WHITE RIVER
PARTNERSHIP

Riparian Restoration Plan

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Executive Summary

The White River Partnership (WRP) is comprised of public, private, and non-profit entities committed to healthy riparian areas along the White River in northwest Colorado and northeast Utah. The WRP developed this restoration plan with a focus on restoring areas infested with tamarisk, Russian olive, and associated weed species due to the numerous negative impacts of these plants on the ecology and economy of the White River basin. This plan was developed with the understanding that scientific knowledge of restoration and best management practices, as well as WRP goals, improve and evolve with time. Therefore, this plan provides a guiding framework for riparian restoration in the White River basin by identifying the common goals among partners, ecological stressors on the system and the assumptions made to address them, and the criteria for prioritizing restoration sites and approaches. This plan also identifies specific 3-year goals and objectives for restoration.

Introduction

Invasive tamarisk and Russian olive (TRO) are present throughout the White River basin in northwest Colorado and northeast Utah. These woody invasive plants and their associated secondary invasive plant infestations cause myriad ecological, social, economic, and land management problems. The WRP developed this restoration plan for the following purposes:

1. To articulate the TRO related vision, goals, and restoration site selection criteria common to White River basin stakeholders in order to facilitate a consistent approach to the restoration of TRO impacted areas in the White River.
2. To increase collaboration and communication among stakeholders to enhance information transfer, adaptive management, and the likelihood of large-scale, long-term successful restoration.

Ultimately, land management decisions are made by land managers and landowners. This document also aims to serve as a resource for land and wildlife management agencies and landowners to develop site-specific riparian restoration plans. These implementation plans will provide detailed approaches for actual work sites including but not limited to: site specific project goals, project timeline and scheduling, a baseline data collection plan, work force selection, post-project monitoring, and a mechanism for maintenance determination and scheduling. Each plan will vary, but using this document as a guide will lend consistency to restoration projects that aid in creating a holistic approach to riparian restoration in the White River basin.

This restoration plan was developed with the understanding that controlling invasive TRO and their associated secondary invasive plant species as well as establishing native vegetation communities are only a few components of a watershed or river restoration plan. Other components that must be considered in a comprehensive riparian restoration plan include flow regimes, responsible livestock grazing, in-stream structures, and non-native fish and terrestrial wildlife species. Many of these issues are addressed by other entities that operate in the region, and related plans (known as of the development of this document) are listed in the Planning Effort Background chapter.

Vision and Guiding Principles

The WRP's **vision** is: The White River is dynamic riverine ecosystem where the threats from Russian olive, tamarisk, and related invasive plant species have been mitigated and native, resilient vegetation communities reflect a healthy river system beneficial to fish and wildlife habitat that supports the ecological, social, and economic sustainability of the multiple land uses found along the White River corridor.

The **Guiding Principles** for the execution of the vision include (these principles are written as the "statement of mutual benefits" in the WRP Memorandum of Understanding):

1. Commitment to meeting restoration goals/objectives and maintaining investment – Ensuring that ongoing consistent active treatment of sites continue until restoration goals/objectives are met so that resources/efforts are not wasted. Once sites satisfy the goals/objectives those sites will be 'graduated' to treatment under Maintenance Plan (see below)
    - Short-term maintenance of restoration goals/objectives – (Once restoration goals are met). Planning and budgeting for short term (3-5 years) oversight and maintenance of restoration efforts (e.g., replanting or reseeding of unsuccessful active revegetation efforts, any remaining invasive follow-up treatment of previous or new infestations) to ensure restoration goals continue to be met. This phase generally requires more resources than long-term maintenance, below.
    - Long-term sustainability/maintenance of restoration goals/objectives – (5 years+) Planning and budgeting for long term oversight and maintenance of restoration sites to ensure restoration goals continue to be met. Ideally most sites will be able to self-sustain riparian health; realistically some sites will continue to experience disturbance and will require continued frequent or infrequent maintenance efforts to ensure protection of restoration investment.
2. Education and outreach – Conducting training workshops and connecting partners with experts and resources to enhance success of restoration efforts; sharing WRP successes and lessons learned with each other (and larger restoration community, landowners, and public to extent WRP feels comfortable).
3. Funding – Working together to identify funding opportunities and secure funding to support WRP activities; partnering on funding applications when appropriate.

   Communication, coordination, and resource sharing – Conducting WRP meetings, sharing opportunities and information through a common mass email, and otherwise encouraging partner-to-partner resource and information sharing to benefit restoration efforts; conducting work in a coordinated manner that maximizes resource sharing and information exchange; working together to track progress towards meeting WRP goals.

Planning Effort Background

In 2016, the WRP held its first official public meeting to initiate increased communication and information sharing between local and regional entities working on natural resource related issues along the White River corridor in Colorado and Utah. At this meeting, attendees agreed that formalizing the WRP would be advantageous to all and that could be achieved by codifying the WRP in a Memorandum of Understanding (MOU). RiversEdge West coordinated expanded outreach in Colorado and Utah. From late 2019 through 2020, partners met regularly to formalize the White River WRP with an MOU and mission and vision statements, as well as develop this restoration plan. The goal of this plan is to provide a framework for improving the ecological health of riparian areas of the White River to meet the needs of land managers, local communities, and private landowners.

The following entities provided comments and expertise for the development of this restoration plan:

BLM Vernal Field Office
BLM Northwest Colorado District
BLM Utah Aquatic Habitat Management Program
BLM White River Field Office
Canyon Country Discovery Center
Colorado Parks and Wildlife
Colorado Water Conservation Board
Natural Resources Conservation Service
Private Industries
Private Landowners
Rio Blanco County Weed and Pest Department
RiversEdge West
State of Utah School and Institutional Trust Lands Administration
Town of Meeker, CO
Town of Rangely, CO
TriCounty Health
Uintah County, UT
United States Bureau of Reclamation
United States Fish and Wildlife Service
Utah Conservation Corps
Utah Department of Environmental Quality
Utah Division of Wildlife Resources
Utah State University
Ute Indian Tribe
Western Colorado Conservation Corps
White River Alliance
White River and Douglas Creek Conservation Districts

Related Plans and Documents

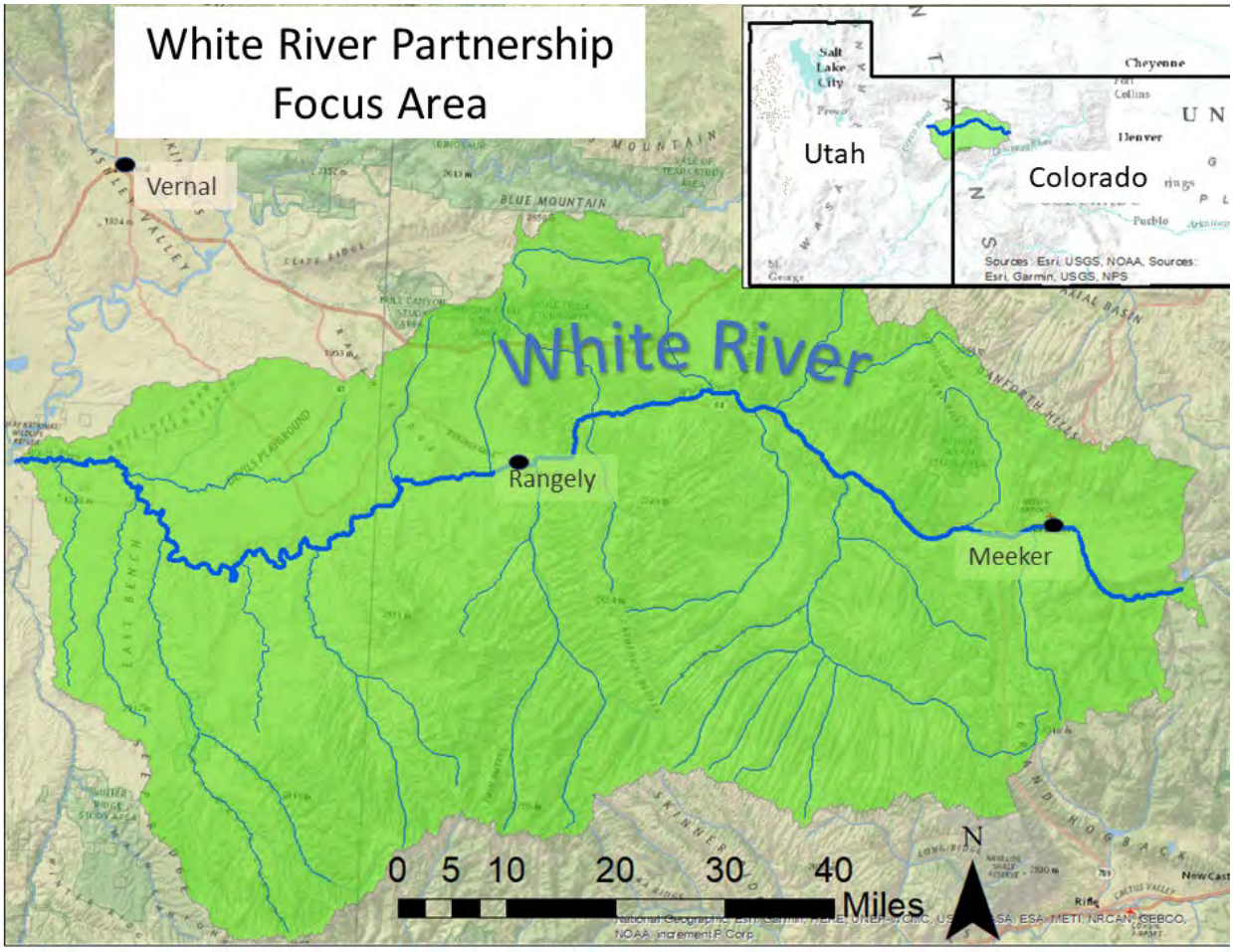
Partners recognize that healthy riparian vegetation is one of many factors that contribute to the sustainability of the White River basin's land and rivers. In addition to meetings and partner input, this restoration plan is informed by related regional planning efforts and is intended to complement those efforts whenever possible. The following chart lists related regional planning efforts known at the time of this plan's development.

Title	Lead Entity/Author	Year
Colorado Action Plan for Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors	Colorado Parks and Wildlife	2020
Colorado's Water Plan	Colorado Water Conservation Board	2015
Conservation and Management Plan for the Three Fish Species	Utah Division of Wildlife Resources	2006
Range-wide Conservation Agreement and Strategy for roundtail chub, bluehead sucker, and flannelmouth sucker	Utah Division of Wildlife Resources	2006
A Consolidated Woody Invasive Species Management Plan for Colorado's Colorado, Gunnison, Uncompahgre, Dolores, White, and Yampa/Green Watersheds	Colorado Headwaters Invasives Partnership	2008
Coordinated Resource Management Planning	White River and Douglas Creek Conservation Districts	Ongoing
Framework for Strategic Conservation of Desert Fishes	Desert Fish Habitat Partnership	2015
Land and Natural Resources Plan and Policies-Rio Blanco County	Rio Blanco County	2016
Recovery Implementation Program Recovery Action Plan (RIPRAP)	Upper Colorado River Endangered Fish Recovery Program	updated annually
Rio Blanco County Noxious Weed Management Program	Rio Blanco County Weed and Pest Control	2014
State Wildlife Action Plan	Colorado Parks and Wildlife	2015
Uintah County Resource Management Plan	Uintah County	2017
West Slope Mule Deer Strategy	Colorado Parks and Wildlife	2014
White River Integrated Water Initiative	White River and Douglas Creek Conservation Districts	2020-2022
White River Management Plan and U.S. Fish and Wildlife Service Programmatic Biological Opinion	Upper Colorado River Endangered Fish Recovery Program	2020-2021
White River Restoration, Conservation and Monitoring Plan	Utah State University	2021
Wildlife Action Plan 2015-2025	Utah Division of Wildlife Resources	2015
Yampa/White/Green Basin Implementation Plan	YWG Basin Roundtable	2015

Description of Focus Area

The White River basin is in northwest Colorado and northeast Utah, south of the Yampa River basin and north of the Colorado River. It begins as snowmelt in the Flat Top Mountains of western Colorado and flows through agricultural communities and the spectacular canyons of Utah's high desert plains before entering the Green River.

The focus area of the WRP and this planning document is the main stem and tributaries of the White River that have been impacted by TRO. Along the main stem, the focus area runs from the Lake Avery dam, east of the town of Meeker, Colorado, to the Green River confluence in Utah (see map below). The focus area includes the entirety of the lower White River watershed (HUC 14050007) in Utah and Colorado as well as portions of the upper White River (HUC 14050005) and Piceance-Yellow Creek (14050006) watersheds in Colorado. While some small portions of the upper White River and Piceance-Yellow Creek watersheds are located in Garfield and Moffat counties in Colorado, the focus area of the WRP is within Rio Blanco County, Colorado, and Uintah County, Utah.



White River Partnership Focus Area

Focus Area Land Ownership and Management

In Utah, lands directly adjacent to the White River are predominantly federal public lands managed by the Bureau of Land Management (BLM). Ute Tribal lands also comprise a significant portion of land ownership in Utah along the White River. There are some state trust lands managed by the School and Institutional Trust Lands Administration (SITLA), and some small pockets of privately-owned lands. In Colorado, lands adjacent to the White River are predominantly privately owned, with small pockets of BLM lands. The towns of Rangely and Meeker also own a small portion of land along the White River, and some lands are managed by Colorado Parks and Wildlife. The River Reaches Appendix includes more detailed descriptions of land ownership and management along the White River.

Goals and Objectives

The restoration plan aims to develop and implement a comprehensive approach for conserving, improving, and creating a healthy riparian ecosystem along the White River that meets the ecological, cultural, social, management, and economic goals of the WRP. The ecological goals are the primary driver of restoration work and facilitate meeting the WRP social, economic, cultural, and management goals. These overarching goals are the following:

Goal	Objective
Ecological/Geomorphic: A healthy White River with a functioning riparian area and in-stream habitat characterized by a resilient community of native and/or desirable vegetation that supports wildlife and fish habitat needs.	To implement a coordinated restoration program on public and private land that manages invasive plant removal, native revegetation, and fish and wildlife habitat restoration work. Restore natural riverine processes in areas where human infrastructure will not be negatively impacted.
Social: A restoration program along the White River that educates youth and the local community about natural resource management and provides opportunities for employment and career advancement in related fields.	To employ and train youth and young adult conservation corps members in the restoration and maintenance of the White River. Work with and engage local landowners and community members. Offer volunteer opportunities for the local community. Cultivate a community of local river stewards (e.g. K-12, youth, local residents, BLM, and businesses) through education and volunteer programs. To the extent possible, work to mitigate wildfire hazards around human infrastructure.
Cultural: A White River with robust cultural resources and adequate protections in place for these resources.	To develop management protocols along the river that protects cultural resources in cooperation with the Ute Tribe, public land managers, and private landowners. Support traditional, cultural, and historic agricultural uses of the White River and its riparian areas.

Management: An established process for ensuring ongoing restoration, maintenance, and stewardship of the river and the sharing of lessons learned with other practitioners.	Establish transparent organizational processes that fairly address all stakeholder interests while also prioritizing implementation actions according to need. Facilitate communication between managers and partners. Garner support from agency budgets and attract other sources of funding Incorporate adaptive processes to improve effectiveness over time and with experience.
Economic: A restored White River that offers opportunities for improved recreation, sustainable agricultural production and ranching, employment for local contractors and youth conservation corps, and is mindful of other local industry's needs.	Improve river access for recreation (e.g. camping, rafting, hiking), hunting, and wildlife viewing (e.g. bird watching) opportunities for locals and visitors. Develop a professional, competitive, and efficient work force by enhancing local contractor capabilities and youth and young-adult conservation corps programs. To increase access and improve habitat through invasive plant removal, which could attract recreation, benefit agricultural producers, aid local industries, and grow the local economy.

System Stressors and Assumptions

To successfully work towards the WRP's Vision, it is necessary to prioritize areas throughout the river system where restoration actions will best meet the plan's ecologic, social, cultural, economic, and management Goals. Therefore, this plan provides a list of Criteria for Prioritizing Restoration Actions.

In order to define these site selection criteria, it is important to understand the ecological and anthropogenic context in which the restoration sites exist. The "stressors" that we define in this section affect the relationship between TRO and native plant species in the White River system. Some of these stressors can be mitigated through TRO control and revegetation efforts. Other stressors are not directly addressed in this restoration plan but still have bearing on the site prioritization criteria due to their ecological impacts.

The Criteria for Prioritization are based on scientifically founded assumptions that direct how this plan addresses the stressors of the White River system's riparian areas. These assumptions link the restoration actions recommended in this document back to the WRP's Goals by allowing that: if the sites recommended by the Criteria for Prioritization are restored, based on the Assumptions listed below, the WRP's Goals will be met.

Stressors associated with the White River system are listed below along with the Assumptions that this plan is operating under to mitigate these pressures and/or work within the current condition of the river system. This document is a concise version of the Stressors and Assumptions related to TRO control. For more in-depth information please refer to the

references listed below and the appendices included in the White River Riparian Restoration Plan.

Tamarisk and Russian Olive: In many cases, TRO control and the reestablishment of native vegetation are the most critical activities necessary to begin the restoration of southwestern river systems. These stands can outcompete and displace native riparian and adjacent upland vegetation, exploit valuable water resources, provide inferior habitat and forage for wildlife and livestock, increase the risk of damage to native vegetation by wildfire, and provide a seed source for continued infestations.

TRO Assumptions:

- Complete TRO eradication is not possible.
- As eradication is not possible, TRO seed sources will always be present.
- Healthy native vegetation is superior to TRO.

TRO Treatment and Restoration Methods: Best Management Practices (BMPs) for TRO control and subsequent restoration and revegetation are constantly evolving. Due to this evolution and the inherently site-specific nature of restoration work, it is difficult to create a definitive guide to TRO control and restoration work. However, there are many resources available for restoration practitioners to use, along with professional judgment, in the process of implementation planning.

TRO Treatment and Restoration Method Assumptions:

- Site-specific implementation plans will provide the detail necessary to conduct successful restoration.
- Where feasible, passive revegetation is preferred over active revegetation. Revegetation methods and resources are presented in the "TRO Management Resources" Appendix.
- TRO treatment methods must be chosen with revegetation methods in mind.
- Sites with good existing native seed sources are more likely to succeed.
- Site-specific revegetation efforts will consider revegetating with understory grasses and shrubs.

Tamarisk Beetle (*Diorhabda* spp.): The tamarisk beetle as a system stressor is complex as it is directly affect another stressor, tamarisk. While the beetle is indeed interacting with the system as a whole, more information on these interactions is needed. Therefore, it is considered here mainly as a tamarisk stressor.

Tamarisk Beetle Assumptions:

- Stressed and healthy tamarisk will experience some level of mortality.
- Beetle will decrease tamarisk seed production.
- Vegetation present, native or non-native, in surrounding area will replace tamarisk.

Hydrology: Peak spring flows result from melting snowpack accumulated at higher elevations during the winter. Peak flows are particularly important for passive revegetation of native plant species and also for transporting sediment that creates and maintains suitable spawning habitats for endangered and other native fishes, as well as numerous backwaters and floodplain

depressions—critical nursery habitat for many in-stream species. Compared to other rivers in the upper Colorado River system, the White River has a relatively natural hydrograph that provides biological, physical, and chemical contributions to the Green River that are similar to historic levels (UDWR 2014; Anderson et al 2019).

Hydrology Assumptions:

- Restoration actions will be guided by the available flow regime.
- Native vegetation is more likely to successfully establish and persist in riparian areas through active or passive restoration.
- Native vegetation is less likely to successfully establish and persist in upland floodplain terrace areas through active or passive TRO removal and will likely require active revegetation.
- TRO establishment that is likely under any flow regime can be mitigated.
- Invasive and non-native fish species (e.g. smallmouth bass) will thrive under low flow conditions.

Geomorphology: TRO can affect the geomorphology of a river system by trapping sediments and converting braided channels into single thread channel configurations. These conditions are complicated and closely associated with hydrology, dense vegetation growth, altered base flow levels and truncated seasonal peak flows.

Geomorphology Assumptions:

- Removing TRO and replacing it with native vegetation can improve geomorphology.
- Meandering sections of the White River, especially below Bonanza Bridge will continue to see channel movement over decades, it is important to allow the main stem channel to continue to move.
- Riparian vegetation contributions to the river in the form of Large Woody Debris (LWD) is essential to in-stream habitat creation.

Livestock and Wildlife Grazing: Livestock grazing within the White River watershed has important implications, economically and ecologically, that land managers incorporate into their management practices. Overutilization by livestock and/or wildlife grazing can degrade grass, shrub, and tree plantings. Thus, it is important to manage grazing and wildlife use to reduce impacts on newly planted grasses, shrubs, and trees (i.e., cottonwoods).

Livestock and Wildlife Grazing Assumptions:

- Best management practices (BMP see below) for livestock grazing will be used on project sites.
- Appropriate exclusions (such as electric fencing and/or resting) will be placed for wildlife and livestock in coordination with the landowner, land manager, and/or permittee of specific sites.
- Cottonwoods > 6 feet tall are considered safe from grazing and browsing impacts.

Saline Soils and Arid Conditions: Both saline soils and arid conditions are common to the White River system due to natural and anthropogenic influences. Such conditions have given

halophytic TRO a competitive advantage over many native species and provide many restoration challenges (Ogle et al. 2004; Morford 2014).

Salinity and Aridity Assumptions:

- Riparian areas slated for restoration are less affected by these issues.
- Salt tolerant plants will survive in saline and arid project areas.

Herbaceous and Woody Invasives: The White River system has infestations of other weeds of concern including leafy spurge, Russian knapweed, white top, and Canada thistle. Implementation Plans concerning other herbaceous or woody invasive species should use current BMP.

Herbaceous and Woody Invasives Assumptions:

- These species must be controlled at project sites to achieve success.
- Specific treatments for these species will be included in site-specific implementation plans.

Climate Change: Climate change could alter factors in the watershed such as temperature and storm intensity as well as precipitation amount, frequency, seasonality, and form. Although the ecological and water system responses to these factors are, as yet, unknown, climate change is likely to exacerbate riparian ecosystem stressors (Poff et al. 2012).

Climate Change Assumption:

- Colorado Water Conservation Board and the NOAA Colorado River Basin Forecast Center have extensive climate change modeling over 100 scenarios which show a hotter and drier climate in the White River basin.
- A warmer and drier climate will likely affect the hydrologic regime as the system changes from a snow dominated system to more of a rain-dominated system.
- Specific potential impacts are unknown and should be addressed using adaptive management.

Recreation: Recreation in non-designated areas can impact riparian vegetation through soil compaction and erosion as well as the trampling of native vegetation.

Recreation Assumptions:

- Recreational use of the White River will increase.
- Vegetation impacts can be mitigated by selecting proper sites for active revegetation and by installing signage and/or exclosures if needed and as decided by the land manager.
- Restoration sites could be used for campsites or to improve river access.
- Increased restoration could increase visitation and advocacy for non-native vegetation removal.

Criteria for Prioritizing Active and Passive Restoration Actions

Establishing a common approach to riparian restoration in the White River basin requires articulating the site criteria that are used to identify and prioritize restoration sites. Suggested criteria for land managers and land owners to use to prioritize sites are listed in Table 1 for active TRO control measures and in Table 2 for biological control measures (tamarisk beetle). These criteria are principally driven by the Ecological Goals for the White River. Social, Economic, Cultural, and Management Goals provide direction for the manner in which selected sites selected are managed.

The selection of actual work sites will be driven by land management agencies and landowners in the context of the many other issues in the watershed (for example land-use issues, workforce availability, budget limitations, and logistical hurdles.) The prioritization criteria are a tool to inform the site selection process in order to increase the positive ecological impacts and the cost-effectiveness of restoration actions.

Feasibility Characteristics: The following three characteristics determine the feasibility of a site to be restored and must be met in order for restoration to proceed on a prioritized site.

1. Funding is available to complete the entire project, including monitoring and maintenance, to a point of success.
2. The landowner is willing. Cooperation, commitment, and common goals with the land owner or land manager are essential. Without long-term collaboration, monitoring, and maintenance, restoration is unlikely to succeed.
3. Site access is economically feasible. The accessibility of the site is important to consider due to the difficulty in management, monitoring, and maintaining the site. If there are adequate financial resources to properly monitor and maintain remote sites this is not an issue.

Criteria for Prioritizing Sites for Active TRO Control

Criteria Category	Criteria Objectives
A. Healthy native vegetation communities	Cottonwood gallery forests and mixed-age stands Plant species or communities identified as threatened, endangered, special status, or of special concern by BLM, Colorado Natural Heritage Program, UDWR, USFWS, or Ute Tribe Islands of healthy native vegetation providing important seed sources for adjacent infested areas and/or high plant species diversity for wildlife Upland areas defoliated by the tamarisk leaf beetle where monitoring indicates that active revegetation is needed Stretches of high-density tamarisk where no active removal is planned but where the tamarisk leaf beetle will be active and the native seed source is insufficient for passive revegetation
B. River channel complexity: side channels, backwaters,	Conserve or restore aquatic habitat for native fish, including ESA (bonytail, Colorado pikeminnow, razorback sucker) and Conservation Agreement (bluehead sucker, flannelmouth sucker, roundtail chub)

Criteria Category	Criteria Objectives
floodplain connection, large woody debris	Maintain or reestablish natural river channel morphology in areas that provide sediment transport and large woody debris inputs
C. Good hydrologic connectivity	Cottonwood stands in areas indicating good hydrology, e.g. young recruits, mixed age classes Low lying areas with stands of invasive woody species that are likely scoured by high flows and that could provide for cottonwood recruitment Oxbows and off-channel emergent wetlands
D. Wildlife areas identified as important by BLM, CPW, UDWR, USFWS, and/or Ute Tribe	Areas that provide habitat for federal, state, and/or tribal priority species Game habitat and/or migratory areas
E. Social, Economic, Cultural	Agricultural or grazing improvement Recreation: enhance access for public and/or improve aesthetics Opportunities for educational outreach Reduce risk to human life and public and private property from wildfires exacerbated by invasive woody species
F. Management	Desires of funding source Maintain existing and legacy restoration sites to not lose past investment and progress Logical expansion of other sites to promote connectivity Educational and training opportunities Opportunistic e.g. small or isolated TRO infestations that are easily managed before they expand

Criteria for Prioritizing Sites for Monitoring and/or Biological Tamarisk Control

Criteria Category	Criteria Objective
A. Costs	Areas with insufficient funding to adequately address all aspects of restoration; i.e., active tamarisk control, revegetation, herbaceous weed control, monitoring, and maintenance Areas with very light tamarisk infestations with good native plant seed source.
B. Landowner considerations	Sites without landowner permission for active restoration methods Sites that are experiencing livestock grazing practices that are not considered Best Management Practices Sites with landowner requirements for control and revegetation that do not meet with the Vision, Guiding Principles, or Goals of the WRP
C. Accessibility	Areas generally inaccessible except through extraordinary measures

D. BMP under development	Areas of high herbaceous weed infestations along with tamarisk that are best left to a future effort that is informed by pilot projects
E. Other situations	Areas that could have sufficient native plant communities that are not considered as significant as cottonwood e.g. rabbitbrush, sagebrush, greasewood Cultural resource sites that would be damaged by active control Wildlife and plant species of concern that could be harmed by active control

Three-Year Goals and Objectives

The previous sections provide the context and framework for riparian restoration and the WRP. The following section details 3-year goals were identified by White River partners. Although this plan is designed to address riparian restoration at the watershed scale and across jurisdictional boundaries, the following goals and objectives are divided into separate parts for Utah and Colorado to facilitate implementation and to account for regional differences in restoration goals. This section is intended to be updated by the WRP as restoration goals are achieved and/or evolve.

Utah Goals and Objectives

- WRP development:
  - Maintain funding for WRP coordination
  - Continue Utah-focused meetings once or twice per year as needed (in addition to full WRP meetings). Late in summer would be a good time because it is just before fall implementation
  - The WRP values input and participation from the Ute Tribe and will continue to support Ute Tribe interests in restoration and the WRP. The WRP also hopes to identify Ute Tribe perspectives and potential goals for riparian restoration
- Community engagement and outreach:
  - Coordinate volunteer event(s) with students such as: Utah State University Uintah Basin (Roosevelt and Vernal campuses); Vernal-area high schools
  - Provide educational opportunities for private landowners
- Implementation:
  - Reach UT1: Continue coordination with Ute Tribe to identify tribal interests in restoration
  - Reaches UT2-UT5:
    - Utah partners will use Utah State University's White River Restoration, Conservation and Monitoring Plan as a guide for prioritizing restoration sites
    - Utah partners value maintaining and expanding existing restoration sites
  - Reach UT6: Continue communicating with private landowners to keep them informed of WRP activities

Colorado Goals and Objectives

- WRP development:
    - Further identify and define roles of different partners in the WRP
- Community engagement and outreach:
    - Encourage engagement from the towns of Meeker and Rangely as well as Rio Blanco County in WRP activities and restoration
    - Provide educational opportunities regarding:
        - Funding for restoration on private lands
        - Best Management Practices for initial treatment and site maintenance
        - Restoration benefits for land values and supporting the hunting economy
        - Site visits for partners and landowners
    - Increase local employment opportunities related to restoration in Rio Blanco County, CO
- Implementation
    - Focus on the eastern extent of Russian olive while infestations are relatively more manageable due to low density
    - Identify potential restoration areas within the zone of critical habitat for endangered fish, particularly below Taylor Draw Dam, that could benefit management programs
    - Outreach to landowners

Initial Restoration Sites:

The following sites were identified as initial priority restoration sites through WRP meetings, partner plans, and site visits. Treatment sites and priorities may change based on partner needs, site accessibility, labor availability, and project funding.

Site Name	Size (acres)	Treatment	State	Ownership/ Management
Big Trujillo	75	Monitoring and maintenance	CO	BLM WRFO
Olive Garden	25	Monitoring and maintenance	CO	BLM WRFO, private land
Stateline 1	3.5	Primary	CO	BLM WRFO
Stateline 2	4.5	Primary	CO	BLM WRFO
Yellow Creek	70 (est)	Primary	CO	BLM WRFO, CPW, private
Mainstem 3	8	Primary	CO	BLM WRFO
Asphalt Wash	12	Monitoring and maintenance	UT	BLM VFO
Bridge D	10	Monitoring and maintenance	UT	BLM VFO
Bonanza Bridge Demonstration Site		Monitoring and Maintenance	UT	BLM VFO, SITLA

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Utah Division of Wildlife Resources (2006) Conservation and Management Plan for Three Fish Species in Utah. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/hydro/weber/resource-reports-and-data/UT-Conservation-Plan-Final-for-Pub_Sept2006.pdf

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Utah Wildlife Action Plan Joint Team. 2015. Utah Wildlife Action Plan: A plan for managing native wildlife species and their habitats to help prevent listing under the Endangered Species Act. Publication number 15-14. Utah Division of Wildlife Resources, Salt Lake City, Utah, USA. https://wildlife.utah.gov/pdf/WAP/Utah_WAP.pdf

Woodward, Brian D. et al. (2018) Data from: CO-RIP: a riparian vegetation corridor extent dataset for the Colorado River Basin streams and rivers, Dryan, Dataset, https://doi.org/10.5061/dryad.3g55sv8

Y2 Consultants and Budd-Falen Law Offices (2016) Land and Natural Resource Plan and Policy-Rio Blanco County. http://www.whiterivercd.com/uploads/2/6/0/6/26068836/2016.05.20_rio_blanco_land_use_plan_final.pdf

Yampa/White/Green Basin Roundtable (2015) Yampa/White/Green Basin Implementation Plan. https://www.colorado.gov/pacific/sites/default/files/Yampa-WhiteBIP_Full.pdf

Appendices

Tamarisk and Russian Olive Ecology Resources

Russian olive:

Biology, ecology and management of *Elaeagnus angustifolia* (Russian olive) in western North America by Gabrielle Katz and Patrick Shafroth: DOI: 10.1672/0277-5212(2003)023[0763:BEAMOE]2.0.CO;2

Legacy effects of Russian olive (*Elaeagnus angustifolia*) in a riparian ecosystem three years post-removal (2020) https://doi.org/10.1007/s13157-020-01385-3

Secondary invasion and reinvasion after Russian-olive removal and revegetation (2017): DOI: 10.1017/inp.2017.36

Tamarisk:

Tamarisk Best Management Practices in Colorado Watersheds. Edited by Scott Nissen, Anna Sher, and Andrew Norton: https://riversedgewest.org/sites/default/files/resource-center-documents/CSUtamariskBMP_lowres.pdf

Tamarisk biocontrol in the western United States: ecological and societal implications (2010): doi:10.1890/090031

Tamarisk and Russian Olive Management Resources

Treatment methods:

Weed Reports from *Weed Control in Natural Areas in the Western United States* provides recommendations on mechanical, cultural, chemical and biological control methods, including herbicide selection and application rates.
Russian olive: https://wric.ucdavis.edu/information/natural%20areas/wr_E/Elaeagnus.pdf
Tamarisk: https://wric.ucdavis.edu/information/crop/natural%20areas/wr_T/Tamarix.pdf

Cut-stump method: The cut-stump method involves cutting the invasive tree as close to the ground as possible and applying herbicide to the stump. It is especially useful where the TRO trees are invading native cottonwood gallery forests since it removes the trees from the area. This reduces the risk of wildfire that could potentially destroy the cottonwood forests and also opens up more space for natural cottonwood recruitment. The biomass removed from cottonwood

forests can be utilized as habitat piles for small terrestrial animals, staged on the riverbank to reintroduce large woody debris (LWD) for native fish habitat, or scattered across the site.

Cut-stump method. Trees should be cut as close to the ground as possible (photo courtesy of Utah Conservation Corps)

Frill-cut method: Frill-cutting involves using a hatchet or saw to cut staggered pockets into the cambium layer of the tree and applying herbicide to the exposed areas. This method is much faster than the cut-stump method as it requires less carrying and piling of slash. It leaves the invasive trees as standing dead, so it is useful in areas where fire is less of a hazard and where canopy cover from other (native) trees is lacking.

Frill-cut method (photos courtesy of Utah Conservation Corps)

Frill-cutting is effective but leaves standing dead trees that can still impede access and act as ladder fuels (photo courtesy of Utah Conservation Corps)

Basal-bark application: This method is commonly used for retreatments of TRO regrowth and resprouts following initial treatments. It involves applying herbicide directly to the bark of younger stumps and shoots

Foliar application: This method can be used on smaller infestations and smaller sized trees. Foliage should be completely covered without dripping. Herbicide should be mixed with dye and a surfactant. The top growth of tamarisk should be left for two years.

General resources:
Colorado River Basin Tamarisk and Russian Olive Assessment (2009): https://riversedgewest.org/sites/default/files/files/TRO_Assessment_FINAL%2012-09.pdf

Field Guide for Managing Saltcedar in the Southwest: https://riversedgewest.org/resource-center/documents/field-guide-managing-saltcedar-southwest-0

Renewing Our Rivers: Stream Corridor Restoration in Dryland Regions (2021) Mark K. Briggs and Waite R. Osterkamp. https://uapress.arizona.edu/book/renewing-our-rivers

Tamarisk Best Management Practices in Colorado Watersheds. Edited by Scott Nissen, Anna Sher, and Andrew Norton: https://riversedgewest.org/sites/default/files/resource-center-documents/CSUtamariskBMP_lowres.pdf

Mechanical Removal/Heavy Equipment

Some sections of the White River have vehicle accessible areas that would enable the use of machinery and equipment.

The following links provide information and examples of some of the heavy equipment that can be used for TRO removal.

- https://riversedgewest.org/sites/default/files/resource-center-documents/Stan%20Young%20Mulching%20Demo_0.pdf
- https://www.youtube.com/watch?v=kuumJ-edCzA

Local contractors may be able to provide this service.

- Colorado State Forestry Service provides a list of forest contractors and their services offered: (970) 248-7325; https://csfs.colostate.edu/grand-junction/
- Meeker Chamber of Commerce: http://meekerchamber.chambermaster.com/list
- Rangely Area Chamber of Commerce: https://business.rangelychamber.com/list
- Vernal Area Chamber of Commerce: https://www.vernalchamber.com/directory.html

Revegetation:

Best Management Practices for Revegetation after Tamarisk Removal in the Upper Colorado River Basin (2010): https://riversedgewest.org/sites/default/files/resource-center-documents/BMP_for_reveg_after_tamarisk_removal.pdf

Cottonwood and Willow Pole Planting:

- https://riversedgewest.org/resource-center/cottonwood-and-willow-pole-planting
- https://www.youtube.com/watch?v=bZbLjAgke9g&t=1s

RiversEdge West Resource Center; Revegetation: https://riversedgewest.org/resource-center/revegetation---plant-materials

Tamarisk Best Management Practices in Colorado Watersheds. Edited by Scott Nissen, Anna Sher, and Andrew Norton: https://riversedgewest.org/sites/default/files/resource-center-documents/CSUtamariskBMP_lowres.pdf

Ute Ethnobotany Project. Summary Report of a Cooperative Project of the Grand Mesa, Uncompahgre, and Gunnison National Forests and the Grand Junction Field Office of the Bureau of Land Management

Mapping and Geographic Information System (GIS) Data:

CO-RIP: A riparian vegetation and corridor extent dataset for Colorado River Basin Streams and Rivers (2018) Woodward et al.
Article: https://www.mdpi.com/2220-9964/7/10/397
Data: https://datadryad.org/stash/dataset/doi:10.5061/dryad.3g55sv8

Riparian Condition Assessment Tool (R-CAT) (2015) Utah State University Ecogeomorphology and Topographic Analysis Lab https://rcat.riverscapes.xyz/UtahImplementation.html

Riparian Land Cover Classification of the Lower White River, Utah. GIS Data, Overflight Data, and Report: https://usu.app.box.com/s/em6ya4uh516w3furpya32b9dwehyq9nx

TRO mapping of lower White River, Colorado (2008) Tamarisk Coalition. Available by request from RiversEdge West as a .shp (ArcGIS) or .kmz (Google Earth) file.

Tamarisk Beetle
Tamarisk beetles have been active in Douglas Creek area (Colorado) where releases occurred over the past decade. They have been found on the White River main stem but it is unknown at this time if a population has or will establish on the main stem of the White River.

RiversEdge West Resource Center: https://riversedgewest.org/services/tamariskbeetle

The Palisade Insectary has information about beetles and beetle releases: https://ag.colorado.gov/conservation/biocontrol

River Reaches

Colorado:

Colorado reaches were developed based on TRO mapping (Tamarisk Coalition 2011), site visits, and WRP meetings. Reach delineations and descriptions were also informed by Colorado Headwaters Invasives Partnership's *Consolidated Woody Invasive Species Management Plan for Colorado's Colorado, Gunnison, Uncompahgre, Dolores, White, and Yampa/Green Watersheds* (2008) and Fraser et al.'s (2017, 2019) fish studies of the White River and are summarized in this section.

CO1: Utah State Line Taylor Draw Dam: This reach has more in common with lower stretches of the White River, such as denser infestations of TRO and the presence of endangered and conservation agreement fish species. It is also more popular for floating and receives more fishing pressure. The majority of this section of river is privately owned, though the BLM White River Field Office manages a few areas, and the Town of Rangely and the Western Rio Blanco Metropolitan Recreation and Park District own a few areas. At the downstream end of this 30-mile river stretch a relatively narrow floodplain contains a highly meandering single channel containing a number of island complexes and a few secondary channels. The floodplain widens gradually upstream towards Kenney Reservoir. Motorized access to the floodplain is fairly good throughout, though there are some isolated areas.

CO2: Taylor Draw Dam to Lake Avery: Taylor Draw Dam to Lake Avery is approximately 93 river miles, ranges between 30-40 meters wide, and is one of the last free-flowing sections of river in the upper Colorado River basin. This reach has fewer and thinner TRO infestations than lower reaches. Public access is more limited and there is less demand for floating or fishing. The majority of this section of the White River is privately owned though the BLM White River Field Office and Colorado Parks and Wildlife manage a few areas; the town of Meeker owns a few areas as well. The main channel meanders through a broad floodplain largely composed of agricultural fields. Due to the developed fields alongside the river, mechanical access is very

good on both the north and south banks of the river in most areas. Lake Avery is located a few miles downstream of the confluence of the North and South Forks of the White River.

Tributaries: (not in order of priority)

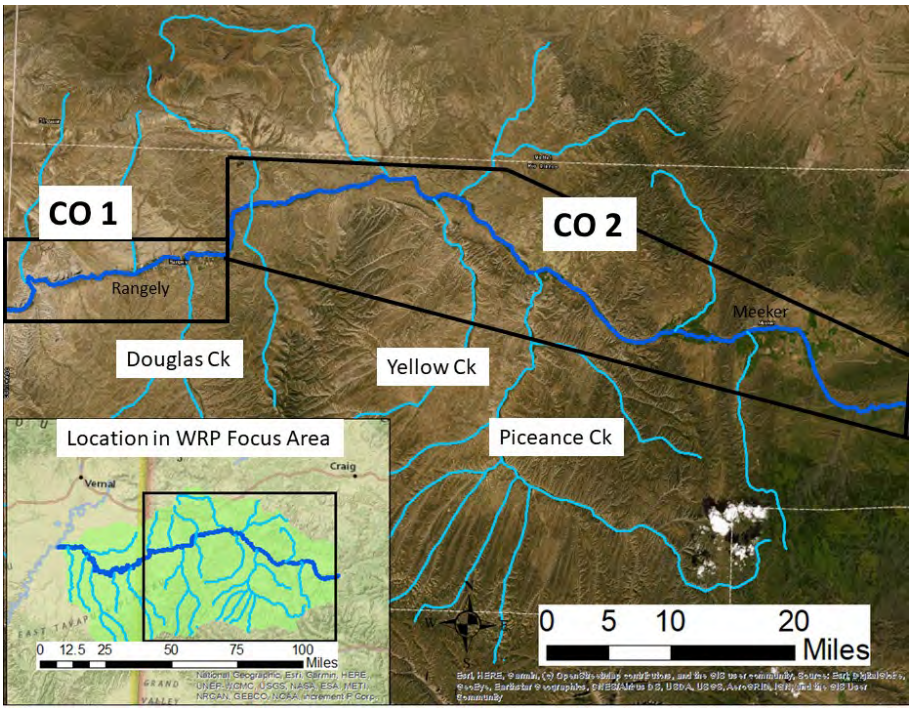
1. **Piceance Creek**: Most of the land along Piceance Creek is privately owned. The BLM and CPW did some treatments near the bridge approximately 10 years ago.

2. **Douglas Cree**k: a small perennial river, approximately 27 miles long with a narrow floodplain. Most of the land is managed by the BLM and there a few private landowners. Since it enters the White River downstream of Taylor Draw Dam, it can contribute important sediment loads to the White River. Tamarisk Leaf Beetle releases have occurred here, and the Bureau of Land Management completes spot treatments of TRO as time and funding allow.

3. **Yellow Creek:** A perennial stream located primarily on public land (managed mostly by the Bureau of Land Management and some sections by Colorado Parks and Wildlife) and some private land near the confluence with the White River main stem. Tamarisk infestations are denser near the confluence with the White River main stem and get thinner as one moves up the creek. There are also good populations of native vegetation; some riparian vegetation (grasses, shrubs, trees) and mostly upland species (sagebrush, greasewood). Some areas have dense sagebrush. Home to native leopard frogs and mountain suckers (both Tier 1 species in Colorado's Wildlife Action Plan) as well as beaver, fish, terrestrial wildlife. Tamarisk infestation is growing but manageable.
   The neighboring landowner is a grazing permittee, has completed some tamarisk removal on the private property, and is supportive of riparian restoration in Yellow Creek.
   Yellow Creek is a priority area identified by White River and Douglas Creek Conservation Districts' Coordinated Resource Management Plan.
   A Proper Functioning Condition Assessment found that riparian areas along many stretches of Yellow Creek ranked between NF (non-functioning) and FAR (functioning-at risk) and it is considered a high priority stream for restoration.
   Yellow Creek is easily accessed by vehicle on the northern end (Highway 64) and the southern end can be accessed by vehicle through Piceance Creek. The middle section is not accessible by vehicles and requires hiking.

4. **Coal Creek:** The area surrounding Coal Creek is in agricultural valley, most land is privately owned.

5. **Other tributaries:**



White River reaches in Colorado relative to WRP focus area

Utah:

Utah reach delineations and descriptions are adapted from Utah State University's Conservation, Restoration and Monitoring Plan for the White River as well as Utah Division of Wildlife Resources fisheries habitat data.

UT1: In this reach the White River flows through Ute Indian Tribe lands. River is wider with less gradient and more fine sediment. River is in a broad alluvial plain with the potential to access the floodplain with vehicles, machinery, and/or on foot. Levees were constructed along some segments to prevent flooding. High numbers of horses and cows have impacted vegetation, including invasive species. Tamarisk becomes a higher percentage of the vegetation, at least equal to Russian olive if not more prevalent. Approximately five miles before the White River meets the Green River is proposed Western Yellow-Billed Cuckoo critical habitat.

UT2: River has less interaction with floodplain and has less sinuosity. Riparian vegetation consists of isolated tamarisk patches about 2m tall. Very little LWD present in channel.

UT3: Wider channel with less sinuosity than Reaches 2 and 3. Similar Russian olive presence as Reach 3, and tamarisk reaches heights of 2m. Less LWD is present.

UT4: River is connected to floodplain with lower sinuosity than Reach 2. Riparian vegetation includes large cottonwood galleries with increased Russian olive and tamarisk presence compared to Reach 2. LWD piles are present at river bends.

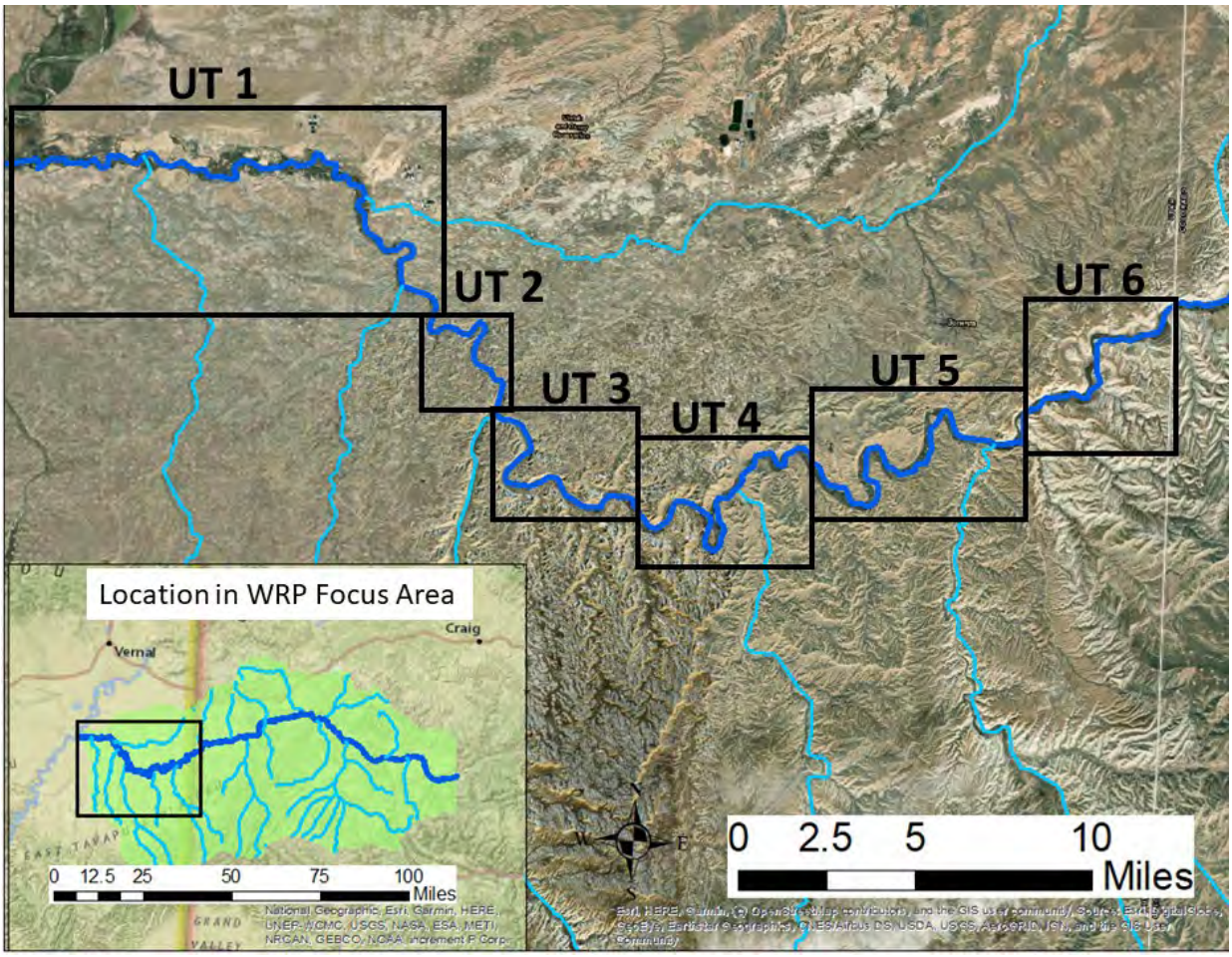
UT5: River is connected to floodplain with wide meanders. Riparian vegetation contains large cottonwood galleries, moderate-high Russian olive and light tamarisk. LWD piles are present at each river bend.

UT6: From one mile above Bonanza Bridge to the Colorado state line.

Tributaries: (not in order of priority)

All tributaries in Utah are intermittent, but these watersheds are vast so each can provide a significant amount of sediment and debris input.

1. Bitter Creek
2. Evacuation Creek
3. Asphalt Wash
4. Coyote Wash
5. Other tributaries



White River reaches in Utah relative to the WRP focus area.

Aquatic Wildlife Habitat

The follow sources were summarized for this section and provide in-depth reviews the importance of the White River for native fish species:

- Conservation and Management Plan for Three Fish Species in Utah: https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/hydro/weber/resource-reports-and-data/UT-Conservation-Plan-Final-for-Pub_Sept2006.pdf
- Range-wide Conservation Agreement and Strategy for roundtail chub, bluehead sucker, and flannelmouth sucker. https://ocs.fortlewis.edu/drd/pdf/Appendix-D%20_Rangewide-3-Species-Conservation-Agreement_3-7-12.pdf
- Keller D. Tamarisk Control and Desert Fish (presentation). https://riversedgewest.org/sites/default/files/resource-center-documents/Keller%20-%20San%20Rafael.pdf
- Review of Fish Studies with Interim Flow Recommendations for Endangered Fishes of the White River, Colorado and Utah. https://www.coloradoriverrecovery.org/documents-publications/technical-

reports/isf/White%20River%20Final%20Interim%20Flow%20Recs%203.2.20%20Formatted.pdf

- Tributary Use by Imperiled Flannelmouth and Bluehead Suckers in the Upper Colorado River Basin. https://doi.org/10.1080/00028487.2017.1312522

The White River provides habitat for native fish essential to the survival and recovery of three endangered fish species and three Conservation Agreement fish species. Regionally, the White River is essential to native fish conservation in the upper Colorado River basin (UCRB) because it provides critical spawning and rearing habitat to bolster metapopulations throughout the basin given that these are highly migratory species.

Endangered fish species: bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*).

- The White River provides shelter, forage, as well as spawning and nursery habitat for these fish species.
- White River is federally designated critical habitat for the Colorado pikeminnow from the Green River confluence to Taylor Draw Dam.
- White River is federally designated critical habitat for the razorback sucker for 18 miles upriver of the Green River confluence.

Bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*C. latipinnis*), and roundtail chub (*Gila robusta*), collectively referred to as the Three Species:

- Are Conservation Agreement Species in Colorado and Utah
- Are cooperatively managed through state and range-wide conservation agreements and management plans to preclude federal listing.
- Colorado Parks and Wildlife's State Wildlife Action Plan (2015) identifies these species as Tier 1, highest conservation priority, among Species of Greatest Conservation Need.
- Utah Wildlife Action Plan (2015) identifies these species as "Species of Greatest Conservation Need."

Upper Colorado River basin (UCRB) regional importance:

- Resident Colorado pikeminnow from the White River spawn in other locations of the UCRB such as the Green and Yampa.
- White River provides designated critical habitat, forage, and breeding areas for Colorado pikeminnow and razorback sucker in the UCRB
- Maintains populations of the three species at all life stages, one of the few remaining strongholds in the UCRB
- Provides spawning and rearing habitat for the Three Species.

Taylor Draw Dam (TDD), located east of Rangely, CO, is the only dam on the main stem of the White River and is a barrier to fish migration. It impounds Kenney Reservoir.

Downstream of TDD:

- The White River is crucial to the survival of the Colorado pikeminnow and the razorback sucker.
- Downstream of TDD supports robust populations of the "Three Species."

Upstream of Kenney Reservoir:

- The Three Species are also present
- There are mountain whitefish (*Prosopium williamsoni*), one of two salmonids native to Colorado.
- Supports "relatively robust" native fish populations such as bluehead and flannelmouth suckers

Tributaries of the White River are crucial for the completion of bluehead sucker and flannelmouth sucker life cycles (e.g. they are used for spawning habitat).

Riparian vegetation management influences in-stream habitat complexity, which directly impacts the complete life cycle of these and other native fishes. In some sections of the White River, braided streams are at risk of converting into a simplified, single channel.

In-stream habitat complexity: Can be defined as the natural variation in macro-habitat (i.e., riffles, pools, runs) and micro-habitat (i.e., depositional and erosional zones, LWD, backwaters, side channels, islands, etc.) within the river channel. The White River's in-stream habitat complexity is driven primarily by its flow regime, which is relatively similar to historic levels and provides continual erosion during high flows.

Side-channel habitat: Remnants of old river meanders that cut through floodplain habitats

Backwater habitat: Zero velocity habitat that is not influenced by upstream flow. These habitats typically occur on the downstream end of sand bars and the upper end of eddies that previously existed during high spring flows. These areas are important rearing habitats for young-of-year native fishes, while also providing foraging opportunities for piscivorous fishes (i.e., Colorado pikeminnow)

Floodplain connection: Prolonged overbank flows promote sediment transport via bank breakdown that in turn incorporate riparian habitat (i.e., cottonwood trees) into riverine habitats to increase in-stream habitat complexity. Overbank flows are also critical to the seeding and establishment of cottonwood trees, which provide a seed source and LWD (see below) for downriver areas as the river channel shifts from erosion.

Large Woody Debris (LWD): creates fish habitat structure and diversity, increases channel complexity by altering river flows, promotes overbank flow

A fallen cottonwood tree contributing LWD to the river ecosystem. Photo courtesy of Matt Breen, UDWR.

Site selection and implementation suggestions for improving native fish habitat:

Large portions of the White River still contain healthy habitat for native fishes. Therefore, restoration efforts should focus on both:

- Treating dense, established TRO infestations in locations that would contribute to native fish habitat (e.g. side channels, backwaters, etc) if they weren't impacted by TRO.
- Treating new and less dense infestations in order to conserve existing habitat elements.

Site-specific implementation plans are decided by the landowner and/or land manager. The following approaches are recommended for riparian restoration projects that have fish habitat improvement goals:

1) Prioritize TRO removal along banks of the river to prevent the "armoring" of the bank, which contributes to bank stabilization.

2) Prioritize treatment on islands in the river, especially islands where TRO is creating a narrowing channel between the river bank. This will help to maintain side channels and overall channel complexity.

3) Prioritize treatments on side channels that are being encroached and/or cut off from the main stem of the river by dense TRO.

Cut-stump Russian olive treatment along a bank of the White River

4) Prioritize treatments on side channels and islands during the early stages of TRO infestation, before the extent and density of the infestations necessitates more intensive restoration practices.

5) Contributing LWD to the river ecosystem:

a) through revegetation strategies that include large trees such as cottonwoods and willows

b) piling "slash" or the material cut from the tree, in areas along the floodplain where it will be gradually taken up by the river

Slash piles that were placed in the flood plain during lower water levels about to be carried into the river during higher flows, adding LWD to the river ecosystem (Photo by David Varner)

Notes on LWD:

- It is important to consult with downstream landowners and managers before putting LWD into the river
- Recreation impacts: slash piles entering the river system can potentially interfere with recreational activities such as boating and fishing. As of writing, this is not a major issue on the White River due to low visitation rates and that boaters generally expect log jams and debris. Most boaters use the system during high flows when it is much less of a concern than during base flows when the channel width narrows significantly.
- Before these piles are picked up by the river, they also provide excellent habitat for terrestrial wildlife like small mammals, lizards, and snakes

Terrestrial and Amphibious Wildlife Habitat

It is estimated that 80%-90% of wildlife depend on riparian habitat at some point in their life cycle, even though riparian areas make up less than 2% of Colorado's land area and less than 1% of Utah's land area. In Utah, lowland riparian areas, which include the White River, cover only 0.2% of the total land area. The riparian vegetation found along the White River corridor, such as cottonwood and willow trees, provides important habitat for birds, small mammals, amphibians, and reptiles. The White River corridor is a key habitat and migratory route for large herds of elk and mule deer.

In Utah, records indicate that the following species are present, likely present, or potentially present in the White River corridor. There are confirmed records/observations for those listed as "present", those listed as "likely present" lack documentation but should utilize the White River corridor, and those listed as "potentially present" could occasionally occur.

Utah BLM Wildlife Sensitive Species:

- Monarch Butterfly (likely present)
- Western Bumble Bee (likely present)
- Great Plains Toad (potentially present)
- Great Plains Rat Snake (likely present)
- Bald Eagle (present)

- Golden Eagle (present)
- Big Free-tailed Bat (potentially present)
- Fringed Myotis (likely present)
- Spotted Bat (likely present)
- Townsend's Big-eared Bat (likely present)

Several additional species are identified in the UDWR Wildlife Action Plan as Species of Greatest Conservation Need (on top of most of those already noted above as Sensitive Species):

- Northern Leopard Frog (present)
- Midget Faded Rattlesnake (likely present)
- Bighorn Sheep (present)
- Little Brown Myotis (likely present)

Based on Utah BLM GIS data and records, the following priority wildlife habitats per species are present along the White River, near current and potential restoration sites:

- Bald Eagle winter roosting habitat (two documented nests along the White River corridor)
- Raptor nest sites for Great Horned Owl and Red-tailed Hawk, Golden Eagle nest sites in vicinity
- Year-long crucial habitat for Wild Turkey and Ring-necked Pheasant
- Rocky Mountain Bighorn Sheep year-long crucial habitat
- Mule Deer year-long crucial habitat

The lower 6-7 miles of the White River on Ute Tribe land near the Green River confluence are proposed Critical Habitat designation for federally threatened Yellow-billed Cuckoo.

Colorado:

- Several bat species depend on native vegetation such as cottonwood galleries and willow species for foraging and roosting
- Northern leopard frogs, a BLM Sensitive species and Colorado Parks and Wildlife Tier 1 priority species, are found along portions of Piceance Creek, Yellow Creek, Crooked Wash, and the lower White River
- Bald Eagles (*Haliaeetus leucocephalus*) utilize the White River corridor's cottonwood gallery forests nest and winter roost sites.

The White River mule deer and elk herds are one of largest migratory mule deer and elk herds in Colorado and potentially the United States. The winter range of these herds extends to within 30 miles of the Colorado-Utah state border along the White River, near the town of Rangely. Hunting for these species contributes tens of millions of dollars annually to the economy of northwestern Colorado.

Colorado Parks and Wildlife's Action Plan for Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors notes that although riparian habitat makes up a small portion of the total range of these big game herds, it is highly important for both game species and other wildlife, by providing:

- year-round forage for deer

- diversity of vegetation and wildlife species
- a longer growing season of grasses, shrubs, and forbs
- the optimum combination of vegetation cover types

Monotypic stands of TRO have replaced the diverse vegetation communities that typically characterize riparian areas, reducing habitat for terrestrial organisms. While several animal species have adapted to life with TRO, replacement of woody invasive vegetation with diverse native plant species to restore the function of riparian ecosystems can conserve, restore, and create habitat for wildlife in the following ways:

Vegetation composition: Diverse, native vegetation will increase habitat and food sources for wildlife

Cottonwood galleries: Cottonwood gallery forests along the White River still have natural regeneration that is threatened by TRO infestations. Cottonwood gallery forests on the White River provide winter and nest habitat for bald eagles.

Hydrology/Geomorphology: Similar to the ways that vegetation management can improve habitat for aquatic organisms, fostering the re-establishment and maintenance of riparian processes (e.g. oxbows, backwater habitats) can benefit waterfowl and amphibian species such as northern leopard frogs.

In addition to the overall habitat improvements achieved through the removal of invasive vegetation and its replacement with native vegetation, restoration implementation methods and actions can create immediate improvements to terrestrial habitat. Implementation approaches can also ensure that existing components of healthy habitat are maintained during the restoration process.

The following are suggested methods for maintaining and/or increasing terrestrial habitat during the restoration implementation process.

- **Snags (standing dead trees)** When possible and safe, snags should be left in place**.** This is especially true for large cottonwoods. Snags contribute to habitat by providing:
    - Perches for birds
    - Nest areas- especially snags with holes or hollowed out areas
    - Habitat for bat species-if there is bark on snags that is loose but still attached, bats can roost between the bark and trunk
- **Nests** Work crews should look out for nests in the branches of trees during TRO removal
- **Habitat piles** TRO limbs and trunks that are cut can be arranged in habitat piles that provide habitat and potential forage for smaller mammals, reptiles, amphibians, and rodents**.**
    - Staggering habitat piles at different distances from the river further diversifies the habitat.
    - If piles are too large or too close to native vegetation they could become a fire hazard

The following resources informed this appendix and provide additional information on wildlife of the White River corridor:

Colorado Action Plan for Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors. https://www.nfwf.org/sites/default/files/2020-09/Colorado2020SAP.pdf

Colorado Wildlife Action Plan: A Strategy for Conserving Wildlife in Colorado. https://cpw.state.co.us/Documents/WildlifeSpecies/SWAP/CO_SWAP_FULLVERSION.pdf

West Slope Mule Deer Strategy
https://cpw.state.co.us/Documents/MuleDeer/MuleDeerStrategy.pdf

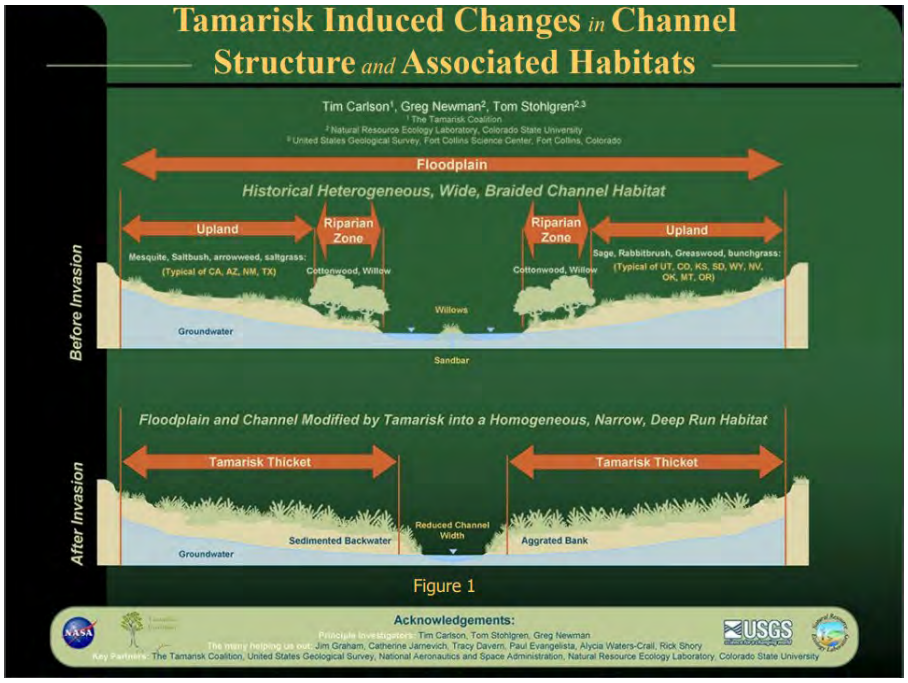
RiversEdge West Resource Center: Wildlife: https://riversedgewest.org/resource-center/wildlife

Utah Wildlife Action Plan: A plan for managing native wildlife species and their habitats to help prevent listings under the Endangered Species Act.
https://wildlife.utah.gov/pdf/WAP/Utah_WAP.pdf

Water Quality and Quantity

Water Quality: Tamarisk brings up salts from the soil and deposits them on the surface, which can impact water quality by increasing salinity levels. TRO removal can also act as a preventative water quality improvement tool by reducing the risk of severe wildfire, which causes runoff and erosion that is detrimental to water quality. Additionally, studies have shown that native riparian species, particularly sandbar willow, can improve water quality by removing pharmaceuticals and other contaminants.

Water Quantity: Water consumption and evapotranspiration rates by TRO, and how those rates compare to native riparian vegetation, is very site-specific. TRO may not transpire significantly more water than native riparian plant species. However, as tamarisk frequently persists on sites that are higher above the water table and too dry for most native riparian species, tamarisk may increase the areal extent of transpiring vegetation and total transpiration-related water losses. Furthermore, TRO are often found in densities that far exceed those observed in native vegetation stands. Therefore, at a landscape scale, potential water savings could be accomplished though the replacement of TRO with native riparian and upland species.



Tamarisk will grow in areas too high and/or too dry for native riparian vegetation

The following resources were used for this section and include additional information about water quality, water quantity as it relates to riparian restoration:

RiversEdge West Resource Center: Phreatophyte Water Usage: https://riversedgewest.org/resource-center/phreatophyte-water-usage

Franks CG, Pearce DW, Rood SB (2019) A prescription for drug-free rivers: Uptake of pharmaceuticals by a widespread streamside willow. Environmental Management. http://scholar.ulethbridge.ca/rood/publications/prescription-drug-free-rivers-uptake-pharmaceuticals-widespread-streamside-willow

Shafike N and Cleverly J (2007) Native versus invasive: Plant water use in the Middle Rio Grande Basin. https://riversedgewest.org/sites/default/files/resource-center-documents/Shafike_et_al_2007.pdf

Sher A, Quigley MF (eds) (2013) Tamarix: A case study of ecological change in the American West. Oxford Scholarship Online. http://dx.doi.org/10.1093/acprof:osobl/9780199898206.001.0001

Utah State University Water Quality Extension (2014) Improving Utah's Water Quality: Virgin/Santa Clara River Watershed. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2278&context=extension_curall

Recreation

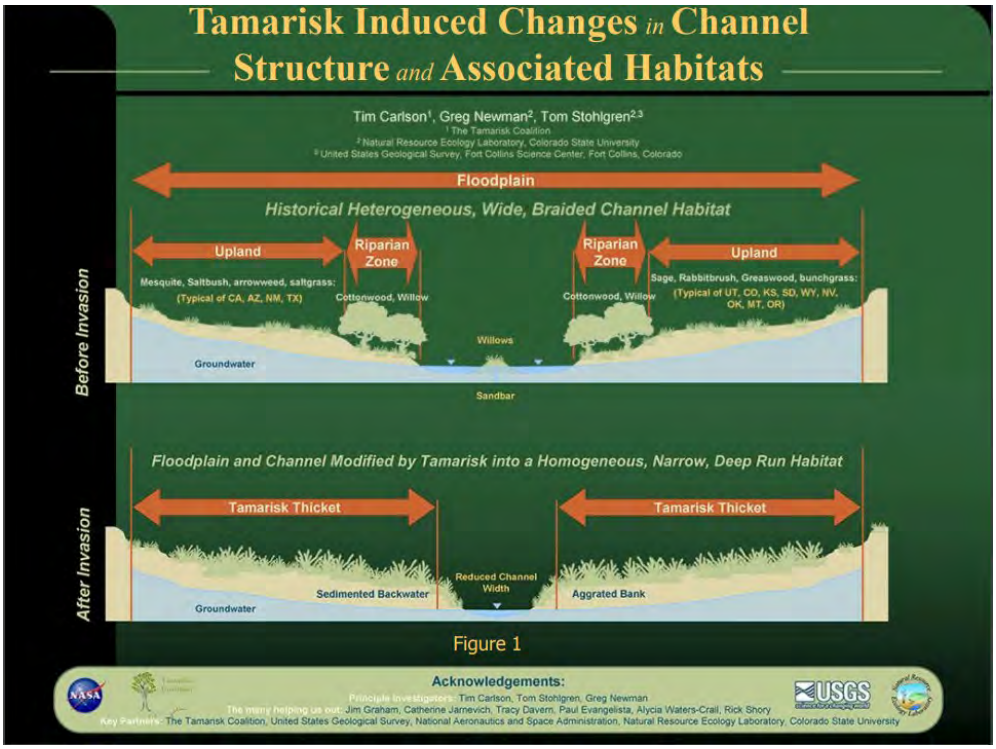
Although current recreational use of the White River in Colorado and Utah is relatively low, recreational use is increasing, particularly for rafting and fishing. Riparian restoration can improve recreational access points, aesthetic views, and campgrounds. TRO that is removed from river banks with recreational use should be cut low and flat to avoid popping rafts. In addition, if fires are permitted, removed woody invasives can be cut and piled for campfires.

The Bureau of Land Management's Environmental Assessment notes that riparian restoration work described in this plan along the White River in Utah would improve the wilderness characteristics by returning vegetation to a more natural composition. The Bureau of Land Management White River Field Office, in coordination with the Town of Rangely, began marking the sections of the river along public lands to inform boaters and anglers in Colorado.

Geomorphology and Flows

Geomorphology

The establishment of TRO inhibits the river channel's natural geomorphic processes by stabilizing river banks, deepening and straightening the river channel, and disconnecting the floodplain from the river. TRO removal can improve and restore natural river functions and geomorphology. Overbank flows are essential for the natural establishment of cottonwood forests by scouring the soil and making it able to support seedling growth. They also contribute large woody debris and organic matter to the river. The following diagram from Carlson and others shows how tamarisk infestations channelize rivers.



RiversEdge West's Resource Center maintains resources for additional information on the relationship between TRO and river geomorphology: https://riversedgewest.org/resource-center/geomorphology

O'Brien and others conducted a geomorphic assessment of the lower White River in Colorado and Utah which also contains background information on the geomorphology of the lower White River: O'Brien, Gary & Stevens, Geoff & Macfarlane, William & Wheaton, Joseph. (2019). Geomorphic Assessment of the Lower White River: Valley Landform Delineation, Reach Typing, and Geomorphic Condition Assessment. 10.13140/RG.2.2.28838.57924/1.

Flows

The White River maintains a relatively natural hydrograph because Taylor Draw Dam is a run-of-the-river dam. It is one of the least altered tributaries of the Green River and makes sediment, chemical, and biological contributions similar to historic levels. The White River is also one of the least altered major rivers in the UCRB.

The Upper Colorado River Endangered Fish Recovery Program and the US Fish and Wildlife are developing flow recommendations that will be finalized over the next few years. Interim flow recommendations for endangered fish species developed by Anderson et al. (2019) are available this link: https://www.coloradoriverrecovery.org/documents-publications/technical-reports/isf/White%20River%20Final%20Interim%20Flow%20Recs%203.2.20%20Formatted.pdf

Additional resources for information of White River flows include:

Fraser GS, Winkelman DL, Bestgen KR, Thompson KG (2017) Tributary use by imperiled Flannelmouth and Bluehead suckers in the Upper Colorado River Basin. American Fisheries Society. DOI: https://doi.org/10.1080/00028487.2017.1312522

Fraser GS, Bestgen KR, Winkelman DL, Thompson KG (2019) Temperature-not flow-predicts native fish reproduction with implications for climate change. Transactions of the American Fisheries Society. DOI: 10.1002/tafs.10151

RiversEdge West's Resource Center maintains resources for additional information on the relationship between TRO and river flows.

https://riversedgewest.org/resource-center/sustaining-or-improving-flows

Wildland Fire

Wildland fire is historically rare in river corridors with native vegetation**.** TRO infestations create an accumulation of wildland fire fuels, which increases the frequency and intensity of wildland fire in the riparian area. In particular, TRO create ladder fuels, which can move ground fires into native cottonwood canopies. Since native riparian species are poorly adapted to fire, and TRO, and other invasive species are fire-adapted, are most likely to re-colonize riparian areas post-fire,

perpetuating the cycle. Wildfire impacts include diminished water quality and drier and more saline floodplain environments.

Invasive Species: Tamarisk and Fire Sprouts (video and article): https://svs.gsfc.nasa.gov/20091

Tamarisk (*Tamarisk spp*) Invasion and Fire in Desert Riparian Ecosystems; Gail Drus https://www.youtube.com/watch?v=Z6i3i6zJomY