Amazing Gabions in Arizona

Where Rocks Have Made the Water Flow

Brad Lancaster

NESTLED IN the western foothills of Arizona's Chiricahua Mountains at about 6,000 feet sits a ranch called El Coronado. The surrounding grasslands are mottled with oak, juniper, and pinyon pines. It is often dry here as the rainfall varies from 7 to 30 inches (175-750mm) per year. Yet El Coronado is a lush oasis in this high desert, with flowing streams, thick grasslands, and abundant wildlife. But things weren't always so.

When Joe and Valer Austin bought El Coronado 18 years ago erosion was severe on the 2,000 acres. Water only flowed in the drainages during the rainy season, and many of the creekbeds showed bare bedrock. Surveying the land just after purchase they wondered, "What do the cattle eat?" Barren outcrops of reddish soil and rock were more prominent than grassy areas.

Today, if you look across the land following rains you'll see water flowing and seeping in and around most of the washes—and in some areas the water now flows year-round. Much of what was once exposed bedrock is now blanketed with a thick, spongy carpet of fertile soil and grasses. The streams are full of waterbugs, fish, ducks, and turtles, who have returned with the water. Even cottonwoods and seep willows are volunteering where 18 years ago there were none. No hunting is allowed on the ranch, yet local hunters complain that that is where all the deer live. "Well," Joe explains, "that's because we've got water and life here."

What has brought about this dramatic change? Simply put, the Austins laid rocks perpendicular to the slope. Specifically, they built gabions, lots of them.

Holding back the water

A gabion is a low, permeable stone structure laid across a drainage. Commonly, rough rocks are held in place by wire fencing or baskets, yet the Austins use only carefully laid, unmortared stone. Gabions don't stop the flow of water, but they do slow it down, allowing more of it to sink into the soil. Once below the soil's surface the water continues to percolate downslope, but without the destructive and erosive force of water flowing above ground. In big rain events plenty of water still flows over and through the gabion, but its force and speed are checked. This reduces erosion downstream while holding resources high in the landscape, as soil, silt, and organic matter ordinarily washed away by the flowing water settle behind the gabion, slowly forming a level terrace. By harvesting runoff water and soil, a gabion creates a very fertile and well irrigated growing zone around itself.

Over time it can also create a very stable and level bed of soil in what was previously a deepening gully or arroyo. That level bed of soil can make a great path or road crossing. For example, a car cannot pass through two feet of flowing water, yet with an 18" high gabion in the same arroyo that flow is spread and the water depth reduced to a very passable six inches or less. In fact it was a driveway with ambitions of becoming an arroyo that originally sold Joe and Valer on the idea of gabions.

About 11 years ago the road leading up to their mobile home would get washed out every time there was a good rain. Rain, repair the road. Rain, repair the road. "Enough!" they proclain. They gathered up rocks, chunks of an old concrete footing, broken bricks, whatever they could find. All was roughly plac on the downhill side of the road. It wasn't pretty, it didn't cost cent, and it worked. It's still working, and in more ways than The road not only stopped washing out during rains, but as soi slowly accumulated on the backside of their structure the road began to improve itself. The Austins also noticed that below th roadside rubble a seep started to form, which lingered long aft the rains and supported a lush growth of vegetation. Upslope the rubble gabion the soil also stayed moist long after the surrounding land had dried out.

Valer Austin showing drystacked gabions in a small watersh Work began at the top (ridgeline right rear). Photo in winte

"Hey," they thought," if a gabion can do this much here wh it's dry, let's see what they can do where MORE water flows!"

Thinking Big

And so they did. Within 10 years they'd put in more than 20,000 gabions—most on their 2,000 deeded acres, with still more on the 14,000 they lease! Two watersheds have been thoroughly checked with stepped gabions running from the ve top of the drainage to the very bottom, and many more scatter all over the minor drainages, dips, and slopes leading into the main waterways.

The results—The Bedrock watershed (180 acres), which would only run one month out of the year before the gabions, now run for 34 months straight. The Turkey Pen watershed (2,000 acres) used to run only three months of the year. Now pools of water linger where before there were none, and wate flows almost all year long. All of it quietly working and buildi

on itself without any further input or cost.

The whole system has become more stable and productive as silt and organic matter gradually settle behind the gabions. With more moisture held longer in the watershed, more vegetation gets established on the landscape, drawing in more wildlife to add yet more fertility.

Gabions act to spread and slow water. This is the polar opposite of eroding gullies or many man-made culverts. An unstable gully cuts itself deeper with every rain. As the bed of the gully or arroyo is cut, the water channel narrows. Water flowing down the drainage is constricted as it hits this narrowed channel, but it will NOT stop flowing, so pressure builds. The water must either speed up or cut a new path. Such constrictions can create rifle barrels that make calm flows destructive or already fast-moving flows even more damaging. Often the channeling of waterways and the placement of culverts in drainages form cannons that erode what lies downstream. The thinking behind such strategies is usually to drain a landscape, not to feed it.

A drainage with gabions feeds the surrounding landscape as it harvests water and soil. Runoff is calmed rather than sped up as the flow is dispersed in a WIDENED drainage made shallower by the spreading gabions and the accumulating soil and plants. It is a wonderfully regenerative strategy, because once in place it grows itself. The fertile soil gathering behind the gabions will support vegetation, eventually creating living gabions. "Set up the right conditions," Valer says, "and both the plants AND the soil will volunteer."

I asked Joe what he plans to do once the gabions are all silted up. He replied with a relaxed and knowing smile, "I'm going to let the vegetation take over." It is well on its way now that the landscape has been stabilized.

Stabilized, but not sterilized. The original impact is light, as the gabions are small, ranging from six inches to three feet in height. At this scale water is not diverted out of any existing watercourse, just slowed and spread. Working with small structures made it possible for the Austins to build everything by hand. All the gabions built since their first rubble heap have been constructed entirely of local stone. No wire, no baskets, just well placed rock that blends seamlessly into the landscape.

Skilled help from Mexico built most of the El Coronado gabions. These men and their ancestors had a strong heritage of working with stone. They taught Joe and Valer how to build gabions that would last. The keys are to build with care, and to start at the top of the watershed, then work your way down. By working from the top down, you reduce both the velocity and volume of overland flow BEFORE it gains the momentum and force that make it destructive. Thus you never need to build a large structure. As Joe says, "The bottom of the watershed is just the tip of the iceberg. Start at the top and you can keep all the work you do at the bottom."

Working Small

When asked how big he makes his gabions Joe replied, "I'd rather make them smaller and put in more total gabions than make them bigger and put in fewer."

All too often water harvesting structures are placed at the bottom of a watershed with nothing upslope. This necessitates huge, engineered, machine-built structures, which can bring on disaster if they fail. The Austin's gabions are too small to cause much trouble if they fail. Only 1% have actually given way and that was mainly due to their dogs, which disturbed some structures by going after rock squirrels.

Not only is a smaller gabion safer, but it's also a heck of a lot cheaper. The Austins didn't spend a cent on materials—they only used what was found on the land. But they did hire skilled workers to build the gabions and to share their knowledge. An experienced four-person team can put in about ten structures a day. Many would say that labor costs would make such work unaffordable. Valer would argue that you can't afford NOT to do the work. If you don't do anything you LOSE more topsoil, organic matter, water, and productivity each year. If you put in these small water-harvesting systems you GAIN soil, organic matter, water, vegetation, and greater productivity each year.

Heavy flow in this large watershed has become perennial.

These strategies don't drain the system over time—they feed it.

The Austins run 200—300 head of cattle under an efficient system of rotations, which has also helped heal the land. Animals are only allowed into sensitive riparian areas during the dormant season—never during the growing time. Young trees are fenced to insure they will grow into large trees and help protect and encourage more young trees and vegetation. Healthier land has promoted better grass and forage production. Good land management coupled with numerous water harvesting strategies has spread water and lush grass all over the land. The cattle now expend less energy in search of food and water, maintain more weight for better health, and return higher profits for the ranch.

Harder to measure, but no less valuable is the benefit of a growing diversity and density of wildlife. Such life will improve the system and further its potential for achieving still higher levels of succession and health. Cottonwood and willow trees have returned to once-barren drainages, and with them have come a plethora of birds and other wildlife. The benefits run deep.

Twenty miles west, down in the Silver Spring flats the Austins manage two stretches of land (7,000 and 9,000 acres respectively) where they have implemented water harvesting earthworks. Not

only has the work there checked erosion, increased vegetative cover, and improved the health and productivity of the land, but the water table appears to have risen. After putting in the earthworks the Austins and their neighbors noticed that well levels went up. Water levels also rose in nearby miners' holes.

Choosing the right technique

So what was done in the flats? Some gabions, but in the flats there's almost no rock, though plenty of soil. When rocks were first laid, they sank into the deep sandy beds of the drainages due to heavy water saturation. The sunken rocks were then used as foundations for other gabions. This has worked, though Joe wonders if wired gabions might've worked better in such sandy areas, as their snowshoe-like footprint could increase stability.

Where they have little soil and plenty of rock the Austins stick with gabions, but where they've got lots of soil and very little rock, as on the Turkey Creek flats, they prefer the gully plug.

A gully plug is a low earthen berm in the bottom of a gully. It creates a barrier—like a gabion, but doesn't stop the flow, as would a dam. A small amount of water is held behind the berm, while in big rains, most of it flows over the plug to continue down the drainage. Where the Austins have used gully plugs much of the captured water infiltrates the soil and continues to travel downstream below the surface.

The gully plug can be built by digging a trench across the gully, then piling the spill dirt just downslope of the trench to create a berm perpendicular to the drainage. Earth easily erodes, thus extreme care must be taken when using such a strategy in a drainage. The berm must be made thick enough with the overflow stabilized by rock or vegetation. The berm must be lower than the gully banks as you want overflow water to stay in the existing drainage—not to cut a new drainage. When building gully plugs or any water harvesting earthworks, it's important to start at the top of the watershed and work your way down. Water flow must be controlled before it hits the gully plug or the structure will be washed out.

A few gully plugs and swales are used in the foothills up at El Coronado, but not many due to the limited soil. At the upper ranch, gabions do the main work of taming flow, " 'cause you've got to calm the water above if you want to keep what's below."

Won't holding all that water high in the landscape dry out the land below?

Nope. You're not impounding the water, you're just slowing it down by putting it in the soil where less will be stolen by evaporation, and more will be available to plants and soil-building microorganisms.

As Joe sat on a thick cushion of vegetation with water bubbling by he reflected. "Had I been told I needed to put in 20,000 stone structures I'd still be thinking about that. You just have to start."

The good news is that even one gabion near the top of the watershed begins the healing process. At El Coronado they just kept going! Δ

Joe Austin pulls back a carpet of sod growing on once bare bedrock. Water is Life.

When the Austins had gabioned most of a small watershed leading to a series of ponds below, folks said the ponds would never fill again. Well, they filled the first year and have become more reliable ever since. As Valer says, "Never underestimate the flow and volume of water on the landscape."

Today, the same amount of water flows through the El Coronado landscape as did before the gabions were built. The difference is that today, with the gabions in place, that flow takes more time. Rather than ripping through in a matter of hours, water now gently meanders over many months.

Thus periodic flows of water in this dryland environment are turning into healthy yearround flows. This is truly wondrous, and if you think about it most of the work is being done by nature.

"Yeah, but 20,000 gabions, THAT'S AN EFFORT," you may say.

Brad Lancaster's fascination with water began with his flooding of sandbox civilizations. High water bills and angry parents temporarily put an end to all that, but later in life he learned to play a bigger and more productive game called "harvest!" That led him to teaching, consulting, designing, and living with permaculture and integrated water harvesting systems in drylands, which he has done since 1994. He is at work on a book titled "Rainwater Harvesting in Drylands—How to Welcome Rainwater into your Life, Landscape, and Soil," to be published in October. The story of El Coronado Ranch is one of many presented in the book, of real people around the globe successfully harvesting rainwater in drylands. Along with the inspirational stories are lots of resources, how-to information, guiding principles for efficient and integrated design, and more! Please contact Brad at bradlank@aol.com.