Dysfunctional Water Management: Causes and Solutions

Daniel P. Sheer, Ph.D., P.E., M.ASCE
10440 Shaker Dr., Columbia, MD 21044. E-mail: dsheer@hydrologics.net

Water is an increasingly precious but still poorly managed resource. There is no need to repeat the litany of ways in which water is vital to the survival of human society and the ecosystems on which we depend. Nor is it necessary to describe in detail how the needs for water, both real and perceived, have changed dramatically, particularly over the course of the last century. Yet the practice of water resources management falls abysmally short of the state of the art. Why? What are the obstacles we face? What can we, as water professionals, do about it?

I believe that the single largest obstacle is simple inertia—both a reluctance to change the way things are done because those ways have not failed dramatically in the past and an obsession with maintaining the status quo in terms of resource allocation. Reluctance to change is not entirely misguided; mistakes in water management can be very costly. But so are the consequences of maintaining the status quo. We cannot adapt to the dramatic changes in needs for water and in climate-change-induced water availability while maintaining the status quo in the way we manage water. In some cases, legal requirements exist to compensate those whose property rights in, or benefits from, water and related resources are diminished; in many cases they do not. Worse, in many cases there is no legal avenue to provide compensation for benefits lost. This leads those who feel they might lose to defend the status quo to the death—almost literally. Add to this the misperception that the allocation of the benefits of water management is a fixed-sum game (i.e., if someone gets something, all other beneficiaries must lose something), and changing the status quo becomes very difficult.

There are other obstacles as well: the basic structure of water management in the United States is simply counterproductive. When we understand the reasons why the current system is failing us, we can use that understanding to propose rational and realistic reforms. Our current slavish devotion to maintaining the status quo is a recipe for disaster.

The Problems

When talking about managing something, it is usually good to start with a proper appreciation of who owns or controls that something and what they want to achieve by managing it. Because most U.S. law derives from English law, it is fairly easy to identify the owner of the water. The states "own" the water. Under English law, the king owned all the water. The king, by custom, granted riparians the right to use the water, provided that their use didn't substantially interfere with the utility of the water for other users.

Prior to the industrial revolution in England, such interference was rare; there was a lot of water, and the population was limited. As the country industrialized, interference, especially due to pollution, became much more common, but it was generally ignored as unimportant, setting a precedent for not controlling the impacts of pollution. This precedent was the beginning of a long history of failing to define management objectives for water. Ignoring (even denying) the "public values" inherent in good management of water resources in favor of allowing anyone to use water for anything they individually desire has little consequence when and where water is found in surplus. It results in disastrous allocations of public resources when water is scarce.

The colonies (and the United States) adopted much of the English law regarding water. The states (representing the citizens) became the owners. Even with water rights in the West, the states still own the water. Water rights give their holders the right to use the water, but not the water itself. As the owners, states could have developed clear management objectives. They did not. In the eastern United States, water was plentiful and pollution continued to be ignored, as was, by then, traditional. In the West, things were a little different. In the West, water was scarce, but the idea of allowing anyone to use water for anything they desired (provided the use was "beneficial," a poorly and loosely defined concept if ever there was one) persisted. The States essentially institutionalized squatters' rights to use water in perpetuity as a property right, first-come, first-served. With the exception of promoting short- (and some long-) term economic development, current and future potential benefits to the owners of the water (the state and its citizens) were completely ignored—something no private entity would ever do. Well, hardly ever.

Worse yet, water rights were designed to be like squatters' rights to real property. Real estate doesn't move. Not surprisingly, water rights tend to greatly inhibit the movement of water use in time and space. This is because water rights law generally prohibits changes that adversely impact any existing water rights holder. Water flows downhill, so such impacts are virtually impossible to avoid if the timing or place of use of a water right is substantively changed. If water use cannot change, then it becomes much more difficult, even impossible, to adapt to changing economic, social, environmental, and (dare I say) political conditions.

The fact that water rights are property rights in the West creates another pernicious problem—theoretical overallocation. In many cases, water rights holders have water rights far in excess of the amount they actually use. In some basins in Texas, the ratio of "paper rights" to actual use approaches three to one. In theory, unused rights generally revert to the states. In practice, that rarely happens. Many states, including Texas, require that new rights be justified assuming that all the water in "paper rights" is actually used. Clearly, if all paper rights are assumed to be fully used, the cost of reservoirs and other facilities needed to make new rights reliable enough to be of value is much higher—sometimes enormously so—compared to what would be needed if current actual use were assumed. The requirement that full utilization of paper rights be the basis for water planning and granting of new rights imposes enormous, unnecessary costs on obtaining new water. It therefore drives up the value of existing rights, making it harder

to change the status quo while also making it harder for water rights holders to realize the value in existing rights (higher prices, less demand). I assert that many (certainly not all) perceived water shortages in the United States are caused more by our water rights systems than by hydrology.

West or East, the states—the owners of the water—have generally never identified and prioritized water use or allocation in a rational manner relative to the overall public interest. In fairness, doing so is not exactly easy, especially since the priorities are likely to be highly dependent on the watershed and because political and watershed boundaries rarely coincide. Regardless, without well-defined and prioritized objectives, good management is simply impossible.

The federal interest in water is different. The federal government generally (with some exceptions) does not own and has no claim to water. The federal interest in water management derives from three main sources: first, the resolution of disputes between the states—the Constitutional prerogative of the Supreme Court; second, the protection of interstate commerce—navigation and navigable waters and waters that impact navigable water; and third, the management of most of the largest water resource projects in the country.

The resolution of disputes between the states is not a matter of management, or even of reason. It is a matter of law. I believe it is fair (and an understatement) to say that the law on resolving disputes between states is "not settled," to use the legal jargon. It is extraordinarily hard to manage resources well in the absence of legal guidance. The situation leads to intentional mismanagement to support legal arguments in cases that may or may not be taken up at some time in the future. I'll leave it at that.

The protection of interstate commerce is what justifies the Clean Water Act, the Endangered Species Act, and the regulatory authorities of FEMA and FERC, among other things. I believe it is fair to say that Congress has considered the objectives of the many acts it has passed in this regard. I believe it is also fair to say that Congress has failed to state many of these objectives in a way that is clear enough to guide the management of resources. Worse, I believe it is also fair to say that Congress has largely failed to provide guidance as to how to balance the achievement of objectives when they conflict. This leads directly to management of resources being dictated by (often inconsistent and/or conflicting) judicial fiat(s). The lack of clarity of objectives can be worse in terms of management than no objectives at all.

The same problem exists when it comes to management of federal water projects. Management objectives are usually poorly specified in the authorizing legislation. When subsequent legislation has imposed additional objectives, usually no balancing guidance is given. In some cases, storage in projects has been arbitrarily allocated to particular purposes to make the cost/benefit and political numbers work. But in almost all of these cases, all the storage must be operated conjointly if any benefits are to be provided at all. In other words, the allocation of storage has little or nothing to do with the production of particular forms of benefits. It is no wonder that the agencies charged with managing these projects are constantly under pressure. The threat of lawsuits and the potential to incur the wrath of any one of 535 members of the U.S. Congress is compelling rationale for not making changes. Unfortunately, while that rationale is compelling, it is not in the national interest (and often not in the interest of the plaintiffs or constituents). It is, however, no wonder that it is impossible to adapt the utilization of vital federal water management facilities to changing needs and conditions.

Just as in the states, lack of legislative direction presents major obstacles to effective management of federal projects. Because the management of water is in major part a local issue, it is very hard to get Congress to focus on management of individual projects, especially existing ones. Improving management does not generate the kind of local political capital that funding new projects does. In fact, as will be discussed, the perception that some people will lose out can carry political costs. The political courage to make good management a priority is hard to come by. The ability to engage in the kind of rational debate over what water management priorities should be, and how they should be balanced, is in short supply.

As much as people like to win, they hate losing even more. When reacting to a water management change that benefits someone else, the normal reaction is "Hell, no!" based on the assumption that if someone else is better off, they themselves must be worse off. Most of the time, it isn't so. The good news is that much of the time it is relatively easy to make all parties better off. The bad news is that our current water management is so atrocious that much of the time it is relatively easy to make all parties better off. The point is that the perception that water management is a fixed-sum game is a large portion of the reason it is so hard to make management better.

There are four main reasons water management is not fixed-sum. First, water can be (and often is) used and reused many times before it evaporates or flows to the sea. Managing to exploit reuse can dramatically increase benefits. Second, in many cases the timing of water deliveries is as—or more—important than the total quantity. Improving timing can lead to more benefit from less water. In my experience, this is especially true for hydropower projects, where water supply and environmental benefits can be achieved with little impact on the value of power produced. Third, water management involves making trade-offs between different objectives, and often a large increase in one objective can be had with little or no decrease in others. Finally, individual water management stakeholders often have multiple objectives and can be compensated for a decrease in one objective with an increase in another.

The problem is that most stakeholders and water managers approach water from the standpoint of volume alone. Using volume as the only measure eliminates the ability to increase the size of the benefits pie, and often leads to unrealistic or even irrational perceptions of the conflicts between stakeholders. Water management is definitely not a fixed sum game. Water management disputes can be resolved much more easily, and sometimes only, when the discussions center on the mix of benefits provided, and not on allocating an arbitrary and fixed measure of water available.

Why Change the Status Quo?

The owners of the water and the water management facilities can achieve substantially more benefit by changing the status quo. The following are examples:

We can continue to draw down reservoirs to produce low-head hydropower. Or, the water could be stored in existing reservoirs and managed collaboratively by several utilities in lieu of building new, environmentally damaging facilities that cost orders of magnitude more than the value of the power lost (*e.g.*, Kansas River, KS). We could build six big new federal reservoirs at the cost of several billion dollars. Or, we can manage just one of those reservoirs in conjunction with three smaller reservoirs owned by local utilities to produce enough additional reliable

supply for the next 50 years (*e.g.*, Washington, D.C.). We could let six neighbor utilities all try to find enough water to meet their individual (and overstated) demand projections. Or, they could collaborate to find and manage enough water to meet a much smaller and realistic projection of their joint demands (*e.g.*, Las Vegas, NV). The potential is enormous. The value of our existing water infrastructure exceeds, by two to three orders of magnitude, the present value of our continuing investment in new infrastructure. Therefore, a small percentage increase in the benefits we get from the infrastructure we already have is worth much, much more than all the benefits we will get from new construction.

Why change the status quo? Do the math.

Potential Solutions

Collaborative Processes and Local Objectives

Any solution to the problem of improving water management in the United States must start with an effort to define objectives. Moreover, the objectives must be defined in a way that allows proposed management schemes to be evaluated. The evaluation should be framed in terms of how well those objectives are likely to be achieved. In water management, many of the major objectives are local, and these must be balanced with regional, state, and federal objectives as well. Fortunately, many techniques, including those of computer-aided dispute resolution (CADRe), computer-aided negotiation, and rapid dispute resolution, have been developed to help define objectives. In my own practice, I have found that having available libraries of displays that have been used in previous disputes can be very helpful.

All of these techniques require involving stakeholders. My firm, HydroLogics, has used a structured process to help resolve very complex, multiparty water disputes. The process has several steps, stakeholders are directly involved in every step, and the order of the steps is very important. The steps are (roughly):

1. Define management objectives in terms that can be evaluated and displayed clearly (graphs, charts, pictures, text). These can be qualitative as well as quantitative displays.
2. Decide on the science and data that will be used to evaluate alternative management strategies. Sometimes more than one method must be used to evaluate the same performance display.
3. Enumerate as many of the types of potential management options as possible to be sure that the evaluation techniques can evaluate them all.
4. Develop (or adapt) evaluation tools that can use the science and data to evaluate all the alternatives.
5. Test a wide range of options. Combine and refine the options to explore the trade-offs between the management objectives.
6. Attempt to reach consensus on an appropriate management strategy.
7. If the strategy requires legal action to allow implementation, change the law if possible. Existing law is not necessarily a binding constraint. Changing the law may be part of the solution.

At the federal level, the Federal Energy Regulatory Commission (FERC) has provided a process that encourages and expedites such efforts for relicensing of hydropower facilities. Because of the enormous revenue streams involved, it makes sense for the operators to figure out what the multiple management objectives are and how to manage effectively to achieve those objectives. At the state level, several states—I am most familiar with North Carolina—have implemented programs to analyze water management issues and to plan at a basin-wide scale.

All of these processes encourage stakeholders to collaborate in the creation and testing of alternatives. These are not administrative hearings or other types of adversary proceedings. This is crucial. In my opinion, adversary proceedings are highly unlikely to produce good alternatives. Adversarial processes force sides to take extreme positions, kill the spirit of compromise necessary to bring the experience and creativity of stakeholders to bear, and result in Solomon-like alternatives. Unfortunately, unlike the Bible story, in water resources those Solomon-like alternatives often actually get implemented. Legislation will be required to encourage—if not require—collaborative rather than adversarial processes in the design of water management alternatives.

This is not to say that adversarial processes can be eliminated. They will always be the last resort. Having them as a last resort can discourage participation in collaborative processes. Legislation that directs that the results of collaborative processes inform and be given preference in resulting adversarial processes should foster increasing levels of collaboration.

Better-Defined State and Federal Objectives

First and foremost, state and federal legislatures need to codify the following directive for managing and allocating water: water must be managed and allocated in real time and for the long term to provide the best possible mix of economic, social, and environmental benefits to the state and the nation. This seems so obvious that one would think it is in force already. Sorry, it's not.

Second, there needs be a listing of the benefits that qualify for consideration at the state and federal level. These must inform the collaborative processes described above. The listing of benefits could override the original authorized purposes of existing programs and projects, but need not; preference (but not absolute preference) could be given to the original purposes. Some direction as to limits on tradeoffs between these objectives also needs to be defined by the legislatures. Without such direction, the discretion can fall to the judiciary. Water policy should not be made by the judiciary.

Science cannot help to define our objectives. Objectives are based on our values. Science can define what needs to be done to achieve objectives, but that is a very different thing. Setting and balancing values for our society is a political responsibility. This difficult task needs to be tackled by the legislatures.

Rolling Reviews

Adaptation must be institutionalized. A legislatively mandated rolling review process for operation of federal and state projects; beneficial use of water in water rights; and balancing of environmental, social, and economic objectives for management and allocation of water resources could do just that. The effectiveness of the rolling review process itself could be evaluated in terms of additional benefits produced. Rolling reviews need to have a cycle of no more than a decade, in my opinion. Rolling reviews or no, economic investment requires that availability of water be assured for a reasonable length of time. That period is likely longer than a decade, and the rolling review process will need to accommodate that requirement. Legislation that allows fair (market value or investment recovery) compensation for benefits no longer supported by new management schemes is, to my mind, both essential and fair.

Water Markets

In the West, water is scarce and water rights are property. To allow water to move to new uses, water rights will need to be transferred, and markets allow for such transfers. But to be effective, trades will need to be regulated so that externalities to other users and to the environment are sufficiently controlled, and also so that traders cannot manipulate the markets. Designing such markets will require much thought, analysis, and testing. Legislation will likely be required to allow for stipulated compensation for small externalities to other users, to specify limits on externalities to the environment and other public uses, to prevent manipulation, and to charge for establishing and maintaining the market itself.

Getting It Done

Legislatures need to be motivated, and must have a means of dodging the inevitable political heat that will be generated.

Motivation

To get a serious hearing in a legislature one must usually ally oneself with powerful economic or public interest groups, or, even better, build a coalition of such groups. Such coalitions have been a part of every successful water management effort in which I have participated. As engineers, we can start the process of building a consensus that the measures described above are vital to successful management of water resources. The first steps in the process are reaching out to environmental and professional organizations and then mounting an information and lobbying effort. Persuasive case studies will be crucial to convincing legislatures to act.

Political Cover

Overhauling water management will be a difficult task for legislators to take on because of misperceptions and local and vested interests. Any powerful legislator will have near-veto power, and when two or more powerful legislators want different things, nothing gets done. That said, I believe that improving water management is at least as vital to our country's well-being as was the onerous task of closing and realigning military bases. The Base Realignment and Closing Commission (BRAC) was created by Congress to provide the necessary political cover for that task. I believe a similar institution could reformulate water operations

Conclusion

History has endowed us with dysfunctional institutions and legal structures for water management. Existing structures do not allow us to adapt our management of water resources to changing needs and hydrologic conditions. A large part of the problem is the lack of clear management objectives for a publicly-owned resource. Reliance on adversarial processes to develop management solutions hinders our ability to create win-win outcomes. Institutionalizing the use of collaborative processes as the primary means of making water management decisions, establishing clear and understandable federal and state management objectives and tradeoffs, providing for rolling reviews of the operation of water management facilities and water allocation policies, and, in the West, establishing of functional water markets would go a long way toward improving management. Implementing these recommendations will take a concerted educational and lobbying campaign and may require a BRAC-like commission to provide recommendations for legislative action.