

A Field Guide on Using Piñon-Juniper (PJ) Materials in Erosion Control Structures



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Introduction:

Slash from woodland thinning can be used effectively to cover bare and eroded spots on the forest floor. Slash will fall apart in plant litter which helps the soil absorb more water. Slash also creates a protective cover that helps re-establish grass, forbs, and shrub seedlings. Slash creates a micro-climate for plant germination, offers micro-habitat for small animals, and protects young plants from foraging ungulates. Slash also protects the soil from the impact of raindrops, wind and stormwater runoff. As a result, the soil is more shielded from splash erosion, precipitation has a chance to settle and infiltrate, wind erosion and dust in the air are kept down, organic matter is gradually absorbed in the soil, and plant growth induced.



Structures covered in this field guide

1. Brush or logs on contour
2. Stick & brush dams
3. Log mats
4. Brush mattresses
5. Wicker weirs
6. Palisade dams
7. Log racks
8. Plug & spread structures



General guidelines for spreading slash (lop & scatter)

- Spread slash over the soil in a manner that it has the greatest contact of biomass with the soil surface.
- Start at the bottom of the slope; lay branches with butt ends in uphill direction; overlap butt ends with tips as you move uphill.
- Cover the soil in such a way that there is approximately 90% ground cover. Dense slash cover may slow grass and forb regeneration. 5-15% of holes in the slash is optimal (enough to see some soil).
- Ensure that slash does not extend more than 12 inches above the ground.
- Do not spread slash on bare ground under trees that are not limbed up more than 10 feet.
- In larger gullies and broad drainages, do not place any slash on the surface. It will most likely be carried away by surface flows and lead to debris jams downstream that can cause accelerated bank erosion in the gully, leading to more soil loss and sediment plugs downstream.

Brush or Logs on Contour

Brush and logs placed on the contour lines of a slope help slow sheet flow. As these simple structures slow down stormwater runoff they trap sediment, which over time helps water infiltrate more easily. Most suitable for slopes between 4-12%.

Design & Construction

- Lay bundles of branches and logs along the contour (against the slope). Overlap the butt and tip of branches. Slash can be laid lop & scatter between the contour lines.
- Generally, use intervals of 100 ft divided by the % of slope. So, at 4% slope, the interval can be 25 ft; at 10% slope, the interval should rather be 10 ft.
- When slopes are close to 10% aim for near 95% cover by slash (5% of visible bare soil), adhering to the general guidelines of slash depth.
- For slopes exceeding 12%, don't use any small pieces of slash and don't use slash in any drainages or depression where slash may be carried away by surface flows. If possible, also place logs on contour in staggered lines (like laying bricks), so that runoff running between logs is slowed down by the lower log line.



Stick & Brush Dams

Stick & Brush Dams are shallow structures made with branches and brush and reinforced with locally found stones to slow and spread flows and retain sediment in shallow arroyos and drainage swales with grades below 10%. Made mostly with locally available woody material they are very suitable in areas where rocks are in short supply. Stick & Brush Dams should be no taller than 18 inches above the channel bottom.

Design & Construction

- Place brush or slash (thin branches with twigs and needles or leaves) across the channel parallel to the flow with butt ends facing upstream. Pack and stomp them down in such a way that the top of the brush layer is more or less level (horizontal).
- Place larger branches and small logs across the upper ends of the brush layer. Ensure that these branches are also as level as possible or together form a slight V-shaped notch in the center across the dam.
- Plug holes in the structure with smaller branches or stones. Place logs or stones on the banks next and slightly above the structure to prevent water from flanking the dam and eroding the banks.
- The larger branches can be wired together with twine for strength and increased stability.



Log Mats

Log Mats are tightly packed “rafts” of tree stems that cover the channel bottom. They reduce channel scour, accumulate sediment, conserve moisture, and shelter young plants. They are most suitable for use in deep rills and narrow gullies (arroyos) with a channel width and depth less than 5 feet.

Design & Construction

- Place a single tier of small logs in the channel bottom parallel to the flow path and ensure that they are secured between each other, the banks, stones, etc.
- The logs can be wired together (with wire or twine) or can be staked in place for increased stability.
- When building a log mat longer than the lengths of the stems being used, start building one log mat at the bottom end of the indicated work area and build a second one upstream which overlaps the first one by 1.5 to 2 feet.
- Very tight, well designed, overlapping log mats are known as Log Step Dams.



Brush Mattresses

Brush Mattresses are branches of green juniper or piñon placed in the bottom of a rill or shallow and narrow arroyo channel to slow erosion, retain sediment, and promote water infiltration and plant establishment. They are most suitable for drainages that carry small amounts of water that would not carry the branches away.

Design & Construction

- Select medium (2-4 ft lengths) to large (4-8 ft lengths) branches and place them lengthwise in the channel and any gently sloping banks, in such a way that the butt ends of the branches points uphill (upstream) and the tip and smaller side branches point downhill (downstream).
- Start at the bottom end of the work area for this treatment and overlap the tips of subsequent layers of branches with the butt ends of the lower branches. Ensure 85%-95% cover (5%-15% bare soil visible between the branches) and do not pile higher than 18 inches of the ground while making sure the branches have optimal contact with the ground (stomp down the mattress of branches).
- Place the branches in such a way that the side branches will impale themselves in the soft, wet soil when pushed down by the force of stormwater runoff during a surface flow event.



Wicker-Weirs

Wicker-Weirs are small dams across an entrenched creek or gully made from juniper pickets and limber branches. Wicker weirs slow and spread flows and retain sediment. As a result, they will hold or raise the grade (bottom level) of a drainage. They are most suitable for small and mid-sized gullies.

Design & Construction

- **Construction:** Drive sharpened (usually juniper) pickets into the channel bed, 12-18 inches apart, in a line perpendicular to the flow. Pickets must extend 15-18 inches above the arroyo bed, while 2/3 of their total length is underground.
- **Keying-in:** Excavate the banks to extend the structure several feet into the banks and prevent water to flank the structure and erode the banks; place stones at the key-in edges.
- **Size:** Pickets should have a diameter of 2-3 inches.
- **Wicker:** Weave limber tree limbs (Rocky Mountain juniper is ideal material), saplings, or willow whips between the stakes. The “wicker” stems should ideally be about ½ inch and a most 1 inch thick.
- **Weaving:** 4-8 layers of wicker material should be woven around pickets (depending on picket height), alternating the weave between layers.
- **Finishing:** Use stones or small logs to plug holes on the upstream side and along the banks and to create a splash apron along the downstream toe of the structure.



Palisade Dams

Palisade dams are C-shaped wicker weirs and are used in medium to large headcuts or across gullies to slow active erosion. They are built in a similar way to wicker-weirs and can be up to 24 inches tall.

Palisade dam
immediately
following
construction



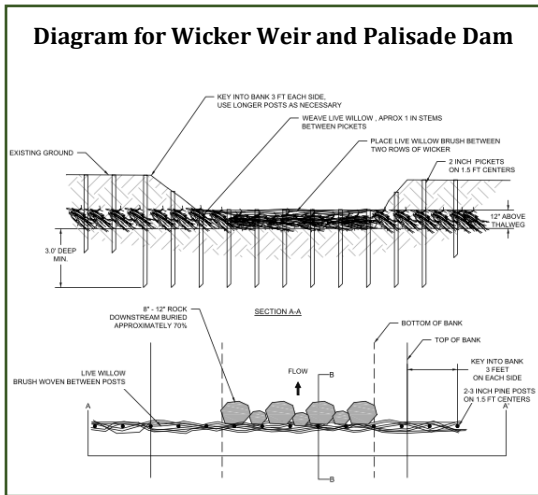
Palisade dam
1 year after
construction



Palisade Dams

Design & Construction:

- Lay out and construct a palisade dam in the same way as a wicker weir, keeping the structure within a few feet and mostly parallel to the actively eroding edge and sides of the headcut. Dig the structure into the banks ("keying it in"), if possible.
- Place fill from the excavation of the post holes between the headcut edge and the structure.
- When the wicker filling of the structure has been completed, excavate ("lay back") the crumbling headcut edge and further fill the void behind the structure, creating a slope behind the structure of approx. 10% between the undisturbed soil above the headcut down to the structure. Tamp well to compact the fill and cover the slope of bare fill material with branches or plant litter.
- Make sure that any holes in the structure are filled with wicker or stones to prevent flanking and undermining of the palisade structure.
- Use existing rock to construct a splash apron at the toe of the structure, as wide as the structure is high.



Log Rack

A Log Rack is used in large arroyos which transport large amounts of water and sediment. Log Rack structures are used to slow down flows and “filter out” the sediment in the water and therefore work well when used in sequence, creating a cascade in the arroyo.

Design & Construction:

- Place 1 or more logs horizontally across the gully at the desired grade level
- Place logs vertically across the first log, packing the logs closely together with small opening to let some water pass through
- An irregular pattern of vertical log lengths is desirable to increase drag on the water and slow it down.
- A spillway of lower logs in the center of the structure could assist medium flows to pass through.
- The vertical logs must be dug a foot or more into the gully bottom and banks and may need to be tied to the cross log with twine to increase stability, or they can be secured with a second cross log across their upstream tips.



Plug & Spread

Unlike the other structures in this book, a plug and spread is typically constructed from excavated fill material (soil) and used to return surface flow to areas that have been starved of water due to flows being concentrated in a gully. However, the core of a plug and berm can be a wicker-weir or log rack covered with fill material.

Design & Construction:

1. Build the plug:
 - Add fill material from bay evenly across the surface in a 3-6-inch-deep layer. Compact the layer and continue to add more layers in the same manner until the gully had been filled. The plug length in the channel should be 4 times as wide as the gully depth. The plug should be tapered at 3:1 slope on both the up and downstream sides.
2. Build the berm:
 - Build the berm perpendicular to the plug and tall enough to route expected flood flows around it (minimum 1 ft above plug). Extend berm beyond gully onto natural soil on each side (~20 ft)
3. Shape the bay:
 - The bay can be created on one side of the gully or both, depending on where you want subsequent flows to be spread. Shape the bay as wide as needed to spread water as widely as possible across the spread zone. The elevation of the bay should be low enough to ensure that flows reaching the plug will change course. Ensure that the brim (downstream edge) is perpendicular to the slope of the land, and that it is level and flat after it has been compacted.
4. Final Steps:
 - Backfill the gully to make sure water is not ponding using fill material from bay.
 - Make sure the brim of the bay is approximately equal in elevation to the lip of the headcut.

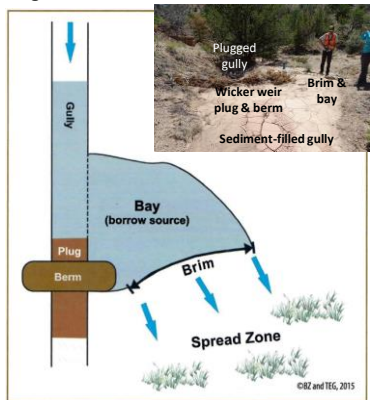


Image from: Zeedyk, William D. and Gadzia, Tamara E. (2015)

When to use what:

Structure:	When to use:
Brush/ logs on contour	Slopes between 4%-12% without advanced gullies or headcuts
Stick & brush dams	Shallow arroyos and drainages with slopes less than 10%
Log mats	Relatively steep, incised gullies less than 5 ft deep and less than 5 ft wide
Brush mattresses	Rills and shallow, narrow or wide arroyos with low flow volumes
Wicker-weirs	Entrenched creeks or arroyos with sandy/cobbly channels with slopes between 2% and 5%
Palisade dams	Wide, actively eroding headcuts up to about 3 feet deep
Log rack	Wide, actively eroding gullies and headcuts deeper than 3 feet
Plug & spread	Narrow, gullied channels that separate and starve a large floodplain of water



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