THE RIGHT INGREDIENTS

NEW RESEARCH EXPLORES WHY BIORETENTION SOMETIMES FAILS.

Bioretention is a way to manage stormwater and to scrub it clean, and in general, it is effective at both, especially when it comes to heavy metals and petroleum pollutants. But as more cities invest in green infrastructure, researchers have been forced to examine whether or not rain gardens are performing when it comes to removing potentially harmful nutrients.

Several years ago, while at the University of Vermont's Bioretention Laboratory, Amanda Cording began testing whether or not rain gardens were successful at removing nutrients like phosphorus and nitrogen. Using 30-square-foot test beds filled with a foot of a typical sand-compost mix, she measured the mass loads of nitrogen and phosphorus and found that the system resulted in an *increase* in nutrients rather than a decrease. In fact, the stormwater contributed just 5 percent of total phosphorus and 10 to 20 percent of total nitrogen. Contributing the most, she found, was the compost used in the planting media, which essentially functioned "like a teabag," she says.

Scientists have been aware of this problem since at least 2007, when researchers at Utah State University identified troubling levels of phosphorus in the outflow of bioretention systems. In 2012, the city of Redmond, Washington, reported high levels of phosphorus, nitrates, and copper in the water leaving a rain garden constructed a year earlier. That discovery became a catalyst for stormwater experts in Seattle, who began testing alternative soil blends in order to reduce nutrient exports. "We have water quality criteria that we are not necessarily meeting," says Shanti Colwell, the interim manager for the city's green stormwater infrastructure program and one of the people leading the current research. "If we have phosphorus-sensitive water, we don't want to send effluent from these systems there."

Cording, now an affiliate faculty member at the University of Hawaii's Water Resources Research Center and the Pacific director of EcoSolutions, an environmental consulting company, is experimenting with native Hawaiian soil blends. For a recent bioretention project on Oahu, she worked with Island Topsoil, a landscape consulting company, and the University of Hawaii to develop a custom, high-calcium medium designed to increase phosphorus adsorption, tweaking the mix along the way to ensure proper drainage.

She and Colwell both are careful not to overstate the issue. Though nutrient pollution can contribute to harmful algal blooms, neither wants to scare cities away from bioretention. Instead, Colwell says, as the technology evolves, "we're trying to refine it for areas that need better removal of certain [pollutants]." She envisions site- or at least area-specific design standards in the future. "That's all part of the work that we're doing," she says, "trying to identify sources that are cleaner so we're not bringing in pollutants that we don't want." ●

AMANDA CORDING

TOP AND RIGHT
A rain garden on Oahu uses a custom blend of native Hawaiian soils to limit nutrient export.