

Introduction

On a sunny winter day in San Francisco, Joel Pomerantz brakes his bike in Alamo Square Park near that famous spot where Victorian houses, the Painted Ladies, front the city's modern skyline.

"Do you notice anything?" he asks me.

I brake too and look around, flummoxed. I lived in this city for seventeen years and have been to this park countless times. Everything seems ordinary. On the paved path at our feet, Pomerantz points to an oblong puddle, which I would assume was left over from the last sprinkler watering.

"That?!" I ask, incredulous.

"Look closer," he says, pointing to its ring of mossy scum. "That's a sign that this water is nearly always here." This diminutive puddle, which I have likely passed without noticing many times, is actually evidence of natural springs beneath the park that seep continually, he tells me. It's a small sign of water's hidden life, the actions this life-sustaining compound continues to pursue, despite our illusion that we control it. As climate change amplifies floods and droughts, people like Pomerantz are recognizing the importance of such minutiae that highlight water's agency.

In his free time, Pomerantz hunts and maps ghost streams, the creeks and rivers that once snaked across the San Francisco Peninsula before humans filled them with dirt and trash or holstered them into pipes, then erected roads and buildings atop them. Such treatment of waterways has become standard practices in cities, where

more than half of us live worldwide. Pomerantz has devoted three decades to exploring the city with water on his mind, making him a kind of water detective. His eyes see what others miss—like this puddle, or certain water-loving plants that are clues to lost creeks. He gestures toward the trees that line the park's edge on Fulton Street. "Willows are like a flag," he says. In fact, the name of this park is actually a plant clue: *álamo* means "poplar" in Spanish, a species related to willows and other streamside trees.

A few blocks away, he checks for traffic, then guides me to a manhole in the middle of residential Eddy Street near busy Divisadero. Cocking our heads, we hear the sound of rushing water. When that sound is constant, he says, especially in the middle of the night, it's a creek imprisoned in a sewer pipe, not somebody flushing.

Later, Pomerantz and I bike to Duboce Triangle, another small park, this one between the Lower Haight and Castro Districts. Duboce lies at a low point of The Wiggle, San Francisco's beloved bike path. Although unmarked for many years, bikers long followed this route, weaving through valleys at the base of hills. A stream, now buried, was the original traveler of The Wiggle, and along its path through Duboce Triangle the city has now built bioswales, vegetated ditches to hold runoff from heavy rains. Although I've biked the route myself frequently, I never knew it was pioneered by a stream. It makes sense, when you think about it. Cyclists, like water, look for the path of least resistance.

Pomerantz—who has published a map of San Francisco's lost waterways on his Seep City website, advised local agencies as a consultant, and leads walking tours to share his hard-won knowledge—is not alone in his obsession. In Brooklyn, urban planner Eymund Diegel has mapped Gowanus Creek's lost watershed. In Victoria, British Columbia, artist, poet, and environmental activist Dorothy Field worked with local historians and First Nations to track the hidden path of Rock Bay Creek, then installed signs and street medians inlaid with salmon mosaics to draw attention to where it still flows underground. As curiosity about buried waterways grows in the popular imagination, the quirky passion is now a global phenomenon. Subterranean explorers, featured in a 2012 film called *Lost Rivers*,

are discovering buried waterways encased in pipes below Toronto, Montreal, and Brescia, Italy. The Museum of London had a *Secret Rivers* exhibition in 2019 to reacquaint Londoners with their lost streams.

Secret rivers, ghost streams, hidden creeks: learning of their existence arouses our innate attraction to mystery and our passion about the places we live. What we learn about the past triggers amazement because our quotidian landscape is so transformed. We've dramatically altered waterways outside of cities too. We've straightened rivers' meanders for shipping, uncurled creeks to speed water away, drained and filled wetlands and lakes, and blocked off floodplains to create more farmland or real estate for buildings.

But our curiosity about water's true nature is not idle, nor an indulgent wish to return to the past. Water *seems* malleable, cooperative, willing to flow where we direct it. But as our development expands and as the climate changes, water is increasingly swamping cities or dropping to unreachable depths below farms, generally making life—ours and other species'—precarious. Signs of water's persistence abound if we train ourselves to notice them. Supposedly vanquished waterways pop up stubbornly, in inconvenient ways. In Toronto, tilted houses on Shaw Street near the Christie Pits neighborhood were long a local novelty, but most people didn't know that the ghost of Garrison Creek was pulling them out of plumb. Worldwide, seasonal creeks emerging in basements are evidence that those houses encroach on buried streams. In my partner's mom's neighborhood in suburban Boston, most houses come with sump pumps because the development was built on the local "Great Swamp." And in the wreckage of disasters like Superstorm Sandy or Hurricane Harvey, we see that homes built atop wetlands are the first to flood.

When our attempts to control water fail, we are reminded that water has its own agenda, a life of its own. Water finds its chosen path through a landscape, molding it and being directed in turn. It has relationships with rocks and soil, plants and animals, from microbes to mammals like beavers and humans. Today, water is revealing its true nature increasingly often, as climate change brings more frequent and severe droughts and floods. To reduce the impacts of these

phenomena, water detectives—Pomerantz and other ghost-stream enthusiasts, restoration ecologists, hydrogeologists, biologists, anthropologists, urban planners, landscape architects, and engineers—are now asking a critical question: What does water want?

California: Where Water Fixations Are Born

Figuring out what water wants—and accommodating its desires within our human landscapes—is now a crucial survival strategy. My own preoccupation with water goes back to childhood. I grew up in California, where jockeying over this molecule has been the unofficial sport since before the state's founding. Water first grabbed my attention during the 1976–77 drought, when grade school assemblies taught us to take quick showers rather than deep baths, and my dad put a brick in our toilet tank to displace volume and reduce the amount we flushed. That message of scarcity, that this vital resource is precious, embedded deeply in my brain.

I also dipped into water's wilder side. My family frequently went camping with another, who had a daughter my age. As California girls, raised on the beach and among the redwoods, we took it as a point of pride to go swimming in any body of water we came across, from big breakers off Santa Cruz to eight-thousand-foot-high alpine lakes partially covered in ice. So it's small surprise that, when I became a journalist, I was drawn to covering California's incessant water wrangles.

The first thing I came to understand—which sounds obvious but I hadn't before given it much thought—is that much of the water we see today, especially in industrialized countries, is not in its natural state. Humans' efforts to control it have created giant lakes behind dams; deeply scoured, fast-flowing rivers; straightened, narrow creeks far below their banks; arrow-straight canals that deliver irrigation water to farms. We've also erased many lakes and swamps entirely. Worldwide, only one-third of rivers longer than 620 miles travel uninterrupted to the ocean. Most of the remaining free rivers run through remote parts of the Arctic, Amazon, and Congo. All

the rest have been dammed, straitjacketed in levees, and dredged to make shipping channels.

What many of us think of as “river” is a hobbled water canal that no longer wanders across its floodplains, depositing nutrient-rich, land-forming silt as it goes. As a kid, the wildest river I knew was the Sacramento. Although nearly a mile wide at its mouth near the East Bay town of Antioch, the Sacramento and its major tributaries are largely tamed by giant dams in the north—Shasta, Oroville, Canyon, Folsom—and the main stem is heavily constrained as it flows more than four hundred miles to the sea. Even in its fan-shaped delta, fingers of water are hemmed in by dirt levees built by hand a century ago. Today the farmland inside those cordons has sunk up to twenty-six feet from the loss of peat, which decays as it dries out, and from blockage of the river’s natural deliveries of sediment that continually build land.

The first time I saw a truly wild river was on a visit to Alaska’s Denali National Park. In late August, I was hiking with friends through spongy tundra, its bonsai shrubs on fire with autumn colors. We chatted loudly as we went to avoid surprising grizzly bears, until we came to the McKinley River. The water spanned maybe forty feet across. Out for a day hike, unprepared to take it on, we had to turn back. As I gazed up the valley from which it flowed, I saw that the barrier blocking us was just one strand of a broad, braided system spread languidly across the floodplain, its columns shifting apart, then twining together. Although at that moment I knew little about hydrology, the science of water, on some instinctual level I understood that this was a free river. And every other river I’d known was markedly subdued.

Letting Go of the Control of Nature

Humans have sought to control our environment throughout history. In looking for an antonym for *control*, I found *chaos*, *lawlessness*, *mismanagement*, *neglect*, *weakness*, *powerlessness*, *helplessness*. It’s a linguistic reflection of how much we crave control and fear letting

go. But if we want to solve the water problems we face today, we need to open our minds. The way we relate to water is not inevitable. And in fact, our infrastructure, our laws for allocation, our striving for control are amplifying these problems. By asking, "What does water want?" water detectives are working from a philosophy rooted in curiosity, respect, and humility, rather than a too-common arrogance. They are also accepting reality: water always wins.

Certainly that's true in geologic time. If water were a category in the game rock, paper, scissors, water would beat them all every time. Part of the sense of awe we get at the Grand Canyon is wrapping our minds around the fact that the reflective squiggle a mile below us carved that natural cathedral out of rock over millions of years. But water also wins by breaking through our dams and levees sooner or later—in a few months, years, or decades. Today's water detectives are acknowledging water's power and aspiring to go with the flow rather than fight it.

The detectives start by uncovering what water did before generations of humans so radically transformed our landscape and waterways. How did water interact with local rocks and soils, ecosystems and climates before we scrambled them?

There are many ways to get to know water's habits and relationships with other entities. One of them is Pomerantz's approach of close observation. Other water detectives we will meet in this book use magnetic imaging, satellite data, chemical analysis, soil core samples, anthropological research, biology, ecology, and more to ferret out what water is doing. Historical ecologists pursue this knowledge by performing a kind of forensic ecology. As the detectives seek answers to water's true nature and make intriguing discoveries, we begin to understand why certain areas flood repeatedly, or how our tendency to speed water off the land deprives us of urgently needed local rainfall. Then we begin to think creatively about how we can solve these problems by making space for water within our existing habitat.

Some of the detectives' early insights astound—and should spur us to change our ways. For example, the carbon dioxide stored in some wetlands is vastly greater than that stored in forests. Surface

water and groundwater are not separate sources but part of a single, interactive system. When rivers shrink to a trickle, water underground can feed them, pushing up through the bottom of the streambed. Conversely, when people pump groundwater and the water table drops, river water can filter through the bottom of the streambed to replenish it. Tidal marshes can actually keep pace with sea-level rise, protecting inland areas, if they have enough sediment—a resource we've made scarce with our widespread dam building and river channelization.

The answers the water detectives are discovering in the cities, fields, swamps, marshes, floodplains, mountains, and forests that we will journey through in this book lie in conserving or repairing natural systems, or mimicking nature to restore some natural functions—not building more concrete infrastructure. These ecosystems can buffer us from bigger rainstorms and longer droughts by absorbing and holding water. When we obliterate them, we make our places brittle, multiplying the intensity of these disasters.

Among water professionals around the world, these reparative approaches go by various names, including nature-based systems or solutions, green or natural infrastructure, sponge cities, low-impact development, and water-sensitive urban design. Because these solutions seek to work with or simulate natural systems, they offer myriad benefits beyond just reducing floods and droughts. For example, they help us address another threat to life as we know it: the dramatic decline of other species that we are causing. Also, because natural systems store carbon dioxide in plants and soil, they help us not just adapt to climate change but also slow its progression. Protecting biodiversity and storing carbon are not peripheral to solving water problems; they are integral to healthy water systems.

Slow Water Manifesto

So what *does* water want? Most modern humans have forgotten that water's true nature is to flex with the rhythms of the earth, expanding and retreating in an eternal dance upon the land. In its liquid state, with sufficient quantity or gravity, water can rush across the

land in torrential rivers or tumble in awe-inspiring waterfalls. But it is also inclined to linger to a degree that would shock most of us because our conventional infrastructure has erased so many of its slow phases, instead confining water and speeding it away. Slow stages are particularly prone to our disturbance because they tend to be in the flatter places—once floodplains and wetlands—where we are attracted to settle.

But when water stalls on the land, that's when the magic happens, cycling water underground and providing habitat and food for many forms of life, including us. The key to greater resilience, say the water detectives, is to find ways to let water be water, to reclaim space for it to interact with the land. The innovative water management projects I visited around the world all aim to slow water on land in some approximation of natural patterns. For that reason, I've come to think of this movement as "Slow Water."

Like the Slow Food movement founded in Italy in the late twentieth century in opposition to fast food and all its ills, Slow Water approaches are bespoke: they work with local landscapes, climates, and cultures rather than try to control or change them. Slow Food aims to preserve local food cultures and to draw people's attention to where their food comes from and how its production affects people and the environment. Similarly, Slow Water seeks to call out the ways in which speeding water off the land causes problems. Its goal is to restore natural slow phases to support local availability, flood control, carbon storage, and myriad forms of life. For many people who study water deeply, these values have become obvious.

Just as Slow Food is local, supporting local farmers and thereby protecting a region's rural land from industrial development and reducing food's shipping miles and carbon footprint, ideally, Slow Water is too. The engineered response to water scarcity has been to bring in more water from somewhere else. But desalinating water or transporting it long distances consumes a lot of energy: in California, for example, the giant pumps that push water southward from the Sacramento Delta are the state's largest user of electricity. Withdrawing water from one basin and moving it to another can

also deplete the donor ecosystem, or introduce invasive species to the receiver ecosystem.

Perhaps the biggest problem with bringing in water from somewhere else is that it imparts a false sense of security. When we live long distances from our water, we don't understand the limits of that supply, so we're less likely to conserve. We also don't understand how the water we use supports its local ecosystem. By overexpanding human population and activities, especially where there isn't enough local water, such as in the US Southwest, Southern California, or the Middle East, we make people and activities vulnerable to the water cycle, rather than resilient.

Slow Water is also in the spirit of the land ethic articulated by twentieth century forester-turned-conservationist Aldo Leopold. It calls for us to treat soil, water, plants, and animals with respect and to strengthen our relationship with them because they are part of our communities and we have a moral responsibility to them. His hydrologist son, Luna Leopold, expanded these ideas into a water ethic that calls for "a reverence for rivers." Both ethics express an interweaving of nurture and need: for nature to provide for us, we must care for it.

Aldo Leopold was inspired by older traditions. Kelsey Leonard is a Shinnecock citizen and assistant professor in the School of Environment, Resources, and Sustainability at the University of Waterloo in Ontario. As she explained to me and an audience of river researchers in an online talk in 2020, many Indigenous traditions don't consider water to be a "what"—a commodity—but a "who." Many Indigenous people not only believe that water is alive, but that it's kin. "That type of orientation transforms the way in which we make decisions about how we might protect water," she said. "Protect it in the way that you would protect your grandmother, your mother, your sister, your aunties."

Such belief that natural things are alive, or have souls, including rivers, rocks, trees, animals—often called animism—is common in ancient thinking worldwide. Similar beliefs elsewhere include Bon, the precursor to Tibetan Buddhism, and Celtic and Norse beliefs

in fairies and elves, the spirits of the grasslands and forest, still held today by many people. From this world view comes the Indigenous water protectors' rallying cry, "Water is life."

In contrast, today's dominant culture is rooted in an ideology of human supremacy: humans' needs and wants—particularly privileged humans—are considered more important than other species' right to exist. (The attitude of supremacy extends to "othering" certain people too.) This us-first stance hasn't done humanity any favors. By focusing single-mindedly on servicing human needs, we ignore other interconnected entities in the systems we change, causing myriad unintended consequences, from climate change to the extinction of other species to water woes. It's also a moral issue, as the Leopolds and Leonard point out: humans are not, in fact, more important than other beings. They, like us, have a right to exist.

Leonard says that one way to solve many water injustices is to recognize water as a legal person with an inherent right to exist, flourish, and naturally evolve. That's not as radical a notion as it might sound: in the United States, corporations were granted legal personhood with all the rights that implies. According to Indigenous beliefs, water is actually alive, while corporations are not. "Who is justice for? Humanity alone?" Leonard asks rhetorically. Indigenous legal systems already protect nonhuman relations, including water.

In fact, a rights of nature movement is starting to infiltrate Europe-based legal systems. Dating back to the 1970s, it argues that nature has a fundamental right to exist. A Pennsylvania-based legal advocacy organization, the Community for Environmental Defense Legal Fund, uses this argument to assert a community's right to prevent a corporation from polluting its territory. Ecuador and Bolivia, which have large Indigenous populations, have enshrined rights of nature in their constitutions. In New Zealand, Whanganui River, sacred to the Indigenous Māori people, has won legal personhood. Same with the storied Ganges River in India and the Magpie River in Quebec that is sacred to Innu people. The Yurok Tribe in Northern California has granted legal personhood to the Klamath River. Other communities around the world are also fighting for legal rights for their rivers, wetlands, and watersheds. A river's rights can include the

right to flow, the right for its cycles to be respected, the right for its natural evolution to be protected, the right to be free from pollution, the right to maintain its natural biodiversity, the right to fulfill its ecosystem's essential functions. With legal personhood, if these rights are violated, people have the standing to sue on the river's behalf.

The water detectives in this book are a diverse bunch and don't all hold these beliefs. But they share an openness to moving from a control mindset to one of respect. Their openness is at the heart of this book. As our long-held illusion that we can control water is crumbling in the face of escalating disasters, we understand, viscerally, that water always wins. Given that truth, it's better to learn how to accommodate water, to work with water, and enjoy the benefits that cooperation can bring.

While politics and finance are fundamental to getting anything done in this world, they are not the primary focus of this book. Similarly, although agriculture is the major human use of water worldwide, I do not delve deeply into the industrial water-energy-food nexus, which would be a tome in its own right. Instead, this book aspires to spark curiosity about what water wants by looking at its physical relationships with other entities.

Within this book I follow a loosely chronological order. Chapter 1 lays out the problems we're currently creating with water. The rest of the book introduces Slow Water approaches from around the world, organized around water's relationship with different natural elements through time. Chapter 2 focuses on water in rock and soil underground: geologic time. Chapter 3 looks at water's interaction with early life: microbes and slightly bigger creatures, meiofauna and macroinvertebrates. Chapter 4 attends to bigger critters—especially that renowned furry water engineer, the beaver. Chapters 5 and 6 look at humans reviving ancient techniques that work with nature to manage water. Chapter 7 addresses the Industrial Era: how did mainstream culture's attitude toward water change? Chapters 8, 9, and 10 provide glimpses of the near future and people's adaptations: natural water towers, coastal restorations—and retreat.

Slow Water solutions are gaining momentum worldwide, so the places we visit in this book—the United States, Canada, Iraq,

the United Kingdom, India, Peru, China, the Netherlands, Kenya, Vietnam—are by no means comprehensive. Rather, they represent a range of continents, peoples, ecosystems, and water problems to show how each place is unique—yet all share common concerns. In these chapters, people are grappling with droughts and floods, melting glaciers and reduced monsoons, sinking ground, soil erosion, decline of other species, sea-level rise, and salt water moving inland. The places featured don't necessarily have it all figured out. Some bold ideas are being implemented piecemeal, as people struggle to get them off the ground or expand to scale. Some governments have policies contradictory to their visionary Slow Water approaches. Healing our relationship with water is a process. In spending time with the water detectives, I've learned a lot about what water wants and how it has shaped and been shaped by various entities through time. My hope is that these stories of innovation can inspire us to think differently about water and the ecosystems we share so we can harvest ideas to try in our own places.