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# Maintaining the Status Quo: How Institutional Norms and Practices Create Conservative Water Organizations

Denise Lach,[*] Helen Ingram,[**] and Steve Rayner[***]

## I. Introduction

Water managers are falling behind in the race to resolve mounting troubles. Adverse environmental and social consequences of past management practices are evidenced by endangered species' lost habitats, the billions of people without access to clean water or sanitation services,[1] and fierce competition among advocates for the use of diminishing water resources. Observers of these and other water problems have been predicting and often advocating fundamental changes in the way we manage water resources.[2]

Such extreme stress on water organizations would seem to be the appropriate context for innovation, and water analysts have suggested a number of techno-scientific, legal, and behavioral modifications that could be adopted in managing water resources. Advances in water metering and pricing could enable water utilities to reduce water demands. Water transfers could ensure that scarce water is used for its highest value. Privatization of water utilities and the substitution of markets for public agency control could introduce economic discipline into water use. Such advances could postpone expensive and environmentally damaging infrastructure construction or even make it unnecessary.

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1. IN SEARCH OF SUSTAINABLE WATER MANAGEMENT: INTERNATIONAL LESSONS FOR THE AMERICAN WEST AND BEYOND (D. Kenney ed., forthcoming 2005); WORLD WATER ASSESSMENT PROGRAMME, UNITED NATIONS, WATER FOR PEOPLE, WATER FOR LIFE: A JOINT REPORT BY THE TWENTY-THREE AGENCIES CONCERNED WITH FRESHWATER 100–23 (2003).

2. *See* TERRY L. ANDERSON & DONALD R. LEAL, FREE MARKET ENVIRONMENTALISM 103–05 (2001) (advocating for more clearly defined and enforced property rights in water); COMM. ON PRIVATIZATION OF WATER SERVS. IN THE U.S., NAT'L RESEARCH COUNCIL, PRIVATIZATION OF WATER SERVICES IN THE UNITED STATES: AN ASSESSMENT OF ISSUES AND EXPERIENCE 111 (2002) (concluding that the presence of private alternatives has motivated improved performance of public utilities and will likely continue to do so); Charles W. Howe et al., *Innovative Approaches to Water Allocation: The Potential for Water Markets*, 22 WATER RESOURCES RES. 439, 439 (1986) (arguing that water markets often possess more desirable characteristics for resource allocation than available alternatives).

We found in our research, however, that existing U.S. water organizations' responses to mounting stressors have been timid experiments with incremental and marginal innovation. Left in place are the longstanding norms and practices that have brought us to the current condition. Many challenges have been met not with technical, legal, or behavioral innovations but with changes in organizational linkages and relationships so that risks inherent in unstable political and physical environments are spread across a wider range of organizations and stakeholders. These new arrangements leave much of the water agencies' structure and behavior unchanged and many problems unresolved.

In the Parts that follow, we explain the methodology we used to explore institutional norms of water agencies in three geographically separate regions. A description of the traditional response of water agencies to what were perceived as ordinary or tame problems will follow. The notion of extraordinarily complex or "wicked" problems will be introduced along with a description of three distinctive strategies for addressing these challenges. The article concludes by assessing the consequences of the strategies that agencies have adopted to respond to changing pressures and constituents.

## II. Methodology

The data for this Article were collected through semi-structured interviews[3] in three locations: the Columbia River system of the Pacific Northwest, the Metropolitan Water District of southern California, and the Potomac River Basin/Chesapeake Bay in the Washington, D.C. metropolitan area. We were funded by the U.S. National Oceanic and Atmospheric Agency Human Dimensions of Global Change Project to examine how water organizations were integrating a sociotechnical innovation in the types of climate forecast products available to water managers. While we did not find much use or interest for the new products, we were able to learn how institutions in water organization are structured to manage changing conditions.

We conducted about 120 interviews with regional staff of federal agencies, regional management organizations, water supply companies, wastewater disposal companies, and emergency management organizations. We also conducted interviews with environmental groups and tribal representatives. Organizations ranged in size from very small water utilities (with less than 15 staff members) to large bureaucratic organizations (such as the Metropolitan Water District in Los Angeles). Sampling for these interviews was nonrandom, variously described as theoretical[4] or purposeful.[5]

3. *See generally* JAMES P. SPRADLEY, THE ETHNOGRAPHIC INTERVIEW (1979) (discussing ethnography and providing a somewhat step-by-step approach to conducting such investigative interviews).

4. *See* BARNEY G. GLASER & ANSELM L. STRAUSS, THE DISCOVERY OF GROUNDED THEORY: STRATEGIES FOR QUALITATIVE RESEARCH 45–77 (1967) (discussing "theoretical sampling" and defining the process as data collection that changes and develops with the "theory as it emerges");

With the assistance of key informants at several institutions, we used snowball sampling to identify others in the social networks within and among organizations in these basins. The approximately ninety-minute interviews were conducted in person by two researchers to reduce interviewer bias. We have modified quotes from respondents as necessary to protect identities.[6] Initial results of our analysis were presented to a focus panel of water resource managers at the Annual Meeting of the Water Resources Planning and Management Division of the American Society of Civil Engineers in 1999. Panel members indicated that our results would resonate with and find widespread acceptance among the water resource management community in the United States.

## III. Institutional Norms and Organizational Practices

Institutions are the clusters of norms and values that are established and strongly supported by group consensus; they carry with them strong sanctions for violation. To become effective lawyers, academics, teachers, or members of any social group, we need to internalize and act on the norms governing the behaviors of the group or face the often negative consequences. Continued reproduction of any institution relies on normalized behavior. While institutions are obviously a source of social stability, they also constantly evolve at both local and global levels because they are created through ongoing social interactions in multiple and changing contexts. During institutional change and transformation, we expect conflict and struggle to gain the legitimacy and authority to reshape norms. A contemporary example showing how stable institutions face constant challenge, evolution, and revision is the debate about defining family and marriage in the United States. Water resource management in the United States is a complicated business. The natural hydrology is often complex, and built systems of supply, use, and recovery have become complicated through aggregation, consolidation, and changing technology. Organizational fragmentation and specialization exacerbate the complexity of these physical characteristics. Each water organization must deal with many other actors, leading to a dense network of connections and interactions among

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*see also* MICHAEL H. AGAR, SPEAKING OF ETHNOGRAPHY 18 (1986) (noting how "ethnographies are . . . a function of the group" studied and how certain actions by or conversations with group members can lead to further research and discoveries).

5. *See* MICHAEL QUINN PATTON, QUALITATIVE EVALUATION METHODS 100–01 (1980) (discussing the differences between random and purposeful sampling and explaining that purposeful sampling is a strategy used to learn in-depth, detailed information about certain select cases without needing to generalize to all such cases).

6. Transcripts of these interviews are protected under Human Subjects guidelines, which prohibit releasing the transcripts to anyone who has not been approved by the Review Committee. These regulations are designed both to protect research respondents and to protect researchers who may find out about questionable behavior during research projects. Because of this unique requirement, propositions throughout the text have not been individually footnoted to specific interviews. All transcripts are on file with the authors.

parties. Making progress toward one organization's mission often involves negative impacts on other organizations, which has traditionally been characterized as the externalization of the originating agency's problems.

In addition, water is not the most reliable resource and often is not where one needs it to be. An unpredictable and inconveniently located resource creates the potential for many events or crises such as drought, flood, contamination, and species endangerment that can impact water supplies and distribution. To deal with this unpredictable resource, water organizations in the three water basins we studied have evolved to attenuate or mitigate crises through infrastructure and organizational processes that offset uncertainty, smooth out fluctuations, and make water more predictable.

The understanding of water as an unpredictable resource is buried deep in the norms of the water resource organizations we talked with—it is an institutionalized way of knowing water. That understanding is manifest in the way water agencies develop infrastructure, agreements, and relationships to control the expected irregularity of water. Seeing water as unpredictable has resulted in an extremely conservative approach to risk and decisionmaking among the agencies in these three water basins. The conservatism is supported and reproduced through three specific organizational practices: routinization of the irregular, dependency on craft skills and local knowledge, and adherence to a hierarchy of values designed to ensure reliability.

### *A. Routinization of the Irregular*

Water organizations in the United States have evolved precisely to attenuate the impacts of weather and other factors that shape the irregularity of water availability and quality. Whether focused on drinking water supply, flood control, navigation, energy production, or ecosystem health, water management's goal is to smooth out fluctuations in the system. The principal historical means used to achieve this goal is redundancy in capacity. For example, the Columbia River system currently has more than 250 reservoirs and 100 hydroelectric projects,[7] all of which were designed to reduce uncertainty in the production of electricity.[8]

Water organizations also consider irregular or infrequent events endemic to water resources in routine decisionmaking. In the Potomac watershed, which serves Washington, D.C., each agency considers the worst drought in history as the baseline for planning, designing, and operating its

7. Edward L. Miles et al., *Pacific Northwest Regional Assessment: The Impacts of Climate Variability and Climate Change on the Water Resources of the Columbia River Basin*, 36 J. AM. WATER RESOURCES ASS'N 399, 410 (2000).

8. *See* BONNEVILLE POWER ADMIN. ET AL., THE COLUMBIA RIVER SYSTEM: INSIDE STORY 9 (2d ed. 2001) (noting that the main purpose of the Columbia River system's dam storage reservoirs is to adjust the river's natural flow patterns to conform more closely to water and energy-demand users), *available at* http://www.bpa.gov/power/pg/columbia_river_inside_story.pdf.

system. At the time of our research, conditions matched the worst drought on record only in 1982. Yet it is perceived as prudent and wise management to create a water system that can respond to the worst case scenario regardless of how many times—or even if—the scenario occurs. It is unlikely that a water organization or water professional would criticize the plan and design of this system, regardless of its cost and efficiency, because it is the standard in the industry.

Water agencies generally operate with very long time horizons. Historically, large-scale infrastructure (e.g., dams, levees, canals, reservoirs) has been the principal tool to manage water resources.[9] Planning these major structures often requires decades of preparatory reconnaissance and feasibility studies. Once planned, these facilities may take even more time to construct. Physical changes to the system have potentially long-lasting effects, with costs and benefits assumed to accrue for fifty years or more, during which time the facilities must be operated and maintained.[10]

Institutional norms and rules are cautionary; structures are designed to deliver reliable services for many decades and pathogens are often regulated at parts per billion regardless of health risks. The process to invent new methods and tools for use in water resource agencies also involves a period of extensive analysis and testing. Due to the difficulty of testing new methods in a system that has to be failproof, there is an enormous time gap between idea and implementation.

### *B. Reliance on Craft Skills and Local Knowledge*

U.S. water systems are extraordinarily diverse and are perceived by the managers we interviewed as highly sensitive to local conditions. Respondents told us that it is not unusual for new personnel to take three to ten years to become familiar with a system's peculiarities. One official at a water supply utility in northern Virginia told us that it took several years for employees to become fully versed in the system. Craft skills—the problem solving abilities born of experience with a particular problem in a particular locale—are highly valued by water agencies. The need for craft skills was voiced throughout the three study areas. Even for techno-scientific fields, craft skills are emphasized; an official in the Department of Water Resources in California reported that long, intense interaction with the models used by the Department was the only way to comprehend them well.

A direct result of this normative practice is that new employees are mentored in the agency's ways for a lengthy period of time until they not

9. *See* NAT'L RESEARCH COUNCIL, NEW STRATEGIES FOR AMERICA'S WATERSHEDS vii (1999) (noting how "trillions of dollars" have been spent on such "machines of water control").

10. *See* DEP'T OF THE ARMY CORPS OF ENGINEERS, CIVIL WORKS PROGRAM STRATEGIC PLAN: FY 2003–FY 2008 DRAFT 12 (2002) (noting that the Corps assumes a 50-year design life for its water resources infrastructure), *available at* http://www.iwr.usace.army.mil/iwr/strategicplan/strategicplan.pdf.

only know the system but also are imbued with the agency's outlook. This tends to ensure long-term stability in the decisionmaking process, a focus on the long-term mission of the agency, and potentially, a lack of innovation or even motivation to innovate.

### *C. Hierarchy of Values: Reliability, Quality, Cost*

Most U.S. citizens expect water systems to be foolproof and fail-safe. Uniform excellence in the delivery of water is universally demanded. We found that these performance expectations give rise to a particular configuration of values. Water managers at all levels and in all organizations we interviewed consistently described a common hierarchy of values for managing water resources: reliability, quality, and cost.

Reliability for these managers means meeting several, often conflicting, demands: (1) water that is always there when the customer turns on the faucet; (2) water for crops on the most critical days of the growing season; (3) water for fish at the lowest stream flow; (4) water to generate hydroelectricity when demand is at peak; and (5) no substantial loss of life or property in the worst flood.

At one California water supply agency, officials said that their agency's mission statement included customer satisfaction, reliability, good service, cost effectiveness, and employee satisfaction. When pressed to explain the source of customer satisfaction, reliability was identified as "job one." An official of a water supply agency in the greater Washington, D.C. metropolitan region told us that 100% reliability was expected. Reliable water supplies are required even in the desert where one California official told us his job description was to make certain that limitations on water supply never become impediments to further suburban development.

We heard virtually the same values and expectations at other water organizations in all three study areas. Agencies dealing with other water functions also emphasized that reliability was their top concern although they seemed to have greater degrees of freedom with regard to performance. For example, fish populations are allowed to vary or decline so long as they do not become endangered. Supplies for agriculture can vary, but only within limits, as lack of availability during critical periods may mean losing an entire crop.

Water quality placed a close second in importance behind reliability. Again, municipal water utility managers seemed tightly constrained by this value, for the water they deliver must be safe for human consumption. Water quality is typically dictated by human and environmental health standards set by agencies external to water organizations; failure to provide high quality water results in fiscal penalties and, as described below, public attention and sanction.

Cost ranks third in the hierarchy of values. According to our respondents, costs should be minimized within the essential and absolutely

binding constraints of reliability and quality. The water supply industry has historically tried to supply low-cost water to users. It has been a fundamental tenet of politicians and industry managers that equity demands should be considered so that no one is priced out of the market. Moreover, the large structural projects erected by the federal government throughout the 20th century have spread costs over a variety of purposes, many constituencies, and long periods of time. Consequently, water rates for actual users in many places are lower than the cost of service. While costs are currently rising in some jurisdictions, they still remain very low compared to other essential or common necessities such as lighting, heating and cooling, transportation, and telecommunication.

Sharp rate increases or perceived high rates are likely to make water customers hypercritical. Therefore, any increase must be justified in terms of reliability and quality improvements. In one southwestern city, sharp increases resulted in the recall of three city council members and the resignation of a fourth.[11] One utility in our study had increased its rates high enough to become one of the ten highest priced suppliers in the United States. An official of this utility stated that its performance was barely acceptable. Should there be "a screw-up in supply, all hell will break loose."[12]

Any adverse change in reliability, quality, or cost is likely to attract unwelcome attention from consumers, bureaucrats, and elected officials. We heard from our respondents that declines in reliability attract more complaints than declines in quality, and declines in quality attract more attention than increases in cost. Because suppliers typically deliver a highly reliable product, customers are reminded only infrequently that the resource is in any way limited. Moreover, water quality is protected by health and environmental regulations, making public attention rare. Finally, agencies can truthfully state they are concerned about cost and are constantly seeking minimum cost solutions, further allaying public concerns. The result of this successful performance to meet institutional norms is that water organizations maintain a low exposure to the glare of publicity. In fact, they are practically invisible.

One of the questions we asked respondents was how they knew they were doing a good job. They told us that they know they are doing a good job when "customers aren't storming the building" or "the governor's not calling my boss."[13] Success means not being noticed. Water managers told us they especially want to stay well below the radar screens of the press and environmental groups, two groups most likely to disseminate news of system failure. One water utility we examined, for example, could legally dispose of solids accumulated during the treatment process back into the river that was

11. WILLIAM E. MARTIN ET AL., SAVING WATER IN A DESERT CITY 20–22 (1984).
12. Interview on file with author.
13. Interview on file with author.

the source of the water. Instead, it routinely chose to wait until flows in the river were sufficiently high to avoid notice. Managers feared that the introduction of solids into the river from the plant would arouse public attention and be perceived as a problem.

The result is that water agencies rarely land on the local newspaper's front page or attract large numbers to public hearings. These events typically happen only when institutional norms have been violated and "all hell has broken loose." Consequently, managers of well-run water organizations tend to perceive any public attention as negative.

## IV. Conservatism and Institutional Risk Management Behavior

In the three study areas, water resource managers are driven by institutional norms and practices that enhance the reliability of a resource perceived as unpredictable. They gauge their success by the absence of political or public attention. We found that water resource managers' hierarchy of values, long-term planning horizons, and need for local knowledge result in a highly conservative decisionmaking environment.

This conservative disposition combined with fragmented organizational responsibilities has led to a sector-wide approach of incremental adaptation (i.e., doing more or less of current activities) rather than innovation (i.e., implementing completely different practices from those currently in use). For example, we found that reclaimed water not treated to potable standards is emerging as a new water source in arid areas, but that it is primarily used for outdoor irrigation of lawns, decorative plants, and golf courses.

Some agencies, such as the Corps of Engineers, have recently been changing their focus from large infrastructure development to more efficient use of existing resources. As one interviewee put it, "The Corps' mentality has changed. The move is away from a construction project development model to looking at nonstructural alternatives."[14] In principle, this shift would seem to offer opportunities to change the way water is managed. However, we found that the water agencies we examined, including the Corps, were reluctant to move into aggressive or innovative adaptation.

## V. Introducing Change in Conservative Water Organizations

The values and norms expressed by water agency officials are manifest in their organizations as an aversion to activities that may lead to unreliable water delivery. These organizations remain satisfied with incremental change. When we asked for criteria against which adoption of significant change might be measured, we were consistently told that innovations had to deliver results that were no worse than current conditions—not very high expectations for an innovation!

14. Interview on file with author.

Innovation must also be compatible with the current craft skills of the organization. As described above, water management is understood to be as much craft as science.[15] We found that while many ideas and technologies are copied from one organization to another, and there is an industry standard of good practice, most changes are vetted by "old timers" at each organization before they are put into practice. If they do not "feel right," or if the changes are not compatible with the "way things are done here," innovations often remain on the shelf, especially if experienced members oppose the changes.

Yet demands on water organizations continue not only to increase but also to change as social priorities shift. We uncovered three distinct strategies for managing the changing demands on water organizations, each of which has interesting and important implications for the future development of water resource management in the United States. These three strategies are not alternative paths along which the field of water resource management might evolve. Nor are they distinct developmental stages through which the field can be expected to pass. Rather, they are coexisting strategies that each organization or suite of organizations employ, depending on contextual drivers.

### *A. Reducing Natural System Complexity*

The first organizational response to changing demands involves reducing natural system complexity to reflect only those purposes the organization deems essential. Water is a resource to be managed by the organization to serve the needs of its "clients"—the public, farmers, fish, and industry. Client needs become the organization's mission, and geographical jurisdiction and service scope are established to serve the narrowly defined purpose. Municipal water agencies and irrigation districts, for example, are bounded by the service area of their customers. While hydropower producers may be able to ship their products long distances, their missions are just as narrowly focused to serve their customers. These organizations focus upon removing as much risk as possible—making the system reliable, high-quality, and low-cost for those they serve—regardless of the impacts to others outside their functional and geographic jurisdictions.

Narrowly focused water organizations in the three basins we examined tend to be populated by engineers who create infrastructure, lawyers who secure water allocation rights, and economists who develop equitable or profitable allocation schemes. One prominent water consultant described this arrangement: "When I went to work for the California Division of Water Resources in l953 the staff consisted of several hundred engineers, one or two economists, no water quality professionals, no biologists (ecology was not yet recognized), no political scientists, and no land use planners." When

15. *See* discussion *supra* subpart III(B).

faced with emerging problems, the solution set for these experts tends to be the construction of structural facilities and allocation of secure property rights, all designed to reduce risk and impose order on the unpredictable resource.

One of the most nakedly ambitious versions of this strategy is found in the water history of the City of Los Angeles and southern California. As early as the 1870s, the City of Los Angeles laid claim to the total supply of the Los Angeles River.[16] The city declared war upon upstream users and won a series of court victories.[17] What it could not achieve through the courts, it won by an aggressive campaign of land annexation.[18] Expanding the city's boundaries was seen as a way of justifying—indeed requiring—more water to build an even more magnificent metropolis.[19] As one official noted, "If you don't get the water, you won't need it."[20] Predictably, this expansion in geographic scope required massive physical infrastructure, out of which evolved a tangled web of organizations charged with overlapping jurisdictions and claims.[21] While neither of the other basins we studied had quite the cinema-worthy annexation history, organizations in both areas secured their resources through ambitious infrastructure development schemes.

Narrowly focused water organizations are typically hierarchical in nature, with clear lines of responsibility. Any challenges to or innovations in existing organizational policies or practices usually come vertically from other organizations. Competing organizations also challenge each other over

16. VINCENT OSTROM, WATER & POLITICS: A STUDY OF WATER POLICIES AND ADMINISTRATION IN THE DEVELOPMENT OF LOS ANGELES 33–35 (1953) (discussing the city's sweeping claim of pueblo rights in the charter amendment, the acceptance by the state and federal courts, and further expansion of the concept); *see* Peter L. Reich, *Mission Revival Jurisprudence: State Courts and Hispanic Water Law Since 1850*, 69 WASH. L. REV. 869, 885 (1994) (citing to the charter amendment, 1874 Cal. Stat. ch. 447, art. 2, § 1, that gave the city exclusive ownership of all water flowing in the Los Angeles River).

17. *See, e.g.*, Feliz v. City of Los Angeles, 58 Cal. 73, 77 (1881) (acknowledging the city's exclusive control and ownership of the Los Angeles River due to longstanding recognition of and allowance by landowners); *see also* Reich, *supra* note 16, at 885–97 (discussing a number of pre-1900 Los Angeles cases that solidified municipal ownership rights over the Los Angeles River).

18. *See* ROBERT M. FOGELSON, THE FRAGMENTED METROPOLIS: LOS ANGELES, 1850–1930, at 226–27 (1993) (outlining the territorial expansion of Los Angeles from 1850 to 1930); Reich, *supra* note 16, at 897–98 (noting the expansion of Los Angeles from 1900 to 1930 due to annexation).

19. *See* FOGELSON, *supra* note 18, at xvi (stating that the "Los Angeles elite" invested to provide the city with an "essential infrastructure"—including water facilities—in order to attract growth, not in response to growth).

20. Interview on file with author. The official's statement was probably inspired by the legendary and controversial William Mulholland, who was instrumental in constructing the Owens River aqueduct. Mulholland reputedly stated: "If you don't get the water now, you won't need it. The dead never get thirsty." MARGARET LESLIE DAVIS, RIVERS IN THE DESERT: WILLIAM MULHOLLAND AND THE INVENTING OF LOS ANGELES 31 (1993).

21. *See, e.g.*, FOGELSON, *supra* note 18, at 171 (discussing how the overlapping management of the street railway led to "discrimination in service and duplication in administration").

the control of resources in order to impose their particular mission. Such battles are often fought in the courts to determine the allocation of water rights. "Success" in these battles often translates into limitations upon the use of water for one or more organizational "losers," who then initiate a search to identify additional sources of secure water. This results in very large systems with redundant sources of supply and increasingly serious side effects, such as those we observed in the three study basins.

Implementing organizational changes to address side effects of management systems or increasing competition for the resource, however, is difficult given the institutional norms and practices described above. It is often unclear to individual organizations how their own or others' innovations will affect the increasingly complex infrastructure and organizational networks of modern water management systems. Our respondents told us that while gains may be possible, it is just as easy to envision costly mistakes that violate all institutional values.

We found that change in these organizations most often originates from inside (i.e., current employees), and as long as the change stays within accepted boundaries of existing practices, a rich information base of experience is available for the change effort. Innovations that are more challenging to accepted practices and arrangements might receive impetus for action from outside (i.e., best practices of industry), although any actual change in a narrowly focused organization is most likely "homegrown" in its design and implementation. When asked to identify examples of innovation, most agency officials readily identified changes they thought were important, and many proudly told us that they thought of their organizations as being "on the cutting edge."

In talking with agency officials, however, we quickly learned that what many identified as important technical, organizational, or behavioral changes were more accurately characterized as incremental modifications. For example, innovations cataloged by our respondents included purchasing an additional sandbag-filling device in preparation for future El Niño events, installing propellers in reservoir tanks to discourage the build up of bacteria on reservoir walls, and acquiring a silt removal machine to improve recharge in infiltration basins. While these technological changes may assist in managing resources, none of these "innovations" challenged any existing norms or practices.

Our respondents most frequently mentioned environmental and health regulations as forces driving change. The Chesapeake Bay Program, for example, was legally required by the Clean Water Act to effect a 40% reduction in phosphorus and nitrate loading.[22] In response to the Endangered

22. The Clean Water Act requires each state to adopt water quality standards, submit them for approval to the Environmental Protection Agency, and review these standards at least every three years. 33 U.S.C. § 1313 (2000). In accordance with this mandate, in 1987 the Chesapeake Bay Program agreed to "develop, adopt, and begin implementation of a basin-wide strategy to equitably

Species Act listing of delta smelt, water deliveries to the Central Valley of California were interrupted for a considerable period because the tiny fish were being drawn into the intake valves of pumps.[23] New organizations with missions in fundamental conflict with the water industry, like these environmental regulatory agencies, are voicing demands that cannot be accommodated through the norms and practices of narrowly focused water organizations. The California Coastal Commission, for example, which regulates shoreline development, was the result of citizen initiative and now plays a role in promulgating regulations that impose innovation upon water agencies.[24] The ratcheting up of water quality and wildlife protection regulations by state and federal agencies means that routines and standard operating procedures need to be continually reexamined, altered, and sometimes changed through incremental or innovative methods.

Decreasing options under existing practices could translate into a favorable context for innovation. However, narrowly focused organizations, with institutional norms and practices that promote reliability, are more likely to adopt something familiar rather than something new—even if it shows great promise. Institutional norms and practices allow—maybe even require—water resources agencies to be satisfied with incremental change. It was not acceptable, for example, for a utility to adopt a water treatment technology that in the long run resulted in better water quality, if in the short run a visible sacrifice was made in the smell, clarity, or taste of water supplies to households. Delivering "junky" water, even if perfectly safe to drink, might well provoke the kind of public outcry that water organizations work most ardently to avoid.

Water managers also understand that successful change requires compatibility with current craft skills in the organization. They reported that the unique nature of their watershed combined with complicated infrastructures means that operators must be able to integrate any innovations

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achieve by the year 2000 at least a 40 percent reduction of nitrogen and phosphorous entering the main stem of the Chesapeake Bay." *See* 1987 Chesapeake Bay Agreement 3 (on file with author).

23. *See* Tulare Lake Basin Water Storage Dist. v. United States, 49 Fed. Cl. 313, 315 (2001) (noting that federal restrictions on "the time and manner of [water] pumping" designed to protect the delta smelt "limited the water otherwise available to the water distribution systems [in Central California]"); Holly Doremus, *Water, Population Growth, and Endangered Species in the West*, 72 U. COLO. L. REV. 361, 375 (2001) (referring to the "minor water crisis" that followed pumping reductions designed to aid the delta smelt that "had lingered in the vicinity of the pumps later in the season than expected"); Douglas E. Noll, *Searching for the Zone of Reasonableness*, 8 SAN JOAQUIN AGRIC. L. REV. 59, 71 n.55 (1998) (identifying the risk that in the absence of pumping restrictions, "migrating delta smelt are sucked into the pumps instead of making their way out to the Delta").

24. *See* Michael Niederbach, *Transferable Public Rights: Reconciling Public Rights and Private Property*, 37 BUFF. L. REV. 899, 911 (1988–89) (describing Proposition 20, an initiative passed by California voters in 1972 that established the predecessor to the California Coastal Commission); California Coastal Commission, Program Overview, *at* http://www.coastal.ca.gov/whoweare.html (explaining the role that the Commission's regulations have played in altering coastal management strategies).

into a system that is understood as sensitive and idiosyncratic. The capacity of craft skills to absorb innovation also limits the type and speed of change within narrowly focused organizations.

While the scope and depth of change that is possible in narrowly focused water agencies is quite limited, incremental change is not without possibilities. Such change may well come from low-level to mid-level technical or management staff who bury incremental change into existing operating procedures. Ultimately, however, incremental innovation simply does not allow for the magnitude of change that may be required to fix emerging problems. The pursuit of further additional sources of secure supply, for example, results in agencies colliding and struggling for control over increasingly scarce water supplies. Collaboration among water agencies becomes difficult because sources of additional supplies that promise benefits to all participants become increasingly difficult to identify. The legal accommodations among agencies imposed by the courts or negotiated among parties become too rigid to respond to the magnitude of problems. Moreover, shifts in public tastes and values result in the passage of laws that make it impossible for water agencies to continue with business as usual because there are other actors with authority that do not share or put the same priorities upon service to water agencies' narrow missions. The need to make real shifts in values and practices was acknowledged in a number of our interviews.

Finally, expectations encouraged by narrowly focused organizations among various publics are ultimately unrealistic and self-defeating. The notion that plentiful, good quality water can come out of the tap simply by turning on a faucet may be an increasingly false expectation. Water consumers have been encouraged to believe that no behavioral change on their part will be necessary. Consequently, they react negatively when water service becomes a public issue. Norms, expertise, and practices are not available within the narrowly focused organization to address new and increasing demands on water resources.

### *B. Coordination and Domestication*

As water organizations and systems continue to overbuild infrastructure and policy regimes as described above,[25] flexibility for responding to new demands is increasingly reduced. Incremental innovation no longer suffices in managing a system designed primarily to meet narrowly focused needs. The Columbia River system provides an example of this problem:

> [W]ith more than 250 reservoirs and 100 hydroelectric projects, [the Columbia River system] is one of the most highly developed in the world. It is generally considered to be a mature water management system with little room for future expansion or development. Under

25. *See* discussion *supra* subpart III(A).

> current conditions and institutions there are very limited possibilities for changes in infrastructure, such as adding additional reservoir storage capacity to better meet conflicting demands.[26]

Even as infrastructure and administrative structures are created and implemented to meet existing conditions, new demands are placed on water systems. The demands can be the result of the new and robust structures or the emerging requirements of phenomena once considered external to the system, such as wildlife habitat or recreation. The constraints on physical, built, and institutional systems make it increasingly difficult for water service providers to respond with the incremental innovation described above. If constituents notice changes in the reliability, safety, or cost of their once taken-for-granted sources of water, agencies violate their institutional norms and face sanctions from regulators and customers.

In the three basins we examined, water organizations came to recognize by the middle of the 20th century that the boundaries drawn around responsibilities and authorities were increasingly inadequate for solving emerging problems. The solution appeared to be coordinating as partners with organizations responsible for managing different aspects of the water system. In its earliest incarnation, this strategy looked like coordination through committee.

Informal federal interagency committees were formed during the 1940s to coordinate the management of large river systems including the Columbia in 1946 and the Pacific Southwest in 1948, although these earliest efforts at coordination have been described as ineffective.[27] Title II of The Water Resources Planning Act of 1965 created and funded seven river basin commissions to replace the interagency committees.[28] Governance of the Commissions included state agencies responsible for water resources in addition to the federal agencies.[29] All three water systems we examined exhibited histories of coordination through committees at the national and local levels. It is important to note that these coordinating committees were made up of bureaucratic organizations sharing a similar set of institutional norms—providing their customers with reliable, high quality, and low-cost water services.

Early coordination committees were designed to reduce the possibility that constituents would fail to receive needed water services because of

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26. Miles et al., *supra* note 7, at 410.

27. Jeffrey P. Featherstone, *Water Resources Coordination and Planning at the Federal Level: The Need for Integration*, WATER RESOURCES UPDATE, Summer 1996, at 52, 53.

28. 42 U.S.C. §§ 1962a, 1962a-2, 1962b (2000); *see also* Charles W. Howe, *Protecting Public Values in a Water Market Setting: Improving Water Markets to Increase Economic Efficiency and Equity*, 3 U. DENV. WATER L. REV. 357, 370 (1999–2000) (describing the establishment and effectiveness of the seven river basin commissions created in accordance with the 1965 Water Resources Planning Act); Featherstone, *supra* note 27, at 53 (explaining the creation, limitations, and eventual dissolution of the seven).

29. Featherstone, *supra* note 27, at 53.

overlapping and conflicting responsibilities of providers. They attempted to coordinate state and federal governments' fragmented responsibilities for water systems, including regulatory authority, taxation, and enforcement. And they managed disputes among different levels of government and agencies responsible for differing aspects of water services, such as coordinating dam building with power needs, municipal and industrial requirements with agricultural needs, and flood control with drought protection.[30] The public and the water sector considered these early coordination committees legitimate ways to ensure reliable water services.

Historically, however, coordination did not solve the problems presented by an overbuilt and oversubscribed system. Demands on water systems continued to increase as population concentrated in urban areas, regulations for clean water and habitat protection were enacted, and infrastructure aged. The emerging problems faced by water service providers went far beyond existing areas of concern into arenas previously considered external to their responsibilities.

Along with new partners and regulations came new constituents, particularly environmental agencies and nongovernmental organizations. The problems and issues raised by these constituents were not easily addressed by water systems overbuilt to meet narrowly focused organizational missions. And overbuilt systems like the Columbia River described above, were unlikely to have the water resources, system knowledge, or institutional arrangements to accommodate challenges that required innovation. By the mid-1970s, with the creation of the U.S. Environmental Protection Agency and the enactment of multiple environmental protection acts, water service providers were facing increasingly visible challenges to their ability to deliver the quantity and quality of water required by customers. Instead of remaining invisible, challenges to system practices, decisions about allocation and supply, and other issues transformed water agencies into commonplace and controversial actors.

New partners brought water service providers problems that were likely to be more "wicked"[31] than the problems they faced in the past. Wicked problems are described as those that cannot be solved within the given worldviews or operating conditions. They are usually not linear in nature so traditional problem solving techniques and tools are not useful, and they are unlikely to be solved in the long run through incremental innovations.[32] Solving wicked problems requires "cycl[ing] through the phases of problem

30. Helen M. Ingram, *The Political Economy of Regional Water Institutions*, 55 AM. J. AGRIC. ECON. 10, 10–18 (1973).

31. *See* Michael Pacanowsky, *Team Tools for Wicked Problems*, ORGANIZATIONAL DYNAMICS, Winter 1995, at 36, 37 (noting that tame problems are "manageable; they come with a proper focus, appropriate definitions, and relevant information," but wicked problems "present no known algorithms for solution; simply identifying the problem can turn into a major task").

32. *See id.* at 36–38 (theorizing that traditional problem solving methods are "decidedly inappropriate for wicked problems, which defy linear resolution").

definition, information gathering, solution, and outcome. It can be said that we do not really 'solve' wicked problems; rather, we 'design' more or less effective solutions based on how we define the problem."[33]

In its latest report on the status of watershed health, the National Research Council (NRC) recognizes that the national goal of restoring and maintaining the physical, chemical, and biological integrity of the nation's waters "will not likely be achieved through the construction of additional control works, more regulations, or more money."[34] Instead, the new problems require exponential increases in our scientific and social understanding of complex systems. Yet, at the same time, the water service providers must continue to deliver safe water reliably and at low cost.

In response, a strategy emerges that echoes earlier efforts to coordinate federal and state agencies. The new strategy creates a council or commission with membership acceptable to all parties; it is designed to remove the issue from public debate—at least for awhile. Water resource problems are now "researched in more detail," and long-term strategic planning efforts convened to develop alternative solutions for future review. These councils include federal and state water agencies as appropriate, but their distinguishing features are the inclusion of new constituents (including the public) and recognition that coordination alone will not solve the problems they face. Instead, they must explicitly conduct a search for some new knowledge or technique that provides an acceptable solution for all constituents.

We call this response "domestication" to suggest that agencies and other water service providers are still trying to find some way to control or tame problems as they were earlier able to control water systems with engineering, administrative, and committee solutions. In the case of water problems needing domestication, however, there is no easy administrative or engineering solution. Recognizing this, the problem is set aside and taken out of the spotlight through agreement among constituents. When asked about progress towards resolving domesticated problems, it is permissible to say, "We're studying the problem," or "The commission is considering all possible alternatives."

Agreement to temporarily table the problem is secured from critics by invitation to participate in finding solutions. Given legitimacy and access through their participation, the new players—including environmental groups, neighborhood associations, environmental protection and regulatory agencies, and citizens—are invited to sit down with the water organizations that have historically made decisions about the system. In effect, these parties now share responsibility for finding acceptable solutions.

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33. *Id.* at 37.

34. William L. Graf, *Preface* to COMM. ON WATERSHED MGMT., NAT'L RESEARCH COUNCIL, NEW STRATEGIES FOR AMERICA'S WATERSHEDS vii–viii (1999).

When partners from outside the water sector come to the table, however, they bring new perspectives and expectations that challenge existing thinking about problems and solutions as well as institutional norms and practices. The norms of water organizations, which have been dominated by reliably providing high quality water at low cost, are challenged by partners representing new values and phenomena externalized by existing values.

With rare exception, partners in early coordination efforts were working within a dominant understanding of water and development that promoted the growth of water infrastructure to support growing populations. Conflicts in earlier coordination efforts are best described as conflicts of mission—a state agency may oppose a dam proposed by a federal agency because it affects powerful constituents, or one municipality may be looking for ways to manage storm run-off that has negative impacts downstream. These types of conflicts were recognized by the National Research Council in their recommendations for managing water resources:

> [A]pparent contradictions among agencies are inevitable in a governmental structure that, by design, represents varied stakeholder groups. However, in general the various levels of government are in pursuit of common goals. Certainly, those empowered to act may have some jealousies about their authorities, but these conflicts are far less significant than the conflicts that arise over how the land and water of a watershed might be used.[35]

As the NRC notes, new partners bring a new category of problems to the water sector; the lack of a shared understanding of how the world works may itself become the source of conflict.[36] Conflicts are now likely to be about worldviews: how problems are framed, who counts as a stakeholder, what counts as evidence, and why decisions are made the way they are.

Cultural theory suggests that three main worldviews—bureaucratic, entrepreneurial, and communitarian—reflect our individual and organizational assumptions about both the social and natural worlds. These worldviews underlie the way we define problems, what we count as evidence that a problem exists or is "solved," and even how we interact with other constituents. In particular, organizations that can make binding decisions on a group (such as bureaucracies) approach problem solving differently than individuals or organizations with weaker ties to a group or those who are able to make choices that bind only themselves.[37]

Bureaucracies represent problems as highly solvable within accepted procedures, and as often as possible, within the organization's boundaries. They perceive the natural world as quite tolerant of human activities within

35. COMM. ON WATERSHED MGMT., *supra* note 34, at 165.

36. *Id.* at 181–86.

37. MICHIEL SCHWARZ & MICHAEL THOMPSON, DIVIDED WE STAND: REDEFINING POLITICS, TECHNOLOGY AND SOCIAL CHOICE 6 (1990).

certain boundaries, so the organization's role is to manage for unusual occurrences.[38] Proposed solutions tend to be large-scale and high-tech, demanding specialized knowledge and centralized oversight, which bureaucracies are extremely good at providing. As we have seen, bureaucratic water agencies typically respond to problems by building large-scale, centralized systems. When coordination efforts and domestication attempts are made to manage increasingly unmanageable systems, however, individuals with new worldviews challenge these century-long institutional practices.

Entrepreneurial individuals or organizations consider themselves less socially bound, allowing them freedom to bid, bargain, or even change the rules as they search for solutions to problems. Their social relationships are based on the bottom line, not the rules or niceties of relationships that drive other social responses. People and organizations with entrepreneurial worldviews perceive nature as benign; such organizations are resilient to all human activities and need little management oversight.[39]

Entrepreneurs are driven by a desire to find efficient responses to problems, often looking to the market for solutions. They are unlikely to see domestication as effective problem solving. Rather, they favor emerging strategies like "water wheeling," interbasin transfers, and other market-based water services. When they become parties to water resources problem solving through domestication, entrepreneurs are likely to become frustrated with bureaucratic agencies whose institutional norms favor a slow, orderly vetting of new ideas through the chain of command.

Others reject both the bureaucratic and the entrepreneurial worldviews and instead promote communal or equalitarian relationships between individuals and among organizations. This communitarian worldview stresses relationships based on cooperative, collegial, and often volunteer responses. Communitarians perceive nature as "ephemeral"—they believe catastrophe is around the corner as human activities threaten the natural world. In opposition to bureaucratic and entrepreneurial arrangements, communitarian individuals and organizations promote small-scale solutions at local levels, aiming to minimize perturbation to natural systems. Local and volunteer watershed basin approaches are typical solutions promoted within this worldview.

Including these multiple worldviews is the price that water organizations pay for spreading the risk of managing their complex systems through coordination and domestication. However, as expected, these worldviews can destabilize traditional organizational arrangements and challenge institutional norms and practices. For example, communitarians promote the fundamental right to water and vehemently oppose rationing by

38. *Id.* at 5.
39. *Id.* at 6–8, 66–67.

price. They argue that rich people will be watering their lawns while poor people are unable to afford drinking water. While promoting such economically rational schemes, entrepreneurs are also pressing for closer tolerances on systems they perceive as bloated and ripe for efficiency efforts. These new partners bring "new ways to notice" water service providers.

All three basins in our study have large scale, ongoing domestication efforts. To date, billions of state and federal dollars have been expended to find ways to ensure that growth in California cities and its agricultural sectors is not limited by water shortages.[40] The region-wide system that ships water to extensive agricultural valleys and the semi-arid Los Angeles area has left behind environmental and social problems in multiple states and countries.[41] The California Bay-Delta Authority oversees the implementation of the CALFED Bay-Delta Program for the 25 state and federal agencies working cooperatively to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem.[42] The California Bay-Delta Authority Act established the Authority as the new governance structure and charged it with providing accountability, promoting balanced implementation, tracking and assessing Program progress, using sound science, assuring public involvement and outreach, and coordinating and integrating related government programs.[43] In other words, its mission is to domesticate the problems of the San Francisco Bay Delta.

The Pacific Northwest Electric Power and Conservation Planning Council, a regional governing body reconciling power and fish habitat needs in the Columbia Basin, has been in existence since 1980.[44] As part of their mandate, the Council has an elaborate decision process designed to elicit information from a wide range of constituents.[45] Professional input is sought from scientific and technical contractors and through workshops and working groups where scientists conduct extensive reviews of current scientific literature and attend professional meetings.[46] External information is also elicited from political sources—including members of the affected public,

40. *See* Steven P. Erie, *Mulholland's Gifts: Further Reflections upon Southern California Water Subsidies and Growth*, 37 CAL. W. L. REV. 147, 149–50 (2000) (arguing that San Diego residents, from 1928 to 1996, underpaid for their water by $1.3 billion).

41. *Id.* at 159 (discussing the environmental degradation to the Imperial Valley, Mexicali, and the Salton Sea, and the harms that may accrue to migratory birds and Mexicali farmers).

42. California and the Federal government partnered to launch the CALFED Bay-Delta Program in 1995 to address the complex issues that surround the Bay-Delta. CALFED BAY-DELTA PROGRAM, PROGRAMMATIC RECORD OF DECISION 1 (2000), *available at* http://calwater.ca.gov/Archives/GeneralArchive/rod/ROD8-28-00.pdf. For more information about the California Bay-Delta Authority, see its homepage at http://calwater.ca.gov.

43. CAL. WATER CODE ANN. § 79401(h) (West 2004); CALIFORNIA BAY-DELTA AUTHORITY, CALIFORNIA BAY-DELTA PROGRAM: OVERSIGHT AND COORDINATION MULTI-YEAR PROGRAM PLAN (YEARS 5–8) 1 (2004), *available at* http://www.calwater.ca.gov/ProgramPlans_2004/Oversight_Coordination_Program_Plan_7-04.pdf.

44. 16 U.S.C. § 839b (2000).

45. *Id.* § 839b(g)–(h).

46. *Id.* § 839b(h)(10)(D).

lobbyists, and representatives from affected federal agencies, state agencies, and environmental groups.[47] Although political and professional information is elicited at the same time, political input has lower credibility than professional input. For example, Council staff told us that input elicited during public hearings carries less weight in decisionmaking than information elicited through contracted professional work. Even though the Council is mandated by law to consider multiple perspectives when making its plans,[48] observers have suggested that very few nontraditional solutions have been produced.

The Chesapeake Bay Program (CBP) includes stakeholders with multiple worldviews and conflicting ways of defining problems.[49] The original CBP charter included commitments to comprehensive and coordinated monitoring among multiple state and federal agencies.[50] Its committees have used monitoring data to assess the effectiveness of meeting program goals, to analyze the effectiveness of water quality control programs, and to set public targets for the politically favored "living resources" (i.e., humans). Over several years, a series of about one hundred "working indicators" have been negotiated among the various stakeholders. The indicators were socially constructed through political discussion and are managed bureaucratically, but they are considered legitimate by all stakeholders as ways to capture information about the Chesapeake Bay. In recent years, the CBP has also sponsored an extensive modeling program based on historical data. One subcommittee chair told us that he was very concerned that the increasing importance of modeling within the CBP has not been accompanied by discussion about the "believability of the model outputs."[51] The domesticating move to system modeling may backfire, he fears, if constituents who do not understand or agree with the assumptions built into the model challenge its results.

As domestication efforts drag on for years without solution, strategies that were once politically unacceptable begin to surface. One example is strategically breaching or removing dams on the main-stem Columbia River—a concept that was such an anathema to most water service providers in the Pacific Northwest that it was ridiculed as impossible only a few years ago. Because smaller dams were being removed from tributaries across the country and environmental groups were continuing to raise questions, the

47. *Id.* § 839b(g).

48. *Id.* § 839(3).

49. *See* Chesapeake Bay Program, Overview of the Bay Program: America's Premiere Watershed Restoration Program, *at* http://chesapeakebay.net/overview.htm (listing a number of groups that have come together to form this "unique regional partnership").

50. *See* 1987 Chesapeake Bay Agreement, *supra* note 22, at 1 ("Representing the Federal government and the States which surround the Chesapeake Bay, we acknowledge our stake in the resources of the Bay and accept our share of responsibility for its current condition. We are determined that this decline will be reversed.").

51. Interview on file with author.

concept took on new life and was seriously considered by the Army Corps of Engineers in a recent recovery plan. Ultimately, however, breaching federal dams was rejected and more traditional technological fixes have been implemented, including barging young salmon around dams, improving hatchery practices, freezing harvest levels, and releasing more water from reservoirs. At great expense (approximately $400 million per year), Columbia River management is still being domesticated through research, commissions, and legislation.

Sometimes, however, acceptable solutions do emerge from domestication efforts. For years it looked as if no solution would ever be crafted through the expensive domestication efforts in the Bay-Delta. But recently the Environmental Water Account was created to determine the amount of water required to protect fish habitats and to lease the appropriate amount from farmers and other rights holders.[52] In return, agricultural and urban water users receive a pledge of "no surprises" and incur no additional costs for fish protection for at least four years, regardless of what happens to the endangered species.[53] Fisheries' managers must follow a water budget and pay attention to whether supplies will last through the season. Thus, while water organizations in southern California have a more secure supply, they are now responding to public interest in sustainable fisheries, which was not in their original mandate. This example demonstrates how extended negotiating processes can provide innovative solutions that correspond to existing water agency arrangements.

The problems and solutions defined by these domestication efforts often turn out to be larger and more complex than imagined. Domestication efforts make modeling and monitoring strategies possible, and even desirable, as participants seek new information about how the system functions. Such efforts bring new types of employees—biologists, social scientists, computer scientists, and public relations specialists—to organizations once dominated by engineers, economists, and lawyers. Employees and new constituents may promote different success indicators (e.g., equity for all users) that complement or challenge the primary norm of providing reliable, high quality, and low cost water services. Proposed solutions to problems may be innovative social, physical, or organizational rearrangements of the existing system.

The domestication strategy's primary limitations are the physical and organizational limitations that remain while solutions are explored and

52. CALFED Bay-Delta Program, Environmental Water Account Fact Sheet, *at* http://calwater.ca.gov/Programs/EnvironmentalWaterAccount/FactSheet.htm.

53. The *Environmental Water Account Fact Sheet* states:

> [I]t is clear that without the EWA water, more fish would have been affected by water project diversions, and deliveries to cities and farms would have been further curtailed without the benefit of another source to maintain supply levels. The result would have been a lose-lose for fish and water users.

*Id.*

created. Water service providers may experience increased violations of norms through public and repeated debate about water management. They face individuals and organizations holding incompatible worldviews, requiring energy and other resources to create acceptable solutions. In addition, some critics are unlikely to ever participate in finding solutions but will have increased access to discussions about problems and solutions.

Despite the criticisms, domestication strategies do have organizational advantages. When problems have difficult solutions, domestication allows time for problems to mature, new solutions to arise, enlarged coalitions to form, and the public to switch its attention to other agendas. Although domestication strategies may serve values in addition to the core institutional values (i.e., reliability, quality, and cost) and may add additional costs, they rarely require complete reorientation of an organization's mission or norms.

### *C. Soft Paths: Civic Science and Adaptive Management*

Water organizations that have become involved in large-scale coordination and long-term domestication activities are increasingly finding these methods too expensive to be satisfactory. New partners, insisting upon what appear to be incommensurable demands, challenge the ability of water organizations to reliably deliver safe and low-cost water in the face of increasing uncertainty. An emerging strategy for managing water resources is a "soft path" strategy (in comparison to the hard path of infrastructure development),[54] also known as civic science[55] or adaptive management.[56] Gleick describes a soft path as meeting the needs of individuals, not merely supplying water resources.[57] This necessitates new ways of thinking about water, such as differentiating among water qualities, looking for decentralized solutions, engaging stakeholders in identifying needs, and finding economies of "scope" (i.e., combined decisionmaking processes like the domestication strategies described above) that may allow the delivery of services at lower cost than traditional projects that look at economies of scale.

In the Pacific Northwest, which has highly complex water systems, allocation strategies, and legally mandated but conflicting priorities, Lee has suggested a strategy of adaptive management.[58] This soft path strategy

54. PETER H. GLEICK, THE WORLD'S WATER 2002–2003, at 3–7 (2002).

55. *See* KAI N. LEE, COMPASS AND GYROSCOPE: INTEGRATING SCIENCE AND POLITICS FOR THE ENVIRONMENT 161–63 (1993) (describing civic science as a combination of both experimental science and reformist policy and asserting that "[m]anaging large ecosystems should rely not merely on science, but on *civic* science; it should be irreducibly public in the way responsibilities are exercised, intrinsically technical, and open to learning from errors and profiting from successes").

56. *See id.* at 9 ("*Adaptive Management* is an approach to natural resource policy that embodies a simple imperative: policies are experiments; *learn from them.*").

57. GLEICK, *supra* note 54, at 3.

58. LEE, *supra* note 55, at 9, 51–86 (noting that practitioners who use adaptive management as an approach to natural resource policy take three basic steps: recording explicit expectations,

recognizes the limitations of human control over unpredictable and dynamic natural and social systems. In addition to trying to capture reality with complex models, Lee suggests that planning should also attend reflexively to local experience and knowledge.[59] Problem-specific information is continuously generated and integrated into the decision process, making problem-specific responses possible in a relatively short time.[60]

Just as biologists and ecologists challenged the norms of narrowly focused organizations, new participants brought different needs, expectations, and worldviews when water resource managers implemented coordination and domestication strategies. These new participants challenged the power of traditional expertise to solve local problems without their explicit involvement. For example, citizens expect decisionmaking processes to be transparent and clear, which necessitates accessible, understandable, and applicable information.[61] Social responses (e.g., values and behaviors) complement the engineering, legal, organizational, and biological expertise common to the strategies for managing water systems described above. Yet social definitions and values challenge the traditional discussions about reliability, quality, and cost, making this adaptive strategy difficult to implement in existing organizations. Expertise in multiple decisionmaking approaches, conflict resolution, and scientific translation and interpretation are all necessary for meaningful participation by the new constituents.

Adaptive management decisions may focus on local and context-specific problems rather than on the system-wide uncertainties addressed by the strategies described above. For example, adaptive decisions may include pricing water differently for different uses; accessing water sources with different levels of reliability, quality, and cost that are appropriate to different uses; and procuring locally appropriate and flexible technology that complements the existing large-scale, long-term infrastructures.

While an adaptive strategy may bring responsiveness to water management, it is information and decision intensive. In addition to water flow, allocation, and distribution criteria, information is needed about local and specific preferences, needs, and interactions with natural and built systems. To gather this information, structures for collecting and integrating information, including meetings, public forums, outreach activities, and other

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collecting and analyzing information to compare expectations with actuality, and transforming that comparison into knowledge by correcting errors, improving understandings, and changing their actions and plans).

59. *Id.* at 80–85 (discussing "adaptive management in real human institutions" and the need for "flexibility and negotiation").

60. *Id.* at 56–67 ("Experiments often bring surprises, but if resource management is recognized to be inherently uncertain, the surprises become opportunities to learn rather than failures to predict.").

61. *See* FRANK FISCHER, CITIZENS, EXPERTS, AND THE ENVIRONMENT: THE POLITICS OF LOCAL KNOWLEDGE 29–46, 193–218 (2000) (discussing citizen participation and the relationship between citizens and experts).

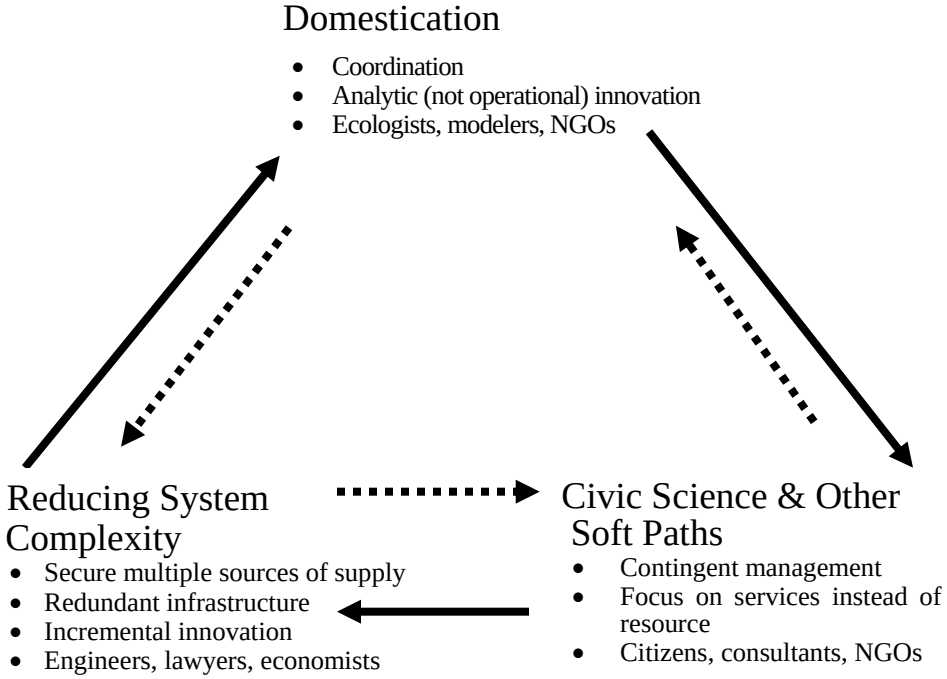
social processes for consultation and decisionmaking, must be established. Not only must participants become better informed about water, they must also attend to value differences and conflicts within the relevant community. The process requires individuals to be open and willing to shift their attitudes and expectations to accommodate the physical system's new demands and other users' diverse attitudes. As a result of public consultation, the organization's visibility is elevated, contradicting the longstanding organizational preference for remaining below the radar of public and media attention.

## VI. Conclusion

Water organizations have access to a range of qualitatively different strategies for responding to challenges and integrating innovation into their existing norms and practices. These emerging responses do not displace existing norms or practices—this is not a model of successive displacement of one organizational strategy for another. Instead, it is a model of accretion where new response strategies are grafted onto existing structures, norms, and behaviors.

Figure 1 describes how water organizations take up the three strategies we have identified for managing pressures to change. Any single organization can use different strategies simultaneously for different, or even the same, problems. The first strategy, which we found was preferred by organizations, assumes that uncertainty can be managed within the individual agency through routinizing both regular and irregular system events. In the past, this required developing redundant infrastructure and operating procedures, all designed to reduce the impact of unusual events. Once the infrastructure and routines are in place, the system is relatively easy to manage. Any change to infrastructure and routines is difficult. Incremental improvements are more common than replacement of any part of the physical or organizational system. Expertise to manage the system is found in the knowledge bases of engineers, lawyers, and economists who can help water resource agencies meet their mission to provide reliable, high quality, and low cost water. Any innovation must be able to support the standard operating procedures that have been developed over the life of the agency or organization.

*Figure 1: Water Organization Strategies for Responding to Pressure for Change*




As constraints on water grow through demand and regulation, organizations pursue domestication strategies of coordination and cooperation with and among other organizations. In particular, we found that environmental and wildlife habitat claims have been drivers in the move to domestication. In addition to ensuring a predictable local system response, organizations undertaking a domestication strategy take on the chore of coordinating their activities with actors who often have missions, needs, and expectations in conflict. Conflicts are smoothed over through delay with the promise of making science-based (i.e., objective) decisions sometime in the future. Expertise is found in the knowledge bases of ecologists, biologists, and modelers who can help the agencies meet the demands of environmental rules and regulations. This expertise supplements the need for engineering, legal, and economic knowledge, rather than displacing it.

Soft path strategies emerge as water organizations attempt to create adaptive and flexible responses to growing uncertainty by welcoming new partners and expectations. Organizations endeavor to integrate new kinds of information and new partners—often conflicting—who bring fundamental challenges to the way decisions are made. For example, new definitions of risk may emerge, which take into account the reliability, safety, and cost of water. Creating adaptive organizations may bring rapid and major changes

to the way water resources are managed, allocated, and distributed. Additional expertise bases include citizens, mediators, and conveners who have knowledge and experience with regard to local situations and problems but who also demand local solutions. Integrating this new knowledge with other expertise bases is a major task facing organizations that adopt soft path strategies.

Each stage in the cycle may present different opportunities for innovation in water organizations. In the first, opportunities are limited to incremental changes, typically introduced discreetly by new recruits into the technical ranks of the organization. However, such innovation has only marginal impacts and goes largely unrecognized by others in the organization. In domestication strategies, the harmless experiments of junior staff may increasingly be used to respond to crises or to represent improved coordination among the actors. Adaptive management and other soft paths would seem to present more opportunities for radical innovation; however, it has been difficult to implement new ways of thinking about water, especially as the stresses and strains of high levels of engagement and negotiation take their toll.

These summaries are static and isolated pictures of strategies used by water organizations to deal with internal and external pressures to change. By freezing the dynamic processes in these organizations, we are able to create a conceptual framework for thinking about introducing innovations. These three different strategies reflect a general trend from hard path strategies (i.e., infrastructure intensive) to soft path strategies (i.e., social interaction-intensive) as envisioned by Gleick,[62] with a time-out for trying to domesticate increasingly wicked problems. Instead of managing physical structures and organized routines, water resource organizations are managing ambiguous relationships with partners who have conflicting demands and needs.

Water organizations inconveniently refuse to stay frozen. We found a general tendency among organizations to resist the shift to soft path strategies; attempts to move back to structural solutions were prevalent. For example, while the Pacific Northwest Electric Power and Conservation Planning Council was attempting a conscious move to an adaptive management strategy, federal water agency decisions took some of the most innovative ideas (e.g., breaching dams on the Snake River) off the table before they could be explored. The talk then reverted back to how much it would cost to safely barge salmon around the dams.

In short, our diagnosis is consistent with that of Miles et al., who found that fragmentation of water resource management in the Pacific Northwest renders unusable even perfect information.[63] However, we are pessimistic

62. *See* GLEICK, *supra* note 54, at 25–30 (discussing the steps involved in moving forward on the soft path).

63. Miles et al., *supra* note 7, at 405.

that recommendations for greater coordination among agencies would greatly improve the prospect for innovation. We found that more than fifty years of coordination and domestication in these three basins has resulted in very few innovations, none of which have spread to other organizations. This is consistent with our findings that water organizations shape innovations to their own particular locale over a long period of time to ensure their efficacy in organizational capacity and infrastructure. We are also mindful of the injunction that innovation cannot be tolerated if it produces even temporary declines in service to consumers that result in violations of water managers' institutional norms and practices.