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WATER MANAGEMENT ALTERNATIVES

INCORPORATING "NEW" WATER MANAGEMENT METHODS AT A WATERSHED SCALE

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INTRODUCTION

Understanding ways in which water can be managed and stored for various uses during the different stages of the hydrologic cycle is critical, particularly in the West where water is such a scarce resource. As noted historian and novelist Wallace Stegner said in 1987, "The West is defined…by inadequate rainfall. We can't create water, or increase the supply. We can only hold back and redistribute what there is."

Western water managers and planners have worked to gain a better understanding of the full spectrum of opportunities to "hold back and redistribute" water in its many forms and through its many pathways. In some cases, scientists and engineers have developed new technologies for water supply storage and management. In other cases, managers have re-discovered and updated old methods used by ancient civilizations.

The manner in which water resources planning and management occurs has evolved significantly in recent decades. Integrated, regional and system-based water planning and management approaches have been developed which recognize the connectivity between groundwater, surface water, and water in other parts of the hydrologic cycle (such as clouds and snow) in all parts of a river basin or watershed. Water planning has also become more collaborative and comprehensive, taking into consideration a wider range of water uses for municipal, agricultural, and industrial water supplies. Habitat, recreational, and traditional requirements, and other water-related values (such as aesthetics) are also being considered. Particularly where collaborative decision-making processes bring together individuals with varying levels and types of educational backgrounds and water experience, it is critical that the various stakeholders have an understanding of the different methods, and how they can be incorporated into the management of water resources.

When developing a truly integrated water plan on a watershed or river basin scale, it is important to recognize and find ways to combine the use of more traditional approaches of water management — such as direct diversions and on-channel reservoirs — with "alternative" approaches to controlled water storage. "Controlled storage" can be defined as water supplies that are deliberately held and managed by specific entities with controlled releases for specific uses. These methods may include: storage in aquifers; voids left by mining activities; tanks and towers; alterations to natural water bodies (such as lakes); and various types of off-channel storage.

Not all methods for augmenting, re-timing, and managing water supplies can be classified as "controlled storage." In developing a comprehensive approach to water planning, there also needs to be inclusion of methods for enhancing the yield of water to storage locations (natural or manmade) and points of direct use, with consideration of such methods as managed aquifer recharge, precipitation management, and vegetation management — recognizing the role of source waters or "headwaters" as a significant factor not just for water quality, but also for water availability.

Water Management Alternatives

Incorporating Alternatives

Once water has been captured in some sort of controlled storage, there are also methods that are in use to "stretch" those stored supplies, such as multi-objective operations, optimization, and market mechanisms (such as "water banks") to serve multiple users and provide multiple benefits. In addition, many uses provide inherent opportunities for water reuse and recycling (for the same use or a different use) — further ensuring that water supply needs for multiple purposes can be met.

Incorporating these alternative methods into an integrated water plan can be challenging for individual water managers trying to meet the needs of a localized area (such as a town or irrigation district) as well as for planners operating on a more regional scale (such as a state or federal agency or multi-stakeholder water planning council). This is particularly true if a method has not previously been used nearby, where there has been a past failure associated with a similar method, or when methods could be labeled as "experimental" or otherwise classified as "crazy ideas." Water managers and planners, as well as citizen boards overseeing water districts or water agencies, are rightfully cautious about expending time, money, and other resources on incorporating approaches previously untried in their area, not wanting to become associated with a failed effort by introducing a method that is not appropriate to their topography, economics or demographics.

Evaluating Options

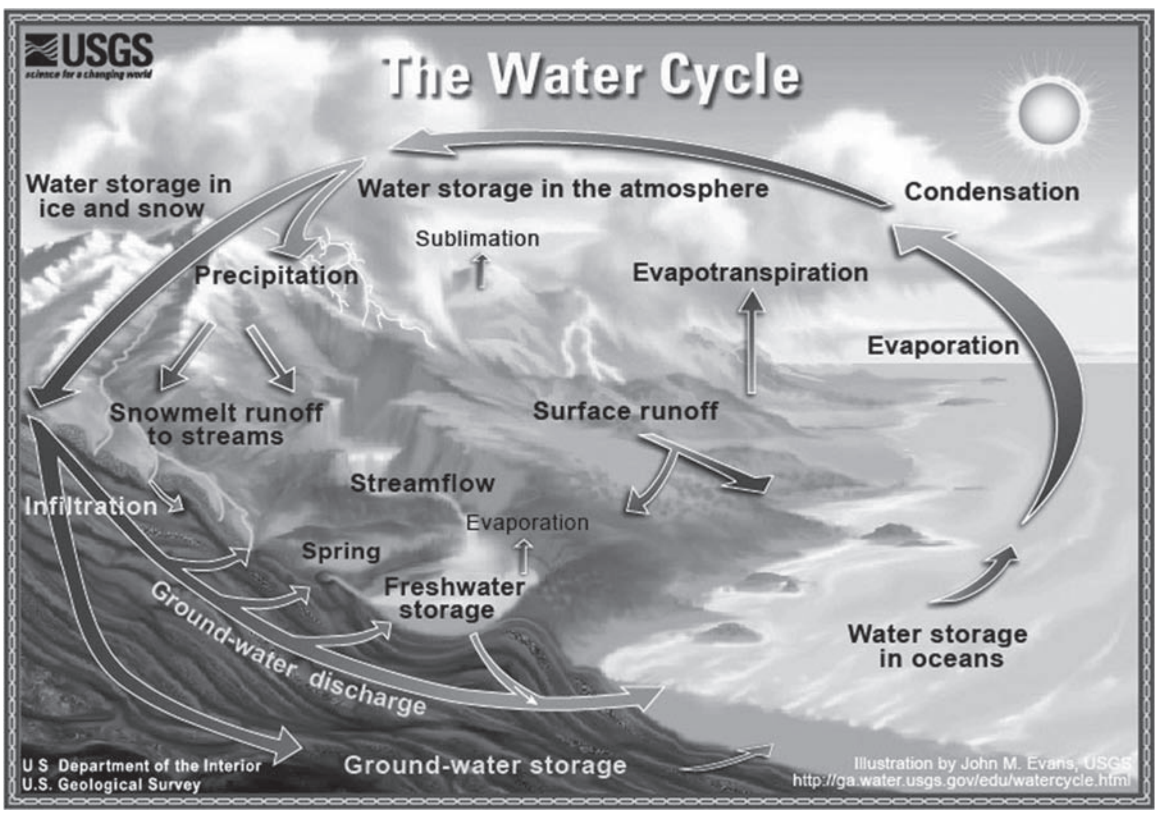
Evaluating regional or watershed water management options necessarily involves developing an understanding of the hydrologic cycle, particularly as it applies to one's own watershed (depicted generically in Figure 1). The hydrologic cycle tells us how water moves and changes form, and how water is stored naturally. However, while understanding a region's hydrology and the physical nature of water forms a backdrop for decision-making, integrated water planning — as a practical matter — also requires planners to address institutional adaptability and other existing constraints.

Typical Planning Issues

Some typical water planning issues include:

- How is a water manager or a water planner to decide whether alternative methods will fit within their integrated water plan? How can they identify the right set of tools to add to their toolbox in order to ensure the best possible water supply availability and reliability?
- How can they determine whether to invest in a method that may involve activities and decision-making *outside* of their immediate geographic area, jurisdiction, or other bounds of their control, particularly when such activities may not be readily attributable to a specific increase in water yield or a specific return on investment?
- How do they even determine which methods have been used legitimately in some other area, under similar circumstances to their own, and aren't just some "crazy idea?"

Figure 1



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Water Management Alternatives

Evaluation Framework

This article presents a framework for understanding different alternative water supply storage and management methods, and how these methods can be incorporated into an integrated water plan. This framework — called the "Water Supply Life Cycle" (depicted in Figure 2) — is similar to the natural hydrologic cycle in that it considers the natural ways in which water enters, moves through, and exits river basins in various forms. The Water Supply Life Cycle, however, considers water availability *from a water manager's perspective*, considering the various uses for water and some specific opportunities for deliberate and controlled capture, and management of water to provide supplies for those uses. This includes management during various stages of the hydrologic cycle, when water naturally moves through various processes (such as precipitation or infiltration), and in different forms of natural storage, such as snowpack.

Once water managers and water planners have been able to characterize alternative methods by understanding where they fall within the framework, and what management challenges are associated with each, then they can begin to work towards evaluating these methods as contributing potential solutions to address their water supply needs.

Comprehensive Assessment

USABLE WATER SOURCES

The concept behind the Water Supply Life Cycle is a recognition that water supplies don't begin as rivers and aquifers, but as precipitation and source waters that follow particular pathways to reach usable forms of water supply — not all of which involve controlled storage. The Water Supply Life Cycle also acknowledges that some water uses can create particular opportunities for reuse of water that might otherwise be considered "waste" to allow for recycling of the same molecules of water as they travel from one end of a basin to the other.

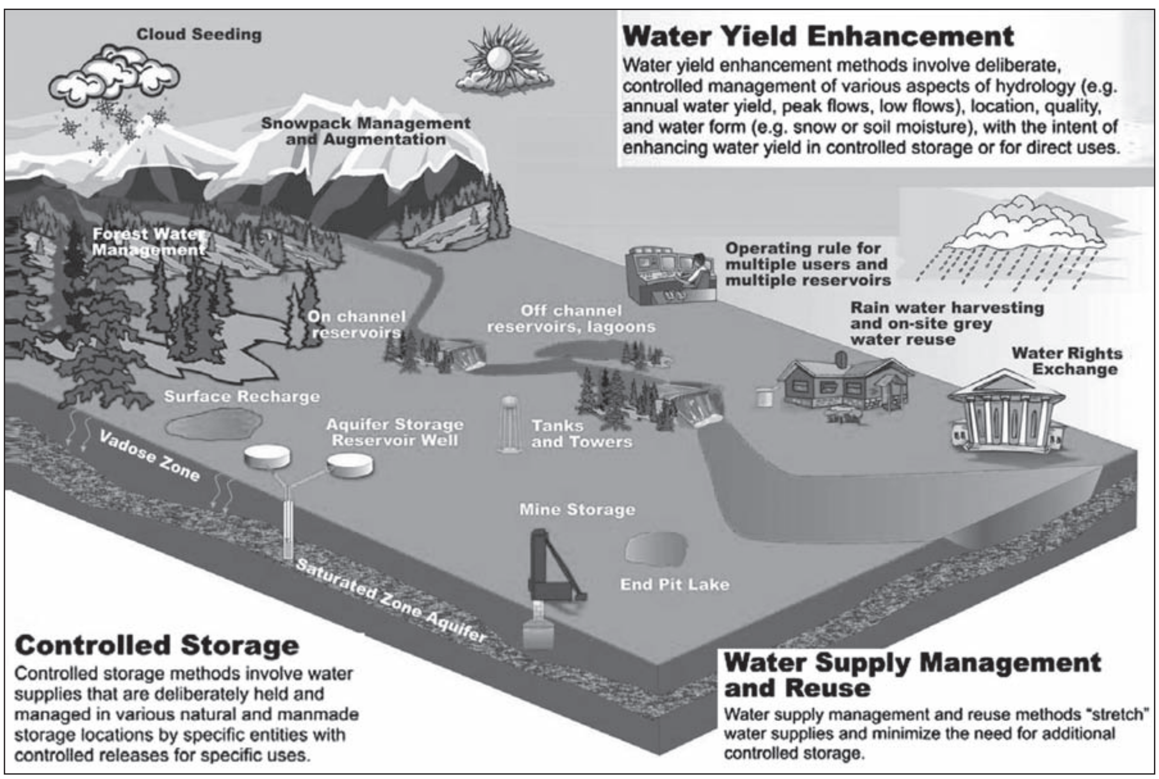
It is helpful to understand the pathways and natural storage of source water to properly evaluate the benefits of various alternative water supply storage and management methods. The value of each method depends on the ways in which water is needed, how much water is needed, and how long water can be stored before use.

Source Review

Water source review includes consideration of:
- Direct supply sources such as lakes, rivers and groundwater aquifers
- The "ultimate water supply" for these sources, i.e. precipitation
- Natural, non-structural forms of storage (such as snowpack)
- Natural, non-structural conveyance pathways and processes (such as infiltration)

Figure 2:

Water Supply Life Cycle



Water Management Alternatives

The selection of alternative storage methods requires the consideration of opportunities across the full Water Supply Life Cycle, including how water naturally comes into the basin, how it moves through the area into useable forms of water supply, and the purpose the water is used for (including direct uses which don't require man-made storage). One must frequently also consider what the requirements are for allowing water to leave an area (such as a particular state) under both "normal" and drought conditions. In this review, reclaimed water was not evaluated as a "new" water source.

Usable Sources

Usable water sources (see McKee, 2000) include:

- Snowpack (SN), used directly for recreation, although it also serves as a natural form of storage of water supplies
- Streamflow (ST), used for recreation; habitat; irrigation; industrial; and municipal water supplies
- Reservoir water (RW), used similarly to streamflow
- Groundwater (GW), used for irrigation; industrial; and municipal water supplies
- Soil moisture (SM), used for natural vegetation and agriculture

Variables

There can be great variations in the length of time it takes for water entering a basin as precipitation to reach one of these usable forms of water. While precipitation can add to soil moisture or snowpack almost immediately, there may be delays of several days or weeks before precipitation adds to the water levels in streams, reservoirs, or groundwater aquifers. Over the course of those delays, some precipitation can be lost to evaporation or sublimation, particularly if precipitation is intercepted (e.g. on forest canopies). Thus, for example, some of the brief summer rains that fall in the Rocky Mountain region will add little or no water to the usable water supply. Water can also be stored as snowpack for months before melting to become streamflow, stored reservoir water or groundwater (McKee et al. 2000).

As illustrated in the two flow diagrams in Figure 3 (from McKee et al. 2000), there are two natural pathways by which water from precipitation becomes a usable water source in snowmelt-dominated regions, such as the Rocky Mountains. In the first pathway, precipitation falls on the ground and becomes soil moisture (SM) and groundwater (GW) to support vegetation and other uses locally where it occurs. A portion may also become streamflow (ST) and reservoir water (RW). This is the dominant pathway for all lower elevations, and for the higher elevations in the summer season.

The second pathway is one in which precipitation falls as snow at higher elevations in the winter season to become snowpack (SN), and later becomes available as streamflow (ST), reservoir water (RW), soil moisture (SM) and groundwater (GW) during the following spring and summer. This is the primary pathway by which mountain snows provide surface water resources, and it creates important peak streamflows during spring melts.

Quality of Water

The quality of water that is needed for each use is important, particularly when considering opportunities to use alternative, lower-quality water sources for some uses (including opportunities for water reuse) in order to keep higher-quality water available for other uses. The conveyance pathways and processes, and natural forms of storage, all have their affects on water quality, and thus on potential uses.

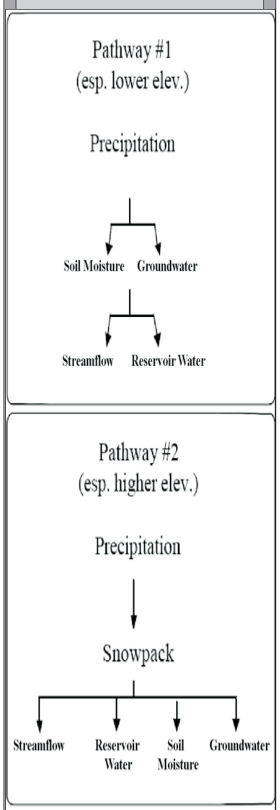


Figure 3: Pathways from Precipitation to Usable Water Sources (McKee et al. 2000)

The quantity of water required for various uses changes as new technologies are developed. Water demands also change with improvement in technologies, such as more efficient irrigation systems. A comprehensive assessment of potential methods considers those technologies and activities that can enhance water yield from natural conveyance pathways and processes, and in natural storage such as snowpack and aquifers. In many cases, important uses of water are "non-consumptive" — such as water in the form of snow for skiing, instream flows used for habitat or recreation, or flowing over manmade structures for hydroelectric power generation.

INSTITUTIONAL CONSTRAINTS AND OPPORTUNITIES

It is important for water managers and planners to understand how water comes into the basin, how it moves through the area into useable forms of water supply, and the purpose for which the water is to be used. However, these aspects do not represent the only constraints and opportunities for selecting water management and storage options. In addition to the scientific and engineering aspects of various methods, water managers and water agency personnel must address "institutional" challenges related to the integration of methods into water planning and management (see Scott, TWR #54).

The recent National Academy of Sciences Study Committee Report entitled *Prospects for Managed Underground Storage of Recoverable Water* (2008) found that, while the science and engineering of managed underground storage methods (e.g. Aquifer Storage and Recovery) is generally well known and established in practice, the biggest remaining issues inhibiting the greater use of these methods are on the institutional side, i.e. the legal, policy, permitting, public and policy-maker perception and education, and planning. It is probable that a similar finding could be made for almost any alternative water supply storage and management method that falls beyond the traditional realm.

Water Management Alternatives

Additional Tools

Increasing Understanding

Important institutional aspects may include:
- Policy and legal changes
- Permitting approaches to ensure methods are applied in a manner that protects human health, the environment, and other water users
- Public and policy-maker education
- Planning metrics, which must be developed to determine economic and financial feasibility of various methods and allow for alternative methods to be compared and combined with traditional methods

While challenges exist in the incorporation of a broader range of methods, having these additional "tools in the toolbox" has become even more critical. Water managers and agency personnel must respond to climate change conditions (under which the old "rules" for water planning may not apply), further increases on water demands by growing populations, and a wider array of uses (see box below). Thus, it is even more critical to find a means of understanding various methods, their potential applicability to local scenarios, and potential institutional barriers or hindrances to their use.

An approach to understanding alternative approaches may include:
- A representation of how the method works, including description and schematics or photos
- A discussion of how the method has been used and its water management purposes
- Case studies and comparison of experiences elsewhere with local conditions
- A review of relative economic and environmental constraints and benefits, including any secondary benefits (i.e. additional to water supply benefits)
- A review of institutional roles, responsibilities, potential policy change requirements and program needs

Alternative Storage and Climate Change Adaptation

Temperature Rise and Increasing Evaporation Rates. The earliest understanding of climate change likely came from recognition of rising temperatures and associated increases in evaporation rates. Most water is currently stored in surface reservoirs, which are likely experiencing higher levels of evaporative losses. Alternative subsurface storage methods (e.g. aquifers or mines) and in containers (e.g. tanks and barrels) are protected from evaporative losses.

Rising Ocean Levels & Seawater Intrusion. One projected consequence of climate change is sea-level rise. According to NOAA, in 2003 approximately 153 million people (53 percent of the nation's population) lived in the 673 US coastal counties. Many coastal communities are dependent upon aquifers for groundwater resources as well as for aquifer storage. Aquifer storage facilities — such as those in Southern California, Florida, South Carolina, and New Jersey — are operated, in part, to prevent seawater intrusion. If federal regulatory changes result in loss of permits for existing or new systems these de facto saltwater intrusion barriers will no longer be available and important groundwater sources of water supply for coastal populations could be further impacted by saltwater intrusion as ocean levels rise.

Changes in Seasonal Hydrology and Surface Water Storage Operations. On-stream surface water storage infrastructure is designed and operated based upon historical records of seasonal and extreme hydrology. As streamflow patterns are changing due to changes in rainfall or timing of snowmelt, resulting in uncertainty with respect to historic trends, greater resilience in the operations of water infrastructure is needed to ensure water supply. Alternative water supply storage and management projects can be used as part of comprehensive "watershed-scale" water management approaches to provide "back-up" water storage when surface water supplies are diminished. Water from alternative storage systems can be used "in lieu" of surface water withdrawals during low-flow periods. As streamflows become less predictable, this flexibility becomes increasingly important.

Changes in Seasonal Hydrology and Aquatic/Riparian Habitat. A critical concern regarding the changes in seasonal hydrology is the impact on streamflows needed to support aquatic and riparian habitat, especially in areas inhabited by endangered species. Alternative water storage projects have been developed to reduce demands on streams for water withdrawals during low-flow periods. Aquifer storage projects are being piloted or operated to store water that can be returned directly to streams during low-flow periods to restore aquatic and riparian habitat ranging from bird nesting habitat in the Platte River, to salmon streams in Washington, to the Everglades in Florida. This application of aquifer stored water back into streams can be particularly valuable when the water stored below the surface is at a cooler temperature than overheated streams during drought periods. Similar applications can be developed for storage in former mines and tanks.

Increased Extreme Weather Events and Associated Natural Disasters. Several aquifer storage systems have been developed to provide protected storage of treated water for events in which surface water supplies, delivery infrastructure and water treatment capabilities are impacted (e.g. Des Moines, IA for floods; Walla Walla, WA for catastrophic fires; Charleston, SC for hurricanes). Integrating aquifer storage into regional water planning increases water reliability for seasonal variability in water supply and demand, and emergency water-supply shortages. Water reliability includes both availability of supplies as well as access to treated water, since many natural disasters can destroy treatment and delivery systems, or cause increases in sediment and contaminant loads that would make treatment of water to drinking water quality temporarily not possible with standard processes.

Storage that Supports Restoration of Barrier Islands and Deltas through Sediment Delivery. Regulation of rivers through surface water storage inhibits sediment delivery to delta systems, including barrier islands. The impacts of river-mouth sediment delivery losses are significant with respect to ecosystems, coastal properties, and buffering of energy from coastal storms (e.g. Katrina). While aquifer storage systems often require diversion of water from surface waters, the aquifer storage zones themselves can provide a means of "off stream" storage that does not inhibit sediment delivery to deltas and barrier islands, as well as to sand bar habitats such as the "Big Bend" in Nebraska.

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Public Education

For policy makers and agency personnel, it is important to recognize that a water agency's role in the potential integration of each assessed method might vary. In some cases, the agency's involvement could be limited to public education — e.g. providing information leading to changes in behavior among individuals, industries, municipal governments, or water providers. This is particularly true where the method is used at a household scale or within a community, such as rain barrels or household greywater reuse. In such cases, agencies may develop educational "extension" materials to help homeowners and the general public, as well as water managers and agency personnel, better understand these methods. In other cases, incentive programs or funding for demonstration projects could be developed by the agency. There may be constraints in code and legal precedents that may need to be addressed through legislation to ensure that a particular method's use is not prohibited, implicitly or explicitly. State agencies may have a role in facilitating discussions between stakeholders or with other states and the federal government, particularly where transboundary and federal lands issues are tied to the areas impacted by the method's application or water supply beneficiaries.

"Water Imports"

Interbasin transfers or "water imports," bringing water into a basin through means other than precipitation, were not considered in the Water Supply Life Cycle, although there are several issues associated with interbasin transfers which often must be addressed by agencies and legislatures (see Meyer, TWR #42). Certain activities, such as cloud seeding or mountaintop forest and other land management activities, may have transbasin effects. *Intrabasin* transfers (moving water from one area to another within the same river basin) can have similar environmental and economic impacts.

Agency Options

In a few cases, particularly where there may be larger projects involving more general public benefits, the agency could choose to become a more active partner in the on-the-ground implementation of these methods — within the constraints of public and political acceptability and the authority of the agency. This agency involvement could include financing or co-ownership of a particular project that uses an alternative method.

COMPONENTS OF THE WATER SUPPLY LIFE CYCLE

Alternative water supply storage and management methods can be divided into three major categories. The methods shown in Figure 2 reflect a bias towards methods applicable in mountain and prairie regions, although the Water Supply Life Cycle could be expanded to include consideration of estuary, coastal and island processes, water use, and management requirements.

Alternatives Categories

As shown in the Water Supply Life Cycle, water storage and management alternatives may include:

- **Water Yield Enhancement Methods,** which involve augmenting the quantity and/or re-timing the availability of water supplies that can be available for controlled storage structures or direct uses, or otherwise enhancing water yield
- **Controlled Storage Methods**, using alternative locations for storage of water supplies — such as aquifers, tanks, and abandoned mines
- **Multi-purpose Management and Reuse Methods,** which involve stretching water supplies in controlled storage or use

The three Water Supply Life Cycle categories are described below, with examples of a few specific methods within each category. A few of the institutional issues, as well as some of the debates and misunderstandings associated with the various methods, are briefly discussed. Entire articles can be, and have been, dedicated to each of these methods. The intent here is simply to briefly survey the array of methods that can be incorporated into integrated planning on a regional or watershed scale.

Water Yield Enhancement Methods

Enhancing Yield

There are many human activities that can have impacts on hydrologic contributions to streams and aquifers — including impacts on climate, overland flows, and infiltration. Such activities may increase or decrease annual water yield, peak flows, or low flows. Not all activities, however, can be performed in a deliberate and controlled manner with the intent of enhancing water yield as part of water supply planning. Water yield enhancement methods are typically *non-storage* methods, and are often *non-structural* or involve minimal structures. Traditional water yield assessments and financial cost-benefit analyses are not directly applicable when evaluating water yield enhancement methods.

Water yield enhancement focuses not only on total annual water yield, but also more specifically on peak flows and low flows. Specific aspects of water supply location, quality, and water form (such as snow or soil moisture) may be addressed.

While it is widely recognized that there are many human activities and other land use changes that can have some sort of ultimate impact on water yield, Water Supply Life Cycle analysis focuses on those water yield enhancement methods that can be used in a "managed" approach, i.e. a deliberate, controlled,

Water Management Alternatives

systematic approach — preferably (but not necessarily) one where the water yield effects can be quantified. This approach includes analyzing whether a water manager or water agency might be able to incorporate this method into their water supply plan to meet water demands.

The type of implementing entity may change due to:

- Scale of the activities included in these methods
- Ownership or control of land and other resources needed to implement these methods
- Water rights and other legal constraints
- Economic and financial constraints, such as the ability to recover direct costs, and whether the operator of the method receives a direct benefit, particularly in terms of use of the increased water yield

For these reasons and others, it may not be possible to quantify exactly how much additional water storage could be developed throughout the area or even in an individual river basin. Be that as it may, many water managers and agencies have found such methods to be worthwhile investments.

Possible Methods

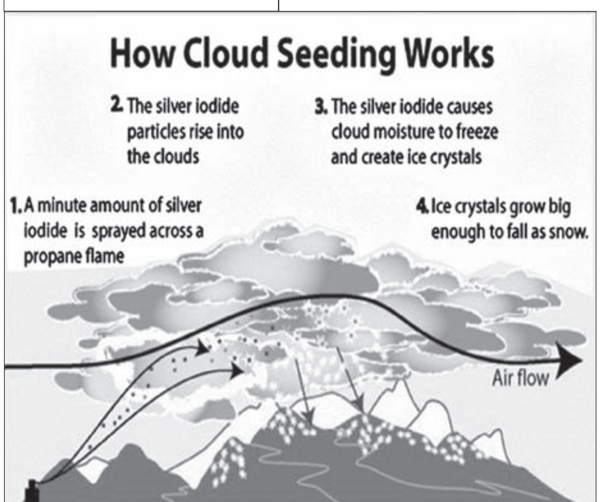
water yield enhancement methods may include:

- Cloud seeding and snowpack augmentation
- Vegetation management, including forest management and phreatophyte control
- Managed aquifer recharge

Cloud Seeding and Snowpack Augmentation

Cloud seeding and snowpack augmentation are often used together in headwaters for water yield enhancement. Mountain or "orogenic" cloud seeding is used, particularly in snowmelt-dominated streams like those in the Rocky Mountains, using methods shown in Figure 4. Orogenic cloud seeding, more often used for water yield enhancement, differs from warm-season cumuliform (convective) cloud seeding, which is more often used for hail suppression. The American Meteorological Society (1998) found that orogenic cloud seeding can produce a statistically significant increase of 10% or greater for seasonal precipitation over natural precipitation. Controversies may surround cloud seeding activities, with downwind water users claiming that cloud seeding activities take water that would otherwise fall elsewhere. The North American Interstate Weather Modification Council (2006) found that cloud seeding activities do not decrease precipitation downwind, and may even increase precipitation as far as 100 miles downwind of the target area. While these debates continue, there have been increasing uses of cloud seeding and snowpack augmentation methods.

Figure 4



The US Bureau of Reclamation (Reclamation) has incorporated cloud seeding into many of its water management programs, particularly in the Colorado River Basin, where headwaters for specific tributary streams have been targeted to help fill Lake Powell and Lake Mead (Hunter 2006). On a smaller scale, there are more localized cloud seeding programs for water supply by individual water providers (such as Denver Water), and programs to support snowpack augmentation to improve ski conditions, including one that has been used at the Vail, Colorado ski resort for 30 years (Zaffos 2006). As with most water yield enhancement methods, it is difficult to establish direct financial benefits and water yield increases associated with cloud seeding for snowpack augmentation, but the Kansas Water Office (2001) has estimated benefits from additional snowpack runoff to be in the range of $1 to $15 per acre-foot.

Land Use and Vegetation Management

Vegetation Impacts

Land use and vegetation management methods may be used to control the amount of vegetative cover and for the purpose of manipulating water yield. Vegetation can change the rate at which water reaches the ground, where it can infiltrate to groundwater, and contribute to streams as baseflow, or flow directly overland to streams. Vegetation can also change water yield by returning water to the atmosphere through evapotranspiration, and by capturing snow, which then sublimates directly back to the atmosphere. Despite continued debates in scientific and popular literature regarding the effectiveness of these methods, many water providers, agencies, and other stakeholders have actively pursued programs using these methods.

Entity Differences

One challenge associated with implementation of these methods is that the entities conducting on-the-ground land management (such as a private timber company that manages forested headwater lands), and the entities responsible for providing water supplies (such as downstream communities) are often not the same. Land management activities are typically not linked directly to water rights and water supply planning, although land management activities may be regulated to ensure no negative impacts to existing water rights. Two methods of land use and vegetation management that may be important for enhancing water yield are forest management and phreatophyte control.

Water Management Alternatives

While forest management plans are not currently used specifically to increase water yields, the Colorado Water Conservation Board has worked with the US Forest Service on behalf of water users to ensure that forest management plans address these concerns, particularly with respect to the North Platte Basin, which is surrounded by forested uplands. The State of Colorado, US Geological Survey, and the Colorado Water Resources Research Institute commissioned a “state-of-the-art review” of forests and water in Colorado (MacDonald and Stednick 2000). This study estimated a decrease in annual water yields of 11 to 13 percent or 150,000 to 190,000 acre-feet per year from the 1.34 million acres of national forest lands in the North Platte River headwaters. The study also estimated that average annual water yields could be increased in the North Platte River basin by approximately 55,000 acre-feet per year if all 502,000 acres designated as suitable for timber harvest was regularly cut on a sustained yield basis.

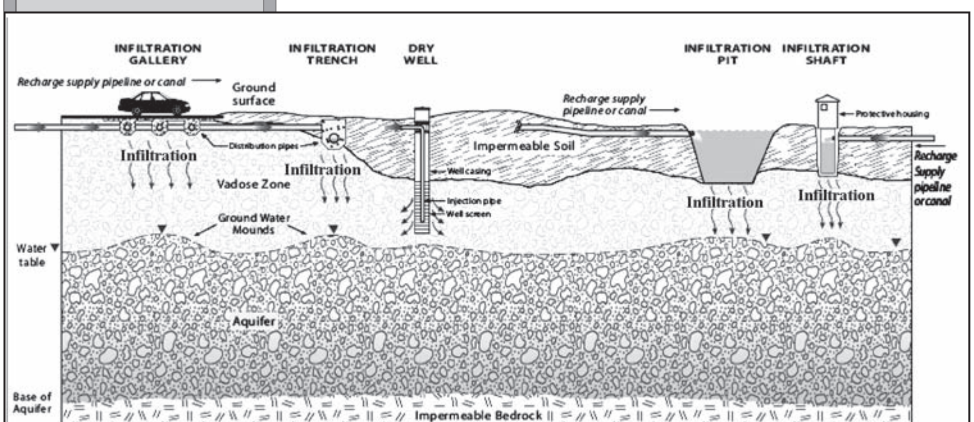
Phreatophytes

Phreatophytes, or “water-loving” plants, are small deciduous trees with deep and extensive roots systems that grow along floodplains and tolerate a wide range of saline or alkaline soils. Often non-native species, phreatophytes such as tamarisk (also known as salt cedar or pink cascade) and Russian olive may capture large quantities of water from tributary aquifers before they can reach rivers as baseflow. Phreatophytes typically have extensive root systems that can grow to 100 feet or more. There is a wide range of phreatophyte control techniques, including mechanical, chemical, and biological methods that should be selected on the basis of local conditions. The Tamarisk Coalition has been a leading nonprofit organization on the development and distribution of information on phreatophyte control techniques. Often, implementation of phreatophyte control programs requires intricate and long-term cooperative arrangements between agencies at different levels and many water and land management districts, such as the 10-year plan recently developed by the Kansas Water Office with more than two dozen other entities (Shrier and Coelho 2008).

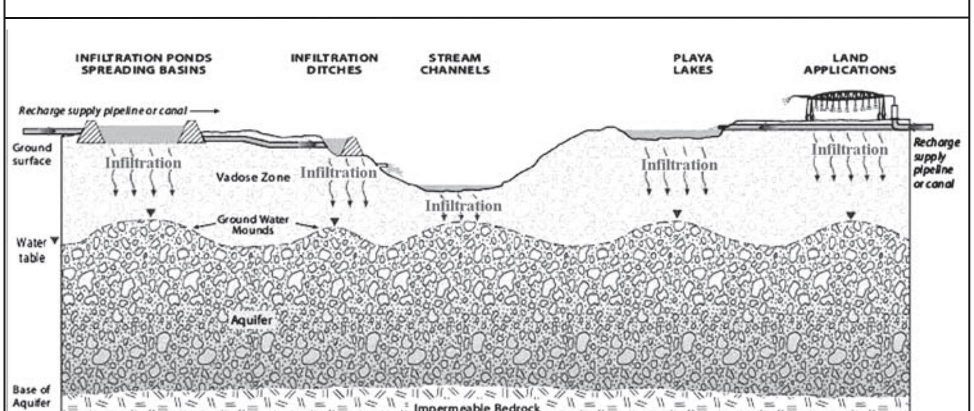
“MAR”

Managed Aquifer Recharge

The term Managed Aquifer Recharge (MAR) is used to describe recharge methods (including enhanced infiltration methods) intended primarily for management of groundwater to enhance water yield from groundwater wells or baseflow to groundwater-fed streams. Maintaining baseflow is particularly important in regions that receive little rainfall for extended periods of time (Topper et a. 2004). Maintaining groundwater levels also provides an economic benefit, since pumping costs increase if a deeper and stronger pump becomes necessary. Prevention of continuous overdraft of aquifers is also important to maintain the storage capacity in an aquifer (to keep pore spaces from collapsing) and ensure saltwater intrusion does not occur. Managed aquifer recharge and enhanced infiltration methods have been used around the world for centuries to increase the availability of water supplies from aquifers, as well as to augment streamflows from groundwater interactions. There are several methods used for enhanced infiltration and artificial recharge of aquifers. Surface infiltration methods are applied to the land surface for infiltration to an unconfined aquifer. Subsurface infiltration methods (such as infiltration trenches and vadose or “dry” wells) may be applied to the vadose zone in unconfined aquifers in cases where the land surface is not suitable for surface infiltration, due to lack of land ownership and control, pavement of land surface, or other land uses that may cause surface infiltration methods to be infeasible.



Subsurface Infiltration Methods from Topper et al. (2004)



Surface Infiltration Methods from Topper et al. (2004)

Unlike Managed Underground Storage methods, including Aquifer Storage Recovery, MAR systems are not developed for “controlled storage” in which the parties recharging the aquifer are planning to recover the same water

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Leadership Needs

later for use. MAR systems are typically developed by irrigation districts, groundwater replenishment districts, agencies, or other entities investing in the management of an aquifer and connected streams. Often, the challenges associated with MAR systems are regulatory and economic. With no direct benefit for water rights holders to recover and use the water placed in the aquifer, it may not be possible to establish a direct financial benefit from MAR activities. Nonetheless, the benefits of maintaining aquifers and baseflow to streams is great enough that many institutions support these activities as part of their water plans. These programs require strong leadership to ensure their inclusion in water management programs, and a strong educational program to ensure public and policy-maker awareness of the importance of groundwater management.

Controlled Water Storage Methods

The importance of water storage as a part of integrated water planning cannot be overemphasized. Water storage is particularly critical in arid and semiarid regions, where natural water supplies are subject to wide temporal variability due to precipitation patterns and the timing of availability of water from natural forms of storage, e.g. snowmelt.

Storage Benefits

Water storage provides a means of capturing water when it occurs naturally and holding it until water is needed. This enables water managers to control the timing of water availability. Water storage is often used in conjunction with water diversions, which move water from the location where storage occurs to where it is needed. Diversion methods, such as canals and pipelines, are used particularly in places where there is a wide range of spatial availability of water supplies, and where the natural location of water supplies often does not match the location of the water use demands (typical in the West). Often, large centralized water storage is coupled with diversion systems to service an extended region.

On-stream Reservoirs

Around the world, traditional water storage has involved on-stream water storage, in which a dam and reservoir are constructed on a major river or stream to trap inflows and regulate releases to meet water needs. On-stream reservoirs are efficient to operate because the reservoir is filled by natural inflows. Dams are often built not only for water supplies, but also for hydropower, flood control, and recreation.

In the middle of the last century, increases in population, industrial water demands, demands for hydroelectric power, and population growth in flood-prone regions led to widespread development of on-stream reservoirs to meet water supply and the other objectives throughout the US and Canada. Larger water supply dams were often constructed with support from federal, state or provincial agencies such as Reclamation and the US Army Corps of Engineers (Corps).

Starting in the 1970s, with the advent of environmental protection legislation, increased public and agency awareness of the potential environmental impacts of on-stream reservoirs, and increased permitting requirements (plus associated costs), the construction of on-stream reservoirs began to decline in North America. Large on-stream reservoirs are still being constructed around the world, with the largest, the Three Gorges Dam in China, having recently begun operations. However, because of concerns regarding environmental impacts and costs associated with construction and permitting, the development of new large on-stream dams on mainstem rivers is generally considered to be infeasible in most cases in North America.

Sediment Benefits

Impacts associated with on-stream reservoirs include prevention of flow of sediment, which has been increasingly recognized as important to the development of ecosystems in braided streams (such as the sand bars for Platte River Whooping Crane habitat), river deltas, and estuaries. Sediment flows also contribute to the development of barrier islands, which form an important defense against hurricane impacts. With an estimated foot of storm surge reduced for every 3-4 linear miles of barrier islands, these coastal features play a significant role in absorbing wind and wave energy before storms hit populated mainland cities, such as New Orleans.

Alternative Storage Benefits

Alternative water storage methods may be preferred over large, centralized, on-stream reservoirs because of reduced stream habitat impacts, smaller construction and operation costs, and closer proximity to point of use (reducing delivery costs). Off-stream surface storage methods such as dugouts and lagoons, as well as reservoirs constructed on the land surface, can function similarly to on-stream storage, except that they require construction of diversions of the water source and additional consideration of drainage or flood release. Off-stream surface storage could be used more extensively and strategically and in a more coordinated manner within a larger river basin plan. In addition, there are other places where voids may exist or can be created that can be used to store water supplies.

Alternative controlled storage methods may include:

- Storage in manmade voids, particularly from mine and mining structures (e.g. pit lakes)
- Storage in containers such as tanks
- Storage underground in aquifers

Water Management Alternatives

Abandoned Mines

Pit Lakes

Rainwater Harvesting

"Green" Design

Legal Constraints

Determining Effects

"MUS" v. ASR

Storage in Former Mines and Mining Structures

Subsurface voids and open pits created by mining activity have frequently been considered for storage. These areas have been converted to storage of petroleum products, landfills and other wastes, and sometimes for water supply storage. For example, some limestone aggregate mines have been converted to use for warehouses, offices, industrial production, agricultural product storage, and even recreational facilities such as tennis courts. The Colorado Geological Survey (Topper et al. 2004) and Kansas Geological Survey (Worley 2001) recently completed studies and worked with water managers to identify opportunities for use of abandoned mines as water supply storage. The suitability of voids and pits left by mining activities for water supply storage varies depending upon the type of mining, geology, water quality and intended water use, and engineering technology. Abandoned coal mines are already being used for water storage, particularly in the Central Appalachia Coal Basin of the US (including West Virginia, Kentucky, and Ohio) to provide municipal water supply. Abandoned metal mines often have more concerns regarding water quality impacts. Salt mines have been used successfully for storage of petroleum products and have been explored for pumped water storage for hydroelectricity, as well as for water supply storage. Pit lakes form in areas of open pit mining activity where the pit bottom is below the water table, and may be used for long-term water quality remediation and storage of wastewater. In many cases, pit lakes developed during mining of metal ore or oil sands are not suitable for storage of municipal water supplies. However, gravel pits, which are formed during mining of construction aggregate, have been used for municipal water storage since the 1980s, particularly in the Front Range of Colorado.

Storage in Tanks and Other Containment Structures

Water storage tanks are used to store water for homes, farms, and small communities. Most water distribution systems include some form of tank storage to manage water demand variations and minimize the impact of peak demands on the system, as well as to provide emergency storage. Tanks, rain barrels, and other collection devices are used as "rainwater harvesting" methods. Rainwater harvesting typically combines containment with other steps to enhance water yield and address drainage issues. Other steps may include: catchment areas on rooftops or land surfaces; changes in land cover through clearing or altering vegetation cover, increasing slope, and soil compaction by physical or chemical means; and conveyance systems to transport water to collection devices or direct uses. Many of these rainwater harvesting methods are being integrated into "green building" designs, "green landscaping" approaches and "sustainable" urban development. Rainwater harvesting systems have been in use for centuries, particularly in wetter regions of the world where there are large amounts of rain and where population demands stress traditional water systems, such as Great Britain, India, Brazil and Sri Lanka. Rainwater impoundment systems have been found in Southeast Asia dating back to the third millennium BCE. India has actively promoted rainwater harvesting over the last 30 years, and has several examples of projects in which government buildings and lands have been fitted with rainwater harvesting systems to meet local water needs. Tanks and other container storage are often used in areas where there is a lack of centralized storage. Within the Western US, there may be legal constraints prohibiting the use of rainwater collection devices, which may be viewed as impacting water rights that would otherwise receive that rainwater. [Editor's Note: see Water Briefs, TWR #53 regarding the State of Washington's approach.]

From a water supply planning perspective, the approach to analysis and management of these methods for water storage tends to be different from approaches used for surface water reservoir storage. Tank and other container storage methods are typically used only to serve a household or small community of households, and sizing of individual household containers can be determined based upon household size and per capita use estimates. Accurately determining the net effect of extensive use of on-site storage on overall water supply for a watershed or basin, or evaluating how these devices can be used to delay construction of new or expanded central storage facilities, is more difficult. The potential impact of these smaller-scale collection devices, however, should not be discounted in larger scale planning.

Managed Underground Storage

Underground storage methods in aquifers have been referred to by several terms, including Aquifer Storage Recovery (ASR), Aquifer Storage and Recovery (ASAR), and Aquifer Recharge and Recovery (ARR). ASR is a term that is used specifically to refer to a technology in which treated water is injected through a well into an aquifer for storage, and later removed for use, typically from the same well (Pyne 2006). The term Managed Underground Storage (MUS) was developed by the National Academy of Sciences (2008) to refer more broadly to systems in which aquifer recharge is used for storage within an aquifer, whether through well recharge or surface recharge.

Water Management Alternatives

MUS Uses

States' Regulations

UIC Permit

"Stretching" Supply

Prior Appropriation

Market Benefits

MUS systems are often operated on a seasonal basis, taking advantage of the temporal variability of water supply during the year. Many systems, however, also use multi-year storage for drought or emergencies, with system operators specifically noting the use of underground storage to protect water supplies during floods (Iowa), hurricanes (South Carolina), and forest fires (Washington) (AWWA 2002). MUS systems are often used to maximize water treatment system capacity. Water can be treated during non-peak demand periods and stored underground. After recovery, this pre-treated water often requires only chlorination before the recovered water is incorporated into the water distribution system.

MUS systems store water for a variety of uses including municipal, irrigation, cooling and other industrial, and environmental applications (e.g., water supplies to augment streamflows or offset withdrawals from streams to protect aquatic habitat). MUS source waters for recharge and storage have included surface water, groundwater, treated effluent, and produced water. There has been an increasing call for use of aquifer storage or "groundwater banking." In the "Dear Colleague" letter that organized the new Congressional Water Caucus (2007), one of the proposed Twelve Principles of Water Policy was to "encourage federal assistance to state and local governments to identify potential groundwater banking as part of sustainable water supplies."

In many states, regulations have been developed specifically to address the regulatory aspects of the development and use of ASR and other managed underground storage systems. An American Water Works Association (AWWA) study in 2002 found that most states in the US with operational ASR systems had legislative statutes or agency rules specifically addressing the operation of ASR systems, often also including other forms of aquifer recharge. Typically, these regulatory programs either addressed water permitting/water rights associated with these storage systems (right to use the water to be stored, right to store, right to withdraw the water, and right to use the water withdrawn), or provided comprehensive regulation of the process by which these facilities would be permitted, so that there would be better coordination among different agencies and project proponents can complete permitting without contradictory regulatory requirements.

When wells are used for recharge, an Underground Injection Control (UIC) permit is required. The US Environmental Protection Agency (EPA) and state groundwater agencies that issue these UIC permits (through primacy) have struggled with application of this regulatory program — which was originally developed for disposal of wastes — to the storage of drinking water. Development of monitoring programs and pilot testing requirements, as well as policy-maker and public understanding of how water is stored underground, are institutional challenges that often face aquifer storage systems. The lack of economic and financial planning metrics, which would help to ensure integrated regional water planning approaches including consideration of both surface and aquifer storage sites, has also created challenges.

Storage and Management for Multipurpose Use and Water Reuse

Water supply management and reuse methods focus on "stretching" the existing water sources via supply management techniques. The efficient use or reuse of water can help to meet multi-purpose water demands without additional storage or new water sources.

Water supply management and reuse methods may include:

- Water markets
- Multipurpose and "optimal" operation of existing storage
- Reclaimed water systems and greywater reuse

Water Markets

Under the Prior Appropriation system in use throughout the American West, water rights are issued to water users giving them the legally protected right to divert and use waters present in surface water and groundwater supplies for beneficial use under a priority system ("first in time, first in right"). A water market, also called a water license exchange or a "water bank," facilitates the transfer of water rights from those with a water surplus to those with a need for water by bringing buyers and sellers together. Water exchanges are also used to enable new water users to acquire more senior water rights, providing the buyers with greater protection during periods of drought. Certain water rights may also be desired and have increased value because of their location.

Water markets can be particularly important as a means of promoting conservation of water, since water rights under the Prior Appropriation legal system typically operate under a "use it or lose it" system in which water rights that are not used are considered "abandoned" or forfeited if nonuse occurs continuously over a number of years. Water markets have been established to enable a water rights holder to allow the right to be used by a different user on a short-term basis under specific conditions, such as during a drought. For example, the 1995 California Drought Water Bank Program was developed during the 1994 drought, allowing the State of California to purchase water rights. This water bank program

Water Management Alternatives

has been re-instituted to address California's current drought issues (see Water Briefs, this TWR). In most states, water banks typically do not purchase the water right, but facilitate the sale or lease of rights between other parties. In all cases, however, a review of exchanges, typically by the state water agency, is required to ensure that other water rights holders are not impacted by an exchange. [**Editor's Note:** In Oregon, a water user may temporarily transfer a water right to an instream right and thereby avoid "forfeiture" that would otherwise occur due to nonuse. ORS 540.523]

Washington State Review

The State of Washington Department of Ecology completed a review of water markets, and found that these institutions could be used to ensure that water rights are used for purposes that are deemed, by society demand, to be of high importance by imposing a monetary cost on the use of the water. The review found that water markets: create greater water reliability seasonally and during dry years; promote water conservation; resolve inequity issues between groundwater and surface water users; and ensure compliance with interstate agreements on instream flow (see "Analysis of Water Banking in the Western United States" (2004) at Ecology's website: www.ecy.wa.gov).

Optimization and Multi-Benefit Operating Rules

Optimal Strategies

Optimal operating strategies refer to the efficient utilization of water from existing water sources and storage. They include a variety of techniques, both for operation of a single reservoir to meet multiple objectives and for operation of multiple reservoirs on the same river basin. These strategies often involve the development of a knowledge-based decision support system. Particularly when reservoir systems are developed and managed by federal agencies in the West, reservoirs are typically constructed and operated to meet multiple objectives, including hydropower generation; storage benefits (e.g. lake fisheries and recreation); and downstream benefits (e.g. habitat and municipal, agricultural, and industrial water demands). Under the Corps' *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983), planning of projects considers multiple objectives with the single goal of supporting "national economic development." Under the Water Development Act of 2007, these Principles and Guidelines are being revised, with draft principles recently posted for public comment including: sustainable national economic development; wise use of water and related land resources; protection and restoration of significant aquatic ecosystems; integration and improvement of how the Nation's water resources are managed; and reduced vulnerabilities and losses due to natural disasters.

Corps Guidance Developments

Operating Rules

Optimal operating rules for reservoirs and water systems with multiple water sources can be used to ensure that the water is utilized efficiently. Operating rules for releases from hydropower generation systems may also include timing to meet downstream water demands, ecological impacts, and operating costs so that a portion of the hydroelectric reservoir storage space can be used for water supply storage. For example, in the Upper Colorado River basin, reservoirs are operated to meet both habitat and hydropower needs, and a portion of the hydropower revenues are used to support fish species recovery efforts. Projects supported by hydropower revenues include fish ladders and stocking of native species.

New Methods Address New Issues

New methods have been applied to planning procedures to address the prioritization of development of new storage and diversion sites, and to support cooperative efforts among water users and other stakeholders. Evaluating each site individually would not only be unwieldy and time-consuming, but could also create unrealistic results. For example, conservative estimates may result from the evaluation of individual sites in isolation when it is not possible to consider the potential impacts of seepage from upstream storage sites. Labadie (2000) completed a state-of-the-art review of optimal operation of multi-reservoir systems. This review found that these new methods have been used increasingly to address a range of issues, including: storage projects performing below planned projections; increasing conflicts and competition among water users; inability of storage projects to be adjusted for new unplanned uses; calls for increased efficiency and operational effectiveness of existing reservoirs as well as new systems; and a need for more integrated operations. Controversies surrounding these methods often involve a lack of confidence or understanding of the methods being applied. Improved communication of planning procedures and results is important, particularly when there are multiple stakeholders involved.

Reclaimed Water and Greywater Reuse.

Reuse Uses

Reclaimed water is generally considered to be effluent that has been captured and usually treated for reuse, rather than discharged back to a surface water body or aquifer. There are many categories of reclaimed water, ranging from household reuse (including greywater and blackwater) to utilizing treated effluent from municipal and industrial operations, as well as stormwater uses and water that has been captured during extraction of minerals or petroleum products ("produced water"). The difference between the capture and reuse of stormwater and rainwater harvesting is not always clear within different jurisdictions. Be that as it may, reclaimed water has been widely recognized as a critical water source. Reclamation Commissioner John Keys has been quoted a saying, "The last river for us to tap is waste water." (Gardner 2002).

Water Management Alternatives

Water reuse and water recycling methods are sometimes discussed within the context of "water conservation" and may be discussed within "demand management" studies. Beneficial supply-side water conservation methods maximize the amount of water that is available for use, compared to demand management measures that reduce the amount of water used. For example, if greywater is used for lawn irrigation, the "demand" on available potable water supplies is reduced but the quantity of water used (applied to the lawn) remains the same. This differs from "xeriscaping," for example, in which lawns are planted with species that require less water, and the quantity of water used for lawn irrigation is reduced.

Greywater Regulation

Many states have passed laws regulating the use of greywater, including restricting the use to nonpotable uses (such as lawn irrigation), and may add further prohibitions related to the method of water use. For example, drip irrigation systems in California cannot use greywater. One potential consideration for the new guidelines, in addition to human and ecological health considerations, is that the water sources most likely to be used for reclaimed water systems are currently approved for non-consumptive use. Water rights changes are sometimes needed to accommodate increased use of reclaimed water systems.

CONCLUSION

Integration Increasing

Integrated water management is necessarily evolving due to the increasing demands on water supplies. Clearly, there are several alternative water supply storage and management methods that can become additional "tools in the toolbox" along with the more traditional approaches of water supply storage and management.

Each tool, however, comes with its own challenges associated with the integration of alternative methods into overall water planning. Often, these methods cannot be implemented under the old "command and control" and "black box" approaches to water management, in which water providers control the activities necessary to provide water to their own service areas. Alterative methods may involve activities applied at the headwaters or otherwise outside of the area controlled by the water managers who benefit from the increased water yield and reliability. In addition, there are more stakeholders involved, and public and policy-maker education on alternative methods is often a critical component in their successful integration.

Each of the methods described above has, to some extent, been used successfully as an integral part of water supply planning in some parts of the West, even though the exact benefits from these methods in terms of money or water supply may not always be quantifiable. As society faces greater challenges, with increasing uncertainty due to climate change on top of the pressures of increasing populations and new types of water demands, we need to find a way to work through the institutional challenges to enable integration of alternative water supply storage and management methods.

Integration Efforts

Integrated water management often involves a combination of efforts, including:

- Review and update of permitting requirements by regulatory agencies responsible for protection of human health and the environment
- Revisions to water rights definitions and review of legal interpretations
- Progressive policy changes, leadership, and support for research and demonstration projects
- Compilation and distribution of information on existing projects
- Educational programs to promote a better understanding of how the methods work and where they have been used elsewhere
- New planning metrics that allow alternative water supply storage and management methods to be compared and combined with traditional methods

Framework

The Water Supply Life Cycle framework was developed to provide a better understanding of how these methods fit within a river basin, and how water managers and agencies can consider combinations of approaches to develop comprehensive and integrated water plans on a regional scale. Using all of the tools we have available will help to ensure sustainable water supplies can be provided in the face of growing demands as well as growing climatic uncertainties.

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Water Management Alternatives

WATER MANAGEMENT ALTERNATIVES

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AWRA Water Storage Conference

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For info: Conference Organizers: Rebecca Ponzio, 360/ 485-7637 or email: reponzio@hotmail.com; Chris Pitre, 206/ 267-1166 x5007 or email: CPitre@golder.com
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Instream Flows

STREAMFLOWS IN THE ROCKY MOUNTAIN WEST

STRATEGIES TO PROTECT AND RESTORE "ENVIRONMENTAL FLOWS"

by Lawrence J. MacDonnell, Attorney and Consultant (Boulder, CO)

INTRODUCTION

This article surveys developments in the eight Rocky Mountain states — Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming — related to commitment of water for environmental and recreational purposes (referred to here as "environmental flows").

Arid Country

Water users in the Rocky Mountain West tend to be pragmatic about water. That's especially true for people whose families have lived in this region for a long time. They know that, to live in a land with limited rain, the water in creeks and rivers and aquifers has to be put to work. They know that means dams, diversions, and pumps, using water to grow crops and sustain cities. That's what it means to build a good life in arid country.

Residents also love the places where they live and play. They love their open spaces, their red rock canyons, and their snow covered mountains. Mostly they live in cities, and increasingly they expect their cities to be attractive and livable. They also love the special places they can get to on the weekends or for vacations. An increasing number are moving to those places. These are often the places that did not get changed much when the region's economy depended heavily on development of its natural resources. In many cases, these are places where there are rivers and streams, springs and marshes — places with water.

Prior Appropriation

The legal rules governing use of water in Rocky Mountain West developed out of the needs of early settlers to put water to direct use and to have certainty that their uses would be protected. These uses required control of some portion of water, typically involving diversion of water out of a river into a ditch for transport to a place of use. The rules rewarded the person making such efforts with a priority right under a regulatory regime that became known as the "Prior Appropriation Doctrine." Under this doctrine, an established water right retains priority over any subsequently granted right ("first in time, first in right") no matter what water needs are involved. The Prior Appropriation Doctrine also made it clear that only beneficial uses would be protected and that continuation of the use is necessary to maintain the water right. This no-nonsense, utilitarian approach suited the time and place.

Instream Needs

There was nothing in the rules, however, about water for the river. Nothing about how it might work if someone wanted to be sure there was enough water to maintain a valuable fishery, nothing about protecting flows that maintained cottonwoods and willows in riparian areas, nothing about keeping flows to allow people to swim and to boat, nothing about just making sure that rivers didn't totally dry up. For a long time, nobody paid much attention to these needs.

Today, rivers in the Rocky Mountain West serve a broader function. They are still essential sources of water for agriculture and for cities, but they are also places people go for recreation, for renewal, and for enjoyment. People go there for the astonishing amount of life these places support. The region's economy is now as dependent on healthy rivers as it is on diverted water.

This regional shift in how people view rivers has been slow but sure. In a sense, it is revolutionary. It turns upside down more than 100 years of effort to put every drop of water to some kind of direct human use, in which water undiverted was considered wasted water and where success was measured by how much water was beneficially consumed.

Beneficial Use

Despite this dramatic shift in human perception about the importance of keeping water in the river, the changes required of the legal system to accommodate this shift have been relatively modest. All that was really necessary was to legally recognize that environmental uses of water are "beneficial uses" and provide rules by which such uses of water can be protected. This is exactly what Prior Appropriation is all about — encouraging beneficial uses of water by protecting such uses from being impaired by subsequent uses. State water laws have adjusted in varying degrees to acknowledge demand for protection of environmental flows.

Uneven Progress

Yet progress has been uneven. Many in the traditional water community still believe that water in the West is simply too scarce to be permanently committed to environmental or recreational purposes. Such uses, they believe, should be incidental to other, more essential, uses of water — nice if they can be supported but not necessary in the way that water for irrigation is necessary. Yet there are many in these states who believe that places with water are special, that they are an essential part of the state's heritage, to be protected and passed along to future generations. They see healthy rivers as necessary to the economy of the future, just as irrigated agriculture was necessary to the economy of the past. They see environmental flows as a beneficial use of water of equal importance with more traditional beneficial uses.

Instream Flows

Primary Tasks

Establishing Flows

Different Approaches

New Mexico AG's Opinion

Stream "Reach"

Ownership Limits

Purpose of Flows

Freshwater ecosystems contain far greater concentrations of life than land or ocean systems (see Postel & Richter, *Rivers for Life: Managing Water for People and Nature* (2003) at 26). Human alteration of these freshwater-based systems has resulted in a rate of species extinction five times greater than for land-based species. The federal Endangered Species Act represents a national commitment to reverse this trend, presenting a substantial challenge to find ways to integrate human uses of water systems with the needs of dependent species. Global warming, with its accompanying increases in stream water temperatures, increases in evaporation, and alterations of flows adds another layer of complexity to this challenge.

Part I of this article considers two primary tasks involved in establishing environmental flows: 1) protecting some portion of remaining flows; and 2) restoring flows where possible in important streams. It describes the kinds of legislative and judicial changes that have been made in state water law for these purposes and the manner in which these new provisions and interpretations have been applied.

Part II of this article provides some general observations respecting progress and challenges. Part III discusses the growing and evolving "instream flow protection toolbox."

The full report from which this information is summarized will include state-by-state surveys of instream flow programs in the Rocky Mountain region. The report, which was not finalized by the time of this publication, will be available soon at the Western Progress website: www.westernprogress.org.

PART I – THE ENVIRONMENTAL FLOW PROTECTION FRAMEWORK

The legal and policy framework which governs establishing environmental flows in the Rocky Mountain West can be divided into two parts: 1) elements that serve to keep unappropriated water in stream; and 2) elements that facilitate flow restoration in dewatered streams.

Keeping Water in the River

Existing State Water Law

There are now established means under state law in every Rocky Mountain state except New Mexico and Utah to keep unappropriated water instream for environmental benefits (see "Selected Bibliography, below). The states have taken different approaches. Half of the states — Colorado, Idaho, Montana, and Wyoming — have enacted special legislation providing specific rules and procedures by which water may be protected instream (referred to as either instream flows or minimum flows). Court decisions in Arizona and Nevada have determined that environmental flows may be appropriated under existing laws.

In New Mexico, there is an opinion of the Attorney General that found no legal impediment under New Mexico law to transferring an existing water right to instream flow purposes, so long as gauging devices are installed to measure the instream flow beneficially used. Opinion of Tom Udall, Attorney General, Opinion No. 98-01, March 27, 1998. While not addressed directly, the legal analysis in this opinion suggests that new appropriations of water for instream flows might also be possible. Utah law allows changing existing rights to instream flow but does not authorize new appropriations for environmental flows.

Water rights for environmental flows are different from traditional appropriations because there is no need for a point of diversion. Instream flow rights are described in terms of two points along a stream between which specified flows are protected ("reach"), or as a specified water elevation for ponds and lakes. The absence of a point of diversion has been the subject of litigation in several states, with the courts uniformly agreeing that a valid appropriation under state water law does not necessarily require a point of diversion. See Arizona: *Phelps Dodge Corp. v. Ariz. Dept of Water Resources*, 118 P.3d 1110 (Ariz.App. 2005); Colorado: *Colorado River Water Conservation District v. Rocky Mountain Power Company*, 406 P.2d 798 (Colo. 1965); Montana: *In re the Adjudication of the Existing Rights to Use All the Water*, 55 P.3d 396 (Mont. 2002).

Most states limit who may establish an environmental flow right, restricting holders to a designated state agency. In Colorado, only the Colorado Water Conservation Board may file for an instream flow water right. In Wyoming, such rights are restricted to the Wyoming Water Development Commission. Idaho restricts instream flow rights to its Department of Water Resources. Montana allows public entities to have "reservations" of water for instream flow purposes established in their name. All of these states provide that other parties may recommend stream segments or lakes for protection. In Arizona and Nevada, by comparison, any party may file for an instream flow appropriation.

States vary in the particular purposes for which environmental flow rights may be established. Colorado, for example, describes their purpose as to "preserve the natural environment to a reasonable degree." Wyoming limits instream flows to maintenance or improvement of existing fisheries. Idaho has the broadest statutory list of potential purposes: protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, transportation and navigation values, and water quality. Montana also recognizes water quality as a legal basis for reserving water for instream flows.

Instream Flows

Quantity of Flow

As with any appropriation, the instream applicant is limited to that amount of water reasonably necessary to accomplish the purpose of the appropriation. The statutes of Colorado, Idaho, and Wyoming use the term "minimum" when describing such appropriations. Each state follows somewhat different procedures for quantifying the claimed flows. In all cases, the claims are necessarily limited to unappropriated water (i.e. water that remains available after considering existing water rights). Typically the applicant must demonstrate the availability of the water it seeks to appropriate for instream flows. Moreover, the applicant must demonstrate the relationship between the desired quantity of water to be appropriated and the beneficial purpose of the appropriation.

Priority Date

Environmental flow rights have as their "priority date" the date of appropriation, commonly the date the application is filed with the state. Given the very recent vintage of such rights, they are typically very junior in priority. Nevertheless, they are protected against flow reductions caused by later appropriations and may require junior appropriations to cease if the protected environmental flow is being reduced because of the later use. Moreover, as water rights, environmental flows are protected from injury in the case of a change of water rights (senior or junior rights), similar to any other water right.

Permanency

In general, environmental flow appropriations have the same permanency as any other water right. The exception is Montana in which flow reservations are to be reviewed every ten years and may be modified or even revoked.

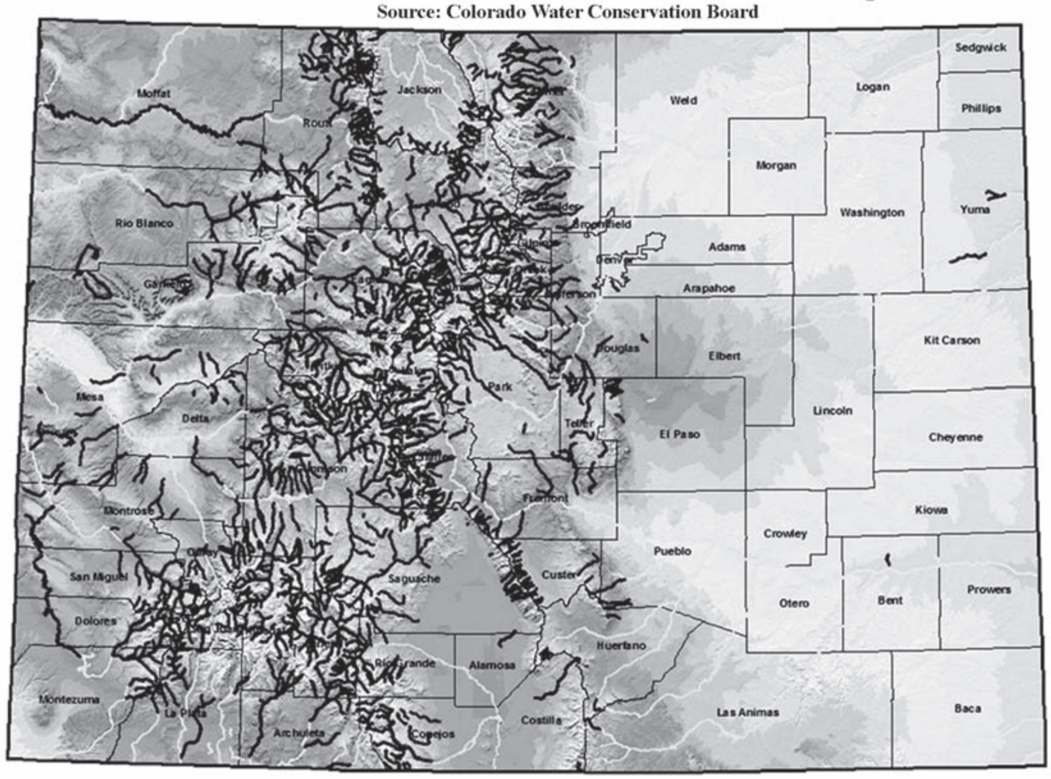
Implementation

Colorado, Idaho, Montana, and Wyoming all have tasked specific state agencies with the responsibility for identifying places in which instream flow protection is considered desirable and feasible, and with either directly taking the steps necessary to obtain legal protection or requesting another agency to take those steps. Perhaps not surprisingly, these are the states with the most instream flow rights.

Colorado Approach

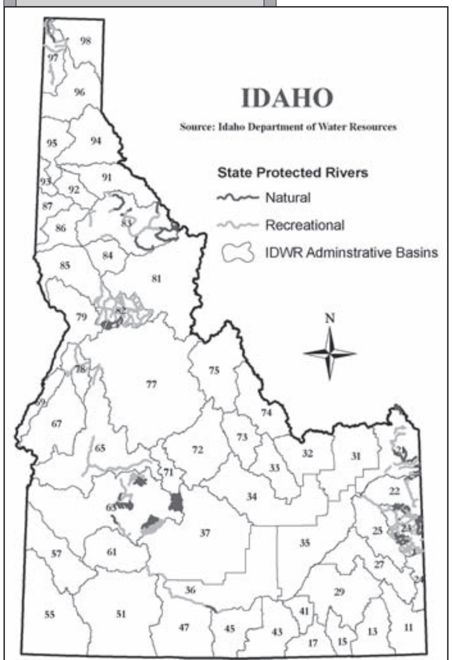
In Colorado, the Division of Wildlife (CDOW) has traditionally taken the lead in identifying places where there are important aquatic values that warrant protection. This agency then uses a particular methodology for quantifying that portion of the remaining flows that it believes should be protected to maintain those values. CDOW then provides a report with this information to the Colorado Water Conservation Board (CWCBoard), the agency authorized to file for an instream flow right. CWCBoard staff evaluates existing stream hydrology to verify that the desired flows are in fact available and weighs the instream use against other potential future uses of the water. The staff may make some modifications to the CDOW proposal before submitting the information to the CWCBoard, which is composed primarily of members from around the state appointed by the governor. Upon CWCBoard approval, staff then files an application with the water court for the basin in which the appropriation is made. Other holders of water rights may file objections, typically based on concerns about potential adverse effects on their rights. Assuming objections are resolved and the legal requirements met, the court awards a decree for the right. Wyoming follows a very similar process by which its Department of Fish and Game identifies the location and quantifies the desired flows and then passes this information to the Wyoming Water Development Commission, which determines whether to file an application with the State Engineer and the Board of Control.

Streams Included in Colorado's Instream Flow Program
Source: Colorado Water Conservation Board



Instream Flows

Most commonly, the presence of a valued sport fishery serves as the basis for establishing instream flow water rights. In general, such fisheries are cold-water based and are located in the higher elevation streams close to the headwaters. In many cases these streams are located in national forests, national parks, Bureau of Land Management (BLM) lands, or in areas with public access to streams.



Originally, it was common for flows to be established at a single level — often representing the minimum flow regarded as necessary to maintain the fishery. Methodologies for evaluating flow conditions necessary to adequately protect fisheries and other aquatic and riparian resources have evolved greatly in recent years (see T. Annear, et al., *Instream Flows for Riverine Resource Stewardship*, Rv'd Ed., Instream Flow Council, 2004). At a minimum it is now more typical for there to be at least two appropriations — one for summer and one for winter. It remains uncommon to have an appropriation that varies across the year with the hydrograph.

In those states with special programs, there was usually considerable activity in the early years as known trout fisheries and other high value stream segments were protected. Thus, for example, Montana went through major basin processes for the Yellowstone and the Upper and Lower Missouri rivers, identifying flows to be protected that resulted in reservation orders in 1979, 1992, and 1994. Additional reservations or other protections of unappropriated water have typically come from other interests such as federal land managers or tribes. Idaho established most of its minimum flow rights between 1978 and 1993. Since then, additional appropriations have come out of negotiated agreements sanctioned by the state legislature or from the basin planning process. In short, the earliest instream flow appropriations were made in areas with high sport fishery values and limited competition for water. Appropriations now are more likely to be in areas in which there is less agreement about the benefits of keeping water instream — for example, to protect a native warm water fishery.

Putting Water Back in Rivers - Restoring Stream Flows

Restoring Flows

As opportunities for appropriating unappropriated water diminish, attention has turned to restoring stream flows and other habitat conditions.

Dam Reoperation

There are two fundamental strategies for improving flows:

1) Reoperating Dams: Restructuring operating procedures for dams to reflect environmental flow needs for "regulated rivers" — i.e. those rivers where flow is "regulated" by dam operations
2) Reducing water diversions via changes to water rights

Relicensing of hydroelectric power facilities now typically involves adding conditions for bypasses of flows determined necessary to protect downstream fisheries and other ecologic values. Dam reoperation involves modifying release patterns to better suit downstream habitat needs. The experimental releases from Glen Canyon Dam in the Colorado River are a prominent example. Often there is considerable flexibility in dam management — flexibility that can provide enhanced instream benefits while still meeting traditional out-of-stream uses. Generally there are no state law limitations on reoperating dams so long as water uses are not changed and water rights are not impaired.

Change of Use

Reducing diversions, on the other hand, may involve making a change of use of an existing water right. Such changes of use generally require state review to ensure no harm to other water rights. Not all states allow a change of use to instream flow purposes. There are also strategies for improving flows that do not require a formal change of use.

Changes of Water Rights to Environmental Flow

State Distinctions

All of the study states provide generally for changes of use of existing water rights, subject to the requirement that the change not injure other water rights (senoir or junoir). However, only the statutes of Colorado, Montana, and Utah explicitly authorize changes to instream flows. Utah only allows instream flow protection based on changing an existing water right, not by appropriation or reservation. Until 2008, Utah limited ownership of such changed rights to its Division of Water Resources or Division of Parks and Recreation but now allows fishing groups to do so temporarily. Wyoming and Colorado laws allow only the state to change a water right to instream flows. By statute, Arizona restricts changes of water rights to recreation or wildlife purposes to public entities. Idaho appears to limit changes to instream flows to temporary transactions through one of its water banks. By statute, Montana now allows any water right owner to change its use to instream flow. Nevada courts have interpreted Nevada law to allow any owner of a water right to change its use to environmental flows.

Instream Flows

Temporary Changes

Leases

Water Banks

Colorado

Utah

Legal Recognition

Limitations

"Minimum" Flows

Oversight

Non-Permanent Transfers

In most of the states. there has been considerable interest with temporary arrangements that help keep historically diverted water instream. Several of the states specifically authorize temporary changes of water rights, subject to the same review as required for permanent changes. In addition, several states have established specific programs by which water rights may be leased for environmental flow purposes. Such programs have been attractive to water right holders not interested in permanently giving up their rights. Some temporary arrangements are tailored to reduce diversions during particular periods of the irrigation season when environmental flows are especially important; others operate only during drought years. An advantage of such limited non-divert agreements is they don't need to go through the state's change of use review process.

Montana pioneered development of a leasing program, beginning with limited authorization only to its Department of Fish, Wildlife & Parks, and then extending that authority to any party. Now anyone may acquire an existing water right, either permanently or temporarily, and change its use to environmental flow purposes. Using this authority, nonprofits such as Trout Unlimited and the Montana Water Trust, as well as the state, have been actively leasing water for streamflow benefits under a variety of arrangements.

In Idaho, water banks have been utilized to facilitate transactions involving temporarily changing existing rights to other uses, including instream flows. Under special legislative authority, the federal Bureau of Reclamation (Reclamation) utilizes the Upper Snake bank to rent water in storage for downstream release to help meet the flow needs of salmon. The legislature established a special bank in the Lemhi River Basin to facilitate transfers of irrigation water to instream flows to enable salmon to reach upstream spawning habitat in the watershed. [Idaho Water Supply Bank website: www.idwr.idaho.gov/waterboard/water%20bank/waterbank.htm]

Colorado has allowed the Colorado Water Conservation Board to accept donations or make acquisitions of water rights for change to instream flows since 1986. In 2008, the General Assembly expanded and clarified the CWCB's leasing authority. Only this agency may hold a water right for instream flow purposes, either temporarily or permanently.

As mentioned, Utah now allows fishing groups to temporarily acquire water rights for instream flow restoration in streams with native trout populations. Two state agencies are authorized to acquire existing rights for instream uses.

PART II – OBSERVATIONS ON ENVIRONMENTAL FLOWS

Equivalent to Consumptive Water Uses

The legitimacy of environmental flow protection has gained increased policy and legal recognition in the Rocky Mountain States since the 1970s, but there remains a reluctance to regard this use of water as equivalent in importance to consumptive water uses. Interest in environmental uses of water has led to affirmative legislative action in most of these states and judicial or administrative action in others. Thus, it is now possible to protect water for environmental uses under state law in some manner in all of the states. Discussion has moved beyond questions such as whether environmental uses can be regarded as a "beneficial use" of water and whether an appropriation water right requires a physical structure to divert and control water. State approaches vary widely, reflecting in part, the degree of policy support for environmental flow protection.

That reservations remain is evident from the many limitations that still apply to establishing environmental flow rights. For example, flows dedicated to environmental purposes in Idaho, Colorado, and Wyoming are expressly limited to the minimum amount. Current policy in these states is to treat this statutory term as justification for limiting appropriations to flow levels below that necessary to fully support fishery and other ecologic values. A strong argument can be made, however, that the word "minimum" is simply another way of stating the fundamental principle of Prior Appropriation law that beneficial use always is limited to only that amount of water reasonably necessary to accomplish the purpose of the appropriation and no more. The quantity of water needed for an environmental flow water right depends on the purpose for which the right is established. See, e.g., the discussion by the Nebraska Supreme Court in *In re Application A-16642*, 463 N.W.2d 591, 610-11 (1990).

Idaho maintains close legislative oversight of flow-related actions by its Water Board. Montana law requires periodic reevaluation of instream flow reservations. Wyoming law only authorizes instream flows for fish. Colorado law subjects instream flow appropriations to considerations of existing but undecreed water uses. It authorizes a reduction in decreed flows at the determination of the Colorado Water Conservation Board. By regulation, it allows inundation of a protected stream segment and, under certain conditions, accepts injury to the right caused by other water right changes. Utah does not allow

Instream Flows

Trend

appropriations of new water rights for instream flow purposes. Several states allow only a governmental entity to appropriate water for instream flow; similarly, several restrict the ability to transfer an existing right to instream flow held by the state. The list of limitations goes on and on.

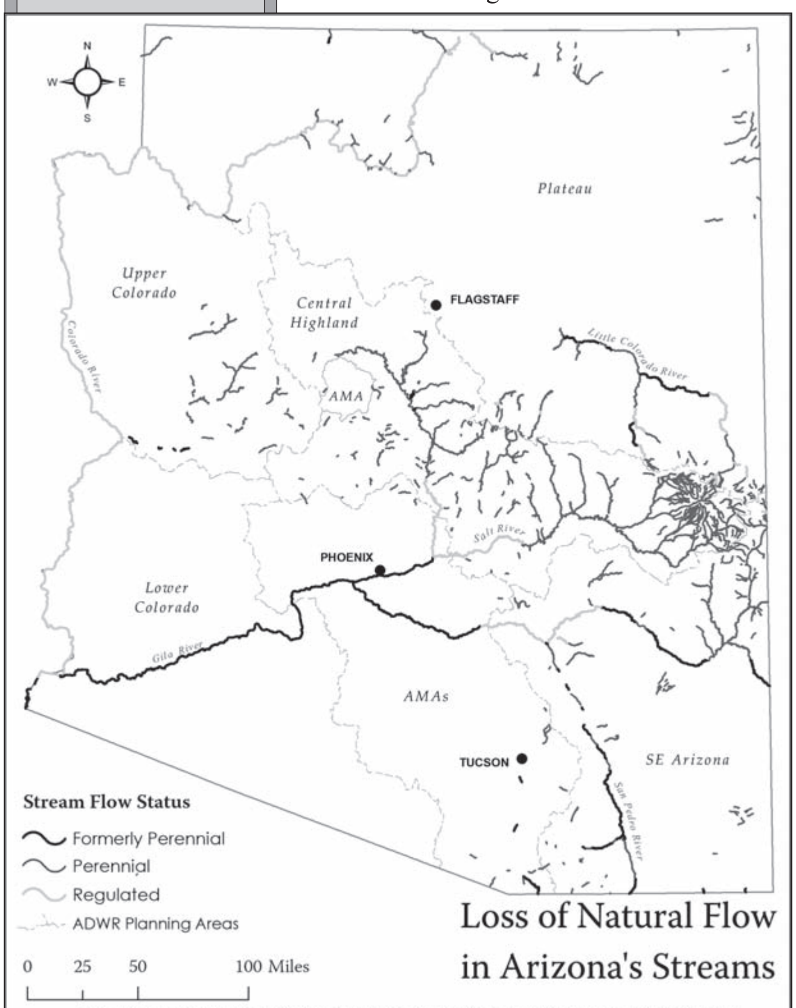
It seems likely that this somewhat second-class status will change over time. There has been a clear trend toward recognizing the importance of maintaining water for environmental purposes. Such uses are non-consumptive. They protect important values without diminishing the amount of water potentially available for meeting other human needs. A few states have affirmatively embraced the importance of environmental water rights. Such affirmative actions have included: establishing active state programs to identify high value places for protection; committing the funding needed to provide the desired protections; and working positively with stakeholders who share this interest. These states recognize the need to protect and maintain the state's water-dependent heritage and the growing desire of many of their citizens to be able to enjoy the recreational and environmental benefits of healthy streams.

Sport Fishing

Prevalence of High Elevation Streams Actions

Overall, the appropriations of water for environmental flows occur predominantly in high elevation, relatively remote streams that support a sport fishery. In part, the prevalence of appropriations in these locations simply reflects the reality that they are the only streams with remaining unappropriated water in most states. Most people live in the lower elevation areas with lands suitable for development, including for agriculture. The streams in these areas have long since been fully appropriated to meet direct human uses. Some storage facilities that divert water from high elevation streams have been built by both urban and irrigation water suppliers, but the fact remains: the more remote a stream is, the less likely it will have been regulated for human water uses. The focus on sports fisheries reflects both the importance of these fisheries to anglers and the role given to state wildlife agencies to identify places for protection of stream flows. As attention turns to protection of important environmental values in lower elevation water sources, it becomes necessary to work with existing water users. States are beginning to develop more tools to work within these settings.

Science Role



Source: "Loss of Natural Perennial Flow in Arizona's Streams" The Nature Conservancy, September 2004

Scientific Understanding of Environmental Flows

Scientific understanding of environmental flows has burgeoned in recent years, providing information needed to understand the essential role played by flows in maintaining healthy streams and helping to inform ways in which human uses of water can better be managed to enable maintenance of environmental values and functions. An early goal of environmental flow protection was simply to prevent rivers and streams from becoming so dewatered as to lose their ability to support a fishery. This goal was achieved so long as some flow remained in the stream. Now our better understanding of the role that stream flows play in supporting stream function calls for managing water so that flows more closely mimic the natural (pre-development) stream hydrograph. High flows are essential for maintaining channel form and for moving sediment. Peak flows that inundate floodplains recharge ground water, create important fish habitat, and support riparian vegetation communities. Base flows are essential to fish and other aquatic life. If flows become too low, water temperatures and concentrations of pollutants may increase beyond the tolerance level of aquatic species.

The Nature Conservancy (TNC) has developed a framework for what is termed "ecologically sustainable water management" (B. Richter et al., *Ecologically Sustainable Water Management: Managing River Flows for Ecological Integrity*, 13 Ecological Applications 206, 207 (2003)). This process provides participants with the information needed to make informed decisions about the tradeoffs between different levels and types of human water uses and the health of the river.

Instream Flows

Sustainable Management

Shaping the Hydrograph

Restoration Challenges

"No Injury" Rule

Historical Consumptive Use

Leasing Rights

Forfeiture

TNC describes ecologically sustainable water management as follows:

> Ecologically sustainable water management protects the ecological integrity of affected ecosystems while meeting intergenerational human needs for water and sustaining the full array of other products and services provided by natural freshwater ecosystems. Ecological integrity is protected when the compositional and structural diversity and natural functioning of affected ecosystems is maintained.

A group of river scientists is developing a methodology they call the "ecological limits of hydrologic alteration." A. Arthington et al., *The Challenge of Providing Environmental Flow Rules to Sustain River Ecosystems*, 16 Ecological Applications 1311 (2006). This approach relies on the use of flow-ecology relationships developed by analyses of numerous rivers within a region. With a better understanding of possible outcomes, actions can be taken to establish the desired flow regime.

Timing the extractions of water for human uses to correspond more closely to the hydrograph may provide better support for a wider range of beneficial uses. The extractions can be distributed over the year to maintain the shape of the hydrograph, but at a lower level. For instance, historic peak flow levels may provide water in excess of that necessary for identified beneficial uses. Such circumstances give rise to the possibility of storing this "excess" to insure beneficial flow levels at other times of year. Protecting the flow regime in this manner has been called an "upside down" instream flow water right because it reverses the traditional baseflow protection approach (N. Silk et al., *Turning Instream Flow Water Rights Upside Down*, 7 Rivers 298 (2000)).

Streamflow Restoration and Water Marketing

Stream restoration activities, sometimes motivated by legal requirements, are being supported through changes in state water law allowing changes of rights to instream flows, including temporary changes through leases or rentals. Streamflow restoration requires working with existing water uses. The challenges here are much greater than in making new appropriations of unclaimed water. Water marketing to shift water from irrigation to urban uses has helped identify many of the challenges involved in making changes of water rights, and some states have modified their laws to better facilitate this process. In most cases, changing consumptive use rights to environmental flow purposes must go through the same procedures utilized to change irrigation water rights to municipal uses. These processes require an affirmative demonstration of "no injury" to other water rights and may include review on other grounds, including public interest concerns.

Most changes to environmental flow simply involve the cessation of diversion of water and the elimination of the associated consumptive use. Whatever incidental benefits may have been associated with the diversion, such as groundwater recharge or growth of phreatophytic ("water loving") vegetation, are not part of the water right. The diverter has no legal obligation to continue to divert water to maintain these unintended outcomes. The only potential injury issue is whether the new use results in an injurious change in the timing of "return flows" (water that is not consumed by the use but returns to the source) so that stream conditions upon which downstream appropriators have depended are unacceptably altered to the detriment of the existing user. Moreover, the matter of historical consumptive use — usually the most contentious matter in a change of water right proceeding — is irrelevant unless there is the intention to legally protect that amount of water downstream beyond the historical point of return flows. Sale of the consumptive use portion to a downstream user can potentially provide a mechanism to help finance the original acquisition. In that case, quantification of historic consumptive use makes sense.

In short, in many instances it may be sufficient to demonstrate merely the historical pattern of diversion to establish the extent of the changed instream flow right and to ensure that historical patterns of downstream conditions are not measurably affected. If the party making the change intends to protect the quantity of water historically consumed further downstream, then it will be necessary to determine the quantity and timing of this amount of water. It will also be necessary to develop a means of monitoring and protecting that water (from diversion) as it passes by downstream headgates.

Water right holders have shown considerably more interest in leasing their rights for environmental flows than in selling them. In addition to specifically providing for the leasing of water rights to support environmental flows, several states have developed mechanisms to facilitate such transactions including Idaho's water banks and New Mexico's Strategic Water Reserve. Using leases, water right holders can avoid the "use it or lose it" rule that forces them to divert water even though they may not want to, in order to avoid forfeiting their rights. Authorizing legislation needs to stipulate that such temporary instream uses do not raise questions of abandonment or forfeiture. Moreover, water right owners will be more inclined to temporarily cease use if the process provides that the measure of the right's historic consumptive use will not be affected. Using a lease, they retain the option to revive their use if they choose. In the meantime, the water stays instream for the benefits it can provide in that use.

Instream Flows

State Controls

"Reserved" Rights

State Law

Federal & Tribal Objectives

Ownership Restrictions

The continuing limitations most states place on an owner of a water right who wishes to change the use of the right to environmental flow is puzzling. Western states uniformly regard water rights as property rights. The water right holder has complied with state law and placed some amount of water to beneficial use. The right to continue the use of water, in priority, is protected. Water right holders are able to transfer ownership of the right and make changes to any other uses, subject to the no injury rule — *except for streamflow enhancement*. By definition, streamflow enhancement increases flows in a stream, benefiting not only the in-channel environment but also the supply of water potentially available for other downstream appropriators. There is no clear explanation of why holders of water rights should not be free to change the use to environmental purposes or why such changes should be limited to a state agency.

Federal and Tribal Lands

While there is improved cooperation between states and federal agencies as well as tribes in addressing their mutual interests in environmental flows, more can and should be done. An historic area of contention between the US and the states concerns the availability of water for uses on federal and tribal lands. In general, states determine and control uses of water within their boundaries. The primary exception is when a reservation of public lands for such things as national parks or Indian reservation is determined to have "reserved" an amount of appurtenant water necessary to fulfill the purposes of the reservation. Such rights are regarded as existing independent of the normal state procedures for water appropriation. Beyond such reserved rights, federal land agencies and tribes must obtain rights to use water under state law.

In general, implied reserved rights that include instream flows have been found to exist for Indian reservations established under treaties that recognized fishing as an important purpose for which the reservation was established, for national parks because of their explicit preservation purposes, and for a few other such reservations. By statute, congressionally-designated wild and scenic rivers are regarded as having reserved water rights. Implied reserved rights for instream flows have not been recognized for national forests. By policy, the US Fish and Wildlife Service has not sought reserved water rights for national wildlife refuges. In general, water rights on BLM lands are also not reserved. Because the federal McCarran Amendment makes federal reserved rights subject to state general stream adjudications, quantification of such rights generally occurs in state proceedings.

States generally seek to encourage resolution of federal interests in streamflow protection through use of state law. Montana has successfully used a special compact process to resolve federal reserved water rights claims. Several states invite federal agencies to submit their instream flow protection interests to the state agency process established under state law. Arizona and Nevada allow federal land agencies to directly appropriate water for environmental flow purposes. However, Nevada has not acted on federal applications for instream flows for many years. Arizona stopped approving such applications during the *Phelps-Dodge* litigation (see above), a process that now has moved into its second phase involving acceptable methods for quantifying instream flow claims. Several states have worked out agreements with the US under which special legislation has been crafted to enable federal interests to be met under state law. Some states have adopted memoranda of understanding with federal land agencies calling for cooperative approaches to water matters.

Nevertheless, state law governing protection of water for environmental purposes typically has a number of limitations that may not be consistent with federal and tribal land management objectives. In some instances, standard state law has been adapted to specially address federal concerns. Where these limitations cannot be bridged, federal agencies may feel unable to follow state procedures and will choose instead to rely on other means to achieve their objectives. One proposed option is to authorize joint ownership between federal and state agencies of instream flow water rights (Lois Witte, *Still No Water for the Wood*s, ALI-ABA Federal Lands Conf., 10/19/01, available online: stream.fs.fed.us/news/streamnt/apr02/apr_02_01.html).

Exclusive State Control & Environmental Interests

There are an increasing number of participants working to protect and improve stream flows in the Rocky Mountain states. States zealously guard uses of water to benefit their identified interests. As noted, in the West such interests were once understood to mean uses that generated income or supplied direct human needs. Today, state interests include helping to find ways to make water available for nonconsumptive, environmental purposes. Unlike other beneficial uses of water, however, most states restrict the ownership of environmental uses to exclusive state control.

Leaving aside the necessity for such restrictions, it is still true that those most interested in using water for environmental benefits are involved in the process. Thus, fish biologists working for state wildlife agencies have been central to state efforts to protect stream flows (e.g. The Instream Flow Council, a non-

Instream Flows

Water Quality

profit organization with membership from virtually all state wildlife agencies as well as their counterparts from Canadian provinces, see: www.instreamflowcouncil.org). Occasionally, state parks and recreation departments encourage protection of flows for recreation if that is an allowable instream flow use. Even water quality agencies may weigh in because of the importance of flow for maintenance of water quality, again if protection of water quality is an allowable instream flow use. In addition, federal land management agencies have been actively involved in efforts to protect flows and lake levels within their lands (a good overview of federal agency efforts through the mid-1990s is provided in Gillilan & Brown, *Instream Flow Protection*, pp. 177-223).

Nonprofits Participation

Nonprofits with a wildlife or biodiversity interest often are active participants. The Nature Conservancy has for many years been a leader in water-based biodiversity protection as a complement to its traditional land-based programs (see www.nature.org/initiatives/freshwater/). Trout Unlimited's Western Water Project, with offices in many of the Rocky Mountain states, actively promotes flow protection and restoration for fish and other aquatic benefits (see www.tu.org/site/c.kkLRJ7MSKtH/b.3022975/). Modeled somewhat along the lines of land trusts, water trusts have been established in several western states with the objective of acquiring water or water rights for instream flow purposes. There are water trusts in Montana (www.montanawatertrust.org/) and Colorado (www.coloradowatertrust.org/). Individual watershed groups have developed in many Rocky Mountain states, some with an interest in streamflow protection and restoration. Cities also are increasingly interested in protecting and enhancing flows on streams that pass through their boundaries (see Knox, TWR #30). In addition, there are riparian landowners — sometimes ranchers — with an interest in maintaining flows in streams that run through their property for fishery and aesthetic benefits. Moreover, rafting and kayaking enthusiasts are strong proponents of free-flowing rivers.

Drawbacks of Limits

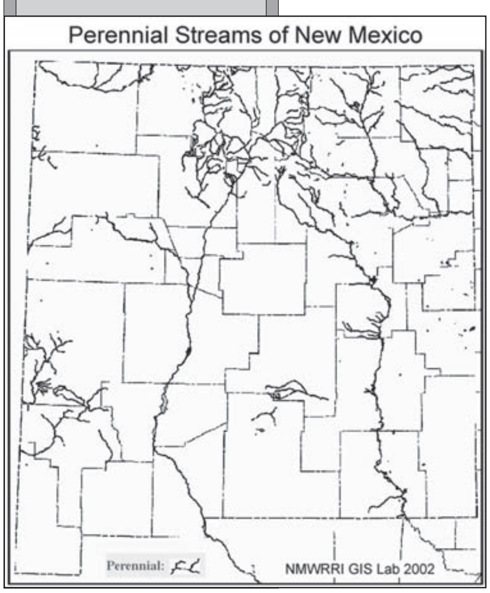
These entities and individuals bring people, expertise, and funding to the task of streamflow protection — much needed resources to supplement what is available through state and federal agencies. Obviously their participation is affected by the degree to which state law and processes enable them to accomplish their objectives. Thus, precluding entities other than a state agency from acquiring and holding a water right for environmental flow purposes reduces their interest in putting in the time and expending the funds needed to make such acquisitions and go through the change-of-right process. Putting restrictions on the purposes for which environmental flows may be protected has the effect of keeping out those whose interests cannot be met. Limiting the tools available for entities to work with, such as by not authorizing leasing of water for environmental flows, limits their options and reduces their effectiveness.

Loosening Trend

That there are so many parties interested in streamflow protection underlines the growing importance placed on this use of water. Some states such as Montana have opened up their systems to enable participation in streamflow protection by all interested parties, in association with state efforts. Others such as Colorado have been welcoming in some respects and unwelcoming in others (such as restricting ownership of instream flow rights to a single state agency). The trend is clearly in the direction of inviting more participation, most importantly by allowing any party to either temporarily or permanently acquire existing water rights and changing their use to environmental flow.

PART III: THE INSTREAM FLOW PROTECTION TOOLBOX

The instream flow protection toolbox is growing even though little has changed in how states choose to set aside unused water for environmental purposes. Most states simply appropriate water for that purpose in the same manner as water users do for other water rights. Montana also uses a reservation system. Idaho and Montana have legislatively closed certain areas to additional surface water appropriation, while Utah and New Mexico have done this in some places administratively. States may also use their approval authority on new appropriations to condition approval on maintaining a level of minimum bypass flow to protect a stream reach.



There has been considerable development, however, in the legal tools by which existing water uses may be changed to provide enhanced stream flows. Some states have explicitly recognized that existing rights may be changed to environmental flow purposes. As mentioned, such changes must undergo state review to ensure no injury to other existing water rights. Several states now have established procedures by which water rights may be leased for instream flow purposes. There may be limitations, however, on who is authorized to hold these leases and on the number of years for which a right may be leased. There may also be limits on the purposes for which these leases may be made or even the watershed in which the transactions are allowed. But the door has been opened, and the results to date indicate considerable success with restoring stream flows using such approaches.

Instream Flows

Creative Options

Purchasers and water right owners have shown considerable creativity in structuring transactions in ways that work for both interests. Some transfers, for example, are triggered only in drought years. Some transfers call for only a limited-term cessation of diversions at the time during the irrigation season when flows are regarded as most critical, for such things as fish passage or to moderate water temperatures. There have been agreements that produced a desired reduction in diversions by paying for water use efficiency improvements. Other agreements have enabled a surface flow water user to switch to groundwater pumping or even to shift to a different, more abundant source of water.

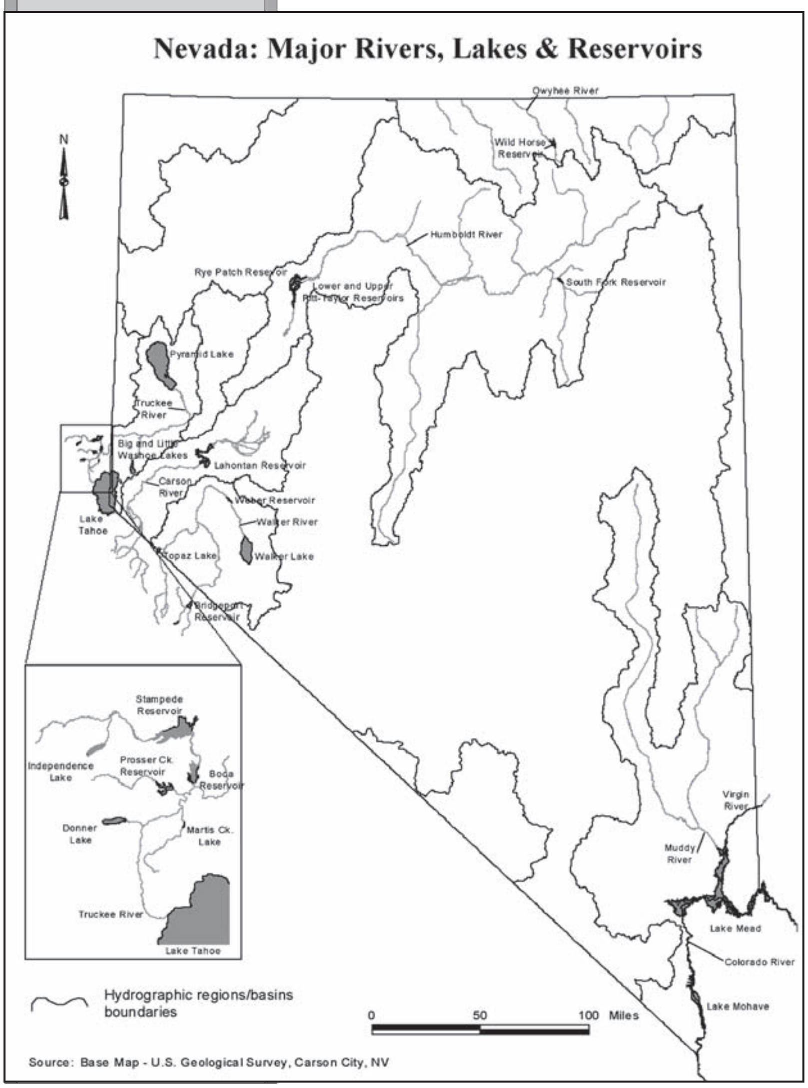
Innovative Program

Transactions Program Spurs Innovation

The Columbia River Basin encompasses most of Idaho as well as western Montana and portions of Nevada, Colorado and Utah (and the non-"Rocky Mountain States" of Washington and Oregon). Funding provided under the Columbia Basin Water Transactions Program (CBWTP) has spurred innovative, voluntary efforts to restore stream flows needed by endangered fish in critical tributaries. Comparable programs should be established in other basins and states.

Relationships Established

While flow restoration on larger rivers can often be achieved through changing storage facilities operating procedures managed by the US Army Corps of Engineers (Corps) and Reclamation, flow restoration in smaller tributaries typically requires reducing existing diversions under individual water rights. Such work is difficult and time consuming and is only possible if there is a reliable source of funding. In just a few years, CBWTP has spurred more than 150 transactions to produce critically needed flows for the benefit of endangered fish. The availability of this funding, generally tied to larger habitat restoration efforts, has enabled states and nonprofits to develop relationships with water right holders in key areas, leading to arrangements with water right holders under which they are voluntarily willing to forego or reduce their diversions, and has encouraged states to develop legislative and administrative rules supporting these efforts.



New Mexico's Strategic Water Reserve represents a state-level commitment to providing funding and staff to acquire water and water rights to benefit federally listed species and, potentially, to help keep species from becoming listed (see Water Briefs, TWR #33). In this way, the state is helping their water users meet their legal responsibilities under the Endangered Species Act through voluntary rather than regulatory means. In 2008, the Colorado General Assembly authorized the Colorado Water Conservation Board to use funds from the state's species conservation trust fund to acquire water rights for instream flow purposes to benefit listed or candidate species or species of concern (S.B. 09-168, Colo. Rev. Stat. § 24-33-11 (2)(II)). These are important commitments of state funds to help support the task of streamflow restoration to meet the needs of species in jeopardy of extinction.

Collaboration Builds Support

Collaborative processes focused on restoring specific streams and stream segments are helping to build support for the importance of adequate flows to enhance and maintain desired healthy streams and fisheries. An important trend in water management over the past 20 years has been the emergence of collaborative, multi-party processes by which acceptable changes in traditional water use patterns have been established to produce a desired environmental benefit.

Sometimes these processes are driven by the need to comply with federal law respecting endangered species protection, water quality, or hydropower licensing. The Upper Colorado River Fish Recovery Program is a prominent example. In other cases, collaboration emerges out of local interests in making watershed

Instream Flows

Flow Regimes

improvement (e.g., restoring flows in the Santa Fe River) or in responding to a perceived threat to the existing condition of the watershed (such as in Arizona's Verde River). Restoration of aspects of stream functionality, such as restoring sinuosity to a channelized stream segment or improving in-channel fish habitat, is often an integral objective. In many cases these processes provide a better understanding of the manner in which the traditional flow regime has been altered and the effects this alteration has had on aquatic and riparian values. Such understanding may lead to a shared interest in taking steps to restore a flow regime that provides increased ecological benefits. Voluntary diversion reductions in the Blackfoot River of Montana illustrate this point.

Flexibility Possible

There have been some striking outcomes. One is the surprising degree of flexibility that is often available within historical patterns of water use. Water uses develop incrementally over many years, based on patterns of growth and associated needs for water. Under the priority system of "first in time, first in right" employed in Prior Appropriation states, these patterns tend to stay firmly in place unless there is some important reason for their reconsideration. Yet the base need is simply to assure that valuable water uses continue, not that they necessarily continue in the same manner as they always have. Once that premise is accepted, many things become possible. Some uses may no longer be important or necessary. New Mexico, for instance, is retiring some irrigation water uses in the Pecos River Basin to improve stream flows. Water stored in Reclamation reservoirs in Idaho can be rented for release to meet downstream flow needs. Other uses may be able to be supplied or managed in different ways. A well can replace a surface water diversion to maintain stream flows. Dams can be operated in ways that are more river-friendly while still meeting their traditional purposes. Perhaps most importantly, these changes have been accomplished voluntarily.

CONCLUSION
The Challenge of Growing Populations and Climate Change

Growing Demands

Committing water to environmental purposes will be challenged by growing demands for consumptive uses of water associated with growing populations and by changes in water availability associated with climate change. Dedicating water to environmental uses will not get easier in the years ahead. The Rocky Mountain West contains some of the nation's fastest growing states. Urban water demands are expanding as a result. Moreover, water demands associated with development of the region's important energy resources are growing as well. Set against this pattern of growing water demands is an expanding body of research indicating that the region's hydrologic patterns as recorded over the past century and more are changing. The consensus is that for some critical sources of water supply, such as the Colorado River, the supply is likely to diminish compared to what was believed to be the historical norm. In other places, continued global warming is going to affect the region's dominant source of supply: runoff from the mountain snowpack. Increases in stream temperatures are already being documented, placing greater stress on fish and other temperature-sensitive aquatic life.

Shifting Debate

In this context, the importance of protecting water for environmental purposes is likely to once again be debated. The discussion, however, is likely to be different from the one held 30 years ago. We are less likely to debate whether environmental water should be protected and more likely to focus on how and where water should be maintained for such purposes. Few today would suggest that protecting water for the environment is not important or has no value. Indeed, its value for these purposes is increasing as such water becomes increasingly scarce. We have learned a great deal about how water for the environment can be protected and restored in a manner that is compatible with other human needs for water. Environmental flows are non-consumptive. Their protection increases beneficial use of water without precluding other uses. We have made substantial progress over the past three decades in environmental flow protection, progress that has occurred while simultaneously meeting new water demands and without forcing an end to existing water uses. We can use the lessons we have gained from these efforts and apply them to the challenges of the future.

For Additional Information: Lawrence J. MacDonnell, 303/ 440-0180, email: l.macdonnell@comcast.net or Western Progress website: www.westernprogress.org

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

Instream Flows

Instream Flow Laws

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Western Progress: Environmental Flows Report

FULL REPORT COMING SOON

As noted, the preceding article was adapted from a policy report being prepared for Western Progress, a non-partisan organization dedicated to advancing progressive solutions in the Rocky Mountain states.

For more information about the Western Progress water policy agenda, contact Sarah Bates, Deputy Director for Policy and Outreach, 406/ 829-6608, or visit www.westernprogress.org. The report reflects information gathered from nearly 60 interviews with knowledgeable people in each of the states. Special acknowledgement is given to Robert Wigington and Bruce Driver for their thorough review and many useful suggestions.

Climate Change

IPCC Technical Paper

CLIMATE CHANGE & WATER

IPCC TECHNICAL PAPER VI

by David Moon, Editor

On September 18, the Intergovernmental Panel on Climate Change released its Technical Paper VI on Climate Change and Water. The Executive Summary provides a snapshot to water users in the West into many areas that demand action to adapt to the coming changes. "By the middle of the 21st century, annual average river runoff and water availability are projected to increase as a result of climate change at high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics. Many semi-arid and arid areas (e.g., the Mediterranean Basin, western USA, southern Africa and northeastern Brazil) are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources due to climate change (high confidence)."

Climate Change

Snowpack

Impacts on snowpack are of particular interest in the western US. "Water supplies stored in glaciers and snow cover are projected to decline in the course of the century, thus reducing water availability during warm and dry periods (through a seasonal shift in streamflow, an increase in the ratio of winter to annual flows, and reductions in low flows) in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world's population currently live (high confidence)."

Flooding & Drought

The increased likelihood of droughts and flooding — along with a myriad of negative impacts — was also highlighted. "Increased precipitation intensity and variability are projected to increase the risks of flooding and drought in many areas. The frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) will be very likely to increase over most areas during the 21st century, with consequences for the risk of rain-generated floods. At the same time, the proportion of land surface in extreme drought at any one time is projected to increase (likely), in addition to a tendency for drying in continental interiors during summer, especially in the sub-tropics, low and mid-latitudes...Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution — from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution, with possible negative impacts on ecosystems, human health, and water system reliability and operating costs (high confidence). In addition, sea-level rise is projected to extend areas of salinisation [sic] of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas."

Sea-Level Impact

Infrastructure Stress

For water managers, the expected impacts of climate change on infrastructure is of particular importance. "Climate change affects the function and operation of existing water infrastructure — including hydropower, structural flood defences [sic], drainage and irrigation systems — as well as water management practices. Adverse effects of climate change on freshwater systems aggravate the impacts of other stresses, such as population growth, changing economic activity, land-use change and urbanisation [sic] (very high confidence). Globally, water demand will grow in the coming decades, primarily due to population growth and increasing affluence; regionally, large changes in irrigation water demand as a result of climate change are expected (high confidence)."

Water Management Needs

The need to change current water management practices is also addressed. "Current water management practices may not be robust enough to cope with the impacts of climate change on water supply reliability, flood risk, health, agriculture, energy and aquatic ecosystems. In many locations, water management cannot satisfactorily cope even with current climate variability, so that large flood and drought damages occur. As a first step, improved incorporation of information about current climate variability into water-related management would assist adaptation to longer-term climate change impacts. Climatic and non-climatic factors, such as growth of population and damage potential, would exacerbate problems in the future (very high confidence)."

Hydrological Experience

Information circulating in the water world recently, particularly in the Colorado River Basin (tree ring studies), has stressed that historical records used to determine water availability for the future are suspect. Problems with predicting water supplies for the future are exacerbated by climate change. "Climate change challenges the traditional assumption that past hydrological experience provides a good guide to future conditions. The consequences of climate change may alter the reliability of current water management systems and water-related infrastructure. While quantitative projections of changes in precipitation, river flows and water levels at the river-basin scale are uncertain, it is very likely that hydrological characteristics will change in the future. Adaptation procedures and risk management practices that incorporate projected hydrological changes with related uncertainties are being developed in some countries and regions."

Adaptation Strategies

The report also delves into potential adaptation strategies. "Adaptation options designed to ensure water supply during average and drought conditions require integrated demand-side as well as supply-side strategies. The former improve water-use efficiency, e.g., by recycling water. An expanded use of economic incentives, including metering and pricing, to encourage water conservation and development of water markets and implementation of virtual water trade, holds considerable promise for water savings and the reallocation of water to highly valued uses. Supply-side strategies generally involve increases in storage capacity, abstraction from water courses, and water transfers. Integrated water resources management provides an important framework to achieve adaptation measures across socio-economic, environmental and administrative systems. To be effective, integrated approaches must occur at the appropriate scales."

For Additional Information:
The Complete Report is available at IPCC's website: www.ipcc.ch/ipccreports/tp-climate-change-water.htm

WATER BRIEFS

DROUGHT WATER BANK CA

CDWR FACILITATES EXCHANGES

The California Department of Water Resources (CDWR) has established a 2009 Drought Water Bank to help facilitate the exchange of water. To implement the 2009 Drought Water Bank, CDWR will purchase water from willing sellers primarily from water suppliers upstream of the Sacramento-San Joaquin Delta. This water will be transferred using State Water Project (SWP) or Central Valley Project (CVP) facilities to water suppliers that are at risk of experiencing water shortages in 2009 due to drought conditions and that require supplemental water supplies to meet anticipated demands.

CDWR and the US Bureau of Reclamation will host several Urban Drought Workshops statewide in October. The workshops will provide the most current information about the water supply situation and how to review, update, and implement Water Shortage Contingency Plans. The free workshops are from 9:30 a.m. to 12:30 p.m. October 15 in Los Angeles, October 22 in Concord and October 29 in Sacramento. Visit www.owue.water.ca.gov for more information.

For info: CDWR website: www.water.ca.gov/drought/

CWA FINE LARGEST EVER LA

STORMWATER CRIMINAL MISDEMEANOR

CITGO, a Delaware corporation, pleaded guilty today and was sentenced to pay a $13 million fine for the negligent discharge of pollutants into two rivers in Louisiana in violation of the Clean Water Act (CWA), the US Justice Department announced on September 17. The $13 million fine is the largest ever for a criminal misdemeanor violation of the CWA.

CITGO pleaded guilty in US District Court in Lake Charles, for negligently failing to maintain stormwater tanks and failing to maintain adequate stormwater storage capacity at its petroleum refinery in Sulphur, Louisiana. As a result of these failures approximately 53,000 barrels of oil was discharged into the Indian Marais and Calcasieu Rivers following a heavy rain storm. In 1994, CITGO converted its lagoon waste water system into a tank system for handling excess waste water and stormwater. To trim costs, only two storm water tanks were constructed, but as early as 1998 employees and outside contractors advised that an additional tank was necessary. Despite being advised of the inadequate storage capacity, CITGO did not approve construction of a third tank until 2005. In addition, the company failed to follow standard procedures for maintaining the tanks. During its operations, CITGO failed to remove oil, sludge and solids from the tanks and failed to repair the skimming equipment. Failing to follow these procedures allowed for the build-up of a significant amount of oil in the storm water tanks, which contributed significantly to the overflow.

Along with the fine, CITGO will implement an Environmental Compliance Plan (ECP) to ensure a spill of this type will not occur in the future. The ECP includes new reporting requirements within the corporate structure regarding environmental issues and tank maintenance, the completion of the third storage tank, and the installation of new and more effective oil removal equipment for the stormwater tanks.

"Companies cannot make economic choices that sacrifice the environment," said Ronald J. Tenpas, Assistant Attorney General for the Justice Department's Environment and Natural Resources Division. "Sound business decisions must factor in the safeguard of the environment or companies will face consequences that in the long run are more detrimental to their bottom line."

For info: US DOJ, 202/ 514-2007

FLOODPLAIN BIOP US

NMFS BIOP ON FEMA FLOOD INSURANCE

On September 22, the National Marine Fisheries Service (NMFS) released a biological opinion (BiOp) on the effects of the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program (NFIP) throughout Puget Sound in Washington State. After two years of consultation, NMFS determined that the action of implementing NFIP causes jeopardy to Puget Sound Chinook and steelhead, and Southern Resident killer whales. NMFS found that the environmental effects of NFIP sufficiently impair the reproduction, numbers, and distribution of these species to appreciably reduce their likelihood of survival and recovery in the wild. NMFS also concluded that NFIP would destroy or adversely modify critical habitat for Puget Sound Chinook and Southern Resident killer whales. NMFS' jeopardy and adverse modification determinations were based on NFIP's effects on habitat and habitat-forming processes essential to supporting salmon and steelhead life histories in riverine and floodplain portions of the watersheds surrounding Puget Sound. Implementation of the NMFS biological opinion will change the way over 270 Puget Sound communities manage their floodplains.

Section 7(a)(2) of the Endangered Species Act (ESA) requires federal agencies whose actions are likely to adversely affect listed species to consult with NMFS to ensure those actions do not jeopardize the continued existence of those species. FEMA requested consultation after the court in *National Wildlife Federation, et al vs. FEMA*, et al, 345 F. Supp. 2d 1151 (W.D. Wash. 2004) found that FEMA violated its responsibility to consult under ESA section 7(a)(2). The court ordered FEMA to consult on the effects of: (1) the regulations establishing the minimum eligibility criteria for NFIP; (2) the mapping of floodplains, and revisions thereof; and (3) the Community Rating System (CRS) for Puget Sound Chinook salmon. Other animals considered in the consultation include Hood Canal chum salmon, Puget Sound steelhead, and Southern Resident killer whales.

In a "Q&A" provided by NMFS on their website, the agency noted that reasonable and prudent alternatives (RPAs) must be discussed to help FEMA ensure that NFIP does not jeopardize the species: "Since NOAA Fisheries' jeopardy and adverse modification determinations were based on the NFIP's effects on salmon and steelhead freshwater habitat and habitat-

WATER BRIEFS

forming processes, the RPA addresses the ways in which the action affects those places and the habitat located there. The RPA changes the proposed action to ensure that habitat-forming processes (such as channel migration, side channel formation, formation of edge habitat, wood recruitment, riparian function, and gravel recruitment) are preserved by protecting river channel, floodplain, and estuarine habitat functional processes." The biological opinion included a reasonable and prudent alternative which can be implemented to avoid jeopardy and adverse modification of critical habitat, while meeting each of the other requirements listed in the BiOp. As set out on page 157 of the BiOp: "The RPA is designed to guide future development away from floodplains that are essential to the recovery of listed species. The FEMA, working with local and state governments, will encourage appropriate land use decisions that constrict development of land that is exposed to flood risk."

According to Acting FEMA Regional Administrator Dennis Hunsinger, his agency is reviewing the entire biological opinion, and, over the next 30 days, will be working with communities to determine the best ways to implement some or all of the recommendations. "We will work together with communities to continue protecting Puget Sound-region residents from floods, while reducing our ecological footprint," Hunsinger said.
For info: NMFS website: www.nwr.noaa.gov/Salmon-Habitat/ESA-Consultations/FEMA-BO.cfm

WETLANDS PENALTY SD

ILLEGAL FILL - CWA VIOLATIONS

The US Environmental Protection Agency (EPA) recently reached an agreement with Randy Brownlee, Rita Brownlee, and Brownlee Construction, Inc. (Brownlees), requiring payment of a civil penalty of $27,500 for violations of the Clean Water Act CWA). The penalty is for discharges of dredged and/or fill material to wetlands adjacent to the Big Sioux River in Codington County, South Dakota.

The civil penalty resolves violations of the Clean Water Act that occurred in 2005 when the Brownlees illegally discharged material into .3 acres of wetlands to prepare the site for commercial use. This activity was completed without a permit issued by the US Army Corps of Engineers (Corps). The CWA prohibits discharges to wetlands and other waters of the US unless authorized by a permit. During their investigation, the Corps found that a total of 0.65 acres of wetlands had been filled with dredged and/or fill material without authorization, including approximately 0.35 acres of wetlands in 1991. The Corps subsequently referred the case to EPA for enforcement. In March 2008, EPA approved Brownlee Construction's wetland restoration and mitigation plan, which is currently being implemented in accordance with an approved schedule.
For info: Diane Sipe, EPA, 303/312-6391

TRIBES JOIN AGREEMENTS NW

COLUMBIA RIVER BASIN

On September 18, the Shoshone-Bannock Tribes (Tribes) announced they intend to join four Columbia River tribes, two states and three federal agencies in an unprecedented set of agreements designed to improve habitat and strengthen fish stocks in the Columbia River Basin over the next ten years. The Tribes are located along the Snake River at Fort Hall Indian Reservation near the southeastern Idaho city of Pocatello. The "Columbia Basin Fish Accords," entered into by four Northwest tribes, two states and the federal action agencies, were announced on May 2 (see Water Briefs, TWR #51). Details concerning the latest agreement and the Accords can be found on the website listed below.

The proposed agreement with federal action agencies would make available approximately $61 million over ten years for actions for Snake River spring/summer chinook, Snake River steelhead in the Salmon River Basin and Snake River sockeye and native Yellowstone cutthroat in the Upper Snake River. The Tribes will restore habitat, manage land for wildlife and native fish, supplement nutrients in streams and develop and operate scientifically-managed hatchery additions to contribute to the recovery of Endangered Species Act-listed and non-listed fish.

The Tribes were the first to petition to list Snake River sockeye salmon as endangered. Snake River sockeye salmon were officially listed as endangered in November 1991 under the Endangered Species Act (56 FR 58619).

The proposal with the Tribes promotes an ongoing collaborative relationship among the parties. The parties agree that in combination with the recently released Federal Columbia River Power System (FCRPS) and Upper Snake biological opinions, the federal government's requirements under the federal Endangered Species Act, Clean Water Act and Northwest Power Act are satisfied as to federal Columbia/Snake River dams for the next ten years and that they will work together to support these agreements in all appropriate venues.

Meanwhile, the long-running litigation regarding NOAA Fisheries Service's latest biological opinion for FCRPS (issued May 5, 2008) continues despite the agreements. In fact, that litigation has expanded to include Clean Water Act claims. US District Court Judge James Redden on September 12 granted a National Wildlife Federation request to file a "Fifth Supplemental Complaint" in the litigation regarding the biological opinions (BiOps). BiOps are required under the Endangered Species Act (ESA) to determine whether federal "actions" jeopardize the survival of listed species. The supplemental complaint continues to pursue federal Endangered Species Act and Administrative Procedure Act claims but also alleges that the dams are being operated without necessary state water quality certifications, thereby making the BiOp incidental take statement illegal. Judge Redden scheduled oral arguments on summary judgment motions for January 16 to be held at Portland's federal courthouse.
For info: Federal Caucus website: www.salmonrecovery.gov

WATER BRIEFS

CAFO CEASE & DESIST TX

CWA VIOLATIONS

The US Environmental Protection Agency (EPA) has issued a cease and desist administrative order to Mark Allen and Vernon Feeders in Vernon, Texas, for violations of the federal Clean Water Act (CWA). The cattle feeding operation, a non-permitted Concentrated Animal Feeding Operation (CAFO), is located in Vernon, in Wilbarger County, Texas. The facility has been ordered to immediately stop all discharges of pollutants in stormwater runoff from its animal confinement areas to Paradise Creek. The cattle feeding operation has been given 45 days to provide to EPA documentation that it has adequate capacity to contain all waste and process-generated wastewater plus stormwater generated during a 25-year, 24-hour storm event. The facility has also been given 45 days to develop and implement a pollution prevention plan that includes procedures specifically designed to minimize the discharge of pollutants from its animal confinement areas.

In June 2008, EPA conducted an unannounced inspection of the facility. The inspection revealed that the facility is not properly designed, constructed, and operated to contain all waste and process-generated wastewater plus stormwater runoff. The inspection also revealed an unauthorized discharge to Paradise Creek, a tributary of the Pease River. Paradise Creek flows about half-a-mile before it discharges to Pease River, which eventually discharges to the Red River. Based on these findings, the owner and operator of the cattle feeding operation has been ordered to immediately take action to bring the facility into compliance with the CWA.

For info: Dave Bary, EPA, 214/ 665-2200 or email: r6press@epa.gov; EPA audio file available at: www.epa.gov/region6/6xa/audio.htm#audio080708_vernonfeeders

CWA VIOLATIONS AZ

$1.25 MILLION CIVIL PENALTY

An Arizona land developer and a contractor have agreed to settle alleged violations of the Clean Water Act (CWA) for bulldozing, filling, and diverting approximately five miles of the Santa Cruz River, a major waterway in Arizona, the US Justice Department (DOJ) and Environmental Protection Agency (EPA) announced October 7. Arizona-based developer George H. Johnson; his companies Johnson International, Inc. and General Hunt Properties, Inc.; and land-clearing contractor, 3-F Contracting, Inc. will pay a combined $1.25 million civil penalty. The penalty is the largest obtained in the history of EPA's Pacific Southwest Region, and one of the largest in EPA's history, under Section 404 of the Clean Water Act, which protects against the unauthorized filling of federally protected waterways through a permit program administered jointly by EPA and the US Army Corps of Engineers.

The settlement resolves a Clean Water Act complaint filed in 2005 by the Justice Department and EPA against Johnson and his companies for clearing and filling an extensive stretch of the lower Santa Cruz River and a major tributary, the Los Robles Wash, without a permit from the Corps of Engineers. The alleged violations occurred in 2003 and early 2004, when defendants bulldozed 2000 acres of the historic King Ranch and La Osa Ranch in Pinal County. The bulldozed areas lie within the largest active floodplain of the lower Santa Cruz River, which meanders through the two ranches in natural braids, a rarity for this heavily channelized waterway. Prior to defendants' land-clearing activities, this stretch of the Santa Cruz River supported a rich variety of vegetation, including one of the few extensive mesquite forests remaining in Arizona's Sonoran Desert region. These areas form a critical corridor for wildlife to move along the Santa Cruz River and from Picacho Peak State Park to the Ironwood Forest National Monument.

The proposed consent decree, lodged in the U.S. District Court in Phoenix, is subject to a 30-day comment period and final court approval.

For info: DOJ, 202/ 514-2007; Proposed consent decree available on DOJ's website: www.usdoj.gov/enrd/Consent_Decrees.html

STORMWATER PERMIT US

NEW EPA MULTI-SECTOR PERMIT

EPA is issuing a new Stormwater Multi-Sector General Permit (MSGP) for an estimated 4,100 industrial facilities in 29 different sectors to implement site-specific stormwater pollution prevention plans to protect water quality. Facilities are required to install control measures that meet established technology and water quality-based effluent limits and must develop a stormwater pollution prevention plan.

The new permit offers several improvements from the previous MSGP, including easier to understand discharge requirements; fast and easy electronic filing of Notices of Intent (NOIs) and monitoring reports; web-based tools for locating waterbodies and determining impairment status; and updated monitoring, inspection and corrective action schedules.

The MSGP applies to facilities in states and territories not authorized to implement EPA's National Pollutant Discharge Elimination System (NPDES) program including: Alaska; Idaho; Massachusetts; New Hampshire; New Mexico; parts of Texas and Oklahoma; Rhode Island; Puerto Rico; the US Virgin Islands; the District of Columbia; and the territories of Guam, American Samoa, Johnston Atoll, and Midway and Wake Islands. The MSGP also applies to facilities located in Indian Country lands in Connecticut; Massachusetts; Rhode Island; Michigan; Minnesota; Wisconsin; Louisiana; New Mexico; Oklahoma; Texas; Arizona; California, Nevada, Alaska, Idaho, Oregon, and Washington, as well as to industrial activities taking place on Federal Facilities in Vermont; Delaware; and Washington.

Under the federal Clean Water Act, all facilities that discharge pollutants into waters of the US must obtain a NPDES permit. The new permit replaces the MSGP issued in 2000.

For info: Enesta Jones, EPA, 202/ 564-4355 or email: jones.enesta@epa.gov EPA website: www.epa.gov/npdes/stormwater/msgp

CALENDAR

October 15-17 OK
158th Council Meeting - Western States Water Council, Oklahoma City. Skirvin Hilton. For info: Cheryl Redding, WSWC, 801/ 561-5300, email: credding@wswc.state.ut.us or website: www.westgov.org/wswc/

October 15-17 CA
2008 Water Quality & Regulatory Conference, Ontario. DoubleTree Hotel. For info: Jo McAndrews, McAndrews & Boyd, 951/ 787-9287, email: sayhijo@empirenet.com or website: www.eastvalley.org

October 16 NE
2008 Water Colloquium, Lincoln. University of Nebraska, Hardin Hall. For info: Lorrie Benson, UNL Water Center, 402/ 472-7372, email: lbenson2@unl.edu or website: http://watercenter.unl.edu

October 16 OR
Water for Life Water Law Bootcamp, Beaverton. OSU Extension Office. For info: Helen Moore, WFL, 503/ 375-6003 or email:helen.moore@waterforlife.net

October 16-17 UT
Utah Water Law SuperConference, Salt Lake City. Marriott Hotel. For info: CLE International, 800/ 873-7130 or website: www.cle.com

October 17 OR
Sediment Remediation Seminar, Portland. For info: Holly Duncan, Environmental Law Education Center, 503/ 282-5220, email: hduncan@elecenter.com or website: www.elecenter.com

October 17-19 IL
"Water - The Next Global Crisis" 2008 Siebel Scholars Conference, Evanston. Northwestern University, Kellogg School of Management. For info: Seibel Scholars website: www.siebelscholars.com

October 18-22 IL
81st Annual Water Environment Federation Technical Exhibition and Conference, Chicago. McCormick Place. For info: WEFTEC website: www.weftec.org/home.htm

October 19-22 TX
American Institute of Hydrology Annual Meeting & International Conference, Houston. RE: Hydrologic Extremes & Global Climate Change. For info: AIH, 770/ 384-1634, email: aihydro@aol.com, or website: www.aihydro.org

October 20-21 WS
Construction Dewatering & Groundwater Design & Modeling Course, Milwaukee. For info: NGWA, 800/ 551-7379, email: customerservice@ngwa.org, or website: www.ngwa.org

October 20-22 NM
Surface Water Opportunities in New Mexico, Albuquerque. Embassy Suites. Sponsored by the Water Resources Research Institute (NMSU). For info: WRRI website: http://wrri.nmsu.edu/

October 20-24 AZ
"Creating A Bright Future:" Interstate Technology & Regulatory Council Event, Phoenix. For info: ITRC website: www.itrcweb.org/2008FallMeeting

October 21 OR
Hanford State of the Site Meeting, Hood River. Hosted by Tri-Party Agreement Agencies. RE: Cleanup Issues. For info: Madeleine Brown, WA/Ecology, 509/ 732-7936 or email: mabr461@ecy.wa.gov

October 21 OR
Statewide Water Roundtable, Salem. Convened by OSU Institute for Water & Watersheds, Oregon Sea Grant Extension, OSU Institute for Natural Resources & Oregon House Committee on Energy & Environment. For info: Michael Campana, IWW, 541/ 737-2413, email: aquadoc@oregonstate.edu or website: http://water.oregonstate.edu/roundtables/

October 21-22 WA
Brownfields & Land Revitalization Conference 2008, Tacoma. Presented by WA/Ecology, Northwest Environmental Business Council & National Brownfield Assn. For info: Sue Moir, NEBC, sue@nebc.org or website: www.nebc.org

October 22 OR
Hanford State of the Site Meeting, Portland. Hosted by Tri-Party Agreement (TPA) Agencies. RE: Cleanup Issues. For info: Madeleine C. Brown, Washington Ecology, 509/ 732-7936 or email: mabr461@ecy.wa.gov

October 22-24 CA
2008 CALFED Science Conference, Sacramento. RE: Ecosystem Restoration, Levee Integrity, Water Quality & Water Supply Reliability. For info: Mary Tappel, SWRCB, 916/ 341-5491, email: mtappel@waterboards.ca.gov or Conference website: www.science.calwater.ca.gov/conferences/

October 22-24 CA
Region 9 Annual Tribal Conference, San Francisco. Sponsored by the Pyramid Lake Paiute Tribe. For info: Greg Phillips, EPA, 775/ 885-6085 or email: Phillips.greg@epa.gov

October 23 WA
Present & Future of Water Storage in Washington (2008 State Conference of AWRA-WA), Seattle. Bell Harbor Conference Center. For info: Jamie Morin, Mentor Law, 206/ 838-7654, email: morin@mentorlaw.com or AWRA website: www.wa-awra.org

October 23 OR
Water for Life Water Law Bootcamp, Sisters. Best Western Inn. For info: Helen Moore, WFL, 503/ 375-6003 or email: helen.moore@waterforlife.net

October 23 WA
Changes Affecting Hydropower Projects Seminar, Seattle. Washington State Convention & Trade Center. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

October 25 OR
6th Annual Celebration of Rivers, Portland. Ambridge Event Center. WaterWatch of Oregon's Dinner & Auction. For info: WaterWatch website: www.waterwatch.org

October 27 WA
Wetlands Seminar, Seattle. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

October 27-28 GA
Southeast Water Law Conference, Atlanta. For info: CLE International, 800/ 873-7130 or website: www.cle.com

October 27-28 WA
Renewable Energy Finance Forum-West, Seattle. Presented by American Council On Renewable Energy & Euromoney Energy Events. For info: Conference website: www.reffwest.com

October 28-30 CA
2008 Headwaters to Ocean, Long Beach. Westin Long Beach Hotel. Organized by California Shore and Beach Preservation Assn., California Coastal Coalition, Southern California Wetlands Recovery Project, & Society of Wetland Scientists (Western Chapter). For info: Conference website: www.websurfer.us/coastal/h20_2008/2008_h20_conference.htm

October 28-30 OK
Governor's Water Conference & Research Symposium, Oklahoma City. For info: Oklahoma Water Resources Board website: www.owrb.ok.gov/

October 28-30 CA
Interstate Council on Water Policy Annual Meeting, Sacramento. Embassy Suites Riverfront Promenade. RE: Quality/Quantity in Water Planning, Climate Change, Infrastructure Needs & Sustainable Decisions. For info: ICWP website: www.icwp.org/cms/

October 30 CA
Willits Illegal Water Diversions Symposium, Willits. Willits Civic Center, 6:45-9:15pm. For info: Jon Spitz at 707/984-6481 or email: jonspitz@xprs.net.

October 30 OR
Role of Wetlands in the Global Carbon Cycle: Implications for Global Warming Conversation, Eugene. Bowerman Center for Environmental Law, 5pm. For info: ENR , 541/ 346-1395, email: enr@uoregon.edu or website: www.law.uoregon.edu/org/enr

October 30-31 FL
Everglades Seminar, Deerfield Beach. For info: CLE International, 800/ 873-7130 or website: www.cle.com

October 30-31 AZ
Growth and Water Supply Seminar, Phoenix. For info: CLE International, 800/ 873-7130 or website: www.cle.com

October 31-November 1 CA
The Fate & Future of the Colorado River, San Marino. The Huntington Library. Sponsored by The Huntington-USC Institute on California & the West and the Water Education Foundation. For info: Kim Matsunaga, USC, email: kmatsuna@usc.edu or ICW website: http://college.usc.edu/huntington/icw_events/

November 1 CA
Small Water Supply Systems: Assessment of Drought Preparedness Conference, Sacramento. Sponsored by Water Education Foundation & California Dept. of Water Resources. For info: Website: www.water-ed.org/briefings.asp#smallwater

November 2-4 CA
29th Annual International Irrigation Show, San Diego. For info: Irrigation Assn, website: www.irrigation.org

November 3-5 TX
Petroleum Hydrocarbons & Organic Chemicals in Groundwater Conference, Houston. For info: NGWA, 800/ 551-7379, email: customerservice@ngwa.org, or website: www.ngwa.org

November 5 TX
Evaluating Groundwater Flow & Transport Modeling Short Course, Houston. Sponsored by National Ground Water Association. For info: NGWA, 800/ 551-7379, email: customerservice@ngwa.org, or website: www.ngwa.org

November 5 OR
Pacific Northwest Section's Water Resources Committee Pre-Conference Seminar, Portland. For info: Renata Sobol, NW Environmental Training Center, 206/ 762-1976 or website: www.nwetc.org

November 5 TX
Groundwater Management Issues in Texas Forum, Houston. Sponsored by National Ground Water Association. For info: NGWA, 800/ 551-7379, email: customerservice@ngwa.org, or website: www.ngwa.org

November 5 OR
Model Toxics Control Act Seminar, Portland. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

November 5 OR
Oregon Brownfields Workshop & Awards Luncheon, Salem. Presented by Oregon Economic and Community Development Department and ODEQ. For info: Conference website: http://econ.oregon.gov/ECDD/CD/brownfield08.shtml

November 5-6 NC
Sustainable and Safe Drinking Water in Developing and Developed Countries Conference, Chapel. For info: Danielle del Sol, UNC Institute for the Environment, 919/ 966-9922 or website: www.ie.unc.edu

November 5-7 OR
Oregon Watershed Enhancement Board Biennial Conference, Eugene. Eugene Hilton & Conference Center. For info: Monte Turner email: monte.turner@state.or.us or website: http://oregon.gov/OWEB/biennialconference_08.shtml

(continued from previous page)

November 6-7 OR

Underground Storage Tank Inspection Training, Portland. For info: Renata Sobol, NW Environmental Training Center, 206/ 762-1976 or website: www.nwetc.org

November 6-7 OR

Oregon Water Law - 17th Annual Conference, Portland. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

November 7 GA

Tri-State Water Compact Conference, Atlanta. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

November 11 OR

Water for Life Water Law Bootcamp, Lakeview. Lakeview Senior Center. For info: Helen Moore, WFL, 503/ 375-6003 or email:helen.moore@waterforlife.net

November 12 WA

Tracking & Eliminating Utiility Water Loss Workshop, Renton. Carco Theatre. Sponsored by the Partnership for Water Conservation. For info: Janet Nazy, PWC, 206/ 957-2199 or website: www.partners4water.org

November 12 OR

Carbon Credits Seminar, Portland. World Trade Center. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

November 12-14 D.C.

2008 Developments in Clean Water Law Seminar, Washington. Fairmount Hotel. Sponsored by National Association of Clean Water Agencies. For info: NACWA website: www.nacwa.org

November 14 WA

Low Impact Development Conference, Seattle. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

November 14 WA

New Rules on Stormwater: How They Will Affect Development in the Puget Sound Area, Seattle. Washington State Convention & Trade Center. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

November 16-19 WA

2008 International Low Impact Development Conference, Seattle. Westin Seattle. Sponsored by American Society of Civil Engineers. For info: ASCE, 800/ 548-2723 or website: www.asce.org

November 16-19 CA

Potable Reuse for Water Supply Sustainability Conference, Long Beach. Sponsored by WateReuse Assn & International Water Assn. For info: Courtney Tharpe, WateReuse Assn, 703/ 548-0880 x101, email: ctharpe@watereuse.org or website: watereuse.org/

November 17-18 CA

Conservation Easements Conference, San Francisco. For info: CLE International, 800/ 873-7130 or website: www.cle.com

November 17-18 FL

Florida Wetlands Conference, Jacksonville. For info: CLE International, 800/ 873-7130 or website: www.cle.com

November 17-18 CA

Conservation Easements Conference, San Francisco. For info: CLE International, 800/ 873-7130 or website: www.cle.com

November 17-19 UT

The West's Water Future: Water Information Needs & Strategies, Salt Lake City. Sheraton City Centre Hotel. Sponsored by Western States Water Council. For info: Cheryl Redding, WSWC, 801/ 561-5300, email: credding@wswc.state.ut.us or website: www.westgov.org/wswc/

November 17-20 LA

American Water Resources Assn 2008 Annual Meeting, New Orleans. Sheraton Hotel. For info: AWRA, 540/ 687-8390 or website: www.awra.org

November 18-19 ID

Idaho Environmental Summit, Boise. For info: Idaho Summit website: idahosummit.org

November 18-20 CA

2008 Groundwater Foundation National Conference, Desert Hot Springs. Miracle Springs Resort. Specific topics include: LEED Building, EPA's Water Sense, gray water reuse, landscape technologies, stormwater management, pollution prevention, take-back programs, business/industry "green" models, media challenges and solutions. For info: Conference website: www.groundwater.org or call 1-800-858-4844

November 18-20 CA

Going Green for Groundwater: Groundwater Foundation National Conference, Desert Hot Springs. For info: TGF, 800/ 858-4844 or website: www.groundwater.org

November 18-20 KS

Alternative Covers for Landfills: Theory, Design & Practice, Kansas City. For info: Steve Rock, EPA, 513/ 569-7149, email: rock.steven@epa.gov or website: phytosociety.org

November 18-20 AZ

2008 Colorado River Basin Science & Resource Management Symposium, Scottsdale. DoubleTree Resort. For info: Water Education Foundation website: www.water-ed.org

November 19-20 CA

California Aquatic Bioassessment Workshop, Davis. UC Davis. Pre-register for free workshop. For info: Mary Tappel, SWRCB, 916/ 341-5491, email: mtappel@waterboards.ca.gov or Conference website: www.science.calwater.ca.gov/conferences/

November 19-20 CA

Emerging Contaminants 2008 Symposium, San José. For info: Conference website: www.grac.org/contaminants.asp

November 20-21 NJ

Natural Resources Damages Litigation Seminar, Newark. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com, or website: www.lawseminars.com

November 20-21 CA

California Water Law Seminar, Pasadena. Sheraton Hotel. For info: CLE International, 800/ 873-7130 or website: www.cle.com

November 24

Groundwater & Well Microbiology Webinar, Web. Sponsored by National Ground Water Association. For info: NGWA, 800/ 551-7379, email: customerservice@ngwa.org, or website: www.ngwa.org

November 28-December 1 CA

National Water Resources Assn Annual Conference, San Diego. Hotel del Coronado. For info: NWRA, 703/ 524-1544, email: nwra@nwra.org, website: www.nwra.org

December 1-5 CA

International Conference on Water Scarcity, Global Changes, and Groundwater Management Responses, Irvine. Convened by UNESCO & University of California, Irvine. For info: Prof. Jean Fried, 714/ 679-6888, email: jfried@uci.edu or website: www.waterunifies.com

December 2 CA

Boalt Environmental Speaker Series: Jeffrey Kightlinger, Metropolitan Water Dist. of Southern California, Berkeley. Boalt Hall, School of Law, 12:45pm. For info: Boalt Hall Event, 510/ 643-8167 or website: www.law.berkeley.edu/1380.htm

The Water Report
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