NEW MEXICO LAND CONSERVANCY

Conserving Land for Water's Sake

Fall/Winter Magazine 2021

NMLC is a 501(c)3 non-profit organization.
505.986.3801 (Santa Fe HQ)

FROM OUR EXECUTIVE DIRECTOR

Water and Land, Go Hand in Hand

Dear Friends,

Land conservation is what we do best at New Mexico Land Conservancy and, as a land trust, we find ourselves in the unique position to be on the ground with land managers and practitioners who think carefully everyday about how they care for the land and water that they are responsible for. We also know well how to work our conservation efforts into local, state and federal policy, and advocate for responsible funding towards working lands for economic and environmental benefits. Most importantly, our work to protect land with conservation easements lasts forever, and the perpetuity of an easement ensures that best practices for water, wildlife and working lands are what moves New Mexico's communities towards greater climate resilience at a grassroots level.

Land conservation helps contribute to water and climate security. When we keep properties whole through conservation easements, we can ensure that our watersheds remain whole and healthy —filtering and replenishing—and that precious, life-giving rivers, streams and other water flows are protected. We also know that wildlife and native plant communities remain intact and healthy when new development and fragmentation is restricted. Farmers and ranchers gain greater water security for their land and animals when water rights are kept legally tied to the land and can be allocated for agricultural and conservation purposes.

Our work to date has ensured the permanent protection of more than 150 miles of perennial rivers and streams, and over 1,000 miles of seasonal waterways across 341,000 acres of high conservation value private lands now under conservation easements. In conserving these lands, we have protected thousands of acres of hydric soils that filter pollution and recharge aquifers, and thousands more of grassland that is key to sequestering carbon. These are lands that are valued as productive agricultural lands, open space and habitat for people, plants and wildlife.

In each of our conservation projects, we work closely with landowners to consider the most responsible ways we can plan for the future of a property's natural and cultural resources. The ways in which we can especially improve both water quality and quantity abound. Land conservation and restoration work has helped stabilize streams from erosion, fence riparian areas from livestock, manage fragile grassland ecosystems, protect upland forests that ensure headwater stream health, limit the impact of natural gas and mining to drinking water supplies, keep irrigation water tied to agricultural lands, and conserve surface water rights for conservation benefits.

It is through the generosity, leadership and vision of the landowners and conservation partners who love their land that we have committed our work to serve the needs of our communities and our natural environment across the state and Southwest. As we look ahead to how conservation will foster future generations, we hope our work leaves the legacy that water is life and it is the strong current that will help us achieve our conservation goals for a more verdant and secure future. #

Gratefully,

J. Scott Wilber
Executive Director

New Mexico Land Conservancy
Conserving Land. Preserving Heritage.

Left: NMLC Executive Director, Scott Wilber, in the Rio Grande canyon, south of White Rock, NM

Cover photo: the East Fork of the Gila River by Clay Ellis. Magazine edited & designed by Sandra Halpin.

Words from an Award-winning World Expert on

Water

Corrales resident and author, **Sandra Postel**, is founding director of the Global Water Policy Project and is considered a world expert on fresh water and related ecosystems. She was recently awarded the 2021 Stockholm Water Prize, the 'Nobel Prize' equivalent for water, for her long and outstanding work to make sense of complex water-related issues. Her book, *REPLENISH; The Virtuous Cycle of Water and Prosperity*, contains numerous real-world solutions, including examples from New Mexico, such as the work that rancher and NMLC advisor, Sid Goodloe, has implemented on his Carrizo Valley Ranch near Capitan, NM. *NMLC thanks the author for allowing us to include excerpts from REPLIISH in this Fall 2021 Magazine, and we highly recommend reading this important and accessibly written book.*

REPLENISH
—The Virtuous Cycle of Water and Prosperity

By Sandra Postel

Water is unlike any other substance. It is always on the move—falling, flowing, swirling, infiltrating, melting, condensing, evaporating—and all the while knitting the vast web of life together. Through its endless circulation, water connects us across space and time to all that has come before and all that is yet to be. Our morning coffee might contain molecules the dinosaurs drank.

This profound connection is created by one of the most mysterious and underappreciated of Earth's natural phenomena: the water cycle. Those fifth-grade textbook diagrams never quite do it justice. We see the labels of water stocks and flows and the arrows signaling movement from sea to air to land, but never really grasp the magic wrought by two atoms of hydrogen uniquely bonded to one of oxygen. Water is the only substance that can naturally exist as a liquid, gas, or solid at normal earth temperatures.

Liquid water has wetted the Earth for at least three billion years. Today, that stock of water is finite, except perhaps for minute additions from so-called cosmic snowballs—small comets made of water that smash into the earth.

This finite supply circulates over vastly different scales of time and space. Some water molecules get trapped ultradeep within the earth, remain there for millennia, and then suddenly burst into the atmosphere through an erupted volcano. Others reside close to the earth's surface, changing back and forth between liquid and vapor as they evaporate from a lake, condense into a cloud, and fall as rain to join a river as it flows to the sea. From there, they evaporate again, and the cycle continues. Still other molecules remain trapped for centuries in glacial ice until they melt to replenish a mountain meadow and the groundwater below.

"Whenever you eat an apple or drink a glass of wine," writes astrophysicist and author Robert Kandel, "you are absorbing water that has cycled through the atmosphere thousands of times since you were born. But you are also absorbing water molecules that have only been out in the open air for a few days or weeks, after tens or hundreds of millions of years beneath the Earth's crust.[10]

. . . A Finite Supply

Almost all the water on Earth —97.5 percent—resides in the ocean and is too salty to drink or to irrigate most crops. Of the remaining, about two-thirds is locked up in glaciers and ice caps. Only a tiny share of Earth's water—less than one one-hundredth of one percent—is both fresh and continuously renewed by the solar-powered global water cycle.

Each year, the sun's energy lifts nearly 500,000 cubic kilometers (132 quadrillion gallons) of water from the earth's surface—86 percent from the oceans and 14 percent from the land.[11] An equal amount falls back to Earth as rain, sleet or snow, but fortunately for us, not in the same proportions. Wind and weather transfer about 9 percent of the vapor lifted from the sea over to the land. This net addition of about 40 cubic kilometers distilled and transferred from the oceans to the land makes its way back to the sea through rivers and shallow groundwater—what hydrologists call "runoff"—completing the global cycle and balancing nature's water accounts.[12]

That runoff is what we tap to irrigate crops, supply water to our homes and businesses, manufacture all of our materials goods, and run turbines to generate electricity. It is also the water supply for all the fish, birds, insects, and wildlife that depend on rivers, streams and wetlands for their habitats. Although the water cycle delivers that runoff each year, water is not always where we need it when we need it. Nature's water deliveries are often poorly matched with where people live or farmers find it best to grow crops.[13]

"When it comes to water, the past is no longer a reliable guide to the future."

Humanity's thirst for water

It's hard to say whether the growing demand for water and development during the last half of the twentieth century was the cause or consequence of massive hydraulic engineering. In some ways, big water infrastructure creates demand for its product: if you build it, they will come—and consume. To no small degree that is what happened.

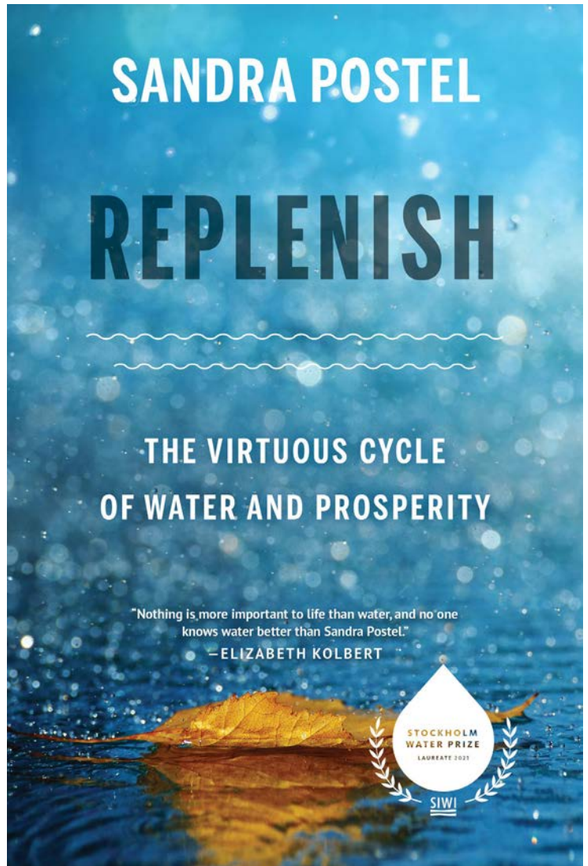
Around the world, humanity's thirst for water grew along with the big dams, canals, and material consumption made possible by control over water. It takes water to make everything—from computers to burgers and blue jeans. Because crops transpire so much as they grow in farmers' fields, our diets are particularly water intensive. In fact, every day we "eat" a thousand times more water than we drink.[21] Totaling it all up, it takes nearly 2,000 gallons of water a day to keep the average American lifestyle afloat. About half of that water is hidden in our diets, a third in the energy we use for travel and to heat and light our homes, 5 or 10 percent in the materials goods we buy, and the remaining 5 or 10 percent for household activities such as bathing, cooking and watering our gardens and lawn.[22]

In some ways it's hard to imagine our world of 7.5 billion people and $80 trillion in annual goods and services without water engineering—dams to store water, canals to move it around, and vast pumps to tap underground supplies. But it's equally hard to imagine continuing down this same path.[25]

The blocking and diverting of rivers is not the only way we have broken nature's water cycle in the pursuit of economic progress. Groundwater depletion has more than doubled since 1960 and is now widespread in many of the worlds' most important food-producing regions. The disconnection of rivers from their floodplains has reduced groundwater recharge, the natural cleansing of river water, as well as habitats crucial for birds and fish. Rivers bearing high loads of nitrogen from fertilizer runoff that wetlands might otherwise absorb instead contribute to the creation of more than 400 low-oxygen dead zones in coastal bays and estuaries around the world.[29]

For the last two centuries, we have been trading nature's services for engineering services. Instead of floodplains controlling floods, we build dams and levees to do that work. Instead of healthy watersheds and wetlands cleansing our water supplies, we build filtration plants to provide that service. For the most part, we viewed this substitution of technology for nature as a sign of progress. It gave society more control over water, opened up new lands for development, and spurred economic growth.

But a different view of nature gradually emerged. Natural ecosystems, when healthy and functioning well, are vital to the economy. Watersheds, wetlands, floodplains and river systems constitute a class of infrastructure doing valuable work, just as dams, canals and treatment plants do. Assessments led by economist Robert Costanza showed, for example, that the ability of freshwater swamps and river floodplains to store water, mitigate floods, and break down pollutants delivered annual benefits to the economy averaging some $13,000 per acre, expressed in 2016 dollars. It was foolish to continue to bulldoze, dike and drain away these services as if their value were zero.[36]



Lastly, and perhaps most importantly, changes in weather patterns and water flows that we're beginning to see as the planet warms call into question the very assumptions that have underpinned our water projects for decades. In 2008, seven top water scientists argued persuasively in the journal Science that "stationarity"—the foundational concept that hydrological systems vary and fluctuate within a known set of boundaries—is dead. When it comes to water, in other words, the past is no longer a reliable guide to the future.[37]

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Sandra Postel. Photo by Cheryl Zook/National Geographic

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Working with Nature

We are living in uncertain times. How then do we protect public health and safety, ensure food security, and manage risk? When the floods come, will the levees hold? With more severe droughts likely, will the reservoirs refill? Will massive amounts of sediment eroded from mountainsides by intense rainstorms fill a new reservoir with sediment and cut short its useful life? Will farms get the irrigation water they need once the glacier-fed river flows have dwindled? How do we plan for what once seemed unthinkable—the disappearance of prime water sources for cities, industries, and farms? In short, how do we live with these new realities?

Decades ago, Albert Einstein reminded us of a fundamental lesson that's hard to learn: "we can't solve problems by using the same kind of thinking we used when we created them." Fortunately, just when it's crucially needed, a new mind-set about water is taking shape. It's one that blends engineering, ecology, economics, and related fields into a more holistic approach that recognizes the fundamental value of nature's services.

This evolving mind-set is already changing the way we manage water. Working with, rather than against, nature, pioneering cities, farmers, businesses, and conservationists are rejuvenating watersheds and floodplains, and replenishing rivers, groundwater and soils. The result is a smarter way to mitigate flood damages, prepare for droughts, restore habitats, grow food, augment water supplies, and generally strengthen water security. **Investing in a healthier water cycle, it turns out, may be the best insurance policy money can buy in this century of rapid change.** #

NOTES

[10] Kandel, *Water from Heaven.*

[11] *One cubic kilometer is the volume of a cube 1 kilometer long, wide, and deep. It equals 1 billion cubic meters or 1 trillion liters. In standard US usage, the equivalent is 264 billiion gallons.*

[12] The components of the global water cycle are estimates and vary to some degree by source. I used the approximations published in Jackson et al., "Water in a Changing World."

[13] UN Food and Agriculture Organization, Aquastat Database; Population Reference Bureau (PRB), "2015 World Population Data Sheet."

[21] Water Footprint Network (WFN), online product gallery at waterfootprint.org. WFN is based in the Netherlands.

[22] National Geographic Society, Water Footprint Calculator, Methodology and Tips. Our team used the best data we could find for each major water-footprint category, but the results are only approximations of one's actual water footprint.

[25] Interception of river flows from Vörösmarty and Sahagian, "Anthropogenic Disturbance of the Terrestrial Water Cycle"; 100 billion tons from Syvitski et al., "Impact of Humans on the Flux of Terrestrial Sediment to the Global Coastal Ocean."

[29] Diaz and Rosenberg, "Spreading Dead Zones and Consequences for Marine Ecosystems."

[36] Costanza et al., "The Value of the World's Ecosystem Services and Natural Capital." This study's valuation estimates were expressed in 1994 dollars; I used an inflation calculator to express their estimate of $19,580 per hectare in 2016 dollars.

[37] Milly et al., "Stationarity Is Dead: Whither Water Management?" #

How Soil and Land Management Influences Water

When we hear someone described as a "water manager," we most likely imagine that person operating a dam, running a treatment plant, or piping drinking water to a city or town. Rarely do we conjure up a farmer or rancher. But those who work the land for a living manage what is arguably the most underappreciated yet vital component of the water cycle —that precious band of Earth we call **soil.**

The world's soils hold about eight times as much water as all rivers combined. This soil reservoir is the principle water supply for forests, rangelands, and croplands; how much water it contains will dramatically influence our food security in the coming decades. On average our diets require about 1 liter of water per calorie. Plants lift water from the soil and use it in the miraculous process of photosynthesis, whereby sunlight converts carbon dioxide and water to carbohydrates and oxygen. Photosynthesis is the foundation not only of global food production but also of terrestrial life—and without sufficient water in plants' roots it cannot occur.[2]

Today, a quiet revolution is taking place in our understanding of that soil reservoir and how land management influences the volume of water it holds. A growing number of scientists, research institutions and government agencies, farmers, and ranchers are realizing that to feed 9 billion people, we must farm and graze livestock in a way that regenerates soils. New methods, if taken to scale, can also sequester vast amounts of carbon in the soils, fighting climate change even as they build resilience to its effects.

—Sandra Postel, from *REPLENISH*; chapter 6, page 108.

[2] One liter per calorie from Molden, ed., *Water for Food, Water for LIfe: A Comprehensive Assessment of Water Management in Agriculture*, 5; eight times from Shiklomanov, "World Fresh Water Resources."

Santuario Nuevo

—*Preserving Northern New Mexico's Land Heritage*

With its spectacular mountain views, clear skies and multiple opportunities for outdoor recreation, including a world class ski resort, the Taos area in northern New Mexico is experiencing increased development pressure due to its appeal as a second home or retirement destination. Rural land prices are appraising at high-end residential rates, and water resources are being sought for new home construction. As a result, smaller family-owned farms are beginning to vanish from the area as property values rise along with land taxes, and agricultural enterprises are harder to support. The temptation to "cash in" on the development wave becomes irresistible or even mandatory for some landowners, and the scenic open space and green farmland gives way to fields of luxury homes and condominiums with more roads, rooftops and other impervious surfaces.

Landowner Holly Difani recognized these signs of increasing development and determined that a conservation easement, completed by and donated to NMLC this September, was the best way to preserve the agricultural heritage and scenic beauty of her 19-acre property, aptly named Santuario Nuevo. Located in El Salto near the village of Arroyo Seco and the road to the Taos Ski Valley, the property is bordered by private land to the north, west and east, and by Taos Pueblo to the south.

Water is a significant aspect of Santuario Nuevo. The Arroyo Seco runs along the southern boundary and together with two ponds, provides critical riparian habitat for a variety of wildlife species. A historic acequia, the Temporales Ditch, runs adjacent to the northeast corner of the property and provides water for irrigating the property's hayfields. The easement now ensures that this verdant sanctuary is preserved for posterity. NMLC greatly appreciates being the land trust chosen to be the recipient of this easement which exemplifies so well northern New Mexico's agricultural land heritage. #

Where the Water Goes

—The legacy of water in land conservation

By Claire Catlett

I have likely walked hundreds of miles of streams—dry and wet—across the Southwest and its borderlands, where water once ran its course to carve out canyons and wash the mountains to the sea. The desert soils and playa formations here remind us that great lakes and seabeds once gathered watery habitats for primordial life. And whether I am walking deep in a canyon or looking out across a great ancient floodplain, I can't help but feel like a small piece of this greater story of how water defines us.

Our human communities have always established themselves around the mouths of rivers, inlets at bays and at mountain and desert springs. How a watershed is defined is where a high point in a landscape drains to a low point, and waters from higher ground flow into perennial and intermittent streams that are the domain of a watershed, or hydrologic basin. In New Mexico, we are defined by the Rio Grande, Colorado River, Arkansas River and a portion of the Texas Gulf as the main watersheds where all the state's land—some 121,298 square miles—drains to one of these four major regional basins. *(see sidebar below)*

The rivers and streams of New Mexico have long supported life in the desert by way of their riparian areas, wetlands, springs and playas that naturally fill with water, filter pollution, store local groundwater and recharge aquifers. These are the systems that also are important wildlife corridors for migration, as well as year-long habitats for rare and important plant and animal species.

Our flourishing as civilizations, too, has long been defined by the availability of water within our watersheds and by the seasonality of flows. Water is life for us all, and being elemental in nature, begets that it is both water quantity *and* quality that are essential to our thriving.

Here, in the arid Southwest, most of the water we know is not on the surface. Only 0.2% of our state's total land area has any surface water at all, making New Mexico the nation's most dry state, followed closely by Arizona (0.3% surface water area). We greet our clouds in the sky each monsoon season knowing that their rainfall will be a temporary relief, but that our best hope for "a good water year" will be the snow that comes later in the winter months. What water seeps underground is what sustains us, as many communities, farms and industries rely on groundwater for their livelihood.

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New Mexico's Four Major Watersheds

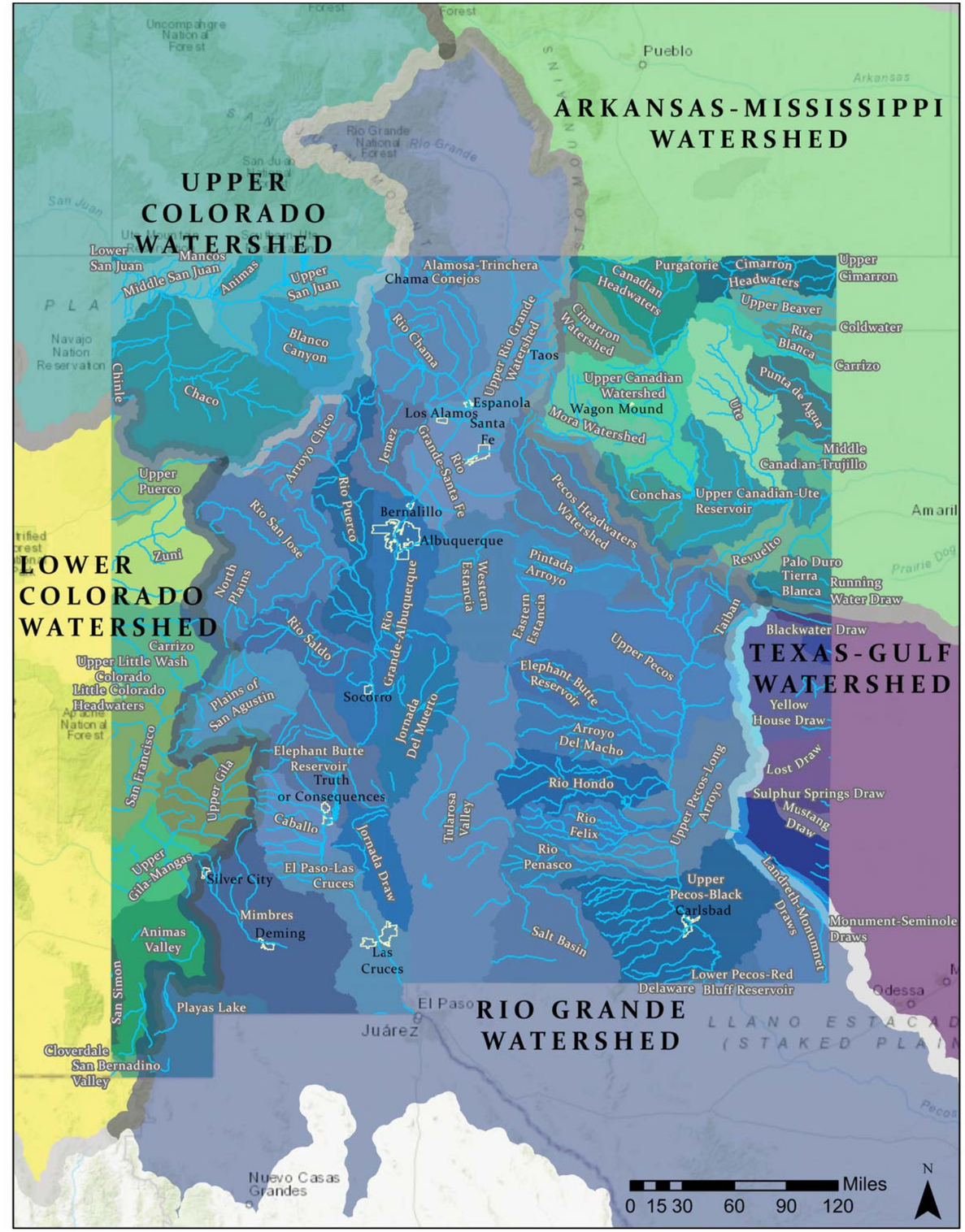
As one of the largest watersheds in the United States, the **Colorado River** combines the waters of California, Nevada, Wyoming, Colorado, Arizona, New Mexico and Mexico (a total drainage area of 246,000 square miles) into the Salton Sea and the Gulf of California. Major rivers that are tributaries within New Mexico include the San Juan, Rio Puerco, San Francisco and Gila Rivers. Water use for the Colorado is primarily hydroelectric, irrigation, and inter-basin transfers (for cities outside the basin including Denver, Salt Lake City, San Diego, Los Angeles, Albuquerque and Santa Fe). Only about 5 percent of the Colorado River's total water is used for public and domestic water supply within its own watershed.

Our beloved **Rio Grande** has its headwaters in the Colorado Rockies and travels 1,901 miles to the Gulf of Mexico, draining some 335,000 square miles of Colorado, New Mexico, Texas and Mexico. The Rio Grande serves also as the US-Mexico boundary for 1,255 miles. Major tributaries include the Pecos River, Rio Puerco, Jemez River, Santa Fe River, Rio Chama, Rio Hondo and Rio Salado. Currently, about 75% of the water of the Rio Grande is diverted for agriculture. While many cities on the US side of the Rio rely on a mix of groundwater and surface water resources (including the Colorado River via the San Juan-Chama River's Buckman Diversion project) to supplement municipal water supplies, Mexican border communities face greater water scarcity due to rapid population growth and industrialization throughout the Lower Rio Grande River valley.

The **Canadian River** is the longest tributary of the **Arkansas River** in the country, taking the New Mexican flows of Ute Creek, Dry Cimarron River, Mora River and the Purgatoire River downstream and eventually emptying its waters into the Mississippi River. While the high plains of northeast New Mexico are marked by arid weather patterns, the landscape here is defined by ancient seabeds that long ago left rich sediments that now form playa-lake features.

Playas are relatively small, round, shallow depressions that collect and hold water from rainfall and runoff, creating temporary wetlands. In drier times, these sensitive wetlands can hold water for weeks that benefits wildlife and livestock. Playas also play an important role in replenishing local water supplies and recharging aquifers at a much higher rate than other areas.

The **Mimbres River** basin is one of only a few closed basins in North America, meaning that the waters of the river end in the desert of Chihuahua, Mexico. With about 5,000 square miles of drainage area that includes Grant, Luna, Doña Ana and Sierra Counties, this watershed namely functions as a recharge zone for local groundwater aquifers, due to the permeability and structure of the region's soils and geologic features. In fact, the only major source of surface water for the Mimbres River is the Mimbres River, whose headwaters start from mountain springs and snowmelt in the Black Range. #



Watershed Map by Claire Catlett

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Surprisingly, as technology has advanced engineering for wells, pipelines and massive reservoirs, some of these tools are beginning to fail from over-reliance. It is increasingly difficult for our human communities to facedown the reality of a changing climate without continuing to use such tools for our collective water security. Yet, the over-allocation of surface water rights, depleting aquifers and changing rainfall patterns have us looking less at the sky for answers, but at our neighbors and ourselves.

In a recent conversation with a friend whose family has ranched in eastern New Mexico for nearly five generations, I learned that her family has noticed over time that it is not the presence of water that defines how they live and work their land, but the **absence** of water. Every bit of grass that grows, every rock that stands and every cliff that hangs over the edge of an arroyo shows that water once was here, now is gone. How we cultivate the land to receive water and store it for those harder, hotter and drier days is what sustainability looks like on the ground for working lands.

Where Land and Water Conservation Intersect

In reading the news, it seems that we are running out of time to deal with the types of existential questions and fundamental change necessary to advance western communities towards greater water and climate security. In 2019, the State of New Mexico launched an interagency Climate Change Task Force that supports interagency work to reduce greenhouse gas emissions from electricity generation, transportation, industry, the built environment, and natural and working lands. And in 2020, the state began developing a comprehensive plan specifically to address the impact of climate change on New Mexico's water supply over the next 50 years.

These are steps in the right direction and engages our state leadership across agencies to focus on climate resiliency and adaptation strategies that embrace renewable energy, energy efficiency, carbon sequestration, land conservation, and urban and community forestry solutions.

Watershed protection efforts can take hold on wild and working lands alike when we build erosion control structures and stabilize streambanks, construct wetlands and playas, re-forest riparian areas and uplands, and keep prairie grasslands intact. Hopeful signs of a more verdant future can be seen in our cities and towns as green infrastructure of backyard raingardens, bioswales and bioretention facilities. In all of these practices, we are enhancing our environment by practicing the art of bio-mimicry, which is to say, we are learning to help nature do what she does best.

Still, many of our communities have yet to comprehensively address water as a critical piece of climate security, and often, it is individual landowners and citizens who find themselves leading by example towards sustainable communities and environments. Climate security depends on healthy, functioning watersheds, and it is here, at the intersection of land and water conservation, that drives how we, at the New Mexico Land Conservancy, work to effectively steward our environment and preserve New Mexico's land heritage for future generations. #

Claire Catlett recently joined NMLC as Stewardship Manager. (See bio on page 23.)

Telling the Story of an Invisible Resource

By Kate Zeigler, PhD, CPG

On the High Plains of northeastern New Mexico, we have very little surface water, even in good years. Dirt tanks have an unnerving tendency to go dry as the drought drags on, as do creeks and streams. Even the Canadian River suffers. And, as this has long been the case out here, we rely primarily on groundwater to keep our farms and ranches going. But this resource is diminishing. Wells are failing and folks are having to drill deeper to seek alternative water sources or abandon areas altogether. Given that groundwater isn't something we can lay eyes on and track like we can our dirt tanks, how do we know anything about this most precious resource which is the backbone of our food supply system?

Geohydrology is the study of these aquifer units that combines hydrologic data (water level measurements, data about water quality, flow rates, etc.) with geologic data. One of the key pieces of information that geology provides for understanding groundwater is the story of the rock record under the ground. As sediments were deposited and slowly transformed into rocks, the region was subjected to mountain building, erosion, faulting, the emplacement of volcanic features, and many other events that each added their own fingerprint to the story of the landscape recorded by the rock record. Each rock unit is unique—some function as aquifers and some serve as barriers to water migration. Understanding the story helps us understand why each well functions the way it does in terms of both quantity and quality. If you think about each layer of rock as the pages in a book, a geohydrologist is trying to read that book to understand why the water is where it is and why it behaves the way it does.

In addition to the bigger picture story told by all the different layers of rock, it's important to understand the physical and chemical characteristics of groundwater, which relate directly to the rock units that host it. An aquifer is defined as a material that is porous and permeable enough to store useable quantities of water. However, the idea of underground "oceans" or "streams" isn't quite what's going on down there. Groundwater is stored in the pore spaces between the grains in some rock types or in fracture systems, but not in cavernous spaces (unless you live over a limestone-hosted aquifer, which is an entirely different beast). Note the italics for "useable" in our definition—what's useable to you? A 5 gallon per minute (gpm) well can be sufficient for a small herd of cattle, especially with thoughtful development of pipeline and storage tank systems. But how about for a large city? The concept of an aquifer is (forgive the pun) a fluid thing that very much centers on the needs of the area.

However, the most critical question that needs to be answered is: what is the potential lifespan of the aquifers on the western High Plains? Can we continue to punch holes in the ground, searching for and using this invisible resource?

Isotopic data from northeastern New Mexico and southeastern Colorado suggests that there are effectively two groups of groundwater resources in the area: shallow and rechargeable as well as deeper and non-renewing. Shallow groundwater resources tend to be alluvial deposits adjacent to drainages where surface water can recharge the system, whereas the deeper groundwater sources are located farther from these points of potential recharge and are often geologically isolated with water found 100 feet or more below the surface. An added problem with searching ever deeper for more water is that the quality of the water in deeper aquifers is often so poor as to be unusable. So deeper is not going to be the solution to aquifer depletion.

With seemingly endless drought and the resulting lack of surface water, the shallow aquifers are faltering, leading to an ever-increasing reliance on the deeper aquifers that are not recharging in a meaningful way. Many ranchers and farmers are utilizing storage and pipeline systems to move water around, installing timers and floats to manage every drop leaving the well, turning wells off when an area is no longer in use, and working to restore soil health to begin to restart the shallow hydrologic cycle. At the end of the day, however, if there's no significant precipitation to help revive our surface waters and seep down to replenish the shallow aquifers, it's nearly impossible to survive. We tend to zone out when driving through the agricultural heartland of America, but what will happen to the groceries we buy or the food on our plates in restaurants when the foundation crumbles from a lack of water? And perhaps less obvious, what will happen as urban areas, with their enormous water needs, encroach into an area with a subsurface that simply can't handle the demand?

One of the most common phrases in the West is "take care of the land, and the land will take care of you." Equally important is the need to take care of the water, both surface and groundwater. Rural agricultural communities are the lifeblood of the West and hold long, deep traditions stretching back centuries. To lose these ways of life would be devastating for the region, but will also deal a blow to the foundation of our food supply system. Understanding aquifers is a critical step to preserving agriculture's heritage of landscape stewardship, and requires learning to manage a resource we can't see. Punching more holes will only get us so far and continues the trajectory of permanent depletion of groundwater, but in no way solves the greater problem. It is well past time for a call to collectively husband every drop of our invisible, and most precious, resource.

Understanding aquifers is a critical step to preserving agriculture's heritage of landscape stewardship

* * *

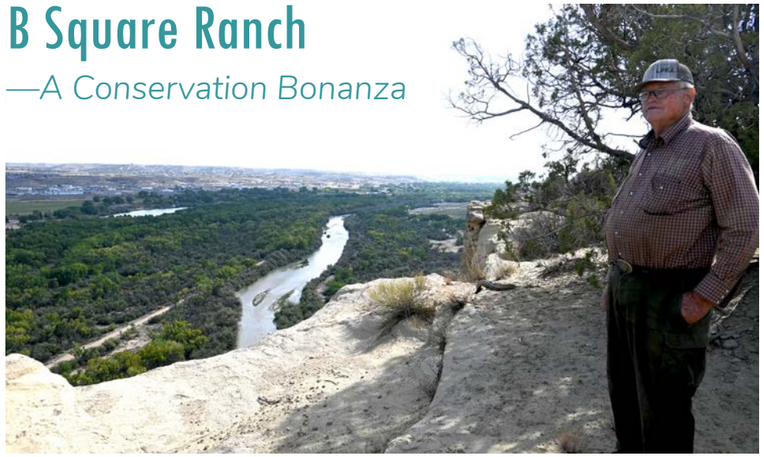
Kate Zeigler is the Senior Geologist at Zeigler Geologic Consulting, LLC, which spearheads groundwater monitoring research projects for Soil and Water Conservation Districts and individual agricultural operations in northeastern New Mexico, southeastern Colorado and western Oklahoma.

In addition, her team supports members of the High Plains Grassland Alliance (HPGA), a nonprofit consortium of landowners and managers in northeastern NM who meeting regularly to share experience and improve their knowledge of conservation-based land and water management. To learn more, visit www.highplainsalliance.org. Kate's email: zeiglergeo@gmail.com

An abridged video of a Kate Zeigler workshop on geohydrology in northeastern NM, is available on our New Mexico Land Conservancy Youtube channel. #

B Square Ranch

—A Conservation Bonanza



The B Square Ranch in San Juan County near Farmington, NM is nothing shy of a conservation bonanza!

Now protected from subdivision and further development by two conservation easements completed by and donated to NMLC by landowner Tommy Bolack this past September, the 12,451-acre property covers an array of conservation values—cultural, archaeological, agricultural, wildlife habitat, water resources and scenic open space.

"I have other conservation initiatives in place already," said Tommy. "The conservation easements go hand in hand with what I want to have happen, so it's a double whammy for conservation. I am relieved to know the ranch will now be protected after I'm gone."

The B Square Ranch is Tommy's legacy, the result of a lifetime of cultivating, expanding and improving upon the humble beginnings of the first 80-acre tract his father, Tom Bolack, bought in the 1950s when Tommy was a boy. Over the years, through various land swaps and purchases, the B Square has grown into a thriving agricultural enterprise and a haven for wildlife, featuring six miles of the San Juan River, seven small lakes and more than 1,500 acres of natural bosque habitat along the riverfront that support an estimated 60,000 migratory birds and waterfowl during the winter months. Several hundred acres of irrigated fields and open-water wetlands also contribute to what Audubon New Mexico designated as one of New Mexico's 63 "Important Bird Areas" in 2020.

Significant pre-Colombian cultural sites on the ranch have been used for research for decades through the Anthropology Department at San Juan College in Farmington. The ancient Anasazi or Puebloan people favored the San Juan river valley because it afforded excellent access to water and fertile agricultural lands, prime hunting grounds along the river corridor as well as the defensive protection of the cliffs and uplands flanking the valley.

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Photos: top, B Square Ranch includes approximately 1,500 acres of irrigated agricultural land, 7 lakes, and 6 miles of the San Juan River. The City of Farmington can be seen extending to B Square's boundary. Bottom left: Research is conducted on the significant Pre-Columbian sites on the ranch through the Anthropology Departrment of nearby San Juan College. Tommy's Bolack Electromechanical Museum, features one of the world's largest collections of glass insulators (one of several display cases pictured here).

B Square Ranch (cont.)

Tommy established a nonprofit 501(c)3 foundation, which upon his death, will assume management of the property—including the agricultural operation, the Bolack Museum of Fish and Wildlife and the Bolack Electromechanical Museum—with specific management parameters spelled out in detail to ensure that the conservation values of the ranch are maintained.

"I may not have my own posterity," said Tommy, who has no immediate heirs, "but there is a larger posterity, and I leave the ranch to that future."

From high up on the bluffs overlooking the San Juan River and the irrigated farmland on the B Square, it is easy to see the City of Farmington, population 43,200 and growing, nudging right up to the ranch boundary. "I envision the B Square someday like a Central Park in the middle of all the development and chaos," Tommy said.

Tommy's business model for growing and managing the ranch is firmly rooted in mixed use with conservation always at the forefront of his decision making. His agriculture operation consists primarily of cattle and alfalfa, and Tommy propagates game birds including his prize Rio Grande turkeys, a species he reintroduced on his ranch and that now thrives throughout San Juan County.

Under the conservation easements, the property will continue to be managed for farming and ranching. The agricultural component is important because it provides much-needed supplemental forage for migratory waterfowl during their winter stopovers.

Historically, portions of the ranch have also been used for fossil fuel production, although this activity has now significantly diminished. Notwithstanding, responsibly managed oil and gas leases have represented a critical revenue source for the large, multi-use property. It was NMLC's overall assessment that the full spectrum of natural, cultural and scenic conservation values on this property far outweighed and had not been significantly impacted by the relatively small portions of the land devoted to extraction.

At the heart of his decision to put his legacy ranch under conservation easements, Tommy said, "We are artists of the earth—we have a mandate to protect the natural resources from which we draw life."

NMLC's Executive Director, Scott Wilber, said "The permanent conservation of the B Square Ranch will be a tremendous asset for the people of San Juan County and the state of New Mexico, and we applaud Tommy for his vision and generosity." #

Bluewater Creek

Keeping the Water on Bluewater Heritage Ranch

Keeping the water on the Bluewater Heritage Ranch is more than a land management strategy for the Nielson family—it's a passion. Russ Nielson has been a student of soil health for many years and his enthusiasm for improving the 7,500-acre property, conserved under two conservation easements held by NMLC, has been a contagious labor of love that his spouse, children and grandchildren have all embraced. During frequent family gatherings on the ranch, family members are as happy to help build Zuni bowls, rolling bars and other erosion control measures as they are about fishing, hiking and hunting.

Zuni bowls are rock structures placed in incised arroyos to build sediment back, retain water, and eventually build healthier soils and restore vegetation. You can't walk very far on the Nielson's ranch without coming across one of the hundreds of Zuni bowls throughout the property.

Equally prevalent are more than 150 strategically placed rolling bars and diversion channels along the two-track roads throughout the ranch, constructed with the help of Steve Carson. Rolling bars—mounds of road material built up like wide, dirt speedbumps, spaced every 300-400 feet or so along the road—help slow down and redirect water. Diversion channels—short trenches that curve up and away from the road at the rolling bars—further help move the water off the road where it can then infiltrate into the soil instead of flashing out of the system and eroding roads on its way out.

It appears that all the Nielsons' hard work is paying off. Despite the ongoing dry conditions, the ranch was "*really* green this year," Russ's wife, Mary, exclaimed. Blue gramma grass is prevalent and bare ground between vegetation is limited to no more than a few inches throughout the property. The metrics on the ranch are extremely important to Russ and his family and they are continually collecting data, whether it is downloaded from their state-of-the-art weather station or hard-sought transect data collected from their numerous vegetative plots dispersed across the ranch.

Russ also invests significant time and resources to restore and maintain Bluewater Creek that runs through the property for three-quarters of a mile. A few years ago, he planted 200 cottonwood trees near the creek, "but the beavers got them all," Russ said, adding, "beavers just doing what beavers do, I guess. It took me awhile to get over it."

Not to be deterred, this past spring, Russ planted 300 more cottonwoods and willows closer to the creek bed and built tall, sturdy, fence cages around each one to protect them from the beavers. "This time, it wasn't the beavers," Russ said. "The drought took a lot of them." But some saplings remain and despite the lack of water in the creek this year, the riparian habitat that Russ and family have worked hard to restore remains lush and green.

Like many ranchers, Russ is concerned about a prolonged drought, but he's all the more grateful to have taken so many preemptive measures to make the most of what water **does** come each year.

At NMLC we are thankful that the Nielsons chose our organization to help permanently preserve their working legacy ranch along with all the family's incredible restorative efforts. #

Right: Russ and Mary Nielson measure transects together this fall.

Getting the Water off the Road!

By Steve Carson

Road into the Nielson family's Bluewater Heritage Ranch near Grants, NM (see previous story on page 15).

Noted wildlife biologist and surface hydrologist, Bill Zeedyk, has observed that, "Roads are the biggest impediment on our watersheds. They concentrate and divert water, dewatering one area and causing erosion in another. Plant vigor suffers, soils are washed away and sediment fouls our water courses." Aldo Leopold made the same observations in his survey of New Mexico and Arizona in the early 1900s.

In conducting numerous watershed condition assessments over the years, primarily using the criteria set forth in Watershed Assessment of River Stability and Sediment Supply (WARSSS), II Edition Rosgen 2009, roads generally come out on top of the list of situations within the watershed that are contributing to watershed instability and an increase in sediment supply into our river systems. The damage created by roads to our watersheds and their surface hydrology is unprecedented to any other anthropogenic activity in the arid Southwest. Couple the effects of roads with the impacts of poorly managed grazing and livestock trailing in past years, and we now have a landscape that is completely changed from what it was 200 years ago.

Since the negative effect of roads on watershed stability has been well documented, it is a forgone conclusion that the condition of many miles of low-standard roads in the Southwest needs to be addressed. Since road drainage is very cost-effective per mile treated and per problem solved, it should then be one of the first treatments conducted in the pursuit of restoring watersheds.

Losing water to the road . . .

Over the years I have personally installed over 7,000 drainage structures across more than 700 miles of roads from West Texas, across New Mexico and all over Arizona. The problem is the same in all locations, as is the solution: to reengage the water back onto the watershed. My working motto is: "It's not a road problem—it's a water management problem."

Roads collect, concentrate and divert the original natural surface flow-patterns within our watershed. This concentration and diversion of flows takes water out of one micro watershed and diverts it into another. The first micro watershed is de-watered and the plant vigor and species diversity is reduced. The second micro watershed is overloaded with the additional flows causing erosion, down-cutting and accelerating sediment contribution into the mainstem system.

Sediment has been identified as the number one water pollutant in our western river systems. It creates geomorphic channel evolution by increasing deposition on point bars, transverse bars and mid-channel bars that accelerates stream bank erosion, which, in turn, contributes more sediment into the system. This sets up an insidious chain reaction that overloads the entire system with sediment and creates mass erosion. This overload of sediment plugs up irrigation works and costs millions of dollars a year to filter out of the water supply so it can be used in municipal water systems. Also, new road construction and the subsequent land disturbance allows noxious weeds to colonize, and the asphalt emulsion and other toxic materials such as the oils used to reduce dust get into our waterways after a rain or snow runoff event.

Slope or No Slope, Drainage is key

When planning solutions to restore and stabilize watersheds, the proper drainage of the road systems will make a significant contribution toward reversing the downward watershed trends and restoring the natural surface hydrological patterns. Road drainage systems are also one of the most cost-effective ways to restore watershed function and decrease erosion and sediment contribution into the overall system.

Two main factors drive the erosion process on roads: 1) the amount of water that is discharged on the road surface (length and width of road) coupled with the amount of time the water is allowed to run down the road surface, and 2) the slope of the road. The first factor, discharge, we can effectively address by aggressively draining the road surface. The second factor, slope, we are generally less able to change due to the topography and/or the cost to reroute the road.

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If the volume of water on the road surface (discharge) remains the same but the slope is doubled (from, say, 2% to 4%), the ability for the water to move surface materials is four times greater and the size of particles the water can move is increased by eight. Hence, the need for more and better drainage features, especially, as the road slope increases.

By the Numbers

Why is harvesting water off roads important? Let's do the math: a 10 foot-wide ranch road, one mile long, will collect 31,200 gallons of water in a 1-inch rain event. Reduce this amount of water for infiltration and evaporation by 20% and now there are 25,200 gallons of water being discharged on each mile of road per one inch of rain. With 14 inches of annual precipitation, each mile of road will collect and discharge 352,800 gallons (1.08 acre feet) of water per mile in one year. Using 20 miles of road (+/- the average miles on a 10,000 acre ranch in NM) = 7,056,000 gallons (21.65 acre feet) that is being discharge off the road surface only in one year. If the water that runs onto the road from the adjoining landform is included, this number can be multiplied by five, which equals 35,280,000 gallons or 108 acre-feet per year of water to be managed off the road. This is an astonishing amount of water that if property redirected off the road can be put to beneficial use. This, in many cases, exceeds the legal number of water rights a ranch may own.

In the practice of road drainage systems in the Southwest, the design and installation of road drainage features needs to be aggressive to be effective, meaning, it's better to err on installing too many drainage features than not enough. Many practitioners after completing a road drainage project and monitoring it for a year have come back with the conclusion, "I wish I would have read the landscape better and installed more drainage. I still have problems that need to be addressed." Also, you need to ensure that a good amount of materials are used in each drainage feature. This will guarantee that the drainage feature will stand the test of time and need very little or no maintenance in the future. The drainage features also need to be constructed so that they drain properly, and do not create a mud puddle or scour out.

When Roads Cross the Water

Road stream-crossing locations can be very problematic and a source of ongoing maintenance cost especially during the monsoon season. The scouring out of the channel-crossing that leaves an elevated drop-off can be easily rectified by placing a boulder grade-control structure on the downstream side of the road crossing. This structure can be in the form of a One Rock Dam, Rock Arch Dam or a Rock Cross Vane. A channel-crossing road should always cross the channel at a right angle.

In some cases, the road runs in a down-valley direction once it crosses the channel and is on the first-terrace elevation (flood plain). A road on the flood plain can lead to what is called "capturing of the flood water." This occurs at high flows and the floodwaters get caught or "captured" in the roadway. This results in the road being washed out and, in some cases, the primary streamflows are rerouted down the roadway. There are a couple of solutions to remedy this situation. The road could be realigned so it crosses the channel at a right angle and immediately climbs up to an elevation that is above the active flood plain. Another remedy is to plug the road at the terrace elevation with a drive-over plug/dike, much like a Rolling Dip. This will divert the floodwaters back into the channel and keep it from being "captured in the road."

Photo of a classic legacy road erosional disaster in Cebolla Canyon south of Grants, NM. The road most likely started in the 1920s, when homesteaders moved to the area. The road crossed a small ephemeral stream channel up a valley and the stream was captured in the road—a very common scenario. Since the road went straight down the valley its gradient/slope was steeper than the stream channel, causing the water to run faster, down-cutting the channel. There is no fix for this other than, if possible, to plug the upper end and put the water back into the original channel.

Other Considerations. . .

Other considerations are the amount and classification of roads within any given management area. Questions the land manager can pose are: Do we really need all the roads that we currently have? Can some of them be left in place, but classified and only used for fire control or big game retrieval, etc.? Can some of the roads be permanently closed, such as double access to the same location? By reducing the number of roads within any land management area we can reduce the cost of road maintenance, erosion and increase the amount of vegetation and forage.

Landowners today must think of themselves as water managers as well as land managers. Road redesign and maintenance are long-term investments landowners can make to maximize the benefits of the precious water they do receive each year. As a side note, conservation easements such as those held by NMLC help protect that investment and support watershed resilience by preventing future subdivision and development and all the associated, additional road work. And, for conservation purposes, easements strictly limit the amount of new roads that can be constructed, even after a property has changed hands.

Same Problem, Same Solution

This type of road drainage and water harvesting can be applied to any dirt, gravel road. We have successfully installed these systems on everything from a simple two-track ranch road to a 30-foot-wide county road with traffic running at 45 miles per hour. This practice has also been used on driveways and rural residential driveways/roads that may be a quarter-mile or more to access the residence.

There are many lifetimes of problematic roads to be drained across the West, so our work is just getting started. At 71 years of age, I am still getting on the bulldozer and fixing roads, but my days are numbered. My focus now is to train others to effectively get the work done.

My simplistic conclusion about the effects of roads on watersheds is this: "Different location, same problem, and same solution—get the water off the road ASAP!" #

* * *

Steve Carson is a surface hydrologist and fluvial geo-morphologist practitioner. He has personally designed and constructed road treatments on projects that encompass all ecoregions within the Southwest, ranging in elevation from 1,500 feet to 10,0000 feet above sea level. He can be reached at: rangehands@gmail.com

The history of modern roads in the arid Southwest started with the first Spanish carts with their crude wooden wheels that cut ruts across the arid landscape. The next set of wheels to follow had steel rims and were introduced via the Santa Fe Trail. The ruts cut by the pioneers' wagons can still be seen today and many of them are now arroyos, 20-foot deep. The steel-wheeled wagons traversed every corner of the West that could be driven over or where a primitive road could be constructed. In many cases the arroyos and gullies we now see are a legacy of these old wagon roads and trails, especially in the valley bottoms where it was the easiest place to travel in a horse-drawn wagon. The ruts in the valley bottom converted the original [water] sheet-flow to a concentrated flow. Once the water was trapped in the ruts the velocity was increased enough to down-cut the ruts to the point that there are gullies today that are 20 to 30 feet deep.

The advent of the automobile exacerbated the scenario. Many of the original auto routes followed the same path as the wagon roads. When a road washed out or gullied out to the point it could not be traversed, the road/wheel ruts were just moved over a bit, and another route was carved out. This scenario can be observed at many locations where there are parallel gullies and/or parallel washed-out roads.

The post World War II era brought us a barrage of heavy earth-moving equipment. The bulldozer was the tool of choice for building all road systems, but especially useful in building low-standard county, ranch, logging and mining roads. Between 1945 and today there have been tens of thousands of miles of low-standard roads carved into the watersheds in the Southwest. Many of these roads are now abandoned and have created miles of eroding gullies and scars across the western landscape.

Although we cannot reclaim all that we have lost in soils and vegetation diversity, we can make the appropriate adjustments in our current road systems to reestablish the original surface hydrological flow patterns that have been disrupted by roads. Using the appropriate road drainage systems, we can then curtail erosion and further loss of soils, harvest road water to reinvigorate vegetation and stitch the natural surface hydrological flow-pattern back together. #

—Steve Carson

In many cases the arroyos and gullies we now see are a legacy of these old wagon roads and trails.

From Ridgetop to River Bottom

—Restoring the whole watershed

Lea Knutson knows the Gallinas watershed in northern New Mexico like some folks know their residential backyards. She is founder and Executive Director of Hermit's Peak Watershed Alliance (HPWA), a nonprofit organization based in Las Vegas, NM, dedicated to restoration work on both public and private land in four watersheds: the Gallinas, Sapello, lower Mora, and Tecolote. NMLC has partnered with HPWA on conservation projects on ranches in northeastern New Mexico.

Gallinas Canyon is where HPWA got its start, with EPA 319 (Clean Water Act, Section 319) funding which requires an in-depth watershed-based plan, with proposed solutions. The plan was finished in 2012 and set the stage for much of HPWA's restoration work.

Lea knows firsthand that it takes a whole community to accomplish watershed restoration.

"We got to know the landowners first, and then followed the plan, up and down the river, making local connections, having coffee at their kitchen tables, and earning their trust. I live in the community, and those local ties are essential," Lea said. She also had to gain the support of the larger community, such as the Las Vegas city council and townspeople, and work with the various state and federal agencies such as the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers who can have conflicting ideas about which methodology is best to use to restore a watershed.

The Gallinas River and several like it throughout the state, has been modified repeatedly over the past two centuries, usually to accommodate more agricultural production and homes. In the valley bottom, for example, the river was straightened in the early 1900s and pushed aside from its floodplain to run along the canyon wall to provide more room and rich soils for growing crops. This straightening and the river's isolation from its floodplain set up a whole series of changes to the valley bottom. Vibrant riparian bosques dried up, the river channel lost falls, pools and riffles, and with those cumulative changes came a reduction in the diversity and abundance of river ecosystem organisms as well as more extreme flooding and droughts.

Most landowners throughout the river valley depend on this limited source of surface water for agricultural use, and the City of Las Vegas, NM, relies entirely on the relatively small Gallinas River for its municipal water.

"Talking to landowners, you've got to find your common ground—what your common goals are," Lea said. "I may want to reduce cows in the riparian area, and you might want water for the cows—how can we work to solve both our goals?"

Much of the restoration work HPWA has successfully performed involves putting the meander back into the river, restoring natural river features, and creating small one-rock waterfalls that keep the water moving and flowing into deeper pools that cool at lower depths, to allow fish to survive the summer temperatures. Anchoring the river with vegetation is critical as well.

"Everyone worries about fire when they think of allocating funding for watershed restoration and protection, but you need to look at the whole watershed—from ridgetop to river bottom," Lea said.

"If you focus mostly on fire in the uplands, you miss other important considerations. It's the health of the entire landscape to consider, and this includes the community and the landowners' relationship to each other. You have to consider the economics as well. Some folks in this county are land rich and cash poor."

Lea is a master organizer—she has to be. "The folks around here are busy with their families and jobs, so they don't often have time to volunteer," she said, "so we work around that by helping them on their lands and connecting neighbors to help each other. We have a large list of names and send out emails to recruit folks. We involve students as interns and network with community organizations. We hire locals and facilitate the work so no one has to commit long-term—they can just come out for the day or two, and enjoy being outdoors, doing something worthwhile."

Lea Knutson in the Gallinas River Park in downtown Las Vegas, NM

Maintaining her enthusiasm for watershed restoration work for 26 years, Lea is spry as ever and shows no sign of slowing down. One of HPWA's recent successes is the Gallinas River Park in downtown Las Vegas, NM, a beautiful two-mile walkway along what is now a clean, winding river (*photo left*). "We've taken this sad, derelict place and turned it into a beautiful healthy ecosystem, with lush green vegetation, and birds, fish and animals are returning," Lea said. Stormwater runoff from the Las Vegas streets above the river now flows into the wetlands along the riverbank, where the water is filtered before returning to the river. George Cathey, Oxbow Ecological Engineering, designed the project and much of restoration work requiring heavier equipment was done by Craig Sponholtz of Watershed Artisans, based in Santa Fe—and there really is an art to river restoration, visible in the remarkable transformation of the area.

HPWA recently finished restoration work on Wolf Creek on the Fort Union Ranch in the lower Mora watershed near Watrous, NM, as a subgrantee under a North American Wetlands Conservation Act (NAWCA) grant awarded to New Mexico Land Conservancy [see *sidebar story*] and Lea is now focusing on the Sapello watershed. For more information or to join the HPWA volunteer email list, contact Lea at: lknutson@hermitspeakwatersheds.org.

Restoring Wolf Creek and the Lower Mora Watershed

It's amazing what is possible with vision, thoughtful design, good oversight, a coordinated approach, a shared landowner vision and adequate funding.

The New Mexico's Front Range Wetland Complex Protection and Restoration Project managed by the New Mexico Land Conservancy (NMLC) and funded by a North America Wetlands Conservation Act (NAWCA) grant to conserve and restore a 1.2-mile stretch of Wolf Creek on Fort Union Ranch (FUR), near Watrous, NM, offers an excellent model for improving stream health, wildlife habitat, and watershed function. Several partner organizations and volunteers worked together on the project, completed earlier this year. Wolf Creek is part of the lower Mora River Watershed; its confluence with the Mora River near Valmora, NM.

As the principal NAWCA grant recipient, NMLC completed and now holds the 3,800-acre Upper Wolf Creek conservation easement on FUR, bringing the total amount of land now under easement on the ranch to nearly 25,000 acres. This NAWCA funded project complemented an earlier project upstream that restored about 3 miles of Wolf Creek with a total of 63 structures.

As the landowners, FUR contributed significant labor and resources, and is the entity responsible for the long-term maintenance of Wolf Creek. "You can accomplish so much more with 'enlightened' landowners like Fort Union Ranch," said Lea Knutson, founder and Executive Director of Hermit's Peak Watershed Alliance (HPWA,) the nonprofit organization and subgrantee responsible for the restoration work on the stream.

As subcontractors, wetlands restoration expert, Bill Zeedyk, of Zeedyk Ecological Consulting, was hired to lead the project design and oversee construction of 24 structures along Wolf Creek. Steve Townsend was hired as the archaeologist to do the cultural survey needed for the US ACE 404 permit.

Volunteers from the Albuquerque Wildlife Federation, New Mexico Highlands University, and numerous HPWA volunteers, contributed substantial labor to build the 24 structures and plant riparian vegetation. Members of the NM Highlands football team in Las Vegas helped build structures in Wolf Creek this spring.

HPWA restoration goals for the project were to restore freshwater and saline emergent and riverine wetlands in and along Wolf Creek to ensure their future viability for waterfowl and water birds in the southern shortgrass prairies of northeastern New Mexico and to brace them to face climate change. To improve the diversity and utility of the area by wildlife, another goal was to enhance woody riparian vegetation in the riparian area.

Restoration success is evident already along Wolf Creek and will continue to improve as riparian vegetation matures.

"The most important thing to come out of the Wolf Creek restoration project, in my opinion, was the coming together of so many partners," said Lea Knutson. "This kind of work takes a lot of cooperation."

The HPWA was recently awarded the 2021 Visionary Award by the Santa Fe Community Foundation. This much deserved award honors an organization that can anticipate the unmet needs of future generations and has the stamina to achieve success.

Note: Portions of this article were abridged from a report written by Lea Knutson, Hermit's Peak Watershed Alliance (HPWA). #

Introducing Solomon Bitsie

—Newest Member of NMLC Board of Directors

The New Mexico Land Conservancy strives to continually develop its Board of Directors to include diverse representatives from around the state who bring skills and experience from a variety of backgrounds, particularly those engaged directly with the land, such as ranchers, farmers and other landowners managing land and natural resources, which can be a challenge considering the demands of the agricultural way of life in the Southwest.

To that end, we are proud to announce that this year, **Solomon Bitsie**, rancher and member of the Navajo Nation joined our Board of Directors.

Solomon's father's father started what is now a fifth-generation cattle and sheep ranching operation on the Navajo Reservation at the base of the Chuska Peak north of Gallup, NM. Everyone in his immediate family—brothers and sisters and their children—is currently involved in the operation.

Individuals do not hold title on Reservation land. "Traditionally, we have what's called 'open range' grazing. You can graze wherever you have animals, but you need to have permits which are handed down from generation to generation. If you fail to renew the permits, you lose them."

Extended drought conditions are challenging for ranchers throughout the state, and no exception on Navajo land. "We haven't had any water in our dirt tanks in three years," Solomon said. "Right now, it's green out there—we've had a little rain, but we still have to bring water in from a pumping station. The conditions are pretty bad." The family also brings in hay to provide supplemental feed for their 32 cows.

Solomon is helping to bring new technology and support to his family's operation. They are currently fencing 7,000 acres, dividing it into sections to manage grazing and improve the land. "We're working to fix the erosion and bring back the water," Solomon said. "There's a lot of water that is not being retained." His father tried to do that, "pretty much on his own, and was not successful," Solomon said, "but now there is more opportunity — more help and more funding from government agencies and the universities," he added, citing New Mexico State University and Purdue University.

"It takes a lot of science and a lot of funds to do this," Solomon said, "Everyone's willing to help once they see what you're trying to do. And you have to have a good vet. We use a native vet. We use all the resources available to us."

Technology includes advanced genetics science to improve the herd. "We're working to raise cattle that can survive the environment—cows that can handle the dry, the hot-cold and the altitude," he said. "And we can't have cows that produce a lot of milk or get too big because the forage just isn't there."

The family just finished getting their cows artificially inseminated and are now getting the lambs into good shape for breeding in the winter. The sheep are pure Mereno, bred for their fine wool, and hailing from a long line dating back to South African Mereno. "Back in the '70s, you couldn't import livestock from there, so we imported the embryos into Canada, artificially inseminated the animals there, and the offspring could cross the Canadian border into the U.S." The wool they take to Roswell Wool in Roswell, NM, the largest wool warehouse in the US by volume under one roof, and, according to Solomon, one of the last places available in New Mexico that markets wool.

As any rancher will tell you, the ranching operation is a 365 and 24 hours a day job. "Cattle are always breaking something, so we're always fixing what they've broken," Solomon said, wryly. But he is committed to the work. "The business is a family tradition," Solomon said, a tradition he intends to help pass along to future generations.

Solomon will bring an essential perspective to NMLC's Board of Directors and we are grateful he is willing to take the time to contribute to our organization's development and future. #

> *"We're working to fix the erosion and bring back the water."*

Sunset photo courtesy of Solomon Bitsie.

Welcome Our New Stewardship Manager

Claire Catlett joined the New Mexico Land Conservancy in October 2021 and is happily returning to the landscapes of New Mexico that are the foundation of her conservation work. Claire began her career as an AmeriCorps VISTA volunteer in Silver City, NM in 2012, and served for three terms of service with conservation organizations in New Mexico, Colorado and Arizona. She has a background in water conservation and ecological restoration, and has worked professionally across the Southwest and its borderlands to restore streams and install green infrastructure.

Claire holds a bachelor's degree in International Relations from Roanoke College and a master's degree in International Development and Sustainability from Denver University. Claire recently returns to New Mexico from her family's home in Virginia's Blue Ridge Mountains. While in Virginia, she worked with landowners and farmers for agricultural practices that improved water quality. She discovered her love for fishing in her work to bring back native trout to streams. She enjoys growing her own food and wrangling two lively farm dogs.

Claire hits the ground running at NMLC thanks to her land trust and conservation experience. Among her many responsibilities as Stewardship Manager, Claire will manage the annual onsite monitoring of NMLC's more than 110 conservation easements, provide stewardship support to landowners, and seek funding sources and support for conservation and restoration projects throughout the state. NMLC welcomes Claire and looks forward to her contributions to the organization and New Mexico. #

A gift that keeps on giving . . .

When you include the New Mexico Land Conservancy (NMLC) in your estate plans, you are making a gift for future generations to enjoy the unique and special places we all cherish. A planned gift, like permanently protected land, is a lasting contribution to ensure that NMLC has the resources to conserve and steward these special places. Making a planned gift to our organization may provide you and your family with valuable tax benefits. Gifts to NMLC are not subject to gift or estate taxes. There are several ways to include NMLC in your estate plans: for example, bequests and gifts of retirement plans, life insurance policies and real estate. Please contact your financial advisors to discuss options that meet your financial planning needs and philanthropic vision. We are here for the long run protecting New Mexico's land heritage in perpetuity for you and your family, and for New Mexico's future.

Visit: www.nmlandconservancy.org

Rio Chama below Abiquiu dam. Photo by Scott Wilber

PO Box 6759
Santa Fe, NM 87502
505.986.3801
info@nmlandconservancy.org

New Mexico Land Conservancy

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