Desalination of aquifers offers drought-weary California new hope

Devika G. Bansal, The Mercury News, 2-5-17

California's historic drought may be winding down. But water officials across the Golden State are increasingly exploring a hidden but promising way to add to the state's water supply: removing salt from the billions of gallons of brackish — or distastefully salty — water that lies deep below the Earth's surface.

A new report by the Pacific Institute that explores the cost of potential water sources in California is spurring hopes that the desalination of brackish water could quickly become a vital tap in the state.

"There are places in California where there may be groundwater available, but it may not be fresh," said Heather Cooley, director of the water program at the Oakland-based think tank. "Those are places where it's possible to use brackish desalination at a much lower cost and with fewer social and environmental impacts than ocean desalination."

The new analysis comes just months before the U.S. Geological Survey is expected to issue a groundbreaking report that will map out aquifers throughout the country that contain brackish groundwater.

The word "desalination" conjures up the image of a gigantic coastal plant that sucks up ocean water to produce fresh water. The state now has five ocean desalination plants — the largest one opened last year in Carlsbad in San Diego County. And a previously mothballed ocean desalination plant is set to reopen in Santa Barbara in March. In contrast, California's brackish desalination plants are mostly located inland. There are currently two dozen such facilities in the state producing a total of 80,000 acre-feet of water per year. That's a year's worth of water for 400,000 people.

In the Bay Area, the Alameda County Water District, which serves 350,000 residents of Fremont, Newark and Union City, has run a brackish groundwater desalination facility in Newark that has been providing about 14,000 acre-feet of water annually since 2003 — about 40 percent of the water supplied by the district. And a coalition of Bay Area water agencies is considering a much larger brackish desalination plant in Pittsburg, with the potential to desalt water from the Delta and deliver 23,000 acre-feet of water per year.

Perhaps the greatest appeal of brackish water desalination is that the salt concentration ranges from 1,000 to 10,000 milligrams per liter, making brackish water about 3.5 times less salty than seawater and roughly twice as cheap to desalt. The Pacific Institute report estimates brackish water desalination costs $950 to $1,300 per acre-foot, compared with $2,100 to $2,500 per acre-foot for seawater desalination.

"The more saline the water, the more intensive the treatment and the more energy required, which makes the cost higher," Cooley noted.

Desalination of brackish water is also far less controversial because, unlike ocean desalination, it doesn't kill marine life. "It's never been a big deal because there aren't many environmental issues related to it," said Newsha Ajami, director of urban water policy at Stanford University's Water in the West. "Ocean desalination is much more complex, especially because it has to be designed in a way so it doesn't impact marine life either during the extraction of water or in the dumping of leftover salts," called brine.

Brackish water naturally exists underground across the U.S. “In most parts of the country, including Northern California, if you drill deep enough you’re going to encounter water, “said David O’Leary, a USGS hydrologist. “And if you drill deeper, you’ll encounter brackish water.”

In some parts of the U.S., brackish water is old seawater that used to cover the land in ancient geologic time, O’Leary explained. Water also becomes brackish when rain flushes concentrated salts from the soil into the ground. In coastal areas, groundwater often becomes brackish when seawater mixes with fresh groundwater. Referred to as “saltwater intrusion,” the process happens naturally to some extent, but becomes more of a problem when coastal areas pump too much water from aquifers, causing seawater to replace the fresh groundwater. Removing salts from this mix becomes a valuable way to produce water.

Desalination is hardly a new concept — sailors and islanders survived for a long time by removing salt from seawater using chemical methods, Ajami noted. The technology we now use works by forcing a huge amount of water through microscopic membranes at extremely high pressures. The difference in the cost of brackish desalination and ocean water desalination comes from the amount of energy used in forcing the water through the membranes.

Treating brackish water has the added benefit of improving water quality. “It can serve more than one purpose – not only to reduce salts, but also other harmful chemicals like metals, trace organic compounds and a large percentage of pharmaceuticals,” said Richard Mills, chief of the water recycling and desalination section at the California Department of Water Resources.

As with most new technologies, however, brackish desalination comes with tradeoffs. One of the main issues is dealing with the brine. For plants near the ocean, brine can be disposed into the sea in a way that protects the environment by blending it with fresh water from other sources, such as sewage treatment plants, going into the ocean already. But inland plants face more of a challenge, Mills said.

In the Santa Ana River watershed in the Inland Empire, desalination engineers came up with a specialized solution: Water agencies in the area built a “brine line” to pipe the super saline water 60 miles to the Pacific Ocean after blending it with treated wastewater along the way. For most inland plants, however, the only way is to evaporate the brine to a point at which highly concentrated salts can be trucked to a proper waste disposal site, while making sure there isn’t any leakage into the groundwater.

Despite the challenges, brackish desalination has been successful in states and countries with scarce water supplies – notably Texas and Israel. The notoriously dry Lone Star State already has 46 inland brackish desalination facilities. A plant in El Paso is the largest in the world, capable of producing 30,000 acre-feet of water per year. Israel, on the other hand, gets about 10 percent of its water supply from brackish desalination plants.

Three new plants are under construction in California and water agencies are planning at least 17 more, one of which will be located in an unincorporated area of Monterey County, just north of the city of Marina. All of the other projects will be located in Southern California.

Sand City, two miles north of Monterey, already has one such plant producing 300 acre-feet of water per year since 2010. The town, with its tiny population of 350 people, seized the prospect to treat brackish water in shallow aquifers along its coastline. The purified water is pumped directly into Sand City residents’ water supply.

The Sand City aquifer has “very sandy soils that go down 60 to 100 feet, and a well there can produce a suitable amount of water for the plant,” said Eric Sabolsice, operations director at California American Water, the private company that operates the Sand City project.

Identifying aquifers like the one in Sand City is often the first step when assessing feasibility of a plant. The upcoming USGS report will include a national map of dissolved salt concentrations across the country at different depths, said Jennifer Stanton, a hydrologist who is managing the project for the agency. The analysis will show local water agencies where to drill wells to draw steady and sustainable supplies of brackish water, she said.

Together the USGS and Pacific Institute reports are expected to spark more interest in brackish desalination, but many water supply experts stress that conservation is still the cheapest route to

follow. The Pacific Institute report estimates that simply removing lawns or using higher efficiency toilets, showerheads and clothes washers could save Californians as much as $3,000 per acre-foot.

Taking the long view, Stanford’s Ajami expects local agencies will find their own mix of water solutions.

“We’ll probably see more communities depend on the shallow groundwater and use it for various purposes,” she said. “And for some communities, depending on where you are and what your options are, certainly brackish desalination might rise up to the top of the list.”