

**Reining in Drought:
How Water Limits Influence Conservation in Massachusetts Towns**

by

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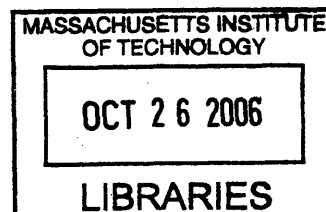
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ABSTRACT

It's surprising to learn that the water-rich state of Massachusetts experiences incidences of water stress, where rivers go dry for stretches of the year and where municipalities struggle to meet water demand. Water conservation and demand management is one important part of reducing pressures on water supplies and alleviating ecosystem stress. Although the state has recently revisited water management policies and has promoted revised measures to increase conservation, the actual measures taken are implemented on the scale of the municipality. This thesis examines three affluent suburban municipalities located in stressed river basins in eastern Massachusetts that have taken different degrees of conservation and demand management efforts. The stories reveal that the decisions to curb water demand have been influenced by the degree to which towns have experienced a perceptible limit to their supply. These towns also show us how a crisis, or an event of water shortage, can bring focus to the limits of water, providing an opportunity for town managers to redefine the problem in such a way that conservation is the solution. As towns continue to face increasing pressure on water supplies, some municipalities would like to turn to regional water. Although these regional systems can help offset some ecological pressures as well as promote economy of scales, it raises questions as to whether such a system would remove the perceptible limit that gives impetus for conservation.

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INTRODUCTION

If you ask Meldina why she bothers saving the water after washing her dishes to use later, she might invite you to join her the next morning for a walk to the well. Meldina lives on the outskirts of Maputo, the capital city of the southern African country, Mozambique. After asking this very question, I met her outside her modest concrete slab home before sunrise, a *capulana*, or cloth sarong, wrapped over my pants. Four of us *malungos* joined her; *malungo* is the name for “white person,” though the term seemed to encompass my friends of South Asian and Philippino descent as well. Carrying two 20-liter plastic jerricans – yellow plastic jugs – Meldina and her friend Amelia, there presumably for entertainment value, began their morning journey with us in tow. We walked down a well-trodden path through a field, passing other commuters carrying bundles of vegetables and fruits on their heads, on their way to the market. Forty minutes later, with just a yawn of sun on the horizon, we arrived at our destination: Meldina’s water source. Behind a locked fence, rows of papaya and banana tree crops hung heavy with ripening fruit. Just beside them, a spring-fed pipe created a wide, deep puddle of muddy water. Since the gates to this agricultural and water cooperative were locked and the guard hadn’t arrived yet, Meldina and Amelia squatted down and made jokes about their company. We *malungos* took turns shaking the jerricans, which Meldina had filled with a few rocks, a bit of soap, and a little water in order to scour out the residue build-up that had accumulated over time.

When the guard finally arrived, Meldina escorted us to the reservoir and revealed the small pipe that fed it. She paid the guard for each jerrican; the fee was little more than

the cost of one gumball in the U.S., but given Meldina's nominal income, there's no such thing as pocket change. After dumping the soap and rocks, and giving the jugs a rinse, she hoisted her *capulana*, waded into the water, and proceeded to fill the jerricans.

Normally, I consider myself a strong and agile person, but not once Meldina hoisted the now 44 pound jerrican onto a *capulana* crown placed on my head. I shuddered under the weight and at the thought of the return walk. The four *malungos* traded off the two jerricans throughout the walk, but Meldina and Amelia needed to relieve us at points, demonstrating how nimbly they each could run and dance with the jugs balanced easily on their heads. If you can manage, it's smart to run since it makes the trip end quicker. I found it hard enough to wield the wobbling weight while walking with my arms clutching the jerrican in attempt to stabilize it. We finally made it back to Meldina's, leaving her with one jerrican. Five of us shared the other jug for the remaining stretch back to Amelia's home in the village. At this point, broad daylight highlighted our struggle and people turned heads to chuckle. My neck and shoulders remained stiff for the rest of the week.

Later that day, I returned to my temporary home in a starkly different section of Maputo. Called the "cement" city, it's the part of Maputo where cars drive on paved roads, trash gets bundled neatly into plastic bags, then set out on the street for someone else to deal with, and water and electricity, both coming from up north, feed directly into homes. Getting some carrots out of the refrigerator, I turned on the tap and began to rinse them off.

On the other side of the world

In the Commonwealth of Massachusetts, we rarely, if ever, worry about water availability, associating such concerns with western states or developing nations. With even more reliable services than Maputo's "cement" city, we might walk ten feet to a faucet, turn a knob to fill our glasses, brush our teeth, or rinse off vegetables. We assume abundant supplies of tested, treated drinking water to wash our dishes, to water our lawns, and flush our toilets. Or do we? Recent studies of certain watersheds and rivers – some of which actually have run dry – reveal that Massachusetts and other New England states need to reconsider the question of water availability.

According to the United States Geological Survey (USGS), water flows in both the Ipswich and the upper Charles River basins regularly drop below the standard needed to maintain a healthy freshwater ecosystem. Indeed, the ecosystem has suffered with the Ipswich River currently supporting fish communities typically found in ponds—not rivers— indicating how low streamflow levels fall (Armstrong, Richards, and Parker 2001). Similarly, the upper Charles River Basin experiences summertime shortages, which the USGS partially attributes to increased water demand due to the 15 percent population increase between 1990 and 2000 (Eggleston 2004).

The low water flows seen in the Ipswich and the upper Charles point to a need for water conservation. Taken alone, conservation and demand management will not restore over-tapped rivers or increase water supplies to meet and future demand. But these strategies will help solve the water availability puzzle, improving ecosystem health. In basins like the Ipswich, water management consultants, Horsley & Witten, Inc., estimate that the annual shortage of water needed to support the ecology approximately equals the

amount used for lawn watering and other outdoor uses (Horsley and Witten, Inc. 2003). Conservation can also provide municipalities and the state with a greater buffer so that natural fluctuations in annual precipitation do not result in crisis. Columbia University's Earth Institute just released a report (May 2006) that calls the water emergencies experienced in a suburban New York community "human induced drought," pointing to the need for conservation (Lamont-Doerty Earth Observatory website 2006).

In spite of water availability problems and the benefits of conservation, water conservation remains a low priority for many Massachusetts municipalities. But why wouldn't it? Most towns have never experienced water shortages – have never seen a local river run dry or been asked to limit their water use for any extended period of time. However, other suburban Massachusetts towns with similar demographics in terms of income and education levels have begun to take aggressive conservation measures and promote greater operational efficiency. Why do these towns in this ostensibly water-rich Eastern state feel a pressure to conserve? What risk do they perceive that other municipalities do not, and what can this teach us about the management of the Commonwealth's water in the years to come?

In three Massachusetts towns, each with different degrees of conservation and demand management efforts, decisions to curb water demand have been influenced by the degree to which towns have experienced a limit to their supply. These towns show us how a crisis, or an event of water shortage, can bring awareness to the limits of water, providing an opportunity for town managers to redefine the problem in such a way that conservation is the solution. The town of Weston, for example, has done little to reduce overall consumption and improve efficiency. Weston gets its water from a regional water

authority, the Massachusetts Water Resources Authority (MWRA) and as of 2005 has a guaranteed supply available for the next 20 years. On other end of the spectrum, Acton has emerged as a state leader in terms of conservation and demand management. Acton has experienced episodes where the Town Water District cannot pump enough water from its local wells to meet demand and faces ongoing growth pressures. These events, combined with a history of water pressures, have led Acton water managers to change their definition of the problem so that conservation and demand management become part of the solution. Between these two poles, Wellesley has adopted modest conservation and demand management measures, but only when the town's water managers have experienced water limits. Once Wellesley became a partial user of MWRA water in 1988, thereby alleviating some pressures on their municipal supplies, the impetus for water managers to redefine the problem declined. Today, however, Wellesley again faces supply limits, giving it reason to make conservation strategies more effective.

An examination of these three municipalities reveals the political, ecological, and infrastructural realities that eastern Massachusetts faces now, and will continue to face in the future. The stories of the three towns are set within the context of changing state water policies that aim to address water availability problems such as those seen in the Ipswich River basin. The recently adopted framework document, the Massachusetts Water Policy (2004), sets forth the goal of "keeping water local," and calls for towns to live within their "water budget." Already, some municipalities live beyond their means, even with demand management strategies in place. As growth continues, infrastructure ages, and municipalities lack the capital to invest in improvements, some towns have begun to murmur about regional water as a way to meet supply and demand.

Understanding the impact of water limits on conservation and demand management in Weston, Acton, and Wellesley offers a framework for how the state might create policies to keep water local while also considering the merits of regional water systems.

But policy-making ignites debate since it creates a forum — or should — for different voices to come to the table. When it comes to making water policy, state agencies, environmentalists, and water suppliers bring different agendas to the table, viewing the problems of dry rivers and supply/ demand struggles through different lenses. This is significant because the range of possible solutions is shaped by how a situation is described and defined.

WHY IT MATTERS IF YOU WIN THE BATTLE TO DEFINE THE PROBLEM

Weston, Acton, and Wellesley, three similar towns in terms of demographics, have taken different approaches to water supply and demand challenges. It is essential to understand what factors lead to policy change. A crisis, abrupt change, or other focusing event can put an issue on the political map and provide a window of opportunity to harness the political will needed to institute changes (Kingdon 1995). Crisis can also change the political climate, allowing for the problem to be redefined and viewed in a different light. While a focusing event might spark new and innovative approaches to address the problem, it also creates the space for ideas that have been, as political scientist John Kingdon (1995) describes, “floating around...for some time,” to take hold. But it’s an opportunity, which might pass with or without being seized.

An opened policy window may create space for a policy entrepreneur to pitch a solution, but the opportunity itself does not lay out a specific solution or guarantee action

(Kingdon 1995). Rather, one can define a problem in more than one way in any given situation. Deborah Stone (1997) identifies two different ways that issues around “commons” problems, such as water or air quality, can be defined within the context of public and private interests. The first way argues that private benefits entail social costs. Alternatively, the definition could state that social benefits necessitate private sacrifices. Each definition refers to the same situation, but the values and implications laden within each are dramatically different.

Given the values implicit in a problem definition, the description that prevails will shape the course of action, or inaction, in response to the problem (Stone 1997, Layzer 2006). As we will see in the town of Acton, for example, a water crisis occurred when the wells could not supply enough water to meet the demands of residents. The water managers defined the problem as a result of excess water use within the town. The obvious solution then, was to reduce water demand among users.

A crisis or focusing event, such as a water shortage, can not only put an issue on the political agenda, but it can change the way a situation was previously understood or perceived. If the event leads to a redefinition of the problem, it opens up a new array of solutions. Often a jostle occurs over who will determine the cause of the problem because of the political implications attached to a given definition (Stone 1989). In winning the struggle over the definition and cause, it can also create a framework for where to assign blame and therefore responsibility to addressing the problem (Stone 1989). In light of the water supply and demand challenges that Massachusetts municipalities have recently encountered, a water shortage or crisis creates an opportunity for water managers to

perceive limits to the resource and redefine the problem in such a way that conservation and demand management are the solution.

HOW HISTORY, POLITICS, AND ECOLOGY SHAPE TODAY

The way problems have been defined in the past has given rise to many of the solutions that we live with today. The ecological history of New England rivers reveals how infrastructure and water policies have, at different points, reflected the way in which we have perceived water and water systems. Over time, our understanding of water systems has evolved to better recognize the relationships between surface waters and ground waters, water quality and quantity, and human systems. And we see how the solutions of yesteryear have also created some of the water supply and demand problems we currently experience.

The Arid Northeast?

Massachusetts does not come to mind as a place of water scarcity. In a state that gets five times more rainfall than Tucson – sometimes leading to the other water extreme: flooding – rivers in eastern Massachusetts can reduce to mere trickles during parts of the summer. In general, Massachusetts has ample groundwater and surface water, but summertime low flows have sparked concern among environmental groups and state agencies. In 2003, American Rivers, a national river conservation organization, designated the Ipswich the third most endangered river in the country for its recurring low-flow levels, particularly near the headwaters (Armstrong, Richards, and Parker 2001). Other rivers in the Commonwealth, such as the Charles, the Sudbury, and the

Assabet, also undergo low flows for parts of the year. Remarkably, the city of Brockton has moved ahead with plans to build a desalinization plant, unable to meet its water demand given existing water available. Swansea just gained approval in March 2006 to follow suit, and other municipalities have expressed interest as well.

This backdrop of strained water resources despite abundant rainfall has caused concern among watershed groups, environmentalists, and state agencies, leading groups like the Charles River Watershed Association (CRWA) and the Ipswich River Watershed Association (IRWA), to declare that a water crisis is looming in the state (CRWA 2005, Zimmerman 2006). In a battle to redefine the problem, many local officials and water managers in Massachusetts resist calling the situation a crisis. Instead, they raise social and political questions and call into question the “science” behind policies that call for conservation by restricting the amount of water that towns can use. Some say that before we go about “rationing water,” in the form of water bans, we need to better understand what’s causing the problem and, for that matter, whether a problem even exists—citing stories of low flows dating back “forever.” (Shaughnessy 2006). But the Massachusetts DEP Commissioner stresses that to avoid future situations like the Ipswich, we must take measures now (Golledge 2006).

Water quality and quantity concerns meet

In fact, water concerns are not new to Eastern waterways, although historically water quality captured most of the focus. In the waterwheels, mills, and tanneries of the Industrial Revolution, human water demands clashed, sparking quantity and quality concerns. Power and factory needs clashed against the plowshares of farmers and tangled with the nets of fishermen, taking the form of lawsuits and vociferous debates. New

England's industrial past is dotted with court cases over polluted waters. Downstream mills sued upstream users for bleeding colors and chemicals into the river, causing economic losses to factories that required a clean source of water for operations (Steinberg 1991). At that time, contamination sparked alarm for its impacts on human uses of the rivers; ecosystem considerations were not on the radar screen, though the ecological losses were immense. Quantity debates also arose, with industry repeatedly trying – ultimately unsuccessfully – to establish exclusive streamflow rights (Steinberg 1991). The dams built in the service of waterpower resulted in both flooding and dry stretches.

Current local and state water and sanitation infrastructures arose in the late 1800s out of new understandings that linked public health with water quality. Cholera outbreaks plagued eastern cities in the throughout the 1800s and early 1900s, resulting from pools of stagnant wastewater. Although public health theories were rudimentary at the time, this public health crisis pointed to the problem of exposing humans to their waste (Steinberg 1991, Tarr 1997). This problem definition spurred engineers to mastermind infrastructure systems that separate people from their waste while also promoting development of urban centers by carrying water into cities and taking sewage and stormwater away.

Federal legislation, such as the Clean Water Act of 1972 and the Safe Drinking Water Act of 1976, also sought to remedy these water quality issues. Although neither federal nor state regulation focused on concerns of water shortage in the Eastern U.S, the environmental era prompted greater attention to the relationship between water quality and water quantity. From an ecological standpoint, we now know that dilution is not the

solution to pollution. However, diminished water flows do prevent the natural flushing of contaminants, both human and natural. Low flows also pose a threat to ecosystem health in their own right, since dissolved oxygen levels tend to decrease, temperatures increase, and sometimes there just isn't enough water to support the type of life that normally inhabits these rivers and stream.

The environmental era also raised awareness over the impact of engineered systems on the hydrologic cycle. Though essential, the infrastructure systems that helped address the water quality and public health concerns helped create the supply problems and low river flows that we experience today. These systems have resulted in the separation of surface water from groundwater. Hydrologically, these two systems seep together, with groundwater continuously feeding into rivers, helping to maintain a base flow of water. Other times, river waters filter down and replenish aquifers (Simcox 1992, Winter et al. 1998). In Massachusetts, however, the former tends to be true, which means that water taken out of the ground for industrial, commercial, and residential purposes impacts the amount of water that flows in rivers and streams (Horsley & Witten, Inc. 1998). Furthermore, if you live in a sewered community, the water flushed down your drain and toilet leaves your home and runs out to a sewage treatment facility for processing and discharge either outside your river basin or in another part of the sub basin. Since water cannot recharge the aquifer, these systems have contributed to basin de-watering. (Horsley and Witten, Inc. 1998).

It is not only water extracted from the ground that affects the flow in rivers and streams. When water can't make it to a permeable surface – a problem that has grown more and more prevalent with increases in paved surfaces – then it flows horizontally

across pavement, concrete, and rooftops, and empties into storm drains, following the fate of the water flushed down the toilet, rather than recharging groundwater supplies.

Stormwater runoff also contributes to instances of flooding, since water travels fast to the surface water, with little tempering its pace.

Massachusetts has begun to address this interface between water quality and quantity. The Massachusetts Water Policy, published in 2004 by the Massachusetts Executive Office of Environmental Affairs (EOEA), aims to coordinate and strengthen existing policies. It calls for addressing water quantity, quality, and habitat concerns in an integrated manner (MA EOEA 2004). Similarly, it argues that to address low stream and river flows, we need to improve efficiency, engage in conservation and demand management, improve land-use planning, and rethink how our infrastructure systems to help keep water local (MA EOEA 2004). It is within this historical context and the more recent policy context that we examine Weston, Acton, and Wellesley and their local approaches to water conservation.

TABLE 1: SUMMARY OF WATER LIMITS & WATER USE			
TOWN	WATER SOURCE	SUPPLY LIMITS	WATER USE 2005 (residential gal/capita/day)
Weston	MWRA (regional water)	Ample supply	123
Acton	Town wells	Steady limits	65
Wellesley	Town wells & MWRA	Periods of limits	80

WESTON: NO LIMITS, NO CONSERVATION

A 12 mile straight-shot from Boston on major highways, Weston – one of the most affluent communities in Massachusetts – has strong schools, open-space, attractive homes and well-kept neighborhoods. The highway passing through Weston crosses two town reservoirs, no longer used for a drinking water supply but maintained for aesthetic reasons. When Route 128 and the Massachusetts Turnpike cut through Weston back in the late 1960s, the highways were built close the town wells (Ferrelli 2006). A few years earlier, in 1963, the town had joined the Metropolitan District Commission (MDC), which owned the system we now know as the MWRA (MDC 1984). Weston tapped into the networked water, though they still relied on their own groundwater sources as well (Ferrelli 2006). With ice and snow commonplace in New England however, road salt from the highways contaminated municipal wells. “Thank God we had the tie in with the MWRA,” Weston Water Superintendent Russell Ferrelli explained to me in his office, because the MWRA then became the town’s sole water source. Today, with guaranteed water from the MWRA, water managers in Weston do not perceive limits to their water supply, so they have made few efforts to promote conservation and reduce demand. To the extent that water managers have perceived water shortages, they have viewed these brief events as problems of limited storage capacity. Because they define the problem as one of storage capacity, the town sees new tank construction as the solution, not conservation.

Perceptions of Plenty

In Weston, water availability is not a primary concern for water managers. Although Weston is located in the basin of the Charles River, which is classified as “stressed” by the Commonwealth’s Water Resources Commission, its water comes from the far off and well-endowed Quabbin Reservoir. In 2005, Weston negotiated approval for another two-decade contract that assures the town an annual increase in their water allotment from the MWRA to account for growth projections. So far, they haven’t come close to using their allowable amount so this adds extra cushion for growth. Just in case the town does need a back-up water source, Weston can also tap into a supply network that links them to nearby Wellesley, Natick, and Needham.

Weston may seem sheltered from water supply woes given their bountiful MWRA supply, but in recent years they have experienced challenges meeting demand. Stephen Fogg (2006), the Weston Town Engineer, indicated that, “we do have a problem locally in the middle of summer when the system we have will pump around the clock and barely keep up with the amount of water in storage.” But, he noted, “it may only happen a few days a year,” and it tends to occur when it’s hot and dry and people kick the sprinklers into high gear to make up for the lack of rainfall. While demands may press on supplies, Weston sets aside two to three million gallons per day for emergency events, fire in particular, and their average daily demand hovers around five million gallons. But, “sometimes you don’t have a lot of room for error” and equipment failure or a water main break could force the town to dip into the emergency storage. All the same, the town does not view the supply and demand challenge as dire enough to warrant immediate attention.

McMansions and megalawns

Water use to maintain the large homes and large lawns of Weston residents is high. Although the town isn't growing much in terms of numbers, the size of homes is increasing. "We have a lot of knock-downs," Superintendent Ferrelli tells me, where smaller homes get transformed into what old-timers in the town call "McMansions." Even the big homes are getting bigger. Mr. Ferrelli joked that the town is transitioning from million dollar babies to billion dollar babies (Ferrelli 2006). To accommodate the water needs of larger homes, even the household water meters, which measure the amount of water used by each home, are big nowadays. "I mean, years ago we used to [use] a 5/8 meter, which is a very small meter. Then we went to a 3/4. Now it's one inch or an inch and a half." Mr. Ferrelli explained, "the pipes are getting bigger. The houses are getting bigger. They want more water." Not surprisingly, the lawns accompanying these homes are also immense. "It's a landscaper's heaven," Mr. Ferrelli told me in his office, which sits adjacent to one such firm.

What may be a landscaper's heaven turns out to be water conservationist's nightmare. Weston residents use high quantities of water, particularly during summer months. In the Annual Statistical Report made to the Massachusetts DEP last year, Weston reported a per capita water use of 123 gallons per day (Weston Water Works 2005). That's more than double the average per capita use for the MWRA system and it also makes them one of the highest users in the state. Most of this water use is attributed to lawn care. When new homes get built or smaller ones scale up, they typically include an irrigation system. As Mr. Ferrelli said, gone are the days when people used to drag a hose around the yard to manually water their lawns. Many residents water their lawns

every other day, daily, or, according to Mr. Ferrelli, even twice a day, even though a lawn in this climate typically needs only about one good soak per week (URI website 2006, MA DEP website 2006). Automated sprinkler systems, now common fare, notoriously lead to over-watering. Unless residents manually switch them off, the sprinklers run during rainstorms and when pipes split or irrigation heads break. Mr. Ferrelli explained, “If you have an...electrical problem, like if the electricity goes off, then the timer’s all gone and it’s like watering every day...” Even when residents take off for chunks of the summer, many continue to run their irrigation systems to ensure a green lawn.

No Limits

To the extent that Weston officials perceive a problem, the few occasions when demand has approached storage capacity created an opportunity for water managers to redefine the problem in ways that would suggest the need for conservation. Instead, Weston’s water managers viewed the problem as a result of insufficient storage capacity. That prognosis has steered town policies and planning toward new storage tank blueprints. After all, their supply from the MWRA is guaranteed, but tank space prevents them from accessing their entitlement. Although Weston has not moved toward securing new storage, the town engineer indicated that within the next few years, he will probably recommend increasing the tank capacity (Fogg 2006).

By contrast, the DEP or the CRWA would look at the per capita usage of 123 gallons and interpret the supply/demand problem as stemming from excessive irrigation. A conservation-oriented definition of the problem would point a finger at residents and suggest they modify intensive lawn care practices. It would also prompt the town to help

transform residential behavior to use less water through landscaping choices and watering practices.

One can understand why Weston's DPW frames the town's supply/ demand challenge as a dearth of storage. In a town where the median household income is nearly \$154,000 (US Census 2000) and people spend a huge amount of money on lawn care and property taxes, the political ramifications of aggressive water conservation are politically unpalatable. With assets invested in landscaping, stringent water conservation steps like water-use restrictions would spark controversies and public outcry, bringing water managers and local officials into a political fire. When I asked Mr. Ferrelli what would happen if the town enacted the watering ban that their new by-law permits, he laughed, "they'd shoot me!" I don't know if a watering ban would lead to assault in Weston, but the fervor with which many residents view their lawns suggests to water managers and decision makers that the political costs of advancing conservation are too great (Kingdon 1995).

Minimal conservation

Without an episode that causes water managers to recognize water limits, Weston has taken few demand management measures beyond those required by the DEP or the MWRA. But, even those measures have not encouraged reflection, adaptation, or response to improve the conservation results. Like a number of Massachusetts towns, Weston uses a two-tiered pricing scheme to charge higher water users more per unit used. According to the Weston Water Superintendent and Town Engineer, the impact of pricing on residents is likely mixed. Some residents respond by lowering their use, but for people who pay hefty sums in property taxes, a high water bill is worth the investment. In

other affluent towns, the findings suggest a similar response. A study of the highest water users in Concord, Massachusetts showed that cost is a factor for determining lawn-watering practices only for some people. Of these people, price is not the only thing they take into consideration. All respondents pointed to the importance of their lawn as an asset or they referred to the importance of owning a “good-looking lawn” (Aceti Associates 2005). Lessons from efforts to curb fossil fuel use show that monetary incentives have minimal impact on wealthy people. We see this with the prevalence of sports utility vehicles on the roads even with high gas prices.

Infrequent billing may further dilute the impact of pricing on water use. Weston residents only receive a bill twice per year, which makes it difficult to link water use to cost, even for people that might alter their behavior based upon price. Like many smaller towns, Weston relies on one staff member who goes from house to house to read water meters and generate bills. To increase water billing frequency under this system would demand another staff person, or a switch to newer radio-signal or wireless meter reading technologies.

The Selectmen of Weston also recently adopted a by-law that allows the town to institute a watering ban should drought emergency conditions arise. The step came as a stipulation of the MWRA in order to make them eligible for water system project funding. The town has not put the ban into effect, however, and likely won't anytime soon since it's designed for implementation in emergencies.

The town also sends out water conservation tips, created by the MWRA, to consumers in the biannual water bills. Residents can also pick up plastic water measuring devices from the DPW office to help determine how much to water in a given week,

based on rainfall. The information, if heeded, could significantly reduce household water consumption. However, if the information does not resonate with customers or they cannot easily access it, then it's not likely to influence behavior. The Concord focus group study found that only one or two of eight participants actually reads the conservation notices that the town sends out with their bills (Aceti Associates 2005). Most people rely on information from word of mouth, largely from neighbors and their lawn-care contractors.

Summary

Weston has access to ample MWRA water and has the capability of tapping into water from other adjacent towns in the event of an emergency. In the absence of a perceived limit to water supplies, efforts to reduce consumption have provided no moment of reckoning, where the town would have impetus to “learn” from what strategies have worked and what have flopped. Consequently, the town has relied upon notices distributed by mail and pricing strategies, potentially useful tools, but untailored to the Weston residents.

When faced with brief episodes where water demand approached supply, Weston's water managers did not seize the opportunity to define the problem in a way that led to conservation. Instead, Weston's water managers viewed the problem as one of insufficient storage, rather than excessive use, focusing solutions on increasing tank size. With no aggressive and sustained conservation measures required, Weston has not experienced a “culture change” to favor reduced water use.

ACTON: CRISIS, PERCEIVED LIMITS, AND SERIOUS CONSERVATION

Acton, another suburb with a generally affluent and well-educated population, sits to the northwest of both Boston and Weston. The story of water availability and use contrasts starkly with that of Weston, however. Initially, a water crisis made the water limits apparent to Acton water managers. The crisis created an opportunity for water managers to redefine their supply/ demand problem to focus on excessive and inefficient use. Part and parcel to this, the water managers saw the need to raise awareness among residents, which led them to hire a full-time staff person to focus on conservation and outreach. Because water managers and local officials have experienced ongoing limits to their water supplies, the Acton Water District has taken extensive measures to promote conservation and demand management. Among these measures, the Acton Water District institutes mandatory water restrictions each year.

The supply crisis

On June 21st in 1999, Acton did not have enough water to meet demand. “We were pumping as much water as we could possibly pump that day and we couldn’t keep up. The tanks were going down,” recounts Acton Water Supply District Manager, James Deming. The problems with water shortage extend far beyond filling water glasses and providing toilet flushes. To water suppliers like James Deming, you’re in trouble when you don’t have enough water to fight a fire, should such an unfortunate event occur. Fortunately for Mr. Deming and for Acton residents it did not. But, the risk created a stir.

Unlike Weston, nearly all of Acton residents get their water from town sources. The Acton Water Supply District owns and operates a number of town wells, in addition to the pumps, and the pipes to distribute water to users. The Massachusetts Department of

Environmental Protection (DEP) that establishes how much water a town supplier can withdraw on an average basis. In 1999, Acton hovered right at their DEP limit and extracted an average of 1.9 millions gallons per day (MGD). But their peak water demand, or the maximum amount of water a supplier can take during the highest use period climbed up to 4.1 MGD (Deming 2006). Even though the water district tended to meet its withdrawal permit on a daily basis, Acton recognized a supply crunch. “Forget the regulatory limit for a minute,” Mr. Deming explained, “People were using water faster than I could physically get it out of the ground.”

Crisis reveals limits

The water crisis brought focus to supply limits and triggered the Water District to take action. In response to the water supply crisis in June of 1999, Acton’s Water District imposed a ban on all users in attempt to bring water demand down to fall within the supply parameters. That meant that Acton residents had to hold off on lawn watering. According to Mr. Deming, over the course of the next two weeks, Acton reduced water demands by 50 percent, and that was without restrictions on car washing and the filling of swimming pools. “It was absolutely extraordinary. So, when we did that, it was obvious that the problem was lawn watering. I mean, you didn’t...need to pay a consultant hundreds of thousands of dollars to tell you...that people were watering their lawns too much.”

The summer of 1999 was not the first time that Acton experienced water supply stress. Back in the late 1970s, the Water District closed down two wells when it discovered groundwater contamination from W.R. Grace, the same company that gained notoriety as a result of Jonathan Harr’s (1996) *A Civil Action*. Although the wells have

since been cleaned up and are back on tap, at the time of the discovery, Acton got hit with supply shortages, forcing the Water District to impose water restrictions. Past contamination has reminded water managers that future groundwater sources could encounter similar problems, limiting their supplies.

Redefined problem leads to conservation

The water crisis gave the water managers at the Acton Water District an opportunity to change their view of the supply and demand problem to address inefficient use and promote demand management. In particular, the results of the crisis-induced watering ban demonstrated to Mr. Deming the impact of lawn watering on supplies. With lawn watering seen as a primary contributor to the water shortage problem, the Water District focused on ways to reduce demand, as well as improve overall system efficiency and repair leaks. Mr. Deming sees education as critical to reducing water use. After the well levels had returned to normal, Mr. Deming approached his Water Commissioners, the body that hired and now oversees him, and proposed funding a new staff position to focus specifically on water conservation. In early 2000, Jane Ceraso began her tenure as the Water District's Environmental Manager.

Ms. Ceraso tailors conservation outreach efforts to different groups in the community. She invests in long-term conservation by visiting Acton classrooms to educate students about the value of water conservation. But youth are not the only targets of water conservation programming, which is important, since adults make household decisions. The Water District also works with local garden clubs and irrigation contractors to discuss alternative landscaping that requires less water. Since the municipality is still growing, the Water District also conducts workshops with developers

to promote practices that don't strip away topsoil. Many developers plant grass species that grow fast and green, like Kentucky Bluegrass, in order to make the home ready for market faster, but these non-native species require intensive watering. Acton helps developers explore alternative seeds, more suitable to drought. Similarly, Water District offers water audits for all commercial users, helping users to identify ways to improve efficiency and conservation (Ceraso 2005, Deming 2006).

At the household level, the Water District sends out conservation tips with customer bills, as seen in Weston. It also includes magnets to stick on the fridge as water-saving reminders. And, the District hands out water conservation devices, like those available at the Weston DPW office, to help residents know how much rain has fallen, so that they don't over-water their lawns. Acton strives to get the message out in many places and through many different means (Ceraso 2005, Deming 2006).

Acton has rules, too. In addition to the "soft" measures to promote conservation through education and outreach, each year Acton imposes water restrictions—no matter what. To Mr. Deming, this is important for two reasons. First, it allows the District to balance supply with demand. But it also promotes ease of implementation. In New England, where the saying goes, "if you don't like the weather, wait a minute," annual restrictions can help people know what to expect. Mr. Deming argues that it's confusing for residents, if you impose a ban, then "...you take it off, then you put it on...all the time." To make it easier, Mr. Deming told me, "our regulations go into effect every year. I don't care if it rains every day. The regulations are the same."

Behavior change and water conservation is one part of water management strategies to reduce stress on river basins. Significant water losses also occur through

aging infrastructure and leaky systems. The water crisis in 1999 triggered the Water District to fix infrastructure, such as water meters, to ensure that they accurately account for the water that flows through them. The Water District also undertook efforts to optimize their existing supplies (Ceraso 2005, Deming 2006).

The strategies taken by the Acton Water District reflect how the water managers changed view of the problem to see demand management as essential. Even though Weston and Acton use some similar conservation strategies, such as conservation tips distributed with the bills, unlike Weston, Acton has had to reckon with the bottom line of finite water supplies. Mr. Deming noted that fines may give reason for some residents to adhere to watering bans, “but not much of an incentive because the people that you’re talking about fining and the amounts you’re talking about fining — money probably isn’t that much of a deterrent.” Like Weston water managers, Mr. Deming understands that pricing and fees alone might not have much of an impact on his users, given the size of their budgets. In Acton, however, water limits lead the Water District to take other tactics to achieve demand reduction. Acton does not just follow a checklist of conservation measures, but modifies programs to decrease pressure on their supplies.

The 1999 crisis created a window for the Water District to redefine the water supply and demand problem, but it took leadership to seize this opportunity. With 19 years of experience in four communities before the Water Commissioners hired Mr. Deming, he came to Acton with extensive experience (Deming 2006). As the Director of the Water District, Mr. Deming reflects the values of the Water Commissioners, and also makes staffing choices based on these values. The Acton Water District, from the Commissioners to the Director to staff, shows openness to new ideas and information,

and a willingness and confidence to try new approaches. Ms. Ceraso's position as a water conservation outreach staff person – one of the first such positions in the state — illustrates innovation on the part of the water managers. It also reflects Mr. Deming's commitment to education as a way to promote behavior change, and culture change—something he sees as necessary to longer-term conservation. Hearing this, I was not surprised to learn that before his days as a water supplier, Mr. Deming has considered pursuing a career in education.

Changing the Culture

Acton's conservation strategies that emerged in response to limits have reduced water demand, but they have also helped shift the town culture toward conservation. For Mr. Deming, the combination of education and annual restrictions has led to a gradual change in culture and expectations among residents. According to Mr. Deming, when the Water District first started instituting stringent water restrictions, residents used to call the office to rat out their neighbors when they witnessed lawn-watering violations. Given the concern that many water suppliers expressed over taking on the role of water police, it's more efficient and effective when communities can reinforce messages of good behavior.

As part of the norms shift, according to Mr. Deming, residents have learned, too. The Acton Water District used the water crisis and ongoing limits to design policies that make the impacts of limits felt for residents. According to Mr. Deming, it's not only that residents police each other, but they've actually reached a new understanding about what a healthy lawn needs. "We're no longer *telling* people they can't water. We're not just hitting them with the rules, or putting up a regulation that says you can only water now.

What we've done is through all of these various methods, people have become better educated in...why they don't need to water as much." He also noted that residents are starting to understand that water is not a limitless supply, another profound shift.

Looking ahead

Although the urgent pressure from crisis has lifted for now, Acton continues to undertake conservation and demand management measures. But for the water managers, the limits are not far off. As growth continues, the Water District anticipates again reaching the limits of their authorized water withdrawal amount under the Massachusetts Water Management Act (WMA). Today, Acton has a cushion before it again bumps up against its regulatory limit on water withdrawals. As Mr. Deming looks ahead, he worries that the Water District has already captured the low-hanging fruits of water conservation. This gives the Water District impetus to stay on track with conservation—it buys time. According to a recent informal study done by the Water District, it looks like they have until 2008 until they will once again lean on their regulatory limit. That's accounting for the 99 new single-family homes that will be built within the next two and half years as well as the 260 apartment units scheduled to be built within three years (Deming 2006). More water limits could also be on the horizon for Acton as it's possible that the plume of groundwater contamination may be headed for another town well. If does look like it will hit one of the public supplies, residents may face further restrictions. He also suggests that the answer to water supply challenges in the future, particularly given the environmentalists' concern for the rivers— is desalinization or regional water.

Summary

Acton has seen both crisis as well as long-term pressure with respect to town water supplies. What started off as a response to crisis — a lawn-watering ban — led water managers to change their view of the supply/ demand problem in such a way that longer term demand management and conservation became the solution. The Water District has undertaken massive steps to improve the efficiency and operation of the system and its infrastructure on top of multi-pronged education and outreach programs to students, households, landscapers, and developers. These actions, combined with an annual watering ban, have contributed to a culture shift in Acton toward water conservation. The water limits experienced by water managers have given impetus to adopt strategies that yield effective conservation outcomes. As Acton looks ahead, water supply limits will continue to present a challenge for the Water District, given ongoing growth and a risk of future well contamination.

WELLESLEY: SOME LIMITS, SOME CONSERVATION

Like Weston, Acton, and Wellesley – an established suburb adjacent to Weston and just 13 miles west of Boston – is home many affluent residents. The population of Wellesley has not changed much since the 1970s, but water demands have. In contrast to other municipalities in eastern Massachusetts, Wellesley’s population has remained relatively stable, since most of the land in the community is developed. In the past 20 years, water managers in Wellesley have experienced episodes where they face limits to their water supplies, and they have responded by promoting short-term water conservation measures. But after Wellesley reached out for additional water supplies

from the MWRA, water managers no longer faced the same limits and efforts to institute conservation declined. The town's infrastructure is getting older, however, presenting new limits to water availability and triggering a renewed response for conservation and demand management. During the episodes when Wellesley has experienced challenges in meeting demand, it made the limits of water resources apparent to water managers. Because the perception of water limits decreased when Wellesley joined the MWRA, however, water managers did not have the impetus to redefine the problem of supply and demand in the context of excessive water use. Consequently, they did not institute stringent water conservation measures.

Crisis prompts conservation

In the mid-1980s, the Wellesley Department of Public Works called upon its citizens to voluntarily conserve water since the wells were getting low. Stretched across bridge-overpasses and strung up on the town hall, the Department of Public Works, responsible for municipal water and sewer services, draped fabric signs saying, "Water Crisis: Save Every Drop." The results were astounding, according to town Water and Sewer Superintendent Joseph Duggan: "Welleslyites tend to be a very conscientious group of people, and when you do something like that—we saw a dramatic change. We did it one summer and it was phenomenal! When we put those bedsheets out there...our water demand dropped just as if it had poured the last day. It really dropped off. People stopped watering their lawns..." (Duggan 2006).

The mobilization for water conservation in the '80s proved so effective that Wellesley rolled out the bedsheets again in the following summer. But, the results were starkly different. In spite of notices to promote conservation, water use that summer

didn't drop off as the DPW had hoped. Mr. Duggan called it, "the Chicken Little Effect...if you cry the sky is falling too many times, then boom!" To Mr. Duggan, the poor response from residents to the conservation call "was a *big* wake up call to human nature." He reasoned, "I think it's inherent in human nature...people will respond to a need. And I think Wellesleyites tend to be a fairly liberal conscientious group of people. And they are going to respond. But if you do it again and again to 'em, they're gonna say...show me. Prove it to me" (Duggan 2006).

Eliminating Limits

Around the same time, in the mid to late 1980s, Wellesley had been weighing the decision to activate their connection to the MWRA. According to former DPW Director, Pat Berdan, whose tenure ended in 1996, water demand had been increasing while well capacity inched down (Berdan 2006). Back in 1974 the town became a member of the regional water system, the Metropolitan District Commission (MDC), later the MWRA. In 1988, Mr. Berdan championed an agreement between Wellesley and the MWRA that helped to defray some of the joining costs: Wellesley would buy water from the MWRA during peak demand periods and, in turn, sell water from its own wells back to the MRWA during the winter. The town would continue to operate its own wells, but it added the MWRA to supplement supply during the "Christmas season" of the water business: summer. It worked out well for the MWRA, too, since at that time they were operating above supply capacity and needed more water.

The additional water source cushioned Wellesley's supplies, removing the impetus to promote aggressive conservation among users. Although water managers

considered the lack of response to the bedsheets in 1986 a “dismal failure” (Duggan 2006), it could have sparked adjustments to their demand management strategies. Instead, Mr. Duggan attributes it to human nature and wonders, “How do you predict human nature? How do you predict the priorities of your consumer public?” in terms of promoting conservation. By contrast, the leadership of Acton, faced with fixed water limits, strived to shape the priorities and expectations of the consumer public using a combination of outreach and predictable rules.

In addition to the absence of hard limits, political factors shape the way that water managers define their supply and demand challenges. Like Weston, many Wellesley residents invest heavily in lawn-care. Mr. Berdan indicated that when people come in and buy a multi-million dollar home, they expect to be able to water their lawns. There’s a sense that any shortage of water is a problem the town must fix, without disrupting residential lawn-care practices. Given this backdrop, the threat of a watering ban or other water-use restrictions to lawn aesthetics, and hence property values, is not a fire that many decision makers want to leap into, if possible (Kingdon 1997). Wellesley, like other towns, uses a second meter system for irrigation water so that the water used on lawns doesn’t get charged a sewer disposal rate on top of water costs. Environmentalists point out that this provides a tremendous disincentive to conservation, particularly since sewer rates are roughly four times those of water. However, when asked about prospects of removing this, Mr. Duggan indicated that the politics would make it very difficult to remove. The system arose in the first place because “there are a lot of lawyers in

Wellesley,” the subtext being that lawsuits might result if this system got nixed. For the time being, the second meter program isn’t going anywhere.

Water Limits Redux

Although water supplies increased when the town activated their MWRA connection, the town again faces limits. That’s largely because the town’s wells are getting older. Currently, the inside of some of Wellesley’s older wells have encrusted with layers of mineral deposits that have accumulated over time, reducing their pumping capacity. To Mr. Duggan, this is one of the biggest challenges pressing on Wellesley’s water supply system. “My problem right now is really our ability to pump water. We have to rely on the MWRA more and more because our wells yield less and less.” Although demands did not actually *exceed* water supplies available, they came closer to capacity than comfortable, given fire safety concerns. Water use in Wellesley accounted for 90 percent of the available supply on their peak days in the summers of 2001 and 2002 (Weston & Sampson 2003).

The aging wells and regulatory limits have again increased attention to water supply limits. Even though the DPW cleans the wells to remove build-up, the effectiveness of cleaning decreases over time. Normally, Wellesley cleans their wells every five years, but Mr. Duggan’s team has multiplied their efforts, undertaking this process for three years in a row, still yielding little improvements. This is troubling for the DPW and has led the town to look into other options, namely the construction of “satellite” wells located within 250 feet of existing wells. The process of gaining approval is still long and costly and even if Wellesley gets approval, it will not increase the amount of water the town is authorized to withdraw.

When I asked Mr. Dugan if the town would need new water sources if residents cut back on demand, he indicated that they might not, at least not in the near-term. He sees lawns as real “water guzzlers” and believes that outdoor conservation will yield the greatest results. In fact, he’s skeptical of low-flow toilets and similar indoor water saving devices, calling them “red herrings.” Since he also wears the hat of sewer superintendent, he sees the connection between the water supply system and sewerage. “We put in low-flush toilets back more than 10 years ago. Back about 15 years ago.” But, due to the slope of the sewerage pipe, low flush toilets have become part of the problem because he needs to flush out the system more often to address problems of clogged pipes. “So basically now all these low flush this and low flush that have literally caused us more flushing of sewers.” And flushing requires lots of water. For this reason, Mr. Dugan claims, “I’ve got a skepticism about a lot of the indoor conservation [measures]...I am an advocate of lawn watering conservation. I think that’s where we’re gonna get our most benefit conservation wise. I think that’s where the most waste is.”

Conservation measures increase

Since the most water waste comes from lawn-watering, and the town has experienced ongoing pressure on water supplies, Wellesley has ramped up conservation efforts. Water managers have renewed steps to make water use more efficient in the town, achieving varying degrees of impact. Never in the town’s history have water restrictions been *imposed*, although last year Wellesley came close. In contrast to years past, a new bylaw, passed in 2003, would have made a water ban legal in Wellesley. In times of drought and low water levels, the town now has the authority to call upon residents to restrict or even stop outside water use.

Last year, Wellesley got rain before they had to put the water ban into effect so it's hard to know how residents would have responded. Mr. Duggan and Assistant Water Superintendent, William Shaughnessy expressed concerned about the influx of resources needed to oversee and enforce violations, but have taken steps to coordinate with the police department to anticipate some of the challenges that will arise.

In addition to the recent by-law adoption, Wellesley has taken other important steps toward reducing demand, though with varying degrees of impact. Like Weston and Acton, Wellesley residents that use more water get billed at a higher rate. Homes with a second irrigation meter automatically get charged at the highest user bracket rate. In contrast to Weston's system, which requires a DPW staff person to physically read meters in each home, a time consuming process, Wellesley uses advanced metering technology that uses radio waves to read meters. This way, residents receive water bills each month, making it easier to connect water use with payment. Among these wealthy users, however, price might not result in conservation. However, the frequent billing does help Wellesley keep track of leaks. As part of a household leak detection program, Mr. Shaughnessy reviews monthly bills and phones about 65 residents per month, diligence that helps prevent significant water loss, and helps anticipate grumpy customers who see a surprising spike in their water bill due to leaks (Shaughnessy 2006). Wellesley also distributes water conservation notices with bills and makes rain-measuring devices available to help residents keep track of how much to water their lawns. On an annual basis, the town sends out conservation tips included in the town's annual water quality report, a report required by the federal Environmental Protection Agency (EPA). The town also posts weekly notices in the local paper, since enacting the water-restriction by-

law, to indicate the level of water stress each day and suggest appropriate conservation measures.

In spite of a basket of water conservation measures undertaken by the town, Wellesley has not examined whether or not these steps have actually resulted in behavior change or reduced demand. For example, the town makes the same assumptions seen in Weston—that conservation information translates to modified water practices. Certainly information plays a component to transforming behavior to be more water conscious, but in a culture where water conservation is not the norm, it may require greater investment to get through to people (Geller 1981, Geller et al. 1983). As with any program, evaluation or monitoring helps ensure that limited funds have their greatest impact. With the MWRA source, even in the face of declining well capacity, Wellesley lacks an edge to aggressively push demand management. Similarly, residential leak detection is a crucial way to avoid drippy taps and running toilets. However, the model does not question existing residential use—a household might receive notice for a spike in the bill, but a repair doesn't necessarily lead to an overarching reduction in water use.

An opportunity exists to market conservation outreach to Wellesley residents. Mr. Dugan pointed out that the town is comprised of conscientious people. They have even demonstrated an ability to respond to a crisis. Longer-term change might demand greater effort to build a change in culture.

Summary

In Wellesley, episodes of water shortage have revealed limits to supplies and sparked conservation. When the town reached out for an additional water source by joining the MWRA, however, the impetus for conservation declined. Water supply

shortages hit Wellesley in the mid-80s, triggering the DPW to call upon residents to voluntarily reduce water use. Residents responded en masse, resulting in dramatic demand reductions. When the DPW attempted the same strategy in the following year, however, it didn't capture a response from town citizens. Not long after, Wellesley activated its MWRA connection, taking the pressure off from supplies and, in turn, the impetus to conserve. When the town wells lost some of their capacity due to aging, Wellesley again shifted greater attention to conservation and demand management. By and large, however, the steps that the town has taken to promote conservation have not been matched by efforts to check their efficacy in reducing demand. So far, the town has not experienced pressure strong enough to spark innovation and adaptation.

CONCLUSIONS

The stories of Weston, Acton, and Wellesley show how supply limits influence water conservation and demand management. Whether a result of infrastructure capacity or regulatory withdrawal restrictions, water limits create opportunities for innovative, aggressive, and results-oriented demand management and conservation strategies. Crisis also creates an opportunity for water managers to redefine the water supply and demand problem in a way that leads to conservation. While an episode of water shortage might crack open a policy window, leadership helps determine whether and how that opportunity is seized. When water managers define that problem in such a way that conservation seems the most logical solution, it creates the impetus to go after sacrosanct behaviors like lawn watering. It also creates a framework for cultural change, a process that requires time and a willingness to accept and expect public opposition.

Limits force results

When faced with perceptible water supply limits, towns will more likely innovate and adapt conservation strategies to ensure a drop in water demand. When the Acton Water District physically could not pump enough water to meet demands and saw tank levels dropping in spite of around the clock pumping, the water managers saw few options except to impose aggressive actions. With continued population growth in Acton, the pressure on water supplies has remained steady, leading water managers to continue to refine conservation and demand management measures in order to realize measurable outcomes. Weston, on the other hand, is one of the highest residential water users in the Commonwealth, but has not experienced resource limits. With enough water available from the MWRA, and not yet having even approached its permissible withdrawal limit, Weston has not taken genuine steps to curb water demand. The town has adopted some conservation measures, but lacks limits to ensure that these steps bring about water savings. When towns rely only on conservation notices inserted in bills, or make rain measuring devices available but difficult to access, the results probably won't lead to wide-spread behavior change. The Concord study of high water users found that few people actually read conservation notices and, what's more, many resent receiving so many of these inserts (Aceti Associates 2005). Although a crisis or event of shortage can focus social and political attention in the short run, it does not necessarily lead to sustained interest that will yield durable change (Kingdon 1995). This is in marked contrast with the sustained interest and action resulting from the continual pressure that towns such as Acton experience. Many of these conservation outreach tactics assume that if information is made available or public, it is used and will result in behavior change.

However, ample literature refutes this assertion, as does evidence from Weston and Wellesley.¹

How the problem gets framed

While water limits can influence how aggressively a town undertakes conservation measures, the way in which water managers define the problem shapes the scope of possible actions that the town might take to resolve it. When a crisis occurs, it creates an opportunity for water managers to change their definition of the water situation to favor conservation and demand management. But while the opportunity to promote conservation exists, it is not deterministic. The window might close without any action taken or the definition might not favor conservation. The political clout of lawn owners, combined with ample water from the MWRA, led Weston water managers to attribute experienced water limits to limited tank size – not excessive use. This set the town on the course to build additional storage, a project that may come about within the next few years. In contrast, the experience in Acton led water managers to see the problem as a result of intensive watering and demand, so set out to reduce consumption as well as optimize existing infrastructure.

The greater the pressure on water supplies, the more towns will up the ante in response, bridging into more politically charged territory, like imposing water restrictions. Politically, the stakes are high when decision makers opt to disrupt the lawn-care regimen of affluent residents. Not coincidentally, big fancy lawns are tied to the big fancy homes. In addition to the political weight that affluent community members often wield, these residents have often invested dearly in their lawns and landscaping. Water-

¹ *see, for example*, Geller 1981, Gellner et al. 1983, Midden et al. 1983

use restrictions and other conservation measures that require behavior change thrusts water managers, many of whom would prefer to avoid politics, into a hot seat where the political costs that could arise from public opposition seem too high (Kingdon 1995).

When excessive and inefficient water use is seen as the problem, it leads to solutions that promote longer-term residential behavior change and an eventual change in culture. Water managers that take this view develop ways to engage users in multiple ways, as seen in Acton. Social marketing scholars Doug McKenzie-Mohr and William Smith (1999) argue that individuals need to understand the rationale for conservation as a requisite for behavior change. The potential for water saving results increases when individual conservation efforts connect to a larger context in which their actions matter (McKenzie-Mohr and Smith 1999). For Acton, the aim of culture change allowed water managers to expect change to occur over a period of time, not immediately. In response, Acton set predictable rules in the form of annual mandatory water-use restrictions, no matter what the climate conditions. Acton has faced angry customers in response to lawn watering bans, but the water managers viewed the discontent as a normal part of culture change. Indeed, after time, restrictions have grown more accepted and residents even help reinforce the rules.

The Acton Water District also aims to “prove” the value of conservation through education and outreach to youth, adult users, and to the developers who are bringing in the new homes to their town. Wellesley has experienced episodes of water limits, though the town did not convey the limits to its residents, so the novelty of crisis wore off. Limits experienced by a water supplier create an opportunity to convey the finiteness of water to users. But, this message is not always translated to residents. The policy window

that might have stirred longer-term conservation closes, whether or not action occurs (Kingdon 1995). If people are told that a crisis exists without explanation or understanding, or if residents can still turn on their sprinkler systems, it contradicts the message of “limits” and may result in skepticism.

The stories of towns’ efforts to meet supply and demand—of water crisis in Acton and abundance in Weston— offer insights into how we might move toward the goal articulated by the DEP Commissioner and watershed groups of using water wisely. Massachusetts is trying to rein in drought by adopting new water policies and strengthening others. The Massachusetts Water Policy (2004) outlines a goal of keeping water local. The water stories of Weston, Acton, and Wellesley suggest that local water supplies might provide a framework for conservation and demand management by helping us to see the finiteness of water. In the context of Acton, it’s the absoluteness of the limits that led the town to undertake aggressive measures, both in terms of promoting behavior change and in terms of infrastructure improvements. By keeping water local, it gives cause for innovation and results-oriented policies and practices, rather than activities to check off the conservation strategy list without actually discerning results.

What does this mean for regional water?

The lessons learned about how water limits shape conservation in Weston, Acton, and Wellesley are both important and timely. Massachusetts is currently reviewing state water policies and making changes to address the unbalanced water budgets. What’s more, portions of the state are experiencing massive growth—often well beyond what the municipality can provide in terms of water and other services. This reality has sparked

discussions of regional water systems to help communities meet demand, while also protecting the health of rivers and streams. Furthermore, the insights into water limits come at a time when the MWRA is beginning to open up its services to new members, since the Quabbin Reservoir currently has a surplus of water available, according to environmental impact assessments.

Weston illustrates the risks of disconnecting water limits from residents from a conservation standpoint. However, regional water systems do have ecological and economic merits as well. We recall that Reading, a town in the Ipswich River Basin recently joined the MWRA specifically to help alleviate pressure on the highly stressed river ecosystem. By supplying residents with water from the Quabbin, located far outside the Ipswich watershed boundaries, it may help restore river flows. Similarly, the city of Brockton will soon begin construction of a desalinization plant to convert Atlantic Ocean water to drinking water supplies. Many environmental groups supported this decision because it will avert pressure from local streams and rivers, helping to protect aquatic life.

The idea of keeping water local is important—but does it mean restricting water to town boundaries? Watersheds span across political boundaries, so should we define local as the watershed unit? The future likely calls for greater cooperation and water sharing across municipalities; this may or may not be conducted on the scale of the MWRA, which has served as a vital part of the Commonwealth's social, political, and economic systems. Some water managers and environmentalists suggest small-scale buying and selling among neighboring towns, and others have more grandiose views of

regional water authorities operating like the MWRA, or even systems set up to function like the electric grid.

In addition to possible ecosystem benefits, regional water systems also allow towns to pool financial resources in order to more efficiently provide services. Municipalities invest significant resources into water and sanitation operations and maintenance. And when towns fail to keep up with the ongoing need for maintenance, the results are leaky infrastructure, providing a conduit for de-watering basins, and degrading water quality. From an efficiency standpoint, some argue that it's crazy for each municipality to own and operate an entire water supply system, particularly when many small towns lack the budget to keep up with ongoing maintenance and upgrades. Regional systems, like the MWRA, have greater capacity and capital to invest in efficiency improvements. In fact, through intensive planning and investment, the MWRA has reduced water demand by 25% since 1987 by upgrading old water mains and fixing leaks.

In spite of these benefits from regional water supplies, Massachusetts residents and planners must be careful and think about ways to maintain a sense of limits, in light of the 123 gallons of water used daily by each Weston resident. If municipalities do join regional water systems and the experience with water supply limits lets up, the feedback loop for innovation, and results-oriented demand management measures threatens to slip.

What's more, the message from DEP Commissioner Gollidge, echoed by many water suppliers, is that the state needs to see a culture change in terms of how we view water use. Individual towns have experienced a shift, but it's difficult to expect this sort

of wide-spread norms shifting when some towns face summer watering bans, but their neighbors seem to face no such limits. It's confusing to hear that water is scarce and then to see residents in neighboring communities watering their lawns. Behavior change is more probable if residents can feel part of a larger collective effort (McKenzie –Mohr and Smith 1999).

In addition to the impact that inconsistent messages can send to users, inherent in it is also a message of inequity. Though finite, when limits are experienced, as in the current levels of the MWRA, those who can afford it pay with little or no inconvenience and use as much as they wish.

As decisions are weighed over whether or not to develop regional water systems, care should be taken, however, to avoid fostering a sense of limitless supplies, as we have seen in Weston. Towns exploring watershed or regional water should first exhaust all other demand management options. Where possible, sharing within a watershed should be prioritized over regional systems. Towns obtaining water from outside sources should also be held to a maximum average quantity per person per day.

In light of historical precedent, when considering water planning we must ask if a switch to regional water supplies will actually *solve* water supply and demand challenges or only further delay shortages. A study by the Earth Institute at Columbia University, published in May 2006, identifies the impact of human demand on recent water emergencies in the northeast (Lamont-Doherty Earth Observatory 2006). The study looked at precipitation variability and drought in Rockland County, N.Y. over the last 100 years and traced water emergencies back to factors such as development, population growth, and failing water supply systems—not just climate—as causes of water

emergencies (Lamont-Doherty Earth Observatory 2006). The implications are huge and, as one of the point people in the study, Bradfield Lyon of the International Research Institute for Climate and Society (IRI), said, "It's going to require taking a hard look at the options and deciding you either have to increase your supply or deal with the demand side of the equation to keep things in balance," said Lyon.

In all likelihood, the response is both. We should remain skeptical of proposals to solve the problems of Massachusetts' long-term water supply through regional water and desalinization, however. We must be wary of supposed silver bullet solutions, since the solutions of yesteryear often result in the problems of today. Without discounting past initiatives, we must be clear about our need to consider broader impacts as we consider decisions to expand regional water supplies. We have seen how the solutions to one set of problems—the dire public health problems at the turn of the 20th century— have contributed to some of the current water supply problems that we face in the state. A byproduct of the water supply and sanitation infrastructure that now serves as the backbone to our society, is a system that exports water out of watershed boundaries, contributing to low and no flows seen in rivers like the Ipswich. We would be wise to learn from the past and take care to anticipate challenges that could arise from a shift to regional water systems.

What follows are recommendations to help maintain a sense of limits in water policy and planning decisions in order to foster conservation and demand management at the municipal level.

Keep regional systems within watersheds

Municipalities should only be allowed to join regional water systems after demonstrating tight systems and stringent conservation requirements passed along to users. To the extent that it's possible, regional supply² arrangements should be kept within a given watershed or sub-watershed, in attempt to avoid dewatering by transferring waters to other basins either through direct transfers or as a byproduct of leaky infrastructure.

Foster a sense of limits

If the MRWA system expands membership to new municipalities, the Authority should establish conservation-minded guidelines or, limits, to be implemented at the municipal scale. Water planning may improve the ability to promote conservation and demand management by establishing mechanisms for communities to experience limits on a local scale.

Conservation programming and demand management should be central

To build conservation norms, water-use restrictions should be coupled with tailored education and outreach. Materials should draw upon social marketing tools to “sell” conservation, rather than passing out bland materials that go unread and unapplied. The need for education and outreach extends to landscapers and developers to help lay the grounds for homes and yards that do not require intensive watering. A lesson can be taken from an intensive undertaking by the MWRA to reel in demand management and promote conservation. In the 1980s, the MWRA invested in studies and analyses to determine how they could drastically cut demand and improve efficiency. The level of

² Regional supply networks can encompass arrangements between or among towns to buy water from one another. It can also include larger-scale operations involving multiple towns and jointly owned infrastructure.

investment in conservation and demand management was akin to that which would have been used to build new infrastructure. For many municipalities, conservation measures come as an afterthought to other water supply systems operations. Just as infrastructure systems require maintenance, so too do social programs, in order to ensure that hard-
results in conservation are realized.

As the Commonwealth of Massachusetts continues to develop and refine policies to achieve a balance of water, conservation will play an important role. Weston, Acton, and Wellesley show us that water crisis can create an opportunity for policy change. But, such a reactionary mode inhibits longer-term planning and can also results in ecosystem strain, as witnessed in the Ipswich River. As the state moves forward with water policies and planning, considering different ways to meet increasing water demand, the lessons of limits and conservation can help inform decisions. In light of the relationship found between human activity and drought, decision makers would be wise to plan and act early to avert further strain. However, history reminds us to wisely consider the implications of our actions so that the solutions we implement today do not create the problems of tomorrow.

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