Groundwater law, winter rain trigger flood of aquifer-recharge experiments around California

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WATSONVILLE -- A historic 2014 law requiring water agencies across California to replenish the state's imperiled aquifers created a new problem: Many local officials just weren't sure how to do it.

But this winter's abundant rains are triggering a flood of experiments that have turned the state's agricultural regions into aquifer-recharge laboratories.

Farmers in Modesto inundated an almond orchard with the city's stormwater. Water managers in and around Fresno have more than 20 new groundwater recharge projects in the works. On the Central Coast, researchers in the Pajaro Valley are carefully designing percolation basins to capture rainfall before it gushes out into the Pacific.

"Groundwater has kind of been out of sight, out of mind for a long time," said UC Santa Cruz hydrologist Andy Fisher, who's leading the research team in the Pajaro Valley. "Suddenly it's on people's radar again."

Californians still don't know if this winter's rains will be enough to refill the state's reservoirs and bring an end to the historic drought. But one thing we do know is that even if Gov. Jerry Brown declares the dry spell over this spring, California's underground water woes will still be with us.

For decades, water has been sucked from aquifers faster than nature can replenish it -- and the drought has only intensified the thirst for groundwater. Scientists agree that it will be decades before a future governor can declare California's groundwater problems solved.

The state has designated 21 groundwater basins throughout the state "critically overdrafted." Most of them are in the Central Valley, but three basins on the Central Coast -- in the Pajaro, Soquel and Salinas valleys -- are also on the list.

California was the last Western state to regulate groundwater. And it took the state's most punishing drought ever to force the Legislature to finally act.

The Sustainable Groundwater Management Act requires local governments to come up with written plans by 2020 that ensure that basins are kept in balance. It aims to make overdrawn aquifers a relic of the past by 2040.

Overpumping groundwater can cause the overlying surface to sink. Last summer, sections of the San Joaquin Valley were collapsing by two inches a month, threatening roads, pipelines and canal linings.

In coastal locations, however, seawater intrusion is a bigger menace than land subsidence. The ocean has crept miles inland in parts of the Soquel, Pajaro and Salinas valleys, turning groundwater into unusable brine.

Fisher and his team got a jump on some colleagues working on recharge projects because they began monitoring one percolation basin in the Pajaro Valley in 2011, just as the drought began.

With Fisher's help, the owners of the property and the company farming the land teamed up to build a series of ditches to capture runoff, the water that collects and flows across the ground when it rains. The ditches direct that water into a sediment-settling pond; then a culvert funnels it into a 2-acre infiltration basin. From there, the water drains through sandy soil to refresh the aquifer below.

Pressure sensors at key points track how much water flows into the basin, and a rain gauge -- its top ringed with prong-up plastic forks to keep birds away -- monitors precipitation. A digital camera mounted on the hillside takes a picture every few minutes to serve as a "gut check" that the flow and rain measurements reflect reality, said Fisher's graduate student Sarah Beganskas, a Ph.D. candidate in hydrology.

Recharging groundwater supplies with surface water isn't a new idea: The Santa Clara Valley Water District maintains 99

percolation ponds, which together total about 265 acres, according to district spokesman Marty Grimes.

Between 1915 and 1965, groundwater overdraft in the Santa Clara Valley led to about 13 feet of land subsidence in parts of San Jose. The district stopped the sinking by replenishing the aquifer below, and the groundwater level has largely rebounded since then.

The Santa Clara Valley district's percolation basins are fed partly by water from the state and federal water projects. The Pajaro Valley and its neighboring basins along Monterey Bay lack a connection to the project pipelines. They depend on other sources of water for groundwater recharge, like recycled wastewater or stormwater runoff.

Fisher and Beganskas are developing other percolation ponds in the Pajaro Valley. Based on maps of soil types and water runoff simulations, they estimate that the valley could support about a dozen sites like the one they're monitoring. Together, the researchers say, the sites could supply about 10 percent of the annual groundwater deficit in the Pajaro Valley.

They've also learned that how hard the rain falls affects how much water the basin collects. During drizzly showers, rain has time to soak back into the soil, then naturally filter down to the aquifer. But during heavy storms, precipitation rushes into rivers and to the ocean -- unless a stormwater collection system is there to catch it.

"During a big storm, that's when you're going to get the most bang for your buck," Beganskas said.

Roughly the same amount of rain fell during the winters of 2011-12 and 2013-14, for example, but in 2011-12 it was mostly light and moderate rain, while the winter two years later saw fewer but more severe storms. The experimental basin collected about 7½ times as much water in the latter year.

Last winter, the infiltration basin gathered more than 100 acre-feet of water, much of it during a single December storm. That's enough to supply 200 families with water for a year.

Months earlier, Fisher and Beganskas had calculated that a large downpour could overwhelm the final culvert leading into the basin, creating a flooding hazard. So acting on the researchers' recommendation, the farming company replaced the pipe with a larger one three months before the December deluge.

That may seem like an easy fix, but it's a crucial one -- and it was only possible because someone was keeping track of the rainfall and runoff data, Beganskas said.

Because of climate change, intense rainstorms may become more common along the Central Coast in the coming decades, said Howard Franklin, a senior hydrologist at the Monterey County Water Resources Agency.

"We're going to see many more drought periods interspersed with extreme events," he said.

Those deluges could be a significant source of water in the Salinas and Soquel Valley groundwater basins, which are overdrawn by up to 28,000 acre-feet per year.

Small field projects such as the ones in the Pajaro Valley supply researchers with knowledge and data they can apply across different kinds of landscapes, as long as they take local conditions into account, said UC Davis groundwater hydrologist Thomas Harter.

"Andy's work has statewide implications and even beyond that," he said.

Fisher and Beganskas certainly hope so.

"You can't just dig a hole in the ground," Beganskas said. "You have to be smart about it."

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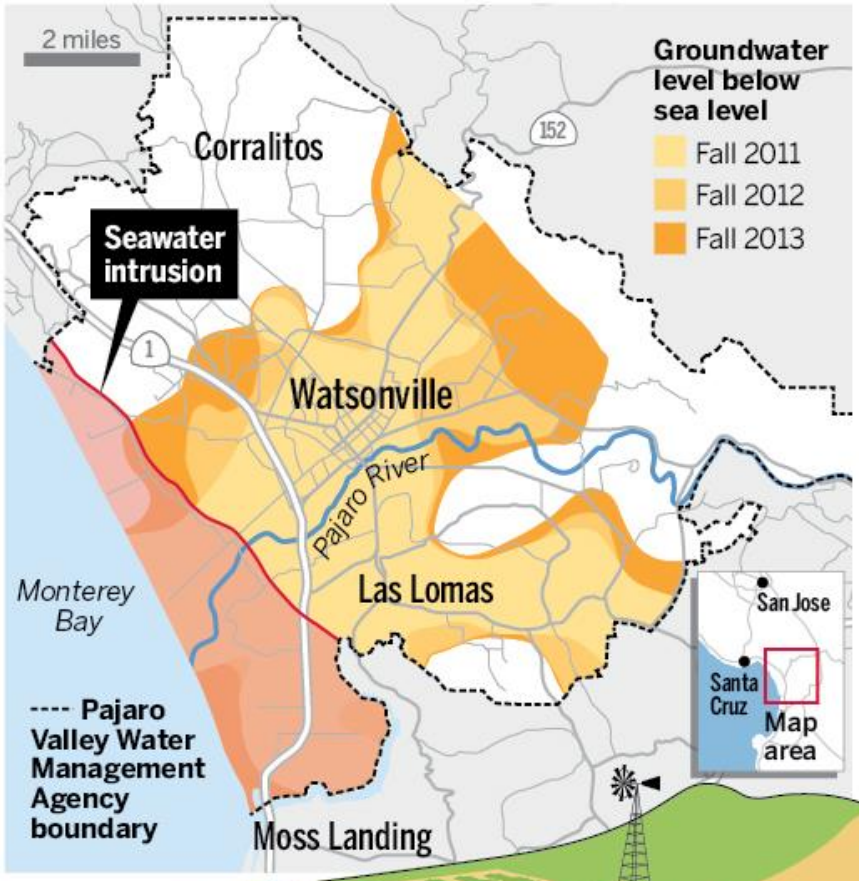
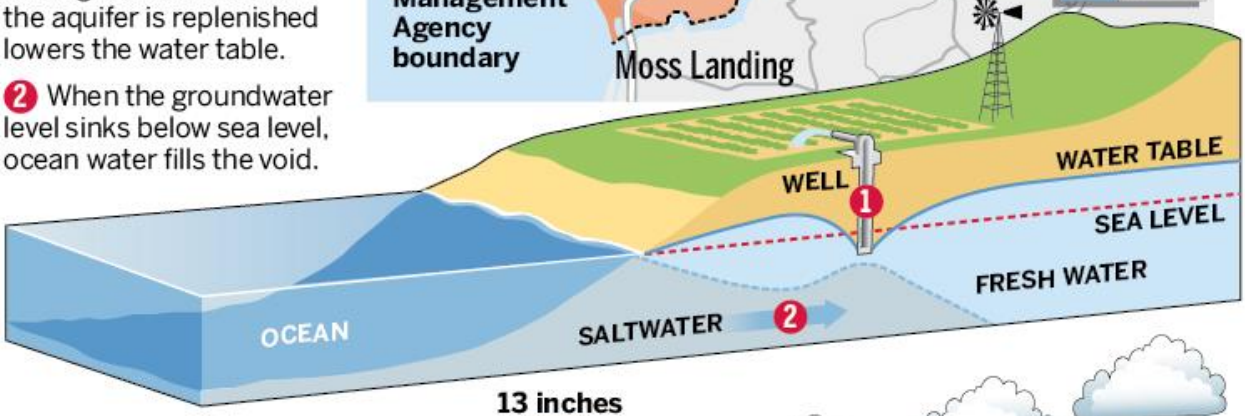
RESTORING AN AQUIFER

Seawater creeping inland can transform groundwater into unusable brine. Drought intensifies the problem: Normally, winter rains help recharge the aquifer, but during dry periods the water table shrinks each year. To help groundwater levels rebound, researchers direct rainwater to areas where it can percolate down to the aquifer.



Problem: Seawater intrusion

1. Pumping water from underground faster than the aquifer is replenished lowers the water table.
2. When the groundwater level sinks below sea level, ocean water fills the void.



TWO KINDS OF RAIN

The ground's ability to absorb rainfall depends on the intensity and length of storms, as scientists monitoring a Pajaro Valley site discovered.

3 Light rain

When precipitation is gentle — think light rainstorms over a long period of time — water has time to filter through soil, naturally recharging the groundwater basin.

4 Heavy rain

When precipitation is intense — think heavy rainstorms during a short period of time — water flows across the land surface as runoff, flowing out to sea instead of seeping into the ground.