Colorado Emergency Watershed Protection (EWP) Program

Sponsored by the Colorado Water Conservation Board (CWCB)
Administered by the Natural Resources Conservation Service (NRCS)

coloradoewp.com

River Restoration Design in EWP Projects

The Colorado Emergency Watershed Protection (EWP) Program implements watershed recovery projects designed to reduce flood hazards and protect life and property by enhancing the long-term resiliency of stream systems. This handout provides information to landowners and other partners on general river restoration principles and includes a glossary of common restoration features and treatments likely to be incorporated in EWP projects.

Learn More

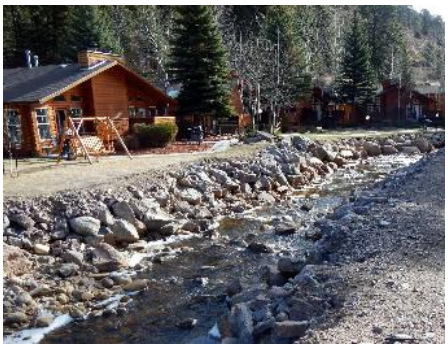
Visit the Colorado EWP website at www.coloradoewp.com for more information. Contact your local project sponsor and/or watershed coalition coordinator for project-specific questions.

Purpose of River Restoration

Rivers are constantly in a state of change, continually adjusting their size and shape in response to the amount of water and sediment in their watershed. Physical channel adjustments are always occurring, and even "stable" rivers shift from year to year. Land use changes that significantly alter or overwhelm the ability of a river to transport water and sediment will cause the river to become unstable and increase the likelihood that catastrophic erosion or sedimentation occurs during a flood event. The purpose of river restoration is to restore rivers to a more naturally stable and functional condition by incorporating specific design features and treatments that encourage a river system's natural processes.

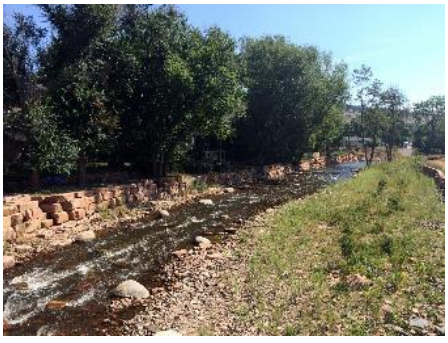
Enhancing Flood Resilience

A common response to floods in the past has been to attempt to **CONTROL** river movement through straightening, channelization, and building berms and levees. These strategies often result in shifting problems upstream, downstream, or across the channel to neighboring properties and can lead to a false sense of safety. In addition, this approach only addresses the river at high flows and inhibits its ability to function during other flow levels. This degraded condition impacts the health of riverine ecosystems and creates maintenance issues for landowners.



Picture 1: A constrained river between two rip-rapped banks

Over the last decade, river management practices have shifted toward an approach to **ACCOMMODATE** natural processes where possible. Giving the river the space for the natural processes of erosion and deposition to occur allows the river to adjust to a more stable form, which means that the river's size and location will change with conditions over time. In developed areas, a strategy of accommodation must occur within the confines of current land uses and prioritize the protection of existing property and infrastructure.



Picture 2: An accommodated river with protection adjacent to homes, riparian vegetation, and space for flows to expand

Project Design Approach

Colorado EWP projects are designed by multi-disciplinary project teams who draw from a range of expertise, including in ecology, aquatic biology, geomorphology, hydrology, and engineering, to consider all the components of a healthy river system holistically. Working with watershed coalitions, landowners, and other partners, project teams establish goals and objectives and identify restoration treatments types that will catalyze natural stream recovery processes to minimize damage and increase resiliency during future flooding.

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River Restoration Features and Treatments Glossary

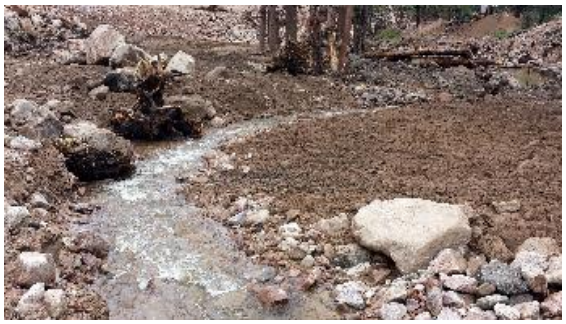
Depending on the particular Colorado EWP project, specific river restoration treatments will be applied to the channel, the bank and adjacent floodplain, and/or the surrounding riparian area. Most treatments have multiple benefits. The following is an alphabetical list of potential treatments that may be implemented in local EWP projects.

Benches and Bars

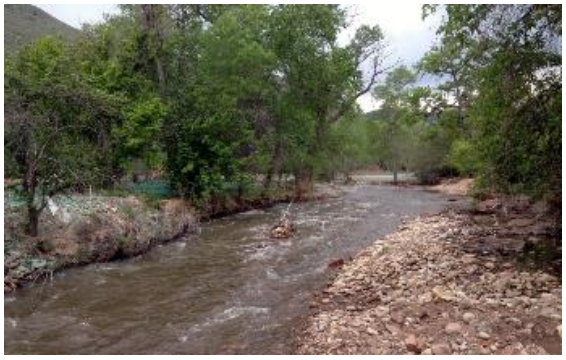
Benches are generally flat areas within and outside of the main channel that allow water to spread out and thus reduce the erosive energy of a stream. Their flat slopes make them excellent areas for growing plants.

Point bars are areas of sediment deposition that form on the inside bends of river meanders.

Benches and bars are formed by natural stream channel processes over time but will be created during the EWP restoration work to attempt to accelerate this natural process.



Picture 3: Constructed point bar on the Little Thompson River in Pinewood Springs, Colorado



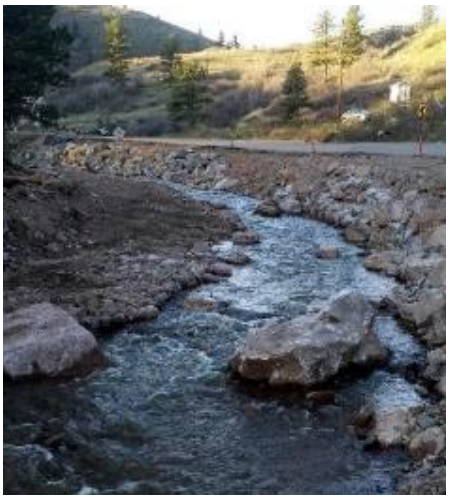
Picture 4: Natural point bar on North St. Vrain Creek in Apple Valley near Lyons, Colorado

Purpose/Benefits

- Distribute and therefore reduce river energy
- Reduce the width of the channel and increase its depth to enable fish and other aquatic organisms to pass through during low-flow conditions.
- Encourage natural sediment transport processes
- Increase floodplain capacity
- Provide ecological benefit by adding complexity to the channel
- Create areas for planting

Boulders

Large boulders or boulder clusters may be strategically placed within the channel, streambanks, and benches as a restoration treatment.



Picture 5: Boulders in North St. Vrain Creek near Lyons, Colorado

Purpose/Benefits

- Create habitat for fish and other aquatic organisms
- Create “roughness” to increase turbulence and reduce water velocities

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Channel Position

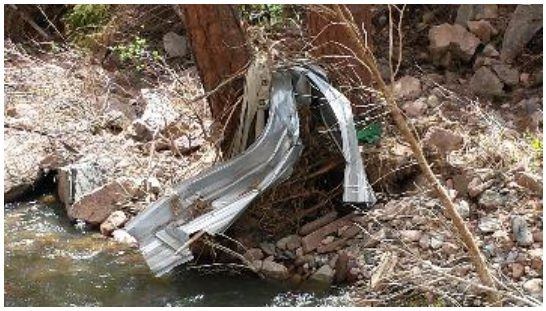
Streams do not have a fixed position naturally but meander over time and space, creating new bends and moving to different locations within the floodplain. Intermittent or transient positions can sometimes be unstable. To accelerate natural processes, river restoration projects may move or realign a channel into a location that is more likely to be stable during both low and high water events.

Purpose/Benefits

- Realign to a historic channel or one likely to be created during a future flood event
- Move the channel to provide a more stable approach to a bridge or other crossing
- Increase the channel length to reduce slope and allow additional meanders, which helps to slow velocity, dissipate energy, and minimize bank erosion

Debris Removal

Debris removal is an important element of many flood recovery projects. Debris includes hazardous materials, building materials, and trash such as household items that were transported, deposited, or buried during the flood.



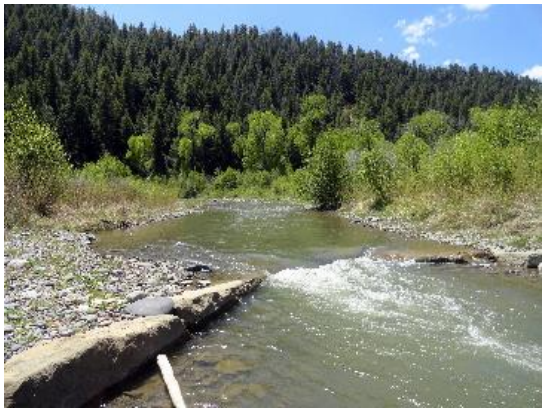
Picture 6: Flood debris snagged in a tree on North St. Vrain Creek near Lyons, Colorado

Purpose/Benefits

- Eliminate debris from being washed into the channel during a high-flow event and clogging a culvert or bridge
- Reduce snagging of additional debris
- Remove a safety hazard
- Enhance aesthetics

Grade Control Structures

Grade control structures are man-made stream features designed to control the elevation of the streambed and maintain floodplain connectivity to reduce the likelihood of severe scour and erosion, direct erosive flows away from banks, and aid in the maintenance of habitat features. These structures are sometimes set into the bed of the stream to be nearly invisible. Others are set to pass water from a higher elevation to a lower elevation while controlling the water's energy and velocity as it moves over the structure. The most common grade control structures incorporated into river restoration projects are "cross vanes" and "J-hook vanes."



Picture 7: Cross vane on the Rio Blanco River in Pagosa Springs, Colorado

Purpose/Benefits

- Reduce scour and maintain floodplain connection
- Divert water toward the center of the channel and away from its banks, minimizing bank erosion
- Create pools to provide cover for fish and other aquatic organisms
- Improve water quality through aeration

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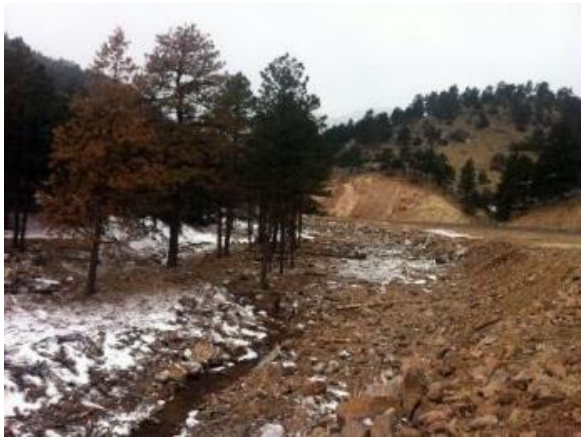
Multi-Stage Channels

Multi-stage channels, or nested channels, are channels with a range of flow-carrying capacities that are inundated at different times of year as the amount of water in a river changes. They typically contain an inner low-flow channel to maintain aquatic habitat during baseflows, a bankfull channel that conveys typical high flows, and a floodplain bench to accommodate flood flows.

Purpose/Benefits

- "Multi-stage, or nested, channel designs, provide a means to create naturally stable channels that convey floods and provide quality habitat for aquatic organisms." (Colorado Parks and Wildlife 2015)
- Address the problem of over-widened channels, which are too shallow to sustain fish during low flows, lack the capacity to effectively transport sediment, and increase water velocities, leading to bank erosion
- Support other river functions such as healthy riparian corridors, continued exchange of nutrients and sediment, groundwater recharge, and channel maintenance



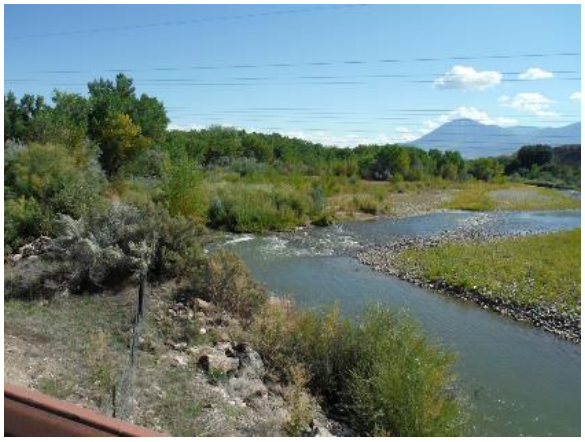
Picture 8: Meandering multi-stage channel (with water in the low-flow channel) on the Little Thompson River near Pinewood Springs, Colorado

Pools

Pools are deep areas that have relatively slow water flow during base flow conditions. Pools are one of the habitat types that comprise a healthy river corridor. In natural systems, they are typically created by erosion on the outside bends of rivers (with point bars occurring on the inside bends), by the transition from a steep to a shallow slope (such as at the end of a drop or cascade), or by a pinching down of the streambanks (from wood being lodged in a stream or where bedrock protrudes into the channel).

Purpose/Benefits

- Dissipate and/or concentrate erosive energy, thus maintaining bank and channel stability
- Provide a refuge for aquatic organisms from high-velocity waters and extreme temperatures
- Promote habitat complexity by offering diverse areas of cover and food
- Act as spawning and rearing areas for fish
- Backwater pools, found in side channels off of the main river stem, further increase aquatic and riparian habitat diversity and provide an area of shallow, slower-moving water for aquatic species, particularly juvenile trout.



Picture 9: Riffle-pool sequence on the North Fork of the Gunnison River in Hotchkiss, Colorado

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Riffles

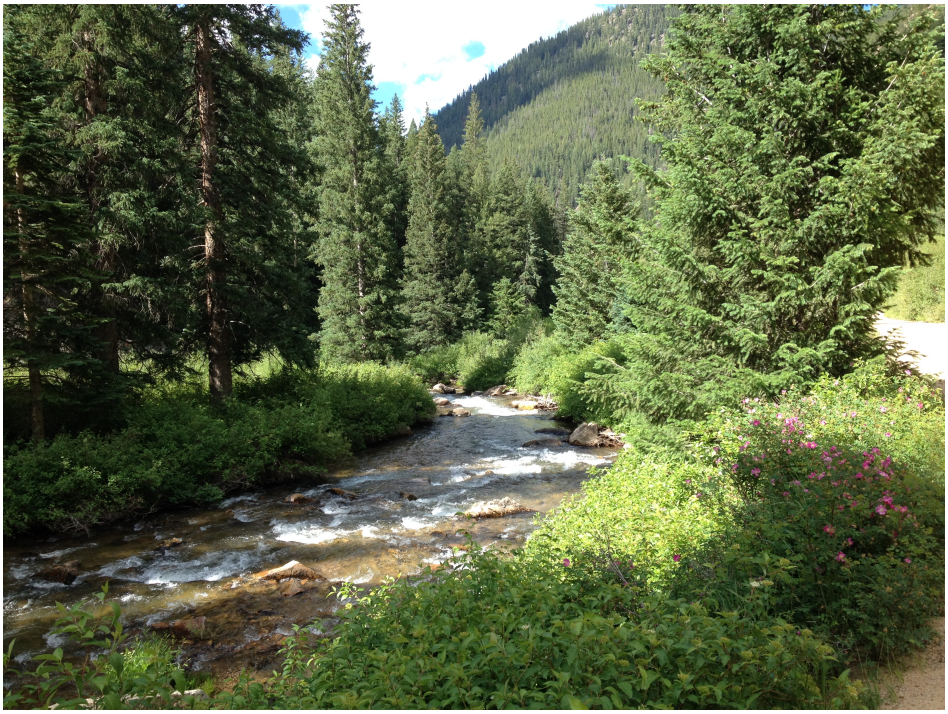
Riffles are shallow sections of stream with relatively fast-moving water created by gravel, cobbles, and/or boulders. Riffles are one of the habitat types that comprise a healthy river corridor.

Purpose/Benefits

- Help to create river meanders and pools
- Provide a diversity of habitats for aquatic organisms
- Oxygenate the water as it flows over rocks

Riparian Vegetation

Riparian revegetation is a vital component of a river restoration project, providing both physical and ecological benefits. Both woody and herbaceous plants should be included in revegetation activities to provide a more diverse habitat for a wide range of terrestrial and aquatic organisms. Riparian vegetation accounts for the most biologically diverse habitat areas in Colorado, supporting a complex network of insects, birds, reptiles, amphibians, and mammals.



Picture 10: Example of a healthy riparian corridor on Spring Creek in Taylor Park, Colorado

Purpose/Benefits

- Physical benefits: stabilize banks, reduce erosion, slow water velocities, and dissipate energy from high-flow events
- Ecological benefits: improve habitat diversity, provide shade to cool stream temperatures, filter pollutants, and increase organic matter to benefit aquatic organisms
- Increase project sustainability and cost-effectiveness by taking advantage of "adventitious roots," a characteristic of woody vegetation such as willows and cottonwoods. Roots of these plants can form from any bud (not just from the bottom of the plant) when the plant comes in contact with moist soil. If a stem breaks loose and flows down the river or becomes dislodged during a flood, the stems can root in the muddy river banks.

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Sediment Removal

Sediment removal is a critical component of many Colorado EWP flood recovery projects. In many cases, flooding has caused excessive bank erosion and large volumes of sediment beyond the river's capacity to carry have been deposited in the channel and on the floodplain.

Purpose/Benefits

- Increase floodplain capacity, creating more space to store future floodwaters and additional sediment
- Restore sediment transport, making the channel a more habitable environment for aquatic organisms and spawning fish

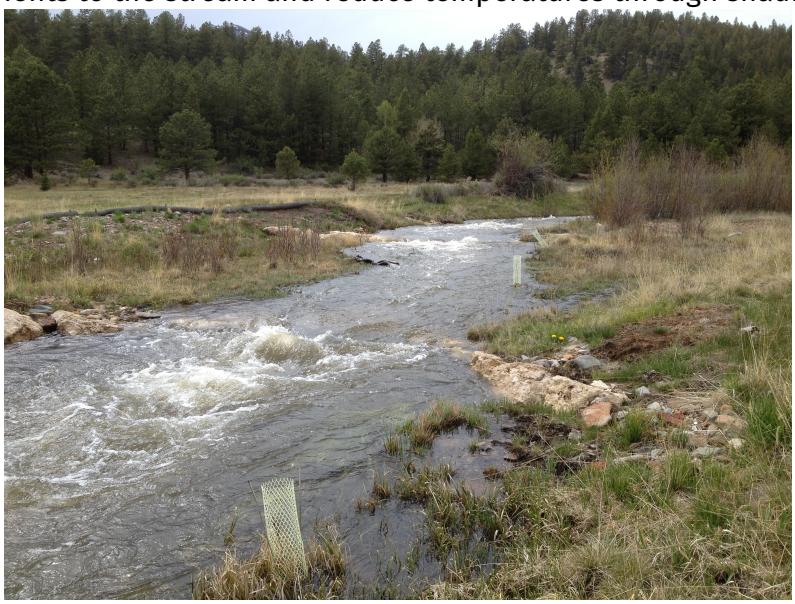
Picture 11: Excessive sediment deposited as a result of flooding on Fall River in Estes Valley, Colorado

Streambank Soil Bioengineering

Streambank soil bioengineering is a useful and natural alternative to rock armoring for bank stabilization and erosion control. Bioengineering approaches use plant matter in combination with natural materials such as wood and rock, and sometimes manmade materials, to stabilize slopes, reduce erosion, and establish riparian vegetation.

Purpose/Benefits

- Stabilize banks and reduce erosion using natural materials
- Reinforce and strengthen banks by using the large web of plant roots that bind the soil together and grow stronger over time as vegetation becomes established
- Help to develop a healthy riparian corridor
- Provide ecological and aesthetic benefits
- Contribute nutrients to the stream and reduce temperatures through shading



Picture 12: Example of streambank soil bioengineering on Kerber Creek in Villa Grove, Colorado

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Wetlands

Floodplain wetlands are areas where a high water table changes the ecological makeup of the plant and wildlife communities. They are a naturally occurring component of a healthy river corridor and help to store water and sediment during a flood.

Purpose/Benefits

- Increase storage areas for water and sediment during a flood
- Act as a filter to improve water quality
- Provide habitat, spawning, and nesting grounds for a diversity of aquatic and terrestrial species

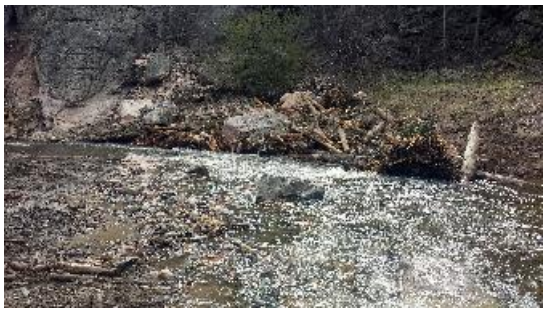
Picture 13: Inundated floodplain wetland on the North Fork of the South Arkansas River in Poncha Springs, Colorado

Wood

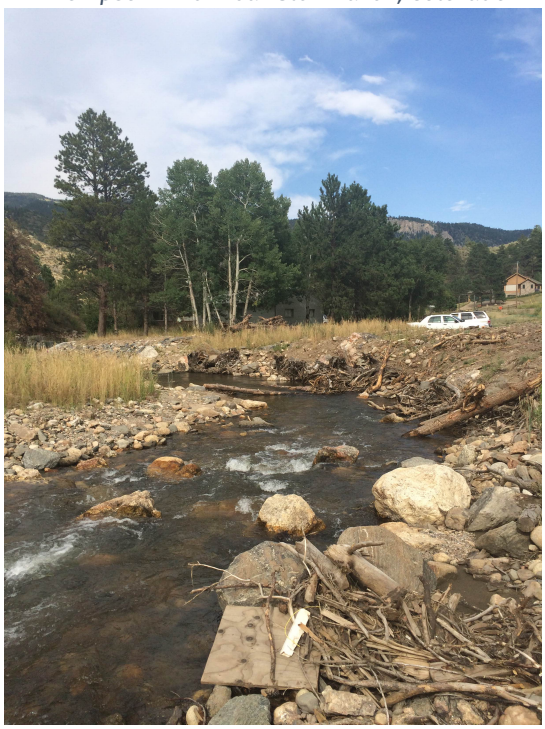
Large woody material is a component of natural river systems and can be incorporated into the river banks, the channel itself, or the adjacent floodplain as a restoration treatment. Depending on the application and purpose, as well as available materials, use of large wood can take the form of single logs, logs with their root system intact ("root wads"), or engineered log jams (clusters of strategically-placed logs).

Purpose/Benefits

- Stabilize streambanks by slowing or redirecting stream currents through addition of "roughness" to the channel, bank, or floodplain
- Create microhabitats and provide cover for fish and other aquatic organisms
- If used on the floodplain, capture fine sediments, organic materials, and native seeds for riparian vegetation re-colonization



Picture 14: Wood jam on the North Fork of the Big Thompson River near Glen Haven, Colorado



Picture 15: Engineered log jam on the North Fork of the Big Thompson River near Glen Haven, Colorado

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