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Getting Outside the Water Box: The Need for New Approaches to Water Planning and Policy

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North American water systems are inadequately prepared to deal with an uncertain future climate and other uncertainties relevant to long-term sustainability. Despite Milly et al.'s (2008) dramatic proclamation in the February 2008 issue of *Science* that stationarity—the idea that natural systems function within a known envelope of variability—is dead, the water resources community has been slow to embrace new paradigms for long-term water planning and policy. Too much attention has been focused on reducing, clarifying, and representing climatic uncertainty and too little attention has been directed to building capacity to accommodate uncertainty and change. Given the limited ability to forecast the future climate, emphasis must shift to the human actors and social dynamics of water systems, including planning processes, work practices, operational rules, public attitudes, and stakeholder engagement.

Many in the water management community have been led to believe that climate adaptation is primarily a science problem—that we need to wait for the results of new rounds of climate modeling and downscaling to reduce uncertainties about future climate conditions. Trenberth (2010), however, has noted that, as our knowledge of the climate system increases, so also has our understanding of factors we previously did not account for or even recognize, such as the release of greenhouse gases from melting permafrost, the fertilizing effect of atmospheric carbon dioxide on vegetation, and the effects of aerosols on clouds. As climate models begin to incorporate these processes, they will inevitably disagree about the nature, extent, and geographic patterns of climate-change impacts. Decision makers will be confronted with more, not less, uncertainty about the future climate.

This uncertainty is problematic for an industry that has traditionally relied on predict-and-plan methods of operations and management. Water planning usually involves forecasting future trends or desired states and then identifying the infrastructure needed to support them. Optimization models, the favored tools of water planners worldwide, seek the most efficient

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allocation across sectors and the most cost-effective investment strategies, but they assume that key features of systems can be predicted. This approach worked well when social and environmental systems were stable, but today's uncertainties about key features of the water system (e.g., climate, land use, lifestyles, population change, housing prices, economic recession) are too large and systems are far too complex for this strategy to work in the future.

The industry also is plagued by conservative decision-making. Several anthropological studies have explored the social dynamics of large water organizations in the USA. Rayner et al. (2005) concluded that decision making is strongly influenced by the need for reliability—the assurance that water is always available when domestic customers turn on their taps, during critical times in farmers' growing seasons, for fish at low stream flow, and to turn turbines of hydroelectric power plants at peak domestic demand. Reliability is supported by an internal culture that favors craft skills based on idiosyncratic local knowledge and experience, little turnover in employment, and low risk tolerance. The penchant for reliability has caused the water community to respond to the need for adaptation with tepid experiments and innovation at the margins. Lach et al. (2005) portrayed water organizations as populated by engineers who create infrastructure, lawyers who secure water allocations, and economists who develop profitable or efficient pricing schemes. When faced with a problem, the favored strategy is to build new infrastructure and acquire new water rights. Water agencies also are averse to public scrutiny; they gauge success by the absence of public debate and public attention.

UNESCO's World Water Development Report 3, *Water in a Changing World*, calls for "getting outside the box—linking water to decisions for sustainable development." Acknowledging the key role of water in agricultural, energy, and urban development, the study concluded that many important water decisions are made by actors in government, civil society, and business outside the water sector (World Water Assessment Programme 2009). In urban areas, de facto water decisions are made by the land planners who decide what type of development they will approve. The term "suburban drought" conveys the idea that water deficit can stem from shifts in land development patterns that favor water-intensive lawn care in low-density suburban settlements rather than from rainfall or soil conditions (Hill and Polsky 2007). Unfortunately, land and water are managed separately in most cities because of organizational and cultural differences between water utilities designed to provide services to municipal customers and planning agencies intended for land use regulation (Gober et al. 2012).

Building resilience and adaptive capacity into the water sector will involve getting outside the water box. One path forward is to embrace principles of decision making under uncertainty (DMUU), including exploratory modeling of alternative futures, searching for robust strategies that work well across a range of future climate conditions, and using foresight and flexibility to anticipate adaptation strategies and monitor change (Lempert et al. 2003; Quay 2010; Gober et al. 2010). Getting outside the box also recognizes that adaptation is not only about future climate conditions but also a range of uncertainties related to lifestyle preferences, growth prospects, and public attitudes. DMUU strategies change the research and policy question from what is the most likely future to what kind of future do we want and what decisions do we need to make to get there. These questions are political, not scientific; they require participation from a very wide range of water stakeholders—from farmers, industries, and municipal water providers and customers to environmental groups and linked land and energy sectors. Engaging these diverse stakeholders in an iterative, long-term discussion about the future of water systems is essential for deciding how much risk of deficit we are willing to take and what sacrifices we are willing to make to mitigate this risk.

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