Pike National Forest Watershed Resiliency
Final Report

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Colorado Watershed Restoration Program
Attn: Chris Sturm

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Rocky Mountain Field Institute

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RMFI
ROCKY MOUNTAIN FIELD INSTITUTE

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Introduction

Rocky Mountain Field Institute (RMFI) is a 501(c)(3) environmental stewardship nonprofit with over 40 years of experience conserving, protecting, and improving natural areas in southern Colorado and the Pikes Peak region. In 2022 RMFI was awarded funding from the Colorado Water Conservation Board's (CWCB) Watershed Restoration Program to support a multi-year, multi-faceted watershed health improvement program in key areas of the Pike National Forest. Watersheds are critical components of ecosystem health and function. Water from Colorado's forests support a variety of uses including public drinking water, agriculture, industrial uses (including mining), recreation, and habitat for aquatic life. Forests exert a strong influence on the quantity and quality of water within watersheds by protecting soil and preventing erosion, enhancing soil moisture storage and groundwater recharge, reducing flooding, filtering contaminants and maintaining the plant communities that also contribute to this process. Forest plant communities have a direct and significant effect on both the production and quality of stream health and fresh water supply. Properly functioning riparian corridors and stream channels are essential in managing pre- and post-wildfire behavior and storm events. They act as a buffer to fire extremes and manage flood and debris flows and kinetic energy release. However, wetland, riparian, and stream health conditions vary considerably across the nation.

In the U.S. Forest Service (USFS) Rocky Mountain Region (Region 2), insect and disease, livestock grazing, transportation, recreation, mining, conifer encroachment, and urban encroachment account for many of the historical and ongoing concerns. As a result, the most common water quality problems on national forests are increases in nutrients, stream water temperatures, and sediment loads (turbidity and bedload). Restoring functionality within these systems helps improve their resiliency to catastrophic events including fire and flooding, resulting in increased ecological diversity, improved stream health, and water quality. The increasing size, severity, and frequency of wildland fires and their impact on water resources compels land managers and resource managers to take a proactive, adaptive management approach to watershed management. Land managers and hydrologists with the Pike National Forest identified a number of locations on the Forest that required adaptive management and treatment to protect critical watersheds. As part of this effort, RMFI played an important role in the implementation of a variety of treatment strategies including stream bank stabilization, trail and restoration treatments, forest thinning, and erosion control treatments. These activities, collectively, function as an interrelated set of actions to help protect water quality, improve habitat conditions, minimize erosion, and enhance watershed health and function.

Background

The multi-year, multi-faceted project was guided by a tremendous amount of research and collaborative initiatives. RMFI played a key role in many of these initiatives, and leaned on our 40-year history of environmental stewardship to assist with collaborative efforts in planning and implementation of the project. Prior to project implementation, RMFI completed similar restoration efforts along the Pikes Peak Highway corridor, erosion mitigation and restoration efforts in the Bear Creek Watershed to help protect the threatened Greenback Cutthroat trout, and conducted post-fire restoration work in the Waldo Canyon and Black Forest burn scars, including hillslope stabilization, erosion control, and riparian restoration projects. Our past experience with watershed restoration and protection proved to be incredibly valuable during implementation of the Enhancing Watershed Resiliency project. As the scope of the project covered multiple years and multiple work sites, a number of different documents and reports were used to guide our actions. A primary document used to guide our actions is a U.S. Forest Service project proposal titled "Investments in Wetland, Riparian, and Stream Health: Taking a Proactive Approach to Land Management." Not only does this document provide overall strategies for managing and improving resiliency of riparian areas and watersheds, it also details specific management activities for a number of locations on the Pikes Peak Ranger District, including the Waldo Canyon and Hayman Fire burn areas, the Bear Creek Watershed, Upper Monument Creek, and the Trout Creek landscape. Specific activities outlined in the document implemented during this project include the removal of encroaching coniferous vegetation to reduce fuel loading and increase watershed resiliency, soil stabilization measures on hillslopes lacking sufficient ground cover to hold back sediment, and trail improvements to mitigate erosion and run-off.

Another guiding document RMFI relied on was the Environmental Impact Statement for the Upper Monument Creek Landscape Restoration Project developed by the USFS. While this document was specific to the Upper Monument Creek landscape, and was invaluable during our management activities in the area, many of the guiding principles it outlined were applicable to a number of the other project locations RMFI worked on.

RMFI has been an active participant and leader of the Bear Creek Roundtable, a collaboration of about two dozen agencies and organizations dedicated to protecting the threatened greenback cutthroat trout and its habitat in Bear Creek. RMFI has been a key partner in the discussions surrounding Bear Creek, and has worked for many years to help improve the watershed and protect the fish. RMFI relied heavily on our experiences with Bear Creek, as well as the guiding documents that were produced as a result of this collaborative approach, including the USFS Bear Creek Watershed Assessment and the Environmental Assessment Decision for the Bear Creek Watershed Restoration Project.

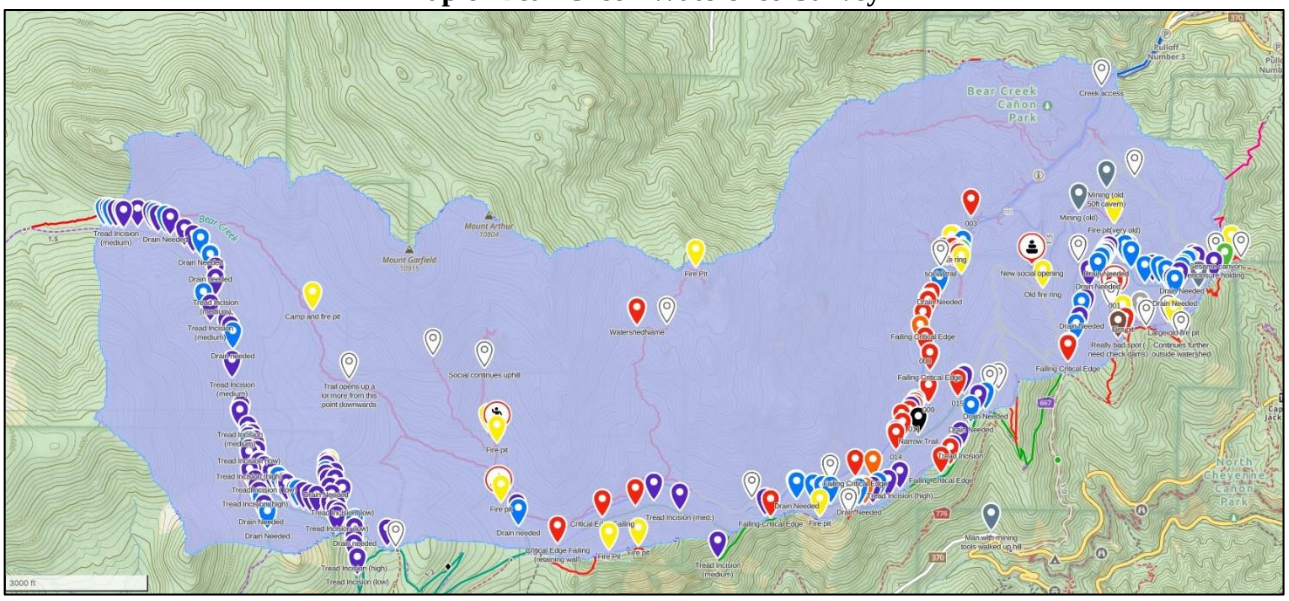
The overarching goal of this project was to enhance watershed resiliency in key areas of the Pike National Forest. Specific watershed health improvement projects included: conducting landscape restoration to facilitate improved water quality; wildfire resiliency; native vegetation rehabilitation; invasive species control; erosion control techniques and mitigation; trail design, reconstruction, and maintenance; improvements trail drainage and sustainability; providing educational opportunities; aquatic and terrestrial wildlife habitat improvements; and assessment and monitoring.

RMFI worked closely with the U.S. Forest Service to identify key project locations each year of the project period. Over the course of the three-year grant period, RMFI completed watershed health improvement activities at three Pike National Forest properties. Please see below a Site Summary for each project site at which work was completed under this grant:

Bear Creek Watershed

Located just minutes from downtown Colorado Springs, the Bear Creek Watershed is home to the last remaining self-sustaining populations of the threatened Greenback Cutthroat Trout. The population of trout in Bear Creek is an important brood stock used for reintroducing the species into other watersheds and is of the highest priority for habitat protection. The focus of RMFI's stewardship work in the Bear Creek Watershed was to close and restore unsustainable illegal trails (cause significant sedimentation into Bear Creek), improve drainage, stabilize hill slopes, and control erosion. The primary soil type in the Bear Creek watershed is highly erosive decomposed Pikes Peak granite. The decomposed granite is well known for its erosive nature and is susceptible to significant sedimentation into nearby waterbodies. RMFI worked closely with the USFS Pikes Peak Ranger District Fisheries Biologist and Hydrologist to develop detailed prescriptions for addressing illegal trails and erosion issues in the watershed. The prescriptions called for illegal trail closure and restoration, installing signage, constructing check dams and retaining structures, and planting native grasses and shrubs. The work prescriptions provided multiple positive outcomes including mitigating erosion caused by the illegal trails and improving the wildland fire resiliency of the watershed by thinning the dense conifer slopes. RMFI also completed a comprehensive mapping survey of the watershed in the spring of 2024. Results from the survey project identified extensive social trail development and dozens of critical erosion and drainage issues. Results from the survey will guide future activities in the watershed (Figure 1). RMFI completed a total of 125 workdays completing stewardship projects in Bear Creek over the course of the three year grant period.

Map of Bear Creek Watershed Survey



Rampart Reservoir Recreation Area

The Rampart Reservoir Recreation Area is a popular recreational area located northeast of Woodland Park, CO and under a 30-minute drive from Colorado Springs. Rampart reservoir is popular with a variety of user groups including hikers, mountain bikers, anglers, and water sports recreationists (kayak, stand up paddle board, canoeing etc.). Rampart Reservoir serves both as a favorite outdoor recreation destination for residents and visitors to the Pikes Peak region and as an important source of drinking water for the city of Colorado Springs. Its importance as a municipal water source requires special care and attention to ensure the quality and integrity of the water is maintained and improved. RMFI completed watershed protection projects at four distinct project sites in Rampart Reservoir Recreation Area: the Homestake Fishing area, Promontory Picnic Area, Meadow Ridge Campground area, and the primary day use parking area northwest of the dam (Figures 2-5). Specific treatment activities were designed in collaboration with the US Forest Service Hydrologist and included erosion control check dam installation, erosion control matting

installation, retaining wall construction, and drainage improvements. RMFI completed 35 workdays completing stewardship project at Rampart Reservoir over the course of the three year grant period.

Homestake Fishing Worksites

Promontory Picnic Ground Worksites

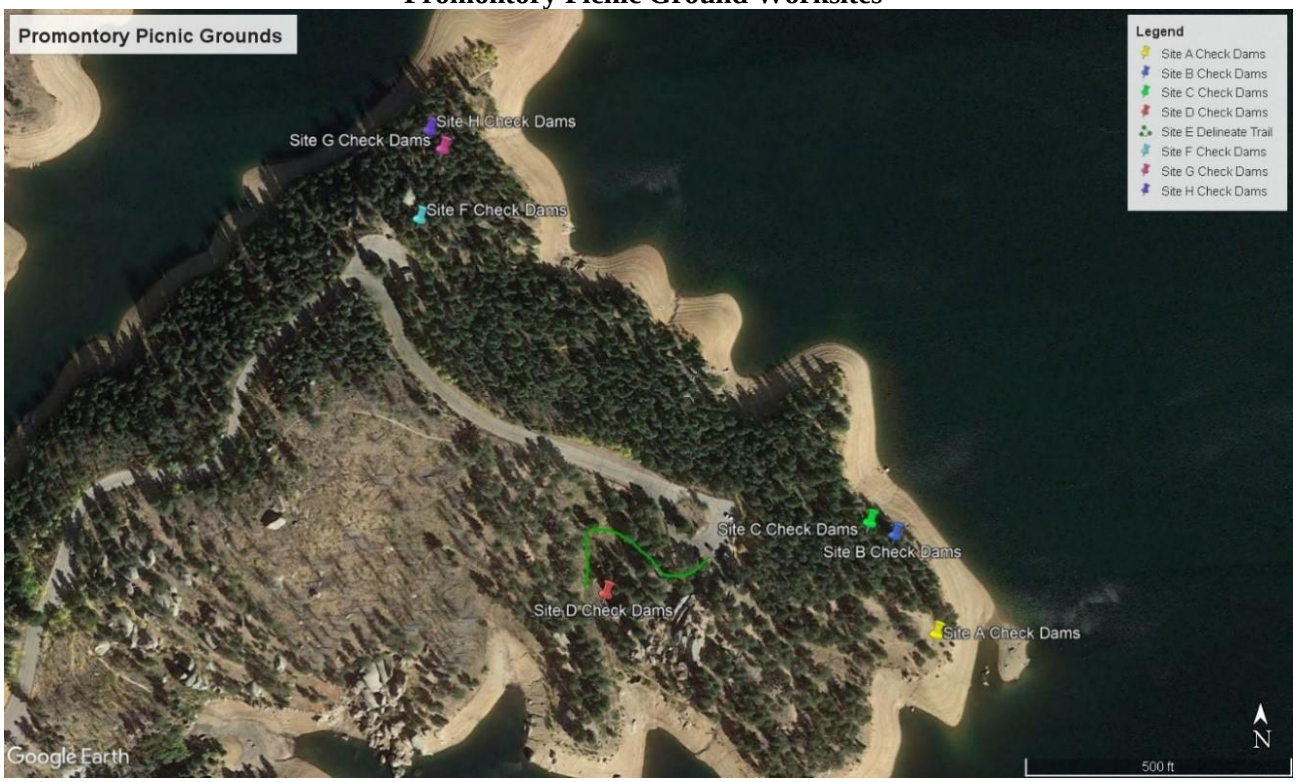


Figure 4. Meadow Ridge Worksites

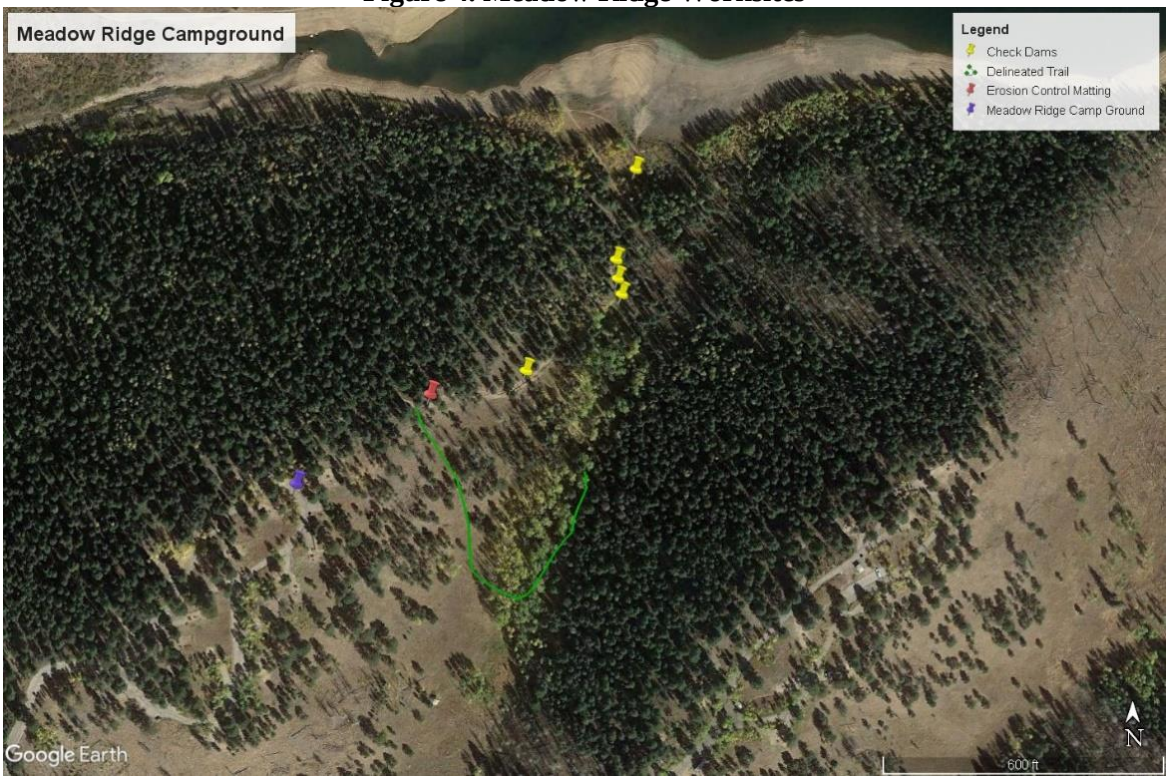


Figure 5. Parking Lot Worksites

Manitou Lake

Manitou Lake is a 5-acre day-use recreation area located roughly 7 miles north of Woodland Park, CO. Manitou Lake is a popular spot for fishing, hiking, and picnicking. The high volume of use, particularly by fishermen accessing the lake, is causing significant degradation of the shoreline and surrounding area. RMFI collaborated with the US Forest Service Hydrologist to design treatment plans for this popular recreation area. Priority objectives including hardening fishing access points with rock steps and armoring, constructing retaining structures to mitigate excessive sedimentation into the reservoir, and improved trail sustainability. RMFI completed a total of 14 workdays completing stewardship projects at Manitou Lake Recreation Area over the course of the three-year grant period.

Manitou Lake Worksites

Methods

The scope of the multi-year, multi-faceted project required significant planning and coordination. RMFI worked closely with our partners to identify project priorities each year. RMFI and U.S. Forest Service staff participated in numerous site visits each year to determine goals and objectives for each work site. Detailed assessment notes were recorded, including treatment prescriptions, GPS data, and photo documentation. The results of those assessments dictated the implementation approach for each site. While many of the objectives for each site were similar (conifer encroachment removal, stream bank stabilization, erosion control etc.) the unique nature of each site required individual scopes of work.

The success of this project was only made possible through the collaborative efforts of multiple agencies, organizations, and individuals. RMFI leveraged funding from the CWCB and the U.S. Forest Service to maximize project outputs and outcomes. CWCB funding supported every facet of the program including staff time for pre-project planning and coordination, collection of site notes and data, and drafting of scopes of work and project oversight. CWCB funding also supported the hiring of seasonal staff who implemented the work plans in the field as well as operational costs of the project. CWCB also supported post-project evaluation, monitoring, and reporting activities.

RMFI employed a crew of 5-6 highly trained RFMI staff to implement project work each season. RMFI staff are trained in timber stand improvement, trail maintenance, and erosion control and active restoration techniques. RMFI staff are also trained in back country medicine and Leave No Trace. In addition, community volunteers were engaged at a select number of project locations.

Timber Stand Improvement and Fire Mitigation

Due to the significant chainsaw work required to complete the types of treatments necessary, all staff on the project were S212 chainsaw certified. Having a crew fully certified to operate chainsaws greatly increased our productivity on project work. Timber stand improvement and fire mitigation prescriptions varied across project sites. U.S. Forest Service personnel determined prescriptions for each site, and RMFI staff implemented the prescriptions.

Lop and Scatter

RMFI felled conifer species 10" DBH or less. Felled trees were "topped", removing the upper most portion of the crown of the tree, and partially limbed. Felled trees were limbed such that the trunk and bole of the tree had good connectivity with the ground to mitigate the creation of ladder fuels. All limbed slash was scattered on the forest floor, away from the base of live trees and stream channels. Slash was widely scattered to reduce heavy fuel loads in one area.

All conifer trees greater 20" DBH or greater were retained. Retaining large conifers promotes the biodiversity of the area and increases structural diversity.

Trail Maintenance

RMFI has over 40 years of experience building and maintaining natural surface trails. While trails provide outdoor recreation opportunities and access to the outdoors for millions of people, heavy use of trails has serious impacts to surrounding natural resources, particularly if trails are not adequately maintained. Several scopes of work for the watershed health enhancement project called for trail maintenance activities near critical creeks, streams, and other riparian areas. A properly maintained trail will keep users on the established trail tread and protect the surrounding areas from impact. A key component of a trail is the critical edge. If the critical edge of a trail is compromised (often by users navigating around wet, snow covered, or otherwise obstructed portions of trail), the trail will quickly erode, and sediment and soils in and around the trail will run-off into water sources.

Over the 3-year grant period RMFI implemented a number of different trail maintenance treatments to prevent the erosion of trails and to mitigate impacts to water sources.

Grade Dips/Drains

Grade dips and drains are constructed to divert water off trail, reducing erosion and protecting the trail from incision. An incised trail can quickly become a large gully, which increases water velocity and exacerbates further erosion. Drains also mitigate standing water on the trail, which users often cut around, compromising the critical edge. The strategic placement of drains has a tremendous effect, improving the overall quality of a trail and greatly reducing impacts to natural resources and water sources.

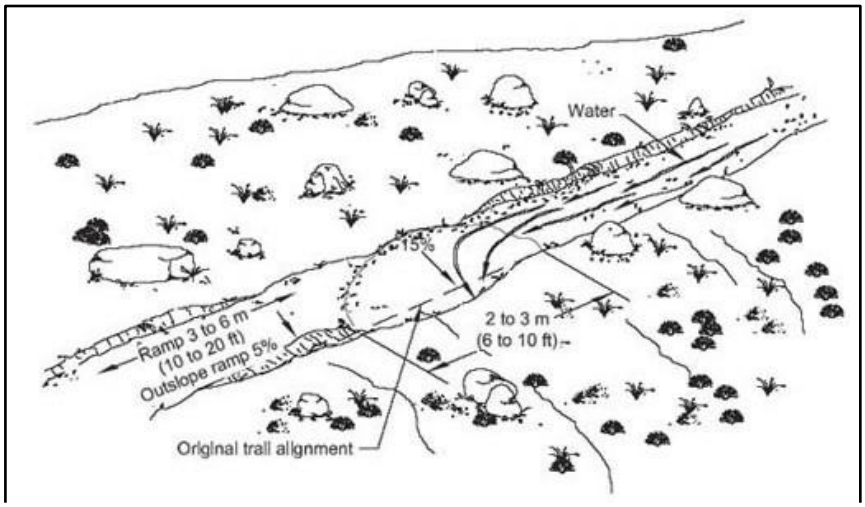


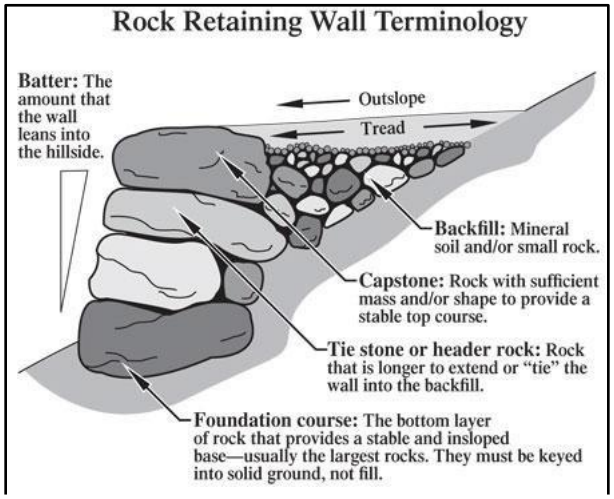
Diagram of a properly constructed grade dip and drain.

Cobbling/Paving

At locations where drain construction was impossible, cobbling or paving a portion of trail was used. Cobbling is useful in low lying sections of trail that collect water and snow melt. Setting stones in these low-lying areas raises the trail tread and protects the trail from erosion.

Retaining/Barrier Walls

Retaining walls and barrier walls are useful treatments in areas with steep side slopes. As water runs downhill, it collects sediment and soil, compromising the stability of the slopes. Retaining walls are installed to help hold the sediment and to support the steep slopes. Though more time consuming than other treatments, walls are often the most appropriate and effective treatment.



Cross section of a rock retaining wall.

<u>Erosion Control/Active Restoration</u>

Erosion control and active restoration were the primary treatments for many project locations. User created social trails are a major contributing factor to erosion and impacts to riparian areas and water quality. The closure and restoration of these undesignated trails was critical to our success on the project. Social trail closure includes the obstruction and closure of points of egress, decompacting the existing social trail, planting native seeds and transplants, further disguising the trail, and the strategic placement of erosion control structures. RMFI also addressed erosion on hillslopes and streambanks to reduce

impacts to streams, creeks, and other water sources. Check dams, log erosion barriers (LEBs), and strategically felled trees all serve to reduce the velocity of run-off, collect sediment, and stabilize slopes.

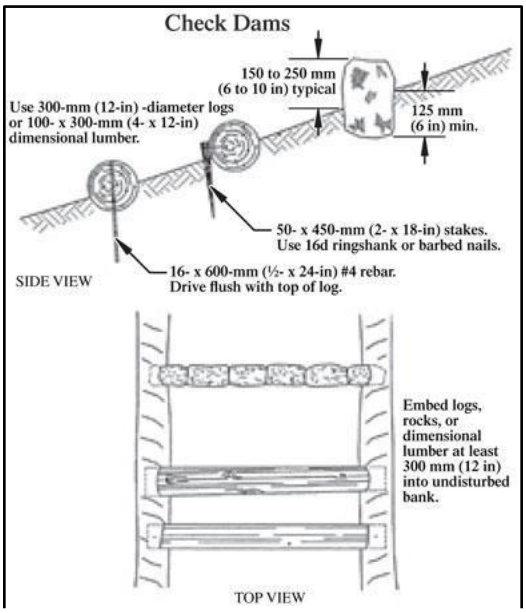
Social Trail Closure

RMFI implements a proven 5-step restoration process for closing and restoring social trails.

1. Decompact Trailbed – Well established social trails often have very compacted socials, impeding revegetation and restoration. Trails were decompacted at least 4-6 inches in depth prior to any revegetation activities (planting seed, transplanting native plants), avoiding existing vegetation and woody materials.
2. Regrade/Address Erosional Water Flow – Once the trailbed has been decompacted, it is important to address any structural issues on the trail (incision, gullying etc.). Often this can be accomplished by simply recontouring the existing trail. Additional fill material may be required to achieve appropriate grade. In highly impacted and deeply incised areas, additional treatments may be required. The installation of check dams can help prevent water from running the length of the trail, picking up speed and sediment as it moves. Check dams are designed to back fill with sediment over time, bringing the trail back to grade.
3. Revegetation – Once erosion is addressed, re-vegetation treatments are applied to achieve long-term slope stabilization and to develop a self-sustaining, native plant community. Spreading native seed and transplanting native plants in the area help reestablish a native plant community and further disguise the area.
4. Minimize Visibility and Access – As long as use continues on restored areas, erosion control and re-vegetation attempts will be unsuccessful. Camouflaging the restored rogue trail or blending it into its surroundings with on-site natural materials attracts less attention and deters continued use. An effective technique that RMFI implements is the strategic felling of trees at points of entry, particularly in more remote locations where other barriers (fencing, signage) are impractical. Trees are felled at critical choke points to obstruct access to the trail and to disguise the existence of the trail. Slash and other debris is scattered along the length of the trail to further disguise and naturalize the area.
5. Stabilize Trailbed – Other erosion treatments may be required on the most severely eroded sections of social trail. These areas require significant structural treatments to address erosion issues. Some examples of additional treatments include sub-surface stabilization structures, multi-tiered check dams, and erosion control matting.

Check Dams

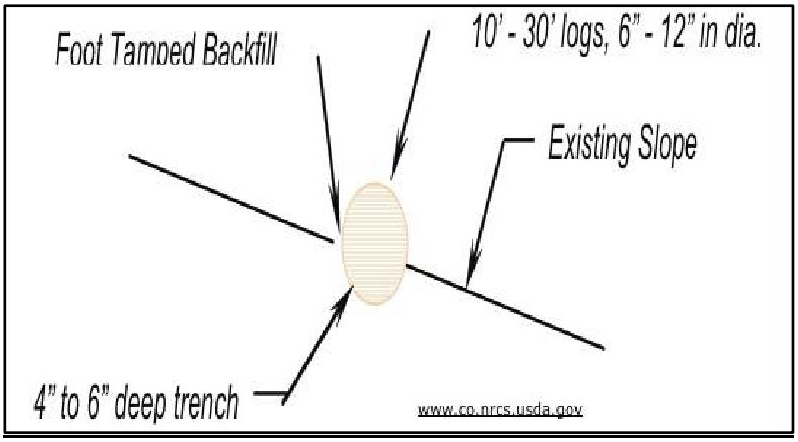
Check dams are important tools used to address erosion on steep slopes and sensitive areas. Check dams can be constructed with rock, naturally sourced logs, or treated timber. The type of material is dependent on available resources and the project scope of work. Check dams are installed in incised or gullied sections of social trail or surrounding natural areas, perpendicular to the direction of water flow. Check dams serve several purposes. First, check dams slow the velocity of flowing water, reducing the water's sediment carrying capacity. Slower moving water has less erosive potential. Check dams also collect sediment from run-off, back filling the check dam. Over time, the check dam will gradually bring the area back to grade with the surrounding area. In deeply gullied areas, and additional tiers may be required to continue the process.



Side view and top-down view of various types of check dams.

Log Erosion Barriers (LEBs)

Log erosion barriers serve a similar function to check dams, but are used primarily on hillslopes rather than in deeply gullied areas. Naturally and locally sourced logs are placed parallel to the contour of a hillside, perpendicular to the directional flow of water. A shallow trench is dug, the log is placed in the trench, and is then secured with stakes. LEBs increase infiltration, add roughness, reduce erosion, and help retain small amounts of soil on site.



Side view of a properly constructed Log erosion Barrier (LEB).

Results

RMFI completed 174 individual workdays performing watershed health improvement work at three unique work sites over the 3-year grant period. Project results and accomplishments are detailed below by project location. Before and after photo documentation of completed stewardship projects are also included below.

Bear Creek Watershed

- Trail Tread Improved/Maintained: 432 linear feet
- Tread Armored: 31 square feet
- Drains constructed: 143 drains
- Drains Maintained: 129 drains
- Rock Retaining Wall Constructed: 8 square feet
- Timber Retaining Wall Constructed: 285 square feet
- Social Trails Closed & Restored: 24,140 linear feet (~4.6 miles)
- Check Dams Installed: 196 checks
- Native Seed for Restoration: 5 pounds
- Native Transplants for Restoration: 95 plants
- Acres of Fire Mitigation Treatment: ~20 acres
- Signs Installed: 8 signs

Before and after of Trail #666 closure

Before and after of fortified check dam

Before and after of Sesame Canyon Trail Closure

Before and after of check installation

Rampart Reservoir

- Trail Tread Improved/Maintained: 921 linear feet
- Drains constructed: 8 drains
- Drains Maintained: 3 drains
- Rock Retaining Wall Constructed: 54 square feet
- Timber Retaining Wall Constructed: 36 square feet
- Impacted Area Stabilized/Restored: 2,499 square feet
- Check Dams Installed: 142 checks
- Native Seed for Restoration: 2.35 pounds
- Signs Installed: 5 signs

Before and after of check dam installation

Before and after of retaining wall construction and erosion control matting installation

Before and after of check dam installation

Before and after of check dam installation

Manitou Lake Rec Area

- Rock Steps Constructed: 14 steps
- Rock Retaining Wall Constructed: 35 square feet
- Timber Retaining Wall Constructed: 49 square feet
- Bridges Constructed: 1 Bridge
- Check Dams Installed: 2 checks
- Native Seed for Restoration: 2.35 pounds

Before and after of retaining wall construction

Before and after of rock step construction

Volunteer Engagement

RMFI strives to engage the community in all of our stewardship activities. Community engagement is essential in everything that we do, and we are appreciative of all of the volunteers who supported our watershed health projects. Below is a summary of our volunteer engagement on these projects, as well as photos documenting our volunteers hard at work.

- Number of volunteers: 21 volunteers
- Volunteer Hours: 169.5 hours
- In-kind Value of Volunteer Time (per independentsector.org): $4,272.30

Conclusions and Discussion

RMFI conducts post-project monitoring at the conclusion of each project. Post-project documentation includes before and after photos of the work accomplished, detailed work metrics, and periodic reports to CWCB and other partners. Post-project assessment and monitoring indicate that, overall, treatments applied were very effective. Trail maintenance and erosion control treatments significantly reduced run-off and sedimentation into critical water resources. The social trail closures in Bear Creek has proved to be very successful. The robust closure and restoration of these trails has deterred access and use, and allowed the area to revegetate. Anecdotal evidence indicates that the reduced use has limited erosion and improved water quality in Bear Creek, enhancing habitat for the greenback cutthroat trout. Maintenance on designated trails has also proven successful in improving sustainable drainage, limiting sedimentation, and limiting social trail proliferation. The treatments provide multiple benefits. First, improvements to the designated trail (retaining walls, drains, tread cobbling) make the trail more attractive to users. The improvements ensure the trail is more sustainable and will mitigate the creation of future social trails. Second, closure and restoration of the social trail has reduced impacts to the surrounding natural resources and water bodies. Check dams and LEBs installed have greatly reduced the velocity of run-off and captured sediment that would otherwise end up in the water sources.

Although CWCB funding was used to address project work focused primarily on erosion control and stabilization, additional project objectives targeted conifer encroachment in riparian areas and wildfire mitigation. Conifers are a fast growing, opportunistic species that, when established, can quickly outcompete other plant species in the area. Conifers are highly susceptible to wildfire, and when clustered in dense stands adjacent to riparian areas, pose a major threat to water quality. The treatments implemented were successful across all project work sites.

Removal of conifer species in critical drainages and riparian areas had a number of beneficial outcomes. Thinning the density of conifer stands greatly reduced fuel loads, alleviating the threat of a severe wildfire. Severe wildfires compromise soil integrity and can increase erosion in a burned area. This is doubly impactful near water bodies and riparian areas, as the increased erosion can impact water quality and aquatic species habitat. Removal of conifers also enhanced the opportunity for riparian vegetation and other fire-resistant species, particularly aspen, to establish and perpetuate. Removing conifers releases the canopy, allowing more sunlight to reach preferred species, breaks canopy continuity to mitigate wildfire "crowning", and increases the structural diversity in a given area.

While the vast majority of treatments were successful, there were opportunities to learn and improve our operations. U.S. Forest Service and RMFI program staff worked closely to develop specific treatment prescriptions for each project site. Occasionally, realities on the ground required adjusting these prescriptions in real time. For example, as crews began erosion mitigation treatments at Rampart Reservoir, the steep grades near the reservoir presented a challenge. RMFI and our US Forest Service partners determined an adjustment to scope was required, and erosion control matting was added to our scope of work. The matting will ensure hillslope stability as the natural revegetation process occurs. Additionally, as with any trail closure, points of entry must often be reinforced to continue to deter access. Users occasionally remove emplaced obstructions (large rocks, deadfall, felled trees) to gain access. RMFI began leaving felled trees attached to their stumps and added additional signage to mitigate this activity, and the slight adjustment has proved very successful.

Some of these "lessons learned" concerned operational logistics. Many of the project work sites were located in remote, backcountry areas. RMFI has extensive experience working in these conditions, but each

site provides its own challenges. Accessibility to safe drinking water was an obstacle that we had to overcome. For many locations, the only option was to pack-in our own water. This often required a resupply in the middle of the hitch. Transportation of equipment was also a challenge on some projects. RMFI engaged community volunteers to assist with gear pack-ins at Bear Creek. This greatly expedited the process, allowing more time for on-the-ground project work.

The success of the Enhancing Watershed Health program has garnered significant support from our partners, particularly the U.S. Forest Service. RMFI has updated our agreement with the U.S. Forest Service and will receive additional support from the agency to continue activities directed at enhancing watershed health and function on the Pike National Forest. The agreement will partially support project work in the coming field seasons. This investment will help ensure the long-term sustainability of the program. Enhancing watershed health is an ongoing effort on Pikes Peak. Water is a limited resource, and efforts to protect and enhance watersheds are critical to the long-term health of the forest and local communities. We coordinate early each year to determine goals and objectives for the coming season. While we will likely continue TSI work in riparian areas, our early discussions with U.S. Forest Service personnel have centered on erosion control measures in sensitive riparian areas. RMFI's experience with erosion control and active restoration position us to have a tremendous impact on our Forest's water resources.

References

- "Investments in Wetland, Riparian, and Stream Health: Taking a Proactive Approach to Land Management" (see attached pdf)

- Bear Creek Watershed Assessment
  https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5434203.pdf

- Environmental Assessment Decision for the Bear Creek Watershed Restoration Project
  https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3846428.pdf