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Curbing Polluted Stormwater and Creating Communities

The Case for Low-Impact Development

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A woman drowns when the basement of her Seattle home suddenly fills with a torrent of filthy water.[1] An overflow of 15 million gallons of sewage and polluted runoff fouls the shoreline of picturesque Port Angeles, putting the waterfront off limits to the residents and visitors of the Olympic Peninsula town due to health concerns.[2] Portlanders are socked with some of the nation's highest water utility rates in order to pay for the city's $1.4 billion "Big Pipe" projects.[3] Northwest scientists document coho salmon dying in urban streams with their bellies full of eggs, perishing before they can spawn.[4]

The culprit in each of these stories is the most mundane of villains: the rain. The rain is not solely to blame, of course. As the rainwater streams off our roofs and across the built environment—over roadways and landscaped yards—it mixes a massive toxic cocktail. It scoops up oil, grease, antifreeze, and heavy metals from cars; pesticides that poison aquatic insects and fish; fertilizers that stoke algal blooms; and bacteria from pet and farm-animal waste. A heavy rainfall delivers this potent shot of pollutants straight into our local streams, lakes, and bays—threatening everything from tiny herring to the region's beloved orcas to our families' health.

Stormwater runoff doesn't match the traditional image of pollution. There are no factory smokestacks belching waste, no pipes with a steady trickle of noxious industrial effluent. But despite appearances, stormwater packs a wallop. Polluted runoff long ago surpassed industry as the number one source for petroleum and other toxic chemicals that end up in the Northwest's water bodies. Each year, the Puget Sound is sullied by 14 million pounds of toxic chemicals and oil and grease—and that's a conservative estimate.[5] The amount of petroleum waste is so vast, it's as if more than 70,000 cars pulled up to the beach and emptied their tanks straight into the Sound each year.[6]

Polluted runoff threatens to make water from Lake Whatcom—the sole source of drinking water for the city of Bellingham—undrinkable, and has helped put shellfish harvesting off limits for Washington state beachgoers from north of Everett to south of Tacoma.[7] Some residents of BC's Salt Spring Island had to temporarily switch to bottled water this winter when toxic algae contaminated their water supply. Where

did the nasty plants come from? The algal bloom was triggered as "a result of excess phosphorous … from surrounding properties," according to news reports.[8]

How has the Northwest's iconic rain been transformed into such a menace? A century of building pipes, gutters, and impervious surfaces is to blame—along with pollution from cars, lawns, farming, and more. Our primary goal has long been simply to shunt water away from buildings and pavement as quickly as possible to save our basements from flooding and to prevent erosion. But we haven't historically given much thought to where runoff goes. The way things are built now, when the rain hits hard surfaces, it grabs dirt and pollutants and flushes them into drains that often lead directly into sensitive local waterways without any kind of treatment.

Stormwater is so polluted with petroleum, it's as if 70,000 cars emptied their tanks straight into Puget Sound each year.

In some cases, the runoff merges with sewer waste, resulting in overflows of raw sewage during heavy storms. Over the past three years, sewage-tainted runoff has forced the closure of 32 Washington beaches, some for a couple of days, others for weeks.[9] Stormwater runoff mixed with sewage can carry salmonella bacteria, parasitic giardia, and Norwalk-like viruses. Ailments caused by exposure to sewage-tinged water include: diarrhea, vomiting, stomach cramps, fever, hepatitis, bronchitis, pneumonia, and swimmer's itch. [10]

But there's a solution for Cascadia's flood waves of runoff. It's an affordable fix that curbs the damage to our waterways while making our neighborhoods and communities more walkable, sustainable, and inviting. It's called low-impact development, or LID. The approach uses a suite of conservation and engineering tools to make developed areas behave more like natural ecosystems. Low-impact development is starting to catch on across the Northwest, but before exploring these green-building strategies, let's dig a little deeper into the challenges posed by polluted runoff.

Rivers of costly runoff

Ten bathtubs full of water. That's how much rain pours off one average-size house during a good-sized drenching. In a typical year in Portland or Seattle, approximately 26,600 gallons of runoff rushes through the gutters of that single home.[11] And there are more than 2.8 million houses in Oregon and Washington, as well as countless more apartments, condos, warehouses, offices, stores, and other buildings.[12]

When the rain runs off that home's roof—and its driveway, sidewalk, and lawn—it flows into a labyrinth of stormwater infrastructure. Even relatively arid cities such as Spokane must maintain more than 300 miles of stormwater sewers.[13] Traditional approaches to handling polluted stormwater have been costly to governments as well as to home and business owners. Cities and counties in Washington spend more than a quarter billion dollars a year trying to control and clean contaminated runoff.[14]

Victoria and Vancouver in British Columbia, Spokane, and Coquille near the Oregon Coast are among the Northwest cities and towns facing expensive upgrades to stop overflows of sewage and polluted runoff that are triggered after a downpour.

For nearly two decades, Portland has been working on its "Big Pipe" projects to stop billions of gallons of raw sewage and stormwater from fouling the Columbia Slough and Willamette River. The $1.4 billion projects should be completed this year.[15] The seaside town of Port Angeles is trying to finalize plans for a project that will cost at least $40 million to control its storm sewer waste.[16] Last year, the city's combined sewer system spewed nearly 24 million gallons of sewage-contaminated stormwater into Port Angeles Harbor.[17]

Sewage-tinged runoff can cause diarrhea, vomiting, stomach cramps, fever, hepatitis, bronchitis, pneumonia, and swimmers itch.

And there are the untold millions spent repairing stormwater-related damage from flooding, landslides, and sinkholes. Over the course of one particularly wet weekend this past December, Seattle Public Utilities reported more than 700 calls about flooding and sent crews to 332 locations. The city has paid millions of dollars to settle flood claims over the past decade, spending more than $6 million for the damage caused in the December 2006 storm that drowned a woman.[18]

Putting a LID on polluted stormwater

A stroll down a stretch of 2nd Avenue Northwest in Seattle is almost a walk in the park. The slightly meandering residential street is lined with wide strips of native grasses, small shrubs, and trees. Along the shoulder, interspersed among parking spots, are swales—or gentle depressions—that fill with water during a downpour. On this street, you won't find sludgy gutters brimming with muddy water and trash, or deserts of black asphalt that foster shoe-soaking puddles.

The street was one of the Northwest's first experiments in natural drainage systems, or low-impact development. A decade ago, workers jackhammered up the block and rebuilt it to catch and clean runoff the way it's done in nature. In a forest, rainwater falls on branches and leaves and slowly evaporates, or it soaks into the ground and gets sucked up by plants. The soil and organisms living in the soil help clean and filter the polluted stormwater. The Seattle project—called SEA Street—has been wildly successful, nearly eliminating runoff, even during heavy rains.[19] The slightly narrowed street is safer for kids and pedestrians, and creates natural park-like spaces that are inviting to wildlife and people.

"LID systems really do have the ability to filter water naturally and create much nicer, softer, greener stormwater facilities that really engage the public a lot more," said Tim Bailey, a geotechnical engineer and experienced practitioner of low-impact development with GeoEngineers, Inc., in Seattle.[20]

The philosophy of low-impact development is to try to replicate nature's way of managing rainfall. It means taking surfaces that normally repel water—roofs and pavement—and making them spongy.

Low-impact development can mean building green roofs covered in water-trapping soil and plants. It can mean hooking downspouts to rain barrels or cisterns to store

the water that does run off, or having downspouts flow into "rain gardens" featuring swales. It can mean building driveways from a lattice of pavers that leave some of the soil exposed, or using permeable concrete that lets water pass through to the soil below. It also means protecting, preserving, and restoring native vegetation.

"There is no reason not to make every single residential-scale property do something (to reduce stormwater pollution)," said Peg Staeheli, a principal with Seattle's SvR Design Co., a local leader in low-impact development. "There are a lot of tools out there now that can be used."[21]

The philosophy of low-impact development: replicate nature's way of managing rainfall by making water-repellent surfaces spongy.

Shifting from gray to green

Seattle is far from alone in realizing that there are alternatives to traditional gutter-and-storm-drain systems—also called "gray" infrastructure—that cost too much and don't work well. In recent years, low-impact development projects have cropped up as smart investments across the region. Here are some noteworthy examples:

Bremerton: A blue-collar city on the shores of Puget Sound, Bremerton is being permeated with green stormwater infrastructure. A new 1,600-foot-long bridge and an industrial roadway project will both use low-impact development to treat much of its stormwater runoff. In each case, state and local partners pushed for conventional stormwater treatment for the projects, but Bremerton officials successfully made the case for using low-impact development because it was cheaper.[22]

Portland: The City of Roses has so many natural drainages that it has published a walking tour for visitors interested in viewing its attractive rain gardens and swales.[23] Portland has grown its green infrastructure in part through policy incentives. It pays residents to unhook their home downspouts from the city's storm sewer system and redirect the water into rain gardens, and its green roof program offers rebates to residents and businesses installing ecoroofs. There are at least 350 ecoroofs in Portland, topping condos, the central library, government offices, and a university building, covering about 26 acres in all.[24]

Puyallup: The once fertile farm town and now suburb of Tacoma has embraced the use of swales and porous asphalt. Puyallup has helped its residents build 20 rain gardens in three different neighborhoods. The installations were done simultaneously within a neighborhood and city officials organized mini environmental fairs celebrating the events, which included guests such as gardening guru Ciscoe Morris.

"I've been seeing neighborhoods coalesce (around the projects)," said Mark Palmer, a stormwater engineer for the city and lead on the effort. "They become a close knit little community."[25]

Lacey: One of the first cities in the state to approve regulations back in 1999 to encourage low-impact development, Lacey has continued pursuing green stormwater solutions. The city requires a developer to use low-impact development to soak up all the rain that falls on a site rather than pipe it into a storm sewer system, provided the

ground is sufficiently absorbent.[26] Lacey's Regional Athletic Complex completed in 2009 features pervious concrete to reduce runoff.[27]

Lacey also has strict tree-protection provisions that call on developers to protect or replant trees, and homeowners must get permission to fell even sick and hazardous trees.[28]

Victoria: There are a number of high profile green roof projects in British Columbia (Vancouver's Convention Center and Olympic Village to name two), but the province has surprisingly fewer examples of rain gardens and swales. One exception is Victoria's Trent Street rain gardens. The 2009 pilot project includes two roadside rain gardens that help soak up street runoff that would otherwise pollute nearby Bowker Creek.[29]

Pringle Creek Community: Called "the nation's first full-scale porous pavement project" by the Asphalt Pavement Association of Oregon, the 32-acre sustainable community near Salem boasts 7,000 feet of porous asphalt roadways and 2,000 feet of porous alleys.[30] Pringle Creek also features swales and narrower roads to create fewer hard surfaces. And it's a leader in tree conservation: 80 percent of the development's trees were protected and one-third of the community is green or open space.

Spokane: In 2007, Washington State University Spokane County Extension and Spokane County Stormwater Utility planted a dozen swales in front yards around the city in order to test which plants worked best in that climate, to monitor for pollutants, and to raise awareness about rain gardens.[31] A recent study shows that many of the swales are performing better over time.[32]

Low-impact development treats larger volumes of water, is cheaper to maintain, boosts property values, creates wildlife habitat, and reduces greenhouse gases.

In these examples and others, low-impact development has been shown to be less expensive and more effective at cleaning stormwater than the traditional gutter-and-storm-drain systems. A study by the US Environmental Protection Agency compared the cost of stormwater clean-up projects that were built using low-impact development techniques to what they would have cost using conventional strategies. In 11 of 12 cases examined across North America, the green option was cheaper than gray by anywhere from 15 to 80 percent.[33]

A study by ECONorthwest, an economic consulting firm, also found that low-impact development costs less for both residential and commercial projects in Cascadia and beyond. The researchers concluded that low-impact development would fare even better in comparisons that considered more than just construction costs. In many instances, low-impact development treats larger volumes of water than traditional approaches, is cheaper to maintain, boosts property values, creates wildlife habitat, and reduces air pollution and greenhouse gases by planting and protecting trees and other vegetation.[34]

Death by a thousand rainstorms

Ailing Northwest rivers and lakes face death not so much by a thousand cuts as by a thousand rainstorms, each flushing filthy runoff into our region's environmentally and economically important waterways.

While low-impact development is gaining popularity, it's far from being standard practice. Developers, planners, and government agencies often are more comfortable sticking with the conventional systems that they know. In many cases, regulations require traditional infrastructure, whether mandating wider roads to accommodate parking and emergency vehicles, or prescribing stormwater pipes when a swale would work better and cost less.

But work is underway to change this. In recent years, the Puget Sound Partnership helped 36 Washington municipalities upgrade their codes to encourage the use of green infrastructure.[35] Now the Partnership is writing a local-code guidebook for governments that want to incorporate low-impact development requirements into their codes and regulations. It should be done in July.[36]

There are stormwater training programs for landscapers and other contractors as well as city and county planners and permit writers. Local universities, utilities, and nonprofit organizations are teaming up to offer seminars and workshops.[37] It's important to improve the level of expertise of those doing low-impact development. Because while green infrastructure offers a great fix for polluted stormwater, trained practitioners are needed—particularly for large projects.

"LID is something you have to look at with the willingness to be flexible and use the most appropriate systems for a given site," Bailey said. "It takes a lot more creativity.

"For small scale (projects) you can come up with something that works most of the time, most of the places."[38]

Seattle recently had a painful reminder that green solutions still require careful planning. A rain garden pilot project in the Ballard neighborhood hasn't worked as expected, resulting in swales that fill with water and don't drain well. The city has formed a task force to solve the problem.[39]

There are additional opportunities for making green stormwater solutions more widespread. In 2010, Washington legislators pledged $50 million for stormwater improvements.[40] This year, a coalition of Washington's city and county leaders, labor representatives, and environmental advocates are asking the Legislature to establish a long-term funding source to pay for more low-impact development. The Clean Water Jobs Act would put a 1 percent fee on petroleum products, pesticides, herbicides, and fertilizers.[41] Oregon lawmakers are considering a ban on copper in vehicle brake pads in an effort to remove one of the prime sources of a pollutant that's harmful to fish and other aquatic life.[42] Washington approved a similar measure last year, becoming the first state to do so.

There is an urgency to act. The Washington Department of Ecology is working on rules that will require more use of low-impact development, and final regulations should be completed by summer 2012.[43] The US Environmental Protection Agency is strengthening national stormwater regulations that should take effect in less than two

years and will encompass more towns and cities than ever before.[44] And the runoff problem is likely to worsen if the population of Washington, Oregon, and Idaho swells to an expected 14.5 million residents by 2030, a roughly 20 percent increase from today.[45]

"Time is not on our side," said Tom Holz, a stormwater and low-impact development expert from Olympia. "We may lose the battle just simply through dallying."

About the Author

Lisa Stiffler is a journalism fellow at Sightline Institute. Previously, she worked as an environmental reporter for the *Seattle Post-Intelligencer* where her work included award-winning investigations into the health of Puget Sound.

Sightline Institute is a not-for-profit research and communication center—a think tank—based in Seattle. Sightline's mission is to make the Northwest a global model of sustainability—strong communities, a green economy, and a healthy environment.

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