



Water Infrastructure

A Toolkit for REALTORS®



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REALTORS®

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Introduction

IN 2007, ATLANTA — A CITY not accustomed to drought as Phoenix or other southwestern cities are—came within a month of running out of water during a severe dry spell. The Atlanta metropolitan area’s water requirements are expected to double by 2030 as the population balloons to 8 million. The U.S. Supreme Court recently ruled that Atlanta no longer has exclusive rights to Lake Lanier and must share its water with Alabama and Florida. Where will residents of the Peach State’s capital get their water?

Southern California has seen several years of acute drought. The state’s water infrastructure is designed to supply water to 18 million people. It now serves 38 million, and another 12 million more are expected in the state by 2040.

Philadelphia has an opposite problem in one way: Its population is dropping. But some of its water mains date to 1824, and a declining population means a weakened tax base. The city has responded with conservation measures such as groundwater recycling. (City examples are from *Infrastructure 2010: Investment Imperative*, by the Urban Land Institute and Ernst and Young.)

Many believe future wars won’t be over oil, but over water. States are already battling over water rights. Georgia is trying to get its border with Tennessee moved slightly north, based on a survey from 1818. If Georgia wins, it would have access to a reservoir on the Tennessee River.

“Water is a scarce commodity,” says Linda Romer Todd, owner of Associated Brokers and Consultants, Grand Junction, Colo., and water activist. “If we don’t start conserving by working on the infrastructure we have and building more storage areas that can survive five- to seven-year droughts, we’re going to run out.”

Every citizen should be concerned about water infrastructure, which includes water storage facilities, treatment, delivery systems, and watersheds. And real estate professionals in particular often find themselves in the thick of water battles. They must explain local water requirements to property buyers and answer their questions about water supply and quality. And sometimes land development projects are affected, or even stopped, by local rules on water rights. Water issues

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Lake Lanier

“have affected all aspects of the real estate industry,” says John Gall, Nextage Realty Solutions, Las Vegas and Scottsdale, Ariz.

This online toolkit will offer resources to REALTORS® who must answer buyers’ questions about water infrastructure and who want to offer an informed voice about water issues in their local communities.

Our Crumbling Infrastructure

The American Society of Civil Engineers, in its 2009 Infrastructure Report Card, gave both the nation’s drinking water and wastewater systems a grade of D-. The report estimates that we will need to spend \$255 billion in the next five years to replace aging facilities and comply with regulations—but only \$146.4 billion has been set aside. A whopping \$1 trillion in water infrastructure investment will be needed in the next 20 years.

Why is our water infrastructure in such dire shape? Some of America’s water pipes are more than 100 years old, and much of the infrastructure was built just after World War II. Age itself isn’t the problem: Depending on when they were built

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and what they are made of, the pipes can last 75 to 100 years or more—if they're properly maintained and rehabilitated. But many have not been.

A few years ago when states had more cash, they rarely saw updating water pipes as a high priority. Water infrastructure maintenance doesn't have the popular appeal of some other municipal projects, and the effects of poor maintenance are often invisible until there's a crisis.

In many cities, there have been crises. Washington, D.C., has had two major water main breaks just in the past year, causing the Water and Sewer Authority to issue temporary warnings to residents to boil their water before consuming it. A more serious problem emerged a few years ago when unacceptably high lead levels were found in the city's drinking water, due largely to aging infrastructure. Although D.C. officials have acted to address the issue, uncertainty remains about the quality of the city's drinking water.

And the nation's capital is hardly alone. There are 240,000 water main breaks a year in systems nationwide, says the Environmental Protection Agency. The increasing danger of water main breaks and waterborne contaminants can cause significant disruption for business and homeowners.

Water Rights Battles

All property owners want to be assured that the water in their community is plentiful and safe to drink. Those are basic assumptions that most Americans take for granted—and they're used to getting them at minimal cost.

But that era is already over in many parts of the West and Southwest, and other areas of the country won't be far behind. REALTORS® find themselves involved in water battles whether it's their choice or not. Terence Sullivan, Sullivan Realty, Spokane, Wash., had a development on hold for two years because he couldn't get water rights for the 600 units.

"I've been a land developer since the late seventies, and I'd never had experience with a water rights situation," says Sullivan. The state told him the water district had already exceeded its rights to extract water from the local aquifer, and no more water rights were available. His efforts to get help from the city or the Environmental Protection Agency came to nothing. He even approached a water broker to try to get water rights from someone who wasn't using them. Sullivan

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was particularly frustrated because his proposal was for an infill project that met all the requirements of the state's growth management law. "I was not asking a water provider to hook up a line to 20 homes 20 miles away," he says.

The restrictions were lifted only when the state needed water rights for another piece of land it wanted to sell. Sullivan's project and the state were able to connect to another water district. The transfer of rights will create a loop system, rather than a simple transfer of water from Point A to Point B. Water is pumped from the district with the surplus water rights to the beneficiary district, where there is room for expansion later if more water is needed for further development. Depending on the final agreement, the provider of water can have access to it when that district has more development. "Ultimately, the water will be connected so we expand the service area of both the water districts," Sullivan says.

It was a creative solution to a seemingly intractable problem, and it offers hope that solutions can be found in other communities that don't now see a way out of their water woes. Regions will have to cooperate if there is to be enough clean water for everyone. "Water knows no boundaries," says Rachel MacCleery, managing director of the Urban Land Institute's Infrastructure Initiative. "It defies our usual political solutions."

Is it Safe to Drink the Water?

That's a question Americans might ask before traveling to Mexico or parts of Asia—but surely not about the water coming from their own taps. Yet 20 percent of U.S. water treatment systems fail drinking water standards. When aging pipes in water delivery systems and wastewater treatment systems corrode or break, the water is vulnerable to contaminants. The older systems were designed to fight parasites and bacteria, but don't do as well with the pesticides, chemicals, and pharmaceuticals in runoff from industrial sites and in modern wastewater.

The projected population increase, aging pipes, and tight budgets at the municipal, state, and federal level won't make it easy to improve drinking water standards anytime soon. Increased funding at all levels is needed. So are innovative funding mechanisms such as an infrastructure bank, more use of state revolving loan funds, and public-private partnerships (see the section on financing for more information).

Water and Private Property Rights

In the Eastern United States, residents are often accustomed to having the right to use whatever is found on their land, whether it's gold (unlikely) or water (which someday may seem as valuable). But it's not that simple in states with a scarce water supply, like Colorado. "Too many people who move here think if they live close to a stream, they can do whatever they want with it, and that's not the case," says REALTOR® Todd from Colorado.

In her city of Grand Junction, when farmlands get developed into housing, the water rights get transferred to the homeowners associations. Although the association has rights to the water, the water itself may come from someone else's land. So the people whose land it's on may not be able to access it. It's the real estate practitioners' job to explain that to the property owners. That means any competent real estate agent—not just those in the West—must be well versed in the local rules and requirements for water rights. That's one purpose of this toolkit (a separate section will cover state and local regulations and legislation).

Particularly in the West, "some of the federal rules keep us from providing water for local communities," says Todd. New water storage areas may not be built in officially designated wilderness areas. It becomes a problem because in higher elevations, wilderness areas are sometimes the only logical place to store water.

Conservation and Sustainability

Is there any way to deal with the situation other than to throw at it massive amounts of money we don't have? Luckily, yes. Conservation is an important weapon in this battle. Among other topics, this toolkit will explore conservation measures such as rain barrels, green roofs, and xeriscaping (landscaping with minimal water). Emerging technologies including smart meters and alternative rate structures will also be discussed.

On a broader scale, sustainability will be crucial. It's not just another buzzword. EPA's water infrastructure sustainability policy, issued in October 2010, states the agency's goal of encouraging communities' sustainability "as a condition of financial assistance" (<http://water.epa.gov/aboutow/upload/Sustainability-Policy.pdf>). For water infrastructure, the term refers to "investments that are cost-effective over their life cycle" and "resource efficient." EPA—which provides much of the money that

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goes to states for infrastructure projects—also says water infrastructure decisions should be made collaboratively among all stakeholders. REALTORS® can play an important role making their voice heard in the collaborative process.

The American Water Works Association, which represents water utilities nationwide, says sustainability means “providing an adequate and reliable water supply of desired quality—now and for future generations—in a manner that *integrates economic growth, environmental protection and social development*” (emphasis added). There can’t be prosperous, livable communities without a strong water infrastructure.

Sustainable Development

What does sustainability mean for REALTORS® other than pointing to the need to have a voice in water issues? Many communities are moving toward sustainable development, which can affect where property can be developed and sold. As in the case of REALTOR® Sullivan from Spokane, goals of sustainability and smart growth sometimes conflict with the need to provide water to communities.

There are good reasons why concentrated development makes sense for water supply. A great deal of water is lost to runoff in developed areas, but that diminishes with more concentrated building that minimizes impervious surfaces. An example from the Urban Land Institute: The runoff from eight homes on eight acres totals 149,600 cubic feet per year, but that drops to just 39,600 cubic feet when there are eight homes on one acre.

In metropolitan areas, a huge amount of water is lost when rain runs off of impervious surfaces like asphalt and washes to places far away. That water doesn’t get infiltrated back into the ground or captured for future use and so is not recovered. The answer is a combination of open space and other permeable surfaces. Of course, that goal may come up against the reality of housing needs—and that is where REALTORS® can again provide a voice for compromise and creative solutions.

Housing and Land Affordability

The difficulty obtaining water rights in some parts of the country and the likely rise in water rates will affect prices for homeowners. As Sullivan knows from his experience fighting for water rights for his development in Spokane, hooking up to the water supply in a private water district is more expensive than using a municipal supply. The extra cost for water adds to the cost of the homes.

Water availability can affect land prices, too. Bob Snowden, owner of the Smith Brokerage Inc., Buffalo, Wyo., offers this example: In many rural areas, a developer or homeowner must drill a well to get water. If there's not an established water table, the ability to find water easily can depend on the luck of the draw—and can make a big difference to the price of the land. Especially when a buyer is new to an area, their real estate agent may be their only knowledgeable resource regarding water availability and cost.

REALTORS® are in a unique position when it comes to water. They see the situation from all sides, whether it's fighting for water rights for a development; keeping on top of local, state, and federal regulations so they can inform their customers; or tracking the effect of water availability on the value of area real estate. This toolkit is intended to offer a grounding in the basic issues of water infrastructure and to point to further resources for those wanting to delve deeper into particular aspects. The information can help REALTORS® be strong advocates for the water rights of their customers and be community leaders proactive in finding solutions to infrastructure challenges. REALTORS® can become an important source of information not just for their customers, but for the public at large.

Financing Water Infrastructure

THE UNITED STATES NEEDS TO come up with a lot of money to maintain and repair water infrastructure. The estimated shortfall in funding is \$20 billion a year for the next five years, says the American Society of Civil Engineers. States and the federal government are broke, and anti-tax sentiment is high. Is our infrastructure doomed to fail?

Engineers, environmentalists, and others who study infrastructure know the need is urgent. As is often the case when it comes to money, everyone thinks someone else should pony up. The utilities believe the federal government should kick in more, and the Environmental Protection Agency and other observers say the utilities don't charge for the full cost of water service. The only thing everyone agrees on is that we need more money.

There are some innovative ways to raise funds. This paper will look at several that have been tried in different states or even abroad. Some will be more palatable than others, but it's clear that we need to at least look at everything.

Who Pays?

Americans pay much less for water as a percent of gross domestic product than citizens in most other developed countries. "In general, we are underpaying for water," says Rachel MacCleery, managing director of the Urban Land Institute's Infrastructure Initiative. "Water rates don't reflect scarcity in the west or the high cost of providing and maintaining water infrastructure in the east." But she says it would be hard to raise them now because people are accustomed to low rates.

The great majority of funding for infrastructure comes from utility companies—about 95 percent, says the Water Infrastructure Network, which represents utilities. The rest comes from federal funds, often in EPA grants, and more recently in stimulus money.

The most likely source of financing for infrastructure is more and higher user fees, rather than general taxes that distort and hide costs from the public, says MacCleery. The first step is to get consumers to look at the fee as the cost of a service, not just another burdensome tax. That reframing might help people

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understand that the public will pay one way or other, through fees and taxes—no matter which combination of the financing methods below is used.

EPA's Four Pillars

In a 2007 paper *Tools for Financing Water Infrastructure*, the EPA outlines its “Four Pillars” approach to promoting sustainable water infrastructure (see end of paper for complete reference). These tenets are important to be aware of given that EPA provides many grants to states for infrastructure.

1. **Better management.** EPA is working with utilities to draw on their best practices and share them throughout the industry, with an emphasis on cutting costs and investing in water systems using a risk-based approach.
2. **Full-cost pricing.** Charging for the full cost of building, operating and **maintaining** water systems is essential to sustainability (emphasis added).
3. **Water efficiency.** EPA is working with manufacturers, utilities, and others to set water efficiency levels for products and to promote water efficiency.
4. **Watershed approaches.** EPA emphasizes the importance of “making sound infrastructure and growth decisions within the context of how water flows through a watershed.” Watershed boundaries may not conform to state or municipal boundaries, so partnerships among federal, state, and local governments are essential.

Of course, applying these goals amid the competing priorities of a state or region is another matter. Below, we examine some financing alternatives.

Bonds

Bonds are the most common method for financing large water infrastructure projects. In 2009, utility bonds accounted for more than 12 percent of actively traded municipal bonds. They were both general obligation debt and revenue supported debt. Bonds are useful for financing capital infrastructure projects that will generate services and income for many years, as the money can be repaid over time. General obligation bonds can be repaid from any municipal source, including taxes. In some states, such as California, general obligation bonds



must be approved by voters. Revenue bonds are repaid using the income paid by ratepayers (users of the water). One advantage to municipal and public utility bonds are typically tax-advantaged for, which allows the borrowing entity to pay lower rates to investors.

But a recent report says that increasing water scarcity in many parts of the country creates a hidden risk for investors in utility bonds. “Utilities rely on water to repay their bond debts,” says Mindy Lubber, president of Ceres, a national coalition of investors, environmental groups, and other public interest groups that produced the report that produced the report with Water Asset Management, a global equity investor in water related companies and assets. “If water supplies run short, utility revenues potentially fall, which means less money to pay off their bonds.” That scenario is a real possibility in water-stressed regions such as Los Angeles, Phoenix, Dallas, and Atlanta. Credit rating agencies, which don’t consistently take water supply problems into account, should use water risk stress tests when evaluating utility bond issuers, the report says.

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Utilities can
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thrifty consumer,
saves water for the
community, and
makes everyone
aware that water
is not a free or
infinite resource.
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State Revolving Funds

SRF programs provide loans for water projects at below market rate. Available in all 50 states, they are backed by state and federal funds. Many states multiply the money raised by issuing bonds backed by the SRF funds. One downside: The money is usually not sufficient to back a large capital project.

The California I-Bank (for Infrastructure and Economic Development Bank) has had a successful SRF since 1999, when it got a single state appropriation of \$161 million. Over the years it has leveraged the one-time funding by making loans and issuing bonds based on loan repayments. It buys down the interest rate—recently, to just over 3 percent, versus the state rate of 4.5 to 5 percent. Even with the lower interest rate, the I-Bank has been able to use the original state appropriation and revenue from the bonds to offer \$400 million in loans to municipalities for all types of infrastructure, says executive director Stan Hazelroth.

Of the total, 19 percent has gone to wastewater, 25 percent to drinking water, and 10 percent to drainage and flood control. Loan amounts range from \$250,000 to \$10 million, with terms of up to 30 years. One recent groundwater management project was approved in May 2010 for \$5.4 million to the Borrego Water District, to design and build two new reservoirs and drill a new well to provide additional water capacity and storage to accommodate planned growth.

Regional Tax Sharing

The Minneapolis/St. Paul region has had a tax-sharing program that shares the cost of infrastructure and schools among seven counties since 1975. The less prosperous counties generally receive more money than they pay, but the region as a whole benefits from having updated infrastructure. Many other cities have studied the Twin Cities plan, in effect since 1975, but no other has used that model. The plan has had the added benefit of narrowing the disparities in regional business tax rates.

Alternative Rate Structures

Utilities can adjust water rates to encourage conservation. That saves money for the thrifty consumer, saves water for the community, and makes everyone aware that water is not a free or infinite resource.

After a drought in 1992, Seattle Public Utilities (SPU) was looking at new supply sources before realizing conservation would be cheaper. It started with a simple consumer awareness program, leaving kits with water-saving showerheads, toilet tank displacement inserts, and faucet aerators on the doorknobs of all homes in its service area. Subsequently, a new state plumbing code set efficiency standards requiring those items.

At the same time, SPU was changing its rate structure. First, it started charging higher rates in summer than winter for residential water use. (Seattle's rainy season is in the winter. It can get quite dry in the summer, when water must be drawn from storage.) So as water rates increased rapidly over the next 10 years, most of the hikes were added to summer rates. The utility also instituted a system where residential charges are higher for any water used after the first 748 gallons.

For its part, SPU improved the efficiency of its system operations. Its own inspectors found the utility produced a large amount of water that wasn't sold ("non-revenue water"), due to leaks in meters and reservoirs. Lining the reservoirs helped reduce leaks, and tightening the high-pressure washers used to clean the reservoirs eliminated wasteful overflow.

As a result of all these measures, Seattle's water use dropped from 170 million gallons a day in 1990 to 120 this year, even as the population has increased, says SPU principal economist Bruce Flory. Per capita water use plunged 42 percent. Now, instead of needing a new water supply in a few years, SPU won't need it until after 2060—an impressive outcome from conservation measures and incentivized rate-setting.

Public-private Partnerships

Public-private partnerships have been tried with some transportation infrastructure projects (although not as much as in Europe, Canada, or Australia), but not with water. Utilities may use private contractors for operations and management, but that's as close to partnership as they get. "People think of [water] as a government function, as a right," says Maureen McAvey, executive vice president of the Urban Land Institute. "They also want some security, and they trust the government to keep [water] clean and safe."

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Nor is there much reason for the private sector to invest in water when rates are so low. Investors get more bang for their buck with toll roads or seaports. On the plus side for water, there is a built-in repayment scheme. Add partnership with private investors to the list of future possibilities.

Different Types of Local Taxes

Some communities tax property owners for drainage improvement districts. The tax amount, or even its existence, can vary depending on rainfall and likelihood of flooding. The tax can be used for flood control and other infrastructure projects. But in the current climate, any new tax is a tough sell.

Fees for Real Estate Practitioners to be Informed About

Sometimes municipalities use real estate charges, such as **impact fees** charged to developers, and effectively passed on to buyers, of new homes to help pay for infrastructure. In some communities, these fees can be thousands of dollars per home. Real estate practitioners need to be aware of them, and make sure their clients are fully informed.

Transaction-based fees or requirements are of particular concern to real estate agents and brokers, and they should be aware that the following two types of fees could be used for water infrastructure purposes:

Point-of-sale Charges

Point-of-sale charges can be used to meet water infrastructure and conservation goals. A seller might, for instance, have to install water-saving fixtures in a home before it can be sold. However, such a requirement would add costs, reduce housing affordability, and potentially hinder real estate sales. And given the slow turnover of properties, it could take decades for a point-of-sale requirement to have an appreciable effect on water usage in a municipality.

Transfer Taxes

Transfer taxes, levied in more than 35 states, are paid by the buyer or seller or both, for general government expenditures. These can include infrastructure, although in many states, transfer tax revenue goes into the general fund rather than fund specific initiatives. (NAR policy is opposed to real estate transfer taxes.)



For More Information

California I-Bank

<http://www.ibank.ca.gov/>

EPA Tools for Financing Water Infrastructure

<http://www.epa.gov/efinpage/waterinfra2007.pdf>

EPA Clean Water and Drinking Water State Revolving Funds Information

<http://water.epa.gov/aboutow/eparecovery/index.cfm>

Urban Land Institute and Ernst & Young. *Infrastructure 2010: Investment Imperative*. Washington, DC: Urban Land Institute, 2010.

The Ripple Effect: Water Risk in the Municipal Bond Market

<http://www.ceres.org/resources/reports/water-bonds/view>

The Regulatory Environment

REGULATION OF WATER AND WATER RIGHTS, says real estate professional Linda Romer Todd, “gets very, very complicated.” The broker and water activist with Associated Brokers and Consultants, Grand Junction, Colo., is in a state where water supply has long been a challenge. But her observation holds true anywhere in the United States.

More than 20 federal agencies regulate different aspects of water, from drinking water quality to irrigation to flood control to endangered fish. The priorities of the Nuclear Security Administration may well conflict with those of the Environmental Protection Agency or U.S. Geological Survey. Factor in all the state and local regulations, and it’s a wonder that clean water comes out of the tap as often as it does.

The current situation of conflicting regulations covering the myriad uses of water and the widespread American expectation of cheap water on demand seem sure to collide. In Colorado, “some of the federal rules keep us from providing for local communities,” says Todd. “In the [federally designated] roadless wilderness areas, we’re precluded from building new storage areas. Everyone says we need to preserve [wilderness areas], but in high country it’s the only logical place to store water.”

The overarching framework recommended by the Environmental Protection Agency for water supply and quality is a watershed approach. This is a broader approach than the usual method of making decisions based on city, county, or state lines. Watershed management looks at water supply and quality, drainage, stormwater runoff, water rights, and overall planning for the human, plant, and animal communities served by a watershed. Land use decisions, such as how much permeable paving is permitted in developments within a watershed, are closely tied to watershed management.

Washington, D.C., for instance, is served by the Middle Potomac-Anacostia-Occoquan Watershed, and includes parts of Virginia, Maryland, and Washington (You can find your own watershed by typing your zip code into EPA’s website, <http://water.epa.gov/type/watersheds/>). Proper watershed management and protection

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require public and private entities in all three jurisdictions to work together across jurisdictional boundaries. Water doesn't respect political boundaries, but state laws and county zoning regulations are sometimes written as if it could be corralled within jurisdictional lines. Cooperation among such disparate groups can be hard to achieve, but pays off down the road with a cleaner, more reliable water supply.

Wells: Not Always a Private Matter

To take just one regulated water issue, look at wells. The U.S. Environmental Protection Agency doesn't regulate the quality of drinking water from private wells, but states may. In Massachusetts, for instance, local Boards of Health can regulate well location, construction, and water quality and quantity. The state Department of Environmental Protection makes recommendations to well owners on testing well water, including frequency and which chemicals to look for, but it has no regulatory authority. In some states, a locality may regulate how far a private well must be from a septic system, to ensure the safety of the well's drinking water.

Sometimes real estate agents get caught in the middle. In some states, they may sell property to an individual who plans to drill a well to supply water to his own home, and the agent must explain about doing a well test and applying for a well permit.

On a larger scale, homeowners may find (again, depending on the state) that their drinking water supply is affected by the legal doctrine of "beneficial use." That means different states give different priority to water used for domestic or municipal needs, farming, power, recreation, or other uses (see "Water Rights: A White Paper" <http://www.legalebook.com/app/RetrievedDocument.aspx?fileid=373> (NRDS log-in required) for more information on individual states).

As with any kind of law, laws and regulations affecting water use may be used to advance a particular agenda, whether it's to promote conservation, slow area growth, or another goal. Again, agents are in the middle, trying to comply with the regulations—and explain them to their clients—while selling homes or commercial property. Two examples, in Santa Fe and in Kittitas County, Wash., give a flavor of how water regulations and home sales can intersect.

Santa Fe's Goal: No Net Increase in Water Use

Santa Fe's water conservation program, started in response to several very dry years, has helped residents bring down their water use 42 percent from 1995 to 2009, to 98 gallons per capita per day. The average American uses 100 gallons a day, but Santa Fe's water resource manager Dale Lyons looks at Europe's 50-gallon-per-day average and sees a lot of room for improvement. He aims to keep lowering the city's water usage by 5 percent a year.

The overall principle, started by San Luis Obispo, Calif., and adopted by other cities, is water demand offset. "We established a limit of the city's water supply," says Lyons. "If you want to take out water, you have to do conservation or buy water rights, so there's no net increase in water use."

That means developers who want to do new construction must buy water credits at a set amount per acre foot to offset the additional water use. The money goes into a pool that is used for consumer rebates for water-efficient appliances including toilets, washing machines, and dishwashers. That way, says the city's water conservation manager Dan Ransom, builders help fund the rebate program.

But Kim Shanahan, executive director of the Santa Fe Area Home Builders Association, is worried that once the economy is strong enough for construction to come back, there won't be enough water credits in the city-managed water bank for developers to offset their water use. Everyone agrees that most of the city's toilets have already been retrofitted.

"What is the developer buying if no credits are coming to the system?" says Shanahan. "How will the developer be able to buy credits? If the city just shrugs its shoulder, that could create a moratorium on construction."

Lyons doesn't see this as a danger. The city offers a substantial \$480 rebate for a front-loading washing machine, and "there's continuing interest among consumers to buy water-efficient appliances." If the city ran out of water credits for developers to buy, Lyons says, it would boost the rebate, and consumer interest would pick up.

For larger projects, developers must buy water rights from someone, perhaps elsewhere in the Santa Fe basin or along the Rio Grande, who has the rights to use water and no longer needs them. For instance, if a farmer's children decide they no longer want to use the family property for farming, they can sell the water

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rights they have used for irrigation to a developer downstream who wants to supply water to new homes. Such transactions could become more common as property owners realize their land is more valuable for its water rights than for agriculture.

Once a water rights seller is found, the developer, like anyone who wants to use water in New Mexico, must apply for a permit from the State Engineer. That office must then “determine that the water is available, that the appropriation will not impair existing rights, that the intended use meets state water conservation efforts, and that the intended use is not detrimental to the public welfare.” (Quotation is from website of the Office of the State Engineer, http://www.ose.state.nm.us/water_info_water_rights.html.)

Developer James Siebert of Siebert Associates in Santa Fe prefers to use water credits for new construction for his clients because buying credits from the city-run water bank is faster and less expensive than buying water rights, which take about a year to obtain. But the regulations require builders to use water rights if their project is over 10 acre-feet.

Whether Siebert uses water credits or water rights, their cost raises the cost of development. But “it’s passed on in the purchase,” he says. “Consumers are probably not even aware of it.”

Santa Fe clearly uses its requirements for new development as a means of water conservation. Perhaps, with the program’s recent expansion to include other appliances besides toilets and the willingness of the coordinator to tweak the program as necessary, all parties will be happy. The answer won’t be clear until construction starts again. But all alternatives are worth exploring in a drought-stricken area that expects continued growth.

Kittitas County’s Water Rights Moratorium

Like Santa Fe, small Kittitas County, Wash., 90 minutes from the Seattle metro area, is aiming for no net increase in water use. But it’s trying to get there in a more drastic way, with a water rights moratorium imposed by the state.

In July 2009, the state Department of Ecology issued an emergency rule that stopped new groundwater withdrawals in Upper Kittitas County unless they were backed by senior water rights. (That means an individual or group had previously established rights to the water under the rule of prior appropriation. See “Water



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They buy land and
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Rights" <http://www.legalebook.com/app/RetrievedDocument.aspx?fileid=373> (NRDS log-in required) for more information.) That in effect meant a moratorium on drilling new wells. The state said the water used by new developments could hurt the water supply for irrigators downstream and the Yakama Nation, which both have senior water rights. Although Kittitas County is small, it had a building boom before the recession. In 2006 and 2007, it issued more building permits than neighboring Yakima County, which has a population six times as large.

In December 2010 the temporary rule was made permanent, at least until the U.S. Geological Survey completes a groundwater study in 2013. The Eastern Washington Growth Board brought a lawsuit, and arguments were heard in the state supreme court. A decision is expected in fall 2011.

Real estate brokers and builders aren't happy. Real estate professional Kitty Wallace, Windermere Realty, Cle Elum, Wash., has many clients who can't get water on their land. "I have retirees—this is their dream house. They buy land and pay it off, but they can't build."

Wallace advises her clients to seek legal advice. "That's all I can tell them," she says.

There are some areas, designated green zones, where water rights can be bought at \$10,000 for 350 gallons of indoor domestic water use, says Wallace. But that means no yard or lot—and no fire protection, which is a must in that part of the country. Without fire protection, the owner can't get insurance. And without insurance, no financing is available.

Wallace bought a parcel of land on which she intended to build a home and a well. But the moratorium sent the land's value plunging from \$200,000-plus to \$5,000.

The county assessor's office sent a notice to property owners affected by the moratorium saying they can petition for a reduction in the assessed value of their property. In four months, only 350 petitions were returned. "We're somewhat surprised there aren't more," says county assessor Marsha Weyand. She expects more when the re-valuations are sent out.

She says her office is having a hard time assessing the effect of the moratorium. If a property's value is down, "we don't know whether it's just the general market or because they have no water rights." With the recession, there have been few property sales this year to use as a gauge.

For More Information

EPA links to water regulatory agencies in all 50 states
<http://water.epa.gov/aboutow/ogwdw/links.cfm>

Santa Fe water offset program

Santa Fe water conservation program
<http://www.water2conserve.com>

New Mexico water rights

http://www.ose.state.nm.us/water_info_water_rights.html

Upper Kittitas County water moratorium

Washington State Department of Ecology
<http://www.ecy.wa.gov>

Blog by real estate broker Kitty Wallace

<http://www.washingtonwaterwars.com>

Water Conservation

MANY WHO WORK WITH WATER SUPPLY ISSUES say if we're worried about an adequate water supply now or in the future, we should look first to conservation. It's no different from fixing a leak in your home plumbing. Why would you think about digging another well to supply water to your home if part of your current supply is lost to a leak?

As states and municipalities have discovered, it's not possible to create more water. One alternative way to feed the needs of a growing population is to import water from elsewhere. In the West, that may mean buying water rights through a broker or directly from a farmer or other individual who has unused rights. Water-thirsty places like Las Vegas have dreams of bringing more water through a giant pipeline running across several states. Whether such grandiose ideas may someday be realized remains to be seen.

But there are ways to squeeze more out of the current supply without going to such lengths. If local water authorities can manage demand for water with incentives and innovative technologies and management practices, they can in effect enhance the supply of potable water.

This section will look at both water conservation (using less water for daily needs) and water efficiency (making better use of the available water—for instance, by capturing stormwater runoff). Jenny Hoffner of American Rivers, which puts a high priority on water efficiency as a means of maintaining flow rates to preserve habitats and recreational opportunities, describes it as “technologies and conservation measures that help us use existing water supplies in smarter, more innovative ways; doing the same work, but with less water.”

Communities around the country are exploring a variety of ways of saving water, from small-scale changes such as high-efficiency toilets and rainwater capture, to larger ones like “smart meters,” aquifer management techniques, and innovative irrigation methods. We will look at which measures have the most impact and which are the most cost-effective.

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Per Capita Household Use

The average U.S. household uses 80 to 100 gallons of water a day for bathing, washing, flushing the toilet, and other basic needs. The biggest household water hogs are toilets, bathtubs, and showers. (Figures are from the 2005 U.S. Geological Survey water use survey.) Americans' use of water more than doubled from 1950 to 2005, in large part because of water waste and neglected leaks. We can do something about both.

Making the changes requires some spending up front, but they will pay off. The EPA's WaterSense website, which promotes conservation, says, "If all U.S. households installed water-efficient appliances, the country would save more than 3 trillion gallons of water and more than \$18 billion per year." A report by American Rivers says installing water-efficient fixtures could result in a 35 percent savings for households nationally; the Pacific Institute came up with similar figures for Calif.

Sounds good. But what does it mean in practice? Would the changes entail point-of-sale home retrofit requirements? These good ideas are never as simple as they seem. Every community must make its own choice, and those that have been through droughts will look at their water use very differently.

Here's a run-through of water conservation and efficiency measures, and different communities' experience with them. (The rest of this section will use "conservation" to refer to either conservation or efficiency measures.)

Smart Meters

Pike Research predicts rapid growth in smart water meters—meters that deliver hourly readings—from 8 percent of the water meters read remotely through communications technology in 2010 to 26 percent in 2016, in its 2010 report *Smart Water Meters*. And a 2010 survey by Oracle, a business software and hardware systems company that also implements smart meter systems, found that 68 percent of water utility managers believe it is critical that water utilities adopt smart meter technologies. Smart meters make it easier to detect water-wasting leaks, save utilities the cost of human meter readers, and have been found to promote conservation, says Pike.

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Some communities, including Dubuque, Iowa, and Gresham, Ore., have used funds from the 2009 American Recovery and Reinvestment Act through the Safe Drinking Water Revolving Loan Fund to replace existing residential meters with smart water meters. Dubuque is working on two projects: one to replace residential meters with smart meters, and the other to create a portal that allows people to check their water usage online.

Currently, the city's 30-year-old water meters must be read by a service worker who goes door to door, then goes back to the facility to turn in the data so the customer can be billed, says Dubuque's water department manager Bob Green. All the meters will be replaced by fall 2011, and the elimination of meter readers will save the city \$145,000 annually, he says.

The second project, creation of a portal designed to help people go online and check their water usage, is being done as a pilot program with IBM for more than 300 city residents. "It allows an individual to see on a daily basis what their consumption demands are," says Green. It offers a way to detect leaks and is a good communications tool for billing staff. When leaks are found, the city will pay half the cost of repairing them. Customers can also see their carbon footprint online.

The plan is eventually to connect water meter readings to gas and electric usage, so customers may decide to save money by running their dishwashers at off-peak hours, for instance. Or they could just decide they want to help conserve water: When Oracle surveyed 1,200 water consumers nationally, 76 percent expressed concern about conserving water in their communities, and said they were more motivated by the desire to conserve than to cut their water bill.

Austin's Rainwater Harvesting Program

Rain water harvesting, with rain barrels, catchment basins, or other means, is a creative way to increase the supply of potable water by capturing rainwater and using it for irrigation or other non-potable needs. As American Rivers' Hoffner says, it doesn't make sense to use Evian-quality water to water lawns.

Austin was one of the first cities with a rainwater harvesting program. In 1999, it started offering rebates of up to \$500 to encourage large-scale collection. The city continued with rain barrel rebates for two years, then sold the barrels at a

discount directly to the public. The program was discontinued as more equipment companies moved to Austin to sell the barrels, and because the overall water savings weren't great enough to justify the cost to the City versus other methods.

In fact, "water savings from rainwater harvesting is marginal compared with other water conservation programs," says Austin Water's Abigail Webster, citing research by the Texas Water Development Board. Peak day savings are estimated at 50.7 gallons a day for systems 500 gallons and larger, and just 5.1 gallons a day for smaller systems.

But the program was not without benefits. "It's more of an education tool, a way people can do something that's hands on," says Webster. "You have it in your yard, your neighbors see it, you can see how much water is saved." Rainwater harvesting creates savings in treated potable water that won't be used to water lawns. And after the worst drought in 50 years hit south and central Texas in 2009, localities are keenly aware that every water conservation measure counts.

In some communities, local regulations don't allow homeowners to capture rainwater on their property and use it for clothes washing and toilet flushing. To help remedy the problem, the American Rainwater Catchment Systems Association and the American Society of Plumbing Engineers have written Rainwater Catchment Design and Installation Standards, so private citizens can safely use the water in their rainwater harvesting systems for non-potable purposes.

A Developer's Creative Water Supply System

Pulte Homes was planning a large retirement community in Manchester, N.H., with 504 houses, a clubhouse and other amenities, and a lot of landscaping. Water use on full build-out of River Pointe, as the community is called, was projected at 500,000 gallons a day. Pulte's head of land development approached Robert Mugavin, co-owner of Aqua-Mist Irrigation Company, and asked how many wells he would have to install to serve the community.

Mugavin's response: Why not use the two large ponds already on the property, which can store 18 million gallons? That way, the water wouldn't leach back into the soil.

That's what Pulte did. When it rains, the rain falls on the roofs, goes through the downspouts, into the drainage system, and in to the ponds. "Every time we get

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one inch of rain, we get 2.8 million gallons of water,” Mugavin says. Each pond has a backup well in case of a long period with no rain. The wells automatically kick in if the ponds get below a certain level.

Aqua-Mist monitors the system offsite over the Internet. If there’s a break in the water main—as has occasionally happened during construction—the system shuts down automatically and alerts the people at Aqua-Mist.

“[Pulte] spent a little more money to put in the proper pump stations,” says Mugavin, “but it’s very green-oriented, and they’re not using any potable water.” Because the homeowners’ water supply comes from ponds on the development property, residents don’t pay a municipal water bill. In general, a developer will get a return on investment in three to five years because there’s no water bill.

Developers in the West and Southwest are more accustomed to thinking in terms of conservation because water is in much shorter supply, and local governments often require more efficient irrigation systems. But it can be done in all parts of the country.

Atlanta’s Conservation Program

Atlanta has had water conservation programs for several years, but they took on renewed urgency after the city almost ran out of water in the drought of 2007. The water department started a leak detection and repair program that cut daily water loss from 20 percent in 2003 to 15 percent five years later, saving up to 7 million gallons a day, according to the American Rivers report *Water Efficiency*.

City and state regulations address various aspects of water use, from a recent city ordinance requiring commercial car washes to recycle 50 percent of the water they use, to statewide, year-round water use restrictions that allow residents to water their lawns only at night.

One of Atlanta’s most far-reaching programs offers rebates for replacing older toilets with more efficient ones. For the past three years, residents in single-family homes have been eligible to receive a \$100 rebate from the city when they buy a 1.6-gallon toilet certified with the EPA WaterSense label. (Under the program, a manufacturer applies to a licensed certifying body to have its product labeled with a WaterSense certificate to show it meets EPA criteria for saving water without sacrificing quality or performance.) Since the program started, the

city has paid rebates for 3,800 toilets and saved 21.9 million gallons a year, says Melinda Langston, director of water conservation in the city's Department of Watershed Efficiency.

What's more unusual is Atlanta's current program to offer toilet rebates in multifamily dwellings. A total of 108,000 units were built in the city before EPA changed national water efficiency standards to require 1.6 gallon toilets in new buildings. Atlanta's multifamily program started at the end of 2010, and Langston projects it will save 3 million gallons of water a day. Because Atlanta has one of the highest water rates in the country, property owners will make back the extra up-front cost on water bill savings in less than a year.

A new statewide standard for new toilets, starting in July 2012, will be even lower, at 1.28 gallons. There's nothing like a drought to make communities take a hard look at their water needs.

DeKalb County, which contains a small part of Atlanta and many of its suburbs, has had a retrofit requirement for unincorporated areas since 2008. That means anyone who establishes a new account with the water department must replace old appliances and fixtures with water-efficient ones.

Other communities around the country have retrofit requirements. Sometimes the requirements are at point of sale, meaning they're a condition of sale. "That puts a drag on the market," says Donna Reynolds, executive director of the Santa Fe Association of REALTORS®, where the city has considered such a law. "Who would consider putting another [requirement], in this market?" REALTORS® have worked with local governments on the issue. Albuquerque, for instance, has backed off its consideration of a point-of-sale requirement.

How Much Water Savings from Efficient Fixtures?

As always, where you stand on the issue depends on your role in the process. Certainly, impeding a home sale seems foolish in this market. In DeKalb County, the retrofit requirement put the onus on the buyer rather than the seller, and REALTORS® were concerned that home buyers would not be able to get water service until they retrofitted the property with new appliances.

From a more global perspective, the water savings—at relatively low cost—if all homes were to be retrofitted with more efficient appliances is undeniable. The

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Pacific Institute studies water use in California. But it can be seen as a microcosm of the rest of the country, taking into account that a greater share of water there is used for agriculture. Early in 2010, Pacific Institute president Peter Gleick testified before the U.S. House of Representatives Subcommittee on Water and Power that “improving the efficiency of our water use is the cheapest, easiest, fastest, and least destructive way to meet California’s current and future water supply needs.”

A September 2010 study by the Institute, *California’s Million Acre-Feet: Saving Water, Energy, and Money*, identified one million acre-feet (see glossary) of water that could be saved through conservation and efficiency in the state, 30 percent of it in the urban sector and 70 percent in agriculture. (A million acre-feet is nearly 12 times San Francisco’s annual water use.)

The upfront cost would be less than \$1.9 billion, said the Institute, compared with \$3.4 billion to build a new dam under consideration, for much less water savings. The urban savings would come from using more water-efficient appliances in homes and commercial buildings, and replacing lawns with low-water-use plants.

Aquifer Management: Edwards Aquifer

The Edwards Aquifer Authority would not exist if it weren’t for a lawsuit the Sierra Club filed against the U.S. Fish and Wildlife Service in 1991 saying the agency wasn’t adequately protecting the endangered species that depend on the aquifer. A federal judge ruled that the state legislature had to enact rules to limit withdrawals from the aquifer, and the Authority was created to “manage, enhance, and protect” the aquifer system, according to its mission statement.

The lawsuit and the resulting 1993 law brought “quite a drastic change in how we use our water,” says the Authority’s Roland Ruiz. Before, “the region operated under the rule of capture: You can use as much [water] as you can capture on your property if you put it to beneficial use.” The law set a limit of 572,000 acre-feet (see glossary) to be withdrawn from the aquifer annually. A permitting system was created, and the Aquifer Authority issued permits based on historic use. All permits have been given out within the law’s limit. “Now,” says Ruiz, “if somebody wants to drill a well or pump for municipal, industrial, or irrigation purposes, they

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have to go to the permit holders and solicit use of all or part of their water rights.” The Aquifer Authority keeps a data base of all permit holders.

“A greater monetary value was assigned to water, so people are presumably going to be more careful in conserving it,” says Ruiz. The added cost and trouble of digging a well is intended to create a different mindset.

Since 2007, the Aquifer Authority has implemented a “critical period management plan” that requires users of the aquifer to scale back their use when aquifer levels drop below certain levels. In the four stages of drought, defined by the aquifer’s water levels, all municipal, industrial, and irrigation users must cut their withdrawals by amounts from 20 to 40 percent. There has already been a Stage 1 drought in 2008 and Stage 2 in 2009. Users are fined \$39 for each acre foot they pump over the limit. In 2009, 56 over-pumping violations yielded more than \$79,000 in fines.

The Edwards region is unique in Texas for the way it manages its groundwater. “In some respects, other parts of the state are grappling with these issues we dealt with 20 years ago,” says Ruiz. For the longer term, the Aquifer Authority has done a recharge and recirculation study to look at the possibility of artificially increasing the overall storage of water in the aquifer, for use during extended droughts. Further studies are needed, Ruiz says.

San Antonio has also been able to stretch its water supply by reusing wastewater. Treated water from wastewater treatment plants is used to water golf courses or for nondrinking needs of industrial users, says Anne Hayden of the San Antonio Water System. “We’ve been able to bring new businesses like Toyota and Microsoft that mostly use recycled water,” she says.

Depending on the level of the aquifer, consumers are encouraged or required to conserve water. Year-round drought restrictions allow landscape watering only between 10 pm and 8 am, unless treated wastewater or recycled water is used. Water waste, such as failing to control a repairable leak, is prohibited and may be fined.

In Stage 3, residents may water their lawns with a sprinkler system only every other week, on a designated day, at night. All private swimming pools must have at least 25 percent of their surface area covered when not in use. And hotels are allowed to change linens only every three nights, except for health and safety reasons.

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The city has another way of managing the water supply from Edwards Aquifer: In 2004, the San Antonio Water System opened the Twin Oaks Aquifer Stage and Recovery facility. Water is pumped from the Edwards Aquifer through the year to the large-scale underground facility, for use during the dry summers. Water can be stored there for the future if not needed in the current year. Twin Oaks can store 100,000 acre-feet or more. And because it's underground, the water won't evaporate.

Aquifer Management: Buffalo Aquifer

The idea of aquifer management is new to Minnesota. It's written into state law, but there hasn't yet been a need to apply it. "Now development has gotten to the point where we are beginning to see water supply problems," says Bob Merritt, area hydrologist with the state Department of Natural Resources.

The first management effort is with the Buffalo Aquifer on the western border of the state near Fargo, N.D. The area served by the Buffalo Aquifer has had excess moisture since 1992, but Merritt expects a future drought similar to the severe one of the 1930s and 1940s. "Climatological conditions have a way

of repeating.” He wants to make sure the city of Moorhead and Clay County are prepared.

Moorhead uses the Red River as its main source of water and reserves the Buffalo Aquifer for times of severe drought or contamination in the river. But the Moorhead Public Service Commission wants to ensure there would be a good long-term water supply during a drought.

The main elements of the aquifer management plan are to establish priorities for water use, allocate water reserves in the aquifer to different users, and set up triggers for implementing the plan. The state lists priorities in a law written after the drought of 1976. “Domestic water supply is at the top of the list,” says Merritt. “Commercial and agricultural activities are further down. It’s a matter of determining what do we have in terms of availability during a drought period, how much do we have in terms of recharge.” The aquifer is recharged by the Buffalo River.

“We need to have an orderly, understandable mechanism by which we protect that aquifer,” Merritt says. The aim is to establish clear cutoff points for when an irrigator, for instance, is told he can’t get any more water because the supply is being protected for the city or local farmers. The best method would be cooperative management among the users that allows them to decide how much water would be available. But, says Merritt, “if they can’t do it, then it’s up to us to create a plan.”

He expects opposition to the state plan from those on the lower end of the priority scale, such as the Anheuser-Busch and American Crystal plants. Agricultural processing is a lower priority in state law. But for now, the plan is stalled for lack of state funding. The Department of Natural Resources will be asking for money again this year to get the plan started.

Xeriscaping

The idea of planting lawns that require little water in drought-prone areas seems like a no-brainer, but try telling that to Eastern transplants who move to the Southwest and want to re-create the landscape they grew up with. Still, xeriscaping is worth pursuing: The Water Research Foundation estimates that landscape watering accounts for 40 to 70 percent of residential water use.

There's more to xeriscaping than using native plants. If plants are grouped by their need for water, drenching won't be necessary. The landscape should be arranged in a way that encourages drainage, so less water needs to be added. Mulch also lessens the need for water.

Some communities pay incentives to residents who adopt xeriscaping. The city of Austin will pay homeowners \$20 to \$30 per 100 square feet of garden that's converted to use plants from an approved list. Residents of Peoria, Ariz., can earn up to \$715 by converting grass on their property to xeriscape. On the other hand, some homeowners associations, even in drought-prone areas, *require* residents to have healthy turf lawns.

So we end with conservation where we began, by saying it's complicated. Solutions that seem clear to conservationists may impinge on property rights. An efficiency measure that saves over the long term often costs extra up front—and city and state governments don't have extra money now, even for a wise investment. Everyone agrees that crisis management is not the best approach to water. We just haven't yet agreed on a better solution.

For More Information

Water Efficiency, the Journal for Water Resource Management
<http://www.waterefficiency.net/>

National Environmental Services Center, W. Va. University
<http://www.nesc.wvu.edu/subpages/conservation.cfm>

EPA WaterSense
http://www.epa.gov/watersense/water_efficiency/index.html

American Rivers Water Efficiency report
<http://www.americanrivers.org/library/reports-publications/hidden-reservoir.html>

Pacific Institute
http://www.pacinst.org/topics/water_and_sustainability/index.php

WATER INFRASTRUCTURE A TOOLKIT FOR REALTORS®

Western Resource Advocates report on conservation measures
in 15 Arizona counties

<http://www.westernresourceadvocates.org/azmeter/>

Smart Meters

Pike Research report on smart water meters

<http://www.pikeresearch.com/research/smart-water-meters>

Oracle Utilities report on smart meters

<http://www.oracle.com/us/industries/utilities/046596.pdf>

Dubuque Water Meter Replacement Project

<http://www.cityofdubuque.org/index.aspx?NID=1304>

Dubuque's Smarter Water Pilot Study

<http://www.cityofdubuque.org/index.aspx?NID=1348>

Austin rainwater harvesting program

<http://www.ci.austin.tx.us/water/conservation/rainwater.htm>

How-to guide for harvesting rain from rain barrels

<http://www.rainbarrelguide.com/>

Texas Water Development Board report on water conservation programs

<http://www.twdb.state.tx.us/assistance/conservation/GDSReport.pdf>

Atlanta's water efficiency program

<http://www.atlantawatershed.org/owe>

Georgia Association of REALTORS® white paper on retrofit requirement

<http://www.garealtor.com/Advocacy/IssuesResources/DeKalbPlumbingFixturesRetrofitPlan.aspx>

Aquifer Management

Edwards Aquifer

<http://www.edwardsaquifer.org/>

San Antonio Water System

<http://www.saws.org/>

Buffalo Aquifer, Minnesota

<http://www.buffaloaquifer.com/index.php/component/content/article/6-why-create-an-aquifer-management-plan.html>

Climate Change and Water Supply

ACCORDING TO MANY CONCERNED WITH future water supply, whether as municipal utility officials or as developers, real estate professionals, and citizens, we need to pay close attention to climate change projections. “Most of the really important impacts of climate change are not going to come directly from temperature increases but because of changes to the water cycle,” says Brad Udall, director of the Western Water Assessment at the University of Colorado and a member of a family known for its political and environmental achievements.

Udall and others say that as a result, the West is likely to see less snowpack, which states in that region now rely on to melt gradually and provide a steady water supply in the spring and early summer. The result could be more drought at times and more flooding at others. Already, more precipitation is coming as rain instead of snow, and droughts are longer and more severe. Because water in the Colorado River, for instance, has been designated to places ranging from Southern California to southern Nevada, “we can’t just draw water out of the river,” says Linda Romer Todd, owner of Associated Brokers and Consultants, Grand Junction, Colo., and water activist. “If we don’t have snow, we don’t have water.”

But the effects of climate change won’t be felt only in the West, according to the Government Accountability Office. A 2008 GAO report stated that at least 36 states would see water shortages by 2013, including eastern states such as Georgia and Florida. Higher temperatures result in greater evaporation, which puts a strain on water supplies. A forecast of continued population growth in major metropolitan areas adds to the pressure.

Part of the challenge in dealing with water supply and climate change is the lack of predictability, says Heather Cooley, co-director of the water program at the Pacific Institute. The need to plan for different scenarios makes it all the more urgent for utilities to work closely with scientists who are closely tracking climate change patterns.

The other problem in state planning is resources, says Will Hewes, associate director for climate policy at American Rivers. All states are short on money

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now, and climate change and water infrastructure programs are often the first to be cut. “It’s about realigning resources,” says Hewes, “providing incentives to reduce vulnerability” to the effects of climate change.

As for the uncertainty, we do at least know the outlines of what future climate patterns will hold, Hewes says: “greater volatility, more extreme droughts and floods, melting snowpack in the West.” He suggests flexible solutions that deal well with volatility.

For instance, a city can promote green infrastructure by embedding green space throughout its landscape to absorb water. Such small, decentralized approaches can control more extreme floods. Philadelphia is investing heavily in green infrastructure as a cost-effective way to control its combined sewer overflows. It didn’t add the green spaces as a way to deal with climate change and water supply, but they will have made it easier to withstand some of the predicted volatility.

What are water utilities and other suppliers to do? Every community would need to increase its available water supply through a combination of conservation,

recycling, new water sources (which will be covered in more depth in the next section of the toolkit) and, in some cases, rationing. Each municipality has to decide on the degree to which it will depend on each of those measures. That in turn will depend on what's practical in an individual situation, and what the local politics will allow.

The politics and policy issues can be controversial. New water sources for one area usually have to come from another community, which may want the water for its own citizens, even if there are fewer of them. The population centers have the need for the water and often have the political clout to claim the water source. "About 80 percent of the water in Colorado is on the west slope, but 85 percent of the population is on the east side," says Stacy Chesney of Denver Water, the city's water utility. So the city is already transporting water from the west slope, on the other side of the Great Divide, and will probably bring more.

Here's a closer look at what a few communities and states are doing to ensure they have the water supply they need as climate change occurs.

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"We will need more
water, like every
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Denver Plans for Warming

Matt Waage, manager of water resources planning for Denver Water, deals with uncertain climate change forecasts every day. For Colorado, "almost as many models say it's going to get wetter as say it's going to get drier," he says.

But it's clearly going to get warmer, he adds, which will mean more runoff from snowmelt and more streamflow in the fall. The hotter temperatures will also result in more evaporation and more consumption of water by plants. Combined with continued population increases, the upshot is this: "We will need more water, like every western state," says Waage.

Working with the utility's climate change policy analyst Lurna Kaatz, Waage is planning for a 5-degree warming in the state by 2050, with no change in precipitation—what he calls a middle of the road projection. That means Denver Water will be pushing hard in all three areas of recycling, conservation, and new water sources. Its board is working on a plan, due out in early 2012, which will determine the right mix for future water supply.

For **new water sources**, the utility has conditional water rights for several reservoirs that haven't been built yet. In Colorado, any entity that wants to draw

water from a piece of land must own the water rights, which are not necessarily associated with the property rights. The owner with the oldest rights has priority. Denver Water is keeping hold of water rights it acquired decades ago so it can build new reservoirs if they're needed.

Based on the board's 2012 plan, the utility will also consider trying to draw more water from the west slope in cooperation with local communities, water rights groups, and environmental groups. The board's policy is that all future drawdown of water from the west should be done in cooperation with western slope interests.

Needless to say, there would be many conflicting interests in such a project. "We want to try to build a multipurpose project that's going to give not only the water supply benefits to Denver, but the local water supply benefits and environmental benefits," says Waage. Any time a reservoir is built in Denver, it can cause low flow for the rivers.

One solution is to store some of the peak flows of runoff in the reservoir to use for municipal purposes, then augment the stream flow when it's low. Storage could help shift the timing of the water flow. When the utility artificially releases water from the reservoirs, it has to work with the state Division of Wildlife to assure minimal environmental consequences.

With water supply always a potential problem in Colorado, a state law requires developers to demonstrate that any new development has a source of water, such as aquifers or wells, that will last 100 years. "So there's been a lot of effort to find renewable supplies for those communities," says Waage. Renewable supplies could include snowmelt, but not groundwater, which could not be replenished unless it's connected to a stream.

What about **recycling**? "Because of the obligations we have to deliver water to states downstream, and the scarcity of supply, every drop of water is already spoken for," Waage says. "So we're looking at projects that would reuse water from wastewater plants." But not all of it is reusable.

That's one reason Denver Water is pushing a **conservation** plan that aims to cut overall water use by 22 percent from 2001 levels (before the drought of 2002 to 2004) in 2016. Some parts of the plan are mandatory, such as year-round restrictions on the time of day and number of days that irrigation is allowed. The utility is generally working to create a "culture of conservation" among residents with measures that include rebates for high-efficiency toilets.

Under the 2016 target, overall use would be 165 gallons per person per day, including residential, commercial, industrial, and institutional. It's hard to compare that figure with use in other parts of the country because other figures may cover only residential use. The U.S. Geological Survey, for instance, estimates national average household use at 80 to 100 gallons a day. However it's measured, western states like Colorado are in a semi-arid climate and may naturally use more water.

San Francisco's East Bay Finds New Water Sources

The East Bay Municipal Utility District (EBMUD) in Oakland, Calif., was dealing with the same problem of unpredictability as Denver. So the utility decided to look at the commonly expected effects of climate change and honed in on decreased precipitation as the factor most likely to affect that region. "We expect more droughts, so there would be more times where we would be unable to provide enough water to our customers," says Mike Tognolini, EBMUD's manager of water supply improvements.

When drawing up future water supply sources, "we tried to maximize water conservation and recycling," says Tognolini. The district's *Water Supply Management Program 2040* sets goals of saving 39 million gallons a day through **conservation** and 11 million through **recycling** (up from 9 million now). Rationing would be capped at 15 percent, meaning customers would be told to use 15 percent less water than they normally would. EBMUD already asked for rationing during a previous water supply emergency, and water rates were adjusted to promote rationing (customers paid proportionately more as they used more water).

New water sources would account for 43 million gallons a day under the plan, through water transfers, groundwater storage, and regional supply projects. EBMUD is pursuing multiple water supply sources to be assured of a robust plan, says Tognolini. For the near term, it completed work in early 2011 on the Freeport Regional Water Project, which will allow EBMUD to take water from the Sacramento River during a drought.

Water transfers from the Sacramento Valley make up one of the biggest pieces of the 2040 plan. Under contracts through the Freeport project, EBMUD could potentially buy water from agricultural users of the Sacramento River. Water

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transfers are generally less expensive than other options such as groundwater banking or desalination because the infrastructure is already in place.

EBMUD has been working on **groundwater banking** for a long time and has recently completed construction of a single well to be used for testing. The idea is to store water in local aquifers in the East Bay and pump it out during dry periods. The amount of water that could be stored is limited by the capacity of the groundwater basin. The cost of groundwater banking is a little higher than water transfer because it requires drilling and monitoring wells, building a treatment facility, and storing the water in the aquifer and pumping it out.

Expanding surface water reservoirs is another possibility, but policy issues make it problematic. To expand the existing Pardee Reservoir, a new dam would likely have to be built. There could be permitting problems and local concerns about whether whitewater rafters could continue to use the stream, says Tognolini.

Farther in the future, **desalination** of seawater remains a possibility, but an expensive and energy-intensive one. For now, EBMUD is monitoring the technology closely, participating in a study with other Bay Area utilities that are discussing a possible joint future project. (The next chapter addresses the above and other new water sources in greater detail.)

With all of the possible new water sources, “there are stakeholders that feel there could be harm,” says Tognolini. “That’s why we haven’t built them yet.” The water transfers from the upper Sacramento River could cause job losses in the farming community. Some endangered species rely on the wet fields created by rice farming, which could be limited.

With groundwater banking, overlying landowners feel they should have first rights to the groundwater basin. San Joaquin County prohibits export of groundwater outside county lines. “Even though we’d be putting water in to the ground, we wouldn’t be able to take it back out,” says Tognolini.

It took more than 30 years and several lawsuits to reach agreement with the Sacramento County Water Agency on diverting water from the Sacramento River to the East Bay. A deal was finally struck in 2002, and construction was completed nine years later.

Maryland: Dealing with More Flood, More Drought

As in the West, eastern states are planning for unpredictability. The Maryland Department of Natural Resources' *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*, published in early 2011, offers suggestions for dealing with the risk of both more floods and more drought. American Rivers' Hewes, who participated in the state's Water Resources working group, calls the Maryland plan unusual in offering concrete strategies for reducing vulnerability in the short term.

For instance, the report recommends protection of source waters and measures that promote conservation by raising the per-unit water rate as more water is used, as EBMUD does. The plan also suggests adjusting funding to promote green infrastructure (the placement of green spaces throughout metropolitan areas to absorb water, as in the Philadelphia example earlier in this paper).

As a coastal state bordering both the Atlantic and the Chesapeake Bay, Maryland is preparing for, and already seeing, sea level rise and changing water patterns in the Bay. The expected increase in precipitation would add to stormwater runoff. That in turn would affect water quality and infrastructure for stormwater, water, and wastewater. To help prepare, the state plan recommends reducing paved surfaces that contribute to runoff in developed areas and removing barriers such as dams.

With the increased threat of drought, regional cooperation becomes more important. "During times of drought," says the report, "the three major utilities of the D.C. area follow water allocations given to them by the Interstate Commission on the Potomac River Basin (ICPRB), independent of the management of any of the utilities." The ICPRB also routinely conducts drought preparation exercises to strengthen regional coordination.

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For More Information

Western Water Assessment
<http://wwa.colorado.edu/>

American Rivers' work on climate change
<http://www.americanrivers.org/our-work/global-warming-and-rivers/>

Denver Water
<http://www.denverwater.org/SupplyPlanning/Planning/FutureWaterSupply/ClimateChange/UncertainFuture/>

EBMUD Water Supply Management Program 2040
<http://ebmud.com/sites/default/files/pdfs/WSMP-2040-Main-Document-October-2009.pdf>

Maryland's climate change adaptation plan
<http://www.dnr.state.md.us/dnrnews/infocus/climatechange.asp>

New Water Sources

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...an area with a growing population in need of more water has various options for increasing its supply of usable or even potable water.

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YOU COULD MAKE THE ARGUMENT there's no such thing as "new" water; it's not something we can create more of. But an area with a growing population in need of more water has various options for increasing its supply of usable or even potable water. Some, such as the trans-mountain diversions of Colorado, have been in use for decades, but are fraught with controversy. Others, like the groundwater replenishment system in Orange Co., Calif., are relatively new and expensive, but promising. Ocean desalination is so far operating at only one plant in the U.S., and it's energy-intensive, controversial, and expensive.

In the meantime, growing metropolitan areas are worried about meeting their water supply needs. Here's a look at some solutions different communities are trying.

Colorado's Trans-mountain Diversions

Water has been pumped through underground tunnels from the west side of the Continental Divide to the east side for more than a century. New projects are under discussion, and they're always controversial. On the face of it, the transfer might seem to make sense: Move the water to the area of greater population. What's the problem?

Regional water questions are never so simple. The largest trans-mountain diversion (also known as a trans-basin diversion) is the Colorado-Big Thompson Project, which moves more than 220,000 acre-feet a year. (One acre-foot provides enough water for an urban family of four for a year.)

That's a lot of water just for the largest of the trans-mountain projects. And it's completely consumptive, which means once it's diverted, the west side won't see the water again. It's not recycled and it's nonrenewable. That matters a lot in an area where recreation and tourism are the economic engines.

Trans-mountain diversions occur at the headwaters, and the headwaters communities make their living from water-based activities such as snow making, fishing, and kayaking. "So the water going to the eastern slope represents foregone economic opportunities," says Chris Treese of the Colorado River

Water Conservation District, on the west slope. And the water being diverted is high-quality mountain water, still free from many of the impurities that are present downstream.

“It’s been a constant battle between east and west,” says Treese. “The tensions are not going to go away.” The question now is, “Does it lead to an escalated fight, or cooperation and mutual agreements?”

Says Drew Peternell, director of Trout Unlimited’s Colorado Water Project, “Many of Colorado’s rivers and streams are depleted to the point that they no longer support robust fisheries or recreational opportunities.”

The headwaters are tapped out, Treese adds, so building new dams or enlarging current ones on the west slope is out of the question. Proposals under discussion now are expensive pumpback projects, which would require pumping water uphill. To develop a new project or squeeze more supply from current ones, water would have to be pumped to more convenient, cost-effective storage or to existing infrastructure.

There have been many lawsuits, but also some cooperative agreements. One such agreement resulted in the construction of Woford Mountain Reservoir in Grand County in 1996. Both east and west benefit: The West Slope has a 66,000-acre-foot reservoir with extensive recreational facilities, and Denver Water pays for the right to use up to 40 percent of the reservoir’s water.

Western Colorado communities and Denver Water have been working on another mutual agreement that they hope to announce soon, delineating existing and future water rights and detailing how water will be used and shared, Treese says.

Orange County’s Groundwater Replenishment System

The groundwater replenishment system in Orange County, California, has something for everyone: Its water filtration technique will please those who are convinced our water needs can be solved with technological breakthroughs. It has won several environmental awards for its overall recycling and reuse methodology. It’s expensive, costing \$481 million to build and \$34 million a year to operate—but that’s about half as much as ocean desalination. It also uses about one-third the energy of ocean desalination.

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Orange County's is the largest indirect potable reuse system in the world. "Indirect potable reuse" means it treats wastewater to make it potable. It's indirect because the highly treated wastewater is injected into the ground and withdrawn for drinking water; it's recycled indirectly.

The water is treated in a three-step process:

Microfiltration—filters out bacteria and viruses.

Reverse osmosis—water is forced through plastic membranes under high pressure, removing dissolved chemicals, viruses, and pharmaceuticals. The result is pure water near distilled quality.

Ultraviolet light exposure—water is exposed to high-intensity UV light with hydrogen peroxide to disinfect and destroy any trace organic compounds.

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**Orange County's is
the largest indirect
potable reuse system
in the world.**
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Half of the water produced is pumped into injection wells, where it serves as a seawater intrusion barrier, safeguarding the fresh water supply from seawater. The other half is used for groundwater recharge, pumped into a 13-mile pipeline to two of Orange County Water District's recharge basins, in Anaheim. (That groundwater recharge explains why it's indirect potable reuse, rather than direct.)

The system provides 70 million gallons a day, enough for 600,000 people—about 15 percent of the district's water supply. It will serve another 250,000 to 300,000 people with an expansion planned to begin at the end of 2011 and take about two years.

Before the water district and the Orange County Sanitation District finished the treatment plant in 2008, the sanitation district was considering building a second ocean outfall that would dump wastewater five miles out at sea. "There would be a huge battle with the environmental community, and it would probably cost \$200 million," says Gina DePinto of the Orange County Water District.

Instead, the two agencies raised more than \$90 million in loans and grants and built the groundwater replenishment system. The result addresses both water supply and disposal needs. The system decreases Southern California's dependence on water from Northern California (the Sacramento-San Joaquin River Delta) and the Colorado River. As we have seen, the Colorado River has battles of its own. And water from Northern California costs almost \$700 per acre/foot, says DePinto,

and is likely to rise to \$800 by 2012. Transportation only adds to the cost. (The movement of water from Northern to Southern California is the biggest user of energy in the state.)

How Feasible is Desalination?

Ocean desalination uses reverse osmosis to remove the impurities from seawater to make it a source of potable water through the water utility. Only one seawater desalination plant is currently operating in the United States, the Tampa Bay Seawater Desalination facility.

The Florida plant has been plagued by financial and technological problems from the start. It first opened in 2003, then had to shut down for a series of repairs. When it finally opened again in 2008, its water supply was well below capacity for more than a year. The capital costs for the plant and the 15-mile pipeline that connects it to the water system were \$158 million, \$40 million over budget.

In fiscal year 2010 the plant produced an average 11 million gallons a day (mgd), less than half its 25 mgd capacity. Operating costs were nearly \$13 million. Spokesman Brandon Moore says the low figure simply means that's all that was needed in a fairly wet year. Tampa Bay Water, the utility that operates the plant, uses the desalinated water to supplement its groundwater and river water supply. The three water sources are blended and sent to six local governments, to be distributed to their water utilities.

When the plant is working at full capacity, it uses about 44 mgd of seawater to produce 25 mgd of fresh water, leaving 19 mgd of concentrated seawater, or brine. The brine is directed back to Tampa Electric's Big Bend power plant, mixed with up to 1.4 *billion* gallons of cooling water and returned to Tampa Bay.

Three counties in northeast Florida are working with the St. Johns River Water Management District on building another desalination plant, to be called Coquina Coast. The plant would have the same planned capacity of 25 mgd initially and is projected to cost more than \$530 million, according to media reports. Final construction costs, as production reaches 80 mgd, are projected to top \$1.3 billion.



And in Carlsbad, Calif., Connecticut-based Poseidon Resources—which worked on the Tampa Bay plant until the public utility bought it out—has been trying to build a desalination plant for more than ten years. The cost for the San Diego County plant is estimated at \$650 million, financed largely through tax-exempt bonds.

The developer has successfully fought off ten lawsuits over the project. Poseidon projects that the plant would provide 10 percent of the region’s drinking water, enough for 300,000 residents—half as many as the Orange County groundwater replenishment system, at substantially higher cost.

Treating the highly concentrated saltwater brine makes desalination an energy-intensive process. “The future cost of desalinated water will be more sensitive to changes in energy prices than will other sources of water,” says the report *Desalination, With a Grain of Salt—A California Perspective*, by the Pacific Institute, a nonpartisan research institute with a focus on water.

The report notes that there are also environmental concerns about desalination. The treatment process may introduce biological or chemical contaminants into the water supply. The machinery kills small fish and plankton. The concentrated

saltwater produced by reverse osmosis may contain chemical pollutants. Safely disposing of the salty effluent can be a problem.

Then there's the high cost. "Desalination is currently too expensive," says Heather Cooley, co-director of the water program at the Pacific Institute. "As water availability becomes increasingly constrained, that can change over time. For California, it will very likely be part of our water resource portfolio ten to twenty years out, when we will have maxed out other available sources."

At that point, Cooley says, "we will need to decide how we build desalination plants." Australia, after a multi-year drought, started a very aggressive conservation program and built desalination plants connected to wind power. Initial construction cost more, but the plants will be more sustainable over the long term.

The San Antonio Water System is looking at an alternative to ocean desalination: brackish water desalination. Like ocean desalination, the system would use reverse osmosis, and there would still be potential problems with brine disposal and electrical costs, says spokeswoman Anne Hayden. But brackish water is more readily available in landlocked San Antonio. And it's not as saline as seawater, so the brine would be less intensive. The plant, the first phase of which would be completed in 2016, would produce about 10 mgd.

For More Information

Watershed management

<http://water.epa.gov/type/watersheds/approach.cfm>

Trans-mountain diversions

<http://www.uawcd.com/faq.php>

Colorado River Water Conservation District

<http://www.crwcd.org>

Colorado Water Congress

<http://www.cowatercongress.org>

Orange County groundwater replenishment system

<http://www.gwrssystem.com>

Desalination

Tampa Bay Seawater Desalination plant

http://www.tampabaywater.org/facilities/desalination_plant/index.aspx

Carlsbad Desalination Project

<http://www.carlsbaddesal.com>

Pacific Institute report on desalination

<http://www.pacinst.org/reports/desalination>

San Antonio brackish water desalination

http://www.saws.org/our_water/WaterResources/projects/desal.shtml

Water Security and Preparedness

THE TERRORIST ATTACKS OF SEPTEMBER 11, 2001, and the mailing of anthrax-laced letters along the East Coast upped the ante for agencies that provide public services, including water. But efforts to secure the nation's water supply go back to the Clinton years. And in the past decade, the water utility sector has made many voluntary advances to protect drinking water.

Federal oversight of the nation's drinking water was formalized in the Safe Drinking Water Act (SDWA) of 1974. When that act was amended in 1996, President Clinton issued an order to protect critical infrastructure, including water supply systems. The President's Commission on Critical Infrastructure Protection later named three imperatives for water: It must be available on demand, supplied with enough pressure, and safe to use.

In a widespread emergency, "If you don't have a reliable water supply, you have difficulty providing mass care and shelter," says policy and legislative affairs manager Bridget O'Grady of the Association of State Drinking Water Administrators. "There's no water to drink, no water for sanitation, hospitals can't treat or perform surgery on the wounded. You've got to have a reliable water source to recover and return to a viable condition."

In 1997, the commission found that drinking water systems were vulnerable to chemical and biological contamination and that technology was not robust enough to detect, identify, measure, and treat toxic, waterborne contaminants. Not only that, but water utilities, which increasingly relied on computers to maintain flow, pressure, and chemical treatment levels, were found to be susceptible to cyberattacks. More recently, a large Southern California water system hired a computer hacker to explore potential vulnerabilities, and in the course of a single day his team was able to gain access to equipment controlling chemical additives to drinking water, and with it control over the safety of water for millions of homes.

In response to the 1997 commission report, a public/private partnership was created in 1998 to improve the security of water systems and other critical infrastructure. The Environmental Protection Agency (EPA) was chosen to head these efforts. It remains the lead agency on water security, working jointly with the Department of Homeland Security (DHS).

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Post-9/11 Requirements

September 11 heightened awareness of threats to the water supply. Before that, most efforts were focused on cybersecurity. The 2002 Bioterrorism Act (officially known as the Public Health Security and Bioterrorism Preparedness and Response Act of 2002) required water systems serving more than 3,300 people to assess vulnerability and draft emergency response plans and submit them to EPA.

No federal funding was tied to these requirements, though EPA has provided grants to water utilities for its Water Security Initiative, whose purpose is to increase the ability of water systems to detect contaminants, intentional or unintentional (it is discussed in more detail below). DHS and the Federal Emergency Management Agency have other rules that localities must comply with to receive federal money.

Nearly all of the nation's affected water systems have complied with the vulnerability assessment and emergency response requirements, estimates Kevin Morley, security and preparedness program manager for the American Water Works Association (AWWA), which represents water utilities.

"We feel [the assessments were] a great benefit to us," says Jeff Swertfeger, assistant superintendent, water quality and treatment for Greater Cincinnati Water Works (GCWW), which serves 1.1 million customers in greater Cincinnati and Northern Kentucky. "By doing these assessments in an organized fashion, we were able to take a close look at our system and make improvements."

Counter-terrorism and Natural Disasters

More recently, and especially given natural disasters like Hurricane Katrina, water systems have looked beyond terrorist threats and taken an "all hazards" approach to security preparations. They recognize four types of threats: intentional, natural, accidental, and dependency, such as a power outage, equipment failure, or line break.

"Nine times out of ten, you're going to be dealing with Mother Nature," says the AWWA's Morley. Though it's important to be vigilant about possible attacks on water and wastewater systems, those are not the chief threat most systems are likely to face.

North Carolina often feels the brunt of powerful hurricanes, and the water sector has adapted. "Lessons learned from weather events have helped our

evolving emergency planning and response, just as 9/11 has,” says Patricia Lamb, preparedness manager for Charlotte-Mecklenburg Utilities, which serves some 774,000 customers. “We have refined our emergency staffing plans, and past events have also helped us identify what physical backup systems need to be installed, in order of priority.”

Long before 9/11, Charlotte-Mecklenburg Utilities viewed water and wastewater treatment as essential, around-the-clock services, says Lamb. So it has long had a comprehensive emergency management plan in place to address potential threats, manmade or natural. The plan is “revised as emerging threats arise, after actual events, and after exercises are held to test our planning and responses,” Lamb says.

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Cooperation with
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and state and federal
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Cooperation

Since 9/11, the utility has made structural improvements and also changed some processes. But most important, says Lamb, “are the relationships we’ve developed with public safety and public health representatives at the local, state, and national level and the contacts we maintain in the public water/sewer utility sector.”

Cooperation with local police, fire, and health departments and state and federal agencies help utilities ensure their responses are as effective as possible. Greater Cincinnati Water Works, for example, uses a DHS program for practices ranging from table-top scenario exercises to multi-state, full-scale drills, says Swertfeger.

Among themselves, water utilities are coming up with best practices that any utility can tailor to fit its circumstances. After Hurricane Floyd struck in 1999, North Carolina’s AWWA/Water Environment Agency section formed a disaster preparedness committee. This, coupled with the City of Charlotte’s active involvement in preparedness and inclusion of the water sector in emergency management planning, has thrust Charlotte-Mecklenburg Utilities into a leadership role to the extent that it often makes recommendations for other water utilities, says Lamb.

Beyond Regulation

In 2005, the Water Security Work Group of the National Drinking Water Advisory Council—created as part of the 1974 Safe Drinking Water Act—drew up the “Features of an Active and Effective Protective Program.” The recommendations were distilled and updated for the joint EPA-DHS Sector Specific Plan for Water in May 2007. (It can be found at <http://www.dhs.gov/xlibrary/assets/nipp-ssp-water.pdf>, with a 2008 update at http://www.epa.gov/safewater/watersecurity/pubs/plan_security_watersectorspecificplan_2008annualupdate.pdf.)

The main goal is to maintain continuous service by helping utilities to:

- create a culture that recognizes the importance of security,
 - prioritize steps to achieve or maintain security,
 - use methods for detecting contamination, and
 - regularly assess vulnerabilities and respond accordingly.
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An expanded version was created in mid-2010 in the American National Standards Institute (ANSI)/AWWA G430: Security Practices for Operations and Management. It sets the minimum requirements for utilities to promote employee safety and public health, safety and confidence. The practices can be applied to any water or wastewater facility, regardless of size or location, says the AWWA’s Morley.

Water Security Initiative

Right after 9/11, many water systems put guards at their reservoirs—but having a human presence 24 hours a day is expensive. So utilities began to build security into their upgrades and their company culture, adding intrusion alarms, security cameras, and monitoring devices.

Medium and large water systems are estimated to have spent millions or even tens of millions of dollars on improvements to physical security, says Dan Schmelling, environmental engineer and project coordinator for EPA’s Water Security Initiative. But when every place with a toilet offers access to the system, more is needed to detect contaminants.



In response to 9/11, EPA launched a Water Security Initiative designed to detect contaminants. The program is in the initial phases, with Greater Cincinnati serving as the pilot, followed by water utilities in New York City, San Francisco, Philadelphia and Dallas. EPA—which has assisted the utilities with grants of \$9.5 million to \$12 million, with the utilities providing a 20-percent match—will assess the results before crafting recommendations and guidance that can be used elsewhere.

At Greater Cincinnati Water Works, the program “goes well beyond the usual testing” that water utilities do many times a day to ensure quality, says Swertfeger. “It also includes enhanced security measures, such as intrusion detection, online water-quality monitoring, grab sampling and analysis, public health surveillance in conjunction with local health departments, and special tools to assist our customer call information.” (Grab sampling is a type of wastewater sampling where all the test material is collected at once instead of over a period such as 24 hours, enabling faster response to potential issues.)

For contaminant detection, a utility would need to set a baseline for water-quality monitoring, says EPA’s Schmelling. That could include chlorine levels,

conductivity, UV absorption, and carbon. Any significant change in the baseline could potentially indicate contamination. And utilities may be able to use unusual spikes in customer complaints to send automated alerts to managers to investigate.

WARN's Cooperative Program

After the massive destruction wrought by the earthquake and tsunami that struck Japan in March 2011, everyone is wondering how well water utilities here would be able to respond to a disaster or intentional contamination. Even smaller-scale disasters could be enough to knock out water service in many places.

That's where mutual assistance among utilities could help. In the U.S., the water sector has a tradition of mutual aid that dates to the early 1940s. Today, mutual aid—which spans human knowledge and expertise as well as the provision of appropriate equipment and labor—has been formalized into the Water/Wastewater Agency Response Network (WARN).

WARN is divided into 10 regions of the country, covering every state. There is no overarching entity that heads up WARN. Rather, utilities from every area formally agree to cooperate in the event of a disaster.

Charlotte-Mecklenburg Utilities was the lead utility in the development of North Carolina's WARN, called NCWaterWARN. It's been active since 2008 and has taken part in exercises and events by the North Carolina Emergency Operations Center (EOC) whenever the center has activated an emergency response, says Lamb.

Since 2008, North Carolina Emergency Management has recognized NCWaterWARN as a State Emergency Response Team member, which means that during activation of emergency response, NCWaterWARN has a representative at the state EOC. The representative helps to coordinate assessments and response within the water sector. Charlotte-Mecklenburg Utilities has taken part in statewide exercises for earthquake and infrastructure response planning.

Getting Ready

It's clear from the tragedy in Japan that sometimes you can be well prepared and still be caught short. But for most emergencies, "the biggest problem is that people fail to prepare themselves," says the AWWA's Morley. Having a 72-hour supply of food, water, and medicines on hand is "the best thing any citizen can do." For water, that means three gallons per person per day.

The Association of State Drinking Water Administrators partnered with EPA in 2009 to create a water emergency discussion guide, a step-by-step plan that encourages water utilities to host a one-day "no-holds-barred critical discussion with customers," says the ASDWA's O'Grady. The guide was tested in Evanston, Ill., but has been scaled down and made as turnkey as possible to serve communities with populations of 10,000 to 50,000 or so. The daylong events are meant to boost awareness of the issues surrounding water that can arise during an emergency, and to help communities become more resilient in the face of such emergencies.

Being prepared saves money in the long run. "It takes a huge amount of pressure off the emergency management community," says Morley. "If [emergency responders] knew they had a little breathing room, they could focus their resources in a different way. It buys time."

For More Information

Preparedness for Everyone

<http://www.ready.gov>

Emergency Preparedness for Businesses

<http://www.preparemybusiness.org/>

Water/Wastewater Agency Response Network

<http://apps.awwa.org/EbusMain/Default.aspx?TabID=283>

Water Security Features

<http://water.epa.gov/infrastructure/watersecurity/features.cfm>

Water security initiative pilots

<http://water.epa.gov/infrastructure/watersecurity/lawsregs/initiative.cfm>

Association of State Drinking Water Administrators' "Security Notes"

<http://www.asdwa.org/index.cfm?fuseaction=Page.viewPage&pageId=498&parentID=496&nodeID=1>

Glossary of Terms

Acre foot: amount of water needed to cover one acre one foot deep (325,851 gallons).

Aquifer: geological formation that contains groundwater that can be drawn upon for a well or spring.

Bioswale: shallow trench planted with native plants to slow surface runoff and allow stormwater to infiltrate into the ground.

Consumptive use: a use of water that consumes it so it's no longer available for use or re-use.

Desalination: uses reverse osmosis (see below) to remove the impurities from a naturally occurring body of water, usually ocean water.

Direct potable reuse: system of recycling where wastewater is treated so thoroughly that it is put back into the potable water supply and can be used for drinking water. There are no direct potable reuse systems in the United States. There is one in Namibia.

Graywater: water from sinks, showers, and washing machines, but not from toilets, kitchen sinks, or dishwashers: in other words, the cleaner portion of "used" water (the rest is called black water). Untreated graywater can be recycled only for nonpotable uses such as irrigation.

Green infrastructure: When it refers to water, this means embedded green space throughout a community to absorb water and so prevent or reduce runoff and flooding.

Green roof: has waterproofing, drainage, and soil, and is covered with plants. It cuts down on stormwater runoff and energy costs, acting as insulation that keeps a building cooler in the summer and warmer in the winter.

Groundwater: water that is stored underground in materials such as sediment or sand.

Groundwater recharge: a naturally occurring process in which water percolates from surface water (including rain and snow) through the soil to groundwater. In artificial groundwater recharge, water may be pumped into an aquifer to replenish the groundwater removed for consumption.

Impermeable (or impervious) surface: manmade surface, such as asphalt, through which water cannot penetrate. Instead, it runs off to other areas and is lost locally as a resource.

Indirect potable reuse: recycling process in which a water utility injects treated wastewater into the local groundwater supply and pumps the groundwater for a variety of public uses, including drinking. Orange County's groundwater replenishment system is an example.

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Naturalized detention: area planted with native plants that temporarily stores rainwater and releases it gradually into the ground.

Nonconsumptive use: use of water that allows it to be reused for another purpose. Examples are rafting and sailing.

Permeable (or pervious) surface: surface that groundwater can seep through and percolate into the soil. Some newer developments are being built with pervious concrete and asphalt to minimize disruption of the water cycle.

Rain garden: area planted with native plants that slow stormwater runoff and let it drain into the soil, reducing local flooding. Usually smaller in scale than a naturalized detention area.

Rain water harvesting: capturing rain water and using it for irrigation or other nonpotable needs.

Reclaimed water: treated wastewater that can be used for irrigation or other nonpotable needs.

Return flow credits: Credit for additional water rights corresponding with a returned flow of treated water. For example, Southern Nevada is allocated a certain amount of water from the Colorado River. But if Nevada can treat its wastewater and return the treated water to the river by way of Lake Mead, it gets return flow credits and can increase its allocated water supply.

Reverse osmosis: a method of wastewater treatment in which water is forced through plastic membranes

under high pressure, removing dissolved chemicals, viruses, and pharmaceuticals. The Orange County groundwater replenishment system uses this method.

Smart water meters: meters that deliver hourly readings so property owners and utilities can track real-time usage.

Trans-basin diversion: moves water from one water basin to another.

WaterSense: EPA program under which a manufacturer applies to a licensed certifying body to have its product labeled with a WaterSense certificate to show it meets EPA criteria for saving water without sacrificing quality or performance.

Water broker: individual who arranges for the monetary transfer of water rights.

Water cycle: continuous movement of water from groundwater to evaporation to storage in the atmosphere to precipitation and back to the ground (there is no particular stopping or starting point). Also known as the hydrologic cycle.

Water demand offset: principle, adopted by some cities, requiring that any new water use be offset by conservation or purchase of water rights, so there's no net loss of water availability.

Water rights: rights to use the water on a piece of property. Person or entity with water rights may be different from the property owner, especially in the West.

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Water table: upper surface of groundwater, below which all cracks and pores in the rocks and sediments are saturated with water.

Watershed management: framework for coordinating water by looking at supply, quality, drainage, stormwater runoff, water rights, and overall planning for the humans, plants, and animals served by a watershed.

Well yield: the amount of water that can be pumped from a well during a set time, measured in gallons or liters per minute.

Xeriscaping: landscaping that doesn't need much water.

Frequently Asked Questions

Who owns the water beneath my property, bordering my property, on my property and/or that runs off my property?

If you live in the East, you are more likely to own the water on your property, under riparian law. But you probably won't have unrestricted use to the water there. Western states generally operate under the doctrine of prior appropriation, which may mean the water rights were granted to others before you bought the property. Water rights can be bought and sold, and in the West, water brokers exist for that purpose. Under prior appropriation, even if you own the water on your property, you may or may not own the water that runs off it or the rain that falls on it. And some water is considered to be in the public domain and isn't owned by any individual. To be safe, you should consult a lawyer who knows local water law. (See "Water Rights: A White Paper Report" <http://www.legalebook.com/app/RetrievedDocument.aspx?fileid=373> (NRDS log-in required) for more information.)



Can I withdraw water from a body of water on my property?

That depends on whether you have rights to the water. See Question 1.

Where does my drinking water come from?

There are two sources of water: surface water (lakes, rivers, and reservoirs) and groundwater (wells that tap into aquifers). Large water utilities that serve cities and surrounding suburbs usually get their water from surface water. Smaller utilities and individuals usually get their water from wells. If you want to know which local body of water supplies your drinking water, check your water utility's website.

Where does water that leaves my property go?

If you live in a metropolitan area, water that leaves your home is directed through sewer pipes to a wastewater treatment facility. For outside water, it depends on the terrain. If the surrounding area is seeded with green space, then runoff water from rain, washing your car, or other domestic activities will seep into the ground. If instead there's a lot of impervious pavement, the water will run off and drain into nearby gutters and eventually, the nearest surface water body such as a lake or river.



Why should I worry about water?

Lots of reasons, which the rest of this toolkit elaborates on. You're probably not asking this question if you live in certain parts of the country, such as most of the West, or Atlanta. Those areas already have seen what happens in a severe drought, and many cities have mandatory conservation measures and water restrictions. Other areas, though they may not have arid climates (as Atlanta doesn't) may soon grapple with similar water supply problems. Potable water is a finite resource, the U.S. population is growing, and our increasing appetite for energy means we'll continue to use more water in the energy plants that power everything from our air conditioners to our PCs. Throw in the unpredictability of climate change, and planning for water supply needs becomes even more difficult. The eastern part of the country has pipes in its water infrastructure that in some cases are more than 100 years old, one reason the American Society of Civil Engineers gave the nation's drinking water and wastewater systems a grade of D-. And there are continuing concerns about whether our water is clean and safe to drink.

How can I obtain the right to use more water?

If you live in the West, a water broker often can connect you with someone who wants to sell unused water rights. In the Eastern United States, you should check with your local water utility.

Where can I find more information about water conservation?

Your local water utility may have a section on its website about conservation. For additional resources, see "For more information" at the end of the water conservation section.

Can I sell my water rights?

In the West, individuals and organizations often sell water rights, usually through a water broker.

Where can I find water rebates?

Rebates for buying water-efficient appliances are available in several states. To find out if they're available in yours, check with your water utility or visit http://www.savewateramerica.com/home.swa#/rebate_map/.



Why are water rates going up?

In many cases, water rates have been artificially low and do not reflect the true cost of providing clean, potable water and maintaining water infrastructure. As aging systems need to be upgraded—whether to make repairs, prevent breakages, or make the infrastructure more robust—utilities may need to raise rates.

How do I know if my drinking water is safe?

Over 90 percent of public water in the United States meets the highest safety standards for potability, according to the Environmental Protection Agency. For information on your local water supply, check with your water utility. It may post an annual water quality report on its website. If not, you can call and ask for one. For more information, go to <http://water.epa.gov/drink/local/index.cfm>.

How can I learn about retrofitting my home to upgrade my water service?

Check with your water utility to see what's needed for what you have in mind, then talk to a contractor.

How can I appeal my water rates?

Talk to your local utility. There may be a set process for appeal.

Is it possible/feasible to get completely off the public water supply grid?

Some back-to-the-land types are working on it, but it's proving harder to supply your own water than to provide your own power through solar panels. Providing your own water would require small-scale wastewater treatment and recycling to create a source of water.

Where can I find information about wells in my area?

Private well construction may be regulated by state and local environmental or health agencies. Real estate professionals must be aware of testing requirements and types of tests at point of sale. Owners must test wells for water safety. Health or environmental departments or county governments should have a list of the state-certified laboratories in your area that test for various contaminants. The health department can also tell you about any regulations for well yield requirements in your area that will govern how much supply a well must provide. For more information, see <http://www.watersystemscouncil.org/>.

How can I determine if my community's water supply is adequate?

Check your water utility website. It probably has a section on current and future water supply, with information about plans to ensure adequate future supply. If not, you can call and ask for a copy of any reports addressing the subject.

How can I identify my local public or private water utility?

For public utilities, look at your water bill. If you live in a multi-unit building and don't pay a separate water bill, ask the building manager. If you live in a community that provides its own water, check with the homeowners association or development company.

Is the amount of water I can use regulated?

Water use is often regulated by state law. Check with your state environmental agency or local water utility.

How do I calculate the amount of water necessary for a development project?

Talk to your local utility to find out the formula in your area. The utility should be able to give you an average for the number of gallons used per household per day.

