Portland.** For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

**May 2 WA**
**Mitigation & Conservation Banking Seminar, Seattle.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**May 4-9 OR**
**Western Division American Fisheries Society Annual Meeting, Portland.** RE: Human Population Growth & Fisheries: The Western Challenge. For info: Neil Ward, CBFWA, 503/ 229-0191 or neil.ward@cbfwa.org or website: www.wdafs.org/meet/meet.htm

**May 5-7 CA**
**Integrated Watershed Management - Reducing Nonpoint Source Pollution: Fourth Biennial NPS Conference, San Diego.** Mission Valley Marriott. For info: Lori Schmitz, SWRCB, 916/ 341-5903, email: lschmitz@waterboards.ca.gov or website: www.waterboards.ca.gov/

**May 5-7 CA**
**Fourth Biennial Nonpoint Source (NPS) Conference, San Diego.** RE: Integrated Watershed Management: Reducing NPS Pollution, CA State Water Resources Control Board, CA Coastal Commission, and US EPA. For info: Lori Schmitz, 916/ 341-5903, email: lschmitz@waterboards.ca.gov, or website: http://www.waterboards.ca.gov/

**May 6-9 CA**
**2008 Association of California Water Agencies Spring Conference & Exhibition, Monterey.** Portola Plaza & Marriot Hotels. For info: ACWA, 916/ 441-4545 or website: www.acwa.com

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**May 8-9 OR**
**Oregon Department of Fish and Wildlife Commission Meeting, La Grande.** For info: Director's Office ODFW, 503/ 947-6044, email: odfw.commission@state.or.us, or website: www.dfw.state.or.us

**May 12 WA**
**Model Toxics Control Act Seminar, Seattle.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**May 13-16 HI**
**2008 Environmental & Water Resources Institute Congress, Honolulu.** For info: Institute website: www.ewrinstitute.org/

**May 15-16 ID**
**Idaho Water Law Seminar, Coeur d'Alene.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**May 15-16 CA**
**California Water Law Seminar, San Francisco.** For info: CLE International, 800/ 873-7130 or website: www.cle.com

**May 18-22 NJ**
**Sixth National Monitoring Conference, Atlantic City.** Sheraton Convention Center. Sponsored by the National Water Quality Monitoring Council (NWQMC). For info: Laura Hughes, Water Education Foundation, email: Monitoring2008@wef.org or NWQMC website: http://lists.wefnet.org:80/t/48085/9999830/799/0/

**May 19-20 CO**
**Colorado Wetlands Seminar, Denver.** For info: CLE International, 800/ 873-7130 or website: www.cle.com

**May 20-22 AZ**
**5th National Environmental Conflict Resolution Conference, Tucson.** For info: ECR website: http://ecr.gov/ecr.asp?Link=604

**May 22 OR**
**Ecosystem Markets: Taking Action, Portland.** Sponsored by Northwest Environmental Busine44+I139ss Council, OSU Institute for Natural Resources, and the Willamette Partnership. For info: NEBC, 800/ 985-6322, email: sue@nebc.org or website: www.nebc.org

**May 28-31 AZ**
**Urbanization of Irrigated Land and Water Transfers: U.S. Committee on Irrigation and Drainage (USCID) Water Management Conference, Scottsdale.** For info: USCID website: www.uscid.org/08conf.html

**May 29-30 OR**
**Oregon Water Resources Commission Meeting, TBA.** For info: Cindy Smith, WRD, 503/ 986-0876 or website: www.wrd.state.or.us

**June 5-6 WA**
**Clean Water and Stormwater Seminar, Seattle.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**June 6 OR**
**Oregon Department of Fish and Wildlife Commission Meeting, Salem.** For info: Director's Office ODFW, 503/ 947-6044, email: odfw.commission@state.or.us, or website: www.dfw.state.or.us

**June 9-12 NM**
**The WINTERS Centennial: Will Its Commitment to Justice Endure? 100th Anniversary Conference, Santa Ana.** Pueblo of Santa Ana Hyatt Tamaya Resort. Sponsored by The Utton Center and the American Indian Law Center. For info: Ruth Singer, UNM, 505/ 277-5655, email: singer@law.unm.edu or Utton Center website: http://uttoncenter.unm.edu/

**June 10-11 MT**
**Montana Water Policy Interim Committee Meeting, TBA.** For info: Krista Lee Evans, Lead Staff, 406/ 444-1640; Committee website: leg.mt.gov

**June 16-17 CA**
**Land Use & Climate Change Seminar, Los Angeles.** For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

**June 16-21 Italy**
**4th European Centre for River Restoration (ECRR) International Conference on River Restoration, Venezia.** RE: Hydrology, Geomorphology, Ecology & Economics. For info: Website: www.ecrr.org/pagina/documents/ecrr4conf.pdf

**June 17 OR**
**Managing Carbon: Policy & Practice, Portland.** Sponsored by Northwest Environmental Business Council, Lovinger Kaufmann LLP, and Oregon Business Association. For info: NEBC, 800/ 985-6322, email: sue@nebc.org or website: www.nebc.org

**June 19-20 OR**
**Oregon Environmental Quality Commission Meeting, TBA.** For info: Wendy Simons, DEQ, 503/ 229-5301 or website: www.deq.state.or.us

**June 22-25 MD**
**Sustainability 2008-Green Practices for the Water Environment Seminar, National Harbor.** Gaylord National on the Potomac. For info: WEF, email: registration@wef.org or website: www.wef.org/Sustainability

**June 24 FL**
**Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) Workshop, Orlando.** RE: Clean Water Act, Scope of the NPDES Program, other water regulations (e.g., SPCC, Wetlands), case studies and more. For info: Trinity Consultants, 800/ 613-4473 or website: www.trinityconsultants.com

**June 24 AZ**
**The Importance of the Colorado River for Arizona's Future, Phoenix.** Arizona Biltmore Resort. Sponsored by the Arizona Water Resources Research Center. For info: Sharon Megdal, WRRC, email: smegdal@cals.arizona.edu orwebsite: www.cals.arizona.edu/AZWATER

The Water Report
Water Rights, Water Quality & Water Solutions in the West
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