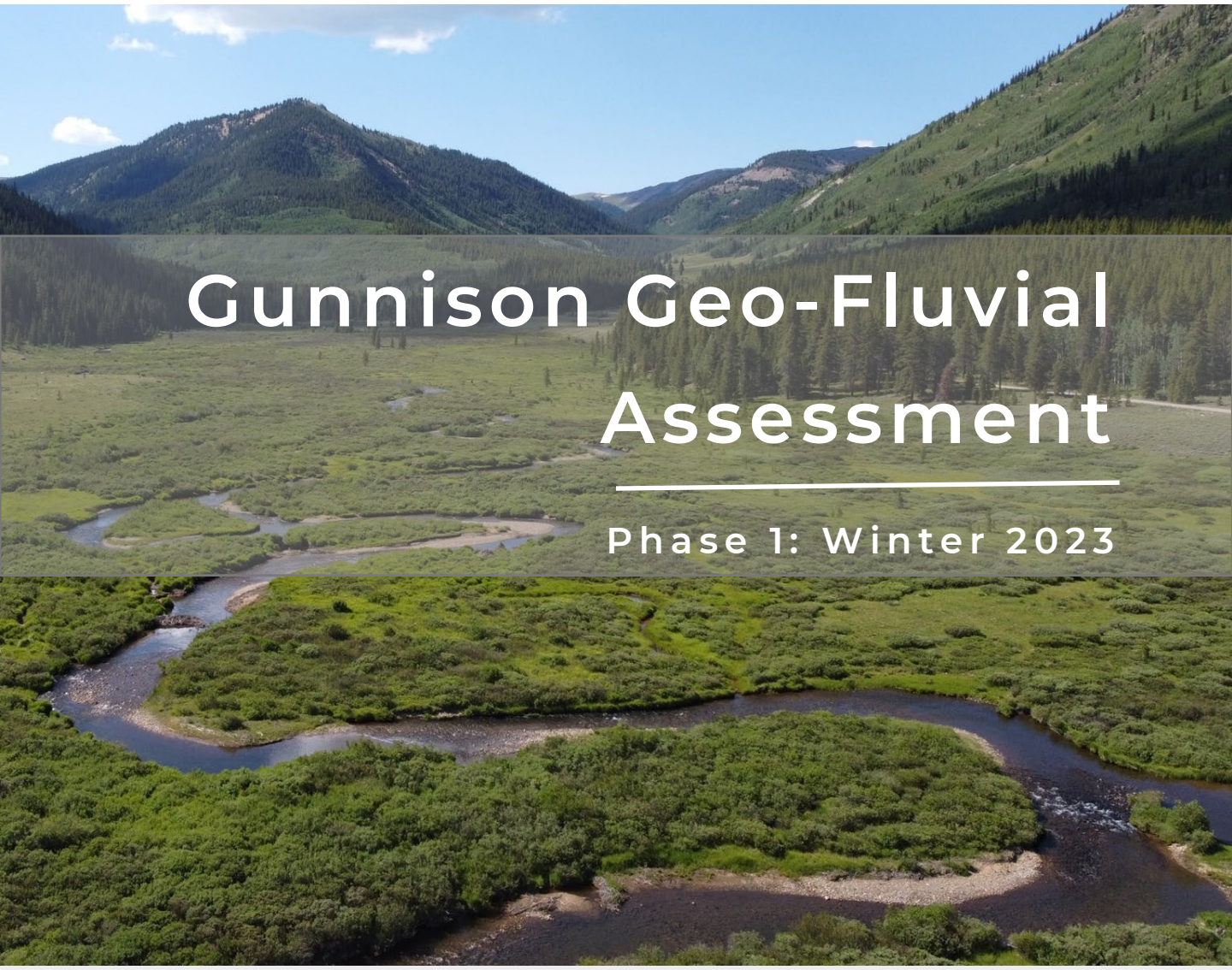


Gunnison Geo-Fluvial Assessment

Phase 1: Winter 2023

Opportunities for Hazard Mitigation & Improved Stream Corridor Function

UPPER GUNNISON RIVER WATER CONSERVANCY DISTRICT 1959

WATERSHED SCIENCE + DESIGN

ROUND RIVER DESIGN

INTRODUCTION

This document recommends specific projects or actions that could be taken to increase the long-term resilience of communities and water resources in the Upper Gunnison Phase 1 Geo-Fluvial Study Reaches. The primary purpose of this exercise was to identify specific practices that may result in the reduction of hazards associated with post-wildfire flooding, and sediment and debris runoff. Secondary effects of this work often include ecological uplift (i.e., improved stream corridor health), improved transportation safety, aesthetics, recreation, etc. and are of value to the community. Several types of actions (both structural and nonstructural) are recommended that may help to protect community assets. A map of these recommendations can be viewed here:

Gunnison Geo-Fluvial Project and Management DRAFT Recommendations

The goal of this work was to look at the stream corridors in the study watersheds and attempt to answer the questions:

- What did these corridors look like prior to European settlement of the valley and how and why have they changed?
- Where are the current areas of greatest risk?;
- If left as is what risk exists to the infrastructure and communities interesting these stream corridors?; and
- If/how to intervene to steer them in favorable trajectories that meet the goals and needs of the community (assuming their existing condition and future trajectories have created a state of vulnerability and risk)?

The proposed study area and reaches are shown in Figure 1 and include four separate stream systems as prioritized by Watershed Management Plan team. This objective of this work is to assist the Upper Gunnison River Watershed Conservation District Watershed Management Plan team with:

- Understanding stream reaches critical for geomorphic recovery and corridor restoration, flood protection, wildfire resilience, fire breaks, and damage avoidance,
- Riparian corridor stewardship, restoration, and protection recommendations.
- Stakeholder education.
- Expectations for understanding and managing the geomorphic corridor, in particular the scope and scale of the issues and management strategies.

Phase 1 Study Reaches

1) The Taylor River: 17 miles above the reservoir on the mainstem plus the lowest 5 miles of Texas, Illinois and Willow Creeks, the other substantial drainages that enter directly into Taylor Park Reservoir as well as the Taylor River for 4 miles below the dam to Lottie Creek confluence;

2) The East River from the Brush Creek confluence to the Taylor River confluence (17 miles) and the lowest 3-5 miles of its major tributaries, including Cement Creek. The Slate River from the Gothic Road Bridge to its confluence with the East River.

3) Coal Creek from the headwaters to the confluence with the East River (approximately 13 miles) and its major tributaries upstream of Crested Butte.

4) Mainstem of Quartz Creek—recommendations for Quartz creek and its tributaries will be provided in Phase 2.

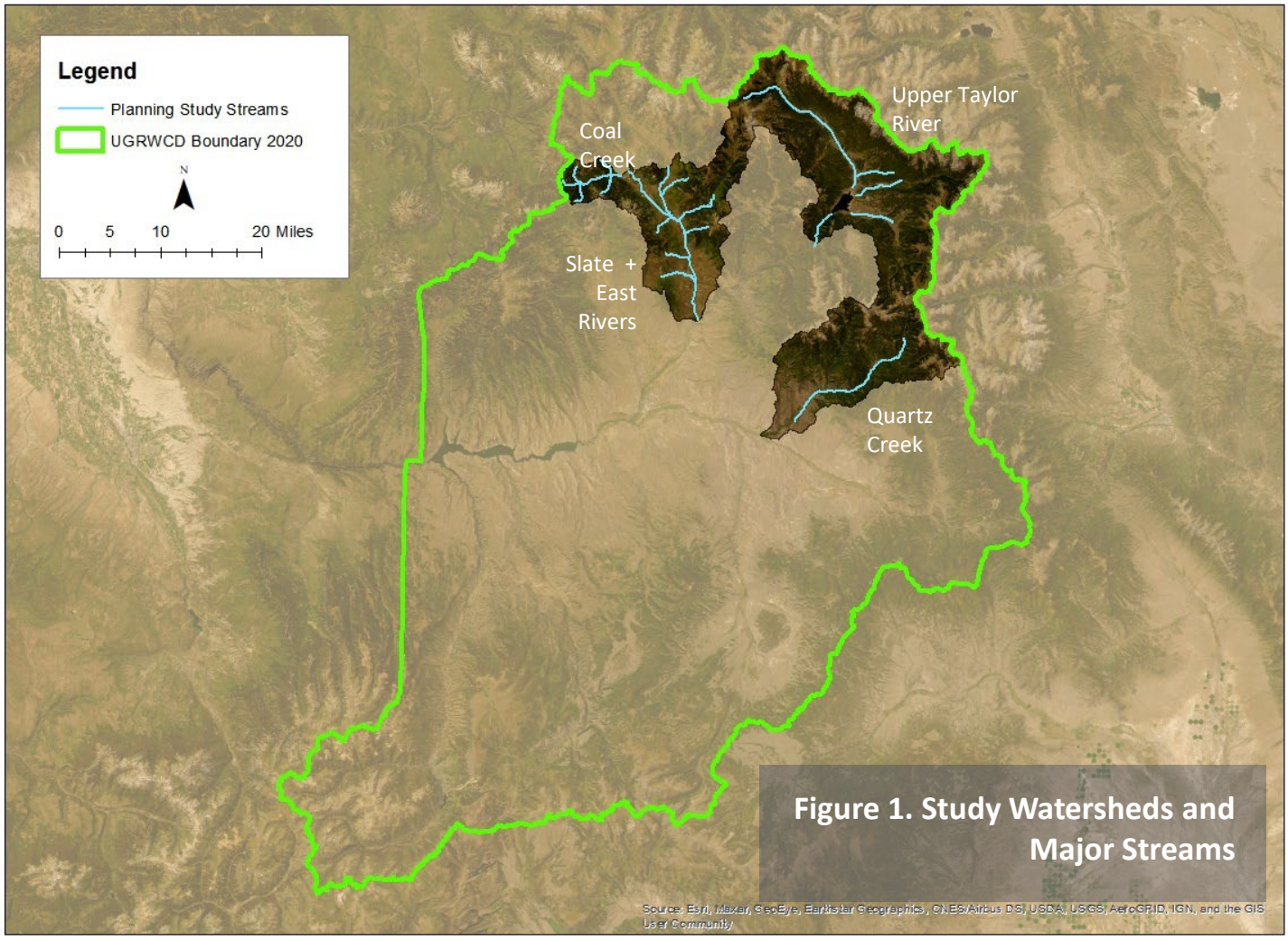


Figure 1. Study Watersheds and Major Streams

OVERARCHING ACTIONS

The following county-wide or watershed-wide actions are recommended to improve information and communication related to hazards in and around stream corridors:

1

Complete Debris Flow Mapping

Request debris flow and alluvial fan hazard mapping from the Colorado Geologic Survey (CGS). Work with community groups and local governments to direct new development away from these hazardous locations and work with existing property owners on hazard mitigation.

2

Steer New Development to Areas Located Outside of Hazardous Locations in the stream corridor

Establish a stream corridor overlay district and/or incorporate fluvial hazard planning into county planning. Incorporate a fluvial geomorphic hazard review where development is proposed within or adjacent to Active Stream Corridors and ephemeral drainages.

3

Install and Maintain Warning Systems

Evaluate opportunities for warning systems in and downstream of the highest-hazard creek systems, specifically for Cement Creek, Coal Creek and the Towns of Almont, Pitkin, and Ohio City.

4

Upgrade Crossings

Begin a stream corridor crossing upgrade process - prioritize and fund crossing retrofits and/or replacements along with improvements to roadways to make them more resilient to fluvial processes. These investments are often multi-benefit projects.

5

Multi-Hazard Evaluations

Conduct a multi-hazard evaluation and evacuation/emergency response plan for the Town of Crested Butter. Evaluate further whether similar plans are needed for Almont, Pitkin, and Ohio City.

At the stream level, recommendations are divided into five overarching strategies

1

Land and Water Protections

Protect and conserve functioning stream corridors in high-priority strategic locations in order to safeguard their functionality into the future. Similarly, protect and conserve corridors in high-priority locations where future work to restore or rehabilitate floodplain functions will benefit the community.

2

Stream Corridor Enhancements

Implement enhancements to functioning or semi-functioning stream corridors in strategic locations. Through relatively small efforts these projects should further increase the stream corridor's ability to capture sediment and debris and to be resilient to disturbances in the watershed. Many of these projects will have multiple benefits such as improved ecological health.

3

Stream Corridor Restoration

Design and implement stream corridor rehabilitation projects in strategic locations that transform low- or dysfunctional stream corridors back into stream corridors that are more likely to attenuate flood waters, sediment, and debris, provide ecological uplift and enhance habitat connectivity, and where necessary increase protection to existing infrastructure.

4

Crossings and Infrastructure Upgrades and Retrofits

Relocate, replace, upgrade, or retrofit existing infrastructure, particularly roadway crossings and embankments as well as water supply and public utility infrastructure, in order to improve resiliency to floods as well as reduce impacts to stream corridor ecosystems. Investments in these upgrades and retrofits is often an opportunity to provide multiple benefits for the community such as improved safety, access, and resilience.

5

Burn Severity Mitigation

Burn severity mitigation practices can range from preventative actions such as prescribed burns, fuels management such as thinning to fire fighting or suppression activities. Some activities will be more appropriate for each area than others and the details of the appropriate measures should be studied further by knowledgeable and invested parties.

1

Land and Water Protections

Ultimately the most cost-effective and resilient option to minimize damage from future floods and floods after fires is to protect areas that are already serving communities and acting as blue-green infrastructure. Protecting and maintaining both the land and the water in these functional areas—as if they were human-built infrastructure–is key to protecting our communities and assets.

Additionally, it is critical to avoid building additional infrastructure or homes in these locations as those actions will 1) compromise the function of these areas and their ability to provide communities protection from floods and fires and 2) will ensure that future floods and fires will have increased monetary damages and possible loss of life.

Therefore, this action seeks to strategically protect and preserve functioning stream corridors in high-priority locations in order to safeguard their functionality in the future. Similarly, we also recommend protecting and preserving the land and water in areas that need enhancement or restoration to ensure their longevity and protect the investment. Specific strategies for land and water protection are on the next page.

1

Land and Water Protections

Stream Corridor Easements and/or Fee Simple Purchases

Strategies for preserving critical lands within the stream corridor may include land acquisition or acquisition of development rights (easements) for parcels (whole or in part) strategically identified in the mapping. A stream corridor easement allows landowners to divest from areas where repetitive losses are experienced or anticipated, while the easement purchaser makes a long-term investment in the soils, property, infrastructure, and ecosystem in the watershed. The resulting protection provides relief to landowners and taxpayers as the need for channel-controlling interventions and maintenance goes away.

Conservation of Agricultural Land and Practices

Many lands adjacent to streams are currently being used for agriculture and/or grazing. In general, these land uses can be considered compatible with functioning stream corridors (although some practices may be in need of improvement in order to protect water quality or the ecological integrity of the stream corridor). Keeping the land in agricultural use, as opposed to converting to residential or commercial development, may reduce monetary damages and loss of life in large flood events and floods after fires.

Land Use Management

There are many ways for local governments to incorporate stream corridors protection into their long-term and land-use planning. The CWCB has produced a Planning for Fluvial Hazards QuickStart Guide outlining many different ways that stream corridors can better be protected through incorporation into local planning and administration. Examples include integration with comprehensive plans and parks and open space plans.

Recreational Management

There may be areas where the land is already in permanent conservation (e.g., USFS) but non-structural use of that land, including heavy recreation, can or may compromise the function of the stream corridor to serve as a buffer against natural disasters.

In-Stream Flow Management

Just as important as protecting the land that provides our communities with these benefits, it is critical to protect and maintain the water that drives the form and processes, including supporting vegetation, in these critical stream corridors. If and when these buffer areas are dried out, their ability to protect us from sediment, debris and high flows diminishes.

2 Stream Corridor Enhancements

Implement enhancements to functioning or semi-functioning stream corridors in strategic locations to increase their ability to capture sediment and debris and to be resilient to disturbances in the watershed.

These projects will focus the on rehabilitation of natural depositional areas which can trap debris and sediment that erodes from upstream reaches in locations where the consequence of aggradation of this material on the floodplain or in the channel is low. When these areas function properly, they act as a sediment sink and energy sponge, absorbing material and slowing water transported from upstream sources such as burn scars, debris flows, and eroded hillslopes. This strategy seeks to recommend small measures such as the installation of BDAs, the addition of large wood, and the removal of berms or artificial levees. Small efforts, many of which also have secondary ecological improvements, that will enhance stream corridor function in order to help mitigate impacts to downstream infrastructure and communities from post-wildfire and flood hazards.

3

Stream Corridor Restoration

Design and implement stream corridor rehabilitation projects in strategic locations that transform low- or dysfunctional stream corridors back into stream corridors that are more likely to attenuate flood waters, sediment, and debris, provide ecological uplift and enhance habitat connectivity, and where necessary increase protection to existing infrastructure.

These projects will focus on the rehabilitation of natural depositional areas which can trap debris and sediment that erodes from upstream reaches in locations where the consequence of aggradation is low. These areas can act as a sediment sink and energy sponge, absorbing material and energy from debris flows and mitigating impacts to downstream residents and communities. This strategy seeks to recommend measures that can be taken in storage reaches to dissipate energy and store sediment upstream of developed areas in order to reduce fluvial geomorphic hazards in populated areas.

4

Crossings and Infrastructure Retrofits and Upgrades

Poorly designed or located infrastructure has often created circumstances that destabilize stream corridors and often increase the magnitude of a geomorphic response during a flood. The two consistent culprits in the study areas are road crossings and road and railway embankments.

Road Crossings

Bridges and culverts are important infrastructure assets that too frequently disrupt the natural movement of water and sediment. Commonly this disruption results in aggradation (build-up) of sediment above them (which can cause a channel to shift in search of a new path), degradation (erosion of sediment below them), and even avulsion (a process where a stream creates a new channel in a different location). The resulting instability caused by poorly designed bridges and culverts often leads to damages to streambanks, damage to roadways and road embankments and other nearby infrastructure, and can even threaten life and property well outside of mapped floodplains. Geomorphic-compatible retrofit or replacement of bridges and crossing structures is an emerging topic as there is great interest to have resilient infrastructure that is also sensitive to aquatic and terrestrial organism passage.

4

Crossings and Infrastructure Retrofits and Upgrades

Roads and Railway Bed Improvement

Roads and railway beds impact the stream corridors in two ways. When built parallel to the river valley river meanders are often straightened out by means of fill and armoring resulting in the truncation of former river meanders. The shortened meanders force the river into bends that are too tight, increase the slope and energy of the river, and reduce floodplain services as well as habitat. Over time a river will attempt to adjust to this imposition transferring energy downstream and often causing ongoing problems with protection and maintenance of highway or railway embankments. Second, when built perpendicular to a river valley Active Stream Corridor processes and functions are impeded. Like de facto dams made of earthen and stone fill, these structures impact flow depths, shear stresses, and sediment transport capacities of channels. These constrictions can affect both upstream and downstream areas.

Because both of these impacts often legacy issues, immediate change may be impractical, however, discussion and documentation are important for several reasons. First, it is possible to quickly retrofit crossings and road/rail beds with a series of culverts (or even additional pre-fabricated bridges) that will provide more opportunity for water moving across a floodplain to pass through road embankments. Second, crossings are consistently being redesigned and rebuilt, especially at the county level, and flagging specific structures and lengths of roadway for re-assessment by and including geomorphic and stream process experts will add resiliency to the transportation network. Such assessment and planning may also illuminate opportunities redesign or relocate roadways and crossings for better safety, and may present an opportunity for consolidation of infrastructure. Lastly, in the event of a major flood disaster where the road and crossing systems will need to be completely rebuilt, concepts for doing so in a more resilient manner will already be developed and available so that any future tax-supported infrastructure investments are made with the goal of long-term river and infrastructure resilience.

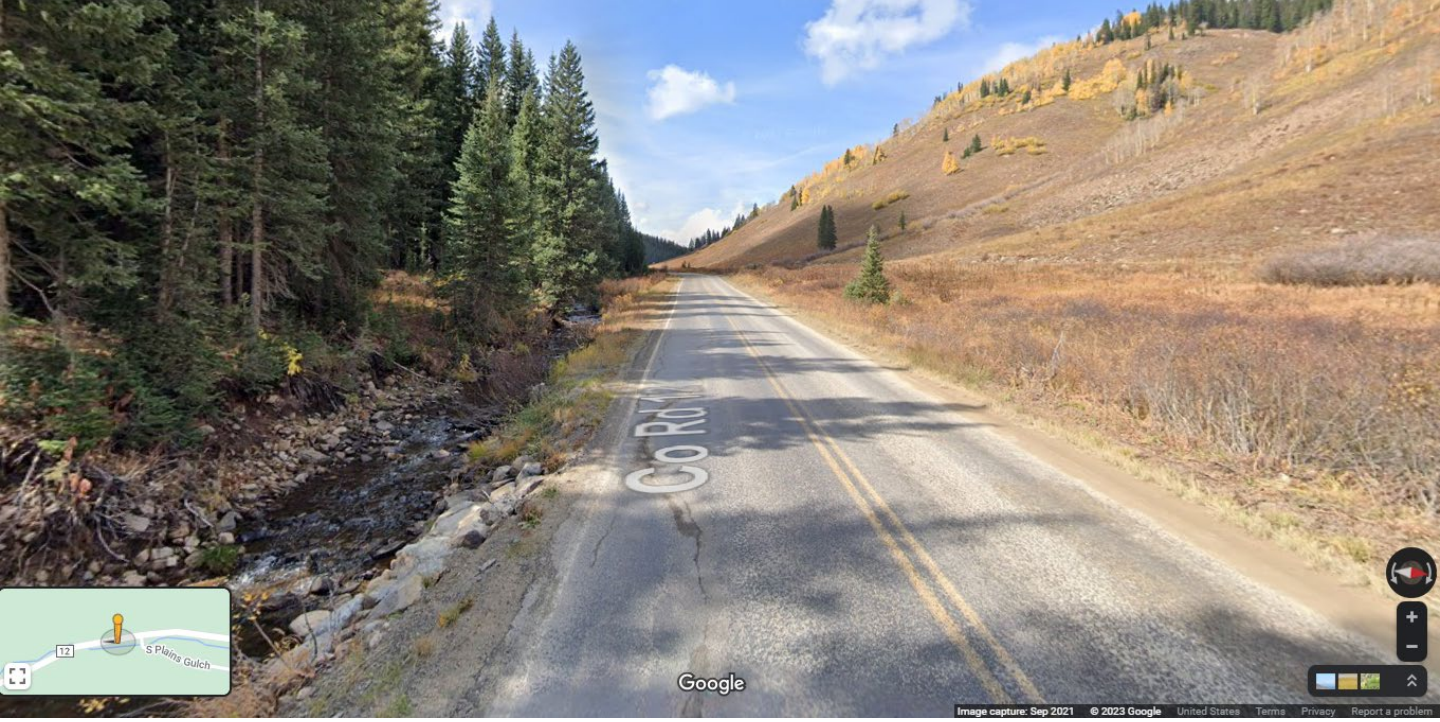
5 Burn Severity Mitigation

In areas where steep valley hillslopes or alluvial/debris fans from steep drainages connect directly to confined stream corridors, there is a higher likelihood that a wildfire burn will result in sediment being delivered directly into stream channels. If there are adequate and functional storage reaches downstream of these landscapes then this hillslope-stream corridor sediment delivery is more likely to be mitigated. However, if these sediment storage sites do not exist and direct transport of post-fire sediments to critical community infrastructure can be anticipated due to the steep confined nature of a stream corridor, we recommend taking action to reduce future wildfire impacts. The most reasonable action in these situations is to work today to reduce the severity of a wildfire which in turn may help to reduce the amount of sediment delivered from a burn as well as decrease the length of time for a hillslope to revegetate and stabilize after a fire occurs.

Burn severity mitigation practices can range from preventative actions such as prescribed burns, fuels management, thinning to fire fighting or suppression activities. Some activities will be more appropriate for each area than others and the details of the appropriate measures should be studied further.

Coal 1: Irwin Stream Corridor Enhancements & Protections

Project Type	1) Land and Water Protection & 2) Stream Corridor Enhancements		
Location	In the vicinity of Kebler Pass Road and Country Road 826A. Project is located in Geofluvial Study Reach Coal Creek 5.		
Intent	Reduce human-beaver conflicts and ensure the long-term success of this critical stream reach. This reach is already in long-term protection as it is in the Gunnison National Forest and on Crested Butte Land Trust property.		
Project Benefits	This area is in a very strategic location for trapping sediment generated in the upper watershed. It is already in good condition and small interventions may help to keep it that way into the future.		
Project Description	We observed human-beaver conflicts in the area. Interventions to alleviate these conflicts are recommended in order to keep the beaver community active and the valley floor functioning and wet. This may include signage or public engagement features that stress the importance of protecting the floodplain and its beaver residents.		
Partners	USFS, Crested Butte Land Trust, Coal Creek Watershed Coalition,	Cost	$
Next Steps	Where and when conflicts arise, consider interventions that support the biotic community and their habitat.		



Coal 2: Coal Creek Realignment

Project Type	3) Stream Corridor Restoration and 4) Infrastructure retrofit/upgrade		
Location	Along Kebler Pass Road in the vicinity and upstream of Splains Gulch Road. Project is located in Geofluvial Study Reach Coal Creek 4.		
Intent	Restore this sub-reach to a depositional reach (human interventions have transformed it into a transport reach); reduce the hillslope connectivity between the north-facing forested hillslope and the main channel of Coal Creek.		
Project Benefits	Realignment will reduce post-fire sediment from the north-facing hillslope from entering into the water and compromising water quality in Coal Creek. Additional ecological benefits will come from a complex, connected floodplain.		
Project Description	Reconnect Coal Creek with its floodplain, which is currently inaccessible due to CO 12, by moving the main channel and all of the flow of Coal Creek to the north side of the roadway. There is already a vegetated floodplain in the proposed channel location. Additionally, this realignment would eliminate two existing undersized crossings.		
Partners	USFS, CDOT, Coal Creek Watershed Coalition,	Cost	$$$$
Next Steps	Develop a rough conceptual plan for the area and reach out to stakeholders and land and road managers.		

Coal 3: Upper Coal Creek Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	Along Kebler Pass Road in the vicinity and upstream of Splains Gulch Road on the hillslopes that drain directly to Coal Creek. Project is located in Geofluvial Study Reach Coal Creek 4.		
Intent	Reduce the potential burn severity on hillslopes that drain into Coal Creek.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment that enters into Coal Creek and reduce flooding and sediment impacts to CO12 that may occur after a fire.		
Project Description	TBD		
Partners	USFS, CDOT	Cost	$$
Next Steps	Develop a burn severity mitigation plan with land managers and stakeholders.		

Coal 4: Splains Gulch Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	Throughout the Splains Gulch watershed, including the hillslopes that drain directly to the lower two-thirds of Splains Gulch. Project is located in Geofluvial Study Reach Splains Gulch 1.		
Intent	Reduce the potential burn severity on hillslopes that drain into Splains Gulch.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment that enters into the transport reaches of Splains Gulch and into Coal Creek downstream. Additionally, reduced flooding and sediment impacts to CO12 that may occur after rainfall after a fire.		
Project Description	TBD		
Partners	USFS	Cost	$$$
Next Steps	Develop a burn severity mitigation plan with land managers and stakeholders.		

Coal 5: Splains Gulch Stream Corridor Restoration

Project Type	3) Stream Corridor Restoration (upper reach)		
Location	In the upper Splains Gulch watershed. Project is located in Geofluvial Study Reach Splains Gulch 1.		
Intent	Restore the upper wet meadow and stream corridor.		
Project Benefits	Slow or stop the channel incision and sediment export from the reach. Return this area reach to a wet meadow or complex stream corridor in order to store sediment (rather than supply it) and to potentially act as a fire break when a fire occurs.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS, Coal Creek Watershed Coalition,	Cost	$$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area. Note: we were unable to visit this location in person.		

Coal 6: Splains Gulch Stream Corridor Enhancement

Project Type	3) Stream Corridor Restoration (upper reach)		
Location	In the upper Splains Gulch watershed. Project is located in Geofluvial Study Reach Splains Gulch 1.		
Intent	Restore the upper wet meadow and stream corridor.		
Project Benefits	Slow or stop the channel incision and sediment export from the reach. Return this area reach to a wet meadow or complex stream corridor in order to store sediment (rather than supply it) and to potentially act as a fire break when a fire occurs.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS, Coal Creek Watershed Coalition,	Cost	$$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area. Note: we were unable to visit this location in person.		

Coal 7: Coal Creek Stream Corridor Restoration at Elk Creek Fan

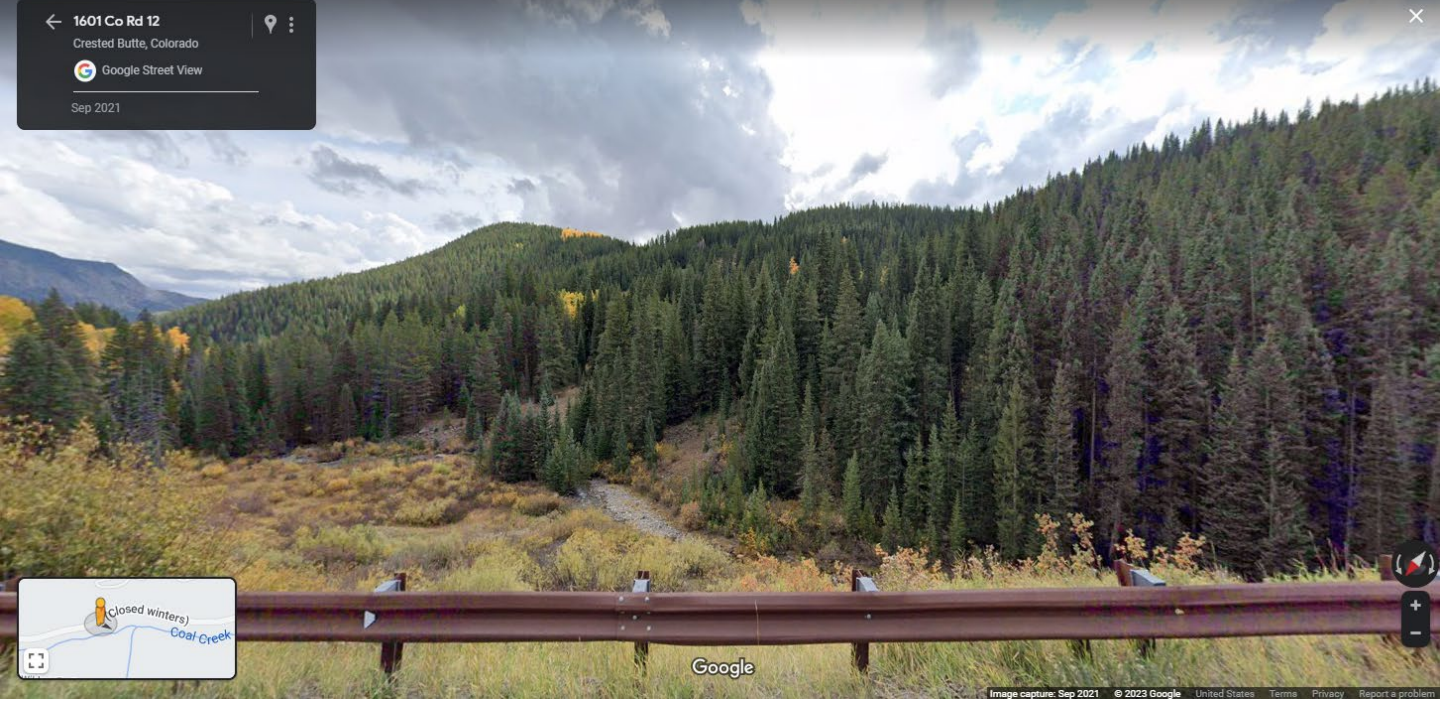
Project Type	3) Stream Corridor Restoration		
Location	On Coal Creek upstream and downstream of the Elk Creek confluence and fan. Project is located in Geofluvial Study Reach Coal Creek 3.		
Intent			
Project Benefits	Slow or stop the channel incision and sediment export from the reach. Return this area reach to a wet meadow or complex stream corridor in order to store sediment (rather than supply it) and to potentially act as a fire break when a fire occurs.		
Project Description			
Partners	USFS, Coal Creek Watershed Coalition,	Cost	$$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area.		

Coal 8: Lower Coal Creek Stream Corridor Enhancement

Project Type	2) Stream Corridor Enhancement		
Location	Coal Creek upstream of the Crested Butte Water Intake. Project is located in Geofluvial Study Reach Coal Creek 3.		
Intent	Restore the upper wet meadow and stream corridor.		
Project Benefits	Slow or stop the channel incision and sediment export from the reach. Return this area reach to a wet meadow or complex stream corridor in order to store sediment (rather than supply it) and to potentially act as a fire break when a fire occurs.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS	Cost	$$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area.		

Coal 9: Lower Coal Creek Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	Coal Creek in the vicinity of and upstream of the Crested Butte Water Intake. Project is located in Geofluvial Study Reach Coal Creek 2.		
Intent	Reduce the potential burn severity on hillslopes that drain into Coal Creek.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into the transport reaches of Coal Creek. Additionally, reduce flooding and sediment impacts to CO12 and the Town of Crested Butte that may occur after rainfall after a fire.		
Project Description	TBD		
Partners	USFS, Town of Crested Butte	Cost	$$
Next Steps	Develop a burn severity mitigation plan with land managers and stakeholders.		



Coal 10: Wildcat Stream Corridor Enhancements & Protection

Project Type	1) Land and Water Protection & 2) Stream Corridor Enhancements		
Location	Wildcat Creek in the vicinity of the Wildcat Trail crossing. Project is located in Geofluvial Study Reach Wildcat 2.		
Intent	Protect and enhance the existing well-connected stream corridor.		
Project Benefits	Protect the land and enhance the stream corridor that has the potential to slow and store the sediment and debris that emanates from the upper watershed.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS, Town of Crested Butte, Crested Butte Land Trust, Private Landowners and Residents	Cost	$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area. Note: we were unable to visit this location in person.		

Coal 11: Gibson Ridge Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	Gibson Ridge and the hillslopes that drain into Coal Creek; along Wildcat Trail. Project is located in Geofluvial Study Reach Coal Creek 2.		
Intent	Reduce the potential burn severity on hillslopes that drain into Coal Creek directly upstream of Crested Butte.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into the transport reaches of Coal Creek above Crested Butte. Additionally, reduce flooding and sediment impacts to the Town of Crested Butte that may occur after rainfall after a fire.		
Project Description	TBD		
Partners	USFS, Town of Crested Butte	Cost	$$
Next Steps	Conduct a site evaluation and develop a burn severity mitigation plan with land managers and stakeholders.		

East 1: East River Floodplain Protection

Project Type	1) Stream Corridor Protection		
Location	East River upstream of the County Road 728 bridge. Project is located in Geofluvial Study Reach East River7.		
Intent	Limit additional human investment in the East River floodplain.		
Project Benefits	Avoid damage from future floods and floods after fires by reducing the consequence of these events (in partnership with projects that reduce the hazard).		
Project Description	Through any and all practices palatable to the community, maintain the current land use in this area or reduce the human investment in this highly hazardous location.		
Partners	Private landowners, Crested Butte Land Trust, USFS	Cost	$
Next Steps	Explore opportunities for land protections.		

Farris 1: Farris Creek Stream Corridor Enhancements

Project Type	2) Stream Corridor Enhancements		
Location	Farris Creek on USFS lands in the vicinity of CR Road 736. Project is located in Geofluvial Study Reach Farris 2.		
Intent	Extend and enhance the existing complex stream corridor both upstream and downstream.		
Project Benefits	Increase the value and benefits of this wet floodplain and complex stream corridor in order to store sediment and to potentially act as a fire break when a fire occurs.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS	Cost	$
Next Steps	Site assessment and conceptual design. Note: we were unable to visit this location in person.		

Cement 1: Horse Basin Creek and Vicinity Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	Throughout the Horse Basin Creek Watershed and the adjacent hillslopes to the north. Project is located in Geofluvial Study Reach Cement .		
Intent	Reduce the potential burn severity on hillslopes that drain into Horse Basin Creek and then into Cement Creek.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into Horse Basin Creek and subsequently into Cement Creek.		
Project Description	TBD		
Partners	USFS	Cost	$$
Next Steps	Conduct a site evaluation and develop a burn severity mitigation plan with land managers and stakeholders.		

Cement 2: Cement Creek Protections

Project Type	1) Stream Corridor Protection		
Location	Cement Creek corridor. Project is located in Geofluvial Study Reach Coal Creek 3.		
Intent	Maintain this reach of stream corridor .		
Project Benefits	Slow or stop the channel incision and sediment export from the reach. Return this area reach to a wet meadow or complex stream corridor in order to store sediment (rather than supply it) and to potentially act as a fire break when a fire occurs.		
Project Description	The exact scale and intensity of the interventions is to be determined, but likely this project will include treatments to reconnect and enhance the channel and floodplain through smaller structures, such as BDAs, large woody, and riparian plantings.		
Partners	USFS	Cost	$$$
Next Steps	Conduct a site evaluation and develop a conceptual design for this area.		

Cement 3: Cement Creek Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	The north facing hillsides that drain directedly or indirectly to Cement Creek. Project is located in Geofluvial Study Reach Cement .		
Intent	Reduce the potential burn severity on hillslopes that drain into Cement Creek.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into the Cement Creek corrior.		
Project Description	TBD		
Partners	USFS, BLM, private land owners	Cost	$$
Next Steps	Conduct a site assessment and develop a burn severity mitigation plan with land managers and stakeholders.		

Cement 4: Lower Cement Creek Restoration

Project Type	3) Stream Corridor Restoration		
Location	Cement Creek Project is located in Geofluvial Study Reach Cement Creek .		
Intent	Restore this sub-reach to a depositional or semi-depositional.		
Project Benefits	Slow and store sediment and debris transported by the creek in the last zone before major human investments start creeping into the stream corridor. Additional ecological benefits may come from a complex, connected floodplain.		
Project Description	Reconnecting the channel with a complex floodplain. The floodplain is currently inaccessible as the channel is pushed up against the left (southeastern) valley margin, and most of the existing floodplain has highly altered vegetation and land use.		
Partners	USFS, South Crested Butte, and Private landowners and residents.	Cost	$$$$
Next Steps	Develop a rough conceptual plan for the area and reach out to stakeholders and landowners.		

Cement 5: Lower Cement Creek Stream Corridor Protections

Project Type	1) Stream Corridor Protection		
Location	Lower Cement Creek corridor. Project is located in Geofluvial Study Reach Cement Creek .		
Intent	Prevent additional human investment in the Lower Cement Creek stream corridor.		
Project Benefits	Avoid damage from future floods and floods after fires by reducing the consequence of these events (in partnership with projects that reduce the hazard).		
Project Description	Through any and all practices palatable to the community and landowners, including agricultural easements, conservation easements, and other tools, maintain the current land use in this area or return the stream corridor to a natural condition.		
Partners	Private landowners, Crested Butte Land Trust, South Crested Butte	Cost	$
Next Steps	Explore opportunities for land protections in conjunction with restoration of the the stream and floodplain.		

Cement 6: Cement Creek/East River Confluence Protections

Project Type	1) Stream Corridor Protection		
Location	The confluence of Cement Creek and the East River. Project is located in Geofluvial Study Reach Cement Creek / East River.		
Intent	Prevent additional human investment in the Lower Cement Creek stream corridor. Protect human life through the development of an early alert system.		
Project Benefits	Avoid damage from future floods and floods after fires by reducing the consequence of these events (in partnership with projects that reduce the hazard).		
Project Description	Through any and all practices palatable to the community, maintain the current land use in this area or reduce the human investment in this highly hazardous location.		
Partners	Private landowners, South Crested Butte	Cost	$
Next Steps	Explore opportunities for land protections in conjunction with restoration of the the stream and floodplain.		

Granite 1: Upper Granite Creek Restoration

Project Type	3) Stream Corridor Restoration		
Location	Granite Creek Project is located in Geofluvial Study Reach Granite Creek 1.		
Intent	Restore this sub-reach to a depositional or semi-depositional.		
Project Benefits	Slow and store sediment and debris transported by the creek in the last zone before major human investments start creeping into the stream corridor. Additional ecological benefits may come from a complex, connected floodplain.		
Project Description	Reconnecting the channel with a complex floodplain. The floodplain is currently inaccessible as the channel is pushed up against the left (southeastern) valley margin, and most of the existing floodplain has highly altered vegetation and land use.		
Partners	USFS	Cost	$$$
Next Steps	Site assessment and stakeholder and landowner outreach. Note: we were unable to visit this location in person.		

Granite 2: Granite Creek Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	The north facing hillsides that drain to Granite Creek. Project is located in Geofluvial Study Reach Granite 1 .		
Intent	Reduce the potential burn severity on hillslopes that drain into Granite Creek.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into the Granite Creek corridor and into the East River.		
Project Description	TBD		
Partners	USFS, private landowners	Cost	$$
Next Steps	Conduct a site assessment and develop a burn severity mitigation plan with land managers and stakeholders. Note: we were unable to visit this location in person.		

Granite 3: Granite Creek Fan Protection

Project Type	1) Stream Corridor Protection		
Location	The confluence of Granite Creek and the East River. Project is located in Geofluvial Study Reach Granite Creek / East River.		
Intent	Prevent additional human investment on the Granite Creek alluvial fan.		
Project Benefits	Avoid damage from future floods and floods after fires by reducing the consequence of these events (in partnership with projects that reduce the hazard).		
Project Description	Through any and all practices palatable to the community, maintain the current land use in this area or reduce the human investment in this highly hazardous location.		
Partners	Private landowners, Crested Butte Land Trust	Cost	$
Next Steps	Explore opportunities for land protections. Note: we were unable to visit this location in person.		

Taylor 1: Trail Creek Stream Corridor Enhancements

Project Type	2) Stream Corridor Enhancements		
Location	Trail Creek. Project is located in a major tributary to Geofluvial Study Reach Taylor.		
Intent	Continue to enhance the sediment storage potential and the connectivity of the Trail Creek stream corridor.		
Project Benefits	This tributary It is already in good condition and enhancements may help to keep it that way—and in better condition—into the future. Trail Creek is a major tributary that empties into the Taylor River downstream of the Taylor River's last depositional reach so to protect the Taylor River and Reservoir, interventions in this tributary will provide the most benefit.		
Project Description	Continue the stream corridor enhancements which include BDAs and riparian revegetation.		
Partners	USFS, Crested Butte Land Trust, Coal Creek Watershed Coalition,	Cost	$
Next Steps	Continue the BDA projects throughout the watershed.		

Taylor 2: Illinois Creek Restoration & Protection

Project Type	3) Stream Corridor Restoration		
Location	Lower Illinois Creek Project is located in Geofluvial Study Reach Illinois Creek.		
Intent	Restore this sub-reach to a depositional or semi-depositional zone.		
Project Benefits	Slow and store sediment and debris transported by the creek in the last zone before Illinois Creeks meets the transport reaches of the Taylor River upstream of the reservoir. Additional ecological benefits may come from a complex, connected floodplain.		
Project Description	Repair the lower reach of Illinois, which is highly impacted by human action. It may be more cost-effective to move the channel into one of the relict channels on the floodplain than trying to reconstruct an appropriate channel in the current location.		
Partners	USFS, Private landowners and residents.	Cost	$$$$
Next Steps	Develop a rough conceptual plan for the area and reach out to stakeholders and landowners.		

Taylor 3: Lower Texas Creek Stream Corridor Protection & Enhancements

Project Type	1) Stream Corridor Protections & 2) Stream Corridor Enhancements		
Location	Lower Texas Creek. Project is located in a major tributary to Geofluvial Study Reach Texas .		
Intent	Continue to enhance the sediment storage potential and the connectivity of the Trail Creek stream corridor. Protect the stream corridor from recreational overuse.		
Project Benefits	This subreach is in good condition but enhancements to further connect the stream channel to its floodplain will enhance its buffering capabilities and its ecological function.		
Project Description	Install stream corridor enhancements which include BDAs and riparian revegetation. Reactivate side channels and create a riverscape similar to the one upstream.		
Partners	USFS	Cost	$
Next Steps	Where and when conflicts arise, consider interventions that support the biotic community and their habitat.		

Taylor 4: Lower Willow Creek Stream Corridor Protection & Enhancements

Project Type	1) Stream Corridor Protections & 2) Stream Corridor Enhancements		
Location	Lower Willow Creek. Project is located in Geofluvial Study Reach Willow .		
Intent	Continue to enhance the sediment storage potential and the connectivity of the Willow Creek stream corridor. Protect the stream corridor from development and recreational overuse.		
Project Benefits	This subreach is in good condition but enhancements to further connect the stream channel to its floodplain will enhance its buffering capabilities and its ecological function.		
Project Description	Install stream corridor enhancements which include BDAs and riparian revegetation; reactivate side channels		
Partners	USFS, private landowners	Cost	$
Next Steps	Continue the BDA projects throughout the watershed.		

Taylor 5: Middle Willow Creek Stream Corridor Protection & Enhancements

Project Type	1) Stream Corridor Protections & 2) Stream Corridor Enhancements		
Location	Middle Willow Creek. Project is located in Geofluvial Study Reach Willow .		
Intent	Add complexity and roughness to the inset and straightened Willow Creek stream corridor. Protect the stream corridor from development and recreational overuse.		
Project Benefits	Connect the stream channel to its inset floodplain and adding complexity to the stream corridor will enhance its buffering capabilities and its ecological function.		
Project Description	Install stream corridor enhancements which may include BDAs, large wood and riparian revegetation.		
Partners	USFS, private landowners	Cost	$
Next Steps	Site assessment and conceptual design.		

Taylor 6: Willow Creek Restoration & Protection

Project Type	3) Stream Corridor Restoration		
Location	Middle Willow Creek Project is upstream of Geofluvial Study Reach Willow Creek 2.		
Intent	Restore this sub-reach to a depositional or semi-depositional zone.		
Project Benefits	Slow and store sediment and debris transported by Willow Creek and/or sediment that is entering into the corridor from the highly connected hillslopes. Additional ecological benefits may come from a complex, connected floodplain.		
Project Description	Remove the tailings from the stream corridor and reconnect the floodplain.		
Partners	USFS, Private landowners and residents.	Cost	$$
Next Steps	Develop a rough conceptual plan for the area and reach out to stakeholders and landowners.		

Taylor 7: Taylor Park Reservoir Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	The east facing hillsides that drain directly to Taylor Park Reservoir.		
Intent	Reduce the potential burn severity on hillslopes that drain directly into Taylor Park Reservoir.		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows may enter into Taylor Park Reservoir.		
Project Description	TBD		
Partners	USFS	Cost	$$
Next Steps	Evaluate the potential burn severity of these hillslopes and appropriate burn severity mitigation measures.		

Taylor 8: Taylor River Burn Severity Mitigation

Project Type	5) Burn Severity Mitigation		
Location	The northwest facing hillsides that drain directly to the Taylor River.		
Intent	Reduce the potential burn severity on hillslopes that drain directly into the Taylor River/		
Project Benefits	By reducing the burn severity, potentially reduce the post-fire sediment and debris flows that may degrade the water coming out of Taylor Park Reservoir which travels through this reach before its use or storage in downstream reaches.		
Project Description	TBD		
Partners	USFS	Cost	$$
Next Steps	Evaluate the potential burn severity of these hillslopes and appropriate burn severity mitigation measures.		

LIMITATIONS & USE

This document only serves to outline projects that may reduce the impacts of post-fire runoff to water resources in the Upper Gunnison River Watershed. These projects may also increase the protection of life, safety, and human investments in stream corridors after fires throughout the Phase 1 study area.

This document will be expanded in late 2023 as analysis is completed in additional watersheds throughout the Upper Gunnison River Watershed.

There are many other reasons to implement projects in stream corridors and on hillslopes that this document does not discuss; just because a project idea or project location does not appear in this document does not indicate that there is not a need, tied to another objective, that may benefit the system or community.

Additionally, projects or management ideas that are proposed here are listed as just that—ideas or concepts that should, based on the science of watershed response and evolution, provide benefits to communities. The ideas have not yet been vetted by the community or landowners nor have the risks been discussed widely. Project participation and implementation is voluntary though notable benefits to landowners and participants may result from the completion of the projects described in the document. Projects can be completed individually or as cohorts and while benefit will come from one-off implementation, the most benefit will come from working through multiple or all the listed projects in a watershed.

While it may seem that this document discusses new hazards, it does not. These post-fire hazards existed before this study began—this study just did the work to understand them and determine mitigation strategies before they were able to threaten water, infrastructure, and life in the Upper Gunnison River Watershed.