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

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Erratum: We mistakenly dropped "Creek" out of the title of last issue's article on the "San Diego Creek" stormwater management system.

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& More!

AQUIFER STORAGE AND RECOVERY

THE TEXAS PERSPECTIVE

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> "Nature within the past decade has inscribed upon the wide-spreading Texas landscape grim warnings of greater disasters to come if development in the state's water resources is neglected.
>
> Texans have seen drought alternate with flood in a disheartening pattern of extremes. In many cases, the same areas suffering from acute water shortages are later ravaged by floods, and the water so urgently needed for the economy of the state wastes to the Gulf, leaving grief and destruction in its wake.
>
> The legendary vagaries of Texas weather, more amusing in folklore than actual experience, discourage any hope of relief through improvement to its natural behavior. If Texans cannot change the weather, they can at least, through sound, farsighted planning, conserve and develop water resources to supply their needs..."
>
> John J. Vandertulip, Chief Engineer, Texas Board of Water Engineers
> Submission to the 57th Texas Legislature, May 1961

INTRODUCTION

Though written in 1961 as Texas was recovering from the infamous "drought of the 50s," the quote from John J. Vandertulip, then Chief Engineer of the Texas Board of Water Engineers (predecessor agency to the current Texas Commission on Environmental Quality) accurately describes Texas' recent meteorological and hydrologic cycle experience. More importantly, the half-century old message is still to the point. The story of water in Texas is the story of its continuous state of drought [See *In re Adjudication of the Water Rights of the Upper Guadalupe Segment of the Guadalupe River Basin*, 642 S.W. 2d 438, 441 (Tex. 1982) ("The story of water law in Texas is also the story of its droughts.")].

Aquifer Storage and Recovery (ASR) technology provides an opportunity to write a new chapter in that story. Moreover, ASR presents an opportunity for water resource planners to achieve the goals of maximizing this finite resource and developing a sustainable water supply.

Surface water and groundwater are subparts of a single hydrologic cycle. [See 3 Waters and Water Rights, § 19.03, p. 27 (1991); Tarlock, Law of Water Rights and Resources, § 2.02, p. 2.2 (1993).] Implementation of the conjunctive use concept to maximize the beneficial use, and minimize the adverse impact to or waste of these valuable resources requires integrated management. In simpler terms, conjunctive management dictates a balancing of the supply and the demand of these water resources to avoid the depletion of the available supply or degradation to the quality of the resource. ASR provides an opportunity to achieve the desired balance—particularly if reuse is incorporated as a management strategy.

Texas ASR

Reserve for Low Flow

ASR Defined

ASR Benefits

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The scarcity of available new sources from "traditional" water supplies (e.g., construction of large surface water reservoirs) combined with the continually growing body of stricter environmental regulatory schemes dictates the implementation of "non-traditional" approaches to the development of water supplies. These strategies include the conjunctive use and management of surface water and groundwater resources. This article will focus on ASR technology as a water development and management technique with an emphasis on its use to extend Texas' limited water resources.

THE HISTORY OF ASR IN TEXAS

BACKGROUND

Where feasible, available water resources, particularly surface water, should be used to meet current demands and provide storage for future demands. This is particularly true during "wetter" periods of the year. The State's groundwater resources should be held in reserve, when possible, to meet demands during "dry" periods of the year. The reserved water can also be used during periods of low flows when the available surface water may have to be left flowing in watercourses to provide for the protection of instream uses, downstream water rights holders, and/or bays and estuaries. As explained herein, ASR technology provides water resource planners the opportunity to accomplish these goals.

ASR can be defined as the storage of water in a suitable aquifer through a well(s) during times when water is available, and the subsequent recovery of the water from the same or other well(s) during times when it is needed. By "definition" ASR compliments the goal of Texas' "Conservation Amendment"which is to capture the water resources of the State during times of plenty, and conserve them ("storage") for use during periods of drought [see Tex. Const. Art. XVI, § 59].

The potential to store significant quantities of water using ASR enhances the availability of water over the long-term similar to surface reservoirs. The reduced losses from seepage, evaporation and/or evapotranspiration associated with ASR, however, can provide a significant benefit over storage in a conventional reservoir.

The viability of ASR requires access to a water supply source and the presence of a suitable subsurface storage zone or aquifer. Often the source water requires treatment to meet standards appropriate for the storage and/or ultimate use. The associated reduction in suspended solids has the additional benefit of minimizing aquifer plugging during recharge operations. A schematic of a typical ASR system is shown in Figure 1.

In 1993, the former Texas Natural Resource Conservation Commission (TNRCC) granted the first water right permit for an ASR project to the Upper Guadalupe River Authority (UGRA). TNRCC is the predecessor agency to the current Texas Commission on Environmental Quality (TCEQ). The UGRA permit authorized the diversion of surface water from the Guadalupe River for municipal use. Incidental to that diversion of state water, the permit authorized UGRA to store the diverted water by injecting it down a well into the Lower Trinity Aquifer beneath the City of Kerrville after this water had been treated to drinking water standards. [See generally TEXAS WATER CODE Ch. 11 (RE: use of state surface water)]

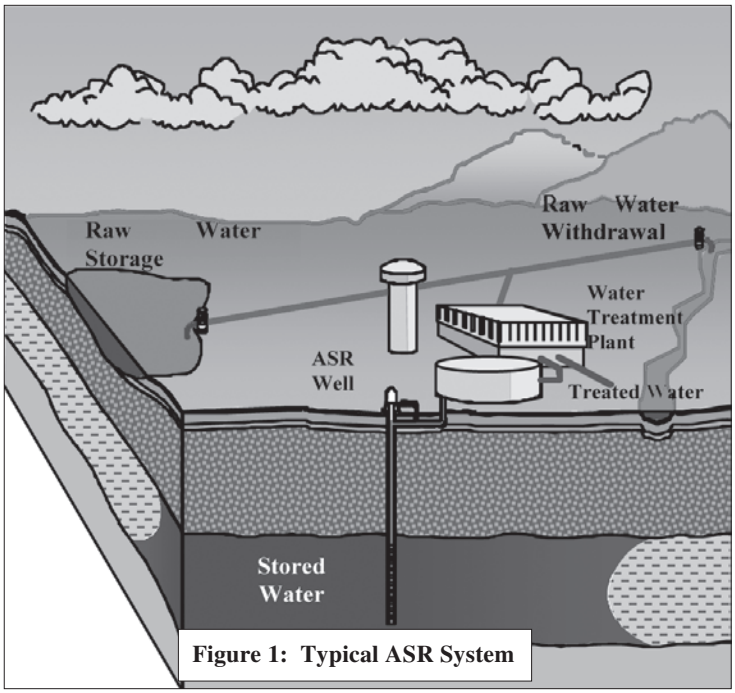


Figure 1: Typical ASR System

The development of UGRA's implementation of ASR in its 1993 permit, however, found its roots in the successful conjunctive management of the ground and surface water resources in Kerr County, Texas.

UGRA's ASR project was not the first major water resource project in Texas to rely upon the injection of treated water into a subsurface reservoir. In the mid-1980s the City of El Paso began injecting treated effluent into an underlying aquifer for additional treatment before pumping the same back into the City's municipal water supply (see Archuleta and Parker, TWR #15).

Texas ASR

"Reuse"

Reclaimed Water

Reuse ASR

Treatment Standard

Potable Aquifer

Industrial Pretreatment

Primary Treatment

THE EL PASO EXPERIENCE

Since 1985, El Paso, Texas, a city of 679,622 people, has been using a modified form of ASR to optimize its water supply "reuse" system operation. The City had estimated that approximately 40 percent of the water utility demand was returned as wastewater. With a growing population and limited availability of new water supplies, the City recognized the value of reuse as a means to meet El Paso's growing water needs.

In cooperation with the US Bureau of Reclamation (Bureau) and the US Environmental Protection Agency (EPA), the El Paso Water Utilities (EPWU) completed construction of the Fred Hervey Water Reclamation Plant (FHWRP) in 1984. With a capacity of 10 **m**illion **g**allons per **d**ay (mgd), reclaimed water produced at the plant was used initially to supply cooling water for the El Paso Electric Company's Newman Power Plant and irrigation water to the Painted Dunes Municipal Golf Course—both of which were previously supplied with potable water from EPWU's municipal system. The effluent not used to meet the demands of these two customers is recharged to the Hueco Bolson aquifer which provided more than 55 percent of EPWU's potable water supply in 1993 (Morgan, et. al., 1993).

A mix of reclaimed water and native groundwater is recovered from the Hueco Bolson aquifer by municipal production wells located both up-gradient and down-gradient of the recharge wells. [See generally "*Treated Wastewater Recharges Aquifer*" Vol. 3, No. 4 Texas Water Savers (Fall 1997, Texas Water Resources Institute)]

In August 1997, El Paso initiated construction of a second effluent reuse project in a joint venture with the Bureau. Effluent generated at the "Northwest Reclaimed Water Project" is used to irrigate golf courses, school yards, parks and athletic fields and, ultimately, residential landscapes. By the year 2006, Project planners estimate that the Project will meet customer demands of up to 1,500 million gallons per year in the northwest portion of El Paso. [See generally "*Northwest El Paso Reclaimed Water Project to Supply Residential , Commercial Irrigations*" Vol. 3, No. 4 Texas Water Savers (Fall 1997, Texas Water Resources Institute)]

While recharge and recovery are not accomplished through the same well, the El Paso reclaimed water projects represent a milestone in reuse ASR development in Texas. The FHWRP plant was one of the first in the nation to take raw sewage and treat it to almost drinking water quality. It was the first, and currently the only, reuse project in Texas to use aquifer recharge as a storage technique. The FHWRP plant was featured in the internationally acclaimed PBS series "*Water: The Drop of Life*." This plant has also received numerous awards including: the 1994 AMSA Public Information and Education Award; second place in the 1994 national EPA Operations and Maintenance Excellence Award, No Discharge category; and the 1998 American Water Works Association's Conservation and Reuse Award. In 1999, the plant received special recognition by the El Paso del Norte Region Mission Possible-Survival Strategies in the category "Protection and Preservation of the Environment."

An Environmental Impact Statement (EIS), required for the project by EPA under provisions of the National Environmental Policy Act, concluded that the wastewater must be treated to drinking water standards prior to injection into the Hueco Bolson aquifer. The EIS also required the reuse water to meet proposed or suggested criteria for compounds such as trihalomethane and certain viruses which were unregulated at the time. The objective of these stringent quality standards was that the reuse water be as safe to consume as any other supply without reliance on the significant dilution and secondary treatment that would occur in the aquifer and, subsequently, in the distribution system upon recovery.

Because the reuse water is recharged directly into a potable aquifer, the system was designed to minimize public health risks. Safeguards include both management of the collection system and reliable, redundant, treatment processes. Finally, the quality of the reuse water is verified prior to recharge.

Wastewater delivered to the FHWRP is primarily of domestic origin with less than 0.1 percent industrial contribution (Morgan, et. al., 1993). An industrial pretreatment program is maintained by the EPWU to protect the environment from the adverse impacts which may occur when hazardous or toxic wastes are discharged into the sewage system.

The main components of the industrial pre-treatment program include: establishment of Technically Based Local Limits (TBLL); discharge permitting; inspection; sampling; and enforcement. The TBLLs are specific numerical discharge limits established to protect the operation of the EPWU treatment system, the quality of the Rio Grande, and the quality of the sludge. Additional discharge limitations apply to individual wastewater discharge permits.

The FHWRP system is divided into two parallel 5 mgd trains for a total rated capacity of 10 mgd. The primary treatment processes include: screening; degritting; primary clarification; two-stage bio physical PACT ® process; lime treatment; recarbonation; sand filtration; ozonation; **g**ranular **a**ctivated **c**arbon (GAC) filtration; and chlorination. The PACT ® process, developed by Dupont and Zimpro,

Texas ASR

combines conventional aerobic biological treatment with **p**owdered **a**ctivated **c**arbon (PAC) to remove the majority of organics and virtually all nitrogen compounds. Lime is used to precipitate a wide band of heavy metals and to enhance virus inactivation and phosphorous removal.

Ozone Disinfectant

Although lime treatment significantly reduces virus viability, ozone is the primary system disinfectant. Ozone is used instead of chlorine because it is more effective at cryptosporidium inactivation and, unlike chlorine, ozone does not generate trihalomethanes. Ozone also improves the performance of the GAC filters by breaking down complex organic compounds and assisting bioactivity on the carbon. The GAC filters also reduce the concentration of taste and odor producing compounds, pesticides, synthetic organics, and trihalomethane precursors. The GAC is a follow-up process to the PACT ® system in organics removal. Chlorine is added to provide a residual in the reuse system as required by regulation.

Safeguards

Verification and Monitoring

The final safeguards in the El Paso system are not physical but administrative. Reuse water is directed to one of three separate 3.3 million gallon clearwells after treatment. Composite samples are collected as each clearwell is filled. Prior to release from the clearwells to reuse customers or for recharge into the Hueco Bolson aquifer, the treated effluent is analyzed for turbidity, nitrate, total organic carbon, pH, alkalinity, ozone residual, and chlorine residual. If any water quality parameter is out of the allowable range, the effluent is recycled to the treatment plant headworks. At any given time, one clearwell is being filled, tested, or drained.

Recharge Wells

Recharge Wells

While the wells at the FHWRP plant are equipped with pumps, the pumps are operated only to redevelop the wells and restore recharge capacity. Recovered water is not routinely delivered to the reuse system customers. As such, while the wells are designed and permitted as Class V ASR injection wells, the operation of the wells does not meet the generally accepted definition of ASR because water is recovered for beneficial use from the same well it was injected into for storage or recharge.

Reuse water which meets water quality standards is either delivered to reuse customers to meet current demands or, when supplies exceed demands, is directed to one of the FHWRP's ten recharge wells. The recharge wells are completed into the Hueco Bolson aquifer and are located approximately three-fourths of a mile up-gradient and one-forth of a mile down-gradient from existing EPWU public supply wells.

Nine of the 16-inch diameter wells are constructed with uncoated mild steel casing and 16-inch diameter galvanized, continuous wire-wrap screen. A combination of 16-inch and 18-inch diameter galvanized mill-slotted screen is used in a tenth well. The wells are completed with multiple screen intervals to a total depth of between 632 and 881 feet below land surface. The average recharge rate after construction was 498 **g**allons **p**er **m**inute gpm with a design backflush rate of 700 gpm (Brock, et. al., 1992).

Costs

Costs

The FHWRP was completed in the fourth quarter of 1984 at a cost of $26.7 million. This cost included all treatment-related facilities. Recharge facilities, including holding tanks, wellfield piping, and recharge wells were also completed in 1984, with recharge operation beginning in May 1985. The cost of these facilities, including monitor wells, was $1.8 million. Operating costs were estimated at $1.55/1000 gallons in 2003, which is comparable to costs for secondary treatment. Through 2002, approximately 18.5 billion gallons of high quality reuse water have been recharged to the Hueco Bolson aquifer (Balliew, personal comm., 2003).

UGRA's Conjunctive Management of Water Resources Leads to ASR

Aquifer "Mining"

UGRA's ASR project, which became fully operational almost a decade after El Paso's FHWRP project in the Hueco Bolson, had its roots in early conjunctive management efforts. Historically, the City of Kerrville, which sits on the banks of the Guadalupe River, relied upon the Hosston-Sligo Sand of the Edwards-Trinity Group of Aquifers as the sole source for its municipal water supply system. According to Kerrville's water use records for groundwater pumped (dating back to the mid-1940s), the City was able to pump sufficient quantities of groundwater to meet 100% of its water supply needs. The City's total dependence upon the available groundwater supplies over the years caused a dramatic drop in the level of the aquifer. By the late-1970s, Kerrville's continued reliance upon groundwater threatened to "mine" the aquifer (i.e., withdraw water in excess of natural recharge).

Surface Water

In 1977 UGRA secured a permit to divert and treat water from the Guadalupe River for municipal purposes. Since 1981, the year UGRA brought its water treatment plant on-line, water has been diverted from the Guadalupe throughout the year to meet the City's base-load daily demands. Reliance upon the City's groundwater reserves has become reserved to the hotter summer months when peak demands on

Texas ASR

Conjunctive Use

Aquifer Recovery

Water Supply Study

Alternatives

ASR v. Reservoir

Permit Protest

Potable ASR

the City's system exceed the capacity of the UGRA plant. The positive effect of implementing the conjunctive use/management scheme is reflected in the reduction of the City's annual demands on groundwater to an average 412 **a**cre-**f**eet (AF) per year. The dramatic influence of this conjunctive management on the City's groundwater supply is reflected by data collected during the period 1981 through mid-1991, when the combination of natural recharge and reduced demands upon the aquifer below Kerrville facilitated a recovery in aquifer levels of approximately 200 feet. By the mid-1990's, aquifer levels recovered to levels seen in the mid-1940s before municipal pumping of the aquifer began to deplete the resource. The City's remaining 3,000 (+) AF per year municipal demand was met from the Guadalupe River as treated surface water.

Through the 1980s the City of Kerrville's municipal demands continued to be met with the combination of the available groundwater and UGRA's surface water supplies. Significant population growth within the City of Kerrville and the entirety of Kerr County during the 1980s, however, brought into question the adequacy of UGRA's existing conjunctive use operations to meet future demands. To quantify those future water demands, identify potential new water supply sources, and insure its ability to meet the same, UGRA spearheaded an initiative to conduct a regional Texas Water Development Board (TWDB)-sponsored study to evaluate all available groundwater in addition to surface water supplies within Kerr County. The UGRA managed study was co-sponsored by the City of Kerrville and Kerr County. The findings and conclusions of UGRA's water supply analysis are documented in a report prepared for the TWDB entitled: "*Kerr County Regional Water Plan Phase 1A*" (CH2M Hill May 1992).

Upon completion of the Kerr County water supply study, UGRA filed a water rights application in July of 1990, seeking approximately 3500 acre-feet of additional surface water supplies out of the Guadalupe River. As initially filed, UGRA's application contemplated alternative water supply strategies. Specifically, the application proposed the construction of a traditional/conventional large off-channel surface reservoir, or, in the alternative, implementation of what was then considered an "innovative technology," i.e., ASR, to firm-up the municipal yield desired in the permit.

Based upon additional testing of the hydrogeologic characteristics of the Hosston-Sligo Sand beneath Kerrville, UGRA concluded that the development of the underlying aquifer as a "storage facility" for surface water diverted from the Guadalupe River would be the most economically efficient and environmentally sensitive feasible means to firm-up the yield sought by UGRA for its municipal use. [See "*Aquifer Storage Recovery Feasibility Investigation Phase 1—Preliminary Assessment*" (CH2M Hill April 1988); "*Aquifer Storage Recovery Feasibility Investigation Phase IIA Monitoring Well PZ-1*" (CH2M Hill December 1989); "*Aquifer Storage Recovery Feasibility Investigation Phase IIB: Full Scale Testing and Evaluation*" (CH2M Hill April 1992).

Results from the engineering analysis commissioned by UGRA convinced UGRA that it could utilize ASR as a substitute for construction of a traditional large off-channel reservoir. The ASR option saved UGRA an estimated $26-to-$30 million dollars in capital expenditures in 1990 dollars, as well as at least a decade in project implementation. The underground storage of the water also eliminated the significant evaporative losses associated with the storage of water in a traditional surface water reservoir. The elimination of these losses in the UGRA system had the beneficial "ripple effect" of reducing the total volume of water required to be diverted to meet the City of Kerrville's annual demand.

UGRA anticipated that with its new permit and the use of ASR, UGRA would be able to meet the municipal demands of the City of Kerrville and surrounding central Kerr County region through at least the year 2040. This supply projection included the possibility of a reoccurrence of a 1950s-maginitude "drought of record."

A protest to UGRA's permit was lodged, relying, in part, on the theory that there was an error of law in finding that the water stored in the aquifer remained "state water." The permit was upheld on appeal. [See *Texas River Protection Association v. Texas Natural Resource Conservation Commission*, 910 S.W. 2d 147 (Tex. App. - Austin 1995, writ denied).]

In 1997, UGRA sold its water treatment system, including the ASR well, to the City of Kerrville. Since then, Kerrville has permitted and brought on-line a second ASR. Kerrville has plans to further expand the system with construction of a third ASR well which is in the design and permitting phase.

San Antonio Implements ASR

Building on the success experienced in both El Paso and Kerrville, the San Antonio Water System (SAWS) implemented a potable ASR system in Bexar County. The system is designed to meet several strategic goals which include achieving full utilization of San Antonio's Edwards Aquifer resources and minimizing the regional impact on spring flows at Comal and San Marcos Springs. During seasonal periods of high flow from springs (usually the winter months) the Edwards Aquifer would be producing available water at a rate exceeding SAWS's daily demands. SAWS is therefore able to store excess

Texas ASR

ASR Benefits

Edwards Aquifer production in the Carrizo Sand Formation of the Carrizo-Wilcox Aquifer utilizing ASR technology. Post-injection, the Edwards water will be recovered from storage either to meet SAWS's peak summer demands, or to augment curtailed supplies during extended drought periods. The benefits of ASR implementation to SAWS include: a 25 percent reduction in peak summer withdrawals from the Edwards Aquifer; no evaporative losses or environmental impacts associated with surface water impoundment; and a more complete utilization of the Edwards source. Initially, the SAWS's ASR system will be operated in a production mode until excess Edwards's capacity becomes available for storage.

The test cycle for the ASR well field (30 mgd) took place in October 2004. Other facilities under construction include a water treatment plant, high service pump station, and 27 mile pipeline to transmit water to and from the SAWS distribution system. The water treatment plant, to be used on an interim basis, is designed to reduce iron and manganese levels in the native groundwater and condition the water to be compatible with the Edwards aquifer water in the SAWS system.

Desal Source

SAWS has begun construction of the next stage of its ASR project, which includes an additional 34 mgd expansion of the ASR well field capacity. SAWS is also investigating the potential of a desalinization project in the "brackish" zones of the Carrizo-Wilcox Aquifer. Water developed from this source, after treatment, may also be stored using ASR. Economic analysis of the feasibility of ASR storage is still necessary due to the high cost associated with treatment of the brackish water to drinking water standards.

TEXAS REGULATORY FRAMEWORK FOR ASR

REGULATION OF ASR COMES TO TEXAS

Permitting Roadblocks

Despite the benefits associated with substituting ASR for a traditional surface reservoir, the permitting of UGRA's ASR system was not without legal roadblocks in 1990. UGRA was required to file an application for the diversion of additional water rights (see TEXAS WATER CODE § 11.121). In addition to the normal surface water rights requirements, UGRA had to obtain permission from the TNRCC to use injection wells to test the "ASR potential" for the project.

General Requirements

The development of an ASR system is governed by the rules for Class V injection wells under the State's Underground Injection Control Program (see 31 Texas Administrative Code (TAC), Chapter 331). Other legal requirements which had to be addressed during the course of UGRA's ASR permit process included the usual requirements to demonstrate: the beneficial use to be made of the water appropriated; that water was available; that no adverse impact to human health or safety detrimental to public welfare would occur; that downstream water rights and vested riparian rights would be protected; that reasonable diligence would be used to avoid waste and achieve water conservation; and protection of instream uses and downstream bays and estuaries.

Rule Vacuum

Ironically, a further "roadblock" consisted of a "non-existent" obstacle. Because UGRA's application to use ASR to firm-up the proposed municipal water supply was the first of its kind in Texas, the TNRCC had no "formal guidance, policy, or rules" with respect to management or the use of ASR. The lack of rules, coupled with the lack of some prior experience by the TNRCC with this type of permit application, left UGRA vulnerable to attacks on a variety of irrelevant issues during the permitting process.

ASR Bill

In 1995, the Texas Legislature addressed the regulatory void UGRA experienced by enacting House Bill 1989 authorizing the storage and recovery of appropriated surface water within or above an **u**nderground **s**ource of **d**rinking **w**ater ("USDW"—see Acts of 1995, 74th Leg. R.S. Ch. 309, codified at TEXAS WATER CODE §§ 11.153-11.155). A USDW is defined as an aquifer which supplies water for human consumption or has a total dissolved solids concentration of less than 10,000 mg/l (30 TAC § 331.2 (94)). Amendments passed in 1997 removed the location restrictions in the original legislation which initially restricted ASR implementation to 10 named counties and eight specific aquifers. No substantive amendments to Texas' statutes regulating surface water have been enacted since 1997 (see TEXAS WATER CODE §§ 11.153 – 11.155).

Surface Water Standards

Pursuant to TEXAS WATER CODE § 11.154, when evaluating a surface water permit that incorporates ASR the TCEQ is required to consider whether the introduction of water into the aquifer would alter the geophysical, chemical, or biological quality of native groundwater to a degree that it would: (1) render the groundwater produced from the aquifer harmful or detrimental to people, animals, vegetation or property; or (2) require treatment of the groundwater to a greater extent than the native groundwater requires before being applied to the same beneficial use. TCEQ must also conclude: (1) that a reasonable recovery of the appropriated surface water will occur; and (2) that reasonable diligence will be used to protect the water stored in the receiving aquifer from unauthorized withdrawals to the extent necessary to maximize the permit holder's ability to retrieve and beneficially use the stored water without experiencing unreasonable losses of appropriated water. The use of the term "appropriated water" limits the application of the statute

Texas ASR

to surface water—as opposed to groundwater which does not require the issuance of a TEXAS WATER CODE § 11.12 permit.

To implement the ASR legislation, TCEQ amended Chapters 295, 297 and 331 of its rules, which are codified in Title 30 of the Texas Administrative Code (30 TAC). Chapters 295 and 297 address the procedural and substantive requirements for obtaining a surface water rights permit for use in an ASR project. ASR wells are considered Class V injection wells for purposes of the State's Underground Injection Control (UIC) Program. The amendments to Chapter 331 address the technical and procedural requirements for obtaining an injection well permit for an ASR project. Section 331.184(3) (30 TAC) authorizes construction and operation of Class V injection wells "by rule" for systems storing potable water.

UIC Program

While *not* controlled by the provisions of Chapter 11, TEXAS WATER CODE, groundwater is still subject to TCEQ regulations for purposes of ASR (see generally 30 TAC Chapter 331). Specifically, ASR projects, regardless of the water source, require Class V Injection Well Permits.

ASR Permitting in Texas

Water Source

The specific requirements for permitting an ASR project are dependent upon the source of water for the project. If surface water is involved, either a water rights permit pursuant to TEXAS WATER CODE § 11.121 or an amendment to an existing water right authorizing ASR will be required (see TEXAS WATER CODE §§ 11.121, 11.122, 11.153-11.155; 30 TAC Chs. 295, 297). In addition to the traditional requirements for a water right permit, a surface water ASR project has special permitting requirements (see 30 TAC Chs. 295 (regulating permitting of surface water) & 331 (regulating Texas' UIC program)).

Surface Water

ASR projects using surface water are permitted in two phases. "Phase I" of an ASR project contemplates the temporary use of state water to prove the viability of the ASR project (see 30 TAC §§ 295.21-295.22).

Viability

AS PART OF PHASE I, TCEQ RULES REQUIRE THE FOLLOWING INFORMATION:

1) Information necessary to demonstrate compliance with 30 TAC Chapter 331 (including subchapters A, H and K) of the TCEQ's rules
2) A map/plat reflecting the proposed depth and location of the injection and recovery wells, and the aquifer proposed for storage of the water
3) If the aquifer is subject to the jurisdiction of a groundwater district(s), then the application must also include:
   a) proof that notice (e.g., a copy of the ASR application) was provided to the district(s) by certified mail
   b) a copy of any agreement with the district(s) regarding the ASR project

Upon completion of Phase I, the applicant must prepare a "final report" compliant with TCEQ requirements and submit it to the TCEQ as part of the ASR surface water application.

Operational Plan

The final report is the first step in Phase II of the ASR application. The next step is the submission of an operational plan outlining the projected: injection rates and volumes; frequency of injection periods; retrieval rates and volume; frequency of retrieval periods; projected annual radial distances of travel from injection well(s); maximum projected travel distance from injection well(s) over projected; and the location of injection, retrieval and monitoring wells.

Protective Requirements

Additionally, the applicant must prepare a report identifying all existing domestic, public water supply, irrigation and commercial wells located within one-quarter mile of the project's buffer zone. A required monitoring plan must describe how water injected and retrieved will be measured and reported. The rules also require the applicant to provide any other information necessary for the Executive Director to protect groundwater sources of drinking water. Unless the applicant has eminent domain powers (i.e., condemnation authority), the application must include written easements, or other evidence of authority, to store the water beneath, or construct and maintain ASR facilities on, the properties of third parties. Finally, an ASR application requires maps which are additional to the "mapping" requirements for a standard water rights application.

ASR Maps

ASR APPLICATION MAPS MUST INCLUDE:

1) Overall project description, including all pertinent facilities
2) Names and locations of all groundwater formations state water will be stored in and retrieved from, and the general flow direction
3) Cross sections/profiles of groundwater formations associated with the project
4) If applicable, identification of any Chapter 294 critical groundwater area in which storage is anticipated

As mentioned, an ASR project must comply with the State's UIC Program. Specifically, the project wells must have Class V injection well permits. As part of the Class V Injection Well permit criteria, the

Texas ASR

Criteria

applicant is required to demonstrate the mechanical integrity of the wells system, and that injection will not result in pollution of an underground source of drinking water. Additionally, the permit must include terms and conditions that will protect fresh water from pollution. Construction standards for Class V wells are prescribed by TCEQ rule. Wells must be installed by a licensed water well driller. Criteria for sealing of well casing, surface completion and other protective measures, including sampling, are also outlined in the rules. The rules require both pre-construction and post-completion reporting to the TCEQ (see 30 TAC § 331.132(b)).

Abandonment of ASR Wells

If use of a Class V well is to be discontinued or abandoned, TCEQ rules prescribe alternative means for closure. As a general rule, closure requires the removal of all casing, and filling of the well bore with cement from the bottom to the land surface. Alternatively, closure may be accomplished by filling the well with "fine sand, clay, or heavy mud followed by a cement plug" at least ten feet below land surface. This alternative, less costly closure, is only available if the well was not completed through zones containing "undesirable groundwater", i.e. water that is injurious to human health and the environment or water that can cause pollution to land or other water. Zones containing undesirable groundwater must be plugged by isolating them with cement plugs and the remainder of the well bore filled with bentonite, and then plugged with cement from land surface to a depth of at least ten feet.

"REUSE"

TAKING ASR TO THE NEXT LEVEL IN WATER RESOURCE DEVELOPMENT

"Reuse" Definition

As the population of Texas continues to mushroom, water managers must develop and implement strategies to increase, enhance and, whenever possible, renew and/or extend the "usability" of Texas' limited surface and groundwater resources. The "reuse" of the available water resources, i.e., the use of treated effluent to meet both potable and non-potable water supply demands, is one of several non-traditional strategies available to meet both existing and growing water demands. If reservoir storage represents a classic example of traditional water development strategy, then coupling "reuse" and ASR is a viable tool for the "re-development" of our finite water resources.

The major water supply planning effort mandated by the Texas Legislature in 1997 (Senate Bill 1) required 16 regional planning groups around the State to both identify supply deficits and consider various water management strategies to meet the identified deficits over a 50 year planning horizon. Of the 14 prescribed strategies, the development or increased reliance on "reuse" of treated wastewater was included as a key management strategy in 10 of the 16 regional plans. In fact, the Dallas and Ft. Worth regional planning group projected that 34 percent of its year 2050 demands would be met with reuse.

In Texas, wet weather reuse supplies greatly surpass demands where irrigation is the primary reuse water demand. Accordingly, seasonal declines in irrigation demands result in significant releases of this valuable resource. In less temperate parts of the United States, the potential loss of the resource is magnified by the shorter growing season.

Supply/Demand Periods

As it has with potentially potable water supplies, ASR can provide an environmentally sound and economically viable means for large-volume storage of reuse water during periods of excess supply for recovery to meet both normal and peak demands during drier periods. This strategy is gaining momentum in the United States. In Florida, the Englewood Water District, which plans to utilize ASR to achieve full reuse of their treated effluent, provides a good example of how ASR can facilitate the storage and beneficial use of treated effluent year-round regardless of seasonal demand fluctuations (see below).

Texas Regulatory Framework for "Reuse"

INTRODUCTION

No specific regulatory provisions or criteria currently exist for the storage of water not meeting drinking water standards within or above a USDW. The current water quality standards adopted by the TCEQ are not specifically mandated by the provisions related to ASR in Chapter 11 of the TEXAS WATER CODE, which requires only that the TCEQ consider whether the injection of the water will affect the native groundwater in a way that will cause its subsequent use to be harmful or detrimental, or require it to be treated to a higher degree than would be required for use of the native groundwater.

TCEQ's rule on "operating requirements" for ASR wells does, however, have a specific water quality requirement:

Drinking Water Standards

> "The quality of water to be injected must meet the quality criteria prescribed by [TCEQ's] drinking water standards as provided in Chapter 290 of this title (relating to Water Hygiene)." [See 30 TAC § 331.184(e)]

The adopted criteria appears to have been based upon the fact that UGRA's ASR project, which was the model followed by the TCEQ (as discussed above), required diverted surface water from the Guadalupe River to be treated to drinking water standards before it could be injected into the aquifer (see TCEQ Water Rights Permit No. 5394 (authorizing UGRA's ASR project)).

Texas ASR

Reuse Requirements

"Demand Basis"

Prior Treatment

Legal Uncertainty

Legislation

"Treated Effluent"

Reuse Permits

CHAPTER 210 (30 TAC)

Unless authorized by an individual wastewater discharge permit issued pursuant to Chapter 26, TEXAS WATER CODE, and Chapters 285 and 305 of the TCEQ's regulations (30 TAC), use of "reclaimed" or "reuse" water in Texas is governed by Chapter 210 of the TCEQ's regulations (30 TAC). Chapter 210 prescribes the general requirements for the use of reuse water, as well as quality criteria, design and operational requirements for the beneficial use of reclaimed water. Authorization to use reclaimed or reuse water pursuant to Chapter 210, however, does *not* provide a substitute for a discharge permit issued under Chapter 305 *if* a discharge into the waters of the State is contemplated.

A thorough discussion of the requirements of Chapter 210 is beyond the scope of this article. However, prior to providing the reclaimed water to a third party, the producer must provide written notice to TCEQ's Executive Director and receive written approval (see 30 TAC § 210.4). TCEQ has not developed a standardized form or application form for the "notice." Accordingly, an applicant should provide the information prescribed in Section 210.4, entitled "Notification," of Chapter 210.

To insure its "beneficial use," and avoid potential and/or actual unlawful and/or harmful discharges into "waters of the state," reclaimed water can only be supplied on a "demand basis" (see 30 TAC § 210.7). Accordingly, the user has the right to refuse delivery at any time. As a result, any plan for using reclaimed water should have an adequate "storage" component. Notwithstanding the "demand" condition prescribed by Section 210.7, however, the user must comply with the terms of an otherwise lawful agreement related to the reclaimed water, e.g., the user may be subject to contractual obligations that protect the producer, such as take or pay provisions, providing adequate user facility storage.

Reclaimed water can be made available for groundwater recharge, as well as aquifer storage and recovery projects, with the recharged reclaimed water becoming available for both potable and non-potable water purposes. The current major issue to be addressed in Texas is the level of treatment that will be required prior to injection and storage and/or recovery for utilization for potable and/or non-potable purposes. As described above, this practice of supplementing municipal water supplies with reclaimed water is utilized by the City of El Paso, Texas (see Roebuck, *City of El Paso Water Conservation & Reuse of Wastewater Program*, 1997 Water Conservation Conference Presentations (available on-line at www.cagesun.nmsu.edu/AGRICULTURE/wcc/epconser/index.html)).

TEXAS' "TREATMENT" OF ASR AND TREATED EFFLUENT

As noted above, neither the statutory nor regulatory provisions of Texas law directly address the issue of injection of treated effluent for storage in, and subsequent retrieval from, an underground reservoir utilizing ASR. The silence on the issue raises the question of whether or not Texas law currently prohibits the activity or limits the practice based upon the level of treatment quality. In an effort to resolve the uncertainty, in the Spring of 2005, the 79th Texas Legislature proposed legislation expressly authorizing the injection of treated effluent for storage and subsequent beneficial use using ASR technology (see Senate Bill 3, 79th Tex. Leg. R. S. (2005)). In the third of what have come to be referred to as "omnibus water bills" considered by the Texas Legislature during the last ten years, legislation introduced as "Senate Bill 3" was designed to address a multitude of surface and groundwater related issues facing the State of Texas.

As part of Senate Bill 3, the Legislature added a definition for the term "treated effluent" to Chapter 26 of the TEXAS WATER CODE.. The proposed definition provided that "treated effluent" means "waste that has been treated as required by, as authorized to be discharged under, a permit [issued under Chapter 26, TEXAS WATER CODE]."

The Legislature proposed amendments to Chapter 26, TEXAS WATER CODE, that would expressly authorize TCEQ to issue permits, or permit amendments, for the injection and subsequent recovery for beneficial use of treated effluent. The Legislature expressly prohibited such a permit from authorizing injection of any "radiological, chemical, or biological warfare agent or high level radioactive waste."

In order to grant an ASR permit authorizing injection of treated effluent, the proposed legislation would require the TCEQ to define that the issuance of the permit would *not*:

1) violate a state or federal law or rule or regulation adopted under such a law;
2) alter the physical, chemical, or biological quality of the native groundwater to a degree that the introduction of the treated effluent would:
   A) render groundwater produced from the aquifer harmful or detrimental to people, animals, vegetation, or property; or
   B) require treatment of the groundwater to a greater extent than the native groundwater requires before being applied to that beneficial use; or
3) interfere with the purpose of this chapter [26].

[See SB 3, engrossed version, Section 2.28, 79th Tex. Leg. R. S. (2005)]

Texas ASR

Legislation Fails

The proposed legislation expressly prohibited injection of treated effluent until TCEQ had either issued a permit authorizing injection from the treatment facility, or granted some other approval as an exception to the statute.

Senate Bill 3 also proposed amendments to Chapter 27 of the TEXAS WATER CODE related to the Texas UIC program expressly authorizing TCEQ to process and issue as Class V injection wells permits for Reuse ASR. The proposed amendments directed TCEQ to seek public comment on applications for such permits. The legislation exempted the applications from public contested case hearings.

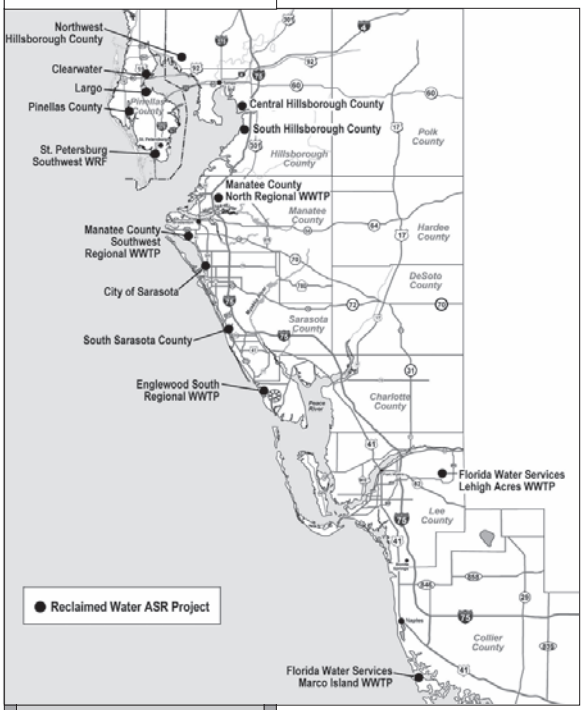
Senate Bill was favorably passed by the Texas Senate (see Proceedings of the Senate - 59th Day, Texas Senate Journal 79th Legislature, Regular Session, at 1486 (April 29, 2005)). The legislation got stalled in the Texas House of Representatives, however, and along with the majority of the water legislation introduced during the Session died. Accordingly, for now, the question of whether Texas law currently prohibits the use of ASR technology to store treated effluent in underground reservoirs for subsequent retrieval and beneficial use, or places any limits on the practice based upon the level of treatment quality, remains unanswered.

RECLAIMED WATER AND ASR: THE FLORIDA EXAMPLE

Florida's leadership role in the area of reuse ASR has been the result of multiple factors. Historically, a large quantity of Florida's effluent had been disposed of using deep injection wells. Increased drilling and permitting costs for development of new deep injection well capacity motivated wastewater utilities and state officials to seek alternative disposal mechanisms. A more positive motivating factor was Florida's existing customer base for the use of treated effluent. The growth of demand by those customers also prompted wastewater utilities and state officials to seek a means to extend the availability of the treated effluent as a water resource supply. The result of these juxtaposed factors has been an increased emphasis in the development of ASR technology as a means to decrease the required disposal capacity through storage and reuse of the state's treated effluent.

The Englewood Water District (EWD) located along Florida's western coast is a particularly helpful example of the expansion of ASR technology in the reuse arena. EWD provides water, wastewater, and reclaimed water services to a community of approximately 50,000 people in Englewood, Florida. EWD is a political subdivision of the State of Florida, governed by an elected Board of Supervisors, with a service area of approximately 47 square miles. Englewood relies heavily on reuse to provide sustainable water supplies for non-potable use. Implementation of reclaimed water ASR has enabled several Southwest Florida utilities, including EWD, to increase the capacity and reliability of their reuse systems over the past several years. Approximately 10 sites have been permitted to construct pilot ASR programs for recharge and recovery of highly treated reclaimed water, four of which have constructed test wells. Two of these facilities began cycle testing using reclaimed water in July 2001, one of which is the EWD's system. Figure 2 shows the locations of utilities with reuse water ASR programs under various stages of development.

Figure 2: Reuse Water ASR Systems In Development



EWD is in the process of providing public sewer service to the vast majority of the community, that, until a few years ago, was almost entirely on private septic systems. EWD's South Regional Wastewater Treatment Plant (SRWWTP) recently expanded from 1.1 mgd to 2.2 mgd and an additional expansion of the facility to 3.0 mgd is underway. The facility is designed to meet Florida's public access reuse standards, which generally require secondary treatment followed by filtration and chlorination. The effluent produced by the SRWWTP either meets Florida's high level disinfection requirements, or the effluent is sent to a 5.2 **m**illion **g**allon (mg) "reject pond." Through July 2001, all reclaimed water produced by EWD had met the high level disinfection standards.

Residential Reuse

Current EWD reuse customers consist of four golf courses and a sports complex. No other disposal alternative was available, and the only available storage was an onsite storage pond with a capacity of approximately 6 mg. Another golf course is scheduled to come online in the near future and a spray irrigation system has been constructed onsite to provide additional effluent management. Residential reuse has not occurred yet as neighborhoods would require retrofits to install dual-piping networks. However, residential reuse is being explored for new development in the EWD Service Area as a method to further conserve the limited groundwater resources available for potable water supplies in the area.

Texas ASR

Seasonal Imbalance

ASR Need

Drinking Water Standards

Alternate Standards

With the aggressive sewering program, 100 percent reuse rapidly became an unreliable method of disposing of the entire wastewater stream. This is typical of many reuse systems in Southwest Florida which can utilize most, if not all, of the reclaimed water produced during the Spring dry season but have little to no reuse demands during the wet weather conditions which continue throughout much of the Summer rainy season. However, other reuse utilities have surface water discharges or deep injection wells to serve as a wet weather backup to their respective reclaimed water programs. Several reuse utilities have placed moratoriums on reuse system expansion until additional dry season supplies can be developed. This is because they are already using all of the available supply and existing reuse customers have often made significant investments in obtaining this service and would not be satisfied with intermittent service. The three days of wet weather storage required by Florida's reuse regulations is insufficient during periods of high rainfall or tropical weather systems regularly affecting the region. Furthermore, limited reuse is necessary during the cooler winter months when evapotranspiration rates are low. These seasonal imbalances of supply and demand are a driving force in the implementation of ASR to provide the large volumes of seasonal storage necessary to expand reclaimed water use along Florida's west coast.

EWD Treatment Facilities

EWD's treatment facilities have reliably met federal primary Drinking Water Standards (DWSs) in the effluent produced. There is sufficient ammonia present in the reclaimed water to form chloramines following the addition of free chlorine, which is beneficial in that **t**ri**h**alo**m**ethane (THM) formation in the reclaimed water is relatively low, averaging 20 to 30 µg/L (i.e., micrograms per liter, indicating 1/1000th of a milligram—a means to measure parts-per-billion). Nitrate and nitrite levels are also surprisingly low for a facility that is not designed for nutrient removal. Cryptosporidium and Giardia Lamblia monitoring has also demonstrated that pathogens are being effectively removed in EWD's existing treatment process.

State secondary standards must also be met in the reclaimed water, or relief mechanisms must be obtained, to allow effluent storage in an ASR well. While the secondary DWS for odor (the "3" **t**hreshold **o**dor **n**umber (TON)) was not reliably met, the native groundwater contained odor greater than 100 TON. This condition enabled an alternative standard at the site and a relief mechanism was not needed. The only other DWS not reliably met in the effluent is color (15 **c**olor **u**nits (CU)). A state relief mechanism referred to as a Water Quality Criteria Exemption (WQCE) was utilized to establish an alternate groundwater discharge standard of 75 CU at this site. During the WQCE permitting process, which requires a public notice period, the permittee is required to demonstrate that there are no health effects or other adverse public effects that would result from allowing the elevated color standard requested. EWD was able to justify the higher level due to the aesthetic-based nature of the color standard.

Re-Use ASR Pilot Program

A cross-section of EWD's ASR pilot system is shown on Figure 3, below. The ASR well consists of a 16-inch carbon steel casing set to a depth of 500 feet **b**elow **l**and **s**urface (bls) with an open hole completion to 700 feet in depth. Three monitoring wells are required to monitor: water quality changes in the storage interval; the first permeable unit within the Underground Source of Drinking Water (USDW) at the site; and an off-site monitoring well to ensure water quality standards are maintained at distance from the ASR operations. The monitoring well monitors the zone utilized by public utilities for brackish water supply for Reverse Osmosis (RO) treatment. The ASR well is capable of recharging and recovering approximately 1,050 gpm (1.5 mgd). The native water quality in the storage zone is saline, with Total Dissolved Solids (TDS) concentration of approximately 20,000 mg/L (CH2M HILL, July 2000).

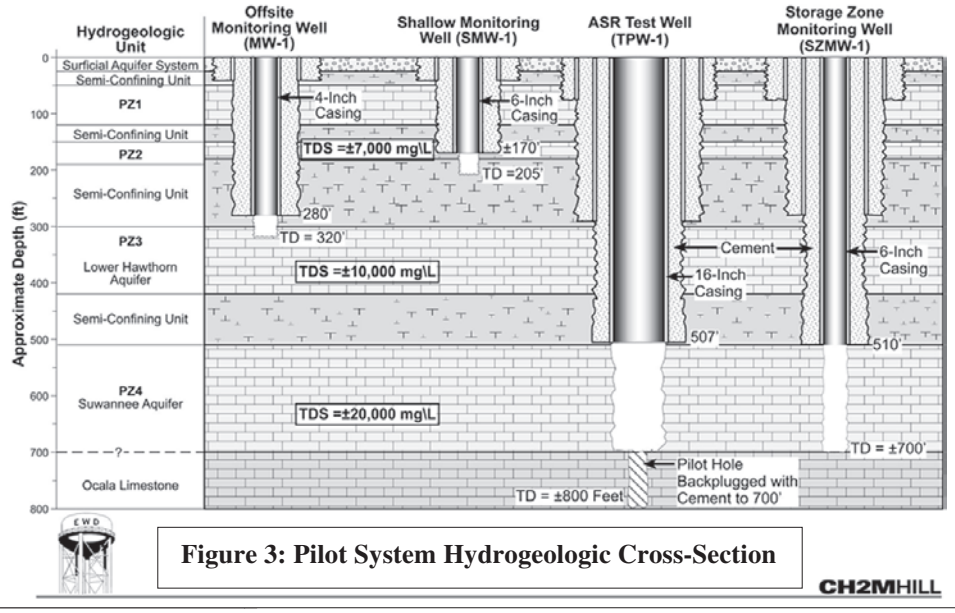


Figure 3: Pilot System Hydrogeologic Cross-Section

Texas ASR

Wet Weather Management

Saline Storage Zone

Figure 4:

Reuse Regulation

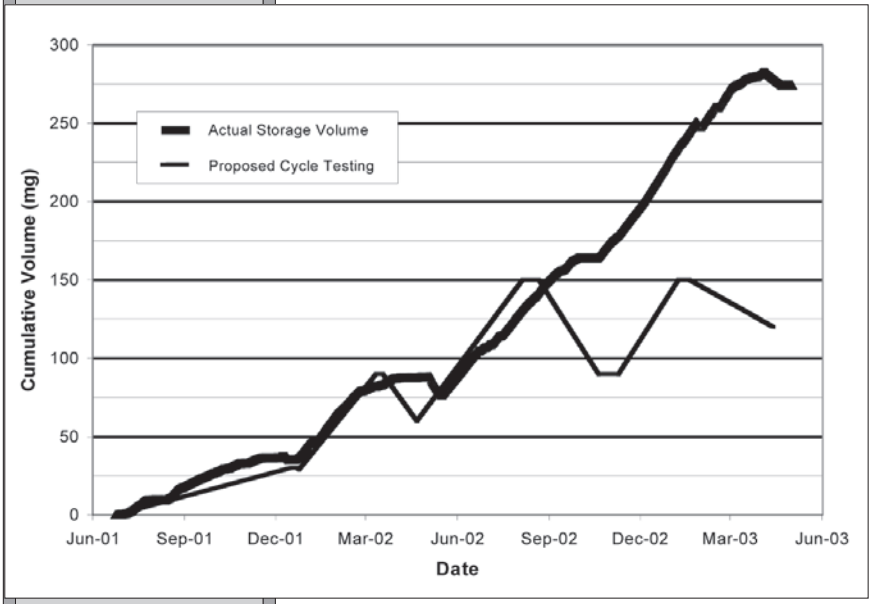
Pre-Storage Treatment

Graduated Standards

Operational Testing of EWD's ASR

The ASR system has provided EWD with a wet weather management system and has provided supplemental dry season supply during its first two years of operational testing. In July 2001, tropical weather in the area caused the 1.1 mgd SRWWTP to see flows in excess of 3 mgd for several days. Inflow and infiltration were occurring at an unprecedented rate, and the EWD's onsite storage pond was within inches of overflowing. Initiating recharge into the well at a rate of 1-to-2 mgd allowed EWD to avoid a surface water discharge at this site during this period and during several other excessive rainfall events following ASR system start-up.

Due to elevated TDS present in the storage zone, a substantial volume of water was expected to be necessary to experience reasonable recovery efficiency in this well. As of late May 2003, nearly 300 mg of highly treated reclaimed water has been injected in this well to enhance recovered water quality that meets reclaimed water standards. A moderately wet winter and spring in 2003 has provided an opportunity to inject more water in this well early in the program, which will benefit the recoverability of high quality water from this well in the future. The cumulative storage volumes in the ASR well are shown on Figure 4.



In May 2003, the reuse system was experiencing demands higher than the available supply. This provided the first true test of EWD's ASR well's ability to provide a supplemental water supply. Recovery was initiated at a rate of between 500 and 700 gpm. Varying the recovery rate from the ASR well to match the reclaimed water demand allowed the system to recover approximately 10 mg during a two-week period. Water recovered from the well met the Total Suspended Solids (TSS) limit of 5 mg/L and the Biological Oxygen Demand (BOD) limit of 20 mg/L. It had no fecal coliform—as is also required by Florida's reuse regulations pertaining to ASR. Water was recovered from the ASR well to the reuse pond and pumped directly to the reuse system without further treatment. The conductivity of the recovered water reached a maximum of 700 µmhos/cm (µmhos/cm or "micromhos" is a measure of the "conductivity" of water, which has a relationship to water salinity—the greater the conductivity, the higher the salinity level), and an estimated 500 mg/L TDS. Following about 2 weeks of recovery, a front moved through the region dropping a few inches of rain, and recovery from the well was temporarily suspended. EWD was attempting to delay any further recharge to the ASR well with the hope of recovering additional water from the well to further test the robustness of the system.

Florida ASR Regulations

Florida implemented revised reuse regulation in 1999. ASR regulations were implemented pertaining to storage and recovery of reclaimed water, which provided an important regulatory framework for reuse utilities to follow in implementing their ASR programs. While most of the regulations are already covered under the federal and state UIC programs, one of the key elements that separates Florida's guidelines pertains to the level of treatment required prior to storage. Florida's regulations require different water quality standards depending on the quality criteria of the receiving zone.

In general, the following standards must be met:

- Aquifers with greater than 10,000 mg/L TDS: Secondary wastewater treatment standards, including less than 20 mg/L BOD and less than 20 mg/L TSS. This is not considered to be a future source of drinking water so minimal water quality standards apply.
- Aquifers with between 3,000 and 10,000 mg/L TDS: Primary DWSs. No secondary drinking water standards apply.
- Aquifers with between 1,000 and 3,000 mg/L TDS: Primary and secondary DWSs. Secondary DWSs can be waived through regulatory relief mechanisms such as a WQCE, Zone of Discharge, or Chapter 120 variance.
- Aquifers with less than 1,000 mg/L TDS: The same requirements as discharge to a 1,000 to 3,000 mg/L aquifer, with additional requirements for Total Organic Carbon (0.3 mg/L average and 0.5 mg/L maximum) and Total Organic Halogens (0.2 mg/L average and 0.3 mg/L maximum)

Texas ASR

Reliability

The preceding article is adapted from an article entitled *Aquifer Storage & Recovery* that the authors presented as part of the Law of the Rio Grande Super Conference sponsored by CLE International, in Albuquerque, New Mexico, January 27-28, 2005.

Suggested Revisions

SUMMARY & CONCLUSION

ASR is a proven water resource development technology. Based upon the success of ASR projects in Texas, and reuse ASR in Florida, expansion of the technology as part of both potable and non-potable water supply systems throughout the State is feasible. The next step to maximizing the benefits of the technology in Texas is to incorporate ASR into the development of "reuse" water as a significant water supply alternative for the future.

As demonstrated by the Englewood District in Florida, the use of the reclaimed water ASR well can provide an important element of reliability in a conjunctively managed water supply system. As demands continue to increase on the system and new users are added, the ASR system will continue to provide an important function, allowing EWD to connect future users with the benefit of knowing that sufficient dry season supply will be available to meet future demands. Once the ASR system demonstrates that a reasonable recovery efficiency can be maintained, EWD will be positioned to become a regional storage facility capable of importing excess wet weather reclaimed water supplies and exporting dry season supplies to help other reuse utilities in the region.

Initial operational testing by EWD has been promising for storing fresh reclaimed water in a saline water storage zone. Recent revisions to Florida's ASR regulations have helped EWD's ASR program, and other similar ASR reuse projects to move forward, which in turn will allow those reuse utilities to expand their systems while still providing a reliable dry season water supply.

Reuse ASR has proven itself to be a valuable water resource tool. Successful storage of both potable and reclaimed water during wet weather periods for use during peak dry weather conditions could extend Texas' finite water resources significantly. The benefits derived by the potentially significant increase in the available volume of water supplies are further enhanced by the economic feasibility and environmental sensibility of the concept of ASR Reuse.

Texas should explore creation of a pilot program for implementation of reuse ASR and amend, as necessary, Chapters 210 and 331 of the TCEQ's regulations to facilitate the program. In particular, consideration should be given to the relaxation of treatment standards for injection and storage into lesser quality aquifers. The "graduated" criteria adopted by Florida as part of its UIC program provides a workable model for Texas to follow. Hopefully, the Texas Legislature will pursue, and pass, legislation in the near future expressly authorizing and, in fact, encouraging the implementation of reuse ASR around the State.

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Montana Groundwater

GROUNDWATER IN MONTANA

MANAGEMENT IN SEARCH OF SCIENCE & REASON

by Eloise Kendy (Kendy Hydrologic Consulting LLP, Helena, MT), John Wilson (Trout Unlimited, Helena, MT), and Laura Ziemer (Trout Unlimited, Bozeman, MT)

"*Facts do not cease to exist just because they are ignored*" (Aldous Huxley)

Introduction

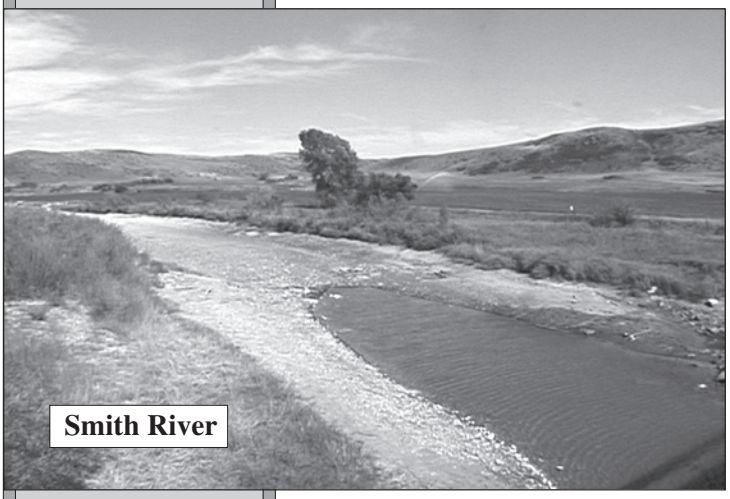
The twin forces of deep, extended drought and rapidly expanding population have created a demand for water in Montana that is unprecedented. While conflict over water helped shape the history of this semi-arid, high-desert state, recent events have caused the spotlight to shine even brighter on the issue of water scarcity. Dry riverbeds, empty reservoirs, fish kills and irrigators watching their crops wither in the field have become facts of life in Montana.

Groundwater Demand

These forces have combined to push the demand for new groundwater development in Montana at a pace that has left lawmakers, agency staff, water right owners, and conservationists struggling to make sense out of the existing scheme for regulating groundwater in Montana. This article chronicles Montana's recent groundwater history, highlighting a key water management issue that most western states are grappling with — the link between groundwater and surface water. Time will tell whether these events will culminate in a rational groundwater policy for the state of Montana, or devolve into endless rounds of expensive litigation.

The View From McGuire Ranch[1]

John McGuire, owner of the McGuire Ranch in Montana's Smith River basin, flood irrigates land about four miles southwest of the small town of White Sulphur Springs in the same way it's been done for the past 120 years. His family moved to the Smith River basin in 1945 when McGuire was in the eighth grade. He and other old-timers say they've never seen the river this dry before, even during the dust bowl drought of the 1930's.



Smith River

It was about five years ago that he first noticed that whenever a new groundwater irrigation well located upstream of his fields was pumping, the South Fork of the Smith River — McGuire's irrigation source — was "close to killed." The new groundwater well was located within a quarter-mile of the South Fork. McGuire wrote to the Meagher County Conservation District in 2002 that "at first we put this down to the dry year, but when the wells were shut down at the close of irrigating season, the creek began to run again about three weeks later, leading us to believe that the wells were affecting the stream flow."

The View From Main Street in Bozeman, Montana[2]

Population Growth

Gallatin County, located just north of Yellowstone National Park, has become the fastest-growing county in Montana. The County includes the City of Bozeman, Montana State University, two ski areas in the County's Gallatin and Bridger mountain ranges, and a small, busy airport. The influx of new people has become a constant. The population has expanded by more than 40 percent from 1990 to 2002, and is expected to double again by the year 2030. This rapid population growth means that the aquifer that feeds the Gallatin River is being tapped for groundwater at an unprecedented rate. Except for the City of Bozeman (pop. 28,000), all 73,000 county residents rely on groundwater for domestic supplies, primarily through individual wells. Gallatin County now has over 12,300 permitted groundwater wells. In 1986, the number was just 6,877.

Over-tapping the aquifer can have a devastating effect on the flows in the Gallatin River. According to Dave Pruitt, long-time chief water commissioner for the Gallatin River, the wells have already impacted the Gallatin River. Increased groundwater withdrawals coupled with prolonged drought have caused the Gallatin to reach its lowest base flow in recorded history in December of 2003. On the Gallatin River, "recorded history" dates back 114 years and includes the droughts of the 1930's.

The View From the Montana Water Code

Conjunctive Management

Montana is a conjunctive water management state and considers groundwater and surface water a unitary resource. The doctrine of prior appropriation governs groundwater users, who must prove "no injury" to senior surface water users in order to obtain a new groundwater pumping permit. Mont. Code Ann. § 85-2-311(b).

Montana Groundwater

Basin Closure

Incomplete Adjudication

Montana's water right claims remain largely unadjudicated and unquantified (see Moon, TWR #2). Though the state has pursued the quantification of water right claims through adjudication since 1982, the task is far from complete, and, to date, is crawling forward at a snail's pace. The extent of valid water claims on Montana's water resources is unknown. However, it is generally accepted that in many basins, particularly in the mountain valleys of western Montana, the surface water is fully appropriated and very likely over-appropriated.

New Permit Moratorium

In the late 1980's and early 1990's, the Montana Legislature acknowledged the over-appropriation of its rivers by enacting a series of basin-closure laws that place a moratorium (with some specific exceptions) on the processing or granting of new water appropriation requests in specific regions of the state. *See* Mont. Code Ann. § 85-2-321 (Milk River basin); § 85-2-330 (Teton River basin); §§ 85-2-336-337 (Upper Clark Fork River basin); § 85-2-344 (Bitterroot River basin); §§ 85-2-342-343 (Upper Missouri River basin). The moratoriums are in place until the final decrees of water claims are completed, which is likely to be decades from now. The basin-closure idea is straightforward: don't compound an already serious problem with additional water demands until Montana quantifies its existing claims and knows whether any water is even available for new appropriation. The closure recognizes that senior water users would be subjected to the expensive burden of having to defend their claims for many decades by formally objecting to an endless stream of new water requests in basins with little or no water available for appropriation.

Closure Exceptions

The basin-closure laws allow some specific new water withdrawals despite the closure. The Upper Missouri River Basin closure which is the focus of this article (see map) allows new withdrawals for non-consumptive water uses; for domestic, municipal, and stock water uses; for applications to store water during high spring flows; and for groundwater (as specifically defined by the basin-closure statute). Mont. Code Ann. § 343(2)(a)-(f).

GW Definition

The Upper Missouri River Basin closure statute specifically defines *groundwater* as "water that is beneath the land surface or beneath the bed of a stream, lake, reservoir or other body of surface water and that is not *immediately or directly connected to surface water*." Mont. Code Ann. § 85-2-342(2). (Emphasis added) In other words, the Montana Department of Natural Resources and Conservation (DNRC) would not even process an application for groundwater that is immediately or directly connected to surface water, let alone approve it.

DNRC Interpretation

Unfortunately, "immediately or directly" is not a hydrologic term. In its implementation of the basin-closure statute, DNRC assumed the task of interpreting what the legislature intended by the phrase "not immediately or directly connected to surface water." DNRC's interpretation has been the source of much recent controversy and is subject to a pending legal challenge. See *Montana Trout Unlimited et al v. Montana Department of Natural Resources and Conservation,* Case No. 05-069.

As documented by a series of departmental memos, DNRC determined that groundwater is "immediately or directly" connected to surface water only if groundwater pumping pulls surface water

Montana Groundwater

into the aquifer, or "induces surface water infiltration." According to this interpretation, even if a well captures groundwater that would otherwise discharge into a stream, such groundwater is not "immediately or directly" connected to surface water, and the permit application may be processed as a groundwater exception to the basin-closure. Once an application is publicly noticed, other water users may object to the application based on the adverse impact on their water right. Mont. Code Ann. § 85-2-311(b).

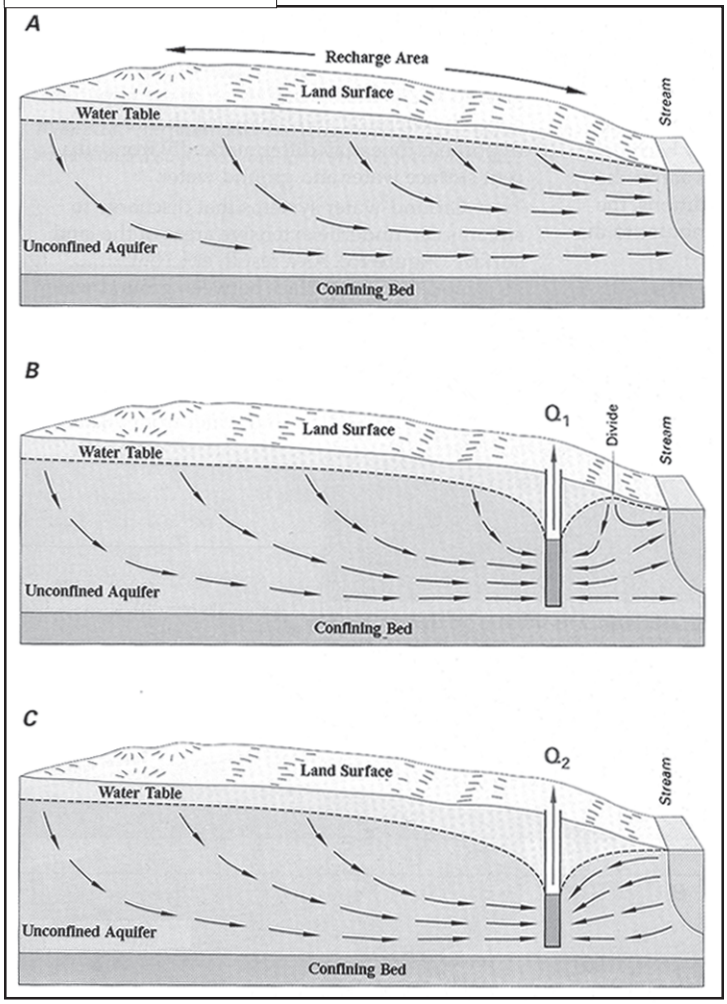
The schematic cross-sections below illustrate this concept. Figure A depicts an aquifer that naturally discharges into a stream, shown in cross-section on the right-hand side of the diagram. The aquifer and the stream are hydraulically connected, as indicated by the continuity between the water table and the stream stage. The arrows indicate the direction of groundwater flow. Because groundwater discharges naturally into the stream, replenishing streamflow, the stream is termed as a "gaining" stream.

The center figure (B) shows what might happen if a new well is installed and begins pumping water from the aquifer. Notice that the flow lines near the stream do not change direction. The stream remains a gaining stream, even though the well captures some of the groundwater that otherwise would have discharged into the stream. Initially, the well pumps water out of aquifer storage, but over the long term the amount of streamflow depletion is equal to the amount of water consumed by pumping.

Figure C depicts what might happen if the well continues to pump for a bit longer, or if the well is located closer to the stream, or if the geological conditions are different. The cone-shaped depression — aptly termed the "cone of depression" — in the water table expands until it reaches the stream. At this point, the arrows show that the groundwater flow direction near the stream has reversed. The formerly gaining stream has been converted into a losing stream. Instead of groundwater *discharging* into the stream, surface water now *recharges* the aquifer. Thus, the pumping well has caused surface water to infiltrate through the streambed, and into the aquifer. Figure C illustrates what is meant by the term "induced surface water infiltration"—DNRC's criterion for "immediate or direct" connection.

According to DNRC's interpretation, only the groundwater in Figure C is "immediately or directly" connected to surface water. Groundwater in Figure B is not, because pumping does not pull water directly out of the stream. The stream is still a gaining stream. An application to permit well B would be processed, even though the pumping would deplete streamflow just as surely as if it pulled water from the stream, like well C; the only difference is that depletion of the stream would be slower to occur than if it resulted from induced infiltration.

Figure A:
Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, "*Groundwater and Surface Water: A Single Resource*" US Geological Survey Circular 1139



Montana's alluvial aquifers are generally quite permeable. Consequently, groundwater pumping tends to create wide, shallow cones of depression. The water-table drop caused by pumping diminishes rapidly with distance from the well. Thus, unless a well is immediately adjacent to a gaining stream, it is unlikely to lower the water table enough to convert a gaining reach into a losing reach, thus inducing surface water infiltration into the aquifer. Therefore, DNRC's requirement to demonstrate an "immediate or direct" connection effectively exempts all gaining streams from the protections offered by the basin-closure statute. Likewise, losing streams are exempt if they are perched above the water table. This leaves only the rare stretch of stream that loses water, but is still connected to the underlying aquifer, eligible for basin-closure protection.

This interpretation of "groundwater" puts senior water users in a very difficult position. Because DNRC will process nearly all new groundwater applications under their limited definition of connectivity, the users' primary remedy to protect their interests is to object formally to each new well application on the basis of its adverse affect on existing water rights. This is a costly, time-consuming, complex, and contentious task.

The connectivity of groundwater and surface water in alluvial aquifers is a basic hydrologic principle. It can be found in virtually any hydrogeology textbook and has been known and documented for decades. Hydrologists recognize groundwater and surface water as "simply two manifestations of a single

Montana Groundwater

Groundwater Capture

integrated resource" (Robert M. Hirsch, Chief Hydrologist, US Geological Survey, in forward to Winter et al., 1998). Any increase in the consumption of one reduces the availability of the other. "Because the groundwater is tributary to the stream, there will then be 'one cup of water less in the stream for each cup of water taken out of the aquifer'. Thus, all groundwater extractions from an aquifer tributary to a stream capture waters that would otherwise enter the stream. Streamflow then is reduced by the total amount of water withdrawn from the tributary aquifer [minus return flow]. This capture is a reduction in discharge from the aquifer to the stream" (Bouwer, H. and Maddock III, T., 1997, p. 27. *Making Sense of the Interactions Between Groundwater and Streamflow: Lessons for Water Masters and Adjudicators*. Rivers, 6(1): 19-31). A DNRC memo dated May 2002 prepared by a staff hydrologist cites no fewer than 25 studies that document the connection between ground and surface water.

Despite the acceptance of this basic hydrologic principle among the scientific community, the policy question of how to square hydrology with DNRC's interpretation of "immediately or directly connected to surface water" has fallen to the courts.

The Smith River

GROUND ZERO FOR GROUNDWATER WARS

Hydrologic Study

In 1999, irrigators in the Smith River basin (part of the Upper Missouri River basin) were concerned enough about their water supply that they asked the Meagher County Conservation District to request DNRC to conduct a hydrologic study of the river basin. Up to 60 irrigators in the upper Smith River basin willingly participated in the study. Concerns were fueled largely by conversions from surface water supplied flood irrigation to groundwater supplied sprinkler irrigation, as well as an overall increase in irrigated acreage made possible by the increasing reliance on groundwater pumping.

Study Halted

DNRC began data collection in 2000, and the study was progressing well until a staff hydrologist wrote in an internal memo in March 2001, that, "it can be stated with certainty that groundwater withdrawals have created impacts to surface flow of the Smith River." Relations between the Meagher County Conservation District and DNRC rapidly deteriorated. There were 15 new water use applications pending before DNRC in the Smith River basin. After an investment of $91,000 and two years, the then-director of DNRC, Bud Clinch, stopped the study.

In addition to providing water for irrigation, the Smith River is a popular recreation river and blue-ribbon trout fishery. In 2001, portions of the river dried up, resulting in fish kills. Irrigators, landowners, outfitters and conservationists began to look beyond the drought for answers. It quickly became apparent that despite the basin-closure, there were a significant number of new applications for groundwater pumping and that many new groundwater permits had already been granted. Montana Trout Unlimited pressed DNRC to complete an Environmental Assessment (EA) on the cumulative impacts of granting the pending 15 applications.

EA Conclusions

The conclusions of the EA were eye opening. The EA stated that "the Smith River and its principal tributaries are interpreted to be gaining streams that are hydraulically connected to groundwater." The EA further concluded that if the new wells were permitted, they would reduce surface flows by an estimated 37 percent of the pumped volume in the first year, with the reduction in surface flows continuing to escalate over time. After ten years of pumping, stream flows would be reduced by 80 percent of the volume pumped and after eighty years, flows would be reduced by 100 percent of the volume pumped, according to the EA.

GW Impact

Streamflow Reduction

Yet, like the well pumping upstream from the McGuire Ranch, DNRC does not consider the groundwater pumped by these wells to be "immediately or directly" connected to Smith River surface water. This is because the streamflow reduction occurs by interception of the groundwater tributary to, and discharging to, surface water (the situation illustrated in Fig. B, above) rather than by inducing surface water infiltration (see Fig. C, above). The science was clear: the groundwater to be pumped by these pending wells was hydraulically connected to the surface water and would result in quantifiable stream depletions in a river that was already over-appropriated. Unfortunately for purposes of the basin-closure, this same groundwater was considered by DNRC *not* to be "immediately or directly connected" to surface water.

Lawsuit

In July 2003, 11 irrigators and landowners along the Smith River, three outfitters, and Montana Trout Unlimited filed an action in district court challenging DNRC's failure to implement the Upper Missouri River Basin Closure's statutory directive. The plaintiffs in the lawsuit alleged that by continuing to process groundwater applications that the agency itself has determined would deplete Smith River flows, DNRC was abusing its discretion under the basin-closure law. In 2004, the district court ruled against the plaintiffs on alternate grounds. First, the district court held that DNRC's interpretation of the basin-closure was within the agency's discretion. The district court also found that the plaintiffs had failed to exhaust their administrative remedies. The matter is currently briefed before the Montana

District Court Ruling

Montana Groundwater

Legal Briefs

Residential GW Use

Contested Case

Petition for Protection

Planning Revision

GW Applications Continue

Adverse Effects

Supreme Court, and awaits the Court's decision. The Montana Supreme Court only hears oral argument on a small number of cases and has not yet requested argument in this case.

Briefs filed with the Supreme Court in *Montana Trout Unlimited et al v. Montana Department of Natural Resources and Conservation,* Case No. 05-069 may be found at http://www.lawlibrary.state.mt.us/dscgi/ds.py/View/Collection-1981. The briefs are sorted by the month that they are filed with the Court. Appellants' Opening Brief was filed May 26, 2005, Respondents' Briefs were filed on July 25, 2005, and Appellants' Reply Brief was filed on August 8, 2005.

The Gallatin River

Meanwhile, on the Gallatin River the expanding extraction of groundwater for residential growth has continued to take its toll. Events came to a head in July 2003, when contested case hearings were held on a developer's application for a new groundwater pumping permit to provide water for a proposed golf course and condominium development along the Gallatin River, on land known as the "Day Ranch."

The Day Ranch developer planned to drill four wells adjacent to Fish Creek, a tributary to the Gallatin. The planned wells would pump a combined total of 920 gallons per minute. Irrigators, conservationists (Trout Unlimited and the Greater Yellowstone Coalition), the Montana Department of Fish, Wildlife, and Parks, and Pennsylvania Power and Light (owner of several hydroelectric dams on the Missouri River downstream) opposed the developer's efforts to obtain a water permit from DNRC. After two days of hearings and several rounds of legal briefing, the hearings examiner recommended denial of the permit application. Although the developer initially appealed, in the spring of 2004 he withdrew the appeal and abandoned the development proposal (Applications 41H-30003523 & 41H-30000806).

The Day Ranch case was the "canary-in-the-coal-mine" for Gallatin County. The effect on Gallatin River flows from rapid groundwater development along the river corridor was now firmly in the public consciousness. Irrigators, conservationists, and the Gallatin County Commission began to grapple with how to address this threat, given that the basin-closure statute provided no protection.

A flurry of events unfolded in the wake of the failure of the Day Ranch permit application. The Gallatin County Commission convened a yearlong Task Force to study water rights and flood-plain issues in the county. Gallatin County surface water irrigators came together and formed the Association of Gallatin Agricultural Irrigators (AGAI), in part to address the threat of additional groundwater pumping proposals. A new citizens group, The Four Corners Community Foundation, was also created. Named after a location along the Gallatin River that is experiencing intense development pressure, the Foundation petitioned DNRC for the designation of a "temporary controlled groundwater area" along the River. Mont. Code Ann. § 85-2-506. The petition is opposed by a number of development interests and is still pending before DNRC.

Citizens also formed a Gallatin River watershed group — the Greater Gallatin Watershed Counsel (GGWC) — and through an open and democratic, countywide public-input process, determined that addressing the groundwater-surface water connection should be one of its primary missions. The GGWC then tapped significant volunteer hours to submit an ambitious grant to the US Environmental Protection Agency for a groundwater study of the area (grant approval is pending). After the Task Force completed its work, the Gallatin County Commission in winter of 2005 revised its subdivision regulations to require developers to obtain water-right permits from DNRC *before* filing preliminary plat applications.

Despite all these actions, groundwater pumping applications continue to be filed with DNRC. There are currently three more contested case proceedings before DNRC on groundwater applications from Gallatin County, each involving hundreds of new residences. In addition, as of February 2005, DNRC had granted 321 new permits to pump more than 38,000 gallons per minute and irrigate 7,300 new acres of cropland within the Upper Missouri Basin closure area since the closure in 1993.

Upsetting the Doctrine of Prior Appropriation

POLICY CONSIDERATIONS

DNRC's limited interpretation of "immediately or directly" has far reaching policy and water law implications. Consider this situation: a developer or rancher applies for a new permit to appropriate groundwater in the fully appropriated Upper Missouri Basin. The well is situated away from the river but captures groundwater that is tributary to the river and therefore contributes to surface flows. The groundwater this well would pump and consume would not be considered directly connected to the river under DNRC's limited definition that the well must "induce surface water infiltration." Yet the well will have an adverse effect upon permitted surface water users. Under Montana law the senior surface users have two options once the application is processed. They can formally object based on adverse effect or they can do nothing. If they object, it is likely that they will prevail on the basis of adverse effect, but at considerable time and expense. To fully protect their interests they must object to every well application in their basin for decades, constantly fighting a battle that the basin-closure law could prevent.

Montana Groundwater

"Call"

Idaho Example

1882 "Call"

No Protection

Legislation Fails

Depletion Threat

Hydrology Ignored

Alternatively, if senior surface users do nothing and they find they are not receiving the water they are entitled to, they can place a "call" on a junior surface water right holder ("call" for regulation under the Prior Appropriation Doctrine). Surface water users, not the much more junior (by over 100 years) groundwater users, get targeted with "calls" for two reasons. First, it is much easier to blame a surface streamflow diversion than a groundwater pump for low flow conditions downstream. Second, because groundwater pumping causes delayed hydraulic responses, it can take weeks to months for streamflow to recover after a well is shut down. The complexity of attempting to "call" junior groundwater users is illustrated in neighboring Idaho, where on April 19, 2005 the Idaho Department of Water Resources issued an order limiting groundwater pumping from the Eastern Snake Plain Aquifer in response to a "call" from irrigators holding senior surface water rights. *See Moon, TWR #15, at pp. 15-17.*

Last summer, in response to low streamflow in the Gallatin River, only water rights with priority dates older than 1882 received their water. Mid-way through the irrigation season, the river commissioner shut off "1883 water" completely, and shut off about half of the "1882 water" rights. Eventually, as "calls" ripple down through the users' priority dates, a point will be reached where a call doesn't work because the junior user has no water to give. At that point, the surface water user, for example one with an 1881 priority date, would be unable to obtain water through a call on junior surface users.

That same surface water user, however, may look across his field and see a 2005 permitted groundwater well pumping and supplying a sprinkler. In most cases, it would be futile for the 1881 priority date surface water user to place a "call" on the well to get his water. Even if the "call" were successfully executed, it could take months for the streamflow to recover depending upon the properties of the aquifer and rate/duration of pumping. For an irrigator, this delay is impractical. October delivery of irrigation water is meaningless. Thus, under DNRC's current administration of the basin-closure law, the reality is that a 2005 groundwater permit that intercepts groundwater, that is tributary to and discharges to surface water, will continue to receive its water at the expense of an 1881 priority date surface water right. In other words, the Prior Appropriation Doctrine of "first in time, first in right" fails to protect senior water right owners in this instance.

Motivated by these kinds of concerns, irrigators from the Gallatin Valley led an effort in Montana's 2005 Legislative Session to amend the Upper Missouri Basin Closure law so that it would explicitly prevent new groundwater pumping that would deplete surface flows. This legislative effort (Senate Bill 269) focused legislators' attention on the problem posed by new groundwater development, but there was not consensus on how best to address it. With mounting support from diverse groups of water users, the bill passed the Senate, but died in committee on a tie vote in the House.

Conclusion

This is a tenuous time for senior water users in Montana. Without a concerted effort on their part, rapidly increasing numbers of new groundwater wells threaten to deplete rivers and streams.

Until the statewide water right adjudication is completed, the amount of surface water available for new appropriation, if any, is unquantified. It is generally accepted that most basins in western Montana are either fully or over-appropriated. In addition to the Smith and Gallatin Rivers, the Big Hole, the Beaverhead, the Jefferson, and the Upper Clark Fork Rivers, just to name a few, have all experienced acute water shortages. Along with the Smith River, irrigators along the upper Beaverhead River are resorting to supplementing their surface water irrigation through groundwater pumping at an unprecedented rate.

By statute, the Upper Missouri River Basin closure allows Montana's DNRC to process and grant new groundwater applications only if the groundwater is "not immediately or directly connected to surface water." Mont. Code Ann. § 85-2-342(2). Contrary to basic hydrological principles and the clear language of the statute, the agency has elected not to include groundwater that is tributary to surface water within the definition of "immediately or directly connected to surface water," even while DNRC's own experts acknowledge that capture and consumption of these tributary groundwaters reduce stream flows:

> "For a hydrologic evaluation to conclude that an 'immediate and direct' connection has not occurred simply means that the groundwater pumped by the well is not immediately and physically obtained from a surface water source. For the evaluation to conclude that no depletion of streamflow will occur is simply erroneous." Uthman, Bill, DNRC 2002. "*Groundwater—Surface Water Interactions, Groundwater Development, Montana Water Law, and Water Rights Permitting*" May 31, 2002 Report to DNRC Water Resources Division, at 14.

Montana Groundwater

Rational Policy?

As a headwater state, Montana is in the fortunate position of controlling nearly all of its own water. As a sparsely populated state, Montana is in the enviable position of having comparatively few user conflicts. As a northern state, Montana has more streamflow than its thirsty neighbors to the south. As a late-bloomer in terms of economic development, Montana's water managers can benefit from the mistakes and successes of other western states. Regardless of its outcome, the Montana Supreme Court's decision on the pending challenge to DNRC's interpretation of the Upper Missouri River Basin closure will be a catalyst for movement toward a rational groundwater policy in Montana that protects the senior water rights of irrigators and river flows while accommodating new population growth and agricultural demand for groundwater. The first step towards such a rational groundwater policy is the recognition that ground and surface water are part of one, limited resource, upon which we all depend.

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Footnotes

1 The information for this case study appeared in the Sunday, August 10, 2003 edition of the Helena Independent Record, "*Water and the Smith*" by Eve Byron.
2 The information in this section appeared in the article by S.R. Kinsella, "*Conserving the West's Groundwater Resources*" TROUT magazine, (Summer, 2004)

Eloise Kendy, principal of Kendy Hydrologic Consulting, LLC, earned her BA in Geological Sciences from the University of California at Santa Barbara (1983), her MS in Geology and Geophysics at the University of Wisconsin, Madison (1986), and her PhD in Environmental Engineering at Cornell University (2002). As a hydrogeologist with consulting firms (1986-88, 1990, 2004-05), the US Geological Survey (1990-99), and the International Water Management Institute (2000-2002), she has addressed a wide variety of hydrogeologic concerns, ranging from ground-water supply to water-quality remediation and protection. In 2003-04, as the American Geologic Institute's Congressional Science Fellow, she served as Senator Harry Reid's science and natural resource advisor.
John Wilson, Conservation Director for Montana Trout Unlimited, earned his BS in Economics from the State University of New York and masters credits in Environmental Studies from the University of Montana. He has been active in Montana conservation issues for 25 years including Montana lawmaking and policy development on land use and water conservation. He served as the State of Montana's Tourism Director (1980-89), and Managing Director of the Montana Land Reliance, a statewide land trust (1990-2000).
Laura Ziemer is the Director of Trout Unlimited's (TU) Montana Water Project. She opened the Montana Water Project office in August of 1998. The Western Water Project works in six states (Montana, Colorado, Wyoming, Idaho, Utah, and California) to restore and maintain streamflows for coldwater fisheries by addressing water allocation issues. In Montana, Laura has expanded TU's water leasing program through legislative improvements to the program as well as completing a number of conversions of irrigation water rights to instream flow rights. In addition to water leasing and other initiatives, she helped close the Bitterroot River Basin to new diversions, initiated a successful drought response plan on the Blackfoot River, and obtained a favorable ruling from the Montana Supreme Court recognizing instream flow rights under the prior appropriation doctrine. Before joining TU, Laura practiced public-interest environmental law since 1993 as an attorney with the Sierra Club Legal Defense Fund (now Earthjustice Legal Defense Fund) out of Seattle, Washington and later in Bozeman, Montana. With the Legal Defense Fund, Laura litigated a variety of public lands issues, including protecting grizzly bear habitat, managing northern spotted owl habitat, and challenging the dioxin discharges of the pulp and paper industry. She tackled litigation over water rights in the Methow Valley of arid eastern Washington, weighing in on water transfers and development that impacted fish and wildlife. Also in Washington State, Laura challenged the grant of groundwater pumping permits, which affected instream flows in nearby streams and rivers. Prior to working with the Sierra Club Legal Defense Fund, Laura served as a judicial clerk for two years to the Honorable Barbara J. Rothstein of the US District Court for the Western District of Washington in Seattle. She is a graduate of the University of Michigan, graduating *cum laude* from the Law School while earning a Master's Degree in Resource Ecology from the School of Natural Resources.

RECYCLING WASTEWATER BY-PRODUCTS

BIOCYCLE FARM

by Kenneth J. Vanderford, Residuals Supervisor, City of Eugene, Oregon

Biosolids

Biosolids are the nutrient-rich organic materials resulting from the treatment of domestic sewage at a wastewater treatment facility. Through biosolids management, solid residue from wastewater treatment is processed to reduce or eliminate pathogens and minimize odors, forming a safe, beneficial agricultural product. Farmers and gardeners have been recycling biosolids for ages. Biosolids can be applied as fertilizer to improve and maintain productive soils and stimulate plant growth. Biosolids are carefully monitored and must be used in accordance with regulatory requirements.

Land Application

The Metropolitan Wastewater Management Commission (MWMC)—which serves the cities of Eugene and Springfield in Oregon—promotes the recycling of wastewater biosolids through land application as the most environmentally sound way to manage these materials. MWMC has operated a very successful biosolids recycling program for over 25 years, relying exclusively on volunteer growers who make their land and crops available for biosolids application. The program has maintained wide public acceptance. Local growers continue to line up to have the nutrient-rich biosolids applied on their land.

Agency Control

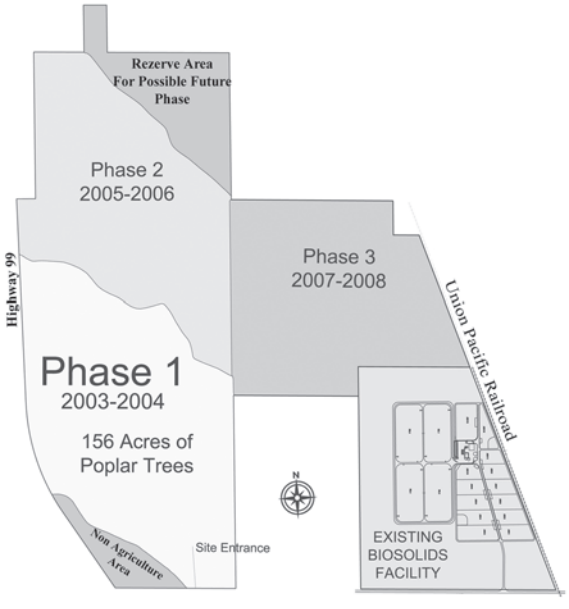
The MWMC biosolids recycling program has greatly benefited from maintaining full agency control over its program—from initial processing to final field application. One area where we looked for improvement was in the scheduling of our biosolids application with our volunteer growers. Biosolids application was increasingly being dictated by the growers' cropping practices, planting, and harvesting schedule. As biosolids production continued to enlarge, timing became an increasingly important factor to consider.

Grass seed is the major crop grown in the Eugene/Springfield area. Of the various grass crops grown, annual ryegrass is the preferred crop for the biosolids recycling program because the dried biosolids can be incorporated into the soil each year. Annual ryegrass seed is typically harvested in late July and early August. Growers begin working the soil and planting seed for the next year's crop in September. The "window of opportunity" was thus condensed into just a few short summer months to process and apply an entire year's worth of biosolids production.

Benefits

The recent addition of the "Biocycle Farm" to MWMC's recycling program allows more control over the application schedule, reduces processing costs, and will produce a marketable commodity to help reduce operating costs over time.

Biocycle Farm



Biocycle Farm

BIOSOLIDS AND RECLAIMED WATER RECYCLING

Biocycle Farm is a biosolids and reclaimed water recycling project that makes use of the high growth rate of hybrid poplars in a short rotation woody agricultural operation. The goal for the farm is to conduct an economically viable agricultural operation that will accommodate a significant portion of the current MWMC biosolids and reclaimed water production (Figure 1).

The 596 acre Biocycle Farm is located at the southern end of Oregon's Willamette Valley, 10 miles north of Eugene, Oregon. At the beginning of the project, it was estimated that the infrastructure at Biocycle Farm would take one to two years to construct and would cost approximately $3.7 million.

In 1997, the MWMC completed a comprehensive evaluation of its wastewater facilities and prepared a facilities master plan (updated in 2005). The master plan included findings that the MWMC Biosolids Management Facility dewatering and reuse programs had insufficient capacity to keep pace with the volume of solids produced by the Eugene/Springfield Water Pollution Control Facility (WPCF). The regional WPCF produces 13 tons of treated biosolids per day. Subsequently, the MWMC appointed a Citizen's Advisory Committee (CAC) to help guide the development of a management strategy for the biosolids program.

The "Preferred Approach" of the CAC recommended management strategy specified application of approximately 20 percent of the total biosolids to a dedicated reuse site. Establishment of the 596 acre MWMC-owned Biocycle Farm was seen as helping the CAC meet its objective of diversifying the region's biosolids management program.

BioCycle Farm

"Reclaimed Water"

Biocycle Farm also benefits from the use of "reclaimed water" for its supplemental irrigation needs. The State of Oregon defines reclaimed water as: "treated effluent from a sewage treatment system which, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur." Oregon Administrative Rules 340-055-0010(8). In 2004, a reclaimed water line was completed linking the Biocycle Farm to the WPCF. The reclaimed water line is designed to deliver up to 3 million gallons per day of treated water to the Biocycle Farm. In addition to replacing potable water for irrigation needs, the use of reclaimed water provides environmental benefits by reducing the thermal load from the WPCF's effluent to the Willamette River.

Poplar Benefits

Hybrid Poplars

Under the right conditions, hybrid poplars grow very rapidly, consuming large quantities of water and nutrients in the process. A wastewater treatment facility is ideal for fulfilling two such conditions: clean water and biosolids. The cleaner the facility makes the water, the more biosolids are produced. The more biosolids are produced, the more nutrients can be provided for crops.

Hybrid poplars are crosses between various species of poplar. Within each cross there are many clones that can be selected for various growth characteristics such as disease and pest resistance, stem form, growth rate, milling characteristics, etc. Hybrid poplars can also be easily integrated into the existing biosolids management program to utilize nutrients, provide a buffer to environmentally sensitive areas, enhance riparian zones, and to provide an odor barrier between the Biocycle Farm and adjoining properties. There are many advantages to using hybrid poplars as opposed to other agricultural crops when recycling biosolids and reclaimed water.

Advantages

HYBRID POPLAR ADVANTAGES INCLUDE:

- Rapid growth rate
- Very high nitrogen uptake
- High transpiration rates which minimize potential leaching to groundwater
- A combination of fine, shallow roots near the soil surface and a deep root system that maximizes nutrient uptake
- Minimal maintenance costs after the first three-to-four years
- Perennial crop, providing for a longer application season
- Farm income from the harvest of trees in 10 years

Crop Management

The concept of hybrid poplar farming is based on the assumption that the trees are an agricultural crop. The crop is established, grown, and harvested using the same intensive, mechanized approach used in the more traditional crops in the region. The short rotation (10-12 years) and the high projected yields are dependent on an aggressive management approach.

Phased Approach

The 596 acre Biocycle Farm is designed for up to 400 acres of hybrid poplars divided into three management units. The remainder of the land is designated for buffers, setbacks and roadways.

Phase One

The first management unit was established in 2004, with 38,000, 22-inch cuttings planted on 156 acres. In phase one, seven different poplar clone varieties were planted. Planting varieties of trees helps determine which ones perform best at the site. This knowledge will be used to choose the best performing varieties to plant in the future phases.

Weed Management

Hybrid poplar plantations require extensive weed management in the first three or four years, as the young trees do not compete well with weeds for water and nutrients. After the third or fourth year, depending on the growth rate and tree spacing selected, the canopy will shade out most of the competing vegetation. Coinciding with the reduced maintenance requirement of the first planting, the second management unit will be planted in 2007. The third and final phase is scheduled for planting in 2010. At full build-out, approximately 100,000 hybrid poplar trees will be growing on the farm.

Two Year Old Trees

Under Irrigation

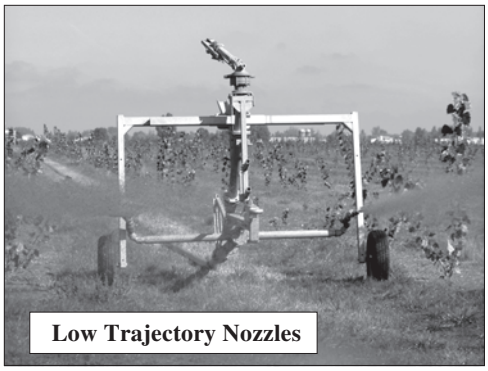
Hybrid poplars use a significant amount of water. Reported transpiration rates indicate up to 35 inches per acre per year after the fourth or fifth year of growth. Current management plans call for a combination of liquid biosolids and reclaimed water to supply only nine inches per acre per year. Under-irrigating the trees, while limiting tree growth rates, will help to ensure that surface runoff or leeching to groundwater is minimized. Future site modifications may include a dedicated reclaimed water system on the farm to supply more irrigation water to enhance tree growth.

BioCycle Farm

Delivery System

Water Savings

Changing Market


Low Trajectory Nozzles

Liquid biosolids or reclaimed water is delivered to the farm with a hard hose reel and irrigation cart system that applies a 56 foot-wide spray pattern, covering four rows of trees per pass. The low trajectory of the fan nozzles allows us to irrigate beneath the tree limbs as they grow. The low pressure of the system and the large droplets produced from the fan nozzles (irrigation cart) minimize any potential for fugitive aerosols or wind drift from irrigation.

Although only nine inches per acre of reclaimed water will be irrigated each year on the 400-acre of trees, this reclaimed water will be replacing up to 100 million gallons of potable water. Water recycling allows the matching of water quality to specific reuse applications, reducing the amount of fresh water required for non-potable uses. Utilizing the benefits of reclaimed water ensures that the best and purest sources of water will be reserved for the highest use—i.e., public drinking water.

Marketing Considerations

With the MWMC's stated goal of achieving an economically viable agricultural operation, a regional market study was commissioned to evaluate existing and alternative markets for hybrid poplar saw logs. Early northwest hybrid poplar plantations were planted with the intention of marketing wood chips to pulp mills for paper production. Market conditions changed over the years and the pulp market potential was never fully realized.

Fourteen in-depth interviews were conducted with wood products producers in the region to determine interests for engaging in buy-on-contract options for the MWMC hybrid poplar resource. Almost all interviewed indicated a strong interest in this contract option. The following list contains the stated reasons for this interest and also describes details provided by interviewees describing their preferred structure of a buy-on-contract arrangement.

BUYER INTERESTS & PREFERENCES:

- Wood product producers are interested in engaging in long-term buy-on-contract options because the harvest schedule is predictable and the wood resource is reliable.
- A contract allows producers to utilize cost saving, "just-at-the-right-time" log delivery to the mill.
- Buyers may want to shape the contract option framework based on their past positive or negative experiences. Some may prefer a two-to-five year contract, while others may require a 10 year contract to ensure a reliable supply.
- Price indexing is often negotiated in contract, especially in long-term contracts. This means that price per board-foot may be discounted during the first year to allow a buyer to gain confidence in the quantity and quality of the supply. The price would then be indexed upwards after the second year to reflect that confidence factor, as well as reflect adjustments in overall market pricing for that year.
- Some buyers may want a "sampling" of hybrid poplars from the site prior to entering any contract in order to ensure that the clone variety offered will mill and dry adequately.

While Biocycle Farm may not be the driving force in developing a hardwood solid log market, we hope to tag on to other large hybrid poplar plantations which are heading in a similar marketing direction. Large poplar plantations located in eastern Oregon are being harvested and thinned in order to develop straight, larger diameter saw logs for the hardwood market.

Because hybrid poplars grow so rapidly, they are not suited for structural uses. However, the wood can be utilized to replace many slower growing trees for products like oriented strand board, plywood, furniture, cabinets, moldings, paint brush handles, etc.

Conclusion

The Biocycle Farm operation dramatically increases the flexibility of the MWMC solids handling options, and provides economical and environmentally beneficial recycling of a significant portion of the biosolids and reclaimed water produced in the area. Final results from a marketing standpoint will depend on our assumptions of costs, productivity, and product prices at the time of harvest.

FOR ADDITIONAL INFORMATION: City of Springfield, Oregon, Public Works, Environmental Services, 541/726-3694; the Metropolitan Wastewater Management Commission Public Education & Information Specialist, email: info@BiocycleFarm.org; Oregon Department of Environmental Quality website for Biosolids Program: www.deq.state.or.us/wq/biosolids/biosolidshome.htm

Ken Vanderford has worked in the wastewater treatment field for 23 years including 17 years in biosolids management. Ken is the current chair the Biosolids Committee for Oregon Association of Clean Water Agencies and Co-Chair of the Research and Demonstration Committee for the Northwest Biosolids Management Association.

WATER BRIEFS

STATE NPDES AUTHORITY AZ

NPDES PROGRAM VACATED

The 9th Circuit Court of Appeals held August 22 that the EPA erred when it transferred authority for pollution control under the Clean Water Act (CWA) to Arizona without first assuring that the action would not jeopardize listed species protected under the ESA. The court vacated EPA's decision to approve Arizona's pollution permitting application.

The transfer of authority to Arizona is important because Section 7(a)(2) consultations required by ESA apply only to "federal agencies," not to state governmental bodies. Accordingly, the EPA's pollution permitting decisions are subject to section 7(a)(2), but state pollution permitting decisions are not. As the court noted, "Although Arizona could voluntarily consult with FWS regarding pollution permits, neither the EPA nor FWS could require Arizona to act on behalf of listed species." Order at 10.

The impact on 44 other states that control CWA permitting is unclear, although the 9th Circuit alluded to the issue: "The EPA has followed the section 7 consultation process before transferring permitting authority to states for more than a decade. Every pollution permitting transfer decision since 1993 has involved some form of EPA consultation with FWS regarding endangered species," but "Earlier pollution permitting transfer decisions do not appear to have been preceded by Endangered Species Act consultation." Footnote 3, Order at 8-9

The court stated that the case turned on "one fundamental issue: Does the Endangered Species Act authorize — indeed, require — the EPA to consider the impact on endangered and threatened species and their habitat when it decides whether to transfer water pollution permitting authority to state governments?" Order at 4-5

The US Fish and Wildlife Service had issued a Biological Opinion (BiOp) premised on the proposition that, when deciding whether to transfer permitting authority to Arizona, EPA lacked the authority to take into account the impact of that decision on endangered species and their habitat. EPA relied on the BiOp's position that EPA lacked such authority.

The Court rejected EPA's approach: "…we hold that the EPA did have the authority to consider jeopardy to listed species in making the transfer decision, and erred in determining otherwise. For that reason among others, the EPA's decision was arbitrary and capricious. Accordingly, we grant the petition and remand to the EPA." Order at 5.

The entire case, *Defenders of Wildlife, et al v. US EPA, et al*, No. 03-71439 (August 22, 2005), is available by going to www.findlaw.com and following the links for the 9th Circuit, August 2005 decisions.

For info: William Lutz, Defenders of Wildlife, 202/ 772-0269, or website http://www.defenders.org/releases/pr2005/pr082305b.html

GW CONTAMINATION CA

SUPERFUND SETTLEMENT

EPA has reached a settlement with the Carrier Corporation and its parent company, United Technologies, Inc. (CC/UT), that requires the companies to spend an estimated $27.8 million on projects and penalties for the cleanup of shallow groundwater contamination at the Puente Valley Operable Unit of the San Gabriel Valley Superfund Site, Area 4 in Southern California.

Carrier Corp. used **v**olatile **o**rganic **c**ompounds (VOCs) for degreasing, metal cleaning and other purposes, which contaminated groundwater at the Puente Valley Operable Unit. The EPA listed several sections of the San Gabriel Valley as Superfund sites in 1984, including multiple areas of groundwater contaminated by VOCs.

The contaminated groundwater associated with all of the San Gabriel Valley sites lies under significant portions of Alhambra, Irwindale, La Puente, Rosemead, Azusa, Baldwin Park, City of Industry, El Monte, South El Monte, West Covina, and other areas of the San Gabriel Valley. There are 45 water suppliers in the Valley that use the San Gabriel Basin groundwater aquifer to provide 90 percent of the drinking water for over one million people. Under the consent decree filed August 17 in US District Court in Los Angeles, CC/UT will spend an estimated $26.5 million to build a groundwater cleanup system that will involve the installation of wells to pump out contaminated groundwater and prevent it from continuing to migrate. CC/UT will also construct a treatment plant (or series of plants), to remove the contaminants from the groundwater. The treated water may be provided to a local water supply distribution system or discharged to surface water.

CC/UT will also spend $468,750 on an environmental project at a former duck farm overlying a portion of the contaminated groundwater at the site. The project will primarily target the use of plants to cleanup low level soil contamination, groundwater recharge, or treatment wetlands at the former duck farm.

The settlement also requires CC/UT to reimburse the EPA $800,000 in past response costs and pay future oversight costs incurred by the agency; pay a $125,000 civil penalty for failing to comply with an EPA cleanup order issued to Carrier; and monitor upgradient contamination.

The work to be performed by CC/UT implements a substantial portion of EPA's interim site cleanup plan. Other portions of the cleanup plan are being addressed by other responsible parties. EPA will ultimately develop a final cleanup plan for the site after the interim remedy has operated for a number of years.

For info: Margot Perez-Sullivan, EPA, 213/ 244-1814, or email: perezsullivan.margot@epa.gov; EPA Superfund website: www.epa.gov/region09/waste/sfund/

CRITICAL HABITAT NW & CA

NOAA CUTS 80%

On August 12, NOAA Fisheries released its final critical habitat designation for 19 evolutionarily significant units of salmon and steelhead in California and the Northwest protected under the ESA. NOAA cut approximately 80% of the

river miles it originally designated in 2000. The 2000 designations had been withdrawn by NOAA as part of the settlement of a lawsuit challenging NOAA's determinations (see National Ass'n of Home Builders v. Evans, No. 1:00-CV-02799 CKK (D.D.C. April 30, 2002)).

NOAA's actions were widely expected following the release of the proposed rules in November 2004. A coalition of environmental groups released a report in August entitled "*A Place Called Home: Why Critical Habitat is Essential to the Recovery of Salmon and Steelhead*" that analyzes how the administration's proposal threatens salmon recovery throughout California and the Northwest. See TU website: www.tu.org

The ESA gives the Secretary of Commerce discretion to exclude areas from designation if he determines that the benefits of exclusion outweigh the benefits of designation. Areas that are currently unoccupied by the species were not designated as critical habitat, except for a small area in Hood Canal, WA. Other exclusions include military properties, tribal lands, some private lands covered by Habitat Conservation Plans, and certain areas based on economic impacts. According to NOAA, the exclusions based on economic impacts will reduce the economic impact in the Northwest by $243.6 million and in California by about $100.5 million. NOAA's related maps, documents, and proposal support data can be found at http://www.nwr.noaa.gov/1salmon/salmesa/crithab/CHsite (Northwest) and http://swr.nmfs.noaa.gov/salmon.htm (California).

For info: Brian Gorman, NOAA NW, 206/ 526-6613; Jim Milbury, NOAA CA, 562/ 980-4006; Susan Holmes, Earthjustice, 202/ 667-4500 x204, or email: sholmes@earthjustice.org

CONJUNCTIVE USE UT

UTAH REPORTS

The Utah Division of Water Resources (UDWR) recently completed a report titled "*Conjunctive Management of Surface and Ground Water in Utah*." It contains information on issues relating to ground water aquifers such as declining water levels, aquifer compaction, and water rights. Conjunctive use strategies, with and without aquifer storage and recovery (ASR), are presented. Recharge water sources and quality along with benefits and limitations of ASR are discussed. Finally, examples of ASR projects in Utah are described along with factors affecting implementation of such projects, including regulation and funding. The report is available on the UDWR website, along with two other reports on Water Reuse in Utah, and Municipal and Industrial Water Conservation

For info: Mike Suflita, UDWR, 801/ 538-7267, or email: mikesuflita@utah.gov; UDWR website: www.water.utah.gov

LANDFILL SUPERFUND CO

CLEANUP SETTLEMENT

The City and County of Denver, Waste Management of Colorado, Inc., and six other companies agreed to pay $13.9 million to reimburse money spent by the US in connection with the Lowry Landfill Superfund Site near Denver. The settlement also requires that the settling defendants continue site cleanup and pay costs incurred by the US with respect to the site in the future. Although initial cleanup of the site is nearly complete, the defendants are responsible for long-term maintenance under the consent decree, which is expected to cost $43 million and continue for more than 30 years. Adolph Coors Company, Chemical Waste Management, Inc., Conocophillips Company, Metro Wastewater Reclamation District, Roche Colorado Corporation, and S.W. Shattuck Chemical Co., Inc. are the six other settling defendants. US EPA and the US Department of Justice (DOJ) announced the settlement on August 22.

Lowry Landfill is one of the nation's largest Superfund sites occupying 508 acres in Arapahoe County. The site received approximately 138 million gallons of liquid industrial waste from 1966 to 1980. The liquids were placed in unlined trenches and pits, most of which are covered by 25 to 60 feet of municipal refuse. The investigation and cleanup has been underway for more than 20 years. In 1984, the site was placed on the National Priorities List of the nation's most contaminated toxic waste sites. That same year, EPA began efforts to address hazards posed by the site by issuing a series of administrative orders which resulted in investigation and the construction and operation of a groundwater barrier, drain, collection, and treatment system.

DOJ filed the consent decree on behalf of the EPA in federal district court in Denver. The consent decree is subject to a 30-day public comment period and final court approval. *US v. City and County of Denver, et al* is available on DOJ's website.

For info: EPA, 303/ 312-6926 or DOJ, 202/ 514-1888, or website: www.usdoj.gov/enrd/open.html

WETLANDS/RIPARIAN US

NONPOINT SOURCE MANAGEMENT

EPA recently published "National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution," a technical guidance and reference document for use by state, territory, and authorized tribal managers as well as the public in the implementation of **n**on**p**oint **s**ource (NPS) pollution management programs. The new guidance contains information on the best available, economically achievable means of reducing nonpoint source pollution through the protection and restoration of wetlands and riparian areas, as well as the implementation of vegetated treatment systems (Publication #EPA 841-B-05-003.

For info: EPA, 800/ 490-9198, or website: http://epa.gov/owow/nps/wetmeasures/

KLAMATH "TAKINGS" OR, CA

IRRIGATORS CLAIMS REJECTED

US Court of Federal Claims Judge Francis Allegra on August 31 rejected the "takings" claims filed by Klamath River Basin irrigators for $100 million. The water users alleged that an unconstitutional "taking" of

private property by the federal government occurred in 2001 when the US Bureau of Reclamation reduced water deliveries to its contractual water users, deciding instead that the water was needed for federally protected species under the Endangered Species Act.

The court did address another "takings" case raised by the plaintiffs that resulted in a settlement of $16.7 million for California irrigators (see *Tulare Lake Basin Water Storage District v. United States*, 49 Fed. Cl. 313 (2001). See Moon, TWR #11. Unfortunately for the plaintiffs, Judge Allegra found that "with all due respect, Tulare appears to be wrong on some counts, incomplete in others and, distinguishable, at all events." Among other problems, the court noted that, "Tulare failed to consider whether the contract rights at issue were limited so as not to preclude enforcement of the ESA. Rather, the court treated the contract rights possessed by the districts essentially as absolute, without adequately considering whether they were limited in the case of water shortage, either by prior contracts, prior appropriations or some other state law principle…Moreover, because it did not view the districts as having a third-party beneficiary contract claim against the United States, the court never reached the issue whether the violations of the contract rights should be analyzed as breaches, not takings, and, as a result, never considered the potential application of the sovereign acts and unmistakability doctrines." Order at 45.

The court opinion also touched on the Prior Appropriation Doctrine and the effect of tribal water rights on the takings claim. "Hence, any water rights provided through these deeds and permits are subservient to the prior interests not only of the United States, but of the various tribes at issue here, whose interests "carry a priority date of time immemorial." *Klamath Waters Protective Ass'n*, 204 F.3d at 1214; see also *United States v. Adair*, 723 F.2d 1394, 1414 (9th Cir. 1984)." Order at 47.

While the court rejected the irrigators' claims under the Takings Clause of the Fifth Amendment, it allowed further briefing on breach of contract claims against the government, even though it observed that on those claims, "plaintiffs face an uphill battle." Order at 44.

Judge Allegra summed up his opinion in the Conclusion on page 48: "Concluding this tour d'horizon, the court is mindful that, despite the potential for contractual recovery here, this ruling may disappoint a number of individuals who have long invested effort and expense in developing their lands based upon the expectation that the waters of the Klamath Basin would continue to flow, uninterrupted, for irrigation. But, those expectations, no matter how understandable, do not give those landowners any more property rights as against the United States, and the application of the Endangered Species Act, than they actually obtained and possess. Like it or not, water rights, though undeniably precious, are subject to the same rules that govern all forms of property – they enjoy no elevated or more protected status. In the case *sub judice*, those rights, such as they exist, take the form of contract claims and will be resolved as such."

For info: Todd True, Earthjustice, 206/ 343-7340 x30, *Klamath Irrigation District, et al v. United States, et al*, Case No. 01-591 L is available by going to the Earthjustice website: www.earthjustice.org/news/display.html?ID=1042

DAM REMOVAL GRANTS US OPEN RIVERS INITIATIVE

On August 31 at the White House Conference on Cooperative Conservation, Under Secretary of Commerce for Oceans and Atmosphere and NOAA administrator Retired Navy Vice Admiral Conrad C. Lautenbacher Jr., announced the establishment of the Open Rivers Initiative (ORI). The initiative will provide grants to communities committed to removing obsolete and derelict stream barriers (dams and culverts). ORI will be administered through the NOAA Office of Habitat Conservation.

Steve Moyer, VP for Government Affairs for Trout Unlimited, told The Water Report that his organization was encouraged by the announcement. A TU press release said that the program was "a progressive initiative with phenomenal potential to restore our home waters." Moyer also informed TWR that "big questions remain. How much money will be put towards the program and what specific criteria will be required to obtain funding?"

In his remarks to the conference, Lautenbacher said that the "goal is to broaden private-public partnerships that will enhance our environment" as part of the "partnership for cooperative conservation." He also noted the general purpose of the program: "At the Commerce Department, we see removal of obsolete dams and other barriers as an additional tool in conserving and restoring our fish populations." Lautenbacher went on to point out as "clearly as possible" that "First, we have no interest in pursuing removal of any dam that serves a useful purpose. Second, we have no interest in pursuing removal of any dam whose owner is not a willing partner."

Stephanie Hunt of NOAA's Restoration Center informed TWR that the three main criteria for the program will be community support, economic benefit and ecological benefit from the removal. She also said that the amount of funding will become evident when the President's next budget comes out in February 2006.

For info:; Robin Bruckner, NOAA, 301/ 713-0174, email: robin.bruckner@noaa.gov, or ORI website: http://conservationconference.noaa.gov/case/open_river.html; Steve Moyer, TU, 703/ 284-9406

CALENDAR

Please Note: An extended Calendar containing ongoing updates now appears on **The Water Report's** website: www.thewaterreport.com. Subscribers are encouraged to submit calendar entries, email: thewaterreport@hotmail.com

September 13-15 WA
Northwest Power and Conservation Council Meeting, Spokane. For info: www.nwcouncil.org

September 14-15 ID
Getting in Step With Phase II: Workshop for Stormwater Program Managers, Boise. Sponsored by EPA (limited to first 100 participants). For info: EPA website: http://cfpub2.epa.gov/npdes/outreach.cfm?program_id=0&otype=1

September 14-16 ID
Symposium on the Settlement of Indian Reserved Water Rights Claims, Moscow, University Inn & Conference Center. Sponsored by Western States Water Council and Native American Rights Fund. For info: Tony Willardson, WSWC, 801/ 561-5300, email: twillards@wswc.state.ut.us, or website: www.westgov.org/wswc/meetings.html

September 14-16 CA
Basin Yield & Overdraft: Scientific & Legal Perspective, Pasadena, Hilton Pasadena. Sponsored by Groundwater Resources Association of California and International Association of Hydrogeologists. RE: Hydrologic Trend Analysis, Evaluating Groundwater Basin Yield, Perennial & Safe Yield, Subterranean Streams, Surface Water/ Groundwater Interactions, Sustainable Management, Field Trip: Raymond Basin on 9/14. For info: GRAC, 916/ 446-3626, or website: http://www.grac.org/

September 14-16 SD
South Dakota Section Annual Conference: American Water Works Association, Brookings. For info: American Water Works Association, 303/ 347-0804, South Dakota Section website: www.sdawwa.org/

September 14-16 KS
Kansas Section Annual Conference: American Water Works Association, Salina, Salina Holidome. For info: American Water Works Association, 303/ 347-0804, Kansas Section website: www.ksawwa.org/

September 15-16 NV
Western Water Law 12th Annual, Las Vegas, Riviera Hotel. RE: Municipal, Regional and International Issues from Water Shortages, Strategies for Maintaining Water Quantity and Quality. For info: CLE Int'l, 800/ 873-7130 or website: www.cle.com

September 15-16 TX
Water Quality Seminar - TCEQ, Round Rock, Austin Marriott North, 2600 La Frontera Blvd. RE: Stormwater Permits & Inspections, Environmental Management Systems & Pretreatment. For info: Diane Stallings, TCEQ, 512/ 239-6333, email: dstallin@tceq.state.tx.us, or website: www.tceq.state.tx.us/assets/public/admin/events/09-05waterquality.pdf

September 15-16 OR
Columbia River Inter-Tribal Fish Commission, Portland. For info: Sandra Peterson, CRITFC, 503/ 238-0667

September 16 CA
California Environmental Quality Act, Costa Mesa. For info: CLE Int'l, 800/ 873-7130 or website: www.cle.com

September 16 WA
Sediment: Evaluation, Management, Treatment & Disposal, 8th Annual *Advanced* Conference, Seattle, Washington State Convention & Trade Center, RE: CERCLA, MTCA, Clean Water Act, Endangered Species Act; Timely Legal Issues; Construction Phase of the Project; Case Studies Including: Duwamish River, Commencement Bay & Portland Harbor Superfund Sites; Technical Solutions and Practical Advice; More. Environmental Law Education Center Presentation. For info: ELEC, 503/ 282-5220 or website www.elecenter.com or email: hduncan@elecenter.com

September 16-18 CA
The Effects of Climate Change on Northern Sierra Nevada Watersheds Conference, Truckee, Alder Creek Middle School. For info: Beth Christman, Truckee River Watershed Council, 530/ 550-8760, or email: bechristman@truckeeriverswc.org

September 18-21 CO
"Water Reuse & Desalination: Mile-High Opportunities" WateReuse Symposium, Denver, Sponsored by American Water Works Association and Water Environment Federation. For info: WateReuse Association website: www.WateReuse.org

September 18-21 MD
2005 National Forum on Contaminants in Fish, Baltimore. RE: Chemical Contaminants, Assessing and Managing Health Risks, Bioaccumulation, Updates from EPA and FDA, Risk Communication, Federal and State Monitoring Programs, Updates on Selected Chemicals including PBDEs, Mercury, PCBs, and Dioxin. For info: Jeff Bigler, EPA, (202) 566-0389, email: bigler.jeff@epa.gov, or website: www.epa.gov/waterscience/fish/

September 18-22 NC
13th National Nonpoint Source Monitoring Workshop, Raleigh, Sheraton Capital Center Hotel. RE: Best Management Practices' For info: North Carolina State University website: www.ncsu.edu/waterquality/nmp_conf/

September 18-23 WA
20th Annual Hazardous Materials Management Conference on Household & Small Business Waste, Tacoma, Sheraton Tacoma. Sponsored by: North American Hazardous Materials Managers Association. For info: NAHMMA, 503/ 797-1682, or website: www.nahmma.org

September 18-23 OR
Pacific Fishery Management Council Meeting, Portland, Embassy Suites Hotel Portland Airport, 7900 NE 82nd Avenue. For info: PFMC, 866/ 806-7204, website: www.pccouncil.org

September 19 WA
Water Resources Advisory Committee (WRAC) Meeting, Lacey, Ecology Hdqrters, 300 Desmond Drive. RE: Water Resource Management and Strategies (Agenda Varies). For info: Curt Hart, Ecology, 360/ 407-7139, email: char461@ecy.wa.gov, or website: www.ecy.wa.gov/programs/wr/wrac/wrachome.html

September 19-20 TX
Texas Water Law 15th Annual, Austin, Hyatt Regency. RE: "Water in the 79th Legislature," Updates on Groundwater, Surface Water, Water Supply and Development, Takings Litigation and Vested Rights, Edwards Aquifer and Guadalupe River Basin. For info: CLE Int'l, 800/ 873-7130 or website: www.cle.com

September 19-20 CA
California Energy Markets Conference, San Francisco, Pan Pacific Hotel. For info: Law Seminars International, 800-854-8009 or website: www.clenews.com/LSI/05/05resca.htm

September 19-20 WA
On-Site Wastewater Treatment: Short Course and Equipment Exhibition, Seattle. Sponsored by University of Washington School of Engineering. RE: Advanced Treatment Systems, Innovative Technologies, New Equipment, Current Research. For info: Engineering Professional Programs (UW), 866/ 791-1275, email: uw-epp@engr.washington.edu, or website: www.engr.washington.edu/epp/wwt

September 19-22 ID
Affiliated Tribes of Northwest Indians Annual Conference, Coeur d'Alene. For info: ATNI website: www.atnitribes.org

September 20 ID
Idaho Water Resources Board, Twin Falls. For info: IWRB, 208/ 287-4800, or website: www.idwr.idaho.gov/waterboard/minutes.htm

September 21-24 AZ
"Conservation and Innovation in Water Management" - 18th Annual Arizona Hydrological Society Symposium, Flagstaff, Radisson Woodlands Hotel. RE: Southwest Water Issues, Regulation, Water Resource Development & Management, Drought Management, Conservation, Stream-Aquifer Interactions, Watershed Impacts, Flow & Transport Modeling. For info: AHS website: www.azhydrosoc.org/symposia.html

September 22 OR
"Goodbye to the Public-Private Divide", Portland, Lewis & Clark Law School. RE: Natural Resources Law Institute Distinguished Visitor Lecture by Eric T. Freyfogle. For info: NRLI, 503/ 768-6784

September 22-23 AZ
Environmental and Natural Resources Law on the Reservation: Evolving Tribal Governments and Cross-Border Issues, Phoenix, Pointe Hilton Squaw Creek Resort. RE: Water Law, FERC's Policies, Hydroelectric De-Commissioning, Navajo Nation's Clean Air Program, Environmental Justice, Skokomish Case, Teck-Cominco Case, Tribal Right-of-Ways, Power Plant & Large Project Siting. Networking Reception Sponsored by The Water Report and Short Cressman & Burgess. For info: CLE Int'l, 800/ 873-7130 or website: www.cle.com

September 22-23 MT
Montana Section Symposium: American Water Resources Association, Bozeman, Holiday Inn. For info: MT.AWRA, 406/ 994-6690 or website: http://awra.org/state/montana/

September 23 CA
California Environmental Quality Act, San Francisco. For info: CLE Int'l, 800/ 873-7130 or website: www.cle.com

September 23-24 UT
Utah Board of Water Resources Meeting, Ruby's Inn, Location TBA. RE: Tour Escalante/Boulder Area. For info: Molly Waters, 801/ 538-7230, email: mollywaters@utah.gov, website: www.water.utah.gov/board/2004SCHED.asp

September 24-28 OR
2005 Annual Forum: Ground Water Protection Council, Portland, DoubleTree-Lloyd Center. For info: GWPC, 405/ 516-4972, or website: www.gwpc.org/

September 25-27 NE
NARD Annual Conference (Nebraska Association of Resources Districts), Kearney, Holiday Inn & Convention Center. For info: NARD, 402/ 471-7670, email: nard@nrdnet.org, or website: www.nrdnet.org

September 26 UT
Utah Water Quality Board Meeting, Salt Lake City, Location TBA. For info: Utah DEQ, 801/ 538-6146, website: http://waterquality.utah.gov/wq_board/wq_board.htm

September 26-27 UT
Principles of Desalting Brackish and Seawater, Salt Lake City, Hilton Salt Lake City Airport. For info: American Water Works Association, **800/ 926-7337** or website: www.awwa.org/education/seminars/

September 26-30 OR
Across the Great Divides: 20th NW ESRI User/Training Conference, Bend. RE: GIS Training and Conference, Pre-Conference Training 9/27-9/27, Workshops in GPS, ModelBuilder, Python & Other Technical Topics. For info: john@junipergis.com or website: www.nwesriusers.org

September 26-30 DC
Water Quality Standards Academy Sessions, Washington, DC. RE: US EPA Introductory Course on Water Quality Standards (Comprehensive), Regulation, Policies, Program Guidance, Water Quality Criteria Development. For info: www.glec-online.com/Announ-Session9.htm

(continued from previous page)

September 27 **CO**

2005 Colorado Nonpoint Source Forum, Glenwood Springs, Hotel Colorado. RE: Watershed Planning, NPS Forum Grant Funds. For info: Loretta Lohman, email: lorettalohman@npscolorado.com, or website: www.npscolorado.com/2005ForumBrochure.pdf

September 27 **NE**

Nebraska Natural Resources Commission Meeting, Kearney. For info: www.dnr.state.ne.us/commembers/commtg.html

September 27 **OR**

"The Apollo Alliance: Shooting for a Clean Energy Economy"—Oregon Natural Step Network Breakfast Meeting, Portland, Multnomah Athletic Club, 1849 SW Salmon St, 7am-9am. For info: ONSN, 503/ 241-1140 or email: events@ortns.org or website: www.ortns.org

September 28 **CA**

2005 California Watershed Forum: Building a Statewide Watershed Program, Sacramento, Cal/EPA Building, 1001 I Street. For info: Mary Lee Knecht, mlknecht@Comcast.net

September 28-30 **OR**

Land Conservation & Development Commission Meeting, Bandon. For info: Sarah Watson, DLCD, 503/ 373-0050 x271 or email: sarah.watson@sate.or.us

September 29-30 **TX**

Texas Water Law Institute, Austin, Hyatt Regency on Town Lake. For info: University of Texas School of Law (CLE), 512/ 475-6700, or website: http://conferences.utcle.org/law/cle/conferences/fall2005/default.php

October 2-7 **CA**

Principles of Stream Restoration, Bishop, White Mountain Research Station. RE: Fluvial Geomorphology & Applications to River Management and Restoration. For info: USU Conference Services, 800/ 538-2663 or website: www.cnr.usu.edu/departments/awer/pages/Shortcourse/shortcourse2005.htm; or website: www.esice.org/geomorph.htm

October 5-6 **OR**

NEPA Practice: 2005 Update, Portland, Oregon Convention Center. RE: Comprehensive Introduction to NEPA, Update. For info: Oregon Law Institute, 800/ 222-8213, or website: www.lclark.edu/org/oli/objects/2005_nepa.pdf.

October 5-7 **NV**

Nevada Indian Environmental and Agricultural Summit, Reno. For info: Staci Emm, 775/ 945-3444

October 6 **AK**

Permitting Strategies in Alaska, Anchorage. RE: Alaska Coastal Management Program, NEPA, ESA, Permitting Appeals & Legal Challenges. For info: The Seminar Group, 800/ 574-4852, or email: Info@TheSeminarGroup.net, or website: www.TheSeminarGroup.net

October 6-7 **CA**

Association of California Water Agencies 2005 Continuing Legal Education Workshop, Costa Mesa, Westin South Coast Plaza. RE: Legal Water Issues. For info: ACWA, 916/ 441-4545, email: lorid@acwa.com, or website: www.acwa.com

October 6-7 **CO**

Environmental Issues in Energy Development, Denver. For info: Law Seminars Int'l, 800/ 854-8009, website: www.lawseminars.com

October 7 **OR**

Oregon Fish & Wildlife Commission, Salem, 8 am. For info: Cristy Mosset, ODFW, 503/ 947-6044, www.dfw.state.or.us/Comm/schedule.htm

October 11 **OK**

Oklahoma Water Resources Board Meeting, Oklahoma City, 3800 N. Classen Blvd., 9:30 am. For info: OWRB, 405/ 530-8800, website: www.owrb.state.ok.us/news/meetings/board/board-mtgs.php

October 12-14 **CO**

Tamarisk 2005 Symposium, Grand Junction. Co-hosted by Tamarisk Coalition and Colorado State University. RE: Riparian Health & Tamarisk, Long-Term Solutions. For info: Tim Carlson, Tamarisk Coalition, 970/ 256-7400, email: tcarlson@tamariskcoalition.org, or websites: www.tamariskcoalition.org or www.colostate.edu/Depts/CoopExt/TRA/Tamarisk2005.html

October 13-14 **OR**

Montana Water Law Conference 5th Annual, Helena. RE: Legislation on Quality & Quantity, Interstate Issues, Milk and Big Hole River Issues. Drainage, Groundwater/Surface Water, Subdivisions, Wetlands, DNRC Amendments, Jurisdictional Issues, Groundwater Code of 1961, Groundwater Modeling. For info: The Seminar Group, 800/ 574-4852, or website: www.TheSeminarGroup.net

October 13-14 **CA**

California Lake Management Society, Kings Beach, RE: Lake Tahoe, Land Management, Land Use Regulations, Water Quality Monitoring, Recreation, Fisheries, and Aquatic Vegetation. For info: Frances Brewster, 408/ 265-2607 x2723, or email: fbrewster@valleywater.org

October 17 **WA**

Water Resources Advisory Committee (WRAC) Meeting, Lacey, Ecology Hdqrters, 300 Desmond Drive. RE: Water Resource Management and Strategies (Agenda Varies). For info: Curt Hart, Ecology, 360/ 407-7139, email: char461@ecy.wa.gov, or website: www.ecy.wa.gov/programs/wr/wrac/wrachome.html

October 17-19 **TX**

Western States Adjudication Conference, San Antonio, Drury Inn & Suites, 201 N. St. Marys. RE: Adjudication and Water Rights Issues; Sponsored by TCEQ. For info: Sue Phillips, TCEQ, 512/ 239-6327, or email: sphillip@tceq.state.tx.us

October 18 **OR**

Drinking Water Advisory Committee Meeting, Salem, Public Utility Commission Office, For info: Diane Weis, DHS, 503/ 731-4010 or email: diane.weis@state.or.us

October 18 **CA**

Water Quality Monitoring Conference, Nevada City, Miners Foundry, 325 Spring Street. Sponsored by the State Water Resources Control Board. For info: Kayle Martin, 530/ 265-5961 x201, email: kayle@syrcl.org, or website: www.yubariver.org

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