Notes on a Progressive National Water Policy

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Introduction

> "Man at last has conquered the land. But to what ultimate end no one can say. There is only a vague, inquiet feeling that in all his scheme of domination there is something he might have forgotten. It may well be that the river itself will have the last word, after all."[1]

Water has long deeply resonated with Americans, especially in less humid parts of the country. Most do not regard it as just another commodity, or indeed as just another natural resource.[2] Today our management and use of water face a fundamental challenge. Current patterns of water use, and the enormous infrastructure built to support them, are based on historic climate patterns as we have understood them, but a near-consensus among climatologists holds that our hydrologic future will not simply mimic the past.[3] Parts of the nation are likely to see longer, steeper droughts and higher temperatures that could lead to more rain, less snow, earlier spring runoff, higher evaporation rates, and increased demand for water.[4] Also, because of the historically tight connection between water and energy use, a carbon-sensitive energy policy will implicate water use, and vice versa.[5] A destabilized

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[1] Frank Waters, The Colorado 360 (Swallow Press 1984) (1946).

[2] One small indication is that many western state constitutions single out water as "public property." *E.g.*, Colo. Const. art. XVI, § 5.

[3] A recent study, which analyzed data from tree rings, sediments, stalactites, and other similar objects, concluded that the 1996–2005 decade was the warmest in the Northern Hemisphere in the last 1300–1700 years. Michael E. Mann et al., *Proxy-based Reconstructions of Hemispheric and Global Surface Temperature Variations Over the Past Two Millenia*, 105 Proc. Nat'l Acad. Sci. 13252 (2008).

[4] *See, e.g.*, P.C.D. Milly et al., *Stationarity is Dead: Whither Water Management?*, 319 Science 573 (2008). Climate change affects all aspects of the hydrologic cycle, including clouds, soil conditions, evapotranspiration rates, vegetative patterns, and storm frequency and intensity. Existing climate models are not sophisticated enough to predict the effects of climate change in a region or river basin with any assurance, adding to the uncertainty.

[5] Michael E. Webber, *Energy versus Water: Solving Both Crises Together*, Sci. Am., Oct. 22, 2008, at 4, *available at* http://www.sciam.com/article.cfm?id=the-future-of-fuel&print=true. Falling water currently produces about seven percent of the nation's electricity. Energy Info. Admin., Electric Power Monthly: November 2008 1 (2008), *available at* http://www.eia.doe.gov/cneaf/electricity/epm/matrix96_2000.html. However, enormous amounts of electricity are required to move water around the supply infrastructure. The largest single consumer of electricity in California is the State Water Project that moves water from Northern California to the Southland. *See* Ronnie Cohen et al., Energy Down the Drain 4 (2004), *available at* http://www.nrdc.org/water/conservation/edrain/edrain.pdf.

climate therefore poses a fundamental challenge for water managers, users, and policymakers.

Several ideas have been put forward to meet this challenge. These include physical solutions, like building new dams and other "plumbing" to bank more water against drought, and technological fixes, like weather modification, cheaper desalinization, and developing more salt-tolerant crops.[6] But, as explained in Part X below, dam-building is not the answer, and, while many ideas for technological solutions deserve careful scrutiny, history is littered with overoptimistic promises of technological breakthroughs.[7]

I argue that the best way to meet the challenge is to reform the institutional and regulatory systems governing water to facilitate smarter management of our developed water supplies. This will require vigorous government action; this article sketches the adjustments that are needed and examines how government might promote them.[8]

Many excellent analyses and water policy reform recommendations have been offered over the years.[9] Here I concentrate on reforms that I believe are politically achievable in the near term. The need for prompt action is urgent because many scientists now believe that the impact of greenhouse gases on the hydrologic cycle may be more profound and rapid than previously thought.

I. An Overview of U.S. Water Resources

Compared to much of the planet, the United States is blessed with large supplies of fresh water. And we exploit them. According to one estimate, Americans use twice as much water per capita as the inhabitants of any other country in the world.[10] While water and oil are both vital to our way of life,

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[6] Desalination has been growing at the rate of about ten percent per year, but conventional methods are energy-intensive. For a comprehensive review, see generally The World's Water 2006–2007 51–89 (Peter H. Gleick ed., 2006); Nat'l Research Council, Desalination: A National Perspective (2008).

[7] The President's 1950 Commission on Water Resources predicted, for example, that cloud seeding could double the amount of rainfall in the United States. It has not happened. Peter Rogers, America's Water: Federal Roles and Responsibilities 63 (1993).

[8] With such a vast topic, some simplifying is necessary, so I will mostly ignore water quality and flood control, instead focusing on the development, allocation, and use of water supplies.

[9] *See, e.g.*, Nat'l Water Comm'n, Water Policies for the Future (1973); Western Water Policy Review Advisory Comm'n, Water in the West: The Challenge for the Next Century (1998), *available at* https://repository.unm.edu/dspace/handle/1928/2788; Western Governors' Ass'n, Water Needs and Strategies for a Sustainable Future (2006), *available at* http://www.westgov.org/wga/publicat/Water06.pdf; Lawrence J. MacDonnell & Denise D. Fort, A New Western Water Agenda (2008), *available at* https://repository.unm.edu/dspace/bitstream/1928/2788/13/Introductory%20Pages.pdf (summarizing selected water policy reform proposals over the past 35 years); Peter Rogers, *Water Resources in the Twentieth and One Half Century: 1950–2050*, 116 Water Res. Update 62 (2000), *available at* http://www.ucowr.siu.edu/updates/pdf/V116_A15.pdf.

[10] Rogers, *supra* note 7, at 4. The United States ranks at the top of OECD nations in per capita water "abstractions" or withdrawals. Overall, OECD countries average 920 cubic meters per capita per year, while the United States uses 1730 cubic meters per capita per year.

in recent years the United States has been consuming a little more than 300 billion gallons of oil *a year*,[11] while it has been using a little more than 400 billion gallons of water *a day*.[12]

Measuring how water is used is not as straightforward as it may seem. Water is different from land and from most other commodities in that it is mobile, largely fungible, and reusable. The latter characteristic makes water very different from petroleum, for it means that one person's "waste" of water often supplies another's use. Most water used inside a household (perhaps ninety percent) goes through a sewage treatment plant and is thereafter discharged to a water body from which it can be withdrawn and used again. A substantial proportion of the water applied to a garden or field crop runs off into a stream (often called "return flow") or percolates to an underground water body (an aquifer), where it too may be available for some other use.

Surface water is mobile and annually renewable for the most part, although its supply can vary greatly from season to season and year to year.[13] Whereas surface water can move laterally several feet a second, water below the earth's surface (groundwater) is not nearly so mobile. It may move laterally a few feet a year. Moreover, unlike surface water, much groundwater is not renewable. Despite these significant differences, surface water and groundwater are often connected—withdrawing groundwater may affect stream flow, and vice versa.

The distribution of water is not uniform across the country. Indeed, we are hydrologically two countries. The hundredth meridian bisects the lower forty-eight states and is the approximate dividing line between areas that receive more than twenty inches of precipitation annually and those that receive less. The more arid land west of that line generally needs artificial irrigation to grow crops. This difference is reflected to some extent in water laws, policies, and institutions. Climate change will, however, likely pose challenges for water managers throughout the country.[14]

ORG. FOR ECON. CO-OPERATION AND DEV., OECD FACTBOOK 2005 136–39, *available at* http://www.oecd.org/dataoecd/42/27/34416097.pdf. There are of course many ways to calculate supplies and use, and good information is not always available from many countries. *See generally* THE WORLD'S WATER 2006–2007 *supra* note 6, at 221. But it is generally agreed that the United States has comparatively rich supplies and uses much more water per capita than just about any other country on the globe.

[11] C.I.A., THE WORLD FACTBOOK: UNITED STATES, *https://www.cia.gov/library/publications/the-world-factbook/print/us.html* (last visited Nov. 26, 2008).

[12] ORG. FOR ECON. CO-OPERATION AND DEV., supra note 10.

[13] In its wettest year of record, the Colorado River carried almost six times the flow it carried in its driest year of record. U.S. GEOLOGICAL SURV., USGS FACT SHEET 2004-3062, CLIMATIC FLUCTUATIONS, DROUGHT, AND FLOW IN THE COLORADO RIVER BASIN (2004), *available a*t http://pubs.usgs.gov/fs/2004/3062/.

[14] See, for example, the U.S. Drought Monitor, which in the summer of 2008 showed that more than half of the southeast United States was experiencing moderate to extreme drought. U.S. Drought Monitor, http://drought.unl.edu/dm/monitor.html (last visited Nov. 20, 2008) (on file with the Harvard Law School Library).

Much of the water used in the United States is surface water, but groundwater furnishes a growing portion of current withdrawals (about one quarter).[15] Groundwater has some advantages, both because it is not as reliant on precipitation and therefore may be more available than surface water, and because evaporation losses and delivery systems pose fewer problems for groundwater use than they do for surface water use. There are some offsetting disadvantages. Most prominent is the cost of drilling wells and of running pumps. Water is, after all, quite heavy: 240 gallons weigh a short ton. In some areas, groundwater is so deep that it is not cost-effective to pay to lift it to the surface. Moreover, some underground water bodies, called aquifers, are replenished ("recharged") very slowly or not at all, and the water in them is effectively a non-renewable resource. In fact, large parts of the United States are depleting their groundwater supplies.

With those caveats, here are some basic statistics on water use: The amount of water required for basic human needs—drinking, cooking, bathing, washing, and sanitation—has been estimated at about thirteen gallons per capita per day, or, for a family of four, about 19,000 gallons per year.[16] United States families use considerably more than that for household uses, and in many U.S. cities water use may range to 200–300 gallons per capita.[17] In a considerable part of the United States, a significant amount of domestic water use goes to landscaping.[18]

Even so, all domestic uses together account for less than ten percent of overall water use. If we exclude water used to generate electricity—nearly all of which is not consumed but remains available for other uses[19]—mining and industry account for an even smaller fraction of water use than domestic uses. Irrigation (watering plants with something other than rainfall) soaks up most of the developed water supply in the nation. Most irrigation is, in turn, used to grow field crops like alfalfa and cotton with comparatively low

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[15] More than two-thirds of the groundwater extracted in 2000 was used for agricultural irrigation. Groundwater accounts for more than forty percent of all water used in irrigated agriculture and about the same percentage of water used for domestic purposes. SUSAN S. HUTSON, ET AL., U.S. GEOLOGICAL SURV., ESTIMATED USE OF WATER IN THE UNITED STATES IN 2000 4, 39–40 (2004), *available at* http://pubs.usgs.gov/circ/2004/circ1268/pdf/circular1268.pdf

[16] *See* Peter H. Gleick, *Basic Water Requirements for Human Activities: Meeting Basic Needs*, 21 WATER INTERNATIONAL 83, 83–92 (1996); THE WORLD'S WATER 2006–2007, *supra* note 6, at 124.

[17] *See* American Water Works Association, Water Use Statistics, http://www.drinktap.org/consumerdnn/Home/WaterInformation/Conservation/WaterUseStatistics/tabid/85/Default.aspx (last visited Nov. 16, 2008) (on file with the Harvard Law School Library); U.S. Geological Surv., Water Q&A: Water Use at Home, http://ga.water.usgs.gov/edu/qahome.html#HDR3 (last visited Nov. 16, 2008) (on file with the Harvard Law School Library).

[18] In California, for example, outdoor use comprises nearly half of residential demand. EPA, CLEANER WATER THROUGH CONSERVATION 9–10 (1995), *available at* http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20004MQA.txt.

[19] This includes water used to cool thermal power plants and to generate hydroelectric power by gravity. *See* SUSAN S. HUTSON ET AL., supra note 15.

prices and profit margins.[20] And much of it is used in the arid West to irrigate crops that can be grown without irrigation in more humid parts of the country.

To make these vast quantities of water available, an enormous infrastructure has been built. It includes some 79,000 dams more than six feet high.[21] Add to this many thousands of miles of canals, pumping and treatment plants, and so forth, and the total investment is in the hundreds of billions of dollars.[22]

Water is regarded practically everywhere as free at its source; indeed, even if water were to become "dirt cheap" its price by weight would have to increase exponentially from its current levels in many locales.[23] Water users generally pay something for the infrastructure and energy to capture, store (if necessary), treat, and deliver water, but, from a retail customer's standpoint, those costs are a small part of most Americans' budgets.[24] Water tends to be a bigger share of the budgets of irrigated farms, even though much agricultural water use tends to be, in one way or another, heavily subsidized by the government. As Peter Rogers has pointed out, water prices "rarely reflect supply" and tend to be "lowest where water supplies are lowest."[25]

II. A Brief Tour Through the Water Law Labyrinth[26]

Determining and allocating legal "rights" to use water is a very complicated matter. When water is plentiful, there is little need for water law. With some exceptions, throughout the country the law and institutions that govern water have remained relatively primitive compared to those governing land.

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[20] According to one calculation, one acre-foot of water generates nearly $1 million when used in semiconductor manufacturing, but only $60 when used to grow alfalfa. Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 Tex. L. Rev. 1873, 1887 (2005); *see also* Marc Reisner & Sarah Bates, Overtapped Oasis 31 (1990). United States water managers usually measure water not by the gallon, but by the acre-foot (AF), the amount of water required to cover an acre one foot deep.

[21] National Inventory of Dams, http://crunch.tec.army.mil/nidpublic/webpages/nid.cfm (last visited Nov. 20, 2008) (on file with the Harvard Law School Library); *see also* Aspen Inst., Dam Removal: A New Option for a New Century (2002), *available at* http://www.aspeninstitute.org/atf/cf/%7BDEB6F227-659B-4EC8-8F84-8DF23CA704F5%7D/damsbrochure.pdf.

[22] Rogers, *supra* note 7, at 3.

[23] Irrigation districts in parts of the west deliver water to farmers for a few dollars an acre-foot. At 1358 tons per AF, a $20 water cost means one dollar buys 68 tons of water. Fill dirt often sells at several dollars a ton.

[24] According to the EPA, the average American family spends $474 per year on water and sewage charges. EPA, Water on Tap 11 (2003), *available at* http://www.epa.gov/OGWDW/wot/pdfs/book_waterontap_full.pdf. This figure is dwarfed by the $5921 and $2013 that the average American family spent for food and gasoline, respectively, in 2005. *See* U.S. Bureau of Labor Statistics, Report 998, Consumer Expenditures in 2005 3 (2007), *available at* http://www.bls.gov/cex/csxann05.pdf.

[25] Peter Rogers, *The Future of Water*, Atlantic Monthly, July 1983, at 81, 86.

[26] *See generally* Joseph L. Sax et al., Legal Control of Water Resources (4th ed. 2006).

Efforts to develop and use water have not produced a stable, predictable, well-administered system of water entitlements, but rather the opposite, a kind of ambiguous, complex mess. That helps explain the old saying that "whiskey is for drinking, water is for fighting over."[27]

Part of the problem stems from the nature of the resource itself. The characteristics that make water quite unlike land pose stiff challenges for those who seek to fashion well-defined rights to use water. Generally speaking, legal rights to water—whether to surface or groundwater—do not convey ownership of molecules of water. Instead, they are usually expressed in terms of rights to use specified quantities of water in particular ways on an annual or other regular basis. These rights are much more correlative than rights to land or conventional commodities. Because water is mobile and reusable, many interests may have legal rights to the same source, and the "rights" to use can add up to a bigger quantity of water than actually exists. This makes water law much more complex than other forms of property law.

Most of the water law in the country is state law. Because of the complexities just described, state water law has gradually but steadily evolved from common law systems, in which courts fashion and enforce water rights, to legislated, state-administered systems governed by bureaucratic decision-making.[28]

Below the state level, so-called special water districts control much of the developed supply of water in the country, in effect wholesaling it to retail water customers at the tap or at the head of the irrigation canal bringing water to a farm. Operators of irrigated farms and other large users of water tend to think of themselves as having private property "rights" to use water, but the water they use is often developed and delivered to them by special governmental water districts. The existence of these districts makes water law and water rights even murkier. In many jurisdictions it is not clear whether a district or the end user of water holds the rights to the water the district delivers, or whether the answer is governed by water law or contract law or some other legal doctrine.[29]

There are other complications. Water disrespects state and even national boundaries, a fact which requires some measure of national government involvement. In addition, because the national government manages about one-third of the nation's land and associated water resources and has special responsibilities regarding Indian Tribes and Indian lands, there is an entire category of water rights bottomed on federal, not state, law.[30] The national

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[27] This quote is usually, but perhaps apocryphally, attributed to Mark Twain. *See, e.g.,* Mark Twain Quotations, Newspaper Collections, & Related Resources, http://www.twainquotes.com/WaterWhiskey.html (last visited Nov. 11, 2008).

[28] The significance of this development was first highlighted eighty years ago. *See* Moses Lasky, *From Prior Appropriation to Economic Distribution of Water by the State—Via Irrigation Administration*, 2 ROCKY MTN. L. REV. 35 (1930); *see also* Samuel Weil, *Theories of Water Law*, 27 HARV. L. REV. 530 (1914).

[29] *See* SAX ET AL., *supra* note 26, at 681–746.

[30] *Id.* at 903–1008.

government also builds and operates (through the Army Corps of Engineers and the Bureau of Reclamation) large water projects throughout the country. These federal agencies usually deliver project water by contract under authority of federal statutes. Most of the time state water law and federal water project law operate synchronously. However, when the laws conflict, the scope and strength of the rights to use the water become much less certain.[31]

Even apart from these water rights considerations, because water resources have always been regarded as having a strong public character, their management and use have long been subject to various regulatory controls imposed at the state and national levels. The most prominent such laws today are the Clean Water Act and the Endangered Species Act.

In short, the law governing water allocation and management in the United States is an intricate, three-dimensional mosaic of private rights, public rights, and public regulatory controls. These have accreted in layers over time, at both the federal and state levels. The system has a lot of inertia and does not readily admit change.

III. The Prevalence of Government in Water Management Institutions

Today government institutions furnish about eighty-five percent of developed water supplies in the country.[32] Federal water projects wholesale water through units of state and local government. Water systems owned and operated by local governments deliver water to many people and industries. Much water, particularly agricultural water, is delivered through special water districts, which are typically organized under tailor-made state statutes, often drafted by district organizers. They usually have the power to tax people and other entities found within their jurisdiction. Their governing boards may be either elected or appointed by public officials. Most of the country's irrigated agriculture—which is, as noted above, the largest single consumer of developed water supplies—obtains water furnished by such districts.[33] Districts may construct and operate dams and diversion facilities, or they may be customers of projects built and operated by other units of government, or both. The amount of state oversight over the operations of these special water districts varies widely.

Government's dominant role reflects a bipartisan consensus—dating at least as far back as the presidency of Theodore Roosevelt—that for most Americans water has too much of a public character to tolerate a large role

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[31] *See, e.g.*, California v. United States, 438 U.S. 645 (1978).

[32] *See* Peter H. Gleick et al., *The Privatization of Water and Water Systems*, *in* The World's Water 2006–2007, *supra* note 6, at 57, 60 (citing J.A. Beecher et al., Regulatory Implications of Water and Wastewater Utility Privatization (1995)).

[33] *See* John D. Leshy, *Irrigation Districts in a Changing West—An Overview*, 1982 Ariz. St. L.J. 345 (1982); John D. Leshy, *Special Water Districts—The Historical Background, in* Special Water Districts: Challenge for the Future 11 (James N. Corbridge ed., 1982).

for private enterprise in its allocation and management. But it was not always thus. In the nineteenth century, private water companies provided more than ninety percent of the developed water supplies. As the Gilded Age ended, around the turn of the twentieth century, governmental control spread practically simultaneously at the local, state, and national levels. Locally, cities and towns took over many municipal systems. In rural areas, special governmental water districts took root and proliferated.[34] At around the same time, as noted earlier, states evolved water rights systems that moved away from common law actions built on private initiative and toward state supervision of water allocation and management through permit systems.

At the national level, governmental public works to control floods began in earnest around the turn of the twentieth century,[35] building on earlier efforts to protect and regulate navigation. Practically simultaneously, the national government launched a program to "reclaim" the arid lands of the West with government-funded irrigation schemes. The Federal Power Act of 1920 created a federal licensing scheme for hydroelectric projects. And congressional authorization of the Hoover Dam in 1928 set the stage for construction of many giant, multi-purpose dams and reservoirs during the New Deal and beyond.[36]

The American people still generally accept a large government presence in water supply and management, despite determined efforts by advocates of property rights and free markets who argue that "[p]olitical control of water preclude[s] efficient pricing, . . . exacerbates conflict, and encourages waste in the decision-making process."[37] When, in recent years, municipal providers like Atlanta, Georgia, and Stockton, California, proposed to privatize their municipal water supply systems—in part due to a belief that private enterprise could be more efficient and more readily raise capital for water infrastructure upgrades—significant opposition surfaced.[38] The brief boomlet of privatization seems to have faded as the general public has apparently satisfied itself that more property rights, freer markets, and less government involvement is not the way to deal with water supply issues.[39]

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[34] This was helped immeasurably by a U.S. Supreme Court decision that rejected various challenges to California's pioneering legislation authorizing formation of special water districts. *See* Fallbrook Irrigation Dist. v. Bradley, 164 U.S. 112 (1896); *see also* SAX ET AL., *supra* note 26, at 681–746.

[35] *See*, *e.g.*, JOHN BARRY, RISING TIDE (1997).

[36] *See*, *e.g.*, MARC REISNER, CADILLAC DESERT (1986).

[37] WATER MARKETING—THE NEXT GENERATION xiv (Terry L. Anderson & Peter J. Hill eds., 1996); *see also* TERRY L. ANDERSON & PAMELA S. SNYDER, WATER MARKETS: PRIMING THE INVISIBLE PUMP (1997).

[38] Symposium, *Private Sector Participation in Water Services: Through the Lens of Stockton*, 57 HASTINGS L.J. 1323, 1331, 1334-35 (2006).

[39] Jim Carlton, *Calls Rise for Public Control of Water Supply*, WALL ST. J., June 17, 2008, at A6; *see generally* PETER GLEICK, THE NEW ECONOMY OF WATER (2002), available at http://www.pacinst.org/reports/new_economy_of_water.pdf.

IV. Water Policy Challenges

Against this complex background, water management today is beset by many challenges. Besides climate change, these challenges include declining levels in groundwater aquifers, growing conflict between users of surface and ground water, a decline in aquatic ecosystem health, aging water infrastructure, and a lack of basic information about water resources themselves.

Groundwater pumping in many parts of the country exceeds replenishment rates, leading groundwater levels to decline. The poster child of this phenomenon is the gigantic Ogallala Aquifer that underlies large portions of Kansas and Nebraska, as well as smaller portions of Colorado, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. The largest aquifer in North America, the Ogallala holds enough water to fill Lake Huron, is tapped by nearly 200,000 wells pumping 18 million acre-feet a year to irrigate fourteen million acres (about twenty percent of all the irrigated land in the United States), and furnishes drinking water to about four-fifths of the people living over it. Despite little natural recharge—if drained it would, because of sparse precipitation and an impervious geological layer between much of it and the surface, take 6,000 years to refill—the Ogallala has been "mined" for the past half-century. In some places its water level is below the economic limit of pump lifts.[40]

While the need to regulate groundwater withdrawals for long-term sustainability has long been recognized,[41] many states are far from regulating groundwater withdrawals in a serious way.[42] The laws of most states also do not adequately take into account connections between groundwater and surface water, even though they have long been recognized.[43] Over-pumping of groundwater dewaters streams and pits groundwater pumpers against both surface water users and advocates of preserving streams and rivers. This is a national problem, threatening rivers from the San Pedro in southeastern Arizona to the Ipswich in northeastern Massachusetts.[44]

Another challenge is ecological—protecting, or in some cases restoring, enough river flow to sustain aquatic and associated riparian habitats. Dams and water diversions are found on almost every river throughout the

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[40] *See, e.g.*, Robert R.M. Verchick, *Dust Bowl Blues: Saving and Sharing the Ogallala Aquifer*, 14 J. Envtl. L. & Litig. 13, 20 (1999).

[41] The National Water Commission forcefully called attention to these problems in its 1973 report. *See* John D. Leshy, *The Federal Role in Managing the Nation's Groundwater*, 11 Hastings W.-Nw. J. Envtl. L. & Pol'y 1, 10 (2004).

[42] *See* Sax et al., *supra* note 26, at 449–50.

[43] *See* Samuel Weil, *Need for Unified Law for Surface and Underground Water*, 2 S. Cal. L. Rev. 358, 369 (1929).

[44] Even though its watershed receives more precipitation than Seattle, the Ipswich has dried up several times in recent years, primarily due to unregulated groundwater pumping. *See* Robert Glennon, Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters 51–66, 99–111 (2002).

country; indeed, the number of undammed rivers of any size outside of Alaska can be counted on one hand.[45] Several hundred thousand miles of streams have been inundated in the process, converting free-flowing rivers into stair-step series of pools. The result is that most river flows throughout the country are now controlled by dam operators, except for occasional floods. Dams have brought large benefits, but ecological considerations often received scant attention in decisions governing dam location and operation. Indeed, many dam operators today still follow management regimes that were worked out many decades ago to serve the narrow objectives of navigation (primarily barge traffic), hydroelectric power generation, and water diversions for agricultural irrigation, industries, and municipalities. All these changes in river flows, temperature, and water quality have had serious and sometimes dire effects on aquatic and riparian habitat and dependent species. In many cases, these ecological costs have taken many years to appreciate, and today freshwater fish are the most imperiled vertebrate group in the United States, and aquatic and riparian-dependent species comprise a high proportion of species formally identified as endangered.[46]

Public appreciation of the need to pay attention to these matters has deepened. One reason is the "growing understanding of the scale of . . . real and potential economic benefits" of such flows.[47] Healthy watersheds furnish "ecosystem services,"[48] as they are called today—protecting water quality, controlling floods, providing recreational opportunities, and so forth. The challenge now, as one commentator has aptly put it, is to convert "working rivers" into "rivers that work."[49] More fundamentally, as Joseph Wood Krutch observed more than a half-century ago, it is "not a sentimental but a grimly literal fact that unless we share [the planet] with creatures other than ourselves, we shall not be able to live on it for long."[50]

Another challenge is that the sizeable water infrastructure built over the previous century needs care and feeding. Dams and diversion facilities can wear out, silt up, and otherwise become obsolete. Some pose health and

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[45] The Yellowstone River is the only undammed river longer than 1000 km in the lower forty-eight states. PATRICK MCCULLY, SILENCED RIVERS: THE ECOLOGY AND POLITICS OF LARGE DAMS 6 (2001); *see also* Peter M. Lavigne, *Dam(n) How Times Have Changed. . .*, 29 WM. & MARY ENVL. L. & POL'Y REV. 451, 457 (2005).

[46] *See generally* Holly Doremus, *Water, Population Growth and Endangered Species in the West*, 72 U. COLO. L. REV. 361, 366–67 (2001).

[47] David Katz, *Going with the Flow: Preserving and Restoring Instream Water Allocations*, *in* THE WORLD'S WATER 2006–2007, *supra* note 6, at 29.

[48] *See* GRETCHEN C. DAILY & KATHERINE ELLISON, THE NEW ECONOMY OF NATURE: THE QUEST TO MAKE CONSERVATION PROFITABLE 5 (2002); James Salzman and J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 612 (2002).

[49] HOLLY DOREMUS & A. DAN TARLOCK, WATER WAR IN THE KLAMATH BASIN 185 (2008); *see also* John M. Volkman, *Rethinking Development and the Western Environment*, *in* BEYOND THE MYTHIC WEST (Stewart L. Udall et al. eds., 1990).

[50] JOSEPH WOOD KRUTCH, THE VOICE OF THE DESERT 194–95 (1956); *see also* Doremus, *supra* note 46, at 361.

safety hazards.[51] Climate change and rising sea levels can make these problems significantly worse, putting places like the California Delta, the lynchpin of the state's elaborate water infrastructure, at risk.[52] Despite the growing problems, investment in maintaining water infrastructure has not kept up with needs in recent years.[53]

A final challenge is that governing authorities often lack information and capacity to manage water intelligently. Many states do not track or police water uses in any systematic way, leading to a wide disparity between what state records show as "legal" uses and actual uses.[54] The U.S. Geological Survey gathers some information on water supplies and uses, but there is much room for improvement at all levels,[55] a matter made more urgent by a destabilizing climate. In most places, for example, not enough is known about the characteristics of aquifers and their relation to surface streams to allow for intelligent management of surface and groundwater together.[56]

While these challenges loom large, the news is not uniformly bad. Many water managers and regulators are beginning to take steps to address these problems, as discussed below. A related and relatively little noted development is that, in the last three decades, overall water use in the United States has stabilized. From 1900 to 1975, water use in the United States grew more than ten-fold, much faster than the rate of population growth. Groundwater extraction alone more than doubled in the first three decades after the end of World War II. Since about 1975, however, water use across the United States has been relatively constant, despite significant further in-

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[51] *See* James G. Workman, *How to Fix Our Dam Problems*, 24 ISSUES IN SCI. & TECH. 31–42 (2007).

[52] *See, e.g.*, JAY LUND ET AL., ENVISIONING FUTURES FOR THE SACRAMENTO-SAN JOAQUIN DELTA 1–60 (2007).

[53] *See* CLAUDIA COPELAND & MARY TIEMANN, CONG. RES. SERVICE, FEDERATION OF AMERICAN SCIENTISTS, WATER INFRASTRUCTURE NEEDS AND INVESTMENT: REVIEW AND ANALYSIS OF KEY ISSUES (2008), *available at* http://ftp.fas.org/sgp/crs/homesec/RL31116.pdf; Collen Long, *US Water Pipelines are Breaking,* ASSOCIATED PRESS, Apr. 8, 2008, *available at* http://seattletimes.nwsource.com/html/nationworld/2004334859_apdeterioratingwaterpipes.html (noting that the EPA recently estimated that more than $277 billion will be needed for repairing and improving drinking water systems over the next two decades, while others peg the figure at closer to $500 billion).

[54] Michael McIntyre, *The Disparity Between State Water Rights Records and Actual Water Use Patterns: "I Wonder Where the Water Went?",* 5 LAND & WATER L. REV. 23, 23–24 (1970); GOVERNOR'S COMM'N TO REVIEW CAL. WATER RIGHTS LAW, FINAL REPORT 16–18 (1978); DOREMUS & TARLOCK, *supra* note 49, at 43, 72–73, 84–86.

[55] *See* ROGERS, *supra* note 7, at 183–85.

[56] *See, e.g.*, MACDONNELL & FORT, *supra* note 9, at 21 ("States have struggled with administration of [groundwater], stymied in part by inadequate information about aquifer function including recharge and discharge and effects of pumping."). To gain that information, often the hydrologic system must be modeled. Computer modeling has made enormous strides in recent years, but the quality of the model depends upon the quality of the information going into it, which can be meager because in many places groundwater pumping is not measured or reported. In fact, such models are often created only when the problems have become acute enough to result in litigation or the threat of it. *See* SAX ET AL., *supra* note 26, at 407–11.

creases in population and a growing economy.[57] Water use has, in other words, been uncoupled from economic and population growth. This is similar to what has happened with energy demand over roughly the same period, and for largely the same reasons: cost constraints on new supplies and more emphasis on conservation and more efficient use.[58]

V. The Case for a National Water Policy

A thoughtful national water policy is needed because, as one knowledgeable observer wrote almost a decade ago, water is "an interstate resource of crucial importance to the nation's health and economy" that is "under severe and increasing stress," and because the government every year spends many billions of dollars on water-related programs "with insufficient policy guidance to insure that those dollars are well spent."[59]

While water policy is stubbornly resistant to sweeping change, the stresses documented in the previous section—and particularly the fears of more sophisticated water managers and others that climate change is undermining the reliability of existing water supply systems—are creating much more receptivity to significant reform than has existed for decades. Perhaps the best illustration of this new openness is the 2007 agreement of the seven Colorado River Basin states to make what may be the most fundamental changes to the fabled "Law of the River"[60] since the original Colorado River Compact was signed in 1922. These changes include more definitive guidelines for apportioning shortages and various incentives for conservation and more efficient use of basin water.[61]

Despite these advancements, entrenched institutional arrangements make truly radical changes unattainable, even when desirable. The ideas sketched out here are relatively modest and, I believe, achievable.

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[57] Groundwater withdrawals declined from a peak of 93 MAF in 1980 to about 86 MAF in 1995, but then increased to a new high of 93.4 MAF in 2000, probably influenced by regional droughts in the late 1990s. *See* Susan S. Hutson et al., supra note 13.

[58] *See, e.g.*, Amory Lovins, *Foreword*, *in* The World's Water 2006–2007, *supra* note 6, at xiii. For a dramatic display of how this trend may not be destiny, and how wrong projections about future freshwater demands can be, see Figure 6.1 in Rogers, *supra* note 7, at 127 (showing how the National Water Commission (1973), Resources for the Future (1971), and the Senate Select Committee on National Water Resources (1961) all failed to anticipate the stabilization in use that began in 1975).

[59] Janet C. Neuman, *Federal Water Policy: An Idea Whose Time Will (Finally) Come*, 20 Va. Envtl. L.J. 107, 108 (2001); *see generally* Rogers, *supra* note 25.

[60] The complex web of compacts, laws, regulations, and other arrangements governing Colorado River water is usually referred to as the Law of the River.

[61] Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, 73 Fed. Reg. 19,873-01 (Apr. 11, 2008); *see also* Press Release, U.S. Dep't. of the Interior, *Secretary Kempthorne Signs Historic Decision For New Colorado River Management Strategies*, http://www.doi.gov/news/07_News_Releases/071213.html.

VI. Advancing the Proper Level of Government to the Front Lines

Ideally, many water management issues would be best addressed on a watershed basis. But that has never proved workable on a wide scale. For one thing, watersheds can span many governmental jurisdictions, including state lines and international borders. Also, water projects often move water from one watershed to another. Groundwater introduces further complications. For such reasons, very few governmental entities that deal with water at any level are organized along watershed lines. It would probably take a heroic, sustained effort even to begin to reorganize water management by watershed across the country.[62]

Local governments and most special governmental districts are too small and tend to lack the institutional capacity and the will to do what is needed to meet current challenges. The federal government has the constitutional authority to nationalize water management, but that would concentrate too much authority and is neither politically feasible nor desirable. That leaves, by default, state governments. They have broader perspectives on water and watersheds than local governments or special districts, and they are among our most democratically accountable institutions, giving them more credibility at the grassroots than the national government. All states have some form of administrative machinery in place to govern water management. Most water law, like most law that applies to land, is state law.

States have not always been very vigorous about asserting regulatory control and oversight over water management matters. Some have tended to defer to powerful locally-organized special water districts. The limits of local control are increasingly apparent, however. No water user, to paraphrase John Donne, is an island. Inadequate management of water in one place reverberates across the landscape. While local governments and special districts will have to play important parts in many efforts to meet water management challenges, they cannot be put, or left, in charge.

The first plank in a progressive national water policy, then, is to strengthen the capacity and role of the states, especially in relation to special water districts and the private sector. The next section describes what they should be doing. Section VIII then describes ways the national government can systematically promote these state-level reforms, and Section IX describes things the national government can do to put its own house in order.

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[62] The 1965 Water Resources Planning Act authorized the establishment of river basin commissions to collect data and plan resource use—but not to regulate, construct, or manage water projects—on a large-scale watershed level. Seven such commissions were formed between 1965 and 1980, but few mourned them when they were abolished during the Reagan Administration. A modest exception to the observation that water management tends not to be addressed on a watershed basis is found in the Delaware River Basin in the mid-Atlantic, where some watershed-level management is carried out, helped along by litigation and an interstate compact. *See generally* Sax et al., *supra* note 26, at 853–58.

VII. Needed Improvements in State Systems

A. States should have better information and more capacity to manage and regulate water use within their borders.

Much of this information can be obtained at reasonable cost through mechanisms such as gauges, meters, and reporting requirements. Sorting out claims of rights to use water is more complicated, but well-delineated entitlements and the institutional and regulatory capacity to enforce them would provide more predictability and fairness, make the transfer of water from lower to higher value uses more feasible, and facilitate the protection of water flows for ecological purposes. A number of states have begun to recognize these problems and deal with them, but progress is slow.[63]

B. States should have effective, comprehensive programs to provide enough water flows in their streams to ensure a meaningful level of ecological health.

Increasingly recognizing that traditional patterns of water development have taken a heavy toll on freshwater ecosystems, governments everywhere are giving much more attention to secure what might be called "environmental flows."[64] Most state laws now provide a number of ways to do this, including putting flow-protecting conditions on water use permits and approvals of water transfers, or simply reserving flows.

But these tools tend to be used sporadically. Few states have programs that aim for systematic and comprehensive protection of ecologically based flows. Moreover, when such tools as do exist are brought to bear, they often focus narrowly on protecting sport fish, even though this may not be a good proxy for general ecological health. As governments have grappled with these issues, they have learned that providing streamflows for ecological health is more complicated than simply establishing "minimum flows" to ensure that streams do not dry up completely.[65] Natural seasonal variations (called the "hydrograph") need to be more closely mimicked to ensure the scouring and maintenance of stream channels and riparian areas to provide good reproductive habitats. Likewise, variations in water temperature may be needed to help control the spread of invasive or exotic species and meet the needs of native species.

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[63] *See id.* at 310–24.

[64] *See* Katz, *supra* note 47, at 29. The new water law adopted in South Africa under Nelson Mandela provides for a water "reserve" in every watershed for ecological health. National Water Act 36 of 1998, §§ 16–18, *available at* http://www.elaw.org/resources/text.asp?ID=1153. *See also* David Takacs, *The Public Trust Doctrine, Environmental Human Rights, and the Future of Private Property*, 16 N.Y.U. Envtl. L.J. 711, 743 (2008); Robyn Stein, *Water Law in a Democratic South Africa: A Country Case Study Examining the Introduction of a Public Rights System*, 83 Tex. L. Rev. 2167, 2181 (2005).

[65] *See* Katz, *supra* note 47, at 38; Jack A. Stanford et al., *A General Protocol for Restoration of Regulated Rivers*, 12 Regulated Rivers: Res. & Mgmt 391, 402 (1996).

For some streams, the objective may be simply to preserve what ecological health remains. But for others, probably the majority, efforts need to be made to restore degraded conditions. Often this can be done by revising operating regimes of existing dams. The good news is that stream systems have "impressive capacity to recover from even significant and sustained disturbances,"[66] and relatively small adjustments in river operation can make a significant difference in ecological health. On the other hand, preconceived notions about what a "natural" system is may have to be set aside.[67] Practicality may dictate, for example, that some groundwater be mined in order to sustain surface ecosystems. Finally, on some streams, carefully designed dam removals might be called for, as they have been shown to have great benefits in some circumstances.[68]

C. States should have effective groundwater regulation programs to sustain groundwater-dependent communities over the long term and to protect associated surface waters.

Many states lack groundwater regulation programs. This can shortchange future generations, undermine the stability of existing uses, and threaten hydrologically-connected streamflows. A number of states are moving to upgrade their groundwater management systems, closing loopholes, and refining management means and objectives, but here too progress is slow and sporadic, usually undertaken only in response to some crisis.

D. States should make stronger efforts to link regulation of land use and water use.

Municipal water providers have long followed the public utility model, assuming complete responsibility for meeting new water demands occasioned by population growth and development.[69] By contrast, land use regulators around the country have for many years required developers to build or help underwrite the cost of new roads, utilities, schools, and other infrastructure needed to service new development, in order to lessen the tax burden on those already there. Finding this model persuasive, a small number of states and local jurisdictions have adopted so-called "show me the water" laws, requiring developers of new communities to demonstrate an adequate

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[66] *See* Katz, *supra* note 47, at 45.

[67] *Cf.* BILL MCKIBBEN, THE END OF NATURE 8 (1989); Peter Kareiva et al., *Domesticated Nature: Shaping Landscapes and Ecosystems for Human Welfare*, SCIENCE, June 29, 2007, at 1866.

[68] *See* THE ASPEN INST., *supra* note 21, at 4. In fact, several hundred dams have been removed in the United States in recent years. THE WORLD'S WATER 2006–2007, supra note 6, at 118; THE HEINZ CTR., DAM REMOVAL: SCIENCE AND DECISION MAKING 49–53 (2002).

[69] *See* CALIFORNIA WATER IMPACT NETWORK, "A COMMUNITY GUIDE TO CALIFORNIA'S 'SHOW ME THE WATER' LAWS INCLUDING THE URBAN WATER MANAGEMENT PLANNING ACT AND SENATE BILLS 610 & 221 12 (2008), *available at* http://www,c-win.org/uploads/Guidebook.pdf.

water supply as a condition for gaining approval to sell lots. One of the first such laws, part of the Arizona Groundwater Management Act of 1980, was enacted partly as the result of pressure from the national government.[70] If well-designed, such "assured supply laws" can protect home buyers, improve planning decisions, help protect existing water rights, more fairly allocate the costs of growth between existing and new residents, and encourage water conservation and more efficient uses.[71] The Western Governors' Association endorsed the idea in its 2006 report.[72]

E. States should vigorously promote measures to conserve and make more efficient use of water.

Many studies document that conservation and efficiency improvements will be very important ways to meet future water needs, especially in water-scarce regions where most sustainable supplies have already been developed.[73] These steps can usually be taken faster, more cheaply, and with fewer environmental impacts than any alternatives. They can be promoted by raising the cost of water supplies, by governmental incentives, by regulation, or by some combination of these.[74]

In the municipal and industrial sectors, conservation can be promoted by metering water use, adopting progressive water pricing structures, enforcing modern plumbing standards, repairing leaking infrastructure,[75] and re-

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[70] ARIZ. REV. STAT. ANN. § 45-576 (requiring subdividers in more populated parts of the state to demonstrate a 100-year "assured water supply" before selling lots).

[71] Lincoln L. Davies, *Just a Big, "Hot Fuss"? Assessing the Value of Connecting Suburban Sprawl, Land Use, and Water Rights through Assured Supply Laws*, 34 ECOLOGY L.Q. 1217, 1292 (2007).

[72] WESTERN GOVERNORS' ASS'N, *supra* note 9, at 5–6 ("To foster sustainable growth policies, states should identify water requirements needed for future growth, and develop integrated growth and water supply impact scenarios that can be presented to local decision makers.").

[73] *See, e.g.*, WESTERN RESOURCE ADVOCATES, SMART WATER: A COMPARATIVE STUDY OF URBAN WATER USE EFFICIENCY ACROSS THE SOUTHWEST (2003), *available at* http://www.westernresourceadvocates.org/water/smartwater.php; Gary Wolff & Peter H. Gleick, *The Soft Path for Water*, *in* THE WORLD'S WATER 2006–2007, *supra* note 6, at 1. Of course, not all water that can be saved by efficiency improvements is otherwise lost. As noted earlier, a good deal of "wasted" water finds its way to aquifers or streams where it is available for other uses.

[74] Some slow-growth advocates may legitimately question the purpose of conserving water if it simply promotes more growth and development. One way to deal with this would be to devise ways to have water suppliers and water users effectively earmark and devote to ecological restoration the water they save by conservation and efficiency improvements. *See* Sharon Megdal, *"Conserve to Enhance," Conserve Water to Enhance the Environment*, ARIZ. WATER RES. PUB. POLICY REVIEW, Jan–Feb. 2008, *available at* http://cals.arizona.edu/AZWATER/awr/janfeb08/policy.html.

[75] PETER H. GLEICK ET AL., WASTE NOT, WANT NOT: THE POTENTIAL FOR URBAN WATER CONSERVATION IN CALIFORNIA 61–62 (2003), *available at* http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf (reporting that California residences lose 250,000 AF of water annually through leaks, and nearly all of this could be saved through widely available technology, audits, and proper maintenance).

using wastewater.[76] A growing number of state and local water authorities are moving in this direction, some quite vigorously.[77]

The agriculture sector, the largest consumer by far of developed water supplies, has huge opportunities for efficiency improvements. Much of irrigation water in the United States is applied through inefficient flood irrigation, and the unlined canals that transmit the water can lose large amounts.[78] Cropping patterns might be changed, because the most water-intensive crops are often the least valuable in the marketplace.

F. States should have clear policies and processes for addressing transfers of water rights, particularly from agricultural to municipal, industrial, and ecological uses.

Water has long been moved from one place or type of use to another. More such movement will have to take place to meet emerging challenges. The most likely will be to shift water to municipal, industrial and ecological uses from agricultural uses. This is because, to paraphrase Willie Sutton, that's where the water is. In California, for example, with a burgeoning population approaching 40 million people, more than eighty percent of the developed water supply is still used on farms,[79] and in most western states the percentage is even higher. This means that shifting just a small portion of water out of agriculture could effectively double the water available for other uses. Much agricultural water is used on crops with comparatively low economic value, supported by subsidies long criticized by economists. As a

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[76] Wastewater reclamation has been growing at a rate of fifteen percent per year in recent years, thanks in part to federal programs that promote it. *See* Dennis Wichelns, *Policy Issues Regarding Water Availability and Water Quality in Agriculture in the United States*, *in* ENVIRONMENT, WATER RESOURCES AND AGRICULTURAL POLICIES: LESSONS FROM CHINA AND OECD COUNTRIES 147–49 (OECD ed., 2006) (describing how the Clean Water Act motivated increased interest in water conservation strategies); *see also* BETSY A. CODY & NICOLE T. CARTER, THE TITLE XVI WATER REUSE PROGRAM: IMPLEMENTATION AND LEGISLATIVE ISSUES 1, 3 (Cong. Research Serv. Report for Cong. RL33707, 2006), *available at* http://www.nationalaglawcenter.org/assets/crs/RL33707.pdf (discussing the implementation of a federal funding program for water reuse).

[77] Perhaps best known is the Southern Nevada Water Authority's program to reduce consumptive use of its very limited supply of water from the Colorado River. Between 2002 and 2006, the Authority cut its water deliveries from 325,000 to 270,000 AF, despite adding an astounding 330,000 new residents to its service area. The program's most remarked upon feature is paying residents and businesses to remove irrigated grass. S. Nev. Water Auth., Water Smart Landscape Rebate, http://www.snwa.com/html/cons_wsl.html (last visited Nov. 20, 2008) (on file with the Harvard Law School Library).

[78] *See, e.g.*, HEATHER COOLEY ET AL., MORE WITH LESS: AGRICULTURAL WATER CONSERVATION AND EFFICIENCY IN CALIFORNIA: A SPECIAL FOCUS ON THE DELTA 33 (2008), *available at* http://www.pacinst.org/reports/more_with_less_delta/more_with_less.pdf; U.S. BUREAU OF RECLAMATION, WATER 2025: PREVENTING CRISES AND CONFLICT IN THE WEST 16 (2005), *available at* http://www.usbr.gov/water2025/images/Water2025-08-05.pdf.

[79] Natural Resources Defense Council, *Alfalfa: The Thirstiest Crop*, http://www.nrdc.org/water/conservation/fcawater.asp (last visited Nov. 16, 2008) (on file with the Harvard Law School Library).

matter of engineering, moving water from agriculture to other uses is usually easy to do.

But achieving such transfers is difficult, as a number of private entrepreneurs like Enron (through its water subsidiary, Azurix)[80] have discovered to their chagrin. A big obstacle is the interlocking character of water entitlements and uses, which reflects communitarian values and gives any water right holder a veto over any transfer of a water right that might cause it injury, broadly defined.[81] There are other obstacles. Many jurisdictions lack clear policies on the extent to which water can be conserved or recaptured and then transferred, and on the respective rights of individual farmers and special water districts to approve or veto transfers proposed by the other.[82]

Looming over the entire subject of water rights transfers is the specter of "another Owens Valley." Owens Valley was a thriving agricultural area nestled below the eastern escarpment of the Sierra Nevada range in California where, about a century ago, the City of Los Angeles bought up most of the land and water rights and exported the water to meet the burgeoning municipal needs of the southern California coastal plain.[83] Many rural areas fight to preserve "their" water and the culture that depends upon it, and some states provide "area of origin" protection to limit water transfers that could adversely affect local economies or prospects for the future. The effectiveness of these laws remains in some doubt, but their very existence is revealing, for water law is "the only [natural] resource-centered body of law that concerns itself with the area of origin."[84]

Because transfers have such enormous potential for meeting emerging ecological and other demands for water, states can and should make improvements in the way they deal with them. A number of relatively modest steps can facilitate transfers while addressing rural concerns. Colorado, for example, has established progressive statewide policies for processing requests to move water away from agriculture, including requiring control of noxious weeds on former cropland and mitigation payments to local government to offset loss of local property tax revenue. This has been touted as a model other states might follow.[85] Other devices can ameliorate some concerns about transfers. Most municipal water interests need a supply of water as insurance against drought. This makes it attractive for them to purchase a right to move water from agricultural uses (those growing annual rather than

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[80] *See* DOREMUS & TARLOCK, *supra* note 49 (providing an illuminating discussion of the difficulties in the Klamath basin); A. Dan Tarlock, *Can Cowboys Become Indians? Protecting Western Communities as Endangered Cultural Remnants*, 31 ARIZ. ST. L.J. 539 (1999).

[81] *See* SAX ET AL., supra note 26, at 270–286.

[82] *See*, *e.g.*, *id.* at 189–90, 197–215.

[83] NATIONAL RESEARCH COUNCIL, WATER TRANSFERS IN THE WEST 115 (1992). *See generally* GARY LIBECAP, OWENS VALLEY REVISITED: A REASSESSMENT OF THE WEST'S FIRST GREAT WATER TRANSFER (2007) (offering a market economist's revisionist view that Owens Valley interests were adequately compensated and otherwise dealt with).

[84] SAX ET AL., *supra* note 26, at 243. *See generally* Joseph Sax, *Understanding Transfers: Community Rights and the Privatization of Water*, 1 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 13 (1994).

[85] MACDONNELL & FORT, *supra* note 9, at 19.

perennial crops) only in dry years.[86] Ecological needs may require a minimum base flow but only occasional variable flows, providing opportunities to avoid shifting water permanently away from agriculture. State and federal agencies have had considerable success in very quickly establishing and operating water banks to meet short-term or emergency drought needs, to pool water rights for rental, and to bring willing buyers and sellers together for short term arrangements.[87]

Moving significant amounts of water from less efficient agricultural uses to more economically productive and ecologically valuable uses will never be easy, nor should it be. But more such transfers will have to take place, and a progressive water policy would improve existing systems for acting on such transfer requests to make sure the transfers are appropriate and fair to exporting regions.

G. States should more vigorously monitor and, where necessary, regulate the activities of special government districts to serve state policy objectives.

Being creatures of state law, special water districts are hardly immune from state regulation. While they have proved adroit in their chameleon-like ability to change from private to public and back again when it serves their narrow self-interests,[88] states can and should take steps to ensure they are instruments for carrying out state water policy, and not the other way around.

VIII. Federal Promotion of Progressive State-Level Reforms

Fulfilling their role as laboratories for government experiment, in recent years a number of states have taken some of the steps outlined in the previous section. A few, like Florida, have thoroughly modernized their water laws in the face of growing water conflicts and other concerns. Some are experimenting with ways to make water transfers fairer and better. A number have some sort of streamflow protection program in place. Some are now addressing long-simmering conflicts between groundwater and surface water users, and addressing other uncertainties about water use and water rights by, for example, conducting massive adjudications of water rights.

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[86] Colorado has established a statutory framework for such arrangements, *see id.* at 20, and such "land fallowing" arrangements have been made in numerous areas by the Metropolitan Water District of Los Angeles, *see* Metro. Water Dist. Of Los Angeles, Palo Verde Land Management, Crop Rotation and Water Supply Program . . . at a Glance (2008), http://www.mwdh2o.com/mwdh2o/pages/news/at_a_glance/Palo_Verde.pdf.

[87] In 1991, with the West entering a fourth consecutive drought year, the state of California established an emergency drought bank that, within forty-five days, purchased 820,000 AF from willing sellers.

[88] *See generally* Leshy, *Special Water Districts*, *supra* note 33.

While these are welcome developments, their progress is neither systematic nor rapid enough to meet the daunting challenges ahead. Like air, water does not respect state lines, and so states need to move with some synchronicity to avoid "race to the bottom" or "tragedy of the commons" scenarios as they compete with their neighbors for limited water supplies. Action at the national level is needed to address these coordination problems.

A national program could take many forms. The more modest of the two programs I suggest here is to condition any federal financial assistance for water management in any state upon state water reform. The precedent for this is found in Congress's action in 1968, when it authorized construction, mostly at federal expense, of the giant Central Arizona Project (CAP). The CAP was designed to bring Arizona's share of Colorado River water to the central and southern part of the state, where a rapidly growing population was outstripping local supplies of groundwater being mined from aquifers. But federal aid came with a price. Arizona had long resisted adopting any effective controls on groundwater pumping, and Congress prohibited the CAP spigot from being opened until the Secretary of the Interior certified that state law had adequate controls on groundwater pumping in place.[89]

Although two blue-ribbon commissions have subsequently recommended much wider use of this tool of conditioning federal aid on state water law or policy reform,[90] the CAP legislation remains a rare approach. Instead, succumbing to the siren songs of "states' rights" and "local control," Congress has contented itself with furnishing money and building infrastructure to "rescue" states and localities from the consequences of their inadequate water policies, without insisting on reform to prevent repeated rescues. Such an approach is wrong-headed from just about every perspective.[91] Tying meaningful strings to federal aid would require Congress to show some spine-stiffening, but that might be forthcoming as the specter of climate change reduces historic state-federal tensions.

The second and more ambitious idea is for Congress to systematically push states toward reform through a federal grant program, or a combination of carrots and sticks, similar to that used in the successful national legislation four decades ago that deepened and broadened the nation's commitment to clean air and water. For example, the federal government could commit to a multi-year grant program to help states reform their laws, institutions, and policies along the lines identified in the previous section. It could require participating states to match the federal funds in some increasing proportion over time, and to meet benchmarks of progress as a condition of continuing

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[89] John D. Leshy, *The Federal Role in Managing the Nation's Groundwater*, 11 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 1, 9 (2004).

[90] *Id.* at 13.

[91] *See, e.g.*, David H. Getches, *Water Wrongs: Why Can't We Get It Right the First Time?*, 34 ENVTL. L. 1, 12 (2004).

to receive funds. The federal money would, in other words, be used to jump-start the effort to upgrade state systems.

Of course, the larger program raises important questions about costs and where the money would come from in this era of ballooning budget deficits. I will leave those questions to politicians and federal budget mavens, with a couple of observations: First, in the total federal budgetary universe, the amount of dollars needed to make a real difference at the state level is not large, a tiny fraction of the cost of the Iraq war or the Wall Street rescue. Second, measuring the benefits to the nation over the long term, the program offers a very big bang for the buck. Upgrading state institutions and systems to foster better, more efficient management and sustainable water use could greatly reduce the demand for costly federal "rescue" projects that are sure to come in the future if we remain on our present trajectory.

IX. Getting the Federal Government's House in Order

A. Congress should make more money available for U.S. Geological Survey data gathering.

Federal data collection and analysis are especially appropriate where there are overtaxed aquifers, disputes between ground and surface water users, and water bodies (surface and ground) with interstate dimensions.

B. National water policy needs to be closely connected to national energy policy.

Water and energy use are intertwined. Water is often used to produce energy, and energy is, in turn, needed to pump, transport, and purify water.[92] And we are increasingly recognizing physical, economic, and environmental limitations in our use of both. Nevertheless, to date, policymakers at both the state and federal levels have not paid very much attention to these connections.

This will have to change as we confront climate change and its principal cause, carbon emissions from energy production. Some forms of energy production that are supposedly more carbon friendly—most notably, biofuels—pose big tradeoffs regarding water use, particularly if the biofuel feedstock is artificially irrigated. Almost one-fifth of the nation's corn crop now goes to ethanol production, which replaces only about one percent of national petroleum consumption, but requires 17,000 gallons of water per gallon of ethanol, mostly for growing corn.[93] It also may be that, in a carbon

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[92] *See, e.g.*, Nat'l Energy Tech. Lab., Estimating Freshwater Needs to Meet Thermoelectric Generating Requirements 8 (2007), *available at* http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/2008_Water_Needs_Analysis-Final_10-2-2008.pdf.

[93] David Pimentel & Tad Patzek, *Green Plants, Fossil Fuels, and Now Biofuels*, 56 Bioscience 875 (2006).

emission conscious world, more hydropower generating capacity is desirable, because its "easy on-easy off" character meshes well with interruptible solar and wind power. The bottom line is that lifecycle water costs need to be factored into the energy policy equation.

C. National water policy needs to be closely connected to national agriculture and food policy.

Although the agriculture sector is by far the largest consumer of developed water supplies, remarkably little consideration has historically been given to water consumption in setting agriculture policy. Subsidies and other features of national agriculture policy generally encourage inefficient water use.[94] So do the subsidies built into the federal reclamation program that delivers artificially cheap water to ten million acres of farmland in the seventeen western states to grow crops that are readily grown in more humid regions of the country and are often subject to production limits in order to keep commodity prices high. Many farmers around the country also benefit from subsidized rates for electricity used to pump water to their fields.[95]

Large quantities of water are used to grow crops to feed to livestock to produce meat and milk. For this reason, the very arid basin of the Colorado River—often called the "lifeblood" of the Southwest—has been described as a "vast feedlot."[96] Health experts cite many reasons for American diets to contain fewer meat and dairy products.[97] It is of course unrealistic to think that water policy can be the primary tool to drive dietary choices, but as we move into more hydrologically uncertain times, we would be foolish indeed to continue to ignore the connection between what we eat and the water used to furnish it.

The politics of linking water and agriculture policy are, however, daunting. Every four years advocates of federal farm program reform come away disappointed. Defenders of the status quo are extremely effective, remarkably so considering that the nation's rural population has declined from about sixty percent of the population in 1900 to less than twenty-five percent to-

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[94] Nat'l. Water Comm'n, Water Policies for the Future 142–48 (1973); see also OECD, Farm Household Income: Issues and Policy Responses (2003) (concluding that agriculture subsidies have contributed to inefficient water use and the deterioration of water quality in the United States); *see generally* David Pimentel, *Water Resources: Agricultural and Environmental Issues*, 54 Bioscience 909 (2004).

[95] These subsidies are found in the form of favorable tax treatment for public power districts and preference in the use of low cost federally generated power. *See* Richard Munson, *Federal Power Dinosaurs: Government-owned Electric Utilities,* Issues in Sci. & Tech., Fall 1997, at 65.

[96] Phillip Fradkin, A River No More 31 (1968).

[97] *See, e.g.*, Alice H. Lichtenstein et al., American Heart Association, Diet and Lifestyle Recommendations Revision 2006: A Scientific Statement From the American Heart Ass'n Nutrition Committee (2006), available at http://circ.ahajournals.org/cgi/content/full/114/1/82.

day,[98] and that there are more than twice as many people behind bars in this country as there are farmers and farm managers, according to the Census Bureau.[99] Still, the water payoff from even modest reforms—like linking federal crop subsidies to meaningful water conservation efforts—would be huge. This makes the effort worthwhile, no matter how quixotic it may seem.

D. The federal government should improve its efforts, including working more closely with the states, to ensure a base level of ecological health in every stream.

The federal government already brings some powerful tools to bear on the problem of declining ecological health. It needs to work with the states so that their respective programs operate synergistically rather than at cross-purposes. For example, the federal Endangered Species Act ("ESA") is now an influential factor in managing many stream systems around the nation. The ESA even forced Texas to regulate, for the first time in history, withdrawals of water from the state's most heavily used aquifer, in the process protecting not only some endangered species (found in springs fed by the aquifer) but also a sustainable future for a significant part of the state's population and economy.[100]

The ESA has sometimes been used to forge more cooperation between state and federal programs. An Upper Colorado River endangered fish recovery plan, for example, uses state processes to implement the ESA's commands, and in southern California the ESA has been merged into California's Natural Community Conservation Program, melding state and federal ecological standards with local land use planning.[101] More such efforts are

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[98] U.S. CENSUS BUREAU, DECENNIAL CENSUS, Tbl. 1 (1995), *available at* http://www.census.gov/population/censusdata/urpop0090.txt (on file with the Harvard Law School Library).

[99] *See* American Community Survey, Data Set: 2006 American Community Survey, Tbl B24010 (2006) (counting 705,965 farmers and farm managers in 2006), *available at* http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=01000US&-ds_name=ACS_2006_EST_G00_&-SubjectID=15170902&-redoLog=false&-mt_name=ACS_2006_EST_G2000_B24010&-format=&-CONTEXT=dt (on file with the Harvard Law School Library); *see also* U.S. DEP'T OF JUSTICE, PRISON AND JAIL INMATES AT MIDYEAR 2006 (2007) (documenting 1.5 million state and federal prisoners in 2006), *available at* http://www.ojp.usdoj.gov/bjs/abstract/p06.htm (on file with the Harvard Law School Library).

[100] For more than a century the Lone Star State stubbornly applied the rule of capture to groundwater, awarding waters of common aquifers to those with the biggest pumps and deepest wells, regardless of priority, type, or reasonableness of use. This freewheeling approach naturally led to unsustainable pumping from many aquifers, including the giant Edwards Aquifer, the sole source of water for the City of San Antonio. After protracted litigation and court orders, Texas was finally convinced to enact a permit system to control pumping from the Edwards Aquifer, through a special governmental district, the Edwards Aquifer Authority. *See In re* Edwards Aquifer Authority, 217 S.W.3d 581 (Tex. App. 2006). For other examples of how the ESA is driving progressive solutions to water problems, see DOREMUS & TARLOCK, supra note 49, at 89–100, 177, 188–89.

[101] Robert L. Fischman & Jaelith Hall-Rivera, *A Lesson for Conservation from Pollution Control Law: Cooperative Federalism for Recovery under the Endangered Species Act*, 27

needed, though they must be done carefully so that the ESA's objectives remain intact, both as a powerful symbol and as an essential means for protecting biodiversity.

Another influential federal tool for environmental mitigation and restoration is the hydropower relicensing process overseen by the Federal Energy Regulatory Commission (FERC). Virtually all of the non-federal hydropower dams in the country are subject to periodic licensing by the FERC.[102] The relicensing process bristles with environmental considerations and has been used not only to reform operation of specific dams, but sometimes as a lever to force basin-wide reforms, including dam removal and major restoration efforts.[103] As a result, FERC has become a key focal point for efforts to restore ecological health to many river systems across the country. There is room for some improvement. The Commission's authority to order dam removal and restoration in appropriate cases could be clarified, and the Commission could be instructed to carefully consider the climate change and carbon emissions implications of its decisions. Also, the Commission's processes might be made more efficient and less burdensome on participants.[104]

E. The federal government should create a mechanism for systematic, periodic review of the operation of federal dams and other federal water projects, to ensure they are being managed to meet progressive objectives.

Federal water projects—those built and operated by the Bureau of Reclamation and the U.S. Army Corps of Engineers (COE)—are usually operated according to criteria worked out many decades ago to serve almost exclusively non-ecological objectives. The FERC relicensing process shows how systematic, periodic re-examination of water project operations can promote more ecologically sensible water management. But federal projects are not subject to such periodic re-examination. Congress could theoretically provide such scrutiny through its oversight function, but it has not because the forces favoring the status quo are too politically entrenched. The ESA

COLUM. J. ENVTL. L. 45, 98–105 (2002); *see generally* DANIEL POLLAK, CAL. RESEARCH BUREAU, NATURAL COMMUNITY CONSERVATION PLANNING: THE ORIGINS OF AN AMBITIOUS EXPERIMENT TO PROTECT ECOSYSTEMS (2001), available at http://www.library.ca.gov/crb/01/02/01-002.pdf. For a description of the program and recent reports regarding its efficacy, see California Department of Fish and Game, Natural Community Conservation Planning, http://www.dfg.ca.gov/habcon/nccp (last visited Nov. 16, 2008).

[102] FED. ENERGY REGULATORY COMM'N, HANDBOOK FOR HYDROELECTRIC PROJECT LICENSING AND 5 MW EXEMPTIONS FROM LICENSING 2-1 (2004), available at www.ferc.gov/industries/hydropower/gen-info/handbooks/licensing_handbook.pdf.

[103] *See* DOREMUS & TARLOCK, supra note 48, at 177–78.

[104] For example, ill-advised reforms sponsored by the hydropower industry and included in the 2005 Energy Policy Act have added many complications to its processes without adding corresponding value. *See* Adell Louise Amos, *Hydropower Reform and the Impact of the Energy Policy Act of 2005 on the Klamath Basin: Renewed Optimism or Same Old Song?*, 22 J. ENVTL. L. & LITIG. 1, 10–13 (2007).

can provide a trigger for re-evaluating federal project operations, but its scope is limited by its focus on particular species. The agencies themselves have sometimes been receptive to "greening" their operations,[105] but much remains to be done. Congress could create a tribunal (or perhaps borrow FERC and its processes for this purpose) to reauthorize—effectively, relicense—federal projects periodically.

F. The federal government should move with vigor to complete the process of quantifying Indian and other federal water rights, favoring negotiated settlements wherever possible.

The special category of water rights based on federal law has long been an irritant to states as well as other non-federal water users, largely because these rights have not been fully identified or quantified. Promptly finishing that task is a good idea for several reasons. First, it brings justice to Indian tribes, many of whose water rights have gone undetermined and unsatisfied for a century or more. Although Indian rights usually take priority over others, delaying their realization has meant that, ironically, the Indian tribes, without certain access to the water they are entitled to, must take on heavier burdens than others to meet the needs of endangered species.[106] Second, many federal water rights, such as those associated with national parks and wildlife refuges and those that satisfy Indian treaty rights to fish and hunt, correlate strongly with ecological health, so settling them can help improve ecological health. Third, the process of settling the claims can provide many opportunities for Indian and other federal interests to establish cooperation with states and other water users in water management matters.

X. Meeting Future Needs: The Illusion of New Surface Storage

For many decades the nation's preferred method of dealing with water supply challenges was simply to build new surface storage facilities. Although some are calling for a new dam-building program, that approach no longer works, and its pursuit distracts attention from more effective options. Just as the U.S. cannot drill its way to energy security, it cannot build its way to water security with more surface storage. The reasons the dam construction era largely ended four decades ago are still relevant today. One is cost: new surface storage tends to be very expensive to build. Moving earth, drilling rock, and making and pouring concrete are all sensitive to the price of energy and are otherwise not very susceptible to cost-saving efficiencies, so

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[105] The COE has, for example, worked with The Nature Conservancy on a "sustainable rivers" initiative. Press Release, The Nature Conservancy, *The Nature Conservancy and the U.S. Army Corps of Engineers Announce Partnership to Improve Management of U.S. Rivers* (2002), *available at* http://www.usace.army.mil/cw/hot_topics/ht_2002/nr-tnc-9jul.pdf (on file with the Harvard Law School Library).

[106] *See* Sax et al., *supra* note 26, at 991–92.

construction costs steadily escalate. Second, the best dam sites have been taken. Third, new dams do not produce new water; they only capture what nature makes available. Because the flows of most rivers (except for extraordinary floods) are nearly fully controlled by existing dams, new dams have extremely low marginal utility. Fourth, new dams tend to exacerbate rather than reduce adverse ecological impacts.

New water projects should most likely take the form of upgrades and perhaps enlargements of existing structures, facilities to reclaim water, new conveyance facilities to provide more flexibility of use, and underground storage and recovery projects. The latter have proved a success in a number of places.[107]

XI. Claims of Water Rights as Obstacles to Reform

Some traditional water users resist some of the reforms advocated here, arguing—in legislative, regulatory, and judicial settings—that such reforms "take" their historic and legally protected "rights" to use water. The argument largely rests on the perception, held by many, that water rights are well-defined property interests, sacred and impregnable. But the rhetoric of water "rights" far outstrips the reality. As noted earlier, rights to use of water are much more ill-defined, tenuous, and limited than rights to use land.[108] A plank in the progressive water policy platform should be to speak the truth about the nature of water rights to counter this misconception.

In fact, water "rights" have not dictated solutions for many disputes over water. Modern history is full of examples of public values trumping claims of private water rights—at Pyramid Lake in Nevada, Mono Lake in California, and the Klamath Basin on the California-Oregon border, to name a few. The courts have almost never awarded compensation for "takings" of private water rights when public values have limited their exercise.[109]

This is hardly to say that those claiming water "rights" are without influence in these conflicts. To the contrary, expectations on which people have built lives, an economy, and a culture are powerful political currency, even if they have not been translated into enforceable legal rights.[110] When the government acts to thwart those expectations, it almost always provides some form of financial largesse to help ease the transition to a new water regime. In the Klamath Basin, for example, the government used various

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[107] *See id.* at 490–506.

[108] *See* John D. Leshy, *A Conversation about Takings and Water Rights*, 83 Tex. L. Rev. 1985 (2004).

[109] *See* Doremus & Tarlock , *supra* note 49, at 100–103.

[110] Although no water right provides protection against drought or flood, water users, particularly in agriculture, have often persuaded the government to build water projects to protect them against such events.

means to compensate farmers for cutbacks in government water deliveries in order to protect endangered fish.[111]

Litigation is an inescapable part of water management, but the judicial role is necessarily limited. Courts can protect against arbitrary and capricious executive branch decisions; ensure that laws promoting public values like protecting endangered species are fully implemented; and protect senior water rights, like those of surface water users against later-initiated groundwater pumpers or those of Indian tribes against incursions by later arrivals. Nevertheless, courts cannot manage water supplies, for, as the California Supreme Court once noted, "[t]he scope and technical complexity of issues concerning water resource management are unequalled by virtually any other type of activity presented to the courts."[112]

Most conflicts over water will have to be resolved by other means, usually negotiations among interest groups and the political process. Such brokered solutions can often yield results unobtainable through the judicial process. Negotiations over Indian water rights have often resulted in creative solutions that the courts themselves could not craft, incorporating market-based transfers of water rights, federal dollars for efficiency improvements, and the like.

Conclusion

Climate change is a two-edged sword for U.S. water management. Its destabilizing effect on water supplies poses a huge challenge to water users and managers. But concern about climate change is also creating a more favorable political climate for adopting long needed reforms in water policy. If the national and state governments move soon to adopt the kinds of reforms identified here, the challenges ahead can be met.

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[111] *See* Doremus & Tarlock, supra note 49, at 19, 150–57.
[112] Envtl Defense Fund, Inc. v. E. Bay Mun. Util. Dist., 605 P.2d 1, 6 (Cal. 1980).