INTRODUCTION

While not stranded on a boat out at sea, a reliable fresh water supply and resilient utilities and infrastructure are of paramount concern to coastal communities. Threats to drinking water quality and supply include salt-water intrusion, drought, or pollution and arise from both governance failures to manage common pool resources (aquifer depletion and surface water contamination) and infrastructure failures from natural disasters and sea level rise (flooding and salt-water intrusion).

Resilient communities are defined as having the ability to “absorb and/or adapt quickly to change and crisis” (Callaghan and Colton, 2008). While the concept of resilient communities has emerged largely in response to sudden environmental shocks and fears of future crises, it has important implications for understanding the various forms of steady, gradual deterioration in environmental conditions that threaten sustainability, such as threats to public water supply and water infrastructure. Public recognition of the importance of a sustainable water supply for the health and safety, environmental integrity, and economic viability has grown (Federation of Canadian Municipalities, 2002), largely through the realization of the unsustainability of past practice and management (Bakker, 2003).

This paper is part of a larger project, the goal of which is to contribute to our understanding about which features of governance capacity are important for building resilience in cities from 7 coastal regions, including 1) New England, 2) Mid-Atlantic, 3) Southeast, 4) Great Lakes, 5) Gulf of Mexico, 6) North Pacific and 7) South Pacific. Coastal areas offer a highly relevant setting for conducting this research given their rapidly increasing share of the world’s population and the socio-economic pressures confronting governance systems, as well as their particular vulnerability to climate change and water resource concerns.

This study begins the process of addressing that larger question by asking utility managers around the coastal areas of the US what they are most concerned about and where their priorities lay. In response to a series of semi-structured questions, these utility managers confirmed some of the themes that dominate the literature on resilience and adaptive capacity, but also introduced additional themes and provided a decidedly practical spin on core concepts such as public participation and democratization, collaboration, and innovation. We have more work to do to explore possible association between the
themes that the interviewees raised and the governance structures of the agencies that they lead. We offer a few preliminary observations here.

FRAMEWORKS FOR RESILIENCE

The literature on two closely related concepts – resilience and adaptive capacity – is characterized by an abundance of explanatory frameworks and high levels of consensus about the factors that comprise those frameworks (configured in various ways), but a general dearth of empirical testing. This is not surprising, given the many difficulties associated with observing and measuring resilience, which tends to be understood as a cluster of capacities. The slipperiness of the focal concept, in turn, makes it difficult to link other phenomena with resilience. A few empirical studies can be found, but these are highly contextualized and difficult to replicate. Counter-factuals in such studies are loosely drawn by necessity.

For example, Engle and Lemos (2010) constructed a mixed-methods study of 18 Brazilian river basins in order to disaggregate the governance mechanisms that were more and less effective in facilitating adaptation to climate change. They built a governance index of water systems, based on surveys of members of river basin councils, tested its internal statistical validity, and then looked for associations between scores on the governance index and evidence of adaptive capacity in practice, with the latter drawn from in-depth interviews in 4 locations. It is a sophisticated piece of research and provides a significant contribution to the literature. The survey, which is the centerpiece of the Engle and Lemos study, was based on what has become the received wisdom about desirable governance characteristics in the space of sustainability, adaptive capacity, and resilience. It is important to note that all of these characteristics are well supported by logic, common sense, and the insights offered by the rapidly expanding science of complex adaptive systems. In most cases, however, they do not add up to an identifiable theory, and most have not been subjected to empirical testing beyond single case studies. The accumulation of case studies in this area may soon reach critical mass and allow for more systematic theorizing.

That list includes the following:

• Participatory, deliberative, polycentric, multi-layered, accountable, and just governance arrangements are hypothesized to contribute to capacities to manage resilience, which manifest in capacities for self-organization and learning / adaptation (Lebel et al 2006).
• Adaptive capacity is enhanced by increased flows of information and knowledge, elements of democratic decentralization (increased participation and representation), social capital and networks, interactions and negotiations between institutions and stakeholders at various levels, resource availability, and equality (Engle and Lemos 2010).
• Open, flexible socio-ecological systems show greater capacity for learning and tend to be more adaptive, even with limited resources (Anderies et al 2006).
• Resilient systems tend to be reflective, robust, redundant, resourceful, inclusive, integrated, and flexible (Rockefeller Foundation 2014).
• Gupta et al (2010) present 22 criteria for adaptive capacity, which align with 6 “dimensions” – leadership, resources, fair governance, learning capacity, variety, and room for autonomous change; these comprise the “adaptive capacity wheel.”

Although different terminology is often used, certain clusters of themes occur over and over in these frameworks: decentralized, polycentric arrangements with significant autonomy to local actors;
collaboration and cooperation horizontally and vertically between organizations and proximate jurisdictions; inclusiveness in the forms of meaningful public participation and stakeholder engagement; integrated, systems-oriented approaches to challenges and opportunities; and innovation, including a capacity for trying new solutions and learning from experience. These concepts are widely accepted, and often repeated in study after study, but considerable further work is needed not only to confirm their centrality, but also to define more precisely what they mean in practice.

GOVERNANCE ARRANGEMENTS OF WATER UTILITIES

Governance arrangements are widely thought to have significant effects on adaptation and resilience with respect to natural resources (Brooks et al 2005; Noble et al), but these take different forms in different sectors.

We therefore begin with a brief description of the primary types of water system governance arrangements in the United States. Literature on utility management has provided some descriptions via case study analysis of specific U.S. States. Classification of the structures of water utilities is important for understanding governance capacity. However, to our knowledge, a formal typology of water utility governance arrangements does not exist. This research hopes to fill that gap by defining and classifying water utilities by their governance arrangement to begin identifying distinguishing governance features.

Much of our current understanding of differences in governance arrangements began to form in the 1980s and 1990s when many American cities undertook significant reforms of their water management systems, motivated by funding through the Clean Water Act’s State Revolving Fund. During this time, States directed municipalities through the organization of water utilities services to meet the needs of their population. Some States took a heavier hand than others by legislatively mandating technology upgrades to improve provision of services. In some instances, State legislatures directed municipalities to reorganize governance structures and centralize water treatment and collection through regional agreements and acquisition of decentralized, private assets (plants).

Typology of Water Utility Governance Arrangements

In assessments of state-owned enterprises, governance has been shown to be central to performance (Vagliasindi, 2008). Water governance refers to a range of political, organizational, and administrative processes used by communities to formulate and implement policies for the management of water resources and delivery of water services (Bakker, 2003).

There are primarily two types of water utility service provision: direct and indirect. Direct management of water utility services is provided by a city’s “municipal department” (e.g. Public Works) under the City Manager or by a “municipal agency” (e.g. Division of Water Management) that reports directly to the Mayor. Indirect management of services is provided by a “contract-operated facility” or “utility authority.” The move from direct to indirect public provision is discussed in the literature where it is often labelled “corporatization” (Berg and Margues, 2013). These governance arrangements are described in detail below.

Municipal Department. This governance arrangement involves the direct management of utility services by an authorized department under City Manager. Responsibility is designated to a top-manager (e.g. Division Director or Department Head) with indirect oversight from the city’s top administration (e.g. Council-Mayor) through the City Manager. Under this arrangement, the provision of water utility services (i.e. water treatment, water sanitation, and water drainage) may be directly provided through municipal-owned facility or indirectly through contract-operated facility. In this arrangement, the
authority to determine water rates and manage utility operations and investments lies with the city council. One criticism of this model is the substantial potential for political intervention. Lacking a clear separation from municipal politics, utility managers face issues, with procurement, multi-layered reporting structures, hiring delays, and other problems (Cruz, Berg and Marques, 2013).

**Municipal Agency.** Under this arrangement, utility services are directly managed and provided by a city department, but responsibility is designated (often appointed) to a utility-manager (e.g. Water Commissioner) who reports directly to the city’s mayor and council. Utility managers retain some authority with regard to policy implementation, but they are at the mercy of elective officials who define them. Closely related to municipal departments, no differences between utility and city employees exist. Water rates are approved by the city council and service quality issues are addressed through public hearings. Despite efficiencies gained by a (presumably) more streamlined reporting structure, the likelihood of politically motivated initiatives to override professional evaluation affects performance of this governance scheme (Cruz, Berg, Marques, 2013).

**Municipal Enterprise.** A relatively new governance arrangement used in government in the U.S. involves the indirect management of public water services through a corporatized, "stand-alone" utility authority (e.g. Board of Directors or Commission). The literature often refers to this form of utility governance as a “municipal or public corporation” (Cruz, Berg, Marques, 2013; Bilodeau et al., 2007). Under this model, the top utility manager (e.g. Executive Director or General Manager) does not interact directly with city officials but with an independent commission or board comprised of specialists or citizens with broad public experience. The Board sets rates and appoints (and removes) the General Manager or CEO of the utility. The CEO is responsible for customer relations, personnel, debt, and utility activities in planning and operations (Cruz, Berg, Marques, 2013). Under this arrangement, the facilities themselves are owned by the municipality or state, but liability for the assets is transferred to a privately-operated entity.

**Contract-Operated Facility.** A sub-form of indirect management is a private or municipally-owned water treatment or sanitation facility that is contracted-out by neighboring municipalities for wholesale production of water services, with that water then collected and distributed via public infrastructure. Under this arrangement, the contracting municipality is at the mercy of the contract-operated facility’s water rates and performance. Wastewater treatment plants are the most prevalent contract-operated facility.

Table 1, below, depicts the various arrangements seen in practice.
Table 1. Diversity of governance arrangements for local water utilities

<table>
<thead>
<tr>
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<th>Governance Structure</th>
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<tbody>
<tr>
<td></td>
<td>Municipal Depart.</td>
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<tr>
<td>Enterprise Fund</td>
<td>• Municipal-owned and operated WTP; distribution and collection system</td>
</tr>
<tr>
<td>City Budget</td>
<td>• Payments to contracted facility; Distribution and collection system</td>
</tr>
<tr>
<td>Wholesale Water Revenue</td>
<td>N/A</td>
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</table>

**Financing Facilities and Infrastructure**

Some have argued that a shift in focus is needed from a regulatory compliance orientation to a resiliency and sustainability perspective (Santora and Wilson, 2008). One of the recommendations for making this shift is to embrace “full-cost” pricing - factoring all costs including operations and maintenance and capital costs into water service charges and rate structures over the long-term (Santora and Wilson, 2008). There are two primary types of water utility costs: 1) day-to-day operations and maintenance of facilities and 2) long-term repair and replacement of infrastructure.

Under direct management of a municipal department, utility managers operate under the municipal department budget. Water rates cover current operating expenses, maintenance of the system, replacement of worn and failing waterlines, emergency repairs, and debt service.
Managers of municipal department facilities typically possess an enterprise fund, which is separate from the city budget and collects revenue from water payments. Such a fund permits water utility managers some flexibility an autonomy in spending of water revenues as it is separate from the city budget.

Municipalities that do not own their own facilities must purchase drinking water from neighboring municipality or investor-owned water treatment plants. They contract waste water services as well to a nearby plant. Under this model, their sole responsibility is in the distribution and collection system (pipes and pumps). They typically charge water rates to cover system maintenance and water payments to contracted facilities. Lacking revenues from water sales, these municipalities are at the mercy of water providers to meet water needs for their residents.

Under the municipal enterprise model, utility managers own assets and are on the hook to finance new infrastructure in addition to facilitating operations and maintenance through water revenue generated from wholesale production of treated water for drinking and collection, treatment and management of waste water.

The results on the effectiveness of municipal enterprises is mixed. Some reports suggest corporatization of services may result in higher cost-efficiency, increased output, revenues and employee productivity (Bioldeau et al., 2007). Others question the level of productivity that may correspond to the level of authority given to municipal authorities (Cruz and Marqués, 2011).

**METHODOLOGY**

This study in the first step in our effort to test the existing consensus around governance characteristics associated with resilience and adaptive capacity, and to explore the role of governance structure in explaining varied efforts toward building resilience capacity. The overall spirit of the study was inspired by Ken Portney’s (2013) efforts to identify cities that “take sustainability seriously.” Portney’s careful choice of words reflects the almost insurmountable difficulty of determining if a particular city actually qualifies as sustainable (or, in our case, resilient or adaptive) at any particular point in time, or over time. This does not mean that we should not try to get closer to that goal of measuring actual sustainability and resilience, but along the way toward that goal, it makes sense to consider what it means for a city to take these concepts seriously.

Toward that end, this study undertakes a broad exploration of what directors of water agencies in the US have on their minds. We selected 10 coastal cities and asked their water management agency leaders a set of semi-structured, but very broad questions about their priorities and challenges. The interviews, all conducted by phone, were designed to create ample opportunities for the interviewees to talk about resilience and adaptive capacity itself (or not) and to raise the themes that dominate the academic literature (or not). The interview protocol prompted for a few of these themes, but only later in the interviews, and did not assume that these were the only themes of interest. The canvas was open for interviewees to bring up other themes and to steer the interview in directions that reflected their interests and concerns. Because all of the interviewees were senior managers or directors within their agencies, they were well-placed to answer these questions.

The word “resilience” itself was not raised by interviewers until the very end of each interview.
The study uses a grounded theory approach and is still a work in progress. Although the 10 interviews completed to date have generated a rich set of insights, we have not reached saturation. In this emergent design process, we coded interview responses into conceptual themes as we went, with the goal of developing a conceptual model to test in a future empirical analysis. New codes are continuing to be found with the new interviews, but in much smaller numbers than with the initial interviews. It is therefore reasonable to expect that saturation will be reached soon.

The findings from this qualitative study will be used to devise a survey questionnaire that will be administered to staff in water management agencies in coastal cities across the country in an effort to examine the effect of selected governance qualities on perceived capacity for freshwater resilience.

THE LOGIC MODEL

In the open-ended portions of the interviews (in response to questions about the goals, priorities, and challenges that characterize their agencies’ work), interviewees raised a variety of different types of themes, from issues of staff development to managing stakeholders, assessing the condition of aging infrastructure, and protecting in-stream flows for fisheries. To bring some order to this wide-ranging data, we will report on the prominent themes raised by interviewees using the familiar tool known as a logic model, as in Figure 1. The logic model, sometimes referred to as a value chain or production function, describes the process through which public policy is administered (by applying inputs and engaging in various activities and processes) in order to produce outputs in the forms of identifiable goods and services, which in turn are expected to generate salutary results and impacts for people, or what Mark Moore (1995) has called “public value.” The intended results and impacts generally go by the term “outcomes” in the logic model, which may be divided into intermediate and ultimate outcomes to capture the realities of complex cause-and-effect chains.
After coding the interviews using a set of 30 emergent codes, we sorted the results according to the logic model components displayed in Figure 2. Four clusters of outcomes emerged, which might also be called values because they are more abstract than a typical outcome label. These are, firstly, reliability, which we would expect to be the number one objective of every water utility, and these interviews bore that out. Reliability refers to an outcome in which all services are provided continuously, meaning without disruption and with consistently acceptable quality. It is closely associated with public health as a primary outcome of concern. The second outcome that emerged was an overlapping pair that we will label stewardship and efficiency. In the cases of both water itself and electricity used to treat it and pump it, achieving efficiencies means less waste of natural resources, which typically counts as at least a first step toward good stewardship of, or care for, those resources. Thirdly, health of the local economy was on the minds of many interviewees. Finally, most interviewees expressed an interest in maintaining their agency’s legitimacy, which may be seen as its own distinctive type of outcome closely tied to public trust and acceptance.
The logic model helps us begin to develop a more complete picture of how water managers see their roles, and the connections that they make between policy, public administration, and quality-of-life results for citizens and users.

**FINDINGS: SUSTAINED RELIABILITY AND ECONOMIC DEVELOPMENT**

The first set of themes nests under the outcome categories of reliability and economic development, and consists mostly of outputs and intermediate outcomes.

*Modernized Infrastructure (output)- A Universal Concern*

The equipment in many municipal water systems dates to the original rounds of Clean Water Act funding in the early 1970s, which makes them close to 50 years old. Horizontal assets in older cities can be well over 100 years old. The median age of water mains in one of our sites (Mid-Atlantic) is 79 years. All but 1 of the interviewees mentioned aging infrastructure and equipment as a very high priority. “We are all heading into this abyss of an aging infrastructure system that’s leaking. You have an incredible amount of non-revenue water being wasted. And nobody wants to deal with it” (Great Lakes). Another interviewee commented similarly: “[You have to think constantly about] the tens of thousands of pieces of equipment that actually deliver the water to the customer and then take it back. And if you’re not updating it, then it breaks, and the most expensive break, the most money that you spend is when it’s a break at 10 o clock at night on a major thoroughfare that you have to fix on overtime” (Mid-Atlantic).

In some cities, plants are a bigger concern than pipes and mains (including one Mid-Pacific wetlands-based treatment plant that was innovative in its day, but needs upgrading). This was even true for one small, North Atlantic city, where the interviewee reported that they had dug up some pipes “well over 100 years old” and were surprised to discover that they “were as good as new.” But in all cities but one, the issue of either aging plants or aging pipes and mains (or both) sat at or near the top of their priorities.

The issue boils down to financing, a prominent theme in every interview. This is discussed further below.

*Redundancy (intermediate outcome) – High Priority for 7 of 9*

The second most commonly expressed priority was what one interviewee called “good redundancy,” a form of preparation for disasters rather than a species of wastefulness. Redundancy manifests in different ways across our sample of cities. Spare parts and equipment were listed as high priorities by 2 interviewees (Great Lakes and South Atlantic), while 4 others noted the importance of back-up power arrangements at plants in case the electrical grid goes down due to extreme weather or other events (Mid-Atlantic, North and South Atlantic, Great Lakes). Having multiple wells into an aquifer also was mentioned as a form of redundancy by one interviewee (Mid-Atlantic).

Asset management techniques were embraced by 3 interviewees, and associated by one with redundancy. Several cities were quite proud of the work they had done to inventory all assets and assess their status – whether in need of upgrading or replacement and when. This work required consultants in some cases. It was considered a critical process toward improving future reliability and reducing costs associated with risk events, and therefore meets the same goals as redundancy.

*Water Supply Sufficient for Growth (intermediate outcome)- High Priority for 5 of 9*
The second most commonly expressed concern had to do with maintaining supplies adequate for growth, another subset of reliability. One city – a smaller municipality in the North Pacific – listed this as their first priority, and expressed concerns about the difficulties of shifting water rights toward public purposes, given the existing strong protections of senior water rights holders. That interviewee noted that public officials do not always understand the differences between various types of public works when it comes to growth. With enough funding, it is always possible to build more roads, “but in terms of water, when you’re out of it, you’re out of it. And so the real issue is where the next increment of water comes from.” According to this interviewee, cities in the coastal Northwest can easily grow complacent about water because of historically high rainfall, but when this does not come at the right times, problems of supply can arise. An interviewee from a Great Lakes city made the same point: “You have to dispel the myth that we don’t have to worry about water because we’re not California or Nevada. [We have to be] good stewards of the Lakes so they are here in perpetuity.” A third interviewee from a South Atlantic city expressed similar concerns. Despite an abundance of good-quality groundwater in that city, supply issues register as top priorities because (1) their allotment of water from the regional system has been capped, and (2) they face the possibility of future salt water intrusion to the aquifer associated with sea-level rise. That interviewee also noted, however, that alternatives always exist, including reuse/recycling of water and desalinization. As is so often true, the core issue is economics: “We are not going to run out of water. It’s just going to cost more.”

“Facilitating continued growth in the economy,” expressed also as “serving customers as they appear,” was listed as a top priority by 2 interviewees and as a prominent concern by 3 others (5 total). The growth that they had in mind includes not only expansion of urban areas, but also agriculture. In one site, local leaders were anticipating the need to clear land for marijuana cultivation to take advantage of legalization-related opportunities. The clearing of land, however, has implications for stream water quality, and in turn, for fisheries, which contribute in important ways to that interviewee’s local economy. In that site, where water supplies tend to be abundant, the interviewee reported that they are looking at designating some of their water rights to maintain in-stream flows to protect the fisheries from threats related to both urban and agricultural development.

All of the remaining interviewees – 1 Great Lakes and 3 East coast cities with abundant supplies from groundwater and rivers – indicated that supply was not a prominent concern, because they could always pump more water (4 total).

One solution to the future supply problem has come in the form of various “smart-growth” laws and policies oriented toward building denser developments, which tend to be more efficient users of both water and energy. Two interviewees (1 North Pacific, 1 South Atlantic) mentioned the important role of densified development in controlling water demand.

Readiness for Climate Change Impacts (intermediate outcome) – Serious Concern for 3 of 9

Climate change-related concerns were raised by 3 interviewees – 1 Mid-Pacific, 1 Mid-Atlantic, and 1 South Atlantic city – all of whom focused particularly on risks associated with flooding, combined sewer overflows, and damage to low-lying facilities from heavy rains and storm surges. The issue of salt-water intrusion arose in one city. “We talk about climate change every day,” said the Mid-Pacific interviewee, due to already observed impacts that include higher flood peaks for urban streams and overtopping of dikes and levees, as well as threats to a treatment plant. In the South Atlantic, some cities have already experienced a “clear-skies
flooding” phenomenon in which very high tides push saltwater up through storm pipes and drainage canals, causing overflow on to city streets. This is now widely accepted to be a result of sea-level rise associated with climate change.

Two cities (1 North Pacific and 1 Mid-Atlantic) reported that they were protected from sea-level rise thanks to the city’s elevation. The two Great Lakes cities were not concerned about either Lake levels (thanks in part to controls by the Army Corps of Engineers infrastructure) or extreme weather events. Thus, 4 cities in total expressed no or low levels of concern about climate change. The topic did not arise at all in 1 interview (Mid-Atlantic).

Water Quality (intermediate outcome) –Top Priority for All, but Few Threats

Every interviewee noted that water quality is a high priority, both in terms of ensuring the cleanliness of what comes through the tap and making sure that wastewater is fully treated before being released.

We were surprised to see low levels of concern expressed about challenges to water quality. Threats to water quality did not come up at all in 3 interviews, while 5 interviewees expressly stated that water quality was a relatively easy goal to achieve both because their supplies were very clean to start with and because water treatment was straightforward and well understood. Compliance with the Safe Water Drinking Act and other water-related regulations appears to have become a routine matter in these cities – one interviewee referred to jumping through hoops – but there were few complaints. Monitoring water quality is built into day-to-day operations and is straightforward.

The one interviewee (Mid-Atlantic) who talked about threats mentioned a new range of challenges in the form of tiny, but ubiquitous, quantities of antibiotics, estrogen (from birth control pills), and other pharmaceuticals that are difficult to remove, and microbeads from cosmetics. This interviewee noted that most water systems are well equipped to handle moderate amounts of contaminants, but tend to experience stress when faced with very small quantities of powerful chemicals or huge amounts of material that suddenly appear due to big events. With respect to regulatory regimes, he noted that “we have done all the easy stuff” associated with compliance, and that “now it is the very expensive stuff at the margin” that they are seeking to address in terms of addressing the new challenges.

FINDINGS: STEWARDSHIP, EFFICIENCY, TRUST AND LEGITIMACY

The remaining themes tend to fit more comfortably in the inputs and activities/processes sections of the logic model. These are the governance attributes that were most on interviewees’ minds.

Local Collaboration and Partnerships (inputs and activities) – Universal Priority, but Highly Varied in Content with Significant Points of Tension

One interviewee (North Pacific) said that the importance of local collaboration was the most important lesson that he had learned as a water manager. In his words, “Everybody looks at the resource a little differently, but everybody wants it for some reason. So you have to work collaboratively. It’s one thing if the name it, claim it, grab it, it’s mine. That’s just not going to work. It’s a go-slow-to-go-fast kind of approach that’s needed. Bring all of the stakeholders in and get everybody’s needs met as best you can. It’s going to take a lot longer to do that in a way, but you’ll actually get to a solution instead of ending up in court.” According to this view, collaboration is essential to meeting the important supply goals noted earlier.
Advisory councils were important to 1 interviewee (Mid-Pacific) in order to obtain expertise from outside government – this was viewed as helpful in developing smart policies. Cooperation with electrical utilities and transportation departments was a repeated theme. Why tear the roads up more than once to repave and fix water mains? Why not test the water plant’s generators during period of peak electricity use to give the electrical plants a break? Two interviewees (North Pacific and South Atlantic) discussed the importance of mutual aid and cooperation among nearby municipalities, including covering peak loads for each other where possible. One large Great Lakes interviewee and 1 North Atlantic noted the challenges faced by smaller municipalities who are facing infrastructure upgrades. Both noted the potential benefits of consolidation into regional systems in those cases.

All but one interviewee also noted significant points of tension within existing regional networks. The North Pacific and 1 South Atlantic interviewee discussed the challenges of buying up smaller “mom-and-pop” systems in order to rationalize water management and take advantage of economies of scale. This was done some time ago in the South Atlantic cities, but has been especially challenging in the North Pacific case (“donut holes” still remain). The other South Atlantic interviewee also noted that a previously patchwork system of divided city-county responsibilities for plants and pipes/mains, etc. is now far more rational, thanks to consolidation into an independent authority. Elsewhere, jurisdictional friction was reported in association with city-county differences in how loosely they want to interpret rules associated with development. Although decentralization and polycentricity is typically held up as the goal-standard of governance, these issues of fragmentation can quickly derail any benefits. The problem of how to coordinate effectively in a polycentric system has not clearly been solved.

Public Outreach (activities and processes) – Priority for All Cities, but with a Different Spin from the Literature

Existing literature focuses heavily on this attribute of good governance, often with a strongly normative message about the importance of upholding democracy and ensuring equal voice. Our interviewees approached the topic from a thoroughly practical set of interests, mostly related to setting water rates.

In the face of aging infrastructure and growth pressures, all of these systems are looking for more money. In most of our cities, this is tied to water prices. Even in cities where the water agency is a municipal department under the municipal budget, the fact of being a revenue center helps them when it comes time to ask for capital funding. As one Great Lakes interviewee said, “We do make money for the city, so when it comes time to spend a chunk of it, it’s not as big of a hit. A lot of times we pay for what we need out of water sales.” This is all the more true for municipal-enterprise-type agencies.

All of the interviewees spoke eloquently about the challenges of convincing water users to pay more for something that they take for granted, and most tended to be surprisingly optimistic about the prospects of doing so. As one Mid-Atlantic interviewee put it, “People are of course challenged by higher rates, but they are open to hearing a value proposition. And our job is to make that pitch for why this is the best money that they will ever spend, something that will matter more to them than anything.” One North Atlantic interviewee (small city) noted that they had raised rates several times in a few years and had very little pushback, apart from the owner of the laundromat and the school district. In several cases, it seemed to be the elected officials who resisted rate increases most strongly, perhaps out of concern that voters would hold them responsible.
Communication with the public tended to be uni-directional in most of these cities. Interviewees talked about annual reports, Facebook pages, tweets, and bill inserts as ways to educate people about water systems. One also mentioned building good will by alerting residents when a water main job has been scheduled for their street. Only one interviewee (Mid-Pacific) described public goal-setting forums.

Win-Wins (activities and outputs) – Priority for 6 of 9

Green infrastructure, water reclamation projects, and alternative power generation projects (capturing methane and employing microbes) were mentioned (with pride) by 2/3 of interviewees. These were examples of innovation in the industry and sources of efficiencies now and in the future.

Such projects defy the usual stereotype of utilities as resistant to change and innovation. Two of the larger city interviewees spent considerable time talking about the creativity being demonstrated by their workforces, particularly in times of fiscal tightening. Another interviewee called for “a paradigm shift” to move away from the old conservatism toward new ways of operating. In these cases, interviewees were talking about more mundane types of problem-solving against day-to-day issues that arise, but the overall theme of creativity and innovation may be seen as consistent with the big-bang projects such as water reclamation and alternative power generation on sit.

Personnel Development (inputs and activities) – Priority for 4 of 9

Working with numerous unions was a concern for one big-city interviewee, but he reported on significant improvements in relations with the union. Two interviewees placed personnel development at their top of their priority lists, including advances in management. Two big-city interviewees discussed the role of performance management in their operations – reporting against goals and metrics – but did not necessarily see this as revolutionary.

FINDINGS: GOVERNANCE STRUCTURE AND FUNDING

Governance arrangements of water systems vary across coasts and even within regions. As the degree of corporatization increases, the degree of municipal, managerial control decreases. For example, utility managers within a municipal department or agency must gain approval for increases in water rates and spending of revenues.

A key finding of this study is that autonomy matters: the further removed from direct management by city government, the more interviewees talked about innovative management strategies and financial flexibility. Corporatized models and enterprise funding permitted these managers greater autonomy in decision making and spending. Hypothesized benefits of the corporatized governance model (autonomy, financial flexibility, and political insulation) from the literature did emerge as themes from our interview sample. Interviewees from agencies categorized as municipal enterprises expressed considerable enthusiasm for this arrangement and attributed much of their own success to it.

Using the typology of governance arrangements described earlier, we classified the municipal water utilities included in our study as follows (Table 2). In further analysis, we plan to cross-walk this information with the interview themes from the coding.
### Table 2 Interviewees’ agencies

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<th>Gov't Form</th>
<th>Region</th>
<th>Governance Structure</th>
<th>Utility Financing</th>
<th>Ranges</th>
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<td>Municipal Department</td>
<td>City budget</td>
<td>&lt;50k</td>
</tr>
<tr>
<td>Council-Manager</td>
<td>Great Lakes</td>
<td>Municipal Department</td>
<td>Enterprise-fund</td>
<td>100k – 500k</td>
</tr>
<tr>
<td>Mayor-Council</td>
<td>Great Lakes</td>
<td>Municipal Agency</td>
<td>Enterprise-fund</td>
<td>2-3 mill</td>
</tr>
<tr>
<td>Mayor-Council</td>
<td>South Atlantic</td>
<td>Municipal Agency</td>
<td>Enterprise-fund</td>
<td>100k – 500k</td>
</tr>
<tr>
<td>Mayor-Council</td>
<td>Mid-Atlantic</td>
<td>Municipal Enterprise</td>
<td>Revenues from Water Sales</td>
<td>500k – 1 mill</td>
</tr>
<tr>
<td>Mayor-Council</td>
<td>South Atlantic</td>
<td>Municipal Enterprise</td>
<td>Revenues from Water Sales</td>
<td>100k – 500k</td>
</tr>
<tr>
<td>Town-Meeting</td>
<td>North Atlantic</td>
<td>Municipal Enterprise</td>
<td>Revenues from Water Sales</td>
<td>&lt;50k</td>
</tr>
</tbody>
</table>

The degree to which managers sought to achieve system-wide impacts seemed to depend on their degree of responsibility and governance capacity. Managing a city’s water distribution and collection systems is simpler than owning and operating facilities, especially where wastewater treatment plants are included. Several interviewees who manage the whole cycle noted the greater challenges associated with the wastewater side of the operation. Because water is relatively cheap, municipal government isn’t always properly incentivized to repair leaking pipes (North Atlantic Municipal Enterprise interviewee). However, when you are responsible for the whole governance system from collection to treatment to discharge, infrastructure concerns take on a whole new meaning, especially in older cities.

Additionally, water utilities are highly regulated entities that are under a lot of scrutiny from regulatory agencies, elected officials and customers. This makes them risk averse and less likely to innovate. “In some respects, we are sometimes seen as risk averse and not trying lots of new things - and I think there is a reason for that. If you're protecting drinking water quality, you don't want to try new-fangled stuff if it might not work. Because it would be an immediate public health crisis and I would be fired.” (Municipal Enterprise Interviewee Mid-Atlantic).

**Economies of Scale and Reach**: Due to their regional scale and comprehensive scope (managing facilities and infrastructure, sometimes drainage), comprehensive operations often find it easier to acquire funding to improve reliability and redundancy. As one interviewee from a large city (Municipal Agency, Great Lakes) told a group of smaller communities who they serve: “We have the 3 R's-redundancy in our system so if there's a problem we can reroute water and you're never without water. And we have the resources. If there is a problem, I have $12m in inventory. I can be anywhere, anytime within 2 hours, with water off, digging for a repair. Reliability- you never have had a problem with our water. You're trying to put a price tag on that reliability.”
Financial Flexibility: “The beauty is that we have what's called an ‘enterprise fund’ so we don't take any money from city budget. We have to pay city to do things for us, such as law department to review contracts and protect us from outside lawsuits; we pay department of procurement services to vet and award our contracts and insure it's done correctly. Every time we save a nickel, the money stays in our department. If we have a savings, it immediately manifests itself into more capital construction out in the field. The $30m [from the rate increase] went right back out into street to replace more water mains” (Municipal Agency interviewee, Great Lakes).

Political Insulation: “The costs [of water utility services], even for a well-managed natural monopoly, can be high relative to some citizens’ ability to pay” (Berg, 2013, pg. 9). As noted above by our interviewees, elected officials are often very concerned with water rates, making it politically infeasible to develop a rate structure that promotes resilience (Berg, 2013). Industry experts recommend developing mechanisms to insulate both the regulator and the utility from daily political pressures, to allow utility managers space to base decisions on long term financial, economic, and engineering considerations (Berg, 2013). Based on a survey of state-owned and municipal water utilities in Latin American countries, Berg (2013) concluded that “the fundamental problem is not engineering: it is the economic incentives and disincentives that accompany excessive political interference in commercial utility actions.” Many of our interviewees confirmed this, without being prompted to do so.

CONCLUSION

We are still in an early stage of digesting the rich data provided by the interviews, and more interviews are scheduled. At this point in the analysis, it seems clear that, from the perspective of senior water managers in cities of very diverse sizes and with very different environmental pressures, certain ‘bread-and-butter’ priorities are truly universal. These include day-to-day reliability, sustained reliability for the foreseeable future, including potential demands for growth, and the imperative of communicating with customers to ensure that they value the services received. Some of our interviewees brought up the types of themes that dominate the academic literature: Collaboration and partnerships were especially important in smaller cities and tended to take very focused forms – collaboration to educate ratepayers or cover peak use periods. Public outreach and engagement was universally important and often focused on managing potential opposition to rate increases. Innovation was important in many of the cities, and took the form of both day-to-day creativity in problem-solving and larger projects to embrace new environmental technologies. Decentralization and polycentricity proved to be a very complex concept, with more exploration needed. The wide variety of governance arrangements currently in use in water utilities around the country demonstrates that decentralization can take multiple forms, not all of which are equally effective. Where fragmentation follows decentralization, processes of integration are needed.

Although the interviewees did not talk about logic models, they clearly see their roles as fitting into a production function. Those operating in more bureaucratically constrained environments with more narrow perspectives tended to focus their comments mostly on inputs and outputs, whereas those with greater span of control demonstrated somewhat more attention to longer-term outcomes and to an integrated view of the whole value chain – but this is a very preliminary observation that needs further study.
BIBLIOGRAPHY


Sanborn, Margaret and Tim Takaro. 2013. “Recreational water–related illness and management and prevention” Environment and Health Series. 59: 491-495


\[1\] The best work here is being done in the area known as socio-ecological systems (SESs). For example, see Anderies et al (2006) for an excellent summary of emerging lessons learned and Folke (2006).