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Saline solution

Desalting seawater can bring relief from water shortages, but it may come at a steep price—to ratepayers and the environment

By Gabrielle Gurley
Photos by Michael Manning

Summer 2007

A SMALL GROUP of Hull residents have roused themselves early on a Saturday morning for a presentation at the local senior center on the feasibility of getting drinking water from the sea. In a sunlit meeting room where a portrait of President John F. Kennedy sits on top of an upright piano, Jeff Musich, the vice president of Wright-Pierce—a Topsham, Maine-based engineering firm—darts between his PowerPoint slide show and several large charts on easels. He explains the technical, economic, and legal issues surrounding the removal of salt from seawater, a process known as desalination (or “desal,” as it’s called in the water industry). By the end of the morning, desalination emerges as within the realm of the possible for this peninsular community. “There’s very energized local support,” Musich says later.

With no sources of fresh water for public use within its boundaries (the town gets its supply from a Hingham treatment plant and pays one of the higher water rates in Massachusetts), Hull is looking to the Atlantic Ocean as a source of po-table water. If it follows through on the idea, the town will join Brockton and Swansea, which have already broken ground for desalination facilities.

The JFK portrait at the senior center may reflect the enduring reverence for the Kennedys in Massachusetts, especially among older Irish Catholics. But it turns out the 35th president had at least a minor fascination with the subject of the early-morning presentation there. In a 1961 speech marking the dedication of a Texas desalination plant, Kennedy said, “One of man’s oldest dreams [is] securing freshwater from saltwater,” a development he called one of the “great scientific breakthroughs of history.”

Desalination isn’t exactly cutting-edge these days. Caribbean and Middle Eastern countries have been doing it for decades, and a long-ago-shuttered desalination plant was constructed for military personnel on Boston Harbor’s Outer Brewster Island during World War II. But the process seems like a radical step for Bay State municipalities anxious to end water worries. Indeed, pursuing the technology in a state that receives roughly 45 inches of precipitation each year is raising eyebrows across the country, as desalination is usually equated with drier areas in Texas or California.

“Massachusetts? People are absolutely shocked because they assume it’s a wet state that should have no problems,” says Zach Corrigan, a staff attorney for Food & Water Watch, a Washington, D.C.-based advocacy group that opposes desalination as a solution to water woes. Yet according to the organization’s Web site, Massachusetts is one of a handful of states that desal companies are looking to turn into “guinea pigs” by pushing a technology that environmental advocates say poses a danger to ecosystems, while often proving far costlier than other approaches to water resource management.

It may not be a desert state, but Massachusetts does have water-supply problems. Development is playing a key role in compromising already stressed watersheds, as terrain is paved over for office parks, residences, and roadways, creating more impervious surfaces that reduce natural opportunities for recharging those water sources. So storm water ends up getting drained out to sea, and treated wastewater often doesn’t return to its original source.



According to Peter Shelley, vice president of the Conservation Law Foundation, the state bears the blame, having failed to integrate storm water, sewage water, and drinking water policies. The turn toward desal, he says, even if only by a few communities at this stage, underscores this larger problem. “Desalination in Massachusetts is a symptom of a totally broken-

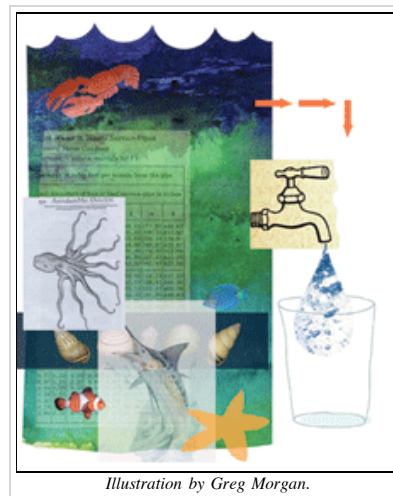
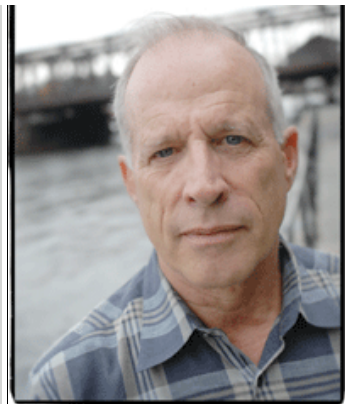


Illustration by Greg Morgan.



Massachusetts has a "totally broken-down water resource management system," says CLF's Peter Shelley.

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Massachusetts is finally working to change the way municipalities, consumers, and developers think about water, in part by updating regulations to require storm water infiltration (reducing runoff by getting water back to the ground using vegetation, drainage ditches, and other means) around state-controlled wetlands and rivers. The state also plans to issue draft regulations later this year for certain types of wastewater reuse.

However, the Commonwealth did not anticipate the turn to desalination by communities, and it has had no policy governing the use of the water treatment technology. State authorities are now trying to catch up. This summer, the Water Resource Commission will distribute a draft of the state's first-ever desalination policy for public comment. It clarifies the review process and addresses some of the environmental issues posed by the treatment process.

In the meantime, not everyone is jumping on the desal bandwagon. Stoughton rejected a proposal to get desalinated water from

Because they eat up electricity, desal plants add to the production of greenhouse gases.

Brockton in 2001, and instead joined the Massachusetts Water Resources Authority (MWRA), the giant regional authority that provides water to 50 communities, the following year. Provincetown abandoned desal last year when state officials said that brine disposal would run afoul of the Ocean Sanctuaries Act, which protects Cape Cod Bay. Residents weren't exactly enthused about the idea anyway: A 2004 "community vision" survey found nearly 65 percent of residents opposed to a desalination plant that could fuel more development in the town or harm ocean water.

But officials in Brockton and Swansea are sold on desal, and Hull may not be far behind. Plenty of questions remain on whether an expensive technology with poorly understood environmental impacts and high energy costs is one to pursue. The experience of these desal pioneers may determine whether other Massachusetts communities follow suit or the technology is dismissed as a quick fix that is no fix at all.

WATER, WATER EVERYWHERE

Water shortages have been especially acute in southeastern Massachusetts, where the demands of population growth have plagued municipal systems for decades. (See "[The Drying of Massachusetts](#)," CW, Fall '00.) But even slow-growth communities such as Hull are bracing for dwindling water supplies in the coming decades.

Then there are the pressures of the marketplace. Massachusetts has some of the country's highest water rates, and last year the average Hull household paid \$548 for water, putting the town in the upper third among Bay State communities. Many residents complain they've been socked with high bills since the 1996 construction of a Hingham treatment facility by Aquarion, the private firm that supplies water to Hull and several other South Shore towns.

Some of those who turned out for the desal presentation in Hull are counting on the technology to lighten that water-bill load. "I can see my own pocketbook affected," says resident Martha Donovan, of a possible move to desal. But her optimism may be misplaced. While a desal facility would address concerns about water shortages, current estimates of desalinated drinking water costs are "in the ballpark of what we are paying now," Rick Mattilla, chairman of Hull's water resources committee, tells residents gathered at the senior center.

It may lack the historic sweep of his challenge to land a man on the moon by the close of the decade, but President Kennedy had big dreams for desal, too, proclaiming in his 1961 speech that desalted water would be produced "at an economic rate" by the end of the 1960s. More than 45 years later, however, desalination remains one of the most expensive water treatment processes available.

What's more, the high cost of desalinating water is linked directly to its high energy use, making the process a significant secondary producer of greenhouse gases. Energy is the "largest single variable cost" in producing desalinated water, according to a 2006 study by the Oakland, Calif.-based Pacific Institute, a nonprofit research organization. The study found that in a reverse osmosis desalination plant, where brackish water (fresh water mixed with seawater, often found in estuaries) or seawater is forced through filtering membranes at high pressure, leaving the salt behind, electricity consumption is about 44 percent of water costs. In the desalination process, the lower the salt content, the less electricity required to remove it, and the lower the production costs. Hull is studying the extraction of seawater with lower salinity using angled wells drilled below the ocean floor from land. (The Brockton and Swansea plants are sited on brackish rivers, which offers some energy cost savings.)

Yet electrical costs can take communities by surprise. In 2001, three years after the Northeast's first municipal desalination plant went online in Cape May, N.J., the city's budget review prepared for the state government indicated that electrical costs were "considerably higher than anticipated."



Officials in Hull are also working to dispel the misconception that wind power could run a desal plant and cut costs. Two turbines currently provide 13 percent of the town's energy, but wind power is not in the plans for the proposed desal facility, whose energy cost estimates are based on current electricity prices from conventional sources.

Cost misconceptions aside, for a good many people at the Hull meeting, the most attractive feature of a desalination plant is the prospect of long-term stewardship of the water supply through a town-owned operation. "People in



Hull residents want an "aspect of control over the resources around them," says Selectman Joan Meschino.

Hull tend to like projects that give them an aspect of control over the resources around them," says Selectman Joan Meschino, a water resources committee member.

The Wright-Pierce study outlines municipal, private, and public-private partnership options that could provide Hull with 2.5 million gallons of water per day, as well as a regional scenario that could serve neighboring towns with 4 million gallons per day. (As of April 2006, costs varied from up to \$24 million for a facility serving the town to \$28 million for a regional plant.) Meschino cautions that enthusiasm for any one model is "premature." Town meeting must weigh in on funding further studies and any bond authorizations, while the Wright-Pierce study projects completion between 2012 and 2014, with five to six years to complete the permitting, design, and construction phases.

In these early days, reservations in Hull have been muted. Although there is concern among fishermen about effects on shellfish beds, no opponents showed up at the recent presentation at the senior center. "We aren't

necessarily for or against a desal plant," says Samantha Woods, a board member of the Weir River Watershed Association, a local environmental group.

As Hull weighs the possibilities, the Swansea Water District's Palmer River desalination plant, the state's first municipal facility and the second in the Northeast after Cape May, is slated to go online by the end of 2008. Swansea experienced water supply emergencies in 1999 and 2002 and imposed a water main extension moratorium. Robert Marquis, the water district superintendent, says that the benefits of going it alone became more attractive as several other options fell by the wayside, including a connection to the Taunton River desal plant that will supply Brockton. (The cost and the politics of running a dedicated pipeline to Swansea through adjacent communities from the Dighton site doomed that proposal.)

Recently, increased water rates and taxes to support the desal plant's development and operation sparked outcry from some Swansea residents. Owners of a \$350,000 home using 100,000 gallons of water per year, a typical usage level, now face an annual water bill of about \$550 to \$600. Still, Marquis suggests the certainty of supply that desal will bring makes the project worth it. The \$18 million plant, he says, "shall end the water shortages that have existed in Swansea forever."

DOWN BY THE RIVERSIDE

From Brockton, it's 16 miles to the construction site along the Taunton River to which the city has hinged its water future. Getting there requires a step back in time, waiting at a traffic light to cross the Taunton via the single lane Berkley-Dighton Bridge, built in 1896. At the Dighton construction site, backhoes excavate earth below silver-colored beams that are already in place, forming the outline of the state-of-the-art plant. The circular floor of what will be a 3.5 million gallon storage tank has taken shape, as has the concrete-walled pump house nestled into the riverbank. Operated as a public utility by Aquaria Water, the Taunton River desalination project is a private joint venture of InimaUSA, a subsidiary of a Spanish construction firm, and Norwell's Bluestone Energy Services. Scheduled for mid-2008 completion, the \$75 million project, the first and largest permitted to date in Massachusetts, will produce up to 10 million gallons of water per day, supplying Brockton with 10 percent to 15 percent of its water as well as all of neighboring Norton's.

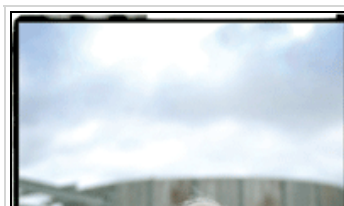
The project went on the drawing board in the early 1990s, but construction began only last year, after the Taunton River Watershed Alliance and the Jones River Watershed Association, the last two environmental groups opposing the project, dropped their appeals upon securing Brockton's commitment to a water management plan. The city submitted its draft plan to the state Department of Environmental Protection this May.

Brockton has cut water use, but local leaders say desal is needed to avoid shortages in the long term.

Growth is the buzzword these days in the City of Champions, and local leaders say desal is the key to making up for lost time. Brockton's population increase from 1950 through 1980 (from 63,000 to 95,000 residents, about where it is now) led to periodic water droughts, and in 1986 the state imposed a moratorium on residential and business water connections in Brockton, compounding the challenges the former mill city already faced in bringing its economy into the post-industrial age. The state lifted the water emergency in 1995, and the city ended a ban on outside water use just last year. How much business did Brockton lose during that period? "It's probably more than we would really want to know," says Mary Waldron, executive director of Brockton 21st Century Economic Development Corp. For Waldron, desalination is a new economic tool signaling to business and New Economy powerhouses like the biotechnology sector that now "the water is here."

Although Brockton instituted water management strategies, including leak detection and repair, that brought water usage down from 11.3 million gallons per day in September 1996 to 9.3 million gallons per day in April of this year, officials see desal as a long-range solution. The city has "made tremendous strides," says Pine Dubois, the executive director of the Jones River Watershed Association. But the Taunton River project is "nerve-racking," she says, because it's "an indication that the city wants more growth and that they are not satisfied with the amount of water they're getting."

The city currently relies on Silver Lake, which supplies about 95 percent of its water. Brian Creedon, the city's water systems manager, says that to ensure future water supplies, the state suggested three potential solutions: procuring freshwater from the northern end of the Taunton River; getting brackish water from the river's southern end, using desal to process it; or joining the MWRA. Despite similar costs to desalination (current estimates run \$50 more per household per year for desalinated water, Creedon says), Brockton ultimately decided against joining the MWRA, and concerns about the effects on wildlife in the low-flowing waters in the northern Taunton



ruled out the freshwater option.

Creedon argues that the desal option is environmentally sound because it circulates water locally, as opposed to the city using the MWRA's Quabbin or Wachusett reservoirs, in central Massachusetts, whose waters ultimately end up in Massachusetts Bay. But that view of desal is not universally shared, especially by environmental groups that have raised concerns about everything from its effect on marine plant and animal life to the greenhouse gases produced in order to satisfy desal's high energy demands.

In an effort to address the ecosystem concerns, the Taunton River facility's intake system was redesigned to reduce "impingement," the sucking in and killing of fish and other animals against intake screens, and "entrainment," the killing of eggs, larvae, and smaller organisms that slip past the screens and die in the treatment process. To alleviate potential environmental stresses caused by brine, the salt-rich waste product of the reverse osmosis process, plant officials plan to discharge the concentrate at high tide after it has been treated to match the salinity of the river water. Swansea will use a similar process to help protect the spawning grounds of the ocean-dwelling shad that return to the Palmer River to reproduce.

The big unknown may be the effect desalination plants have on nearby marine ecosystems.



Brockton water manager Brian Creedon says desal is better than taking supplies from the Quabbin Reservoir.

Nevertheless, more attention has been paid to desalination technology and its energy consumption than to its marine ecosystem impacts, according to Heather Cooley, an author of the Pacific Institute desalination study. "That's the big unknown," she says.

To secure renewal of their 2005 state discharge permit, the Cape May desal plant operators were required by New Jersey officials to conduct quarterly tests on one shrimp and one minnow species in the estuary where the plant is located. Tests showed no harm to either. "We have had zero net effect on the receiving body of water," says Carl Behrens, the facility's chief water treatment plant operator. But Jennifer Samson, principal scientist with Clean Ocean Action, a New Jersey advocacy group, argues that to gauge the true impact on the local ecology, more studies should be conducted on the larger environment, not just on the plant's effluent or selected species. "It's important to know how [desalination] is affecting the entire system," she says.

As for Brockton's dive into desal, Shelley, the Conservation Law Foundation vice president, says, "There are a lot of questions around water that things like [the Taunton River] desalination plant will start to trigger in people's minds."

GOING EASY ON THE SALT

What desalination triggered on Beacon Hill was the realization that current regulations and policies were lagging behind municipalities' embrace of the technology. Local, state and federal officials, and private sector representatives met for five months in 2005 to hammer out what would become the state's first draft of a desalination policy.

The draft policy, to be distributed this summer, directs communities to look to all other water sources first before considering a desal project, including wastewater reuse, storm water recharge, and other water conservation strategies. Further, a water supplier should demonstrate that available water supplies are insufficient for anticipated business and population growth, while a community would have to outline how it plans to grow with any new water supply. "We don't want water to become the fuel for growth," says Kathleen Baskin, the executive director of the state Water Resources Commission.

Any large desalination plant proposal is already subject to review under the Massachusetts Environmental Policy Act, which assesses the environmental impact of a project, its alternative options, and identifies mitigation measures that may need to be undertaken. The new policy supplements MEPA by closing gaps in environmental protection and streamlining the current lengthy and, at times, uncertain multiple-agency environmental review process. For example, while discharges into bodies of water are well protected under existing state and federal measures, there are fewer protections concerning the drawing of water that affects fish and larvae; the new policy provides additional protections. Siting plants on estuaries or near other sensitive habitat areas also will be discouraged, while co-locating desal plants with power or wastewater treatment plants (in part, to dilute brine discharge by combining it with the effluent produced by those facilities) will be encouraged.

Future desal plant proponents will also have to anticipate their facility's contribution to regional greenhouse gas production and consider ways to reduce such output, a requirement of all large development projects under new climate change policies the Patrick administration announced in April.

One uncharted area of regulatory oversight relates to international trade and investment. Currently, water services, such as providing drinking water, are not subject to the General Agreement on Trade in Services, or GATS, a major international trade agreement. But as European multinationals like Inima, whose U.S. subsidiary is a majority partner in the Taunton River plant, venture into the American private water market, the European Union wants those services covered by international rules. If U.S. negotiators agree, desal projects owned by multinationals could be subject to new rules that could potentially jeopardize the ability of states to impose limits on those companies. Some environmental regulations, for example, could be viewed as impermissible trade barriers.

"European ownership brings local water service within the reach of international trade rules," concluded a 2004 study on international trade rules and state regulation of desalination facilities by the Georgetown University Law Center's Harrison Institute for Public Law. While international negotiations are very much in flux, municipal and state officials "definitely

should be aware of” potential effects on water system regulation, says Cooley, the Pacific Institute researcher. “It could be on the horizon.”

For all of desal’s complexity, Baskin sees municipalities’ interest in desalination as ultimately limited—by dollars and cents. “While we’re expecting the proponents to look at environmental concerns and alternatives, certainly the cost is going to drive them away from desal,” she says. But for the water-poor communities that have seized on desalination as the answer to their water management issues, there is no turning back. “This is a state problem, a southeastern Massachusetts problem, not an individual city problem,” says Brockton’s Creedon, “but we’re handling it.”