Photo by Christopher Keeran

HILLSIDE STEWARDSHIP

Methods for Reducing Erosion, Establishing Vegetation, & Enhancing Water Catchment

hill country alliance

INTRODUCTION

Photo by Jordan Moore

As its name suggests, the Texas Hill Country is comprised of innumerable hills carved by creeks and rivers. Effective stewardship of these hillsides requires careful observation and thoughtful, long-term practices (e.g. planned grazing, selective brush management, and native plant restoration) to sustain and enhance soil health. In conjunction with these long-term practices, land stewards can also promote healthy hillsides through the use of certain erosion-control structures.

Soil Erosion is a form of soil degradation in which the top layer of soil is carried away by wind and water. Rain and channelized water flow dislodge and wash exposed soil downhill. This cumulative loss of soil poses a major challenge to landowners and managers.

This guide highlights a series of erosion-control structures that Hill Country landowners and managers are using to slow and sink water into the land.

When landowners can slow and sink water into their land, this physical process provides a variety of benefits, including reduced erosion, increased water infiltration into soil and aquifers, increased soil moisture and vegetation production, flood mitigation, drought resilience, habitat enhancement, and increased flow of spring-fed creeks. Given the severe flood events that the Hill Country is known to produce, often a series or combination of structures is needed to withstand extreme weather. Used in concert with the long-term practices described earlier, these site-specific structures can be quite effective in enhancing the overall health of a landscape.

Before creating any erosion-control structures, the landowner should study the site thoroughly. Examine topographic maps to understand the larger context for the movement of water and walk the site numerous times, observing the pattern of runoff from below and above the eroded feature. Methods used should be appropriate to the site, consistent with land management goals, regularly monitored (especially during and after large rain events), and adapted as needed.

__NOTE__: If there is an ongoing trigger for erosion (e.g. current grazing or mowing practices, vehicular use, or road design), managing these stressors will be critical for success. Otherwise, the erosion-control structures described in the following pages may simply act as band-aid approaches to more pressing management needs.

1. Rows of Rocks: Slow and sink water flow across a slope

Rows of Rocks are a simple method used to help slow and sink the flow of water along a hillside. These structures can be particularly helpful for areas with early or mild signs of erosion or bare ground. During the process of slowing and sinking water, rock rows also capture the sediment that travels with water. This accumulation of sediment provides soil in which vegetation can establish.

Rows of Rocks can often be built using materials on site. In the picture below, a landowner created this structure over the course of an afternoon with a strong rake and small rocks already present on her property. Two years ago, the hillside in this picture was bare, exposed caliche. By using a series of simple rock rows, this landowner has slowed down water and trapped enough sediment to enable Texas native grasses to establish.

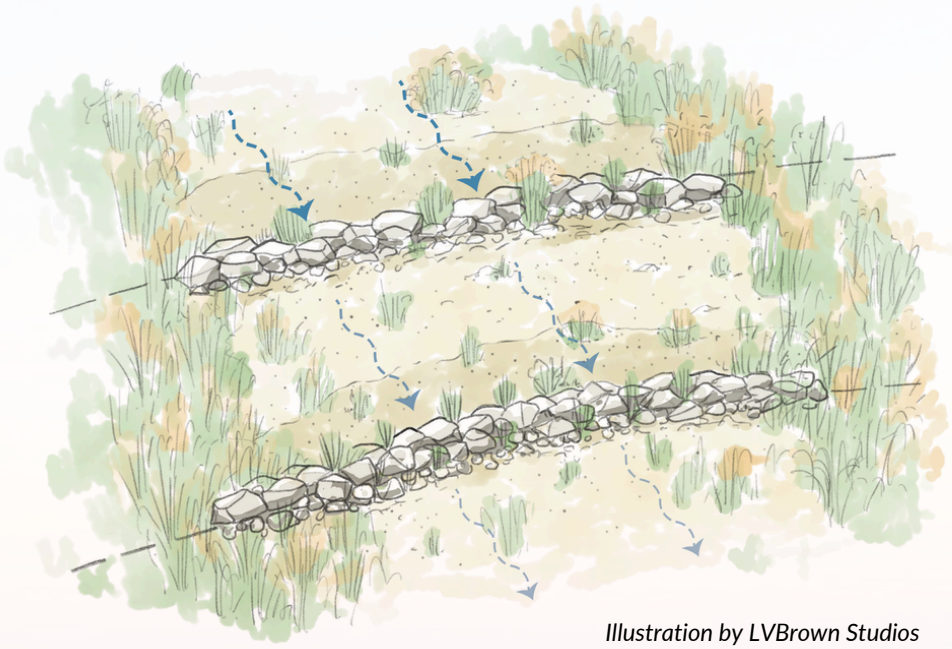

Illustration by LVBrown Studios

How to create:

The size and number of these structures can vary greatly depending on site needs. Typically, a series of several rows is needed for reinforcement to effectively slow, spread, and sink water. Build rock rows following the contour lines on a hillside (*Resources for learning the contour lines are included on page 7)*. You can use a rake or shovel to organize rocks into rows or place larger rocks by hand. When placing rocks, do not stack them on top of each other. As mentioned before, landowners are encouraged to use rocks and gravel already present on their properties; however, loose rocks can also be purchased for use. If purchasing rocks, aim for angular rocks that can fit together easily and avoid round rocks.

Close up segment of a Row of Rocks that extends a few yards laterally beyond the photograph. Note the hat for scale. Rocks do not need to be stacked on top of each other.

2. One Rock Dam: Slow concentrated water flow in a channel

A One Rock Dam is used in a slightly different landscape context. These structures are installed in areas where a channel is being cut into the soil surface by concentrated water flow *(like the channel pictured in the top right image)*.

One Rock Dams slow water, capture sediment, and eventually help raise the grade of the channel. The goal of this structure, along with the other structures described in this guide, is to create a safe and stable space for the reestablishment of native plants. Vegetation benefits from the increased soil moisture and sediment capture these structures promote.

How to create:

These structures are called One Rock Dams because they are one rock tall, so be mindful not to stack rocks on top of each other. When collecting or purchasing rocks, aim for angular rocks that can fit together easily. The rocks need to be tightly placed, or keyed together so as not to provide a straight path for water runoff. Rocks should extend laterally past the bottom of the channel and up the banks of the slope so that in high runoff events, the water does not flow around the edge of the structures (*as practiced in the illustration to the right and the image on the bottom right*). Unless highly invasive or noxious, existing vegetation should always be incorporated into the structure, not removed.

Concentrated water flow has eroded a channel into this property.

Illustration by LVBrown Studios

Example of One Rock Dams to help dissipate concentrated flow in a channel

3. Berms and Swales: Slow and sink large amounts of water into the land

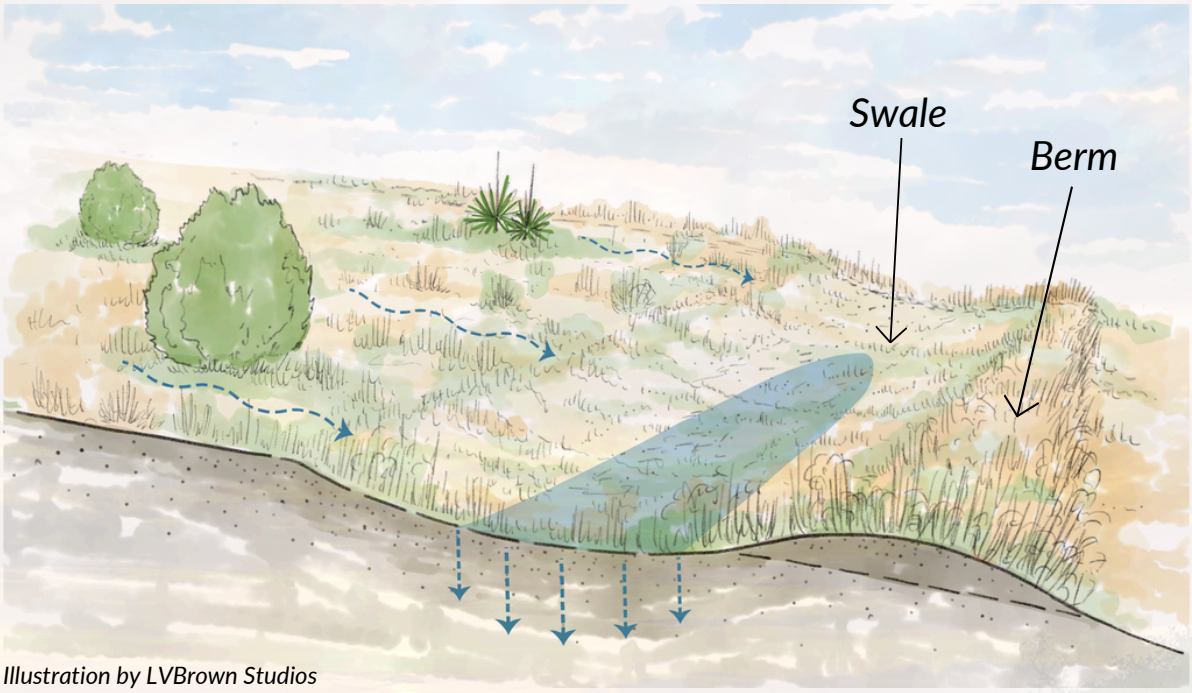

Illustration by LVBrown Studios

Berms and Swales may be used to slow and sink large amounts of water into the ground and/or re-direct runoff for storage. The term Berm refers to a raised slope, while Swale refers to a depression or ditch (*examples of each are labeled in the illustration above and the picture below*). Swales used in conjunction with Berms can also help encourage plant growth.

How to create:

To build a Swale, excavate the soil surface to form a depression along the contours of a hillside. Swales should be dug wider than they are deep. The soil excavated from the Swale can then be used to create a Berm down slope of the Swale. The Berm and Swale combination has many design considerations such as steepness of slope, rainfall amount, and spacing. In more gently sloping areas, experimentation with Berms and Swales is relatively low risk. The steeper the slope and the higher the amount of runoff, the greater the need to consult a professional. A good source of technical considerations for these types of structures may be found in the *Rainwater Harvesting for Drylands and Beyond* book series by Brad Lancaster.

Example of a Berm and Swale on a Hill Country property

4. Woody Materials: Slow and sink water flow across a slope

Using woody slash, such as branches and trunks of smaller trees, can be a great practice for slowing and sinking water. Thoughtful placement of woody materials, like leftover limbs from Mountain Cedar (i.e. Ashe juniper or *Juniperus ashei*) management or trimmings from dead Live Oak trees, is a great way to protect the soil surface and prevent erosion. Proper methods for brush management are beyond the scope of this resource; however, woody debris that is naturally deposited or leftover from selective brush management can provide a free, easily accessible material to slow and sink water. This section discusses four different methods for using woody materials to mitigate erosion and promote plant growth.

***Lop and Scatter*:** After managing brush, landowners can scatter the leftover branches and small tree trunks onto areas of bare ground to provide a physical structure for trapping water and sediment. Vegetation will start to grow in the accumulated sediment, helping cover and stabilize exposed soils.

Log Cage: Given the overabundance of native white-tailed deer and other non-native herbivores (e.g. Axis deer & feral hogs) in the Texas Hill Country, some landowners use woody slash to protect native seedlings and saplings from herbivory. Simply place a barrier, or cage, of branches around young trees or new plantings to deter herbivores as demonstrated in the below picture. In addition to protecting young plants, this cage of branches will also provide protective conditions for natural recruitment of other plant species. In the photo below, the landowner identified native Redbud, Spanish oak, and Mexican buckeye from seed that she planted that have established with protection from the cedar slash.

A landowner uses cedar slash to protect establishing native plants from herbivory.

STRUCTURES TO SLOW, SPREAD, AND SINK WATER

***Mulching*:** A third method to help protect bare ground and capture water and sediment is to add a thin 1-2 inch layer of mulch (e.g. shredded or chipped Ashe Juniper) onto exposed areas of soil. If feasible, avoid laying more than a few inches of mulch as too thick of a layer will impede grass germination.

Logs on Contour: Often, a single row of logs is ineffective for slowing and sinking water. Hence, some landowners will build a series of log berms or rows on their hillsides. In the bottom right photograph, a landowner used three rows of cedar logs to slow down erosion, trap sediment, and improve conditions for native Texan grasses. Logs on Contour provide many of the same benefits of the rock structures on contour discussed earlier in this guide.

How to create Logs on Contour:

Place logs carefully to follow the contour line along the hillside. Logs may be slightly buried into the soil to ensure there are no gaps between the log and the soil surface. Consider using cedar mulch on the upslope side of the logs to further ensure that water does not have the opportunity to flow between the bottom of the log and the soil surface.

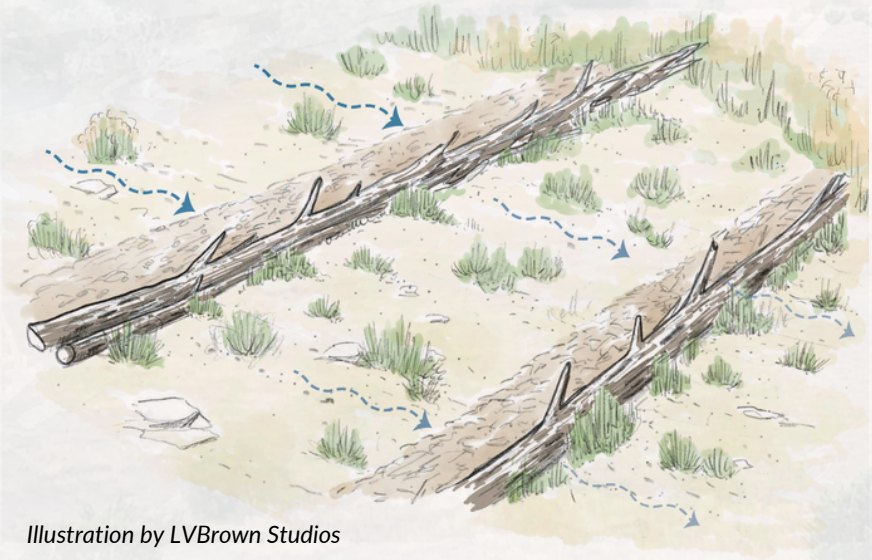

Illustration by LVBrown Studios

Not sure how to identify the contour lines on your hillside?

Contact your local USDA NRCS District Conservationist to schedule a site visit. They will typically have a laser-level tool to help identify and flag the contour lines. Using topography as your guide will greatly enhance your ability to reduce erosion, sink water, and build healthy soil and plant communities.

Landowner used three rows of cedar logs to slow and sink water into the land

5. Media Luna: Slow and spread concentrated water flow over a slope

Media Lunas are designed to alter the flow of water. They may be used on a gentle or steep slope and—when oriented as a happy face with the tips facing upslope—slow, capture, and redistribute concentrated water flows.

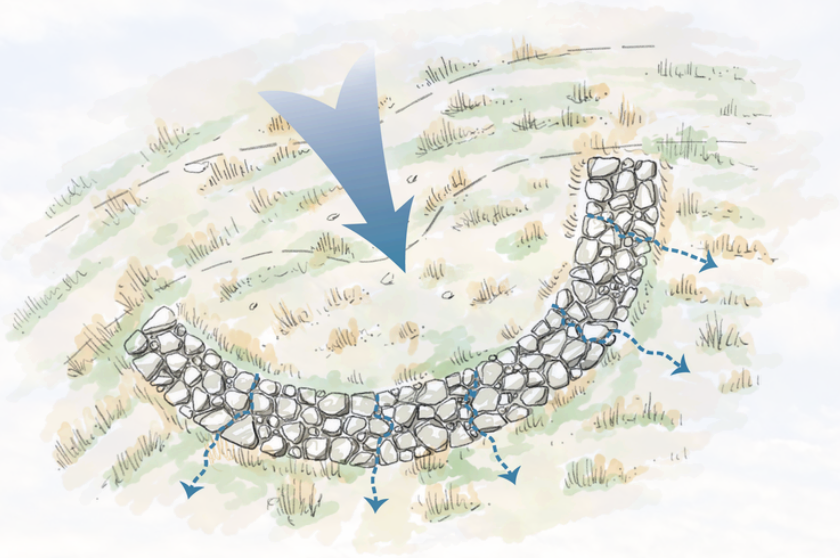

Illustration by LVBrown Studios

Rocks in the Media Luna slow water at the bottom of the curve and as the structure fills with water, the concentrated flow is spread out through the rocks toward the tips (*as modeled in the illustration above*).

Landowner uses a Media Luna on their hillside to dissipate concentrated water flow

How to create:

The location of the tips of the Media Luna should be at the same elevation, which can be determined using a laser level. The bottom of the curve of the Media Luna should be centered where water is becoming channelized (*as indicated by the solid blue arrow in the illustration above*). Dig a small trench to place larger footer rocks and help anchor the structure. This downhill row of anchored rocks should only protrude an inch or two above the soil surface, or be augmented with a row of flat rocks below. By making this lowest row of anchor rocks nearly flush with the soil surface, this reduces the chance for downhill erosion. When placing rocks, maximize contact between the surface area of the rock and the ground, and avoid placing rocks on top of each other. Media Lunas can also be used in a series, which may be desirable on steeper slopes.

1. Rock Run Down: Stabilize a low-energy headcut

A Rock Run Down can be used for a moderate, low-energy headcut that is less than two to three feet deep. Headcuts occur when a concentrated channel of water causes an abrupt drop in elevation as soil is eroded away (*an example of a headcut is provided in the image to the right*). Rock Run Downs are not intended for high-energy features such as a wet-season creek.

Example of a headcut on a small slope

How to create:

To build a Rock Run Down, landowners should take note of existing vegetation that may be incorporated into the design and source enough rock material that can blanket the entire headcut feature snuggly. Angled rocks fit together better than round rocks; however, the resourceful landowner will use whatever rock material is close at hand. Plant seed may be scattered onto the bare soil before placing the rock and/or scattered on top of the completed structure.

Illustration by LVBrown Studios

Some landowners may need to remove the bare soil at the top of the headcut to reduce the angle of the slope. For an optimal slope angle, aim for one unit of height for every three units of width. If soil disturbance is warranted, consider using the removed soil to fill in spaces between rocks. In the photograph below, the landowners did not need to modify the shape of the headcut because of the good perennial grass cover at the top of the headcut. Removing vegetation should be considered a last resort as plant roots are holding soil intact.

Carefully place rock so that:

- there are minimal gaps between rocks,
- the rocks placed at the top of the headcut are flush with the soil, so that water can run down, through the structure, and
- similar to the Media Luna (*page 8*), a row of larger, footer rocks is dug in to help anchor the structure (*pictured in illustration above*).

This landowner has used a Rock Run Down to mitigate a low-energy headcut.

2. Zuni Bowl: Stabilize large headcuts from concentrated channels of water

A Zuni Bowl is used to stabilize a large headcut with a drop of more than 2-3 feet. Large headcuts typically occur in places where high volumes of water are concentrated in a channel causing an abrupt drop in elevation as soil is eroded away. Zuni Bowls are often necessary in ephemeral creeks and in locations where culverts have been improperly placed and erosion has resulted (*see example below*). A Zuni Bowl can be constructed to fit the contours of the headcut, lining the feature like a bowl (*see illustration and picture to the right*).

Example of a large headcut that has occurred from an improperly placed culvert

How to create:

Use rocks to construct a "rock bowl" that can capture and dissipate a large volume of water. The Zuni Bowl should have two armored pour-over points. The top of the rocks at the first pour-over (i.e. upper lip of the bowl) should be flush, matching the ground surface at the height of the headcut. The plunge pool at the bottom of the bowl should be lined with a single layer of flat rock. The lower pour-over (i.e. the downstream lip of the bowl) should be constructed with large rocks and should be at least half of the height of the headcut. Rock edges should be offset from one another so that there is no straight pathway for water through the structure.

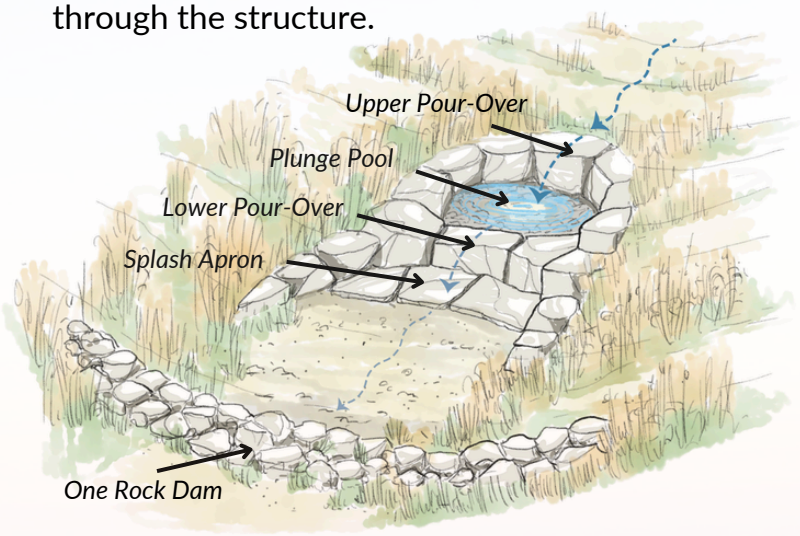

Illustration by LVBrown Studios

Important components of the Zuni Bowl include:

- a lower splash apron placed at a distance from the headcut that is at least three times the height of the headcut. (e.g. a 3-foot deep headcut would need a splash apron placed 9 feet from the upper pour-over), and
- a One Rock Dam (*page 4*) downstream of the Zuni Bowl (*see illustration above*).

Example of a Zuni Bowl on a property

Note: Detailed instructions and diagrams may be found in the *Erosion Control Field Guide* listed on the next page.

ADDITIONAL PRACTICES & RESOURCES

When done in concert with long-term management, these additional practices can also be used for slowing and sinking water and mitigating erosion:

- siting and scaling ponds appropriately along hill sides,
- improving dirt roads to avoid soil erosion and preserve the natural drainage patterns,
- installing rainwater harvesting systems, rain gardens, and/or permeable pavers that allow precipitation to sink into the soil and not to runoff the land,
- incorporate soil health principles, as explained by Soil for Water, highlighted below, and
- seeding with hearty, native upland species to jump-start site recovery and water catchment.

Technical Resources and Guidance:

Hill Country Alliance: Hill Country based non-profit that offers educational resources and stewardship workshops to support private landowners with their land management goals. Visit: bit.ly/HCALandProgram

Natural Resources Conservation Service (NRCS): Federal agency that provides technical and financial assistance for landowners and producers, including for planned grazing. Visit: nrcs.usda.gov/about

Quivira Coalition: Visit quiviracoalition.org/techguides to access the following useful guides and more from Quivira: *Erosion Control Field Guide*, *A Good Road Lies Easy on the Land*, *and Chapter 2 of Characterization and Restoration of Slope Wetlands in New Mexico.*

Project Bedrock: To learn more about nature-based solutions to enhance our karst aquifers, including new approaches to managing and understanding Mountain Cedar (i.e. Ashe juniper) visit: projectbedrocktx.org

Soil for Water: A project of the National Center for Appropriate Technology, Soil for Water provides information about improving soil health. Incorporating soil health principles is critical for managing productive, healthy lands. Visit: soilforwater.org

Mapping Your Property:

Texas A&M Forest Service: This organization provides online mapping resources to help study the topography on and around your property.
Visit: texasforestinfo.tamu.edu/mapmyproperty

Additional mapping resources are available through the U.S. Geological Survey at viewer.nationalmap.gov/advanced-viewer/ and Texas A&M Natural Resources Institute at txmap.nri.tamu.edu.

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The mission of the Hill Country Alliance is to bring together a diverse coalition of partners to preserve the open spaces, starry night skies, clean and abundant waters, and unique character of the Texas Hill Country.

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Acknowledgements

Many of these practices have been used by indigenous peoples in arid areas to manage water resources. We want to thank Mollie Walton, Vick and Dorothy Williams, Quivira Coalition, Lauren Brown, Texas Parks & Wildlife Department, Dixon Water Foundation, and the USDA Natural Resources Conservation Service for their support.

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