



Though most of the Clinch River runs through private land, it still has some of the finest undeveloped riverfront in the Appalachians, including this stretch in Virginia.

Chapter 8

WATERSHED LITERACY: RESTORING COMMUNITY AND NATURE

by Brock Dolman

Watershed, catchment, drainage, basin, cuenca: by any name they function the same, and everyone on the planet lives in one, sailors on the sea alone excepted. Watersheds at all scales are uniquely evolved geomorphic, hydrological, and biological entities that provide all members of the community a benchmark for judging the wisdom of our past, present, and future land and water use practices.

At the most basic level, a watershed encompasses all of the land surface that collects and drains water down to a single exit point. The continual cycle of erosive water flowing over uplifting and weathering land has sculpted all landscapes into distinct cradlelike entities known as watersheds. Everything we do for work, play, school, shopping, farming, recreation, and so on occurs in a watershed somewhere.

Watersheds can be as large as the Mississippi basin, the fourth-largest in the world, which drains 41 percent of the lower 48 U.S. states into the Gulf of Mexico. Or watersheds can be as small as all the land in your neighborhood that flows from your yard, roof, driveway, and streets to the storm drain and out to your local creek, lake, and

eventually the ocean.

If you want to envision a watershed, bring your hands together and cup them, creating a vessel. Imagine the rim of your hands being a water-parting divide with thumb and fingertips as ridgeline spires. Fingers become the mountain slopes, palms the hills and floodplains. Each wrinkle and crease a watercourse conveying flow to the riparian ecotone of adpressed hands, spilling forth towards the mouth of articulated wrists. We all hold the watershed in our hands, and in turn, we are all held by the watershed.

The History of "Watershed"

The word "watershed" has many different meanings and intentions. In its most literal sense, watershed refers to the parting of waters, the actual ridge dividing drainages. In 1852, Charles Darwin referred to the "Line of Watershed dividing inland streams from those on the coast," the Continental Divide of North America being a primary example. In 1878, Thomas Henry Huxley invoked watershed as a landscape entity or catchment basin, stating it is "all that part of a river basin from which rain is collected, and from which therefore the river is fed." This definition encapsulates the basic physical definition of a watershed in common parlance today.

Our challenge is to move beyond a static, hydrologic definition towards a dynamic understanding of the wholeness of watersheds and how they literally underlie all human endeavors. Watersheds at all scales are evolved, living entities that topographically define community. The health of your watershed depends on collaborative relations between neighbors in your shared basin, so ensuring a healthy "basin of relations" is paramount.

In the world of watershed thinking exists the phrase "We all live downstream," implying a deep sense of interconnection between how the behavior of one person can impact the quality of life for someone downstream.

The exciting art and science behind thinking like a watershed nurtures our hearts and sparks our imaginations. I emphasize *heart* here because as a global society, the quality we most urgently need is an open heart, a humility that allows us to perceive the Earth's watersheds not as human commodities but as living communities. In light of recent events and global climate trends, the current commodity-based path seriously threatens the continuance of our own and all species. Solar power functionally fuels all life and watershed processes, but it will take *soul-ar* power to regenerate and restore healthy watersheds.

Watersheds in the Mind

Soular-powered watershed regeneration rests in the hands and hearts of each one of us: the power to restore ourselves by restoring our relations with our home basins. This challenge before us begs our collective capacity to think like a watershed, striving to understand the wisdom of watershed consciousness.

Again, like all watersheds that begin in the

headwaters, so must we begin our restoration process in the most critical of all headwaters—the very water in our own heads! Thus watershed restoration begins with *restoryation*. What is the story you believe? Is our planet a community or a commodity? Are you on the path of dead oil or living water?

To begin with, we need to learn to read the place that we are in. Ecological illiteracy is the single greatest global epidemic we face as a human species today. Effective watershed regeneration and restoryation must be based in watershed literacy—a literacy of home, a literacy of place.

How do we bring to bear the scientific and professional capacity to convey this information in a manner that pragmatically supports an increasing proficiency of watershed management at all levels of society? The pedagogy of place-based learning is critically dependent on the clarity of being actually able to describe where you are.

We need to learn to speak of and teach about place in terms that are inclusive to the idea that we are a part of place and not apart from place. Speak with elders in your community about what the river used to look like after a rain storm or where there used to be big trees or good fishing and hunting. Make a public map of your watershed and engage the community in adding to it points of historical interest or rare resources or issues of concern and pollution. Interview local farmers or public servants on their memories of place and concerns about the future of your watershed. Take guided walks with native plant or wildlife experts, or simply explore places in your watershed you are drawn to, from the ridgeline down to the river mouth.

In what ways can we support a literal sense of embodiment with our watershed? In

many ways the body mirrors our watershed. We can imagine the branching patterns of waterways as a macro expression of the same branching patterns of our lungs, capillaries, and neural pathways. Wetlands provide a similar environmental service for watershed health as our livers and kidneys. Soil and skin are both thin and proportionately cover the most surface area. Like our bodies, the life of the watershed is by volume mostly water—in the soil and vegetation such as in our flesh and living tissues. We are actually walking watersheds.

A Watershed Moment

"Watershed" is continually used in reference to a significant event. Lodged deep within our collective psyche is a subconscious recognition of the profound meaning each distinctive drainage basin holds: new creatures, new places, new experiences, a new face of divinity awaits. A certain excitement of impending discovery, an archetypal intrigue, arises as you pass into a new "watershed."

Watershed as metaphor brings awareness to a critical transition or point of demarcation, as, for instance, "they reached a watershed in the peace negotiations." What does it imply to "reach a watershed"? How does this resonate with the feelings of awe and apprehension at cresting a ridge and gazing down into a new, unknown, and promise-filled "basin of relation"?

The figurative watershed moments in one's life are often where a certain clarity is achieved, marked perhaps by a rite of passage fulfilled or by the unexpected reappraisal of deeply held beliefs.

In Aldo Leopold's *A Sand County Almanac*, he describes a personal "watershed" moment after shooting a wolf in the Gila Wilderness in 1922: "We reached the old wolf in time

How Big Are Watersheds?

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What is a Watershed?

Literally:

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Technically:

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Metaphorically:

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to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes, something known only to her and to the mountain. I was young then and full of trigger itch; I thought that because fewer wolves meant more deer, then no wolves meant a hunter's paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view."

In this watershed moment, Leopold witnesses an interconnectivity that comes to fruition later in life when he writes about the idea of "thinking like a mountain"—an understanding of the relationship among wolves, healthy deer herds, and forested mountain watersheds.

These literal watershed moments allow us to observe the many ways in which water weaves together all living things into a dynamic whole.

The Threatened Health of Our Watersheds

Our watersheds today are vastly different than just centuries ago. The earliest descriptions of North America by Europeans evoke a vision of snow-capped peaks, forested ridges, wooded slopes, rolling prairies, flood plains, riparian jungles, beaver wetlands, and river mouth estuaries brimming with wildlife. It was an ecstatically pervious world that cleansed and cycled and savored its own water to the benefit of unfathomable biodiversity.

Let us dive into that vision for a moment: rain falling at 30 mph is slowed and sweetened by outstretched leaves; these in turn drip nutrient-laden tea from the canopy to the forest floor. Infused with humus capable of absorbing 10 times its own weight in water, this protective sponge spreads the life-giving liquid over

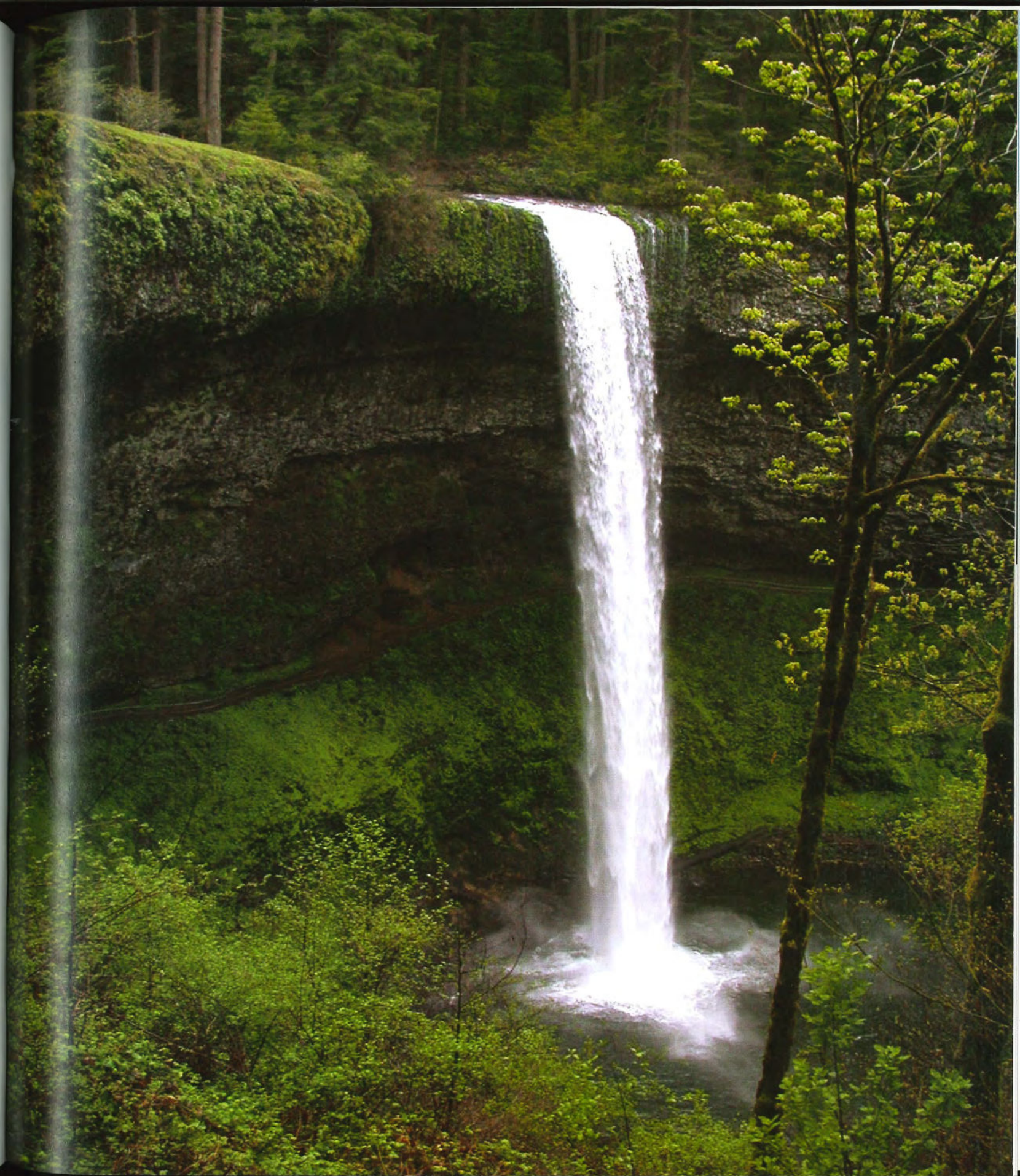
soil shot through with nutrient-grabbing mycorrhizae, the fungal threads connecting all the rooted plants. These vegetated landscapes of yore seeded and combed the aqueous clouds, rehumidified the downwind air, buffered their own climates, and passed on the surplus to recharge groundwater aquifers that sustained the flow of springs, creeks, and rivers.

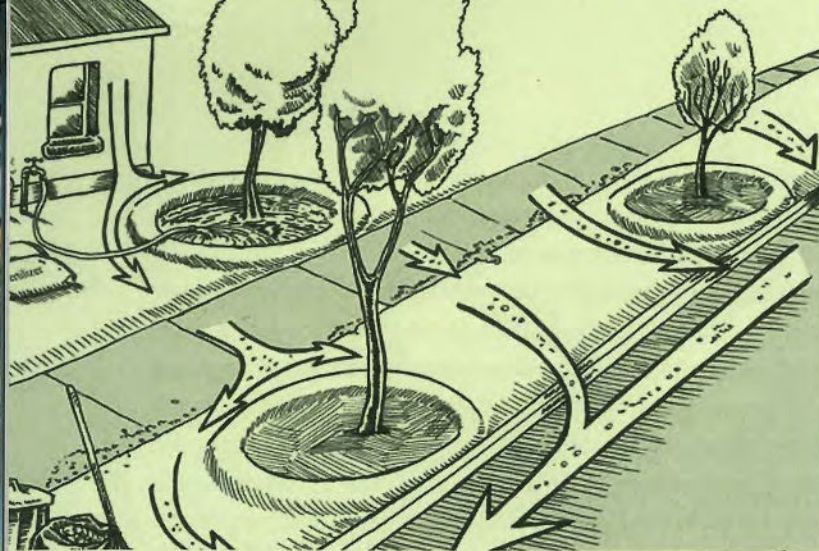
Now imagine this hydrological wonderland after some centuries of development based on dessication: Wholesale clearing of forests and draining of wetlands have hardened rivers and streams, the upland capillaries and aquatic arteries of the landscape. Clear-cut logging, mining, overgrazing, plow agriculture, housing, commercial development, road building, and parking lots have all damaged watersheds, making them extremely impervious.

This is where we stand today, with a major challenge ahead of us to restore our water systems, for the sake of our own survival and that of the world around us. Astute ecosystem managers clearly recognize that watershed-scale restoration begins with addressing issues that affect the headwaters of any watershed. To seriously take on this survival challenge, we must first and foremost mitigate the cerebral imperviousness of our own internal "headwaters"—to change the way we think about the natural world and our place in it.

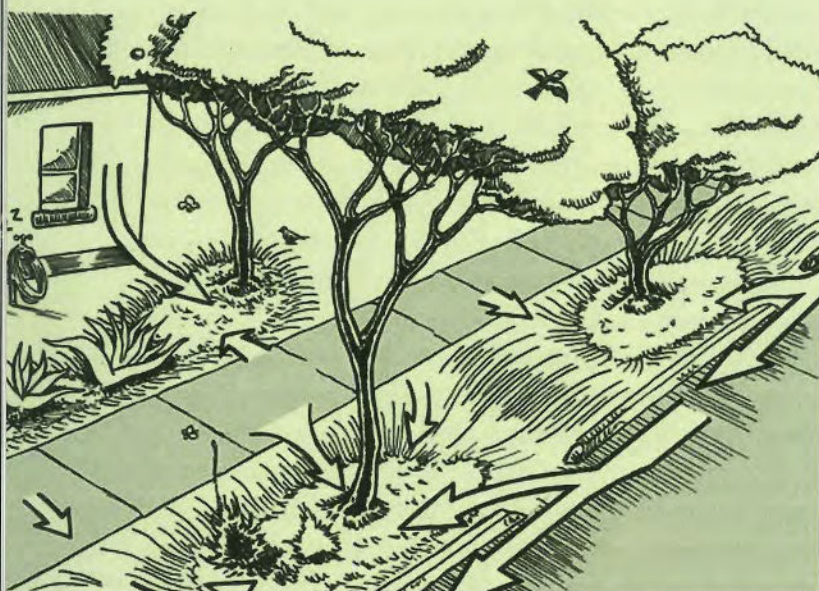
Therefore, it becomes clear that the work of the day to restore ecosystem function must begin with functional restoration of our collective ego system. Forming collaborative interpersonal and working social relationships between all people who share a watershed rests at the center of our potential for success or failure.

A waterfall in Silver Falls State Park, Oregon.





The wrong way to landscape. Rain, runoff, and topsoil are quickly drained off the landscape to the street where the sediment-laden water contributes to downstream flooding and contamination.



The right way to landscape. Rain, runoff, leaf drop, and topsoil are harvested and utilized with the landscape contributing to flood control and enhanced water quality.

We Face a Future of Thirst

Some will argue that water has never limited human growth and development, that humans have tenaciously applied their technological ingenuity to move water great distances and pump it from deep below the surface to fuel burgeoning growth. It has been said, "Simply bring the water, and the people will come." In the past few centuries, however, this command-control-and-conveyance attitude towards water has begun to show signs of deepening failure.

Our societal addiction to the combustion of carbon-based fossil fuels for energy is now unequivocally understood to cause global climate change due to excessive accumulation of "greenhouse" gases in the atmosphere. These gases thicken the atmosphere's capacity to retain solar energy, leading to an increase in the planet's average surface temperatures. Solid, liquid, and gaseous phase changes by water are the thermal mechanisms through which the planet primarily attempts to regulate its human-induced "fever." Water is manifesting some of the most dramatic expressions of this climate change, with melting polar ice and glaciers, rising sea levels, coastal inundation, ocean acidification, warmer tropical water and air temperatures, slowing of the Gulf Stream, stronger hurricanes, and increased floods and droughts.

Peak Water

As we confront the burgeoning reality of "peak oil"—the knowledge that we are now approaching the halfway point of global petroleum production capacity—we also see a new crisis appearing on the horizon: "peak water," which has deep implications for "peak food," and consequently, "peak population." Responding in a timely manner to this triangle of energy, water, and

food interdependence is one of our challenges. The difference between peak oil and peak water is that, while the total amount of water and oil on the planet is finite, water, unlike oil, cycles infinitely through our lives and watersheds.

Watershed by watershed, functional sustainability will be exemplified by our ability to sustain the integrity and resilience of the water cycle. As the Titanic of cheap energy sinks below the surface, a prudent option would be to perceive our watersheds as living lifeboats and to use the principles of "conservation hydrology" to batten down the hatches. It is incumbent upon us to realize that together we can each work to ensure that all watershed lifeboats float together as a regional raft of resilient stability.

Moving from a "Dehydration Model" to a "Rehydration Model"

There are tools, like conservation hydrology, that we can use to begin to restore our watershed and our thinking.

Conservation hydrology utilizes the disciplines of ecology, population biology, biogeography, economics, anthropology, philosophy, and history to guide community-based watershed literacy, planning, and action. It advocates that human development decisions must move from a "dehydration model" to a "rehydration model."

To achieve this goal we must retrofit existing development patterns with new ones based on the principles below. Therefore, much like the discussion of our carbon footprint (i.e., the relative relationship of our lifestyle and how it impacts the planet via our consumption of carbon), we can also invoke this same process of inquiry and evaluation to the idea of our water footprint.

Developing a consciousness that appreciates water as the ultimate resource is critical. Thank-

fully, the federal Clean Water Act now recognizes the "pave, pipe, and pollute paradigm" of past decades as disastrously flawed and hydro-illiterate. These outmoded engineering practices captured, concentrated, and conveyed water away from a site as quickly as possible. The old *drain-age* is now being replaced by a new *retain-age*, the key to a healthy watershed.

Balancing Our Water Budget

Our new way of looking at watersheds is a lot like managing money. For a moment, consider water in budgetary terms. Successful businesses must account for income and expenses in order to ensure profitability. Yet how many cities or counties actually have balanced income and expense budgets for their water resources?

In simple fiscal terms, most municipalities are operating deeply in the "red," with ecologically and socially damaging hydrological deficits. Typically, the demand or expense side of their water budgets far exceeds their income streams. Impervious surfaces, such as roads, parking lots, and compacted fields, impede water's ability to make deposits that could recharge groundwater savings accounts.

Ever-increasing reliance on overdrafted groundwater accounts will leave our grandchildren with unrecoverable and undrinkable debts as many of the world's watersheds verge on hydrological bankruptcy. Unlike corporations and people, our watersheds cannot file for Chapter 11 and then just reorganize. Direct deposits of freshly distilled rain and snow are the annual allowance, the only real renewable income source on Earth.

Expenditure of our groundwater trust reserves should be limited to the annual earned interest income of infiltration, with the princi-

pal left untapped. All life-forms are shareholders with a fixed interest in ensuring that our watershed economies remain viable and continue to operate in the "blue."

Four Rs of Conservation Hydrology

Here's how that budget actually breaks down. The four "Rs" of a water budget are equivalent to income, deposit, savings, and expense. We want the water balance of our watersheds to run in the blue and not in the red. We want to insure that our liquid assets continually produce a high quality return on investment back into our watershed.

Receive=Income. Watersheds receive water only as snowfall, rainfall, and fogfall. Annual precipitation is the only true source of income to resupply our community's water budget allowance.

Global climate changes are predicted to dramatically alter the frequency, intensity, and type of precipitation events that watersheds can expect to receive. Thus, conservation hydrology advocates the adaptive management of watershed lands to optimize rehydration. Practices such as eco-forestry, holistic rangeland management, organic no-till agriculture, urban forestry, stormwater management with bioswales and rainwater harvesting are but a few examples of land-use practices that can be designed to help rehydrate our watersheds. We must implement and enforce these types of land-use patterns that enhance the receptive capacity of our watersheds in times of excess and in times of scarcity.

Recharge=Deposit. Recharge processes are critical for the water cycle to annually refresh itself via the deposit slip called infiltration. The capacity to make water deposits depends on the watershed's recharge potential. Precipitation received by our watershed must percolate and be absorbed, or else there is no replenishment of

our water savings account.

Recharge potential and functions are impaired by the hardening and paving over of natural recharge areas, the disconnection of rivers from their floodplains, the deforestation of native vegetation, and the draining of wetlands. Therefore, to increase recharge, we must limit impervious surfaces and the wholesale conversion of native vegetation.

We must implement stormwater techniques designed to "slow it, spread it, and sink it" so that water seeps back, as a deposit, into the Earth. We must protect open space in known groundwater recharge areas. If site conditions and/or soils are not conducive to recharge, then we install proper biofiltration structures, such as rain gardens or bioswales, to help clean all surface waters prior to their discharge from the site as they are redeposited into rivers, wetlands, lakes, estuaries, and oceans.

Retain=Savings. The retention of recharged precipitation is a savings account asset. The storage of water is often the most challenging aspect of water supply management. Conservation hydrology strategies should appropriately slow water down, increasing the residence time of water storage in our watersheds. This will optimize the amount of water available.

We must avoid overdrafting our watersheds. Water should never be extracted from storage in amounts greater than what is annually received and recharged. All sources of water must not be polluted by development, wastewater systems, agricultural runoff, or industrial effluent.

To protect our water savings, we must develop water budgets for all watersheds to ensure that extractions of water do not exceed inputs of water. We must implement groundwater and surface water management programs. We must ensure that surface and groundwater quantity and quality protection programs are funded, monitored, and enforced.



A rainstorm in north central Arizona is typical on most warm summer afternoons in the area.

And we must continually defend the legally established public ownership of water as a public trust resource and resist the privatization of water.

Release=Expense. The planet utilizes many ways to release its signature element naturally to the ocean, land, and atmosphere in a process known as the water cycle. Through seasonally melting glaciers, groundwater springs, and seeps, water is returned to creeks and rivers. Solar evaporation and the evapotranspiration of plants help to form clouds and feed the cycle anew. The infinite nature of this cycle is to continually flow and be in flux as the expense of one stage produces income for the next.

Human development practices (creating impervious surfaces, channeling stormwater, etc.) tend to increase the rate and volume of stormwater's return to the ocean via excessive runoff and heightened flood discharges. This directly reduces the landscape's ability to retain water and diminishes the amount of water available for later release during the dry season, when it is most needed.

Therefore the implementation of watershed-scale conservation hydrology practices must be designed to protect reception, amplify recharge, and thus optimize retention. These are the critical steps that can ensure optimal amounts of water will be available for future release.

Watershed issues provide us with many avenues to become involved. Some solutions are small and only require making different choices as an individual or family. These can be done

today in your home or yard by using low-flow appliances, creating a stormwater harvesting rain garden, focusing on the use of drought-tolerant native plants, and installing a rainwater cistern for all irrigation and a graywater system to irrigate a home orchard. Other solutions are more complex, requiring behavioral changes in neighborhoods, communities, or cities, with broad-based participation over some years. Ideas like forming a community watershed group, or implementing habitat restoration projects, or creating watershed literacy curriculum for your local schools are projects that require more group collaboration and planning.

In order to catalyze changes in water security for future generations, we must implement a whole class of democratic opportunities for social policy change at all levels of government. Changes are necessary at the personal, public, and political levels.

On the personal level, practicing water conservation by reducing our demands for water is one of our most powerful acts, individually and collectively. Water conservation has a cascade of positive effects and can influence the overall quantity and quality of available freshwater.

Every gallon of water you choose not to use equals one gallon not taken from your river or aquifer. It means the system does not need that gallon's worth of electricity to pump it nor the chemicals to make it potable. It means that one gallon is not being degraded into "waste" water, which would require additional electricity to pump again, treat, and dispose of in our environment. Choosing not to use water saves water quantity and improves quality. It saves energy and money. It helps reduce demands on our watersheds. And it helps to mitigate climate change-induced water stresses by reducing the collective water footprint of humankind.

On the public level, we are perched on the tipping point of a "watershed moment." From the global scale to the local scale, we are faced with a multitude of issues and decisions that will determine the future world our children will inherit and how to ensure that our watersheds remain healthy in perpetuity.

Viewing your watershed as a shared "basin of relations" allows you and your neighbors to truly define the boundaries of your community and organize around meaningful issues of true and lasting local social security. Each process, like every watershed and its associated community, is unique. Oftentimes you will find that certain local, city, county, state, and federal jurisdictions are ready and waiting to collaborate with these efforts. In the absence of support from the local community, it is often impossible to achieve measurable objectives and resource management goals, especially in areas where the majority of the land is in private ownership.

And politically, when you consider the importance of water, it is essential to involve yourself in the politics of water resources. Do you know the members of your local, city, county, or regional water board? Of your irrigation district, planning commission, board of supervisors, or city council? How about your state and federal legislators? How do they make decisions? Have you ever thought about running for a local office yourself?

Sustainable Water Policies

Ultimately, lasting change will have to occur via the arenas of politics and democratic decision making. "We the People" are responsible for sane water policies and laws through our legislative, executive, and judicial branches. Metaphorically, you could conceive of these three branches as expressions of social water-

sheds. At the confluence of these three watersheds, the health of the "mainstream" is only as good as the health of each contributing watershed branch. It is our collective responsibility to make sure each branch of our democratic structure crafts adequate, supportive conditions to care for our collective water resources.

The choice is ours whether to move forward to face the challenges head on or not. We do not lack the prescient clarion call of the future or the opportunity to observe the highly degraded state of our watersheds after only a few hundred years of so-called civilized occupation. We do not lack any amount of information or practical knowledge on how to implement regenerative watershed practices.

So, what will it take to motivate us to move in the direction of mitigation and adaptation on behalf of future generations? The ecological literacy of seeing the world through the lens of our watersheds offers communities a realistic scale for feedback that is pragmatic and inspirational.

In ancient Greece, the mathematician and inventor Archimedes purportedly stated: "Give me a place to stand and a lever long enough, and I will move the world." Several thousand years later, his wise insight offers us a perfect challenge to social movement organizing: Are you willing to take a stand for your watershed community? Where strategically will you place yourselves and insert your lever against what fulcrum? If you wish to move your watershed world in the direction of resiliency, how many people can you convince to pull on the lever with you? Can you leverage the community willpower to pull on the oars of your watershed lifeboat in a coordinated manner as if your lives depended on it? It is time not just to ask the hard questions but to find the answers, because all of our lives and those of future generations do depend on it.

HOW TO HELP PROTECT YOUR WATERSHED

Household Actions

- Use low-flow appliances and fixtures
- Create a stormwater harvesting rain garden
- Focus on the use of drought-tolerant native plants
- Install a rainwater or graywater system for all irrigation

Community Actions

- Form a community watershed group
- Implement habitat restoration projects
- Create watershed literacy curriculum for your local schools