Technical Document*

Rock Weirs

About Rock Weirs

Rock weirs are structures that act to slow water down in streams or ditches, decreasing erosion and creating habitat. Weirs offer low-tech solutions to issues that can plague landowners as they manage water crossing their land, and can be a powerful management tool. The strategic addition of rocks to streambeds creates turbulence and drag, which slows water down, reducing its capacity to carry sediment and erode the land. Weirs have been used as a water management tool for thousands of years, but the early 1900s saw a rise in their use for habitat and stream restoration.

What is a weir?

There is no single definition of what constitutes a weir. But in general, weirs are permeable rock structures that slow water without stopping its flow.
From the USGS:
“River spanning loose-rock structures provide sufficient head for irrigation diversion, permit fish passage over barriers, protect banks, stabilize degrading channels, activate side channels, reconnect floodplains, and create in-channel habitat. These structures are called by a variety of names including rock weirs, alphabet (U-, A-, V-, W-) weirs, Jhooks, and rock ramps. These structures share the common characteristics of:

1. Loose rock construction materials (individually placed or dumped rocks with little or no concrete);
2. Extents spanning the width of the river channel; and
3. An abrupt change in the water surface elevation at low flows.”

*WLA Technical Document

WLA technical documents are collections of studies and other information plus explanations of key concepts for topics important to landowners. These documents are meant to be starting points for landowners about a complex topic or practice, providing vetted information and a guide for how to apply it to problems or issues on their properties. They are ***not*** *meant to be exhaustive lists of all possible resources or solutions.*

Weirs reduce the velocity of the water. This reduction in flow rate, combined with obstacles (like the rocks that form a weir), reduces water's power to erode. If the reduction in flow rate is large enough, it can also cause sediment to deposit below the weir (aka, reduce the "sediment load"): once sediment is in suspension, the velocity required to maintain its suspension is significantly less than that required to initially move it into suspension. Additionally, water carrying sediment has significantly higher erosive capacity due to grains of sediment striking other grains, so settling further reduces downstream erosion.

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Erosion Prevention

By slowing water and reducing sediment load, weirs reduce erosion in stream beds and along stream banks. For many irrigators and landowners, reducing erosion is important for long-term success and ecological health.

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How to Design Your Rock Weir

One of the most important parts of designing a rock weir is getting the right sized rocks for the device. Depending on the amount of water flowing and gradient through a waterway, weirs can require anywhere from very small rocks (6-inch diameter) to very large rocks (multiple feet in diameter) to create the correct amount of drag in the water for weirs to work successfully. Protecting the footing of a weir is also important, and concrete or other materials can be used to keep a weir from eroding out.

Correct angle and geometry also matters to the long-term success of a weir. Here are the nine general design principles for a rock weir according to the Forest Service:

1. Location
2. Height
3. Spacing of rocks
4. Angle and offset of the weir
5. Profile of the weir to the stream bed
6. Width of the weir
7. Length of the **bank key** (rocks or logs buried into the bank perpendicular to the flood flows of the stream to prevent flanking)
8. Depth of the **bed key** (rock buried below grade in the channel at the bottom of the weir to prevent scouring)
9. Weirs should be **constructed during low flow** conditions to minimize disturbance. Rock should be **placed, not dumped** and the rock should be made to interlock and be stable in the stream.

This low weir is slowing water during a monsoon rain event in Southwest Montana.
Photo by Erik Kalsta/WLA

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This simple dry stacked rock weir slows seasonal runoff, causing it to pool and deposit sediment and organic matter, raising the channel level on this ranch in Southwest Montana.
Photo by Erik Kalsta/WLA

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