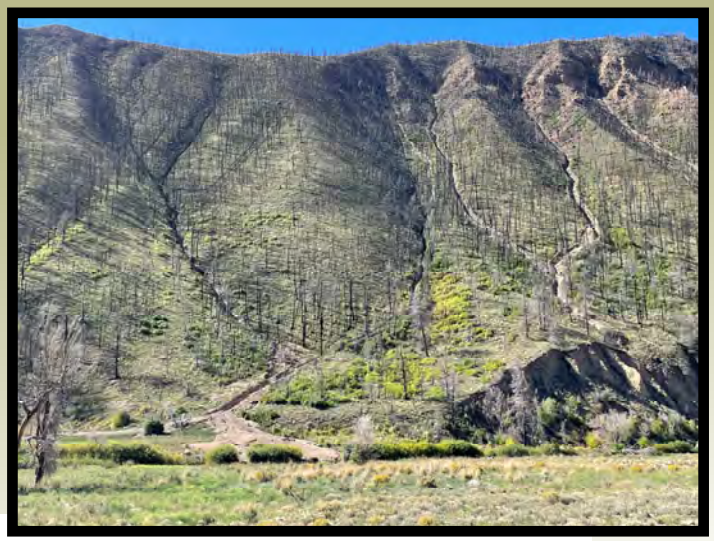
Dollar Ridge Restoration Plan
Draft Environmental Assessment



RECREATION RECOVERY RESTORATION CONSERVATION

UTAH RECLAMATION MITIGATION AND CONSERVATION COMMISSION

An Executive Branch Agency of the Federal Government

February 2023

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Dollar Ridge Fire Restoration Plan Environmental Assessment

Working Draft

Prepared For:

The Utah Reclamation Mitigation and Conservation Commission and
United States Forest Service (Co-Lead Agencies)
The United States Bureau of Reclamation and
Utah Division of Wildlife Resources (Cooperating Agencies)

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List of Acronyms

amsl	above mean sea level
ATVs	all-terrain vehicles
AUMs	animal unit months
BDAs	beaver dam analogs
BMPs	best management practices
cfs	cubic feet per second
CRCT	Colorado River cutthroat trout
CUP	Central Utah Project
CWA	Clean Water Act
DO	dissolved oxygen
EA	environmental assessment
ELJs	engineered log jams
ELR	Eco Logical Research
ESA	Endangered Species Act
EWP	Emergency Watershed Protection
IBAT	Interagency Biological Assessment Team
IPaC	Information for Planning and Consultation
JWA	JW Associates
LEBs	log erosion barriers
LTPBR	low-tech, process-based restoration
LWD	large woody debris
NDVI	normalized difference vegetation index
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NTUs	nephelometric turbidity units
NWI	National Wetlands Inventory
OHV	Off Highway Vehicle

List of Acronyms

LRMP	Land and Resource Management Plan
PALS	post-assisted log structures
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
UDWQ	Utah Division of Water Quality
UDWR	Utah Division of Wildlife Resources
URMCC	Utah Reclamation Mitigation and Conservation Commission
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTVs	utility task vehicles
UWAP	Utah Wildlife Action Plan
WMA	Wildlife Management Area

1 Introduction and Planning Process

1.1 Project Overview

In July and August of 2018, the Dollar Ridge Fire burned almost 70,000 acres within the Strawberry River Watershed in Duchesne and Wasatch Counties, Utah. As a result, the Project Area has experienced significant downcuts, excessive sediment deposition, channel aggradation, massive debris flows, activated and confining alluvial fans, complete loss of soil stability in many areas, loss of stream "sorting" of materials, weed infestations, and loss of stream functionality and productivity as a fishery. The Dollar Ridge Fire Restoration Plan (Restoration Plan) has been developed to identify and describe management activities that would promote the natural healing processes within the watershed to restore upland, riparian, and aquatic habitats. **Table 1** below summarizes the objectives of the Proposed Action, restoration activities associated with the Proposed Action, and environmental effects of the Proposed Action on resources in the Project Area. Activities that would be implemented to treat resources that are outside of their properly functioning conditions are described in detail in Sections 2.2.1.2 and 2.2.2.2 of this document, in the Restoration Plan (**Appendix A**), and in the Activity Cards (**Appendix B**). The effects of these activities on specific natural, cultural, and community resources by implementation of the Restoration Plan are explained in detail in Chapter 3 of this document.

Table 1. Summary of Environmental Effects of the Proposed Actions

Proposed Actions	**Description of Activities**	**Environmental Effects of the Proposed Action when compared to the No Action Alternative**
Upper Watershed		
Reduce soil/hillslope erosion and surface runoff	Mulching, mastication of burned vegetation, construction of log erosion barriers, seeding and planting desired plants, install cross-slope water bars	Increased soil stabilization, reduced soil erosion, enhanced vegetation growth and reduced sediment loads to surface waters. Increased local upland biodiversity and ecological resilience to natural events such as disease
Stabilize actively eroding gullies	Directional tree felling, install rock or log grade-control structures, install straw wattles	Slows the water velocity, which increases sediment deposition on the slope and promotes establishment of vegetation. Reduces potential for enlargement and future rill and gully formation.

Proposed Actions	Description of Activities	Environmental Effects of the Proposed Action when compared to the No Action Alternative
Vegetation Management	Plant shrub and tree seedlings, seeding with desired plant species, install aspen enclosures. Control noxious and invasive weeds.	Increased vegetation cover, shift in vegetation communities to native perennials with greater capacity to hold soil in place. Reduced sediment loads to surface waters. Improved nutrient addition to the soil and aquatic ecosystem from leaves and other organic matter, increased riverbank stability. Improves recruitment and establishment of native and desirable plant community species, reduces sediment loads to surface waters.
Create more resilient road/stream crossings	Install cross-drain culverts, properly sized culverts, bottomless culverts and other road crossing structures, install engineered log jams	Short term impacts from ground disturbance associated with the use of heavy equipment. Mitigates channel erosion and pulses of sediment to surface waters.
Riverscape		
Structure Addition	Build post-assisted log structures (PALs), build beaver dam analogs (BDAs), place boulders in channel	Facilitates creation and maintenance of complex fish and wildlife habitat and floodplain connectivity. Enhancement of riparian vegetation. Increased levels of dissolved oxygen through aeration.
Channel Modification	Excavate new channel(s) in the existing floodplain, modify channel cross section or plan form, open blocked channels, Increase geomorphic complexity	Increase the length and area of side channels available to fish at multiple flows. Provide flow refugia (e.g., backwater areas) and greater habitat complexity. Results in reduced erosion and turbidity. Short term impacts from ground disturbance associated with the use of heavy equipment.
Floodplain Reconnection	raise water surface elevations using BDAs or PALs, remove levees, construct or repair irrigation canals	Increased water, sediment, and wood retention during high flow. Recruit riparian vegetation to provide flows refugia for aquatic species and other wildlife species. Improves water quality through filtration, shading.
Riparian Plantings	Plant woody vegetation propagules	Larger, healthier riparian areas and establishment of a woody debris source. Enhancement of fish habitat (shading of streams decreases water temperature) and wildlife habitat (more areas of structurally diverse vegetation).

1.2 Background and Project Setting

The Strawberry River Watershed has been a focal area for Central Utah Project fish and wildlife mitigation for almost 40 years. The area consists of private, state, federal, and tribal land ownership, and provides the public with multiple highly valued outdoor recreation opportunities. Together, the Utah Division of Wildlife Resources (UDWR), U.S. Bureau of Reclamation (Reclamation), Utah Reclamation Mitigation and Conservation Commission (URMCC), and the United States Forest Service (USFS) manage approximately 60,783 acres within the 77,047-acre Dollar Ridge Fire Project Area (Project Area) including over 19 stream miles of the middle Strawberry River. Within the Project Area, the USFS manages approximately 37,783 acres of federal land in the upper portions of the watershed for multiple uses while UDWR, Reclamation, and URMCC cooperatively oversee their respective ownerships in the lower portions of the watershed, including the river itself, for mitigation, conservation, and compatible recreational purposes (see **Figure 1**). All 6th Level watersheds that are within the Dollar Ridge Fire project area were included in the analysis and are listed in Table 2. These watersheds were delineated into smaller (7th Level or HUC 14) watersheds for the prioritization of specific upper watershed hazards. The total Project Area covers 77,106 acres and includes six 6th-level watersheds and 93 7th Level watersheds"

USFS lands within the Project Area fall within the Ashley National Forest and are managed in accordance with the Ashley National Forest Land and Resource Management Plan (LRMP) (USFS 1986). These lands are managed for multiple uses including commodity (timber) production, forage production and livestock use, dispersed recreation, research natural areas, and wildlife habitat.

UDWR's specific management goals for the Project Area have been outlined in the Strawberry River Wildlife Management Area (WMA) Habitat Management Plan (UDWR, 2021). These goals include preserving and enhancing wildlife habitats and populations and preserving public angler access to the Strawberry River between Soldier Creek Dam and the river's confluence with Red Creek near the Strawberry Pinnacles.

Reclamation and the URMCC acquired approximately 12,630 acres of property within the Strawberry River Watershed as mitigation for the construction of and operation of the Bonneville Unit of the Central Utah Project. Since the late 1990's, the Mitigation Commission has been providing funding to the UDWR to manage the federally owned properties on an interim basis as part of the UDWR's Wildlife Management Areas until their final disposition was determined. A Final Environmental Assessment was completed in 2020 and a determination was made to transfer the federally owned properties to UDWR. [1]The property transfer is anticipated to be completed by the second quarter of 2023. Reclamation and URMCC outlined their management goals for the Strawberry Aqueduct and Collection System, including the Middle Strawberry River, in an environmental assessment (EA) prepared for the Angler-Access

[1] Transfer of Bonneville Unit Wildlife and Aquatic Mitigation Land to State of Utah, Environmental Assessment, September 2020, U.S. Department of the Interior, Central Utah Project Completion Act Office. Bureau of Reclamation, Utah Reclamation Mitigation and Conservation Commission

Mitigation Program of the Central Utah Project (CUP) (URMCC, 1999). One of the stated goals was: "…To restore, protect, and enhance the health and function of riparian and aquatic ecosystems."

In 2020, Duchesne and Wasatch Counties, with assistance from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) Program funding, began making repairs and improvements to roads, bridges, and other infrastructure. Work in 2020 was conducted along lower Timber Canyon Road and the Strawberry River Road from the Strawberry Pinnacles to just above Timber Canyon. Repairs to the Strawberry River Road above Timber Canyon continued in 2021. Additional work on sections of the road and river near Lost Canyon and Timber Canyon were completed in the Fall of 2022. EWP projects ranged from road realignment, three new bridge spans within 2.5 km (1.5 miles) in the vicinity of Timber, Simmons, and Lost Canyon with capacity to pass larger flows, stabilized water crossings, and construction of retention basins. Other instream projects included installation of bank armor, bridge abutment protection, debris catchers, crass vanes, J-hooks, and root wads.

To address ongoing issues as a result of the Dollar Ridge Fire and augment projects implemented by the EWP Program, Reclamation, URMCC and the Utah Division of Wildlife Resources partnered to hire a team of consultants, led by Martin & Nicholson Environmental Consultants, LLC (Martin & Nicholson), with expertise in post-wildfire restoration to conduct a watershed assessment and develop a restoration plan.

The National Environmental Policy Act of 1969 (NEPA) requires all Federal Agencies to consider the environmental impacts of their proposed actions before they implement them. The environmental review requires agencies to consider the environmental effects, including impacts on social, cultural, and economic resources, as well as natural resources. The purpose of this document is to inform and disclose to the public and other interested agencies the environmental impacts of adopting the Restoration Plan and implementing the restoration activities that have been identified to address the resource issues associated with the Dollar Ridge Fire. The NEPA process provides an opportunity for interested agencies and the public to review and comment on the Restoration Plan and its recommendations. The URMCC and USFS serve as co-lead agencies while Reclamation and UDWR serve as cooperating agencies in this NEPA process. This Environmental Assessment (EA) fulfills the requirements of NEPA.

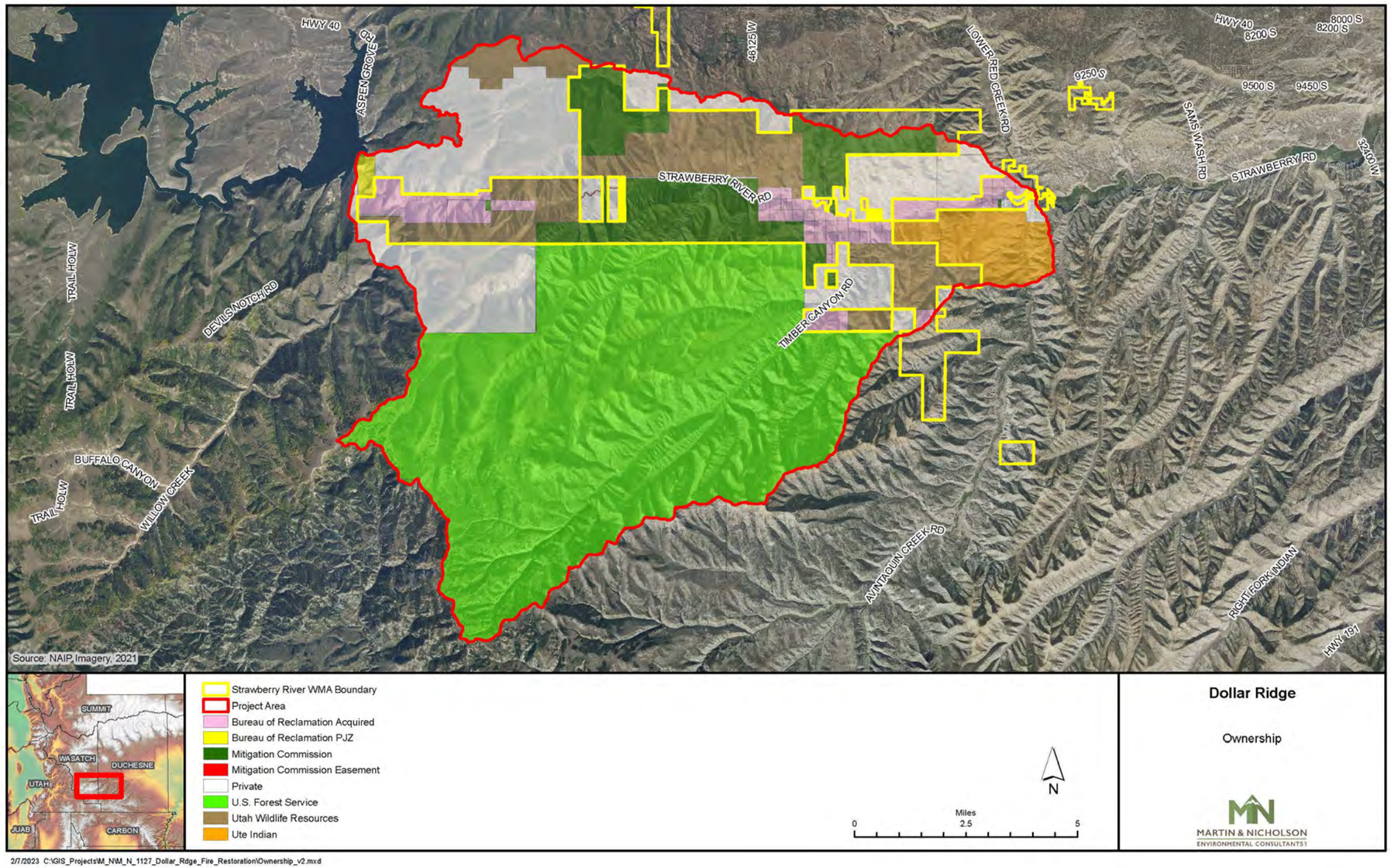

Figure 1. Land Ownership within the Project Area

1.3 Purpose of and Need for the Restoration Plan and Environmental Assessment

The purpose of the Dollar Ridge Fire Restoration Plan (Restoration Plan) is to identify management activities that would promote the natural healing processes to restore upland, riparian, and aquatic habitats in the Project Area impacted by the 2018 Dollar Ridge Fire. The Proposed Action is summarized in Chapter 2 and described in detail in the Restoration Plan **(Appendix A**) and associated Activity Cards **(Appendix B)** which describe the treatments that could impact each of the resources discussed in this EA. The need for the Proposed Action is to mitigate on-going impacts from the 2018 Dollar Ridge Fire by repairing or improving conditions on fire-impacted lands and put them on a trajectory for natural recovery. Restoration activities need to be taken to stabilize areas damaged by fire to maintain or improve soil stability and site productivity, reduce erosion and sediment deposition, and restore fish and wildlife habitat and the health and function of the Project Area's riparian and aquatic ecosystems. Activities also need to be taken to address past actions to improve roads/access and protect/replace infrastructure. The Proposed Action is consistent with and would move toward accomplishing the goals identified in Reclamation and URMCC's Angler-Access Mitigation Program for the CUP and UDWR's Strawberry River Wildlife Management Area (WMA) Habitat Management Plan.

1.4 Description of the Planning Process

The planning process to develop the Restoration Plan was initiated in April of 2021. A steering committee consisting of representatives from the lead and cooperating agencies (URMCC, USFS, Reclamation, and UDWR) identified a group of stakeholders to participate in development of the restoration plan. Stakeholders included representatives from the Central Utah Water Conservancy District, Ute Tribe, Bureau of Indian Affairs, Duchesne County, Wasatch County, and Trout Unlimited. Members of this group met by video conference approximately once per month from April 2021 through June 2022 and again in November and December 2022, and January 2023 to identify and discuss resource issues, share data and to review and provide input on the Restoration Plan and Environmental Assessment (EA).

The Restoration Plan was prepared by Eco Logical Research (ELR), a subcontractor to Martin & Nicholson, and is included as **Appendix A**. The restoration plan also includes the *Dollar Ridge Fire Post-Fire Upper Watershed Hazard Analysis & Recommendations* (Watershed Hazard Analysis) prepared by JW Associates (JWA) and the *Geomorphic Assessment of the Strawberry Watershed within the Dollar Ridge Fire Project Area* (Geomorphic Assessment) prepared by ELR, both of whom are sub-contractors to Martin & Nicholson.

The lead and cooperating agencies and other stakeholders agreed on using a condition-based management Environmental Assessment format. According to the USFS and in the case of this Restoration Plan, condition-based management allows restoration practitioners to make landscape-level decisions while maintaining flexibility to respond to on-the-ground conditions and confirm the right treatment is prescribed and conducted at the right time (USDA, 2022). This can be important because project surveys, permitting, and implementation planning can take years to complete or occur in phases

based on funding. Over the course of a landscape-level restoration process conditions may have changed by the time the restoration practitioner is ready to implement activities on any part of the project area.

1.5 Identification of Resource Issues

Resources with potential to be affected by implementation of the Restoration Plan were identified during conversations with the Steering Committee and individual stakeholders as well as best professional judgement of the consulting team. The following resources were identified for detailed analysis in the EA:

- Hydrology
- Water Quality
- Soils
- Floodplain, Wetland, and Riparian Resources
- Upland Vegetation
- General Wildlife
- Fisheries
- Cultural Resources
- Access and Recreation
- Climate Change

The following resources would not be substantively impacted by implementation of the Restoration Plan and have not been carried forward for detailed analysis in this EA:

- Land Use
- Socioeconomics
- Environmental Justice

Current land uses on federal, state, and local lands within the Project Area would continue as they are at present and would not be substantively affected by implementation of the proposed upland and riverine restoration activities outlined below.

Regarding socioeconomic resources, there would be short-term economic benefits associated with the labor and equipment used to implement various restoration activities, but these are not expected to be at a level that would impact local government services or contribute substantially to the local tax base. Thus, the Proposed Action would have negligible effects on socioeconomic resources. No minority or low-income communities would be adversely affected by implementation of the proposed restoration activities. Thus, the Proposed Action would result in no impacts to environmental justice and this resource is not carried forward for detailed analysis in the EA.

2 Alternatives

Two alternatives are analyzed in this EA: the No Action Alternative and the Proposed Action. These alternatives are described below.

2.1 No Action Alternative

NEPA requires the No Action Alternative be considered in the environmental analysis process. The No Action Alternative describes events likely to occur if the Proposed Action were not implemented. The No Action Alternative serves as a baseline against which to compare other alternatives. Under the No Action Alternative, the Restoration Plan would not be implemented, and the Project Area would continue to be managed in accordance with existing plans including the USFS Ashley National Forest Land and Resource Management Plan of 1986 (currently under revision) (U.S. Forest Service, 1986), the UDWR Strawberry River WMA Habitat Management Plan of 2021 (UDWR, 2021), and the Angler-Access Mitigation Program (URMCC, 1999). Weed treatment would continue as necessary on UDWR-managed lands and USFS-managed federal land. Effects of 2019 aerial re-seeding of portions of the Project Area and the Emergency Watershed Protection (EWP) Program actions taken from 2020 through 2022 would continue to occur along with the long-term effects of maintaining the structures that were created under this program, i.e., removing accumulated sediments from retention basins and removing large woody debris from debris catchers. Additional seeding efforts in the Project Area took place in late November of 2022. Beyond these management actions, the Project Area would continue to respond naturally to the changes in vegetation cover, debris flows, and water and sediment dynamics resulting from the Dollar Ridge Fire along with other on-going natural and human-caused disturbances within its boundaries. It may take many years for the system to naturally recover on its own.

Photo 1. Current Condition (2021) of the Strawberry River at mile 8.1 just below Beaver Canyon. The sediment bar in the middle of the river is an example of existing condition(s) throughout the river channel.

2.2 Proposed Action

Under the Proposed Action, the Project Area would continue to be managed in accordance with the respective management plans referenced above. However, additional management actions outlined in the Restoration Plan **(Appendix A**) would also be implemented. To develop the Restoration Plan, the consultant team divided the 70,000-acre burn area into riverscape and upper watershed components and first compiled and analyzed data to prepare the Geomorphic Assessment and Watershed Hazard Analysis. The riverscape consists of valley bottom features including the river channel and major tributaries, floodplain, and riparian zone. The remaining terrestrial slopes and plateaus within the burn area comprise the upper watershed. With guidance from agency partners and stakeholders, the consultant team synthesized findings from the *Watershed Hazard Analysis* and *Geomorphic Assessment* into the Restoration Plan, which identifies restoration activities and potential locations. On-the-ground assessments would be completed to determine the specific locations where actions would be needed to mitigate on going effects of the 2018 Dollar Ridge Fire within the Project Area through use of the Activity Cards (**Appendix B**) and the Implementation Checklist (**Appendix C**). If site conditions are within the condition/situation trigger description of the Activity cards anywhere within the project area, multiple restoration activities and their associated treatments are available to be implemented. Activities and treatments would target site-specific conditions and be followed by post-treatment monitoring. Based

on the monitoring results, additional management actions from the list of activities and treatments may be implemented to achieve restoration objectives. These activities and treatments would take place starting in 2023 and continue as needed in response to effectiveness monitoring results and as funding and other resources remain available. The process of implementing activities and treatments, monitoring ecological response, and then determining if additional actions are needed would occur over a period of many years.

2.2.1 Treatment Areas and Restoration Activities

2.2.1.1 Upper Watershed Treatment Areas

Small watersheds (7th level) were defined within the Project Area and analyzed for soil burn severity, debris flow hazard, soil erodibility, and roads. Those factors were used to identify and prioritize the small watersheds for treatments. These areas were identified based on GIS modeling using available spatial datasets, aerial image interpretation, and from data collected in the field. While the areas described in **Figures 2 and 9** below are prioritized for treatment, site specific areas outside of those priority areas may be identified for treatment as well. Treatments were identified that would address one or more of the following goals.

- Reduce soil/hillslope erosion,
- Reduce surface runoff that contributes to increased peak flows,
- Stabilize actively eroding gullies
- Establish native vegetation
- Identify and control noxious weeds
- Create more resilient road/stream crossings

JWA prioritized approximately 6,846 acres of target spruce-fir and mixed conifer vegetation type treatment areas for restoration as illustrated in **Table 2**. While these treatment areas would be prioritized for restoration, restoration activities could occur anywhere in the Project Area where conditions described in the Activity Cards (**Appendix B**) are present. Four areas identified for culvert replacement are also located on USFS administered land 12.3 to 14.3 kilometers (7.6 to 8.9 miles) up Timber Canyon from the confluence of Strawberry River (**Figure 3**).

Table 2. Priority Vegetation Treatment Areas by Sub-watershed

Watershed-Sub watershed	Priority Treatment Area (acres)
Beaver Canyon-Strawberry River	
Beaver Canyon	2,439
Slab Canyon	1,996
Simmons Canyon-Strawberry River	
Lost Canyon	594
Timber Canyon	

Watershed-Sub watershed	Priority Treatment Area (acres)
Cow Hollow	973
Timber Canyon	844
TOTAL	6,846

2.2.1.2 Upper Watershed Restoration Activities

Four different but interrelated actions have been identified for restoration of upper watershed areas within the Project Area. These activities would occur on uplands outside of the riparian and riverine habitats of the Strawberry River and its tributaries (i.e., Riverscape area). For simplicity, the actions have been described in bullet format. As noted above, additional details on these actions can be found in **Appendices A and B**.

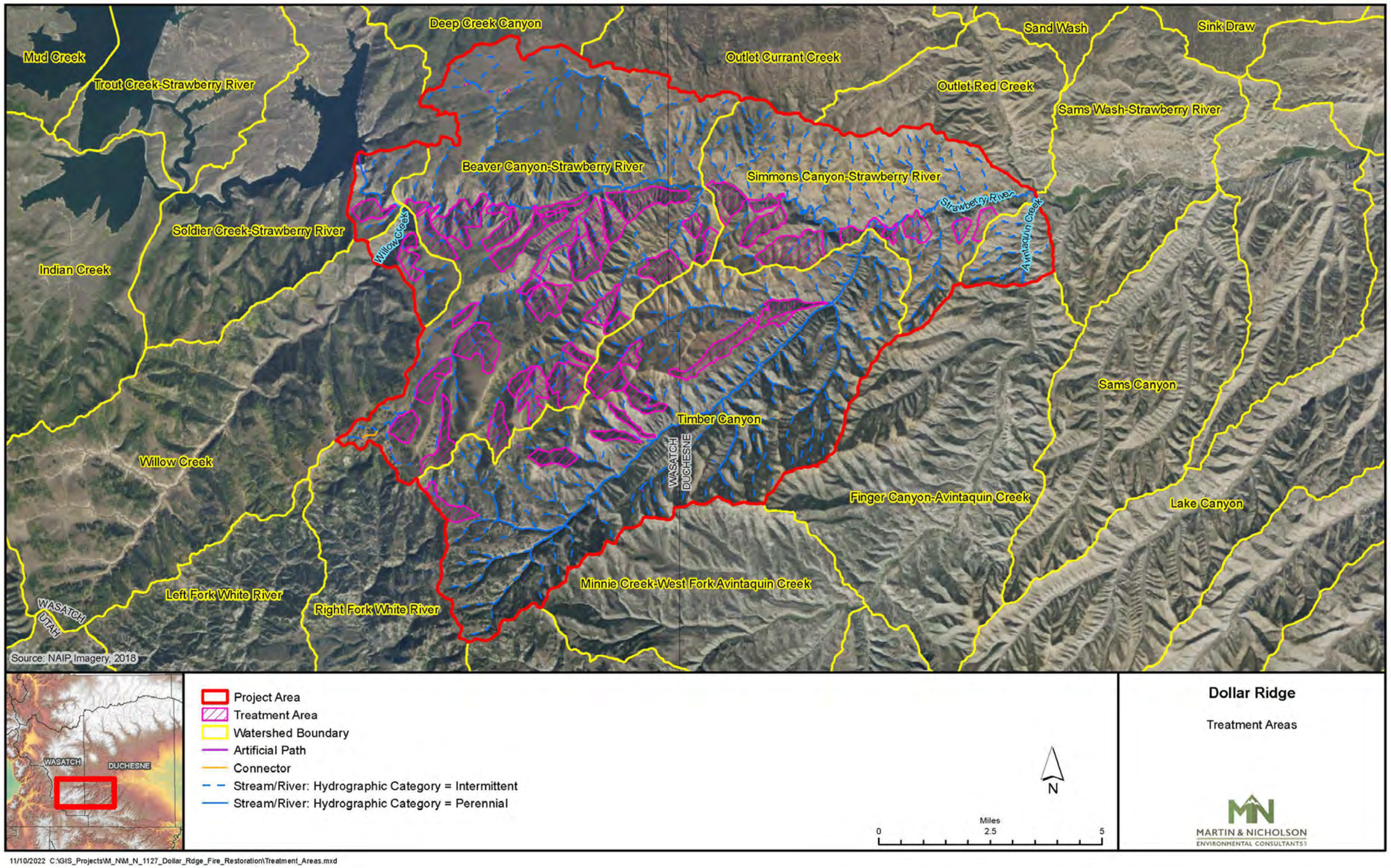

Figure 2. Priority upland restoration treatment areas identified through geospatial data.

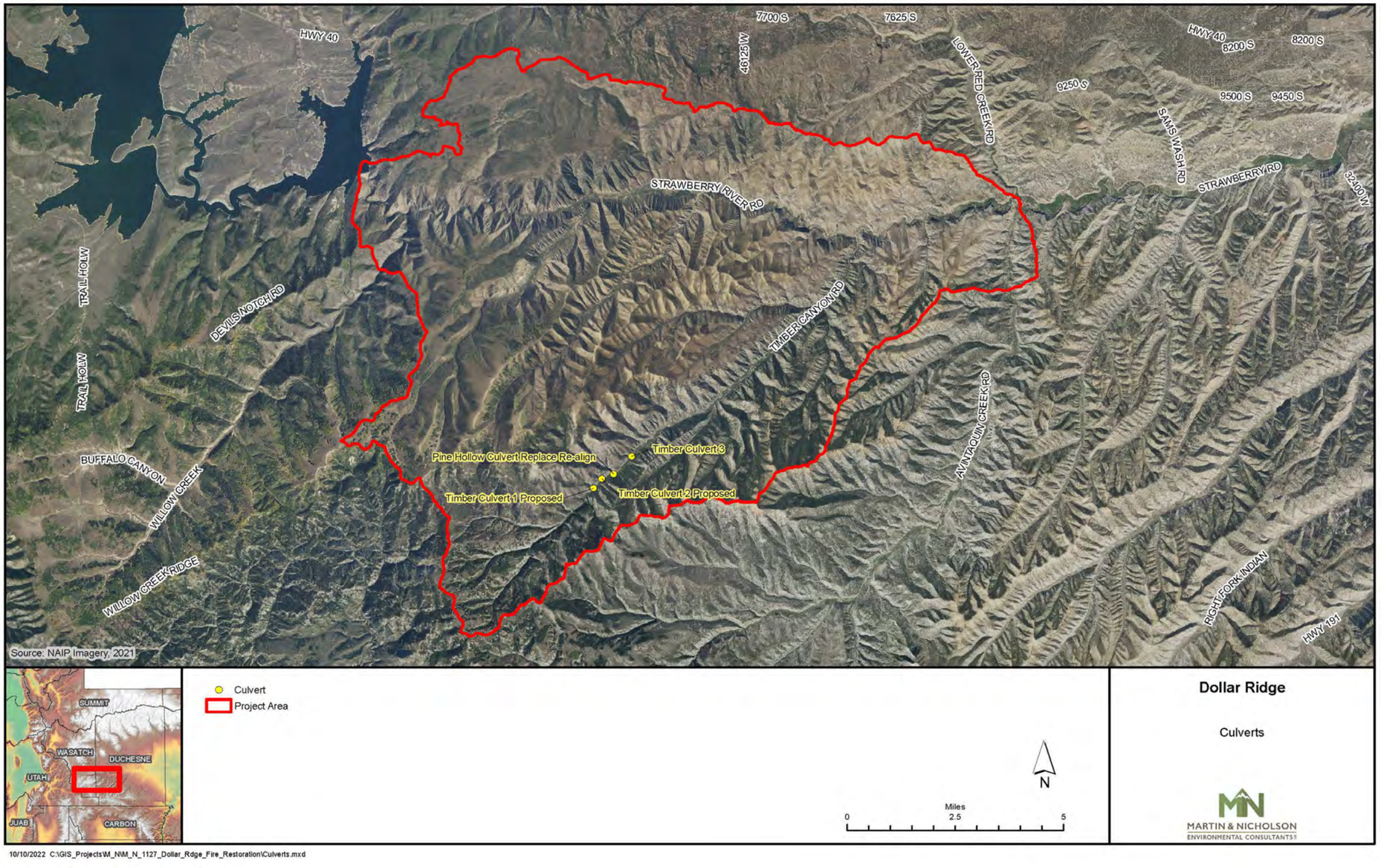

Figure 3. Proposed culvert installation locations

Soil/Hillslope Erosion Reduction

Hillslope cover treatments can be very effective at reducing soil erosion, reducing sediment yield from burned hillslopes, and increasing water infiltration and soil moisture. It is often more effective to reduce erosion where it occurs in the upper watershed than it is to collect sediments downstream via in-channel treatments. Erosion control measures that would be conducted under this action include the following:

- Ground-based mulch application using certified weed-free agricultural straw or wood mulch applied by hand, truck, or a combination of methods. In addition to manual laborers, this activity involves trucks or utility task vehicles (UTVs) and hand tools (See Photo 2 below).
- Mastication of burned vegetation into mulch using large equipment to chip dead and downed plant materials and spread them across the ground surface. This approach is limited to slopes less than 30% and involves laborers, trucks, mechanical chippers, and hand tools.
- Creation of log erosion barriers (LEBs) by felling and limbing burned trees and placing them on the ground perpendicular to the direction of the slope. LEBs are typically dug into the soil and staked to avoid surface runoff from eroding under the log. LEBs must also be installed level so that surface runoff is not directed to one side of the log where it becomes concentrated and forms an erosion gully. Creation of LEBs involves laborers, chainsaws, and other hand tools.
- Seeding native plants by hand or aerial application using helicopters or fixed-wing aircraft. Hand seeding requires laborers, seed dispersal equipment (which differs based on slope steepness), trucks and/or UTVs, and hand tools.
- Install cross slope water bars on some trails and in some roads if they collect water from an area greater than 0.5 acres. Construction of water bars involves laborers, chainsaws, rock bars, and other hand tools.

These measures can be implemented on slopes with bare soils but would generally occur in areas where hillslopes are actively eroding and on high hazard areas identified through remote sensing, GIS analysis, and field verification.

Photo 2. Example of mulching in burned forest areas

Gully Stabilization

The purpose of this activity is to minimize post-fire erosion, stabilize existing gullies, and reduce peak flows downstream of areas of erosion that appear to be forming gullies (rills). Gully stabilization actions include one or more of the following activities, each of which could involve the use of all-terrain vehicles (ATVs) or UTVs to access the treatment sites.

- Directional tree felling: felling mostly burned trees into actively eroding gullies to reduce erosion in the gully and capture sediment that would otherwise be carried downslope. Directional tree felling is conducted by identifying gullies that would benefit from stabilization and have an adequate number of burned trees available adjacent to the gully. Downed trees would also be used to stabilize gullies. Trees are felled into the gully using chainsaws, usually by hand crews. The trees are then cut into smaller pieces, so they have good contact with the soil and other felled trees. These features can be installed by work crews using chain saws and hand tools to dig rocks and trees into the gully bottom but can also be installed with backhoes where access permits.
- Installation of rock or log grade-control structures in actively downcutting gullies to stabilize and reduce channel incision. Installation of these structures can be accomplished by hand crews or heavy equipment (e.g., backhoes). Rocks and logs would typically be anchored into the gully

banks to minimize erosion along the edges of the structures. Equipment used includes hand tools, chain saws, and backhoes where access allows.

- Installation of straw wattles (long, wrapped tubes composed of certified weed-free straw or aspen stems) in erosion rills and gullies to capture and contain sediments from being washed downslope. Use of straw wattles is generally limited to gullies with lower runoff volumes. The wattles are secured in the gully with rocks and/or stakes pounded into the gully or gully banks. Since straw wattles can quickly fill with sediment, they should be installed in a series to be most effective. Equipment and materials used for installation of straw wattles is typically limited to ATVs or UTVs, hand tools, certified weed-free straw, stakes, and rocks.
- Conditions warranting the implementation of gully stabilization activities include areas identified as containing slopes with bare soils where gullies are forming.

Photo 3. Felled trees placed for gully stabilization

Vegetation Management

The purpose of this action is to improve species composition and percent cover of native or already present, desirable plant species and promote post-fire recovery of native plant communities. Vegetation management activities involve maintaining and enhancing native vegetation cover to help stabilize soils that might otherwise be prone to erosion. These measures may include one or more of the following activities:

- Planting shrub and tree seedlings by work crews using hand tools.
- Reseeding can be accomplished by work crews using manual or mechanical broadcast seeding or, in a few locations, using a seed drill. Aerial broadcast seeding may be used to reseed large, remote areas inaccessible to ground crews. Seed mixes would be developed for specific habitat types and soil conditions. They would be approved by the landowner/manager.
- Installing aspen exclosures to protect aspen seedlings and saplings from browsing or trampling by native ungulates and/or livestock. Exclosures consist of fences high enough and sturdy enough to prevent large ungulates including mule deer, elk, moose, and cattle from browsing young aspen. Fence posts are dug or driven into the ground using hand tools or power augers and fencing materials are transported to the treatment sites via pickup trucks or UTVs or are dropped on the site via helicopter.
- Noxious weeds and invasive, non-native plant control including work crews pulling weeds and/or using backpack and/or OHV-mounted sprayers to apply herbicide. Weed control work would be accompanied by reseeding with native grasses and forbs. Aerial herbicide application would not be used. Special care would be taken to ensure weed control and revegetation of disturbed areas associated with road crossings and heavy machinery staging areas.

These measures would be implemented in areas that have been identified as containing infestations of noxious weeds or other invasive, non-native plant species and/or other areas that do not appear to be recovering to a desirable, native plant community.

Photo 4. Example of an exclosure

Road/Stream Crossing Improvements

These measures are intended to increase the resiliency of road systems in the post-fire environment. Road/stream crossings can become hazards during floods and following wildfires if they do not have adequate capacity to carry the high peak flows and debris from these events. Culverts and even bridges can fail when they become clogged with debris and are overtopped, causing massive erosion of the road fill and potentially initiating a larger debris flow downstream. Where new or re-built roads cross ephemeral, intermittent, or perennial drainages, outside the main stem of the Strawberry River, improvements to facilitate conveyance of high flows would help to avoid or minimize erosion of these crossings and associated downstream sedimentation. These measures include:

- Improving road drainage by adding cross-drain culverts, improving drainage ditches, and/or out-sloping sections of roads.
- Installing properly sized culverts, including bottomless culverts, or other road-stream crossing structures with greater capacity for accommodating passage of peak flows and debris.

These activities would be implemented where roads within the Project Area cross streams that have culverts, bridges, or other drainage structures that are not capable of passing post-fire peak flows and debris. Roads that receive hillslope or gully erosion from hillsides that do not have adequate drainage to accommodate post-fire runoff can also benefit from these improvements. In most cases, construction of improved road/stream crossings would involve the use of heavy equipment such as backhoes, graders, loaders, dump trucks, small excavators, and hand tools.

Photo 5. Example of a clogged culvert

Photo 6. Properly functioning culvert

2.2.2 Riverscape Treatment Areas and Restoration Activities

2.2.2.1 Riverscape Treatment Areas

ELR divided the Strawberry River within the Project Area into four reaches as illustrated in **Figure 4**. Reach divisions are defined by valley bottom properties such as gradient, width, confinement, and channel type. The length of the Strawberry River valley bottom within the Project Area is approximately 19.9 miles (32.0 km) of which 9.2 miles (14.8 km) are recommended for one or more riverscape restoration activity. The riverscape consists of valley bottom features including the river channel and major tributaries, floodplain, and riparian zone. The valley bottom developed over centuries of flooding and other fluvial geomorphic processes and can be used as a surrogate for the historic floodplain and riparian zone. At present, due to conditions such as a single-threaded channel caused by flow modifications below Soldier Creek Dam and restrictions to lateral movement caused by infrastructure, much of the Strawberry River valley bottom no longer floods or meets maximum riparian vegetation potential. To estimate the area in which natural riverine process could be restored, ELR modeled what is potentially "floodable" using the proposed treatment activities.

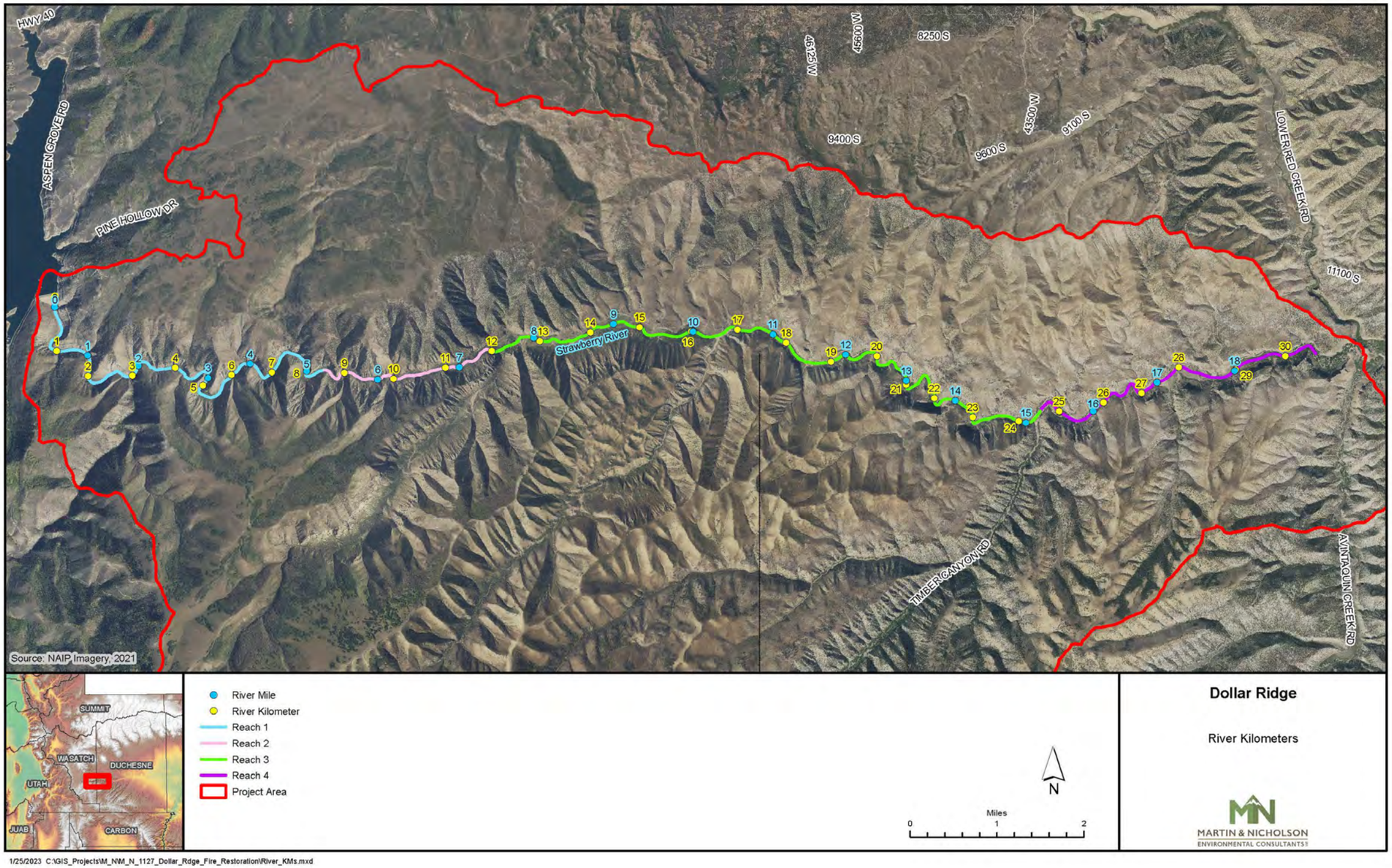

Figure 4. River miles/kilometers in the Project Area

The riverscape treatment areas include a 1-meter-high (above riverbed) zone of inundation and 3-meter-high zone of influence as described in detail in the Restoration Plan. Using Sulfur Draw as an example, **Figure 5** illustrates the differences in extent of these zones above and below where this canyon intersects the Strawberry River. The zone of inundation equates to 14.5% of the valley bottom in the Project Area while the zone of influence comprises 47.2% of the valley bottom mapped in the Project Area. These two zones correspond to the areas available for floodplain restoration and areas available for the re-establishment of riparian vegetation, respectively. As described in **Table 3**, priority locations for riverscape treatments occur within specific segments of Reaches 3 (river mile 7.5 – 15.25 or river km 12 – 24.5) and 4 (river mile 15.25 or river km 24.5 to Strawberry Pinnacles. Unless conditions change, Reaches 1 (river mile 0 – 5.25 or river km 0 – 8.5) and 2 (river mile 5.25 – 7.5 or river km 8.5 – 12) should generally not be considered for restoration because the river is currently in good condition relative to floodplain and riparian zone connectivity within a naturally narrow valley bottom. Other river segments not currently considered for restoration include the recently formed Slab Lake, located near the mouth of Slab Canyon because it provides habitat diversity, a 1-mile section of the river bottom located at the very east end of Wasatch County that includes several private property ownerships, or areas of recently constructed infrastructure. No riverscape restoration activities have been identified as of yet for Timber Canyon or Avintaquin Creek. Should conditions change and/or reflect conditions described in the Activity Cards (**Appendix B**) restoration could occur at these locations.

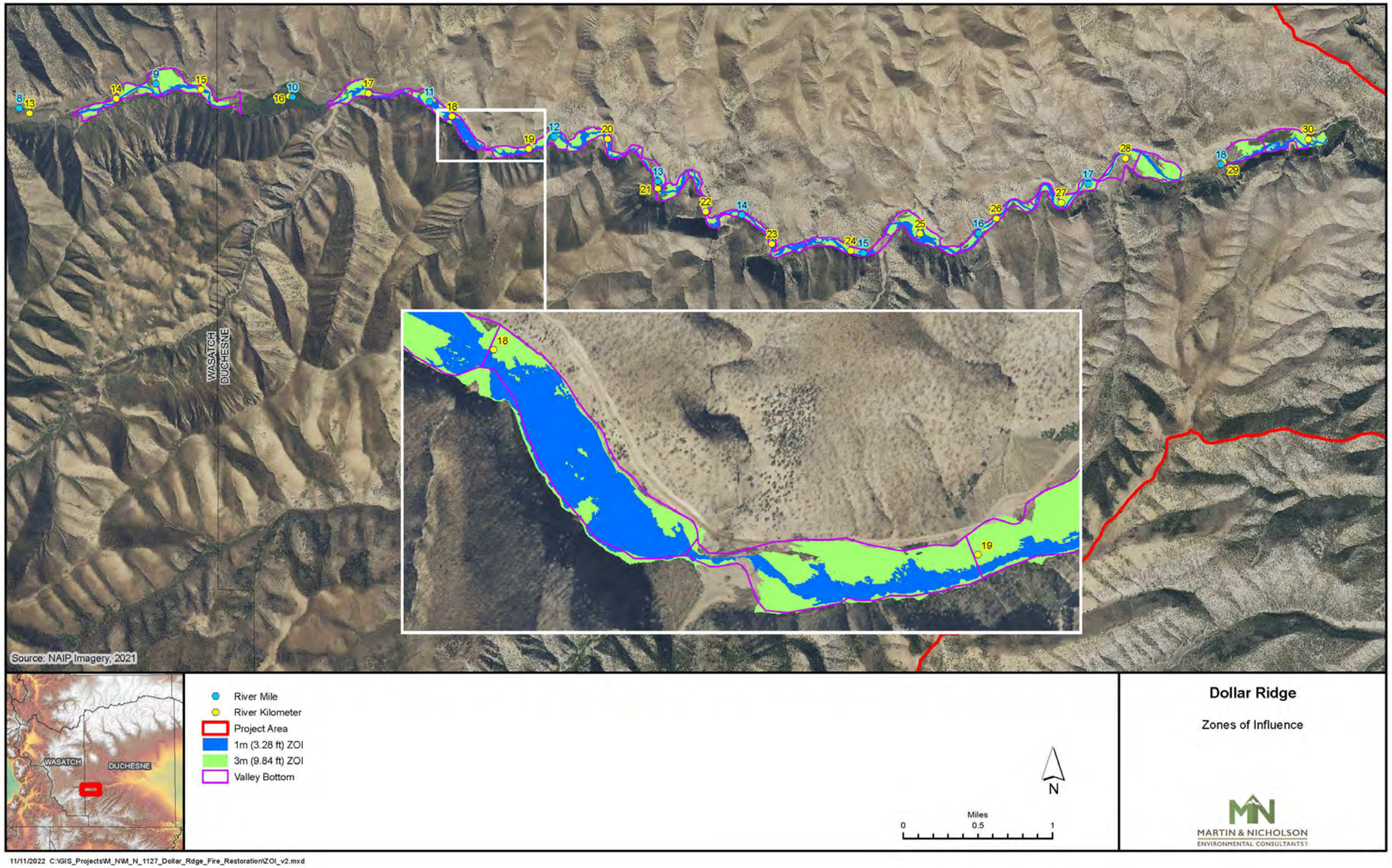

Figure 5. Strawberry River zones of influence- Sulfur Draw Example

Table 3. Priority Locations for Riverscape Treatments

River Mile/(KM)	Zone of Inundation 1m (acres)	Zone of Influence 3m (acres)	Activity	Note
Reaches 1 and 2				
0-7.5 (0-12)	N/A	N/A	None	Stream is in good condition given restricted flows
Reach 3				
7.5-8.4 (12-13.5)	N/A	N/A	None	Adaptive Management Plan for flow augmentation impacts on private property
8.4-8.7 (13.5-14)	2.04	6.69	Structure Addition	Use low-tech, process-based restoration (LTPBR)structures to increase channel complexity and lateral connectivity
8.7-9.2 (14-14.75)	3.61	24.17	Structure Addition, Channel Modification, Floodplain Connection, and Riparian Plantings	Structure Addition and Channel Modification to increase Floodplain Connection. Irrigation for Riparian Plantings
9.2-9.6 (14.75-15.5)	3.20	13.49	Structure Addition	LTPBR Structure Addition to increase channel complexity and Floodplain Connection. Could get inundated by Slab Lake
9.6-10.3 (15.5-16.5)	N/A	N/A	NA	Slab Lake provides extensive water storage and deep habitat
10.3-10.6 (16.5-17)	2.55	10.56	Structure Addition	Maintain multi-threaded planform and increase complexity
10.6-10.9 (17-17.5)	2.26	4.34	Structure Addition	Increase habitat complexity in confined reach

River Mile/(KM)	Zone of Inundation 1m (acres)	Zone of Influence 3m (acres)	Activity	Note
10.9-11.2 (17.5-18.0)	4.45	12.35	Structure Addition and Channel Modification	Structure Addition to increase complexity, but heavy machinery needed to create new channels and increase Floodplain Connectivity
11.2-11.5 (18-18.5)	9.95	13.22	Structure Addition and Riparian Plantings	Maintain multi-threaded planform, increase complexity, and Floodplain Connection. Riparian Plantings where there is floodplain connection or supplemental water
11.5-11.7 (18.5-18.75)	1.88	6.26	Structure Addition, Channel Modification, and Riparian Plantings	Use heavy equipment and LTPBR to increase complexity
11.7-12.0 (18.75-19.25)	1.61	4.92	Structure Addition	Maintain multi-threaded planform and increase complexity
12.0-13.8 (19.25-22.25)	17.89	58.21	Structure Addition	LTPBR to increase complexity
13.8-14.6 (22.25-23.5)	4.51	13.19	Structure Addition	Increase complexity, expect small gains because of road rip-rap
14.6-15.1 (23.5-24.25)	7.49	15.79	Structure Addition, Channel Modification, and Floodplain Connection	Channel Modification to increase width & lower banks. This and Structure Addition to increase Floodplain Connection
15.1-15.2 (24.25-24.5)	N/A	N/A	NA	Avoid work at the mouth of Timber Canyon to avoid impacts to the bridge.
Reach 4				

River Mile/(KM)	Zone of Inundation 1m (acres)	Zone of Influence 3m (acres)	Activity	Note
15.2-15.8 (24.5-25.5)	7.74	22.56	Structure Addition, Channel Modification, and Floodplain Connection	Channel Modification to multi-threaded planform. Structural Addition to increase Floodplain Connection
15.8-17.2 (25.5-27.75)	11.30	38.97	Structure Addition	Structure Addition and channel Modification to increase Floodplain Connection. Irrigation for Riparian Plantings
17.2-17.7 (27.75-28.5)	4.57	25.60	Structure Addition, Channel Modification, Floodplain Connection, and Riparian Plantings	Wide valley bottom. Channel Modification to remove levee and increase Floodplain Connection allow for Riparian Plantings
17.7-18.0 (28.5-29.0)	N/A	N/A	NA	Two large wood debris catchers in this section
18.0-18.6 (29.0-30.0)	6.36	25.81	Channel Modification and Floodplain Connection	Remove levee and create side channels to increase Floodplain Connection
18.6+ (30+)	N/A	N/A	NA	Concerns about infrastructure downstream, plus already has intact riparian
TOTAL	91.42	296.13		
Valley Bottom % (627.7 acres)	14.5%	47.2%		

N/A – Not modelled as these river segments are not being considered for restoration.

2.2.2.2 Riverscape Restoration Activities

When results of the on-the-ground assessments indicate that treatment is needed to maintain or improve upper riverine conditions, one or more of the following actions may be implemented. Four main activities are proposed for restoring the riverine and riparian systems within the Project Area. These activities would be implemented primarily along the mainstem Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles but could also be applied in perennial or intermittent/ephemeral tributaries within the Project Area including Timber Creek. As with the upland restoration actions presented above, these riverscape restoration actions can be used in conjunction with each other. These activities are summarized below and described in detail in **Appendices A and B**. Activities implemented below the Ordinary High Water Mark of a jurisdictional stream or in wetlands will require a Department of Army Permit while activities located in the channel and within twice the width of the active channel (up to 30 feet) are regulated by the Utah Division of Water Rights (State Engineer) under the Stream Alteration Program.

Structure Addition

Habitat structure created by beaver dams, wood jams, and boulders, is essential to the healthy functioning of streams and rivers. Structure influences hydraulic, hydrologic, geomorphic, chemical, and biological processes and helps to create and maintain instream and floodplain habitats for both aquatic and terrestrial flora and fauna. Low-tech, process-based restoration (LTPBR) can be considered the underlying philosophy behind these actions. LTPBR uses simple, cost-effective, structures that mimic natural structures such as beaver dams and natural log jams. LTPBR structures are not intended to be permanent. Instead, they are designed to initiate or enhance natural hydrologic, geomorphic, and biological processes that lead to healthy riverscapes and the processes that maintain them.

Large woody debris (LWD) is known to benefit fish habitat by increasing cover, providing refuge habitat during high flows, promoting aquatic habitat diversity including the formation of pools and resting and foraging areas, and by facilitating connectivity between the river channel and floodplain, which is critical to recharging the water table and providing water resources to riparian areas. Beaver dams provide similar functions and are particularly effective at increasing the channel area and maintaining floodplain connection even during low flows. Boulders also can create complex riverine habitats by diversifying hydraulics. Structure additions would only be used where the risk to roads and infrastructure is low. Equipment used in creating structure additions can include hydraulic post pounders, chainsaws, shovels, loppers, and buckets. In some cases where there is existing access, heavy equipment (i.e., mini-excavator, backhoe) may be used to move substrate and push posts into the ground.

Structure addition activities include the following:

- Building post-assisted log structures (PALS) using locally available wood sources for lattice and purchased untreated wood posts to hold in place (see **Figure 6** below).
- Building beaver dam analogs (BDAs) using untreated wood posts, branches, and existing substrate to mimic a natural beaver dam, mainly in side channels or where immediate floodplain connection can occur (See figures in Appendix A).

- Placing boulders in the channel where stream power is high. Suitable boulders can be found near the Strawberry River throughout the Project Area and can be moved and placed in the stream channel using heavy equipment.
- Although not a LTPBR action, engineered log jams (ELJs) can be used for the same purposes as PALS in stream reaches subject to high stream power near roads and bridges where long-term stability of the structure is required (See figures in Appendix A).

Implementation of structure addition activities would occur in portions of the Project Area where the Strawberry River exhibits low channel complexity (see **Table 3** above).

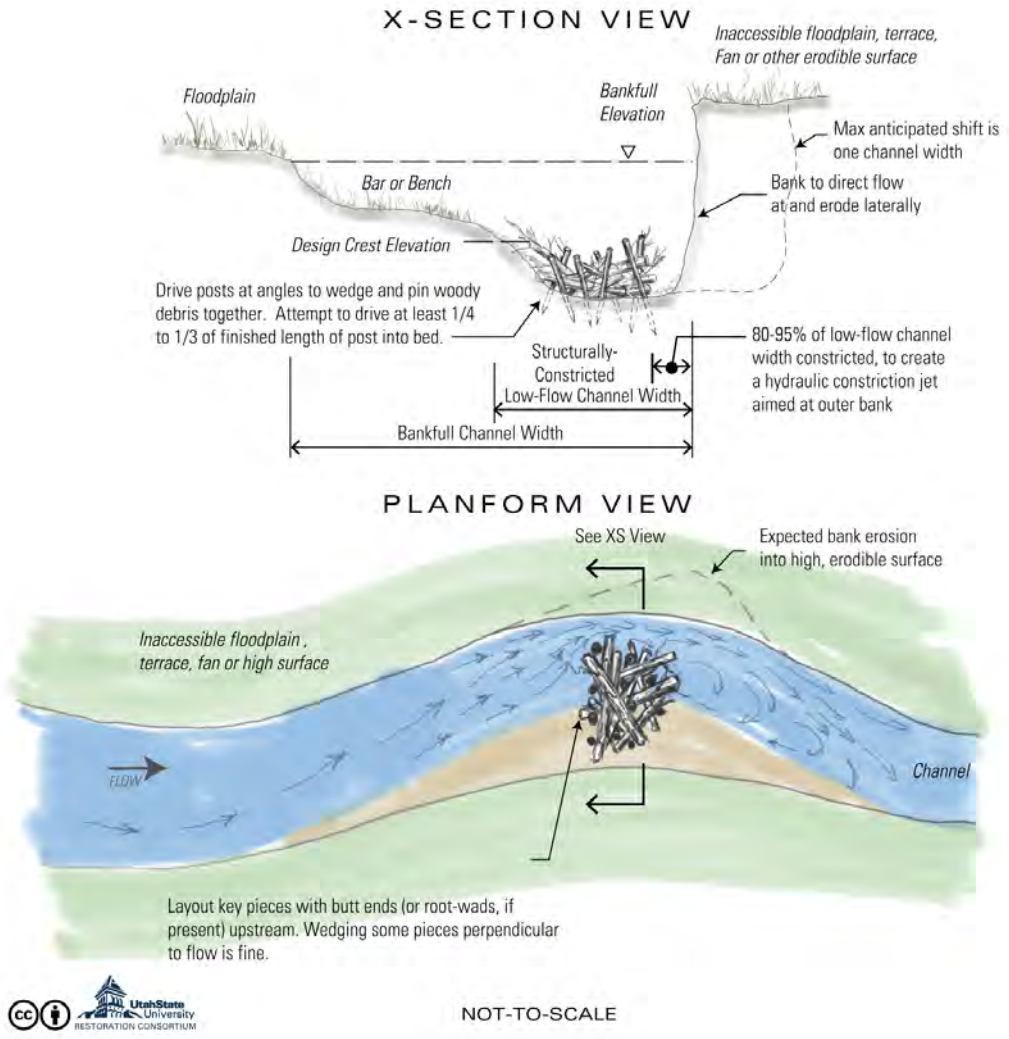

Figure 6. Cross-sectional, and planform views of typical bank-attached Post-Assisted Log-Structure (PALS) (Wheaton, Bennett, Bouwes, Maestas, & Shahverdian, 2019).

Channel Modification

This action can occur in the main channel and side channels in floodplains to increase the complexity of the riverscape and restore channels that have been highly modified (e.g., straightened, undersized). Channel modifications can be used to increase the length of channel available to fish at multiple flows to provide flow refugia and higher habitat complexity. Heavy construction equipment (including but not limited to excavator, backhoe, bulldozers, etc.) is typically needed to make channel modifications (See photo 7 below and figures in Appendix A). Because modifications can cause disturbance to stream and riparian areas, this action is most appropriate in areas that are already highly disturbed and lacking in riparian habitat quality or quantity.

Channel modification activities include:

- Excavating new channel(s) in the existing floodplain
- Modifying channel cross section or plan form
- Open blocked channels
- Increase geomorphic complexity where the main channel has been heavily modified through previous work.

Conditions warranting the implementation of channel modification activities include areas where the main channel has been modified, straightened, or moved and where the floodplain elevation is not too high above the main channel, i.e., where the new channel bottom is connected to the floodplain during high flow releases, and one or both of the following situations is present:

- The floodplain is wide enough to allow meandering and branching of new channels
- LTPBR approaches are unlikely to create new side channels in the near term (5 – 10 years).

Photo 7. Multi-thread channels in the Strawberry River (2021)

Floodplain Reconnection

Reconnecting the Strawberry River to its floodplain is fundamental to increasing riverscape and riparian resilience to disturbance events. Energy, sediment, water, and wood are dispersed across the floodplain during high flow events, providing refugia for aquatic fauna, and attenuating floodwaters. Frequent inundation also increases water storage and recruitment of riparian vegetation, which improves habitat for both aquatic and terrestrial species.

Floodplain reconnection activities can be used in conjunction with the channel modification described above and can be accomplished through:

- Using LTPBR techniques such as BDAs or PALS to raise water surface elevations in the main channel.
- Use more highly engineered approaches using heavy equipment to remove levees that might prevent high flows from reaching the floodplain. Levees in place to protect infrastructure or existing roads would not be subject to removal. Surplus streambed material obtained through side channel construction or levee removal may be used to backfill large BDAs or PALS to raise channel and surface water elevations in the main channel to allow higher flows to access the floodplain.

These activities would be implemented in areas where levees are preventing high flows from accessing the floodplain and at least one of the following conditions are met:

1. The floodplain can be accessed by the river during high flow events.
2. Irrigation canals are present that could be used to divert water onto the floodplain into newly created channels.

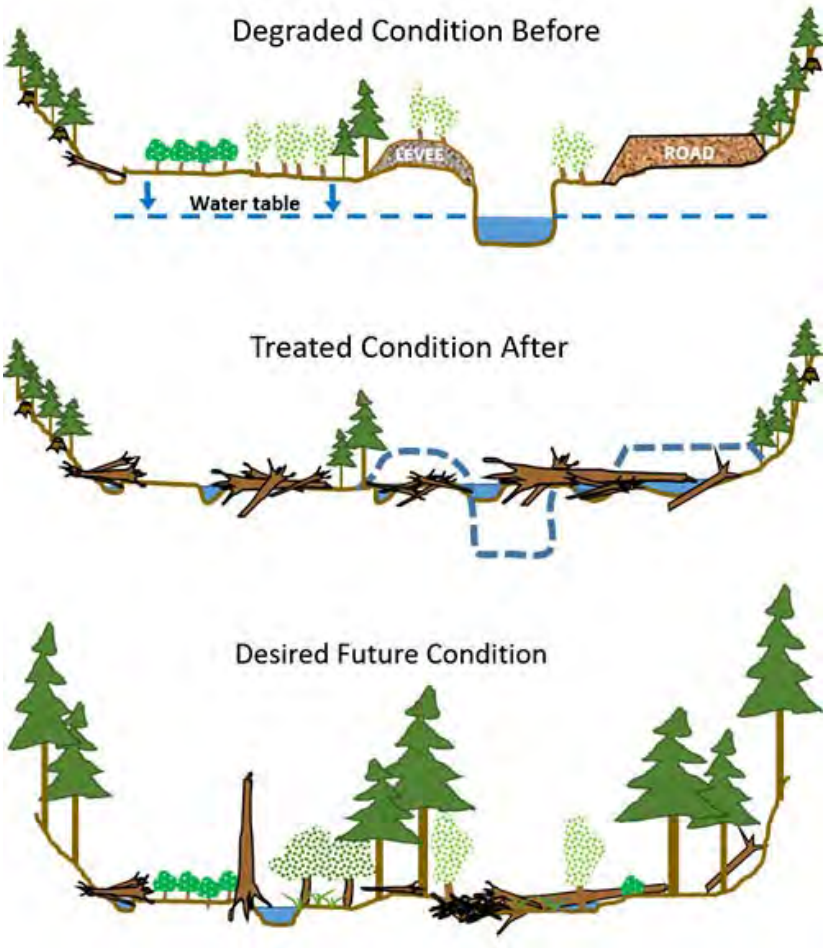

Figure 7. Cross-section of reconnecting a floodplain achieved by the removal of a levee and road and then using the material to fill in the incised channel. Structure was used to further capture sediment and alter flow paths on the floodplain (USDA Forest Service, 2022).

Riparian Plantings

Diverse and abundant riparian vegetation benefits wildlife, mediates water temperatures, increases fish production, provides a source for and retention of large woody debris, increases bank stability, and mitigates the spread of wildfire and noxious weeds and other invasive plant species. This action includes:

- Planting woody vegetation propagules, such as cottonwood and willow seedlings and cuttings.

This activity would be implemented in areas where fire-related tree mortality is high and/or existing riparian vegetation density is low, there is a lack of native or desirable species, and the water table is relatively shallow and easily accessible. Riparian plantings can also be implemented where there is existing or new irrigation infrastructure capable of delivering water high on the floodplain. Existing water rights would be used in areas where they could provide the most benefit. Equipment used in riparian plantings includes power and/or hand augers and other hand tools. Where existing irrigation infrastructure is present but requires repairs or upgrades or where new irrigation infrastructure is planned, heavy equipment may be needed to clean out or excavate irrigation ditches.

To facilitate restoration activities, specifically floodplain connection and riparian planting, the water right holder can use six water rights along the Strawberry River (Reach 3) with points of diversion within the Project Area. As illustrated in **Table 4**, these rights amount to 3.93 cubic feet per second (cfs) and can irrigate 90 acres in several different locations. Due to the Dollar Ridge Fire, irrigation ditches have been damaged and previously irrigated areas have been altered by debris flows and new stream morphology (Personal communication, Richard Mingo). Considering current conditions, Reclamation in coordination with UDWR, intends to use water rights where they provide the most habitat enhancement as informed by the restoration plan while minimizing operation and maintenance requirements. In some situations, this could result in a change to the point of diversion.

(Bair, Loya, Powell, & Lee, 2021)

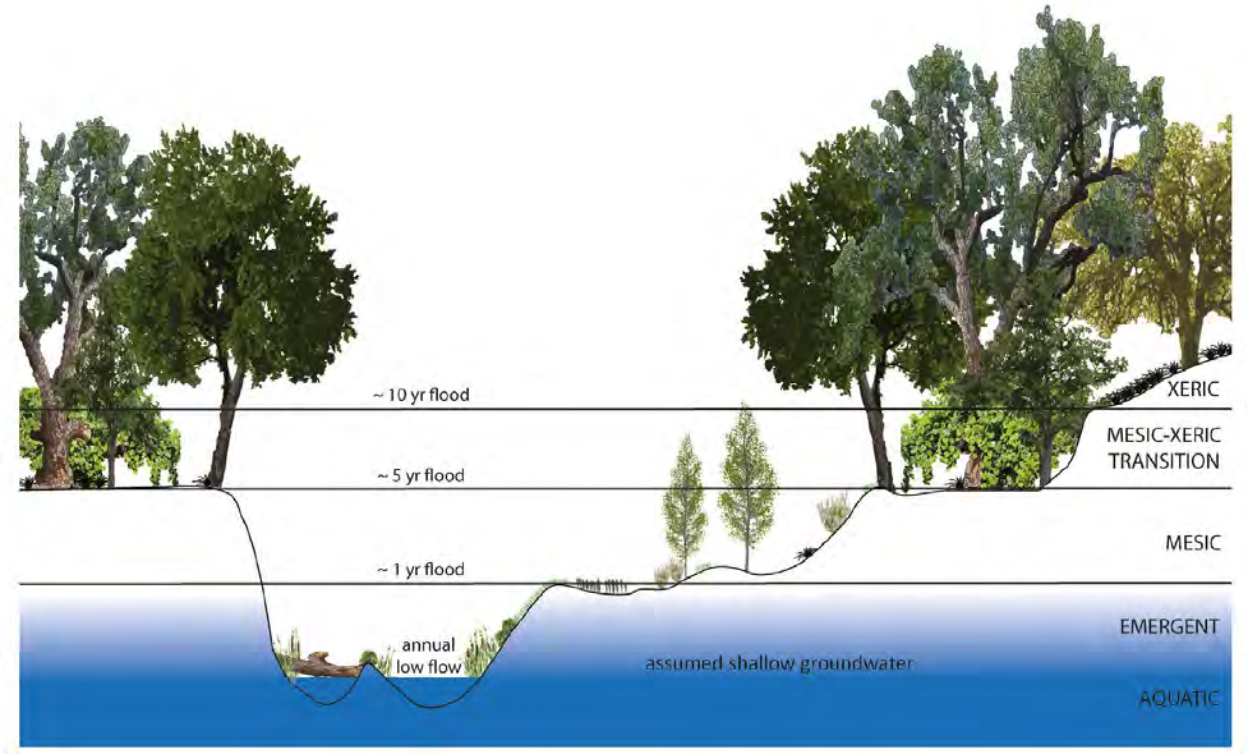

Figure 8. Planting zones in riparian areas, defined by the relative height of the approximate flood recurrence interval and the surface elevation (Bair, Loya, Powell, & Lee, 2021).

Table 4. Water Rights in the Project Area

Water Right #	Type	River Mile (KM)	Priority	Irrigation Amount (acres)	cfs
43-1140	Surface	10.6 – 10.9 (17.0 – 17.5)	19460424	7.4	0.30
43-1278	Surface	11.5 – 11.8 (18.5 – 19.0)	19501216	16.7	0.93
43-2806	Surface	9.0 – 9.3 (14.5 – 15.0)	19460424	1.4	0.06
43-389	Surface	9.0 – 9.3 (14.5 – 15.0)	19460424	27.0	1.11
43-510	Surface	10.3 – 10.6 (16.5 – 17.0)	19460424	7.8	0.32
43-1275	Surface	8.4 – 8.7 (13.5 – 14.0)	20210316	29.3	1.21
TOTAL				**90**	**3.93**

The total river lengths in which each riverscape restoration activities could be implemented within the Project Area are shown in **Table 5**, below.

Table 5. Estimated River Lengths for Each Restoration Activity

Riverscape Activity	**Total Miles (KMs)**	**Percent of River in Project Area**
Structure Addition	8.5 (13.75)	42.9%
Channel Modification	3.1 (5.00)	15.6%
Floodplain Connection	2.6 (4.25)	13.2%
Riparian Planting	1.4 (2.25)	7.0%

3 Affected Environment and Environmental Consequences

Fire is a natural disturbance event that can also exacerbate other types of disturbance such as erosion and debris flows. Resource managers have observed negative effects from erosion and debris flows in the riverscape and upper watershed components of the Project Area. These include gullying, sediment deposition, channel aggradation, loss of soil stability, weed infestations, and loss of stream functionality and fishery productivity. In addition, erosion and mobilization of debris impacts roads, bridges, and other infrastructure. Immediately after the Dollar Ridge Fire this temporarily and severely restricted public access for homeowners, emergency responders, and recreationists along Strawberry River Road and Timber Canyon Road.

In addition to the effects of the Dollar Ridge Fire, the condition of the Strawberry River is also a function of streamflow modifications. The Geomorphic Assessment included in the Restoration Plan and research conducted by Glissen (2000) identifies key findings that compare historic to current conditions. Historically the Strawberry River was characterized by diverse channel and floodplain features within the valley bottom. The river consisted of confined, single threaded, high gradient, and low sinuosity reaches as well as wider floodplain, less confined, and multi-threaded reaches. However, construction of dams upstream modified flows as well as decreased sediment and large woody debris inputs. This resulted in a loss of stream complexity, floodplain connection, woody species recruitment, and maintenance of riparian areas. It created a system much less resistant to disturbance, e.g., high intensity storms that generate debris flows, that affects the Strawberry River in this post-fire period.

In the four years since the Dollar Ridge Fire, much of the upper watershed including herbaceous and shrub communities have stabilized or are on a trajectory toward recovery. However, some locations in the upper watershed continue to experience erosion and gullying in response to high intensity precipitation events. These correspond to areas of high burn severity, hillslope and soil erosivity, and steepness/ruggedness that supported pre-fire mixed conifer and spruce-fir vegetation communities as identified in the Watershed Hazard Analysis. These locations can generate large debris flows that migrate down canyons, potentially affecting infrastructure and aquatic resources. For example, a post-fire debris flow generated in Slab Canyon created a natural dam across the Strawberry River. Ponded conditions behind the natural dam, referred to as Slab Lake, provide fish and wildlife habitat diversity within the Strawberry River, which since Soldier Creek Dam installation has lacked channel complexity. Below Slab Canyon, the debris flow created other geomorphic features superficially similar to historic pre-dam conditions such as multi-threaded channels, input of wood forming log jams, and floodplain connectivity. Fortunately, this occurred at a location away from roads, structures, and other infrastructure unlike the debris flows generated in Cow Hollow, which have had a greater impact on the built environment in Timber Canyon.

The following sections describe the affected environment and the environmental consequences, or effects, of implementing the Proposed Action with the Project Area. The remainder of this section considers the Proposed Action relative to specific resources. Only those resources identified for detailed analysis in Section 1.4, above, are described and analyzed below. Resources that would not be affected or for which effects would be negligible are not discussed further in this EA.

3.1 Hydrology and River Geomorphology

3.1.1 Affected Environment

3.1.1.1 Hydrology

Rivers are more than just water conveyances; they also transport sediments and large woody debris. It is the timing and quantity of these flows along with local geology and gradient that dictate channel form (single vs. multi-threaded channel), channel cross section, instream structure (boulders and log jams), floodplain size and connectivity, and riparian extent. Considering these components together, healthy streams are in "dynamic equilibrium," a condition in which the energy of a stream affects its physical characteristics to maintain channels in their most efficient and least erosive form (Vermont Agency of Natural Resources). Dynamic equilibrium and associated geomorphic processes are important for creating and maintaining quality fish and wildlife habitat.

The Strawberry River is the largest perennial waterway in the Project Area. Named tributaries to Strawberry River include Soldier Creek, Avintaquin Creek, Willow Creek, Beaver Canyon, Timber Canyon, and Simmons Canyon and correspond to sub-watersheds listed in **Table 6** below. In addition, a total of 51 intermittent/ephemeral tributaries enter the Strawberry River in the Project Area (28 from the north, 23 from the south), equating to approximately 2.6 tributaries per mile (1.6 tributaries per kilometer) of the Strawberry River within the Project Area (**Appendix A**).

Photo 8. Strawberry River at mile 8.7 (2021)

Table 6. Sixth Level (12-digit HUC) Watersheds in the Project Area

HUC12	Name	Acres	Percent
140600040106	Soldier Creek-Strawberry River	1,486.1	2%
140600040301	Willow Creek	1,533.5	2%
140600040302	Beaver Canyon-Strawberry River	30,091.2	39%
140600040304	Simmons Canyon-Strawberry River	13,315.1	17%
140600040303	Timber Canyon	28,923.6	38%
140600040204	Finger Canyon-Avintaquin Creek	1,696.7	2%
TOTAL		**77,046.2**	**100%**

Flow data are available from three gaging stations on the Strawberry River (USGS, 2022). Gaging station 09285000 is the upstream-most gaging station in the Project Area and is located approximately 750 feet downstream of Soldier Creek Dam at about 7,360 feet elevation above mean sea level (amsl.) It monitored flows from a drainage area of 213 square miles and recorded daily flows from October 1, 1942, to September 30, 1994. Gaging station 09285700 was located at the mouth of Timber Canyon at an elevation of 6,360 feet. It monitored flows from a drainage area of 363 square miles from October 1, 1963, to October 28, 1981. These gages are no longer active, and the data are not represented graphically in this discussion of existing conditions but can be found in the Restoration Plan.

The current active gaging station is 09285900 and is located near the Strawberry Pinnacles at an elevation of 6,060 feet, upstream of the Strawberry River's confluence with Avintaquin Creek and Red Creek. This station monitors flows from a contributing area comprising 372 square miles and has been in operation from February 10, 1990, to the present with a gap from approximately 1994 to 2005.Recent mean daily discharge recorded at active gaging station 09285900 is approximately 50 cubic feet per second (cfs) with some mean daily discharge peaks of between 400 and 450 cfs. Actual annual peak streamflow measured at this gaging station is typically below 600 cfs but reached 1700 cfs in 2018, 1300 cfs in 2019, and 720 cfs in 2021 not long after the Dollar Ridge Fire, as illustrated in **Figures 9 and 10** below and discussed in more detail in the Restoration Plan in **Appendix A**.

Another tributary to the Strawberry River within the Project Area is Timber Canyon Creek. It is often perennial but occasionally intermittent during low-snowpack years at low elevations near the confluence with Strawberry River. Timber Canyon widens in the upper Timber Creek watershed and this section of the creek was little affected by the Dollar Ridge Fire in terms of burn area and/or debris flows. It currently supports beaver dam complexes and an intact fishery. The lower section of Timber Canyon downstream of Cow Hollow to the confluence with the Strawberry River was significantly impacted by debris flows and contributed large volumes of material to the Strawberry River. There are no United States Geological Survey (USGS) gaging stations on Timber Creek.

Photo 9. Debris flow in Cow Hollow (2021)

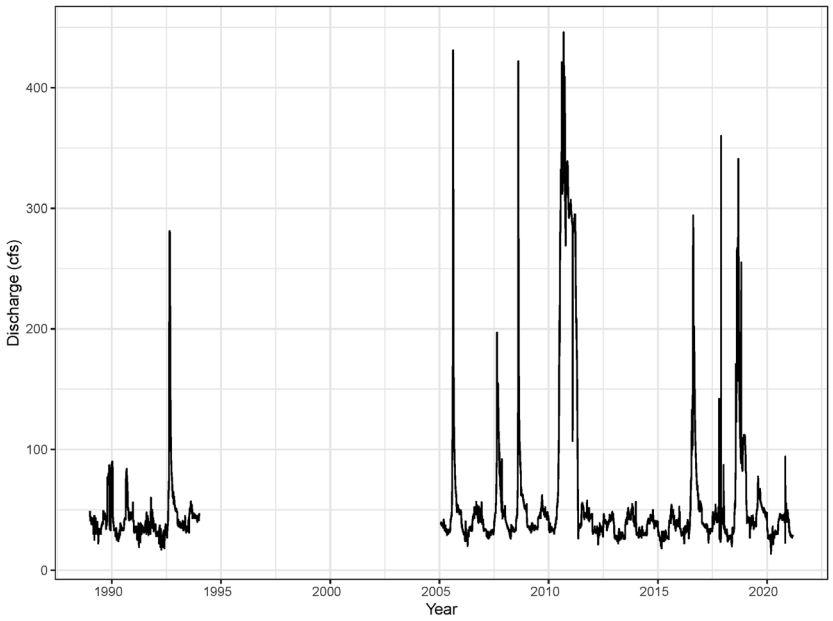

Figure 9 Mean Daily Discharge at USGS Gage 09285900. USGS data gap from 1995-2005 – Strawberry River at Pinnacles Near Fruitland, UT

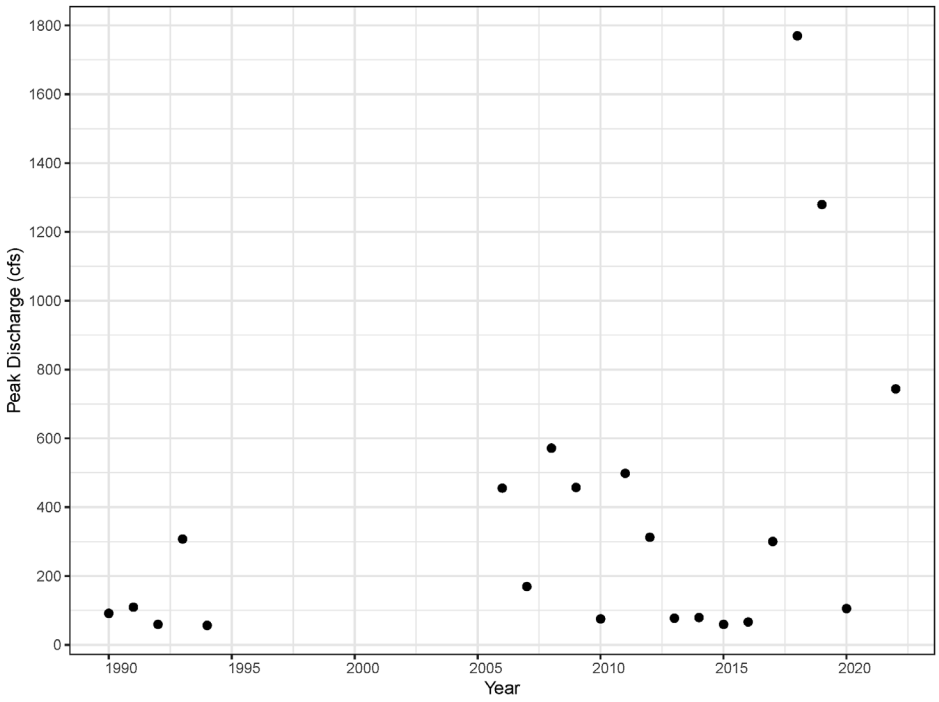

Figure 10. Actual Annual Peak Streamflow at USGS Gage 09285900. USGS data gap from 1995-2005. - Strawberry River at Pinnacles, Near Fruitland, UT

Large-scale water development in the Strawberry Valley began with the completion of the Strawberry Dam in July 1912 (Glisson, 2000). Storage of water in Strawberry Reservoir behind Strawberry Dam and irrigation diversions into the Utah Lake Drainage through Diamond Fork, significantly altered the natural hydrology of the downstream river corridor. Water storage and flow alteration were further increased with the completion of Soldier Creek Dam in 1972. Typical winter (October 1 to March 31) flows out of Soldier Dam are 13 cfs and 26 cfs in the summer (April 1 to September 30). Storage of natural stream flows and regulation in the amount and duration of releases to the Strawberry River below Strawberry Reservoir has limited natural processes such as channel-migration, overbank flows, wood recruitment, and the establishment of riparian vegetation. This has resulted in an overall decline in riparian extent, a narrower active channel, a laterally disconnected floodplain, and overall simplification of instream habitat (Glisson 2000) relative to pre-dam conditions. To mitigate adverse conditions caused by flow regulation, an Interagency Biological Assessment Team (IBAT) periodically calls for higher releases of flows for channel maintenance using project water reserved for such purposes. In general, high releases peak at 26 cfs between 2012 and 2022 with the exception of a 37 cfs flow on August 23, 2021 and a 77 cfs flow on October 1, 2019. (T. Davidowicz, Bureau of Reclamation, personal communication, December 9, 2022).

The most recent large and lasting release occurred between March 2011 and January 2012 when mean flows were approximately 200 cfs and peaked at 278 cfs. These releases were in response to high water levels in Strawberry Reservoir and storage capacity maintenance. In May 2009, an additional 3,541 acre-feet of water that peaked at 268 cfs, was progressively released over a 15-day period from Soldier Creek Dam to the Strawberry River as a flushing flow at the request of the IBAT team to benefit aquatic habitat

below the dam (T. Ovard, Central Utah Water Conservation District, personal communication, December 9, 2022).

3.1.1.2 Geomorphology

As presented in the Restoration Plan (**Appendix A**), flow is considered the master variable in determining riverscape health because of its importance to geomorphic, chemical, and biological factors. Variability of flow can create physical heterogeneity, i.e., different habitat conditions, within river channels and adjacent floodplains. Healthy river systems that maintain quality fish and wildlife habitat include but are not limited to those with multiple channel forms, e.g., single thread and multi-threaded depositional reaches; backwaters; high channel-floodplain connectivity that mitigates the transport of water, sediment, and wood downstream during flood flows; extensive riparian areas; and in-channel structures such as beaver dams, wood jams, and boulders. These characteristics constitute a desired future condition for the geomorphology of the Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles that guide riverscape restoration and maintenance and enhancement of existing conditions.

In an area prone to high-intensity summer storms that generate flash floods, the dense network of intermittent/ephemeral tributaries is an important characteristic of the Strawberry River watershed. For example, the presence of large alluvial fans on both sides of the valley indicates that even intermittent/ephemeral tributaries with small drainage areas can generate and deliver significant quantities of sediment and debris in this semi-arid landscape. Field observations and topographic data analyzed by ELR during the assessment process indicate that these alluvial fans were present before the Dollar Ridge Fire, but that following the fire significant amounts of sediment continued to be delivered from small tributaries.

Characterizing the natural sediment regime of a river system is challenging because sediment is delivered, transported, and stored over varying temporal and spatial scales, and often in episodic events (Wohl, 2015). How sediment moves through the Strawberry River has been impacted by both the Strawberry and Solider Creek Dams, which completely cut-off sediment delivery to the Project Area from reaches upstream of the dams. If flow conditions are similar to pre-dam levels, a decrease in sediment supply can lead to channel downcutting, as transport capacity exceeds sediment supply. Channel armoring can also occur if flow levels are sufficient to move smaller sediment sizes but not larger ones. The sediment regime of the Strawberry River is also characterized by high intensity rain events that have capacity to deliver large quantities of sediment via side tributaries. Substantial sediment delivery has been demonstrated in many locations, most notably the formation of what is informally known as “Slab Lake.” Storm events following the Dollar Ridge Fire caused the Strawberry River to be dammed by a debris flow from Slab Canyon to the south. Such debris flows can create extensive backwaters above the mouth of the side canyon and produce braided stream reaches below it.

Photo 10. Slab Lake was created by events following the Dollar Ridge Fire that caused the Strawberry River to be dammed by a debris flow from Slab Canyon in the background (2021)

In the Project Area, these occasional events likely represent an important sediment source given the disconnection of the Strawberry River from sediments transported by its headwaters above Soldier Creek Dam. Nonetheless, in the absence of flows capable of moving sediments delivered by occasional high precipitation events, they may not be transported, sorted, and stored in ways that are beneficial to instream and aquatic habitats **(Appendix A).** Existing flow conditions, changes to how sediment enters and moves through the system, and recent management activities all contribute to the current hydrologic condition of the Strawberry River.

Other important components of river geomorphology include wood recruitment, channel migration, and overbank flow (Glisson, 2000). Wood jams, and beaver dams which function similarly, are important for creating complex instream habitat by causing both erosion and deposition, creating flow refugia for fish and other aquatic species, improving channel-floodplain connectivity, and increasing sediment storage (**Appendix A**). ELR assessed the presence of wood jams and beaver dams in the Project Area both pre- and post-fire. This assessment is summarized in **Table 7** below.

Table 7. Presence of Beaver Dams and Wood Jams Pre- and Post-Fire

	2013 (pre-fire)		2019 (post-fire)	
Reach	**Beaver Dams**	**Wood Jams**	**Beaver Dams**	**Wood Jams**
1	6	6	8	36
2	0	3	0	12
3	0	9	0	41
4	0	6	0	11

While there was little change in the number of beaver dams post-fire, there was an increase in the number of wood jams. Increases in wood jams occurred in Reaches 1 and 2 (river mile 0 – 7.5 or river km 0 – 12) primarily due to channel-hillslope connectivity, higher transport capacity, and higher roughness that causes wood jams to form (**Appendix A**). Where present in Reach 3 (river mile 7.5 – 15.2 or river km 12 to 24.5) and Reach 4 (river mile 15.2 or river km 24.5 to Strawberry Pinnacles), wood jams were found in areas with the ability to trap large woody debris. These areas included alluvial fans and/or multi-threaded channels (**Appendix A**). Few wood jams were found in Reaches 3 and 4 where single-threaded channels persisted.

Photo 11. Single-threaded channel located in Reach 3 at river mile 8.7 (2021)

This could be a sign of variation from natural conditions. Finally, based on the amount of EWP Program work done in Reaches 3 and 4, it is likely that wood jams were removed from these locations. Strawberry River reaches vary in their potential to support lateral channel migration based on valley setting (**Appendix A**). Reaches 1 and 2 have narrow valleys and are less likely to experience channel migration. The wider valleys present in Reaches 3 and 4 have potential to experience channel migration. However, based on aerial image interpretation, this process was not evident between 2005 and 2017, likely due to lack of channel modifying flows out of Soldier Creek Dam. Prior to the Dollar Ridge Fire, overbank flow onto floodplains rarely occurred except for in Reach 1 below Soldier Creek Dam where beaver activity allows for ponding and floodplain connectivity. Post-Dollar Ridge Fire, little appears to have changed.

Photo 12. Abandoned floodplain in Reach 3 where overbank flow rarely occurs (2021)

In summary, post-Dollar Ridge Fire geomorphic conditions in Reaches 1 and 2 appear to be like pre-fire conditions and are affected primarily by low flow levels below Soldier Creek Dam. Specific characteristics of these reaches include the presence of wood jams and beaver dams, limited lateral migration to be expected in a narrow valley, and occasional overbank flows in Reach 1 where beaver dams cause ponding and create floodplain connectivity.

Photo 13. Wood jams in Reach 1 (2022)

Overbank flow in Reach 2 is considered poor due to lack of beaver dams. While overall conditions are poor in Reaches 3 and 4 below Beaver Canyon in part due to lack of wood jams, single thread channels, and reduced floodplain connectivity, some localized areas have improved where the valley bottom is wider with more room to add geomorphic complexity. Based on the ELR assessment, some beneficial post-fire characteristics in localized areas include wood jams, bare alluvial surfaces, wide active channel, and multiple channels leaving or entering the main channel.

Photo 14. Multiple channels leaving or entering the main channel in Reach 3 (2021)

Following the Dollar Ridge Fire in 2018, several severe flash flood events discharged sediments, wood, and other material from side canyons into the Strawberry River. These events realigned the river channel and, in several places, resulted in damage to the Timber Canyon Road, Strawberry River Road, and bridges within the Project Area. In 2020, Duchesne and Wasatch Counties, with assistance from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) EWP Program funding, began making repairs to the Timber Canyon Road and the Strawberry River Road from the Strawberry Pinnacles to just above Timber Canyon. Repairs to the Strawberry River Road above Timber Canyon continued in 2021. Additional work on sections of the road and river near Lost Canyon and Timber Canyon (approximately river mile 13 to 16 or river km 21 to 26) were completed in the Fall of 2022. Specific actions implemented under the EWP have been taken from permitting designs and "As-Built" designs prepared by Jones & DeMille Engineering and submitted to the U.S. Army Corps of Engineers as part of the Department of Army Permitting process.

Photo 15. Bridge blowout at mile 8.1 (2021)

Past actions on the river to improve roads/access and protect infrastructure have affected geomorphology in multiple ways that vary by action and location. These include: 1. simplifying channel form through creation of a single channel or removing material that could cause development of multi-threaded channels, 2. Sediment removal and side casting that reduces channel-floodplain connectivity by creation of levees, 3. creating retention basins in ephemeral tributaries that reduce the benefits large woody debris and other material have when introduced to the mainstem Strawberry River but can improve water quality, 4. Hardening banks that shift erosional forces downstream or degrade the channel bed, 5. Expanding the width of the valley bottom by relocating roads, 6. Increasing channel floodplain connectivity by installing post assisted log structures that create dams and force water onto the floodplain, 7. Adding boulders to increase in-channel structure, and planting willows along the streambank, and 8. Installing new bridges with greater capacity to pass high flows.

A description of specific EWP Program activities by sub-watershed is found in **Table 8** below. EWP as-builts and permitting designs (Jones & DeMille Engineering, 2022) are available in the administrative record.

Table 8. Emergency Watershed Protection Program Actions

Sub-watershed Name	EWP Activities
Soldier Creek-Strawberry River	Contains River miles 0 – 1.2 (river km 0 to 3) of the Strawberry River. No EWP activities were conducted in the sub-watershed
Beaver Canyon-Strawberry River	Contains Strawberry River miles 1.2 – 10.3 (river km 2.0 to 16.5). Beaver Creek enters Strawberry River at approximately river mile 7.5 (river km 12). Within this section of the Strawberry River and outside of the channel, the EWP removed sediments and debris from flows out of side canyons, constructed riprap water crossings along the road, and installed water-spreading ditches and berms adjacent to private property. Within the active channel, the EWP installed bridge abutment protection, cross vanes, and J-hooks, removed large woody debris and other material from the channel, and cut new channels within the existing channel.
Simmons Canyon-Strawberry River	Contains Strawberry River miles 10.3 – 18.6 (river km 16.5 to 30). Within this section of the river and outside of the channel, the EWP removed sediments and debris flows out of side canyons, realigned the road upslope of the river, constructed riprap water crossings along the road, and installed water spreading ditches, post assisted log structures, and berms adjacent to private property. Within the active channel, the EWP installed bridges, beaver dam analogs, bank armor, cross vanes, root wads, and J-hooks, cleared large woody debris and other material from the channel, and cut new channels within the existing channel and in adjacent uplands.
Timber Canyon	Timber Canyon Creek enters Strawberry River between river miles 14.6 and 15.2 (river km 23.5 and 24.5). Duchesne County implemented components of the EWP between the confluence with Strawberry River and Cow Hollow (approximately 3.25 miles upstream). The primary activities included realigning the previously existing channel into a designed channel. In some locations where the existing channel was not realigned EWP installed bank armor or a rock chute.

3.1.2 Direct, Indirect, and Cumulative Effects

3.1.2.1 No Action Alternative

Under the No Action Alternative, the current management of hydrologic and geomorphic resources in the Project Area would continue. Soldier Creek Dam would continue to be managed under its current operating protocol with periodic flushing flow releases if/as requested by the IBAT. Past actions used to improve roads/access and protect infrastructure would continue to remove sediment sources that restrict creation of multi-threaded channels, periodic removal of large woody debris from debris catchers, prevent or inhibit channel/floodplain connectivity due to channel realignments and cleaning,

and restrict channel migration that has resulted from bank armoring. On-going maintenance of structures such as debris catchers would continue, further decreasing the amount of large woody debris present in the river system and potentially inhibiting and in some places preventing the creation and maintenance of high-quality fish and wildlife habitat.

3.1.2.2 Proposed Action

Restoration activities are proposed in the 9.2 miles of Reaches 3 and 4 of the Strawberry River in the Project Area to contribute to the creation and maintenance of high-quality fish and wildlife habitats. These activities would influence hydrology and river geomorphology by introducing structure and roughness to channels, increasing channel complexity, increasing overbank flow onto floodplains, and enhancing the riparian zone. The Restoration Plan estimates that areas adjacent to the Strawberry River could be inundated up to 1 meter above the current streambed because of these activities. Another zone of influence extends an additional 2 meters above the level of inundation due to decreased depth to groundwater.

Effects Common to all Activities

The effects of proposed upland restoration activities on hydrology and geomorphology of the Project Area would include mitigation of extreme rain events by retaining water, sediment, and other material higher in the watershed. Short-term effects from upper watershed activities could include soil disturbance if machinery is used during installation. Any short-term impacts resulting from restoration activities would be avoided or minimized with implementation of erosion/sediment control best management practices (BMPs). Riverscape activities would not be implemented on private land to avoid bank erosion, flooding, or other real or perceived damage to private property. Similarly, riverscape activities will not occur in locations that could damage infrastructure, e.g., bridges and hardened water crossings. Short-term effects and disturbance from installing riverscape activities in the channel and on the floodplain could be mobilization of sediment and debris as well as damage to vegetation.

Cumulative effects on hydrology and geomorphology include past, present, and future activities taking place in and adjacent to the Project Area. Past actions on the river to improve roads/access and protect infrastructure include road crossings, structure addition, channel modifications, road relocations, floodplain reconnection, debris basins and bank armoring that have hydrology and geomorphology. Some actions increased channel form and aquatic habitat diversity while others have restricted lateral migration of the channel, simplified channel form, created levees that separate the channel from its floodplain, and hardened banks that can exacerbate erosion.

The following sections describe the anticipated additional effects of specific restoration activities on the hydrology and geomorphology of the Project Area.

Soil / Hillslope Erosion Reduction

The long-term effect of erosion reduction activities is soil stabilization. Other effects include enhanced vegetation growth and reduced sediment loads to surface waters.

Gully Stabilization

The long-term effects of gully stabilization activities consist of stopping or reducing the development and enlargement of erosion rills. Other effects include protection of upland slopes and other upland watershed treatments such as reseeding areas and downslope stream crossings. Gully stabilization would also reduce sediment loads to surface waters.

Vegetation Management

Vegetation management consists of reseeding, planting woody seedlings, and treating annual weeds that provide limited erosion control due to their lack of root structure. The long-term effects of vegetation management consist of increasing vegetation cover as well as shifting vegetation communities to native perennials with greater capacity to hold soil in place. Other effects include reduced sediment loads to surface waters.

Road / Stream Crossings and Improvements

When not adequately sized, bridges and culverts can clog with debris, which causes water, sediment, and other materials to back up behind the infrastructure. Under severe conditions the infrastructure can fail due to the pressure behind it and result in a pulse of water, sediment, and material downstream that can damage fish and wildlife habitats and private property. The long-term effect of this activity is mitigation of channel erosion and pulses of sediment to surface waters by replacing inadequately sized culverts and bridges with ones that allow water, sediment, and material to pass through under normal hydrologic and geomorphic conditions.

Structure Addition

In areas of low channel complexity, the addition of boulders, wood, post-assisted log structures, and beaver dam analogs under the Proposed Action would mimic and promote the same instream structure that occurs naturally but which is currently deficient in the system. An increase in the structural complexity of the stream would facilitate creation and maintenance of complex fish and wildlife habitat and facilitate floodplain connectivity. Long-term effects would include new localized erosion and depositional patterns due to changes in river hydraulics and more frequent floodplain connection. Other effects of structure addition activities would include enhancement of riparian vegetation as the activities cause river flows to expand farther onto the floodplain with greater frequency.

Channel Modification

Channels have natural sinuosity and often exhibit side channels in floodplains or multi-threaded main channel forms. Current channel forms within the Project Area are generally simple, i.e., single-threaded, because of flow modifications caused by Soldier Creek Dam, lack of large woody debris entering the system, and/or channelization to protect infrastructure and private property. The long-term effects of modifying channels with heavy equipment would include creation of greater channel form diversity by reshaping the channel and floodplain to a desired form within the confines of existing flow and sediment

transport conditions. This activity could result in changes to bed and bank erosion and deposition, both of which are considered natural processes of river equilibrium.

Floodplain Reconnection

Floodplain reconnection involves raising channel and water surface elevations or removing levees. Techniques described above under Structure Addition, e.g., installation of PALs and BDAs can also be used to raise the channel bed and water elevations. Levees along the Strawberry River generally are found where channels have been straightened and dredge material deposited on adjacent banks, effectively raising the floodplain. Heavy equipment would be used to pull back levees that are preventing high flows from reaching the floodplain. Long-term effects of floodplain reconnection include energy, sediment, water, and wood dispersal across a larger area of floodplain during high flow events. Short-term effects include removal of levees and any vegetation established on these surfaces. Other effects include improvements to recruitment of riparian vegetation and creation of flow refugia for aquatic animals.

Photo 16. Proposed Levee removal at Sulphur Draw (2022)

Riparian Plantings

Over time, riparian plantings have the potential to add woody material to the river system, which can result in wood jams and become a source of building material for beavers. Woody material increases

roughness within the river system. Increased roughness can cause localized overbank flows, which are beneficial for maintenance of the riparian areas. The long-term effects of riparian plantings include larger, healthier riparian areas and establishment of a woody debris source. There would likely be increased woody debris entering the Strawberry River and the creation of more log jams. Log jams would need to be removed if they threaten private property or infrastructure. Other effects would include enhancement of fish habitat (shading of streams decreases water temperature) and wildlife habitat (more areas of structurally diverse vegetation).

3.2 Water Quality

3.2.1 Affected Environment

Water quality parameters are chemical, physical, and biological properties of water that can be measured such as temperature, dissolved oxygen, dissolved solids, etc. Parameters can be assigned numeric standards, i.e., the maximum concentration of a given parameter that is still protective of human health and/or the environment. Parameters of concern and associated standards can vary depending on the use of the specific waterbody. For example, higher water temperatures might not be of concern for irrigation water but could have negative effects on certain desirable fish species. To protect waterbodies from pollution, the state of Utah classifies rivers and streams in terms of beneficial use. These broadly consist of Class 1- Water for Domestic Use, Class 2 – Recreational Use and Aesthetics, Class 3 – Aquatic Wildlife, and Class 4 – Agriculture.

The three main perennial waterbodies in the Project Area are the Strawberry River, Timber Canyon Creek, and Avintaquin Creek. All three waterbodies within the Project Area share the same beneficial uses and each are classified as 1C – Domestic Drinking Water with prior treatment, 2B – Infrequent Primary Contact Recreation, Class 3A – Cold Water game fish and other Aquatic Life, Class 4 – Agriculture including irrigated crops and stock watering. In their Integrated Report on Water Quality to the Environmental Protection Agency, the Utah Division of Water Quality (UDWQ) analyzes water quality data to determine if assessed waterbodies support their designated beneficial uses (UDWQ, 2022). Waters that fail to meet water quality standards are placed on the Clean Water Act 303(d) list of impaired waters and may require development of water quality plans.

Within the Project Area, there are 11 water quality sampling locations (Strawberry River – 6, Timber Creek – 4, and Avintaquin Creek – 1) with water quality data gathered periodically between 1975 and 2017. Based on analysis of available water quality data, all four beneficial uses are supported in the Strawberry River (UDWQ, 2022). However, Timber Canyon Creek and Avintaquin Creek are considered impaired because levels of arsenic found in these waterbodies exceed the standard allowed for domestic drinking water (Class 1C).

Common physical and organic water quality parameters with numeric standards associated with cold water fisheries (Class 3A) that have the potential to be affected by upper watershed and riverscape restoration activities consist of dissolved oxygen, maximum temperature, pH, turbidity increase, nitrate, and total phosphorus. Turbidity, a measure of suspended material in water and an indication of water clarity, is of particular interest within the Project Area because of the erosive geologic conditions, frequency of intense seasonal weather events, and vegetation cover impacted by the 2018 Dollar Ridge

fire. These natural conditions can cause an increase in sediments and other material entering rivers and creeks. High turbidity levels affect other water quality parameters including reducing the amount of dissolved oxygen, raising water temperatures, generally affecting fish vision, spawning, and breathing. Turbidity is not always bad and many streams in Utah have a naturally wide range of clarity to which native aquatic life have adapted (USU Extension, 2022). For example, recorded turbidity measurements in Strawberry River have varied from 0.4 to 360 Nephelometric Turbidity Units (NTUs) and could possibility have been higher during extreme precipitation events that mobilize debris and sediments.

Temperature and dissolved oxygen are also important water quality parameters in the context of cold water game fish and other aquatic life. They are not only related to turbidity but also indicators of healthy habitat for these species because desired and/or native aquatic organisms can have low tolerance for high temperature and low levels of dissolved oxygen. Water temperature is primarily a function of water source and ambient air temperature. High temperatures can be mitigated by shading from adjacent riparian areas. Recorded temperature in the Strawberry River ranges from approximately 32 degrees Fahrenheit (F) to 72 degrees F. The maximum temperature for cold water game fish and other aquatic life is 68 degrees F.

Dissolved oxygen concentrations in waterbodies are primarily driven by diffusion from the atmosphere or as a biproduct of photosynthesis. However, in some cases water is aerated as it passes over falls and rapids. The general lack of instream structure, narrow single channel, and simplification of instream habitat of the Strawberry River found by Glisson (2000) and ELR reduces the opportunity for aeration as water flows through the Project Area. Recorded Dissolved Oxygen in the Strawberry River ranges from 6.22 to 18.24 mg/l. The minimum dissolved oxygen (DO) for cold water game fish and other aquatic life is 8.0 mg/l for early life stages and 4.0 for all other life stages.

In the context of the Proposed Action, riparian zones play a vital role in protecting water quality. In addition to decreasing soil erosion, filtering water, and storing organic matter and nutrients, riparian vegetation moderates water temperatures through shading (USFS, 2022). Some segments of the Strawberry River riparian zone, e.g., Reaches 1 and 2, exhibited good cover and plant density relative to managed flows and available floodplain, and provided sediment filtration prior to the Dollar Ridge Fire. Riparian zones in Reaches 3 and 4 appear to be stressed in many locations, supporting non-riparian and weedy species. Although riparian vegetation burned in some locations, it appears to be recovering well. Other factors, some exacerbated by the fire but primarily due to flow regulation below Soldier Creek Dam, have resulted in an overall decline in riparian extent (Glisson, 2000). Consequently, the Strawberry River riparian zone does not mitigate impacts to water quality as much as it could.

3.2.2 Direct, Indirect, and Cumulative Effects

3.2.2.1 No Action Alternative

Under the No Action Alternative, the effects to water quality from land and river management will remain on the current recovery pace and trajectory. Water quality will improve, albeit more slowly, as vegetation regrows along the stream banks and in riparian areas. the same. Sediment loads within the Strawberry River and its floodplain will continue to move downstream during base and high flow periods, which can raise turbidity levels. Precipitation events, especially extreme ones, will continue to

add more sediment and debris to the system, causing short-term increases in turbidity. Lack of riparian zone restoration and enhancement will leave larger areas of the river exposed to direct sunlight, raising temperatures. Since warm water holds less oxygen in solution than cold water, the Strawberry River is likely to have lower levels of dissolved oxygen under the No Action Alternative compared to the Proposed Action. Moreover, the relative lack of instream structure such as boulders and log jams and lack of diverse channel types will continue to limit aeration of stream water within the Project Area. It is assumed that water quality conditions under the No Action Alternative would remain highly variable with periods of low and high turbidly, temperature, and dissolved oxygen until some dynamic equilibrium is achieved, which may not be a condition that benefits aquatic organism, especially cold-water trout species.

3.2.2.2 Proposed Action

It is the intent of the Proposed Action to moderate the input of sediment and other debris to surface waters within the Project Area, thereby mitigating spikes in turbidity. However, the Project Area falls within a landscape characterized by erosive geology and soils where mobilization of sediments is a natural process and occurs within a wide range of frequency and volume.

Effects Common to all Activities

The long-term effects on water quality of the upper watershed restoration activities such as soil/hillslope erosion reduction, gully stabilization, and vegetation management included in the Proposed Action would include stabilizing soils and capturing eroding sediments before they become extreme debris flows that impact water quality in the Strawberry River. The long-term effects on water quality of the proposed riverscape activities would be to mitigate high water temperatures and filter surface water by expanding and enhancing riparian areas. Instream structural additions could increase dissolved oxygen by providing roughness and subsequent aeration. The Activity Cards and associated actions that could affect water quality parameters are provided in **Appendix B.**

The proposed riverscape restoration activities require work within the channel or along its banks and floodplains. These activities can cause ground surface disturbance, especially if heavy equipment is used, which can lead to short-term increases in stream turbidity. Work will be conducted during periods of low water, preferably from July 15 to September 30, to avoid or minimize impacts to fisheries that can result from increased turbidity. Erosion and sediment control BMPs would be integrated into both upper watershed and riverscape restoration activities to minimize direct impacts to water quality.

Cumulative effects on water quality include past, present, and future activities taking place in and adjacent to the Project Area. Past actions on the river to improve roads/access and protect infrastructure implemented hardened low water crossings, structure addition, and floodplain reconnection that have beneficial effects on water quality by reducing sedimentation in the mainstem Strawberry River. Other actions such as channel form simplification, deposition of dredged material that has created levees along the Strawberry River, and bank armoring have the potential to maintain erosive processes that mobilize material from the bed and banks, decreasing water quality. Ongoing upland seeding by the Forest Service and UDWR increases vegetative cover, stabilizes sediments, and decreases

transport downslope into surface waters. Finally, newly constructed sediment basins can also reduce sediment delivery to the channel.

Additional effects of specific upper watershed and riverscape restoration activities on water quality are summarized below.

Road / Stream Crossings and Improvements

As described in the hydrology section, the long-term effect of new culverts or hardened crossings on water quality is mitigation of channel erosion and pulses of sediment and debris that enter the Strawberry River when undersized infrastructure fails. Other effects could include decreased potential for water quality impacts resulting from road maintenance and refurbishment activities following culvert failures.

Structure Addition

The long-term effects of structure addition on water quality would include increased levels of dissolved oxygen through aeration. Some structures such as log jams or beaver dam analogs that span the channel can slow flows causing sediments and other debris to settle out, decreasing turbidity.

Channel Modification

The long-term effects of channel modification on water quality would be reduced erosion and turbidity. These effects would foster conditions favoring the creation of more balanced channel conditions and establishment of a dynamic equilibrium that allows channels to function in their least erosive form.

Floodplain Reconnection

The effects of floodplain reconnection activities on water quality would include deposition of sediment and other debris outside of the stream channel during high flow events. Other effects could include riparian zone enhancement, which improves water filtration, shading, and fish and wildlife habitat.

Riparian Plantings

The effects of riparian planting activities on water quality would include moderating turbidity spikes through filtration and reducing water temperatures through shading.

3.3 Soils

3.3.1 Affected Environment

The most common soil types on the approximately 6,846 acres of upland and approximately 19 miles of Strawberry River riparian corridor proposed for restoration are listed in **Table 9** below. Where data was available, soils in the Project Area are in the high or very high runoff class. The upland areas recommended for restoration are discussed in detail in the *Dollar Ridge Fire Post-Fire Upper Watershed Hazard Analysis & Recommendations* (**Appendix A**). All treatment areas have a composite post-fire

hazard rank of Moderate, High, or Highest. Prior to the Dollar Ridge Fire, the upland forests and riparian areas along the Strawberry River and Timber Canyon Creek were generally in good condition. High severity fires destroy the forest understory, which increases erosion susceptibility (Moody, et al., 2013).

High severity fires may also create hydrophobic soils, a formation consisting of a waxy, water repellent layer, that reduces water infiltration rates and increases runoff (**Appendix A**). The fire burned several areas in the riparian zone along the Strawberry River and many large trees were lost. Other riparian vegetation, however, showed quick re-growth after the fire. Flash flooding and debris flows shortly after the fire led to increased erosion that may continue to impact soils in the Strawberry River riparian corridor for some time.

Table 9. Major Soil Types in the Project Area

Soil Type	Slope	Soil Description	Runoff Class
Rial-Bigbug complex (YPE)	15-55%	Channery silty clay loam	Very High
Saddlehorse-Rock outcrop-Pathead complex (198)	40-80%	Extremely stony loam	High
Paudtheeagon-Senchert complex (JyE), very bouldery	35-80%	Gravelly clay loam	High
Kingmine-Bumper-Longridge complex (ANF215)	15-70%	Very gravelly clay loam	Not listed
Tosca, deep-Paunsaugnut-Minnimaud complex (MXE)	**20-55%**	Very channery loam	Medium (Tosca), Very High (Paunsaugnut), High (Minnimaud)

Source: (USDA NRCS, 2022)

* The likelihood for surface runoff to occur during rainfall or snowmelt. Surface runoff is generated when the movement of water into the soil is slow enough to result in water flow along the land surface and into waterbodies.

3.3.2 Direct, Indirect, and Cumulative Effects

3.3.2.1 No Action Alternative

Under the No Action Alternative, current vegetation management activities would continue in upland and riparian areas. Going forward, these activities would include annual spot treatment of weeds on National Forest System lands and lands managed by UDWR (approximately 630 acres/year). Additional willow plantings along the Strawberry River are also expected to continue under the No Action Alternative. In November 2022, aerial reseeding of 600 upland acres will occur in the portions of the areas shown on **Figure 2**. There is also the possibility of opening up wood cutting permits in the future in designated areas along the south-facing slopes along the Strawberry River near the mouth of Slab Canyon to remove burned timber.

There would not be any additional slope stabilization activities implemented under the No Action Alternative. The adverse effects of not stabilizing the bare soils left after the Dollar Ridge fire would be the loss of soils from hillslopes and streambanks due to the increased erosion rates associated with

burned areas. Under the No Action Alternative, vegetation is expected to naturally establish to stabilize bare soil areas associated with Dollar Ridge Fire. Due to accelerated post-fire surface runoff and associated soil erosion induced by precipitation and snow melt, the timing of natural vegetative establishment in these areas is unpredictable.

3.3.2.2 Proposed Action

Up to 6,846 acres of upland vegetation, or approximately 9 percent of the 77,047-acre Project Area, and 19 miles of riverscape riparian (43% of the 43 miles of perennial streams in the Project Area) would be considered for various restoration treatments as part of the Proposed Action. Restoration treatments are discussed in detail in **Appendix A.** The Activity Cards and detailed actions that could affect soils in the restoration areas are provided in **Appendix B.**

Effects Common to All Activities

The general effects of these restoration activities on soil is a decrease in erosion associated with unvegetated slopes. However, restoration activities and/or access to restoration areas by ATVs and backhoes can cause soil compaction, which can have direct, adverse effects on soil function. Compacted soils limit root penetration and the ability of the soil to hold water. These factors can lead to decreased revegetation success and increased surface water flow following a rain event. These impacts are likely to be negligible due to the small number of ATVs and people that would very occasionally access the Project Area to conduct restoration activities. Best management practices would be implemented to minimize and mitigate soil compaction and construction sites would be ripped and reseeded upon completion.

Gully Stabilization Activities

As described in the Gully Stabilization Activity Card (**Appendix B**), gullies and other eroding areas with bare soils would be considered for gully stabilization activities including directional tree felling and the installation of grade control structures and straw wattles.

Bare soils on steep slopes can experience overland flow during rainfall events, particularly in severely burned areas, that can concentrate into steep gullies and fill with soil. This soil can be further transported into adjacent flowing streams (JW Associates, 2022). Tree felling into gullies slows the water velocity, which increases sediment deposition on the slope and promotes establishment of vegetation, thus reducing the potential for future rill and gully formation. Erosion hazard ratings for soils in the Project Area are not available (USDA Natural Resources Conservation Service, 2022).

Cumulative effects of gully stabilization on soils in the Project Area include past, present, and future activities taking place in and adjacent to the Project Area. Following the 2018 Dollar Ridge fire, approximately 10,704 acres of the northern section of the Project Area were seeded to stabilize the slopes. An additional 2,517 acres adjacent to and upslope of the Project Area were also seeded at that time. The cumulative, beneficial effects of gully stabilization in conjunction with seeding burned slopes is the reduction in erosion-related soil loss on slopes. There would be negligible cumulative, adverse effects resulting from soil compaction associated with accessing gully stabilization treatment areas in the Project Area.

Vegetation Management Activities

As described in Section 2.2.1 above, vegetation management activities would occur on up to 6,846 upland acres in the Project Area where a higher percentage of weeds have been identified (see Activity Cards in Appendix B). Vegetation management activities include chemical or mechanical weed treatment followed by monitoring until control is achieved, broadcast seeding with native and desirable species, planting woody species seedlings, constructing exclosures to reduce herbivory, and mulching.

The beneficial effects of weed removal, seeding with native and desirable species, and planting woody species seedlings in the Project Area is the germination, recruitment, and establishment of native and desirable plant communities.

Cumulative effects of vegetation management on soils in the Project Area include past, present, and future activities taking place in and adjacent to the Project Area. Current and past management activities on Forest Service land include the annual chemical treatment of approximately 130 acres of upland vegetation for weeds (T. Irish, Forest Service, Personal Communication, June 29, 2022). UDWR has and will continue to treat weeds chemically and manually on approximately 500 acres of their managed lands on an annual basis (R. Thacker, UDWR, Personal Communication, June 30, 2022). Chemical and mechanical weed treatment is likely to have occurred and will continue to occur on private property in and adjacent to the Project Area. The cumulative, beneficial effects of past, present, and future weed removal in and adjacent to the Project Area, include a larger area where native plant and desirable plant species will be more likely to become established and stabilize the soils in and adjacent to the Project Area. There would be negligible, cumulative, adverse effects resulting from soil compaction associated with accessing vegetation management areas in and adjacent to the Project Area.

Soil/Hillslope Erosion Reduction Activities

As part of the Proposed Action, bare soils would be considered for Soil/Hillslope Erosion Reduction activities (See **Appendix B**-Soil/Hillslope Erosion Reduction Activity Card). These activities include applying mulch on bare soils, placing LEBs perpendicular to the slope, and seeding with native plant species.

The application of wood mulch on bare slopes results in a 60 percent or greater reduction in sediment movement (Robichaud, Ashmun, & Sims, 2010). Cumulative effects of Soil/Hillslope Erosion Reduction activities on soils in the Project Area would be the same as discussed in the Gully Stabilization section above.

Riparian Planting Activities

As part of the Proposed Action, up to 1.4 miles of riparian habitat along the Strawberry River between the Soldier Creek Dam and the Strawberry Pinnacles (7% of the riparian habitat identified for treatment) would receive riparian plantings. Riparian plantings include planting woody tree, shrub, and forb propagules (e.g., willows, cottonwoods, sedges, and forbs), and seeding riparian areas (including associated wetlands and floodplains) with native plant species. As described in the Riparian Planting

Activity Card (see **Appendix B**), planting would take place in areas where existing riparian vegetation density is low because of high tree mortality due to fire or other reasons, and a water source is easily accessible (e.g., irrigation, high water table). In non-irrigated areas, survival of plantings can be increased by drilling holes deep enough to access the water table. In areas that may attract herbivory, implementing protection, such as temporary fencing (i.e., exclosures), vole guards, or vented tree shelters is important (Hall, et al., 2015).

The beneficial effects of riparian planting on soils is nutrient addition to the soil and aquatic ecosystem from leaves and other organic matter and an increase riverbank stability which prevents stream sedimentation.

Cumulative effects of riparian planting on soils in riparian areas in the Project Area include past, present, and future activities taking place in and adjacent to the Project Area. As part of the EWP Program, native willows were planted in various locations along the Strawberry River in the Project Area (See Section 3.4 Riparian, Wetlands, and Floodplains below). The beneficial, cumulative effects of past, present, and future riparian plantings include water temperature moderation, increased stability of streambank soils and decreased river sedimentation.

3.4 Riparian Areas, Wetlands, and Floodplains

3.4.1 Affected Environment

3.4.1.1 Riparian Areas

There are approximately 43 miles (69 km) of perennial streams in the Project Area (USGS, 2022). Of these, approximately 18.6 miles (30 km) of the riparian corridor adjacent to the Strawberry River between Soldier Creek Dam and Strawberry Pinnacles, are the focus area for riparian restoration activities. Prior to the Dollar Ridge Fire, some segments of the Strawberry River riparian zone, e.g., Reaches 1 and 2, exhibited good cover and plant density relative to managed flows and available floodplain, and provided sediment filtration prior to the Dollar Ridge Fire. Riparian zones in Reaches 3 and 4 appear to be stressed in many locations, supporting non-riparian and weedy species. Riparian habitat along the Strawberry River was characterized by cottonwood and Douglas-fir in the over story with occasional white fir, blue spruce, and box elder. The riparian understory was made up of willows, river birch, red-osier dogwood, golden currant, and Oregon grape (UDWR, 2021). The fire burned several areas in the riparian zone along the Strawberry River and many large trees were lost. Other riparian vegetation, however, showed quick re-growth after the fire. Some areas of the riparian zone were un-burned and in good condition. Flash flooding and debris flows shortly after the fire impacted the riparian zone further and changed the stream channel in some areas, but riparian vegetation in the Project Area generally appears to be recovering well. Increased erosion resulting from the fire may continue to impact riparian corridors for some time. Weeds, especially tamarisk and musk thistle, appear to be expanding in the riparian corridor due to the Dollar Ridge Fire.

UDWR seeded approximately 585 acres of the riparian zone along Strawberry River and in portions of Cow Hollow and Slab Canyon with native species and alfalfa in the fall of 2018 and 2022 as shown on **Figure 11,** below. Willows were then planted by EWP Program along the river in Reaches 3 and 4 (pers

comm. Richard Mingo, 6/8/2022). In the fall of 2021, tamarisk was removed on approximately 10 acres on a floodplain of the Strawberry River near mile 15.5 (km 25) of the Project Area.

3.4.1.2 Wetlands

According to the National Wetlands Inventory (NWI) there are approximately 926 acres of wetlands and approximately 22 acres of perennial ponds in the Project Area (U.S. Fish and Wildlife Service, 2022). Some of these areas are adjacent to perennial waters, while others are associated with ponds, seeps, and springs. There are no wetland-specific treatments currently taking place in the Project Area. Tree planting in wetlands would require a permit under Section 404 of the Clean Water Act (CWA). Only the wetlands associated with the Strawberry River floodplain are considered in this section. Plantings, weed treatment, and seeding with native species as described in the Riparian section above have occurred in wetland areas associated with the Strawberry River riparian corridor.

3.4.1.3 Floodplains

Floodplains are low-lying areas adjacent to rivers, formed mainly of river sediments, and subject to periodic flooding. There are floodplains associated with the entire 18.6 mile (30 km) stretch of the Strawberry River proposed for restoration activities in the Project Area. Floodplains can be a source of large woody debris. Connected floodplains can dissipate flood energy, act as sediment sinks, wood sinks, and often result in multithreaded channels. As discussed in the Section 3.1 Hydrology and River Geomorphology above, the loss of peak flows can lead to decreased overbank flow, reduced nutrient exchange between the channel and floodplain, prevention of groundwater recharge, and limitation of water resources to sustain extensive riparian communities. Flow regulation on the Strawberry River has resulted in severely degraded riparian areas, especially with respect to cottonwoods, whose specific life history makes them particularly susceptible to alterations in the flow regime, and in part due to lack of germination substrate, i.e., moist, bare alluvial sands and gravel (Glisson, 2000).

Reaches of the mainstem of the Strawberry River above Beaver Canyon (miles 0-1.2) generally have steep gradients and narrow valley bottom widths. ELR determined that the Strawberry River at this location is confined in a canyon without much floodplain except in patches where the active channel is not as wide as the valley bottom. Floodplains in this area might be more heavily vegetated due to the lack of annual or biannual scouring flows (Glisson, 2000). Reaches 3 and 4 of the Strawberry River below Beaver Canyon have wide floodplains. They are considered discontinuous because the channel meanders from one side of the canyon to the other, effectively eliminating continuous floodplains on both sides of the channel. Channel – Floodplain connectivity in these lower reaches of the Strawberry River is variable (**Appendix A**).

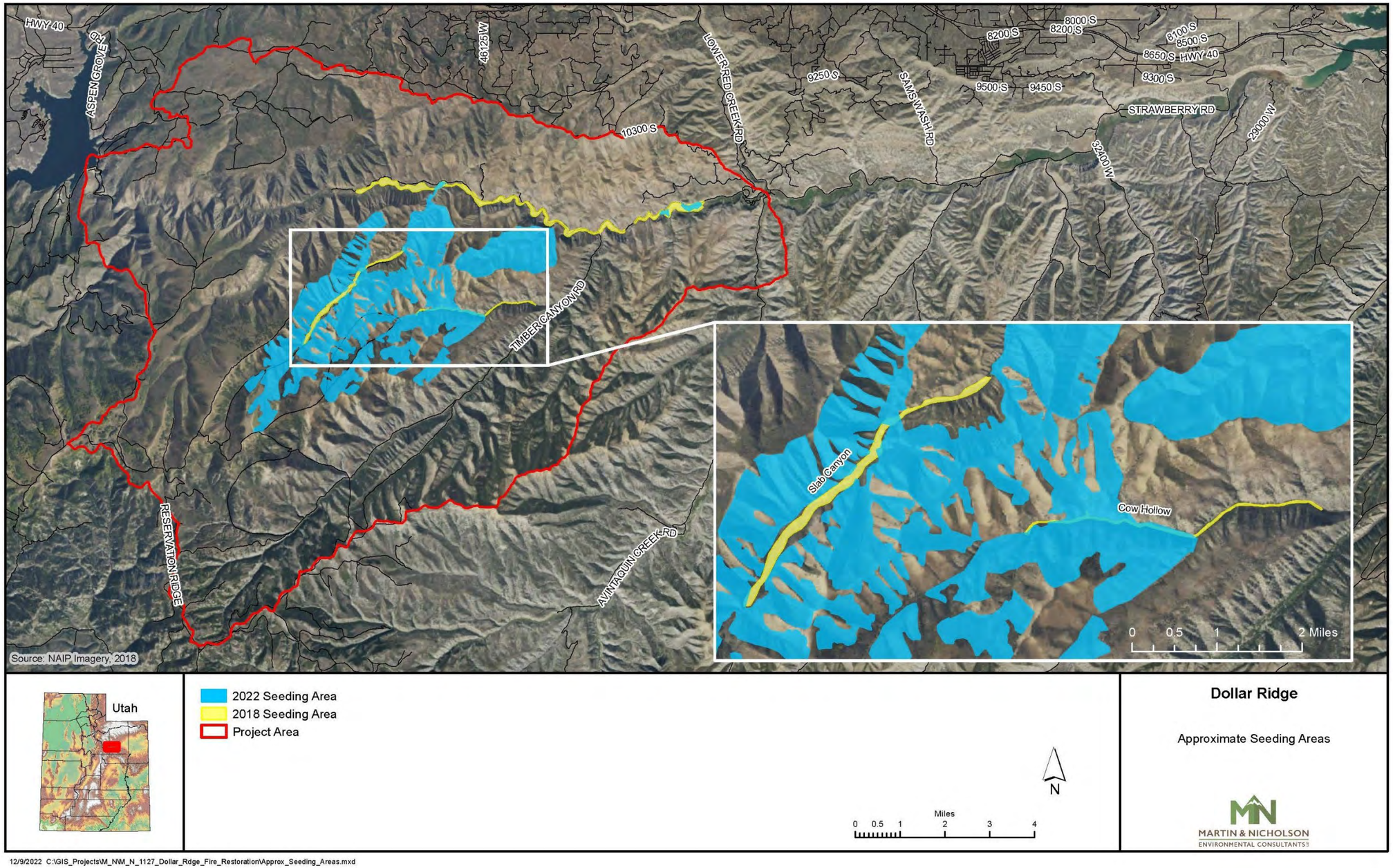

Figure 11. Riparian Areas seeded in 2018 and 2022 (T. Mathis, personal communication, 12/07/2022).

3.4.2 Direct, Indirect, and Cumulative Effects

3.4.2.1 No Action Alternative

Under the No Action Alternative, the current management of riparian areas, wetlands, and floodplains in the Project Area would continue. Approximately 500 to 600 acres along the Strawberry River corridor are currently spot treated with herbicides each year, and this would continue as part of the No Action Alternative. Planting and seeding would continue to take place, as necessary, on areas within the approximately 150 acres of the riparian zone of the Project Area each year. The effects of weed treatment and riparian planting and seeding are the same as discussed in the Riparian Plantings and Vegetation Management sections above. Past actions on the river to improve roads/access and protect infrastructure resulted in some adverse effects on riparian corridors and associated floodplains and wetlands by limiting the water supply currently reaching riparian areas due to the construction of levees and associated impacts on floodplain connectivity.

Photo 17. Riprap currently located along the Strawberry River Road.

3.4.2.2 Proposed Action

There are approximately 18.6 miles (30 km) of the Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles that are being considered for various treatments as part of the Proposed Action. There are several locations along the Strawberry River that were previously irrigated, as recently as 2018, and as such have existing irrigation infrastructure or ditches that can be used or reestablished to

support riparian vegetation across the valley bottom. There are also existing water rights in the area that could be used to create new water sources for riparian restoration. The Activity Cards and associated actions that could affect riparian areas, wetlands, and floodplains are provided in **Appendix B.**

Vegetation Management Activities

As described in the Vegetation Management Activity Card, noxious weeds and other invasive species (weeds) would be reduced via mechanical and/or approved chemical methods in riparian areas and associated wetlands and floodplains where a higher percentage of weeds have been identified or the area is not returning to a native plant community naturally (see **Activity Cards-Appendix B**). Any weeds identified during other Activity Card actions taking place in riparian areas, wetlands, or floodplains would be treated either chemically or mechanically. Up to 18.6 miles (30 km) of the Strawberry River riparian corridor (100 % of the area considered for restoration) would be seeded with native vegetation and treated for weed infestations.

The beneficial effect of weed removal is to allow for germination of native plant species, which would increase the abundance and diversity of native vegetation in the Project Area. Areas treated for weeds would be monitored annually and re-treated as necessary. Cumulative effects of vegetation management on riparian areas, wetlands, and floodplains in the Project Area include the annual chemical and manual treatment of weeds in the riparian areas along the Strawberry River by UDWR. Chemical and mechanical weed treatment is likely to have occurred and will continue to occur on private property in and adjacent to the Project Area. The cumulative effects of past, present, and future weed removal in and adjacent to the Project Area would be beneficial and include a larger area where native plant species will be able to germinate as well as a decreased likelihood of weeds spreading into the Project Area from adjacent areas.

Road/Stream Crossing Improvements

There are currently three culvert-improvement projects planned in Timber Canyon and one in Pine Hollow (**Figure 3**). This action includes the installation of concrete, road base, road fill, boulders, and culverts using heavy equipment. Heavy equipment would be cleaned prior to entering the Project Area to reduce the potential for spreading weed seeds through the riparian corridor. Trash racks or similar devices that prevent debris from clogging the culvert inlet would be installed in stream crossings that have a high potential for delivering debris to the crossing.

The ground disturbance associated with the use of heavy equipment and the installation of boulders and culverts could have adverse effects on riparian corridors and associated wetlands and floodplains due to the potential for weed spread. The installation of trash racks would mitigate the negative effects associated with a clogged culvert inadvertently diverting water from riparian floodplains and wetlands. The cumulative effects of implementing the proposed road/stream crossing improvement activities on riparian areas, wetlands, and floodplains would augment past actions to improve roads/access and protect infrastructure.

Channel Modification Activities

As part of the Proposed Action, channel modification would be used on sections of the Strawberry River where the main channel has been modified, straightened, or moved, and/or where the elevation of the floodplain is not too high above the main channel to render channel modifications infeasible. Also, channel modification would only be used in areas where the floodplain is wide enough to allow meandering channels, and LTPBR approaches are unlikely to create new side channels in the next 5-10 years (see **Activity Cards-Appendix B**).

A beneficial effect of increasing the length and area of side channels would be to create more riparian areas and associated wetlands and floodplains in the Project Area. The negative effects of ground disturbance and weed spread would be the same as those discussed in the Road/Stream Crossing and Improvements section, above. Cumulative effects of channel modification on riparian areas, wetlands, and floodplains in the Project Area included the installation of riprap bank armor, removal of sediment from channels (i.e., channel cleaning), riparian planting, and placement of in-stream features (e.g., rip-rap J-hooks). They also included stream crossing improvements including the addition of boulders, fill, and concrete to build/repair roads across the Strawberry River. The adverse effects of these past actions include disconnecting portions of the floodplain from the Strawberry River channel, which result in adverse effects on the health of riparian and wetland vegetation.

Floodplain Reconnection Activities

As part of the Proposed Action, levees that might be preventing high flows from reaching the floodplain would be removed from the Project Area. Levees that are in place to protect property would not be removed. As discussed in the Floodplain Reconnection Action Card section, additional conditions that would need to be present to trigger levee removal are the presence of a floodplain that the river could access during high flow events, and the presence of irrigation canals that could divert water onto the floodplain (see **Activity Cards-Appendix B**). The Proposed Action also includes the possible restoration of irrigation diversions and associated ditches located on floodplains along the Strawberry River. If UDWR is able to move the water rights associated with the damaged and destroyed irrigation diversions and associated ditches downstream, then the restoration of irrigation diversions and ditches would not take place (P. Rainbolt, UDWR, personal communication, July 6, 2022). The Proposed Action also includes the installation of large beaver dam analogs (BDAs) or post-assisted log structures in locations on the Strawberry River that meet the Floodplain Reconnection Activity Card conditions outlined above.
The removal of levees would have beneficial effects on floodplains and associated wetlands and riparian areas in the Project Area by restoring high flows, which increase nutrient exchange between the channel and floodplain, recharge groundwater, and provide water to help establish and maintain riparian plant communities (Glisson, 2000). The restoration of irrigation diversions and ditches and the installation of BDAs would allow water to get out of the river channel(s) and up onto the floodplain in areas with low connectivity, which would have the beneficial effect of providing a more consistent and plentiful water supply to riparian areas and associated wetlands and floodplains. The negative effects of ground disturbance and weed spread associated with floodplain reconnection would be the same as those discussed in the Vegetation Management section above. The cumulative effects of floodplain reconnection activities on riparian areas, wetlands, and floodplains in the Project Area would be the same as those discussed in the Channel Modification section above.

Riparian Planting Activities

As part of the Proposed Action, up to 1.4 miles (2.25 km) of riparian habitat along the Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles (8 % of riparian habitat defined for treatment) would receive riparian plantings. As described in the Riparian Planting Activity Card (see A**ppendix B**), planting would take place in areas where existing riparian vegetation density is low because of high tree mortality due to fire or other reasons, and a water source is easily accessible (e.g., irrigation, high water table). Riparian plantings should be coordinated with other restoration actions to ensure that plantings have access to sufficient water resources. In non-irrigated areas, survival of plantings can be increased by drilling holes deep enough to access the water table.

The beneficial effect of riparian planting is to increase the diversity and abundance of native plant species in the Project Area. An adverse effect of riparian and wetland planting and seeding is the potential establishment of noxious weeds and other introduced and/or invasive plant species inadvertently brought into the Project Area on equipment used during restoration. Restoration activities have the potential to be ground disturbing, which can result in disturbed soils where weed seeds can readily germinate (Bainbridge, 2007). This effect would be mitigated through monitoring and treatment of weeds (including reseeding) in restoration areas. Cumulative effects of riparian planting on riparian areas, wetlands, and floodplains in the Project Area include past restoration associated with the EWP Program. In 2020-2022, native willows were planted in various locations along the Strawberry River in the Project Area.

3.5 Upland Vegetation

3.5.1 Affected Environment

LANDFIRE was used to determine the distribution and extent of each plant community in the Project Area. The acres of each plant community provided by LANDFIRE are only estimates. Ground-truthing would be required prior to determining precise restoration locations (See map in Appendix A). There are an estimated 16,758 acres of Pinyon-Juniper, 3,333 acres of Mountain Shrubland, 16,858 acres of Sagebrush, 2,829 acres of Grassland, 834 acres of Riparian, 2,109 acres of Cliff/bedrock, and 457 acres of developed land in the Project Area. The areas burned in the Dollar Ridge Fire that would most benefit from restoration activities (Priority Treatment Areas in **Figure 2**) are part of the Mixed Conifer plant community described below. Following the Dollar Ridge Fire in 2018, approximately 10,704 acres of upland within the Project Area were reseeded. In November 2022, an additional 6,210 acres were reseeded with a primarily native grass mix (see **Figure 12** below).

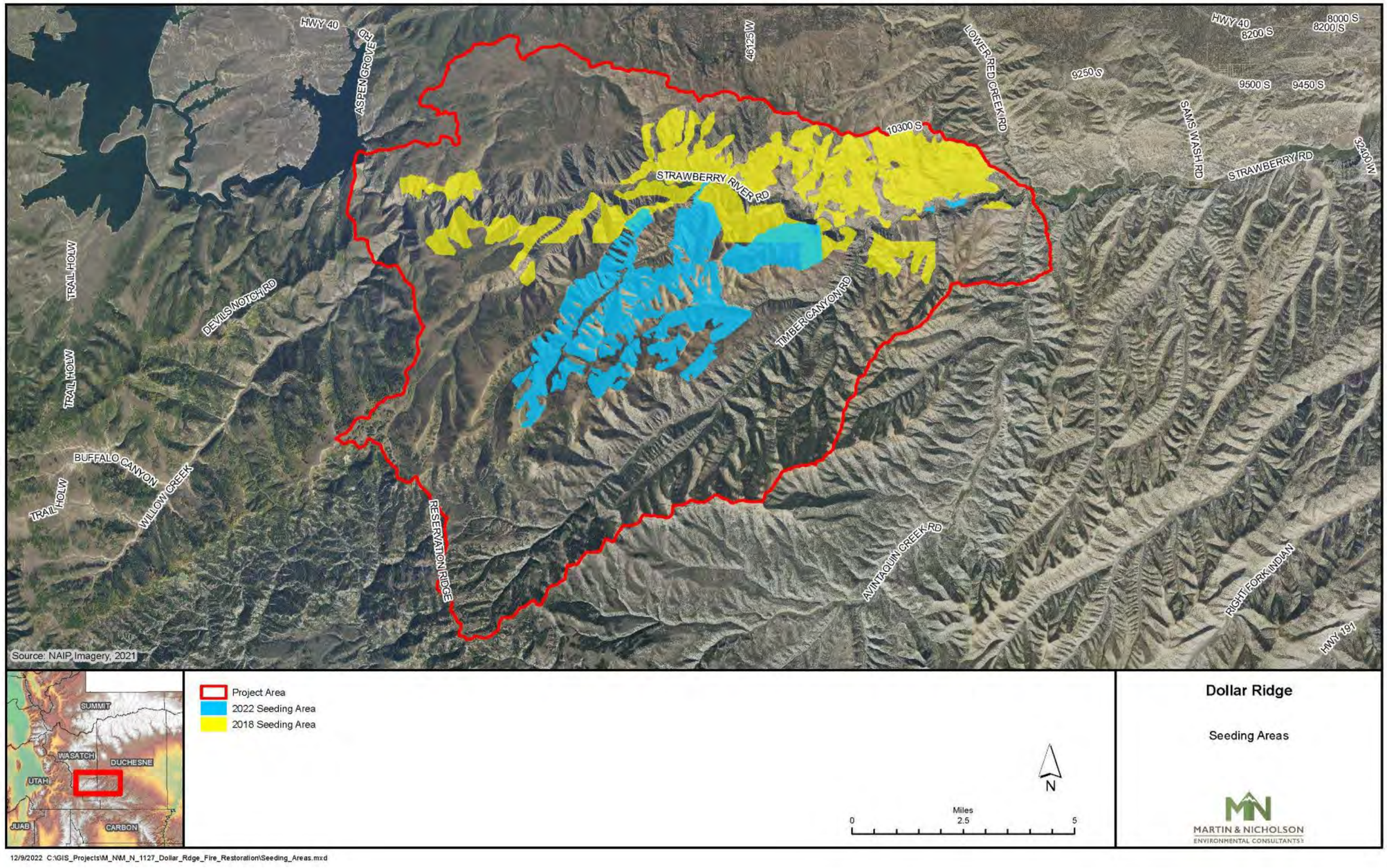

Figure 12. Upland areas seeded in 2018 and 2022

3.5.1.1 Mixed Conifer/Aspen

This plant community combines the Spruce-fir, Mesic Mixed Conifer, Dry Mixed Conifer, and Ponderosa Pine, and Aspen vegetation types described in the Dollar Ridge Fire Restoration Plan (Appendix A). Upland vegetation treatments would occur on approximately 6,846 acres or 20 percent of the approximately 33,932 acres of this plant community in the Project Area. The north-facing slopes of the Project Area are dominated by Douglas fir (*Pseudotsuga menziesii*) and blue spruce (*Picea pungens*) forest. Some areas previously dominated by conifers were severely impacted by the 2018 Dollar Ridge fire and will likely be grass- and shrub- or aspen- (*Populus tremuloides*) dominated communities, interspersed with pockets of unburned conifers, for years to come (UDWR, 2021).

3.5.1.2 Pinyon-Juniper

Upland vegetation treatments would occur in this plant community if determined to be necessary during on-the-ground restoration site selection in the Project Area. The dominant overstory species are two-needle pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Understory species include Phlox sp.), sulphurflower buckwheat (*Eriogonum umbellatum*), and Indian ricegrass (*Achnatherum hymenoides*). Prior to the Dollar Ridge Fire, pinyon-juniper woodlands dominated the drier slopes with western and southern aspects in the Project Area (UDWR, 2021).

3.5.1.3 Mountain Shrubland

Upland vegetation treatments would occur in this plant community if determined to be necessary during on-the-ground restoration site selection in the Project Area. It combines the Shrubland and Maple vegetation types listed in Table 9 of the *Dollar Ridge Fire Post-Fire Upper Watershed Hazard Analysis & Recommendations* (JW Associates, 2022). Gambel oak (*Quercus gambelii*) communities in the Strawberry River WMA are small and localized. Other shrub species, such as Saskatoon serviceberry (*Amelanchier alnifolia*), antelope bitterbrush (*Purshia tridentata*), and curl leaf mountain mahogany (*Cercocarpus ledifolius*) are scattered throughout the area. Mountain shrubland communities appear to be recovering relatively quickly following the Dollar Ridge fire of 2018 (UDWR, 2021).

3.5.1.4 Sagebrush

Upland vegetation treatments would occur in this plant community if determined to be necessary during on-the-ground restoration site selection in the Project Area. Upland areas of the Strawberry River WMA are dominated by sagebrush (*Artemesia tridentata*) (UDWR, 2021).

3.5.1.5 Grassland

Upland vegetation treatments would occur in this plant community if determined to be necessary during on-the-ground restoration site selection in the Project Area. Native grass species identified in the Project Area include Indian ricegrass, wild rye (*Elymus* sp.), cheatgrass (*Bromus tectorum*), and bluegrass (*Poa* sp.).

3.5.1.6 Forest Service Sensitive and Federally Listed Plants

The area between the Promised Land Resort and Timber Canyon was part of the 2020-2021 Duchesne County Dollar Ridge EWP project. After conducting an on-site visit in November 2019, USFWS determined that no Ute ladies'-tresses (ULT) surveys would be required and that there would be no effect to ULT by implementing the Duchesne County Dollar Ridge EWP project (Rita Reisor, USFWS, Personal Communication, November 21, 2019). For the Wasatch County EWP project (the Dollar Ridge Project Area upstream of Timber Canyon), USFWS determined that ULT surveys would be required (Wyatt Shakespear, Jones and DeMille Engineering, Personal Communication, November 23, 2022). There were no UTL individuals found during any of the three years of surveys conducted in this section of the Project Area (Western-Enviro Resources, Inc., 2020). The potential for federally listed and forest service plants to occur in the Project Area are discussed in **Table 10** below.

Table 10. Status of Federally Listed and Forest Service Sensitive Plants in the Project Area

Species	Status	Description of Suitable Habitat*	Potential to Occur in the Project Area
Ute ladies'-tresses *Spiranthes diluvialis*	Federally Listed Threatened	Wet meadows, stream banks, abandoned oxbow meanders from 4,300 to 7,000 feet elevation. Blooms from July through early October.	None. No individuals were found during surveys conducted in 2020, 2021, and 2022.
Wavy Moonwort** *Botrychium crenalutam*	FS Sensitive Species	Marsh or spring areas, around 8,000 feet elevation. Wet Meadow. Fronds mature June-July.	Very Low
Purple Slipper** *Cypripedium fasciculatum*	FS Sensitive Species	Duff in spruce-fir or lodgepole pine forests and along shaded streams between 8,000-9,000 feet elevation. June-July	Very Low
Untermann Daisy** *Erigeron untermanii*	FS Sensitive Species	Pinyon-juniper, mountain mahogany, limber and bristlecone pine, and sagebrush communities on calcareous shales & sandstone between 7,000-9,400 feet. May-July	Low

* (Utah Naitve Plant Society, 2022)

**ALLEN HUBER, USFS, PERSONAL COMMUNICATION, NOVEMBER 28, 2022

3.5.2 Direct, Indirect, and Cumulative Effects

3.5.2.1 No Action Alternative

Under the No Action Alternative, current vegetation management activities would continue in upland and riparian areas. Going forward, this will include annual spot treatment of weeds on Forest Service land and lands managed by UDWR (approximately 630 acres/year). Additional willow plantings along the Strawberry River are also expected under the No Action Alternative. In November 2022, aerial reseeding of 6,617 upland acres occurred in the areas shown on **Figure 12**. There is also the possibility of UDWR opening up wood-cutting permits in the future along the south-facing slopes along the Strawberry River near the mouth of Slab Canyon.

Adverse effects on upland vegetation in the Project Area under the No Action Alternative would be a reduction in native plant diversity and cover on hillslopes resulting from erosion and the continued spread of invasive plant species associated with insufficient weed control and lack of monitoring.

3.5.2.2 Proposed Action

Up to 6,846 acres of upland vegetation (9 percent) of the 77,047-acre Project Area would be considered for various treatments as part of the Proposed Action. As discussed in **Appendix A**, forested areas with burned, unhealthy or standing dead vegetation would be chosen for upland vegetation treatments. Treatments are summarized in Chapter 2 and discussed in detail in **Appendix A** and would include hillslope cover treatments (i.e., mulching), aerial- and ground-based seeding with native species, directional tree felling to stabilize gully sediment, LEBs or straw wattles to mitigate hillslope erosion, tree planting, temporary fencing (i.e., exclosures) to protect some plantings (e.g., aspen), and physical and chemical weed treatments and monitoring. The activity cards and associated actions that could affect upland vegetation are provided in **Appendix B**.

Soil/Hillslope Erosion Reduction

As part of the Proposed Action, bare soils on areas that were identified as upper watershed treatment areas would be considered for Soil/Hillslope Erosion Reduction activities (See **Appendix B**). These activities include applying mulch on bare soils, placing LEBs perpendicular to the slope, and seeding with native plant species.

An effect of reducing hillslope erosion is the establishment of native plant species resulting from the reduced soil loss on slopes. Potential negative effects associated with erosion reduction activities would be associated with ground-disturbing activities and are the same as those discussed in the Gully Stabilization section below. The cumulative effects of seeding burned slopes when combined with proposed erosion reduction activities, include the reduction in erosion-related soil loss on slopes, which should further reduce the number of gullies formed in the burned area.

Gully Stabilization

As described in the Gully Stabilization Activity Card (**Appendix B**), gullies and other eroding areas with bare soils on areas that were identified as upper watershed treatment areas would be considered for

gully stabilization activities which include directional tree felling, the installation of grade control structures and straw wattles.

A beneficial effect of gully stabilization on upland vegetation is the establishment of native plant species resulting from the reduced erosion-related soil loss on slopes. A possible adverse effect is the potential for establishment of noxious weeds and other introduced and/or invasive plant species inadvertently brought into the Project Area on heavy equipment used during the restoration activities. Restoration activities are ground-disturbing, which can result in disturbed soils where weed seeds can readily germinate (Bainbridge, 2007). This effect would be mitigated through monitoring and treatment of weeds in restoration areas (**Appendix A**).

Following the 2018 Dollar Ridge fire, approximately 10,706 acres of the northern section of the Project Area were seeded to stabilize the slopes. An additional 2,517 acres adjacent to and upslope of the Project Area were also seeded at that time. Cumulative effects of Gully Stabilization activities on upland vegetation in the Project Area also would be the same as those discussed in the Slope/Hillslope Erosion Reduction section above.

Vegetation Management

As described in the Vegetation Management Activity Card (**Appendix B**), vegetation management activities would occur on areas that were identified as upland watershed treatment areas that have a higher percentage of weed cover or have been identified as areas that are not returning to a native plant community naturally. Vegetation management activities include chemical or mechanical weed treatment followed by monitoring until control is achieved, broadcast seeding with native species, planting woody species seedlings, constructing exclosures, and mulching.

The effects of weed removal, seeding with native species, and planting woody species seedlings is to allow for germination of native plant species, which would increase the abundance and diversity of native vegetation in the Project Area. Potential adverse effects of vegetation management could occur in conjunction with those activities that involve ground disturbance. These effects are described in the Gully Stabilization section above.

Current and past management activities on Forest Service land, lands managed by UDWR, and private lands include the annual chemical treatment of upland vegetation for weeds in the Project Area. The cumulative effects of past, present, and future weed removal in and adjacent to the Project Area include a larger area where native plant species will be able to germinate and the decreased likelihood of weeds spreading into the Project Area from adjacent areas.

3.6 Wildlife

3.6.1 Affected Environment

There are an estimated 16,758 acres of Pinyon-Juniper, 3,333 acres of Mountain Shrubland, 16,858 acres of Sagebrush, 2,829 acres of Grassland, 834 acres of Riparian/wetland, 2,109 acres of Cliff/bedrock, and 457 acres of developed land in the Project Area. The areas burned in the Dollar Ridge Fire that would most benefit from restoration activities (Priority Treatment Areas in **Figure 2**) are part of

the Mixed Conifer and Riparian plant communities. Restoration activities associated with the Proposed Action would occur primarily in Mixed Conifer and Riparian/wetland habitats. Since there are often small patches of one habitat type located within another (i.e., a small patch of grassland within a forested area), it is likely that proposed reseeding activities may extend beyond fringes of target habitat. Therefore, wildlife species associated with all identified habitat types are considered in this section. section.

3.6.1.1 Federally Listed Threatened, Endangered, and Candidate Wildlife Species

The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) web site was used to identify Endangered Species Act (ESA) listed threatened, endangered, and candidate wildlife species that have potential to occur within the Project Area. These species are listed in **Table 11** (U.S. Fish and Wildlife Service, 2022). Threatened, endangered, and candidate fish species are discussed in Section 3.7 Fisheries.

Table 11. Federally Listed Species Listed on IPAC

Species	Status*	General Habitat Characteristics and Range in Utah**	Potential to Occur or be Affected by Alternative Action***
Mammals			
Canada Lynx (*Lynx canadensis)*	T	Boreal or subalpine and montane coniferous and mixed forests with thick developing understory. Utilizes caves, rock crevices, banks, and logs for denning. Limited by abundance of snowshoe hare.	None. Suitable habitat and necessary abundance of prey are not present in the Project Area.
North American Wolverine (*Gulo gulo)*	P	Alpine and arctic tundra and contiguous boreal and montane coniferous forest with winter snow cover. Riparian areas provide important winter habitat. Dens and births in caves, rock crevices, in and beneath fallen logs, and in thickets. The southernmost occurrence of this species in Utah was documented in the Uinta Mountains.	Low. The Project Area provides extensive winter riparian habitat and limited contiguous montane coniferous forest habitat. No occurrences of this species are known in or near the Project Area.

Species	Status*	General Habitat Characteristics and Range in Utah**	Potential to Occur or be Affected by Alternative Action***
Birds			
Yellow-billed Cuckoo (*Coccyzus americanus)*	T	Breeding and nesting habitat comprises patches of multi-layered woody riparian habitat at least 12 acres in size (including a minimum 328 ft x 328 ft area of such habitat) with a canopy of riparian trees such as cottonwood and willow and at least one layer of understory shrubby vegetation.	None. Suitable breeding and nesting habitat is absent from the Project Area.
Mexican Spotted Owl (*Strix occidentalis lucida)*	T	Roosts and breeds in in mature, uneven-aged, multi-storied, complex forests with high canopy cover or in steep, forested rock canyon habitats. Nests in large coniferous trees, cliff ledges, or in tree cavities.	None. Suitable habitat is not present in the Project Area.
Insects			
Monarch Butterfly (*Danaus plexippus)*	C	Breeds in all patches of milkweed (Asclepias spp.) throughout North America, being dependent in their larval stage upon their nectar-rich flowers for survival. Early in the season before milkweeds blossom, Monarchs visit a variety of nectar-rich flowering plants, such as dogbane (Apcynum spp.), lilac (Syringa spp.), red clover (Trifolium pratense), lantana spp., and thistles.	Moderate. Suitable breeding habitat in the form of milkweed patches may occur in the bottom of Timber Canyon near its confluence with Strawberry River (river miles 15.1 – 15.2 or river km 24.5 - 24.6).

* Status: E = Federally listed Endangered; T = Federally listed Threatened; P = Proposed for Federal listing; C = Candidate for Federal listing

**Sources: (NatureServe, 2022), (Utah Division of Wildlife Resources, 2019), (USFWS, 2017) (U.S. Fish and Wildlife Service, 2022)

***Sources: Kristy Groves, USFS, Personal Communication, June 29, 2022

3.6.1.2 Migratory Birds

The USFWS IPaC web site was used to identify migratory Bird species of Conservation Concern (BCC) that have potential to occur in the Project Area. BCC species are those whose populations or habitats appear to be under threat, but for which no regulatory protection is yet offered beyond that of the Migratory Bird Treaty Act (MBTA). These species are listed in **Table 12** (U.S. Fish and Wildlife Service, 2022)**.**

Table 12. Migratory Bird Species of Conservation Concern with Potential to Occur in the Project Area

Species	Breeding Season*	General Habitat Characteristics and Range in Utah**	Potential to Occur and/or be Affected by Proposed Action***
Cassin's Finch *Haemorhus cassinii*	May 15 – July 15	Breeds in open coniferous forests where it nests in conifer limbs. During winter and migration, occurs in deciduous woodland, second growth forest, and scrub or brushy areas.	High Suitable coniferous breeding and nesting habitat is found throughout upper elevations of the Project Area.
Clark's Grebe *Aechmophorus clarkii*	June 1 – Aug 1	Inhabits aquatic and wetland habitats such as marshes, lakes, estuaries, bays, and less commonly along seacoasts. Nests in tall emergent vegetation on large inland bodies of water, typically in or near deep water.	Low Small patches of suitable marsh, lake, and emergent vegetation breeding habitat is present in the Project Area, specifically along the Strawberry River valley bottom. This species commonly utilizes Strawberry Reservoir, which is adjacent to the west of the Project Area.
Clark's Nutcracker *Nucrifraga columbiana*	Jan 15 – July 15	Occurs in open coniferous forest, forest edges, and clearings, primarily in mountains. Nests in conifer limbs at elevations between 5,900-8,200 feet AMSL.	High Suitable montane forest breeding and nesting habitat is present throughout the Project Area.
Evening Grosbeak *Coccothraustes vespertinus*	May 15 – Aug 10	Breeds primarily in spruce and fir forests. Uses a variety of forest and woodland habitats during migration and in winter, including deciduous and second growth woodland, parks, and areas near human habitation. Nests in dense foliage of tree.	High Suitable oak woodland breeding and nesting habitat is present throughout the Project Area.
Lesser Yellowlegs *Tringa flavipes*	Breeds Elsewhere	Inhabits marshes, ponds, wet meadows, lakes, coastal salinas, and mudflats. Nests in muskeg country to the edge of tundra, in marshes or bogs, in forest clearings, or burned areas in black spruce forests.	Low This species breeds elsewhere. It may occur in riparian areas in the Project Area on a transitory basis during migration.
Olive-sided Flycatcher *Contopus cooperi*	May 20 – Aug 31	Breeds in coniferous and mixed woodland and forest habitats, especially where there are standing dead trees. Nests in trees, commonly near bogs, marshes, and wet meadows which provide an abundance of flying insects.	High Suitable woodland breeding and nesting habitat is present throughout the Project Area.

Species	Breeding Season*	General Habitat Characteristics and Range in Utah**	Potential to Occur and/or be Affected by Proposed Action***
Pinyon Jay *Gymnorhinus cyanocephalus*	Feb 15 – July 15	Year-round inhabitant of pinyon-juniper woodlands less frequently inhabits pine or scrub oak forests and sagebrush steppe. Nests in shrubs or trees.	Moderate Prior to the 2018 Dollar Ridge Fire, pinyon-juniper woodlands were dominant along the canyon walls and rim of the Project Area. Patches of suitable breeding and nesting habitat is still present throughout the Project Area.
Virginia's Warbler *Leitohylpis virginiae*	May 1 – July 31	Arid montane woodlands, oak thickets, pinyon-juniper, coniferous scrub, chaparral, steep brushy mountain slopes near dry coniferous woodlands, and ravines or rocky slopes with dense scrub oak or mountain mahogany overstory. Nests on ground among dead leaves, or in small depression concealed by bark, moss, lichens, grasses, or roots.	High Suitable breeding and nesting woodland and shrub habitats are present throughout the Project Area.
Western Grebe *Aechmophorus occidentalis*	June 1 – Aug 31	Breeds in marshes, lakes, and bays. In migration and winter, frequents sheltered seacoasts and sometimes rivers. Colonial nester on large inland bodies of water, where nests are anchored to or built over living vegetation in or close to water deep enough to allow this species to swim submerged.	Low Small patches of suitable marsh, lake, and emergent vegetation breeding habitat is present in the Project Area, specifically along the Strawberry River valley bottom. This species commonly utilizes Strawberry Reservoir, which is adjacent to the west of the Project Area.

*Status: E = Federally listed Endangered; T = Federally listed Threatened; P = Proposed for Federal listing; C = Candidate for Federal listing

**Sources: (NatureServe, 2022), (Utah Division of Wildlife Resources, 2019), (USFWS, 2017)

***Sources: Kristy Groves, USFS, Personal Communication, June 29, 2022, (eBird, 2022)

In addition to those BCC species identified in the USFWS IPaC report, multiple species of migratory passerines protected under the MBTA likely nest in and utilize habitats located in the Project Area throughout the year.

3.6.1.3 U.S. Forest Service Region 4 Sensitive Wildlife Species

The National Forest Management Act requires that land management plans provide for a diversity of plant and animal communities based on the suitability and capability of the specific land area to meet

overall multiple-use objectives. One aspect of this responsibility is met through the USFS Region 4 (Intermountain Region) Regional Forester's identification of Threatened, Endangered, Proposed, and Sensitive (hereafter "Forest Sensitive") wildlife species whose long-term persistence may be at risk. Such wildlife species with potential to occur in the Project Area or be affected by the Proposed Action are discussed below. As noted in Section 3.6.1 above, restoration activities associated with the Proposed Action would only occur in Mixed Conifer and Riparian/Wetland habitats. Therefore, only species using these habitat types are considered in this section. Forest Sensitive wildlife species associated with other habitat types located in the Project Area, such as greater sage-grouse, Townsend's big-eared bat, pygmy rabbit, and peregrine falcon, are excluded from further analysis. Forest Sensitive fish species are discussed in Section 3.7 Fisheries.

Mixed Conifer and Aspen Habitat Species – Bald Eagle, Northern Goshawk, Three-toed Woodpecker, Flammulated Owl

Mixed conifer and aspen habitats were the dominant upland vegetation cover types in the Project Area prior to the 2018 Dollar Ridge Fire, and account for approximately 6,846 acres of upland vegetation proposed for various treatments in the Project Area. These habitats were some of the most severely impacted by the fire and those that burned will likely exist as grass- and shrub-dominated communities for years to come (Utah Division of Wildlife Resources, 2021). Consequently, the following Forest Sensitive wildlife species were those most affected by the Dollar Ridge Fire and would be most affected by the Proposed Action and No Action Alternative.

Bald eagles (*Haliaeetus leucocephalus*) are highly associated with and build nests in trees and cliffs adjacent to lakes, reservoirs, and rivers that provide quality foraging habitat. Wintering bald eagles frequently utilize the Project Area, though no nesting is known to occur here (Utah Division of Wildlife Resources, 2021). A large debris flow from Slab Canyon following the 2018 Dollar Ridge Fire dammed the Strawberry River and created a natural perennial lake known as Slab Lake at river miles 9.6 – 10.2 (river km 15.5 – 16.5), which provides potential seasonal foraging habitat for bald eagles and may in turn attract future nesting.

Northern goshawks (*Accipiter gentilis*) utilize mixed-conifer and aspen forest habitats with high, dense canopies over sparse groundcover to forage, nesting in large coniferous trees, commonly adjacent to aspen groves. Nesting territories for a single breeding pair ranges from 235 acres to 8,650 acres depending on habitat quality (NatureServe, 2022). Currently, a single inactive nesting territory is known to be present along Long Ridge in the upper ranges of Timber Canyon, though suitable habitat unaffected by the fire is present throughout the upper elevations of the Project Area to the south of Strawberry River (Groves, 2022).

The American three-toed woodpecker (*Picoides dorsalis*) is associated with mature or old-growth coniferous forests with an abundance of insect-infested snags or dying trees and in the western U.S. is often associated with recently burned habitats (Tremblay, Leonard Jr., & Imbeau, 2020). They forage for wood-boring insects in scaly-barked tree species such as Engelmann spruce and lodgepole pine and have been documented foraging for bark beetle larvae on moderately burnt spruces in and immediately under the bark (Utah Division of Wildlife Resources, 2019). Cavity nests are constructed in standing snags of dead conifer and aspen trees. Though a sizeable acreage of potentially suitable habitat was

reduced by the fire, nesting and foraging habitat was likely created by the fire in less severely burned areas of the Project Area. Extensive areas of potentially suitable nesting and foraging habitat is present in Willow Creek Canyon and upper Beaver, Slab, and Timber Canyons, much of which is located outside of proposed treatment areas within the Project Area.

Flammulated owls (*Psiloscops flammeolus*) inhabit mature montane stands of dry mixed-coniferous forests with scattered thickets of saplings or shrubs and relatively open canopies, especially ponderosa pine and Jeffrey pine, though aspen and mixed spruce-fir forests provide suitable local habitat. Nests are built in abandoned tree cavities of large conifer or aspen trees (Utah Division of Wildlife Resources, 2019). Declines in the extent of mature conifer forest due to historical timber harvest and fire in the Project Area, such as the 2018 Dollar Ridge Fire, may have had a detrimental effect on local population numbers, though suitable aspen forest habitat remains present at upper elevations and limited canyon bottoms.

As many Forest Sensitive wildlife species overlap with Utah State Species of Greatest Conservation Need (SGCN) identified in the Utah Wildlife Action Plan, species described above are not further analyzed in the SGCN section below.

Riparian Habitat Species – Boreal Toad, Columbia Spotted Frog, Spotted Bat, Monarch Butterfly

The Forest Sensitive species analyzed in this section are grouped together because they are all regularly dependent on riparian habitats and associated vegetation (e.g., stream banks, ponds, lakes, wetlands). Elements of the Proposed Action and/or No Action Alternative with potential to affect these habitats may, in turn, affect these species.

Boreal toads (*Anaxyrus boreas*) and Columbia spotted frogs (*Rana luteiventris*) inhabit slow moving or stagnant waters often found in or near historic or active beaver ponds, lakes or ponds with emergent vegetation, and moist upland areas. Primary threats to toads and frogs are loss and degradation of aquatic and riparian habitat associated with urban expansion, climate-change-induced water withdrawal, pollution and diminished water quality, livestock use, and non-native predator introduction to breeding areas (Utah Division of Wildlife Resources, 2022). No known populations of either species are known to occur in the Project Area, but suitable riparian habitat required by each species is found throughout the 627.7-acre Strawberry River valley bottom.

The spotted bat (*Euderma maculatum*) roosts and hibernates in cracks and crevices of cliffs or in caves, most commonly in deep, narrow, rocky canyons bounded by precipitous cliff faces similar to those found in Timber Canyon, Cow Hollow, and along the upper Strawberry River canyon and Strawberry Pinnacles. This species forages in various open habitats, including forest clearings, meadows, and open wetland and riparian habitats (Utah Division of Wildlife Resources, 2019).

Monarch butterflies (*Danaus plexippus*) breed in all patches of milkweed (*Asclepias* spp.) throughout North America, being dependent in their larval stage upon their nectar-rich flowers for survival. Early in the season before milkweeds blossom, Monarchs visit a variety of nectar-rich flowering plants, such as dogbane (*Apcynum* spp.), lilac (Syringa spp.), red clover (*Trifolium pratense*), *lantana* spp., and thistles (NatureServe, 2022). Patches of milkweed providing suitable breeding habitat for the monarch may

occur in the bottom of Timber Canyon near its confluence with Strawberry River (river miles 14.6 – 15.2 or river km 23.5 - 24.5) (Kristy Groves, USFS, Personal Communication, June 29, 2022).

Sagebrush and Mountain Shrubland Species – Townsend's Big-eared Bat, Greater Sage-grouse, Pygmy Rabbit

The Townsend's big-eared bat (*Corynhorinus townsendii*) occurs in various habitat types throughout Utah, but forages primarily in sagebrush steppe, pinyon-juniper woodlands, mountain shrub, and montane meadow and mixed coniferous and deciduous forests. This species does not move long distances between roosts sites, being dependent on local complexes of cave and mine roost sites. Highest population densities occur in areas where roosting complexes offer diverse, relatively isothermal roost conditions throughout the year, which are absent from the Project Area (Utah Division of Wildlife Resources, 2019).

Greater sage-grouse (*Centrocercus urophasianus*) occur in foothills, plains, and mountain slopes dominated by sagebrush. Lek sites are located on open areas such as ridges, landing stripes, knolls, or grassy swales near potential nesting habitat where female traffic is high. Nests are a ground depression beneath a sagebrush or other shrub (Utah Division of Wildlife Resources, 2019). Two active lek sites and approximately 7,629 acres, 8,027 acres, and 22,325 acres of UDWR-designated nesting/brooding, winter, and non-winter habitats are present on upland plateaus in the northern Project Area (Wildcat Wildlife Management Area), respectively (**Figure 13**). Following the Dollar Ridge Fire in 2018, approximately 10,704 acres of upland within the Project Area were reseeded, much of which occurred in designated greater sage-grouse habitat in the Wildcat WMA. According to the UDWR, the Dollar Ridge Fire did not attribute to any appreciable decline in local sage-grouse populations, and likely increased acreage of utilizable grassland and low shrubland habitats preferred by this species in the Project Area (Utah Division of Wildlife Resources, 2021). No future restoration activities are planned in UDWR-designated greater sage-grouse habitats under the Proposed Action.

Throughout northern and western Utah, the pygmy rabbit (*Brachylagus idahoensis*) occurs in dense stands of big sagebrush growing in deep, loose soils, sheltering in burrows beneath shrubs and feeding on sagebrush buds and grasses (Utah Division of Wildlife Resources, 2019). Though suitable upland sagebrush habitat is present throughout the Project Area, there are no known occurrences of this species there (Emilia Sopranzi, USFS, Personal Communication, November 03, 2022)

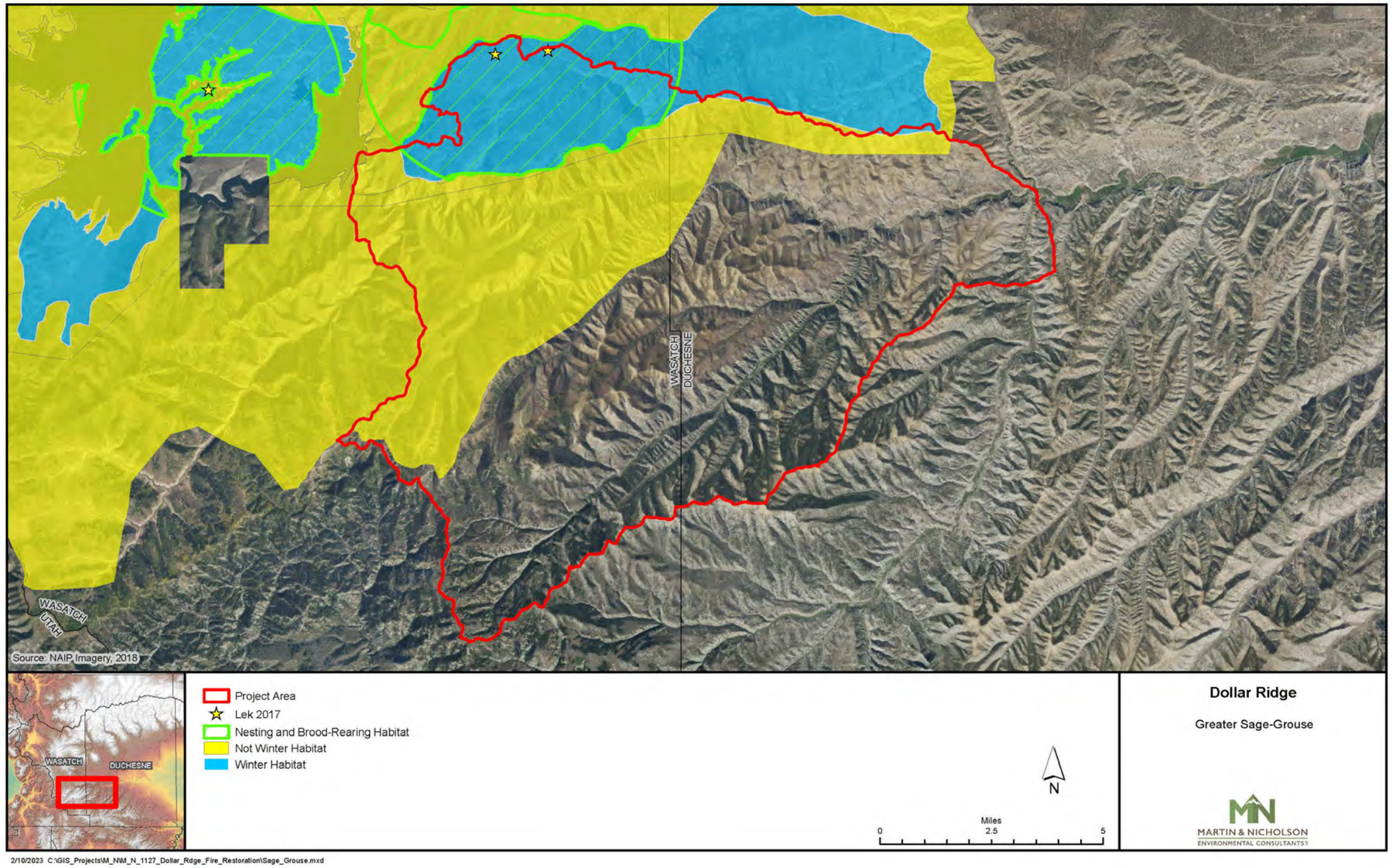

Figure 13. Locations of greater sage-grouse leks and habitat in and adjacent to the Project Area

Grassland and Rock or Barren Species – Peregrine Falcon, Rocky Mountain Bighorn Sheep

The following species are grouped together because they are found most commonly in open, rocky, steep terrain during the growing season or breeding season, though they spend much of their time foraging in various other habitats.

The peregrine falcon (*Falco peregrinus*) nests in holes on cliff faces, cliff ledges, bluffs, caves, and crags, often near open areas and water where prey is abundant. This species forages in various open habitats, primarily hunting passerines and waterfowl in flight (Utah Division of Wildlife Resources, 2019). Peregrine falcons nest in cliffs along Strawberry River near Timber Canyon (river mile 15, kilometer 24.5) (Utah Division of Wildlife Resources, 2021). Suitable cliff breeding habitat is found throughout the Eastern Project Area in Strawberry River Canyon and in Cow Hollow in Timber Canyon.

Key elements on suitable bighorn sheep (*Ovis canadensis*) habitat include steep, broken terrain and scree, which serve as escape cover, near vegetation types that provide high visibility and forage, such as grasslands, shrublands, and alpine tundra. This species spends most of the year at relatively higher elevations that provide these elements but migrate to lower valleys in the winter depending on snowpack and resource availability (Utah Division of Wildlife Resources, 2019). The Project Area contributes approximately 44,769 acres of yearlong Rocky Mountain bighorn sheep habitat, where it occurs in Timber Canyon and along steep, rugged terrain adjacent to Strawberry River. According to UDWR, the 2018 Dollar Ridge Fire has resulted in improvements to and increased acreage of viable year-long foraging habitat for this species throughout the Project Area (Utah Division of Wildlife Resources, 2021).

3.6.1.4 Utah Division of Wildlife Species of Greatest Conservation Need

The Utah Wildlife Action Plan (UWAP) has been created "to manage native wildlife species and their habitats, sufficient to prevent the need for additional listings under the Endangered Species Act." The State of Utah has identified several SGCN, which "do, or potentially could, present the possibility of an ESA listing.'" (Utah Wildlife Action Plan Joint Team, 2015). Up to 26 wildlife species listed under the UWAP could potentially occur, at least occasionally, within the Project Area. For many of these, very little is known about the species, and species-specific surveys have not been conducted in the Project Area. Of these 26 wildlife species, seven are known to occur in the Project Area, or to have occurred in the Project Area prior to the 2018 Dollar Ridge Fire (Utah Division of Wildlife Resources, 2021). The bald eagle and pinyon jay, Utah SGCN, are also Forest Sensitive species and Bird species of Conservation Concern and are discussed above. Three designated fish SGCN are discussed in Section 3.7 Fisheries. The remaining two species, the golden eagle and northern leopard frog, have potential to be impacted by the Proposed Action and/or No Action Alternative and are discussed below.

Riparian Habitat Species – Northern Leopard Frog

Northern leopard frogs (*Lithobates pipiens*) occur in the vicinity of permanent water with rooted emergent vegetation, such as springs, slow streams, marshes, bogs, floodplains, reservoirs, and lakes. Northern leopard frogs are known to exist along Strawberry River, but information regarding current presence in the Strawberry River WMA is limited (Utah Division of Wildlife Resources, 2021).

Additionally, this species has not been encountered during amphibian survey efforts conducted in suitable riparian and aquatic habitat in the Project Area's Ashley National Forest (Ronald Brunson, Personal Communication, November 4, 2022). Erosion events and efforts to rebuild the Strawberry River Road associated with the EWP Program following the Dollar Ridge fire severely impacted water quality and fish populations downstream and may have been detrimental to leopard frog density (Utah Division of Wildlife Resources, 2021).

Grassland, Sagebrush, and Rock or Barren Species – Golden Eagle

The golden eagle (*Aquila chrysaetos*) forages in various open and semi-open landscapes, including tundra, grasslands, shrub-steppe, mountain shrublands, and open forest habitats. Nests are constructed on cliffs and rock outcrops and rarely in trees. Golden eagles are consistently documented nesting at various locations throughout the Project Area, primarily in cliffs along Strawberry River Canyon, with suitable breeding habitat also located in Timber Canyon, Slab Canyon, and Cow Hollow (Utah Division of Wildlife Resources, 2021).

3.6.1.5 Utah State Key Wildlife Species

In addition to the species identified above, the Project Area provides important seasonal and crucial habitat for mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*), moose (*Ulces ulces*), and black bear (*Ursus americanus*). The entire Project Area is summer range for these species and contributes approximately 44,769 acres of yearlong Rocky Mountain bighorn sheep habitat, and 76,047, 77,015, and 32,152 acres of crucial black bear, elk and moose range, respectively. Other key wildlife species identified by the UDWR include the cougar (*Puma concolor*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), ringtail (*Bassariscus astutus*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), mink (*Neovison vison*), cottontail rabbit (*Sylvilagus* spp.), jackrabbit (*Lepus* spp.), dusky grouse (*Dendragapus obscurus*), wild turkey (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), and the occasional river otter (*Lontra canadensis*) (Utah Division of Wildlife Resources, 2021). For some of these wildlife species, such as mule deer, elk, and bighorn sheep, the Dollar Ridge Fire resulted in some habitat improvements, such as elevated forage value and rejuvenation of plant communities dependent on disturbance (Wyoming Game and Fish Department, 2004). For other species, there may have been significant losses of habitat. It is currently unknown what effects the fire had on population numbers for most of these species, but there has been no appreciable decline in mule deer or elk populations that can be attributed to the fire (Utah Division of Wildlife Resources, 2021).

3.6.2 Direct, Indirect, and Cumulative Effects

3.6.2.1 No Action Alternative

Under the No Action Alternative, the current management of riparian, riverine, and upland habitats and associated wildlife species would continue as at present. Wildlife within the Project Area and Strawberry River WMA would be surveyed and managed in accordance with the WMA's Habitat Management Plan (Utah Division of Wildlife Resources, 2021), Wasatch Mountain Mule Deer (Utah Department of Natural Resources, 2020) and Elk Herd Unit Management Plans (Department of Natural Resources, 2020), Upland Game Management Plan (Utah Department of Natural Resources, 2022), the Utah Conservation

Plan for Greater Sage-Grouse (State of Utah, 2019), and by strategies outlined in the Utah Wildlife Action Plan (Utah Wildlife Action Plan Joint Team, 2015). Wildlife habitat occurring on federal lands and waterways in the Ashley National Forest portion of the Project Area would continue to be managed by the U.S. Forest Service in accordance with the existing LRMP (U.S. Forest Service, 1986). The Ashley National Forest Plan is currently under revision, and the Forest Service will continue to manage the Ashley National Forest under the existing plan until the new Forest Plan is adopted. All management decisions implemented by State and Federal agencies share a common goal of promoting long-term beneficial effects to wildlife species and their habitat located in the Project Area.

3.6.2.2 Proposed Action

As described above, up to 6,846 acres of upland vegetation and 9.2 river miles in Reaches 3 and 4 of the Strawberry River within the Project Area would be prioritized for various restoration treatments under the Proposed Action. Additional areas meeting the criteria for restoration activities would be treated throughout the Project Area as necessary. Proposed treatments to stream and riverine habitats in the Strawberry River would generate a 91.42-acre zone of inundation (defined as 3.3 feet or 1 meter above the riverbed) and a 296.13-acre zone of influence (9.8 feet or 3 meters above riverbed) along the 627.7-acre Strawberry River Valley bottom. These zones correspond to restored floodplain areas and areas for the establishment or re-establishment of riparian vegetation, respectively.

Wildlife species known or having potential to occur in the Project Area that are associated with habitat types targeted for restoration activities would be directly and/or indirectly affected under the Proposed Action. Not all the proposed treatments are expected to affect wildlife. For example, upper watershed restoration activities including soil/hillslope erosion reduction and gully stabilization activities would have negligible effects on wildlife and are not discussed further. Restoration activities are summarized in Chapter 2 and described in detail in **Appendices A** and **B.**

The Migratory Bird Treaty Act (MBTA) states that it is unlawful to destroy an active nest of any migratory bird. It is recommended that, if vegetation- or surface-disturbing activities are to take place in the Project Area during the avian breeding season (generally January 1 – August 31 for raptors and March 1 – July 15 for passerines) the presence of active nests will be assessed and construction in the immediate vicinity of those nests avoided until the nests are no longer active.

Soils / Hillslope Erosion Reduction

Ground crews using chainsaws and hand tools, trucks, off-highway vehicles, chippers, and helicopters or airplanes would apply mulch to bare soils, masticate burned woody debris, strategically place LEBs, and seed native vegetation on up to 6,846 acres of upland habitat and bare soils identified as high or highest severity burn areas. Refer to Section 2.2.2.1 and **Appendix B** for further details pertaining to this activity.

Implementation of this activity would reduce hillslope erosion, soil loss, and downslope sedimentation into aquatic habitats. Seeding native vegetation on bare soils would also enhance the complexity, area, and abundance of natural resources available to associated wildlife in the Project Area. It could also result in increases to local upland biodiversity and ecological resilience to natural events such as disease (Oliver, et al., 2015). A potential adverse effect associated with this activity would be the potential

establishment and/or spread of noxious weeds and other introduced or invasive plant species inadvertently introduced into the Project Area on equipment used to perform this activity. This effect would be mitigated through cleaning equipment to ensure it is free of noxious and invasive plant seeds and monitoring and treatment of weeds and invasive plant species in restoration areas.

The Soil / Hillslope Erosion Reduction activities that would be implemented under the Proposed Action, when combined with past and future seeding efforts (described in Chapter 2, Alternatives), would have the cumulative effect of further stabilizing slopes and contributing to the re-establishment and spread of upland vegetation and associated wildlife habitats within the Project Area.

Gully Stabilization

In conjunction with Soil/Hillslope Erosion Reduction activities and surface runoff treatments, installation of grade control structures and straw wattles and strategic directional tree felling would be used to stabilize up to 6,846 acres of upland and bare soil habitats classified as high and highest intensity burn areas. Accomplishing this activity would require use of ATVs, backhoes, and ground crews with chainsaws, ropes, and hand tools. Refer to Section 2.2.1.2 and **Appendix B** for further details pertaining to this activity.

The direct, indirect, and cumulative effects of Gully Stabilization would be the same as those described above for Soil / Hillslope Erosion Reduction activities.

Vegetation Management

Chemical and mechanical weed removal treatments would be performed on up to 6,846 acres of upland habitat in the Project Area and up to 296.1 acres of existing and potential riparian habitat in the Strawberry River Valley bottom. Additionally, broadcast seeding, mulching, woody seedling planting, and exclosure-fencing installation is proposed in upland habitats. Refer to Section 2.2 for further details pertaining to Vegetation Management.

The effect of weed removal, broadcast seeding, and seedling planting is to improve wildlife habitat by increasing the abundance and diversity of native upland, riparian, and riverine vegetation. Promoting the establishment of native vegetation would enhance the ecological resilience of wildlife habitats to natural events such as disease, fire, and floods (Silverman, et al., 2018). Potential adverse effects of exclosure-fencing would include temporarily restricting wildlife access to localized upland, riparian, and riverine restoration areas while fencing is present. Other potential impacts to wildlife include those associated with increased human activity in and around treatment areas as well as fugitive dust generation and noise disturbance associated with use of mechanized tools, vehicles, and heavy machinery.

Spot treatment and removal of undesirable invasive or non-native woody riparian vegetation would temporarily affect nesting habitat for riparian-associated avian species. Future removal of undesirable species such as tamarisk, would be implemented in stages coinciding with stand-replacing planting or seeding of native habitat that promote similar niches.

Past and current activities on lands managed by the USFS include annual weed treatments on approximately 135 acres of upland habitat to promote the seeding and germination of native vegetation as native wildlife forage and habitat. Additionally, the UDWR has and will continue to annually treat weeds and invasive species such as tamarisk on all lands managed within the Strawberry River WMA (Utah Division of Wildlife Resources, 2021). Following the Dollar Ridge Fire, access to the Strawberry River bottom between Willow Creek and Red Creek was limited due to road closures. As a result, weed management did not occur until the road was improved via the EWP Program undertaken between 2020 to 2022. The cumulative effects of Federal and State-level annual weed management when combined with the vegetation management activities included in the Proposed Action would be to further improve wildlife habitats by decreasing the likelihood of weeds becoming established and spreading throughout the Project Area.

Road/Stream Crossing Improvements

Heavy machinery and ground crews with hand tools would be used to install concrete, road base, road fill, boulders, and culverts and to improve roadways via grading, gravel surfacing, and gully stabilization upslope from roads. Three imbedded culverts would be installed or improved in Timber Canyon and one in Pine Creek Canyon. Refer to Section 2.2.1.4 for further details pertaining to this activity.

The long-term effects of this activity would be to increase the resiliency of road systems in the post-fire environment, reducing downslope and downstream sedimentation and turbidity induced by erosion which would, in turn, enhance habitat for aquatic and semi-aquatic wildlife. In addition, improved stream crossings would benefit terrestrial wildlife by providing increased migratory and seasonal habitat connectivity, especially during peak- or high-flow events. This activity is expected to benefit wildlife by reducing adverse impacts associated with the frequency and duration of human presence and noise-related disturbance associated with continued road maintenance and use of heavy machinery in the Project Area.

Potential adverse effects associated with road/stream crossing improvements are similar to all activities that entail the use of heavy machinery (e.g., Channel Modification, Structure Addition, and Floodplain Reconnection) and include temporary disturbance to riparian areas and adjacent upland wildlife habitat, short-term increases in river turbidity, noise and dust pollution, inadvertent introduction of noxious weeds and other introduced or invasive species into treatment areas, and accidental dispersal of substances associated with use of vehicles and heavy equipment (e.g., motor oils, hydraulic fluids, coolants, etc.).

Past activities affecting wildlife and their habitats include road/stream crossing improvements and the associated use of heavy equipment. Additionally, the U.S. Forest Service replaced a perched culvert with a baffled imbedded culvert in Timber Canyon near the confluence of Shotgun Draw and Timber Creek in 2007. The baffles hold substrate in the bottom of the culvert and maintain a more natural stream channel than a perched culvert. The Proposed Action, when considered in combination with these past activities, would provide a cumulative, beneficial effect of promoting upstream and downstream fish migration and ease of access to tributary spawning areas.

Structure Addition

Implementation of large, locally available wood and boulders, post-assisted log structures (PALS), and/or beaver dam analogs (BDAs) would be used in conjunction with other restoration efforts to increase fluvial channel complexity on up to 8.5 miles (13.7 km) of the Strawberry River. Proposed Structure Addition activities would require use of heavy machinery and ground crews with hand tools. Refer Section 2.2.1.5 for further details pertaining to this activity.

The effect of adding in-stream channel structures would increase riverine habitat complexity and floodplain connectivity and would indirectly recharge the local water table in the Strawberry River valley bottom, providing water resources to promote germination and expansion of riparian vegetation. This activity would increase connectivity, size, and complexity of riparian habitats, which are known to improve vegetation productivity, wildlife forage, and local ecological resilience to natural disturbances such as disease, fire, and flood hazards (Silverman, et al., 2018). In addition, expansion of riparian areas and wetlands would increase the availability of suitable amphibian, avian, and terrestrial wildlife habitats, ultimately promoting increased local biodiversity. Increased local biodiversity would, in turn, promote the maintenance of local ecosystem function and its resiliency to accelerating rates of environmental change, specifically those relating to climate change (Oliver, et al., 2015). Potential adverse effects associated with the installation of riverine structures are similar to all activities associated with the use and routing of heavy machinery (e.g., Road / Stream Crossing Improvements, Channel Modification, and Floodplain Reconnection).

Past, present, and reasonably foreseeable events and actions affecting wildlife and their associated habitats in the Project Area include the Dollar Ridge Fire, weed control and re-seeding actions, and actions taken under the EWP Program between 2020 to 2022. The Proposed Action, when considered in combination with these events and actions, would reduce the adverse impacts associated with the fire and certain channel modifications as well as augment the benefits of these actions to wildlife habitat.

Channel Modification

Heavy machinery, including backhoes, excavators, and bulldozers, would be required to excavate new channels, modify channel cross sections, lower floodplains or floodplain benches, and open blocked channels on up to 3.1 miles (5.0 km) of the Strawberry River. Refer to Section 2.2.1.6 for further details pertaining to this activity.

Channel modifications would increase riverine habitat complexity by increasing the length and area of side channels available to aquatic and semi-aquatic fauna including fish, amphibians, and macroinvertebrates in various flows, and thereby enhance foraging habitat for waterbirds and other terrestrial species that feed on aquatic life. Channel modifications would also encourage the expansion and complexity of riparian areas, providing benefits similar to those associated with Structure Addition, Floodplain Reconnection, and Riparian Plantings. Potential adverse effects associated with Channel Modifications would be like all activities associated with the transport and use of heavy machinery (e.g., Road/Stream Crossing Improvements, Structure Addition, and Floodplain Reconnection).

Past activities affecting wildlife and their associated habitats include channel modifications and the removal of sediment, large woody debris, and rocks completed between 2020 and 2022 under the EWP Programs. Channel modification activities that would be implemented under the Proposed Action, when combined with activities completed under the EWP program, would have the cumulative effect of reversing some of the adverse impacts to wildlife habitat associated with past channel modifications.

Floodplain Reconnection

Under this proposed activity, levees that could be preventing high river flows from reaching historical floodplains would be removed. Similar techniques, tools, and machinery required to accomplish Channel Modification and Structure Addition would be required to achieve this activity on up to 2.6 miles (4.3 km) of the Strawberry River. Refer to Section 2.2.1.7 and **Appendix B** for further details pertaining to this activity.

In conjunction with Channel Modifications and Structure Additions, proposed floodplain reconnection activities would benefit wildlife by promoting the frequent inundation of historic floodplains to improve riparian habitat complexity and vegetation recruitment and provide flow refugia for fish and other aquatic life that provide prey for terrestrial wildlife. Potential adverse effects associated with Floodplain Reconnection are similar to all activities associated with the use and routing of heavy machinery (e.g., Road/Stream Crossing Improvements, Structure Addition, and Channel Modification).

Past activities affecting wildlife and their associated habitats include actions taken under the EWP Programs between 2020 to 2022, and construction of irrigation diversions and associated ditches on private lands in the Project Area. Activities taken under the EWP included the use of dredged sediments and material to construct levees, which effectively raised the height of the riverbank in affected areas. Floodplain Reconnection activities that would be conducted under the Proposed Action, when combined with those undertaken by the EWP Programs, would have the cumulative effect of reducing impacts associated with the creation of levees in the Project Area.

Riparian Plantings

Under this activity, ground crews using hand tools and heavy machinery would plant native woody riparian vegetation and seed native grasses and forbs on up to 1.4 miles (2.3 km) of Reaches 3 and 4 of the Strawberry River in areas between Soldier Creek Dam and the Strawberry Pinnacles where tree mortality caused by the Dollar Ridge fire was high and/or where native riparian vegetation density is low for other reasons, including effects of post-fire erosion events and re-construction of the Strawberry River Road. Temporary exclosures or vented tree shelters would be used to protect newly planted seedlings from foraging wildlife and human-induced impacts. Refer to Section 2.2.1.8 and **Appendix B** for further details pertaining to this activity.

The effect of Riparian Planting would be to increase the diversity and abundance of native riparian plant species. Increased riparian vegetative complexity and abundance would benefit wildlife by mediating water temperatures, providing linear habitat connectivity, and linking aquatic and terrestrial ecosystems to increase the likelihood for long-term persistence of aquatic and riparian wildlife as well as by providing thermal riparian refugia for wildlife (Seavy, et al., 2009). Additional benefits of this activity are

the same as those associated with Structure Addition, Channel Modification, and Floodplain Reconnection. A potential adverse effect of Riparian Plantings would include the potential establishment and/or spread of noxious weeds and other introduced or invasive plant species inadvertently introduced into the Project Area on the vehicles and equipment used to perform this activity. This effect would be avoided or minimized through monitoring and treatment of weeds and invasive plant species in restoration areas.

Under the EWP Programs, native willows were planted in various areas of the Project Area along Strawberry River between 2020 and 2021. providing beneficial effects to wildlife by increasing riparian habitat size and complexity, forage, and thermal refugia. Riparian plantings conducted under the Proposed Action would have the cumulative effect of further enhancing and expanding riparian wildlife habitat within the Project Area.

3.7 Fisheries

3.7.1 Affected Environment

There are approximately 43 miles (69 km) of perennial streams and waterways located in the 77,047-acre Project Area. Of these, the aquatic analysis area includes an approximately 18.6-mile (30-km) stretch of the perennial Strawberry River from Soldier Creek Dam downstream to the Strawberry Pinnacles, as well as sections of Timber Creek, a perennial tributary to Strawberry River. Because proposed restoration activities are exclusive to sections of Strawberry River and Timber Creek, other perennial and ephemeral ponds, springs, and streams and their tributaries located in the Strawberry River Watershed (HUC 14060004) in the Project Area such as those found in Willow Creek Canyon, Beaver Canyon, Simmons Canyon, Slab Canyon, and Avintaquin Canyon are excluded from analysis in the following section.

The Project Area includes 18.6 miles (30 km) of Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles. This stretch of Strawberry River was, prior to the Dollar Ridge Fire, classified by the UDWR as a Blue Ribbon Fishery (BRF). BRF waters are managed principally by protecting, maintaining, and restoring habitat, and through appropriate angling regulations. BRF waters in the state of Utah provide a quality angling experience in an aesthetically pleasing and unspoiled environment with a unique opportunity to catch specific fish species and a satisfactory catch rate regarding size and numbers of fish caught, are environmentally productive and maintained predominately through natural reproduction with limited hatchery-produced fish, and are publicly accessible (Garn Birchell, UDWR, Personal Communication, November 9, 2022). A total of approximately 9.2 miles (14.8 km) or about 49% of the Strawberry River within the Project Area is being considered for one or more treatments under the Proposed Action. Various restoration activities are proposed in portions of Reaches 3 and 4 of Strawberry River, specifically at river miles 8.4 – 9.6, 10.3 – 10.9, 11.2 – 15.0, 15.2 – 17.7, and 18.0 – 18.6 (river km 13.5 – 15.5, 16.5 – 17.5, 18 – 24.25, 24.5 – 28.5, and 29.0 – 30.0) (**Appendix A**). Within the Project Area, the fish population in the Strawberry River is comprised of brown trout, Colorado River cutthroat trout, and brook trout (Utah Division of Wildlife, 2019).

Timber Creek is a perennial tributary (periodically intermittent at the confluence) to Strawberry River. Timber Creek originates in the heads of Timber Canyon and Shotgun Draw and converges with

Strawberry River approximately 12.4 stream miles (20 km) downstream at the mouth of Timber Canyon (Strawberry River mile 15.2 or river km 24.5). Timber Creek contains a conservation population of native Colorado River cutthroat trout (CRCT), a U.S. Forest Service-designated sensitive wildlife species and Utah state-designated SGCN. In 2007, the U.S. Forest Service installed a fish barrier in Timber Creek approximately 3.5 miles (5.6 km) upstream from its confluence with Strawberry River to exclude nonnative brown trout from migrating upstream, which were predating upon and replacing native CRCT populations (U.S. Forest Service, 2021). The stream channel above and below the fish migration barrier has filled with debris and sediment caused by debris flows following the 2018 Dollar Ridge Fire, rendering the fish migration barrier ineffective. Maintenance using heavy equipment is needed to remove accumulated debris and restore effectiveness. These same debris flows created an effective low flow barrier approximately 50 meters downstream of the installed barrier, though it is not expected to persist. Additional proposed post-fire restoration activities in Timber Creek include the installation of four imbedded culverts, located near Pine Hollow and Jackson Hollow approximately and 10.8 miles upstream of the Timber Creek-Strawberry River confluence (**Figure 3**). Timber Creek is inhabited only by CRCT above the existing fish migration barrier, with populations of brown trout, brook trout, and CRCT below the barrier.

3.7.1.1 Federally Threatened, Endangered, and Candidate Fish Species

Threatened, endangered, and candidate fish species with the potential to occur within Reaches 3 and 4 of the Strawberry River and Timber Creek are listed in **Table 13**, below (U.S. Fish and Wildlife Service, 2022).

The cold, clear, highly oxygenated riverine habitat of the upper Strawberry River (river miles 0 – 18.6 or river km 0 – 30) created by the release of deep waters from the bottom of Strawberry Reservoir does not provide suitable habitat for the bonytail, Colorado pikeminnow, humpback chub, or razorback sucker, which are relatively warm water associates, favoring medium to large rivers of various depths and turbidity. According to the U.S. Fish and Wildlife Service, the nearest suitable habitat for these species is in the tailwaters of the Duchesne River near Randlett, UT (U.S. Fish and Wildlife Service, 2002) (Groves, 2022).

Table 13. Federally Listed Fish Species with Potential to Occur in the Project Area

Species	Status[1]	General Habitat Characteristics and Range in Utah[2]	Potential to Occur or be Affected by Alternative Action[3]
Bonytail *Gila elegans*	E	Warm water species favors deep swift water, flowing pools, and eddies of various turbidities adjacent to main current in main-stem rivers. Spawning occurs in spring months over rocky substrates.	None Suitable habitat is not present in the Project Area. Nearest suitable habitat is located in the lower Duchesne River near Randlett, UT.

Species	Status[1]	General Habitat Characteristics and Range in Utah[2]	Potential to Occur or be Affected by Alternative Action[3]
Colorado Pikeminnow *Ptychocheilus lucius*	E	Medium to large rivers, preferring various habitats such as deep turbid currents, eddies, runs, flooded bottoms, and backwaters. Spawning occurs where large, deep pools and eddies intermingle with riffles, runs, and cobble bars of gravel, cobble, and boulders.	None Suitable habitat is not present in the Project Area. Nearest suitable habitat is located in the lower Duchesne River near Randlett, UT.
Humpback Chub *Gila cypha*	T	Various habitats in large rivers, such as deep turbulent currents, shaded canyon pools, shaded moderate currents, riffles, and eddies. Spawning occurs in shoreline eddy and run habitats.	None Suitable habitat is not present in the Project Area. Nearest suitable habitat is located in the lower Duchesne River near Randlett, UT.
Razorback Sucker *Xyrauchen texanus*	E	Deep runs, eddies, backwaters, and flooded channels of medium to large rivers. Spawning occurs in rivers during spring months over bars of gravel, cobble, and sand in widely ranging flows, depths, and water temperatures, but may also occur in reservoirs over rocky shoals and shorelines.	None Suitable habitat is not present in the Project Area. Nearest suitable habitat is located in the lower Duchesne River near Randlett, UT.

[1] Status: E = Federally listed Endangered; T = Federally listed Threatened
[2] Sources: NatureServe
[3] Sources: (Kristy Groves, USFS, Personal Communication, June 29, 2022) and (U.S. Fish and Wildlife Service, 2002)

3.7.1.2 U.S. Forest Service Region 4 Sensitive Fish Species

The National Forest Management Act requires that land management plans "provide for diversity of plant and animal communities based on a suitability and capability of the specific land area in order to meet overall multiple-use objectives". One aspect of responsibility is met through the Intermountain (USFS Region 4) Regional Forester's identification of Proposed, Endangered, Threatened, and Sensitive or "Forest Sensitive" fish species whose long-term persistence may be at risk. In Ashley National Forest, the Colorado River cutthroat trout (CRCT, *Oncorhynchus clarkii pleuriticus*) is identified as a Forest Sensitive fish species with potential to occur in the Project Area or be affected by the Proposed Action. In Utah, the CRCT is limited to isolated headwater areas and other riverine environments in the tributaries of the Green and Colorado rivers. Populations of this species are found in the Project Area in Strawberry River and its tributaries including Willow Creek, Timber Creek, and Avintaquin Creek (Utah Division of Wildlife Resources, 2021) (Utah Division of Wildlife Resources, 2019). Proposed riverscape restoration activities have potential to affect this species where it occurs in the Strawberry River and Timber Creek.

3.7.1.3 Utah Division of Wildlife Resources Species of Greatest Conservation Need

The Utah Wildlife Action Plan (UWAP) has been created "to manage native wildlife species and their habitats, sufficient to prevent the need for additional listings under the Endangered Species Act (ESA). The State of Utah has identified several SGCN, which "do, or potentially could, present the possibility of an ESA listing.'" (Utah Wildlife Action Plan Joint Team, 2015). Three fish SGCN are known or have potential to occur in the Project Area: the bluehead sucker, flannelmouth sucker, and CRCT. The CRCT is also a Forest Sensitive species and is discussed in Section 3.7.1.2, above. The bluehead sucker and flannelmouth sucker share similar riverine preferences, occurring in various fluvial habitats ranging from cold, clear trout streams to warm, very turbid streams in small to large rivers. Prior to the impacts on water quality and fish populations caused by the 2018 Dollar Ridge Fire, populations of both species were found in abundance in lower sections of the Strawberry River, downstream of the Wildlife Management Area, with relative abundance increasing downstream, though neither species is known to occur in the Project Area (Utah Division of Wildlife Resources, 2021).

3.7.2 Direct, Indirect, and Cumulative Effects

3.7.2.1 No Action Alternative

Under the No Action Alternative, the current management of fish habitat and abutting riparian areas, wetlands, and floodplains in the Project Area would continue. Within the Strawberry River Wildlife Management Area, aquatic habitat would continue to be managed in accordance with the UDWR's Strawberry River Habitat Management Plan (Utah Division of Wildlife Resources, 2021). Aquatic habitat located on federal lands managed by the U.S. Forest Service would continue to be managed in accordance with the Ashley National Forest Plan (U.S. Forest Service, 1986) and in conjunction with practices outlined in the Draft Timber Creek Fish Habitat report (U.S. Forest Service, 2021). The existing Ashley National Forest Plan is currently under revision and will continue to guide management of National Forest System lands in the Project Area until a new plan is adopted.

Planting of native woody vegetation and seeding of native grasses and forbs would continue to take place, as necessary, on up to 150 acres of the Strawberry River riparian zone in the Project Area each year. Past channel modifications in Strawberry River associated with the EWP Program between 2020 and 2022 could have resulted in adverse effects on fish habitat caused by inconsistent and insufficient water supplies to adjacent riparian areas and floodplains, which aid in the dispersal of energy, sediment, and nutrients during peak-flow events, and help mitigate fluctuating water temperatures.

Under the No Action Alternative, sediment loads within the Strawberry River would continue to move downstream during base and high flow periods, which could raise suspended sediment loads and increase turbidity levels. Without proposed upland restoration activities aimed at stabilizing sediment, precipitation events, especially extreme ones, would continue to add more sediment and debris to the system, further raising turbidity. Anthropogenic- and erosion-induced increases in sedimentation are correlated to a chain of adverse impacts resulting in reduced production, survival, foraging ability, and ultimately abundance of salmonid and other aquatic species (Kemp, Sear, Collins, & Naden, 2010).

Lack of riparian zone restoration would continue to expose large areas of the Strawberry River to direct sunlight, resulting in increased water temperatures. The system could potentially hold lesser concentrations of dissolved oxygen due to relatively warmer temperatures in addition to lack of aeration induced by absence of instream structures. As discussed in Section 3.2 it is assumed that water quality conditions, and therefore conditions of local fish habitat, under the No Action Alternative could remain highly variable, with periods of low and high turbidity, temperature, and concentration of dissolved oxygen, until some equilibrium is achieved. Over time, conditions associated with the No Action Alternative are expected to support a healthy fishery. However, whether these conditions would support a cold-water trout fishery similar to that which existed prior to the 2018 Dollar Ridge Fire, or a warm-water fishery similar to that which likely existed prior to the completion of the Soldier Creek Dam in 1974 is unknown.

3.7.2.2 Proposed Action

As noted above, approximately 9.2 river miles (14.8 km) in Reaches 3 and 4 of the 18.6-mile (30-km) stretch of Strawberry River between Soldier Creek Dam and the Strawberry Pinnacles would be considered for one or more restoration activities under the Proposed Action. Activities associated with in-stream disturbance and/or with potential to temporarily increase suspended sediment and turbidity in the Strawberry River (e.g., Structure Addition, Channel Modification, Floodplain Reconnection, Riparian Plantings, and Road / Stream Crossing Improvements) may effect spawning salmonids (Bryan Engelbert, Personal Communication, October 3, 2022). Additionally, anthropogenically induced increases in sedimentation are correlated to a chain of effects resulting in reduced production, survival, forage ability, and ultimately abundance of salmonid species (Kemp, Sear, Collins, & Naden, 2010). To mitigate potential adverse impacts, these activities would be implemented during periods of low stream flow, primarily between July 15 and September 30, outside of seasonal spring CRCT and fall brown trout spawning seasons. To promote increased native CRCT populations in the Strawberry River, which are outcompeted by introduced brown trout, a secondary implementation window would be undertaken during the fall spawn between September 30 and May 15, promoting a temporary disadvantageous spawn cycle for brown trout (CRCT Coordination Team, 2006).

All proposed activities involving the use of heavy equipment and machinery would affect fish habitat via noise and ground disturbance (e.g., vibration, erosion, increased sedimentation and turbidity).

Soils/Hillslope Erosion Reduction

In conjunction with Gully Stabilization activities, ground crews using chainsaws and hand tools, trucks, off-highway vehicles, chippers, and helicopters or airplanes would be used to apply mulch to bare soils, masticate burned woody debris, strategically place LEBs, and seed native vegetation on up to 6,846 acres of upland habitat and bare soils identified as high or highest severity burn areas. The effects of this activity on fish habitat would be the same as those associated with Road/Stream Crossing Improvements, Vegetation Management, and Gully Stabilization. Similarly, potential adverse effects of this activity on fish habitat would be the same as those associated with the use of heavy equipment and machinery described above for the proposed Structure Addition, Channel Modification, Floodplain Reconnection, and Road/Stream Crossing Improvements activities.

The effects of proposed Soils/Hillslope Erosion Reduction activities on fish habitat in the Project Area, when combined with past post-Dollar Ridge Fire activities such as seeding approximately 10,706 acres of upland habitat would have the cumulative effect of further reducing erosion-induced sedimentation and turbidity in perennial waterways in the Project Area.

Gully Stabilization

In conjunction with Soils/Hillslope Erosion Reduction and surface runoff treatments, off-highway vehicles (OHVs), backhoes, and ground crews with heavy equipment and hand tools would be used to install grade control structures and straw wattles and strategically directionally fell trees to stabilize up to 6,846 acres of upland and bare soil habitat classified as high- and highest-intensity burn areas. The effects of this activity on fish habitat would be the same as those associated with Road/Stream Crossing Improvements and Soils/Hillslope Erosion Reduction.

Cumulative effects of Gully Stabilization activities on fish habitat in the Project Area would be similar to those described above for Soil / Hillslope Erosion Reduction activities.

Vegetation Management

Broadcast seeding, mulching, and woody seedling planting would be utilized to promote native plant recovery and percent cover on up to 6,846 acres of upland habitat in the Project Area and up to 296.13 acres of existing and potential riparian habitat in the Strawberry River bottom. The effects of this activity on fish habitat include reducing sediment loads and turbidity in Strawberry River and potential increases in the abundance, survival, and production of fish and aquatic macroinvertebrate species and increased diversity of aquatic fauna.

The effects of Vegetation Management on fish habitat in the Project Area combined with past and on-going vegetation management actions would result in cumulative effects on fish habitat in the Strawberry River. Planting and seeding would continue to take place, as necessary, on areas within the approximately 150 acres of the riparian zone of the Project Area each year. Cumulative, beneficial effects of past, present, and future riparian plantings on fish habitat would include the promotion of native aquatic and riparian habitat.

Road / Stream Crossing Improvements

Heavy machinery such as backhoes, graders, loaders, dump trucks, and small excavators would be required to improve three imbedded culverts in Timber Canyon and install one culvert in Pine Hollow (**Figure 3**). The potential effects of this activity on fish habitat would be the same as those associated with Vegetation Management, Soils / Hillslope Erosion Reduction, and Gully Stabilization. Similarly, the potential adverse effects of this activity on fish habitat would be the same as those associated with the use of heavy equipment and machinery described under the Structure Addition, Channel Modification, and Floodplain Reconnection activities below.

The effects of implementing the proposed Road / Stream Crossing Improvements on fish habitat in the Project Area, when combined with past road / stream crossing activities such as the USFS's 2007 replacement of a perched culvert in Timber Canyon with an imbedded culvert near the confluence of

Shotgun Draw and Timber Creek and past actions to improve roads/access and protect infrastructure, would result in beneficial cumulative effects to fish habitat in the Project Area by promoting upstream and downstream fish migration and ease of access to tributary spawning areas.

Structure Addition

The use of heavy machinery and ground crews using chainsaws, hydraulic post-pounders, and hand tools would be required to install locally available wood and boulders, post-assisted log structures (PALS), and beaver dam analogs (BDAs) on up to 8.5 miles (13.75 km) of the Strawberry River. Structure Addition, in conjunction with other restoration efforts including Floodplain Reconnection, Channel Modification, and Riparian Planting, would be implemented to increase fluvial channel complexity in areas where channel complexity is relatively low. The addition of riverine structures would directly benefit fish species by increasing in-stream cover, providing seasonal and flow refugia, promoting physical habitat complexity (e.g., the formation of pools), increasing hydraulic diversity, and providing resting, spawning, and foraging areas for fish (**Appendix A**). Another direct benefit of increasing riverine structure complexity would be promotion of aeration and turbulence across the air-water interface, which would promote an increased concentration of dissolved oxygen available to fish and aquatic macroinvertebrates. The restructuring of fish migration barriers would directly benefit Colorado river cutthroat trout (CRCT) populations in Timber Creek by excluding nonnative predatory brown trout and brook trout from CRCT habitat (CRCT Coordination Team, 2006). Structure Addition would also benefit fish populations by decreasing inter- and intraspecific competition via increased habitat availability, potentially leading to an overall increase in salmonid abundance, survival, and production. In addition, this activity would include increased channel roughness to promote channel-floodplain connection which is critical to water table recharge, ultimately increasing riparian and bankside-rooted vegetative complexity and density which is known to thermally regulate water temperatures and increase ecological resilience to environmental disturbance such as fire, flood, and erosion (e.g., sedimentation and turbidity).

Adverse impacts of Structure Addition include short-term disturbance to stream and riparian habitats and increase in sedimentation and stream turbidity associated with the transport and use of heavy equipment to install structures, which is particularly impactful to salmonids during spawn (Bryan Engelbert, UDWR, Personal Communication, October 3, 2022). Potential adverse effects of restructuring fish migration barriers in Timber Creek include habitat fragmentation and reduction in genetic variation within local CRCT populations, which may lead to decreased population resiliency to natural disturbances, and in the long-term, the ability to evolve in response to changing environmental conditions (CRCT Coordination Team, 2006). As discussed above, potential adverse impacts of in-stream activities would be mitigated by implementing these treatments during strategic timeframes throughout the year.

Past activities affecting fish habitat in the Project Area include actions taken under the EWP program between 2020 and 2022, specifically the addition of riverine structures such as j-hooks, riprap, and instream debris catchers in the Strawberry River and the construction of an effective fish barrier in the form of a hardened concrete stream crossing in Timber Creek, approximately one mile upstream of its confluence with Strawberry River. Structure Addition activities that would be implemented under the Proposed Action, when combined with activities completed under the EWP program, would have the cumulative effect of furthering the beneficial effects of riverine structures created as part of the EWP

program and reversing some of the adverse impacts to fish habitat associated with past channel modifications. Additionally, the effects of temporary increases in turbidity associated with sediment disturbance that would be caused by proposed Structure Addition activities would be similar to but much less impactful relative to the effects of natural erosional and depositional events likely to occur under the No Action Alternative.

Channel Modification

Heavy machinery would be used to construct side channels in historic floodplains and realign or increase structural complexity of modified channels on up to 3.1 miles (5.0 km) of the Strawberry River. This activity would directly benefit fish habitat by increasing the length and area of side channels available to fish in various flows, providing flow refugia via backwater areas and eddies, enhancing and increasing resting, spawning, and foraging areas, and increasing riverine habitat complexity. Channel modifications would create more balanced channel conditions that reflect their most efficient and least erosive forms, directly benefiting long-term fishery conditions by reducing turbidity. Indirect effects of this activity would increase salmonid abundance, survival, and production. Potential adverse effects of proposed Channel Modification activities would be the same as those associated with Structure Addition, Floodplain Reconnection, and Riparian Plantings.

The cumulative effects of proposed Channel Modification activities on fish habitat in the Project Area combined with the effects of past actions to improve roads/access and protect infrastructure would be similar to those described above for proposed Structure Addition activities.

Floodplain Reconnection

Similar techniques, tools, and machinery required to accomplish Channel Modification and Structure Addition would be used to remove levees that might be preventing high flows from reaching the floodplain and the possible restoration of existing historic irrigation diversions and associated ditches on up to 2.7 miles (4.3 km) of the Strawberry River located in the Project Area. In conjunction with Channel Modification, Floodplain Reconnection strategies would benefit fish habitat by providing flow refugia for fish, increasing nutrient exchange between the Strawberry River channel and floodplain, and increasing resting, spawning, and foraging habitat for fish. Other beneficial effects of this activity would be the same as those associated with Channel Modification. Potential adverse effects resulting from Floodplain Reconnection activities would be the same as those associated with the use heavy machinery and equipment for other proposed activities including Structure Addition, Channel Modification, and Riparian Plantings.

Cumulative effects of Floodplain Reconnection on fish habitat in the Project Area would be like those described above for proposed Channel Modification and Structure Addition activities. Other past floodplain reconnection activities include the construction of irrigation diversions and associated ditches on the Camelot, Hayes, and Giles mitigation parcels, which were damaged or destroyed during the 2018 Dollar Ridge Fire and subsequent erosion events. As discussed above, damaged or destroyed irrigation diversions and associated ditches would be restored and adverse effects of emergency actions taken in the past would be reversed under the Proposed Action.

Riparian Plantings

Ground crews using hand tools and heavy equipment would be required to plant native woody riparian vegetation and seed native grasses and forbs on up to 1.4 miles (2.25 km) of the Strawberry River in the Project Area. A beneficial effect of this activity would be increasing riverine habitat complexity and diversity, moderating turbidity spikes through filtration, reducing water temperatures through aerial shading, and contributing leaves and other organic matter that provide nutrients. Other beneficial effects to fish habitat would include increased concentrations of dissolved oxygen in the river and the associated potential for increased survival, abundance, and production of fish and aquatic macroinvertebrate species. Other beneficial effects of Riparian Planting activities would be the same as those associated with Structure Addition, Channel Modification, and Floodplain Connection. Potential adverse effects of this activity would be the same as those associated with the use heavy machinery and equipment under other proposed activities such as Structure Addition, Channel Modification, and Floodplain Reconnection.

The cumulative effects of Riparian Plantings on fish habitat in the Project Area combined with willow plantings completed under the EWP program include decreased streambank erosion and turbidity.

3.8 Cultural

3.8.1 Affected Environment

To date, 31 cultural resource surveys have been conducted in portions of the Project Area. Since these surveys only cover approximately 10 percent of the Project Area, much remains unknown about cultural resources in the Project Area. “Historic” refers to sites with materials and items common to European immigrant cultures of the Western Frontier, and the use of such sites usually dates after AD 1860. “Prehistoric” refers to sites with materials and items common to American Indian cultures and the use of these sites usually dates before AD 1860. Thirteen of the cultural resource sites documented in the Project Area to date are historic and three are prehistoric (Certus 2022). Of the 16 sites recorded, seven have been determined eligible for listing on the National Register of Historic Places. Ten of the sites are located along the Strawberry River. Some of the homestead sites recorded were either damaged or destroyed in the 2018 Dollar Ridge Fire; specifically, Simmons Ranch, which burned in the fire and was impacted by debris flows.

3.8.2 Direct, Indirect, and Cumulative Effects

3.8.2.1 No Action Alternative

Under the No Action Alternative, current management plans would continue to guide and implement actions within the Project Area. The No Action Alternative would have the indirect, adverse effect of maintaining the current level of slope instability associated with unvegetated, burned areas. If no action is taken to reduce these risks, cultural resources are vulnerable to modification or destruction associated with erosion.

3.8.2.2 Proposed Action

Up to 10,530 acres of upland (14% of the 77, 047-acre Project Area) and 18.6 miles (30 km) of riverfront riparian (43% of the 43 miles [69 km] of perennial streams in the Project Area) would be considered for various upland and riparian restoration treatments and river channel and floodplain modification treatments as part of the Proposed Action. Restoration treatments are discussed in detail in **Appendix A** and would include hillslope cover treatments (i.e., mulching), aerial and ground seeding with native species, directional tree felling to stabilize gully sediment, log erosion barriers (LEBs) or straw wattles to mitigate hillslope erosion, tree planting, temporary fencing to protect some plantings (e.g., aspen), and physical and chemical weed treatments and monitoring.

Effects Common to All Activities

All the activities detailed in the Activity Cards would have potential to involve the use of heavy equipment, which could impact cultural resources in the Project Area (**Activity Cards**- **Appendix B**). The tree planting and fence installation associated with riparian plantings could directly impact cultural resources. However, all federally administered activities in the Project Area are subject to the National Historic Preservation Act, Section 106 compliance requirements, which would entail survey and avoidance or mitigation of impacts to NRHP-eligible sites. Historic properties will remain at some risk to inadvertent damage, loss, destruction by natural processes and human activity, but appropriate consideration and management actions would be taken to protect or mitigate adverse effects to historic properties if they are discovered.

3.9 Access and Recreation

Publicly accessible land within the Project Area is predominately U.S. Forest Service administered land and the Strawberry River WMA, which is made up of state land and federal lands administered by the Utah Reclamation Mitigation and Conservation Commission and Bureau of Reclamation but managed by the UDWR. National Forest land is managed under the Multiple-Use Sustained Yield Act of 1960, which along with other things allows for development of recreation resources and provision of these products and services. The purpose of the Strawberry River WMA is to preserve and enhance wildlife habitats and populations and preserve public angler access to the Strawberry River between Soldier Creek Dam and its confluence with Red Creek near the Strawberry Pinnacles (UDWR, 2021).

Based on these management mandates, the National Forest and WMA afford stakeholders various access and recreation opportunities. In general, consumptive recreation opportunities within the Project Area include angling and hunting (both upland game and big game species) while non-consumptive recreation opportunities include camping, bird watching, wildlife viewing, horseback riding, and Off Highway Vehicle (OHV) riding.

Roads and trails within the Project Area whether, Forest Service, tribal (if associated with an easement), county, or private (if associated with an easement) provide access to recreation, land management, and grazing for the public, specific stakeholders, and agency personal. The total miles of road by land ownership within the Project Area are shown in **Table 14**.

Table 14. Roads in the Project Area

Land Ownership	Miles
Ute Indian	1.9
Bureau of Reclamation	13.7
Utah Reclamation Mitigation & Conservation Commission	7.2
Private	32.3
State Wildlife Reserve/Management Area	6.0
U.S. Forest Service (USFS)	62.2
Total	123.2

The Strawberry River Road provides access along the Strawberry River until gated approximately 0.5 miles west of the Duchesne/Wasatch County line. Authorized access is allowed for private property owners beyond the gate. The closure was implemented to protect the private property rights of those landowners. The Timber Canyon Road provides access to this canyon and once on Forest Service administered land leads to a network of trails, i.e., two track roads. Forest Service roads within the Project Area and illustrated on the Ashley National Forest Motor Vehicle Use map (USFS, 2022) are considered open to all vehicles. Both Strawberry River and Timber Canyon Roads are well used but can become impassible during winter months or during high river flow / high-magnitude storm events.

3.9.1 Affected Environment

3.9.1.1 Fishing

The Strawberry River contains the following popular sport fish - Colorado River cutthroat trout, brown trout, and brook trout. Prior to the Dollar ridge Fire, the section of the Strawberry River from Soldier Creek Dam to the Red Creek confluence was classified as a Blue Ribbon Fishery (Utah Division of Wildlife, 2019). However, since the fire and multiple debris flows associated with intense precipitation events the reach has been downgraded to a potential Blue Ribbon water (UDWR 2021). The Strawberry River from the confluence of Red Creek upstream to Soldier Creek Dam is managed as an artificial fly-and-lure-only stream. There are 12 angler access locations along this section of the Strawberry River (Utah Division of Wildlife Resources, 2021). At the gated end of Strawberry River Road, vehicle access beyond that point is limited to private property owners with cabin sites. However, angling easements were acquired from those owners and the Strawberry River is open to angling and passage within 20 feet of each streambank from Soldier Creek Dam to the Strawberry Pinnacles.

3.9.1.2 Hunting

The Project Area is within the Utah Division of Wildlife Resources' Wasatch Mountains Hunting Unit, and Avintaquin, West Strawberry, and Current Creek Subunits. Hunters with a valid hunting license and permit can hunt both upland game (e.g., grouse, hare, and rabbit) and big game, (e.g., deer and elk). R-Bench, is a 1002-acre hunting property located partially within the Project Area, north of the Strawberry River. Hunting guides (R. Brunson, Personal Communication, June 16, 2022) that operate in or near the Dollar Ridge Project Area are:

- Wade Lemon
- Shawn Labrum – Wild Mountain Outfitters
- Garrett Smith – Alpha Outfitters
- Neil Crump – Double C

3.9.1.3 Camping

There are no formally established camp sites within the Project Area. Overnight camping is not permitted along the Strawberry River Corridor or in the lower reaches of Timber Canyon within the Strawberry River WMA. These riparian areas are day use only. Dispersed camping is allowed in other locations within the Strawberry River WMA. UDWR limits camping to no more than 14 consecutive days on the Strawberry River WMA unless otherwise specified. On Forest Service administered land, dispersed camping is allowed 150 feet off the centerline of roads and trails within the Project Area. Camp sites must be at least 100 feet from a stream, wetland, or other body of water.

3.9.1.4 Off Highway Vehicle (OHV) Use

OHV use is limited to existing roads. Off road travel is prohibited on Forest Service administered land and the WMA. There is a concern that off-road OHV use could become a problem in areas where illegal OHV use from adjacent private properties periodically occurs, e.g., Long Ridge area, Beaver Canyon, and on the ridges north of the Strawberry River (Utah Division of Wildlife Resources, 2021). Enforcement patrols are difficult in these areas due to the remoteness and private property ownership.

3.9.1.5 Other Non-consumptive Uses

Other recreational uses include horseback riding, hiking, birding, and wildlife viewing. No use data for these activities are available.

3.9.1.6 Wilderness/Roadless

There are no designated wilderness areas in the Project Area. There are 37,131 acres of roadless area on the Ashley National Forest within the Project Area (see **Figure 14**). As per ***36 CFR 294.13 (b) (2),*** "The cutting, sale, or removal of timber is incidental to the implementation of a management activity not otherwise prohibited by this subpart; Paragraph (b)(2) allows timber cutting, sale, or removal in inventoried roadless areas when incidental to implementation of a management activity not otherwise prohibited by this rule. Examples of these activities include but are not limited to trail construction or maintenance; removal of hazard trees adjacent to classified roads for public health and safety reasons; fire line construction for wildland fire suppression or control of prescribed fire; survey and maintenance of property boundaries; other authorized activities such as ski runs and utility corridors."

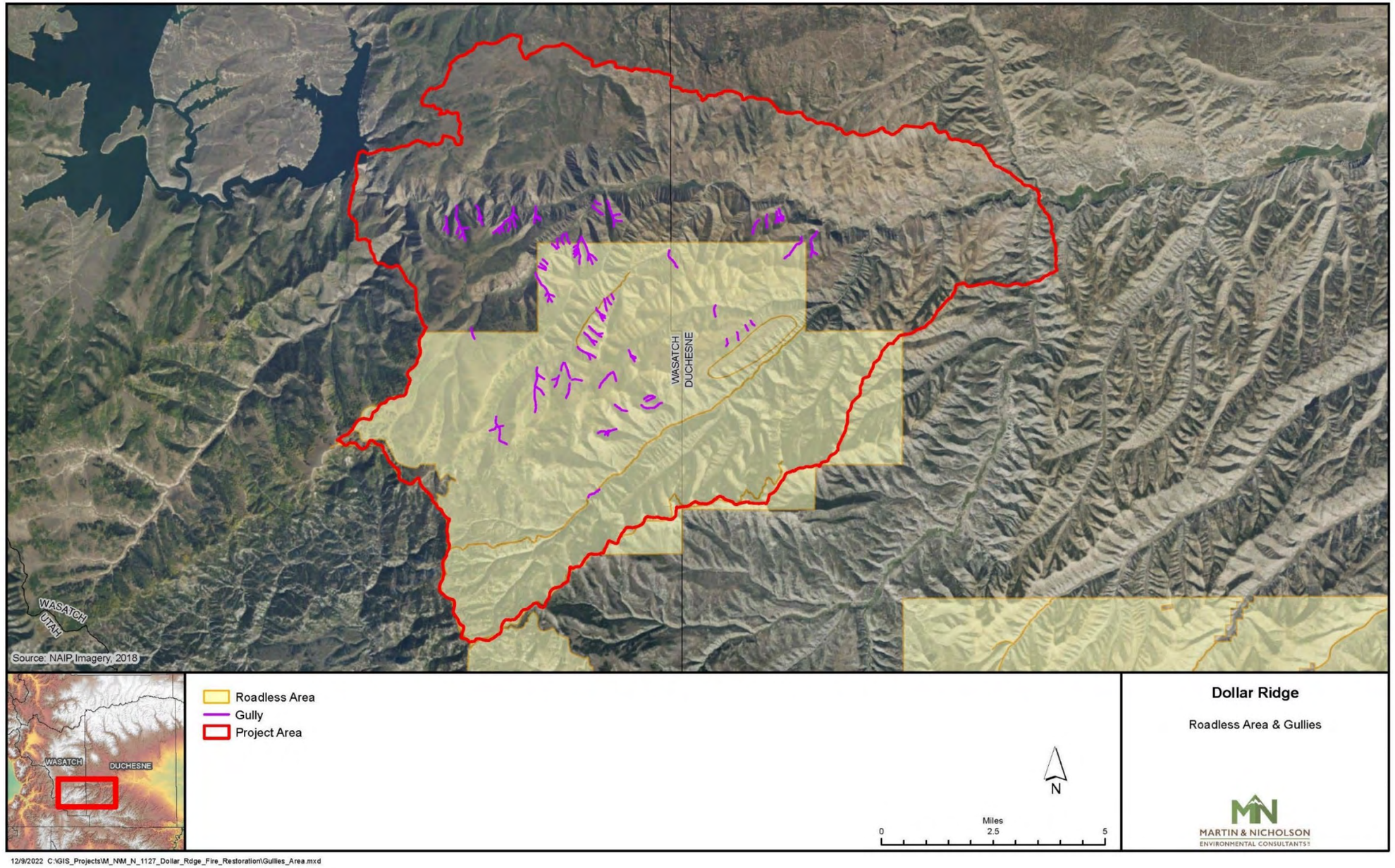

Figure 14. Locations of potential gully treatment areas located within the Ashley National Forest Roadless Area

3.9.1.7 Grazing

UDWR uses domestic livestock grazing to manage vegetation on Division lands if the Division determines that such grazing is beneficial for the maintenance or improvement of wildlife habitat. In recent years, UDWR used grazing as a management tool in the Lion Hollow parcel within the adjacent USFS cattle allotment. An annual grazing lease for 25 animal unit months (AUMs) is currently offered for the Lion Hollow parcel to the permittee running cattle on the adjacent USFS allotment (Utah Division of Wildlife Resources, 2021) Current grazing allotments, all of which include active permits, in the Project Area are provided in **Table 15** below.

When the UDWR obtained the Childs Ranches and incorporated it into the Strawberry River WMA, a Cattle Foraging/Grazing Deed Reservation was included, which allows for annual cattle grazing on the portion of the property "which is located south of the Strawberry River and is higher than 7,800 feet in elevation, together with that portion which lies within Willow Creek Canyon" (UDWR, 2021).

Table 15. Grazing Allotments in the Project Area

Allotment	Admin	Season	Number	Class	Acres	AUM
Slab Canyon/$1200 Ridge	Ashley	7/1 – 9/30	80	cow/calf	4657	319
Strawberry	Ashley	6/16 – 10/15	145	cow/calf	10535	768
Timber Canyon	Ashley	6/16 – 10/15	180	cow/calf	14547	953
Beaver	UWC	7/1 – 10/5	1000	Ewe/lamb	3044	957

3.9.2 Direct, Indirect, and Cumulative Effects

3.9.2.1 No Action Alternative

Under the No Action Alternative, the current management of recreation resources on U.S. Forest Service administered land and Strawberry River Wildlife Management Area would continue as per existing planning documents. The upland and riverine settings of the Project Area are used for fishing, hunting, other recreation, and grazing. These activities will continue under the No Action alternative. In some locations along Strawberry River Road and Timber Canyon Road implementation of the EWP Program temporarily limited access, however, this project is complete, and all roads are open according to state and federal management plans. Over time access, recreation, and grazing could be affected by the No Action Alternative if precipitation events wash out sections of road and/or if the upland watershed and riverscape do not recover under a trajectory that improves aquatic habitat, terrestrial habitat, and forage for wildlife and livestock.

3.9.2.2 Proposed Action

The intent of the restoration plan is to reestablish watershed and riverscape processes that directly and indirectly improve fish and wildlife habitat with the Project Area.

3.9.2.3 Effects Common to All Activities

Effects of the proposed action are generally positive for fish- and wildlife-focused recreation. Maintenance, enhancement, and restoration of aquatic and terrestrial wildlife habitat could result in better recreational experience due to increases in wildlife populations. However, implementation of the restoration plan and specific activities could result in temporary closures and restrictions to access for recreation and grazing in much the same way that the EWP Program resulted in temporary closures to Strawberry River and Timber Canyon roads. For example, work along the Strawberry River could result in temporary closures to the road while heavy machinery is in use. Similarly, vegetation management or erosion control treatments in the upper watershed could result in temporary closures or exclosures to grazing while native or desired vegetation is established. The activity cards and associated actions that could affect recreation are provided **Appendix B**.

Cumulative effects on access and recreation include past, present, and future activities taking place in and adjacent to the Project Area. Past actions to improve roads/access and protect infrastructure constructed hardened low water crossings, bridges, and a road realignment that make Strawberry River Road and Timber Canyon Road less susceptible to damage from high flows. Similarly, the U.S. Forest Service has replaced and enlarged culverts in tributaries to Timber Canyon to improve travel and fish passage. These actions improve access for management, recreation, and grazing. Reseeding activities have improved the vegetative component of wildlife habitat for native ungulates and livestock. To maintain a conservation population of native Colorado cutthroat trout the UDWR periodically treats Timber Canyon and Shotgun Draw with rotenone, followed by stocking.

Gully Stabilization

There are approximately 16 miles of gullies on the Ashley National Forest that need to be field verified to determine if stabilization treatments are needed. Up to 650 trees of various sizes would be needed per linear mile of gully requiring treatment. It is assumed that at least 95 percent of trees used to stabilize gullies would be already downed wood or standing dead trees. A maximum 520 living trees (5%) and a maximum 4,160 (40%) standing dead trees would be cut down as part of this activity (see **Figure 14**). Trees would only be cut down within 300 feet of the gully requiring treatment. This would result in a maximum of 1,164 acres of land in the roadless area being impacted by the Proposed Action.

Floodplain Reconnection

The effects of floodplain reconnection could be a limitation to the areas where the Strawberry River can be directly accessed for fishing during high water.

Riparian Plantings

Denser riparian vegetation could affect fishing by making it more difficult to access the Strawberry River.

Road / Stream Crossings and Improvements

Construction of stream crossings and improvements affect access for recreation and grazing by reducing the potential for culvert "blow outs," which would close roads and limit access.

3.10 Climate Change

Globally, the most prevalent (79% of total) greenhouse gas that enters the atmosphere because of human activities is carbon dioxide (CO2); therefore, CO2 is used as a reference for other gases related to their respective global warming potential. Global warming potential refers to the capability of a gas to trap heat in the atmosphere over a 100-year period. At present, the United States contributes approximately 5.2 billion metric tons of greenhouse gases (CO2e) per year. The main source of greenhouse gas emissions is electricity production, which accounted for 25 percent of the U.S. emissions in 2020. The next-largest contributors are the transportation sector (27 percent) and industry (24 percent) (EPA, 2022).

Implementation of the Proposed Action would involve pickup trucks, all-terrain vehicles (ATVs) and/or utility task vehicles (UTVs) or side-by-sides to transport workers to the individual treatment sites. Chain saws would also be used for several of the restoration activities. Heavy equipment (e.g., backhoes) may be used for some of the restoration activities that would occur under the Proposed Action, in areas where existing roads provide adequate access to the treatment areas. It is expected that the negative effects of emissions of greenhouse gases from this equipment would be minor, short-term (limited to the construction period), and would not measurably contribute to the buildup of greenhouse gases associated with climate change. Restoration of native vegetation in the riparian corridor and adjacent uplands would have a relatively small, beneficial effect on reducing greenhouse gases through carbon dioxide update by vegetation in the Project Area.

4 Consultation and Coordination

4.1 Tribes, Agencies, Organizations, and Individuals Consulted

During the development of this Restoration Plan and Environmental Assessment, the URMCC and USFS (Co-Lead Agencies) engaged with federally recognized tribes, federal, state, and local agencies, special interest groups, and individuals. The agencies did this to ensure compliance, in both spirit and intent, with 40 CFR 1501.6, 1501.7, 1502.19, and 1503. As part of a scoping process, the two agencies implemented collaborative outreach that included inviting other agency personnel to be cooperative partners for Restoration Plan and EA development. Other agencies or stakeholders not considered a cooperating agency, participated as a member of the Steering Committee / Stakeholder Group. In addition, the two agencies held one public open house during the required 30-day comment period to solicit questions and feedback from stakeholders and other interested individuals.

4.1.1 4.1.1 Government-to-Government Consultation

The federal government works on a government-to-government basis with Native American tribes, who are recognized as sovereign governments. This relationship was formally recognized on November 6, 2000, with Executive Order 13175 (Federal Register, Volume 65, page 67249). In support of URMCC, Reclamation coordinates with all tribal governments, associated native communities, native organizations, and tribal individuals whose interests might be directly and substantially affected by activities overseen by the agency. In addition, Section 106 of the National Historic Preservation Act requires federal agencies to consult with Native American tribes for undertakings on tribal lands and for historic properties of significance to the tribes that may be affected by an undertaking (36 CFR 800.2(c)(2)). Bureau of Reclamation's 2020 manual *Working with Indian Tribal Governments* guides consultation between Indian tribes and Reclamation staff.

Executive Order 13175 stipulates that, during the NEPA process, federal agencies consult tribes identified as being directly and substantially affected. The Bureau of Reclamation notified several tribes of the proposed action in writing in XXXXX 2023 of the availability of the draft Restoration Plan and EA. Letters were sent to . . . . Comments consisted of …

In preparation of this EA, a cultural resource specialist conducted a Class I literature review to identify previous cultural resource surveys and recorded sites within the Project Area. A Class III intensive pedestrian survey was not conducted. No consultation with the Utah State Historic Preservation Office (SHPO) has occurred at this time. The Restoration Plan proposes terrestrial and aquatic habitat restoration and enhancement projects as well as other ground disturbing activities that have the potential to negatively impact cultural resources. Prior to future implementation, URMCC and Reclamation will work closely with Utah SHPO to identify any potential impacts on cultural resources.

Consultation with the USFWS is required under Section 7(c) of the ESA before the initiation of any project or plan that may affect federally listed or endangered species or their habitat. At the beginning of the project, the USFWS was invited to participate in the planning process and respectfully declined. During the planning process the agencies presented the Draft Restoration Plan to the Interagency Biological Assessment Team (IBAT) on October 18, 2022. This meeting was facilitated and attended by

George Weekley, Deputy Field Office Supervisor in the USFWS's Utah Ecological Services Field Office. Based on this coordination, URMCC does not anticipate the need to draft a biological assessment to evaluate the potential impact of the Restoration Plan on federally listed threatened and endangered species. There is no evidence indicating the presence of ESA-listed species in the Project Area

4.1.2 4.1.2 Participating Agencies

NEPA requires the URMCC to coordinate planning with other federal agencies that have jurisdiction by law or special expertise with respect to any environmental impact from a proposed action (see 40 CFR 1501.8). A federal, state, or local government agency or Native American tribe may enter into a formal agreement with the lead federal agency as a cooperating agency to help develop an environmental analysis. Cooperating agencies and tribes share expertise and knowledge of the Project Area to draft planning documents for public lands and communities within a regulatory framework. Agencies that were invited to participate in various capacities in this Restoration Plan and NEPA process are presented in **Table 16**, below.

Table 16. Agency Participation

Agency	Invited	Accepted
Lead Agencies		
Utah Reclamation Mitigation and Conservation Commission	Yes	Yes
U.S. Forest Service	Yes	Yes
Cooperating Agencies		
Bureau of Reclamation	Yes	Yes
Utah Division of Wildlife Resources	Yes	Yes
Tribal and Other Governmental Stakeholder Agencies		
Ute Tribe	Yes	Yes
Bureau of Indian Affairs	Yes	Yes
U.S. Fish and Wildlife Service	Yes	No
National Resource Conservation Service	Yes	No
U.S. Army Corps of Engineers	Yes	No
Central Utah Project Completion Act Office (CUPCA) (Department of Interior)	Yes	Yes
Duchesne County	Yes	Yes

Agency	Invited	Accepted
Wasatch County	Yes	No
Central Utah Water Conservancy District	Yes	Yes
Non-Governmental Stakeholders		
Trout Unlimited	Yes	Yes
The Nature Conservancy	Yes	No

5 List of Preparers

The Restoration Plan and Environmental Assessment were prepared primarily by staff from the lead cooperating agencies, members of the Steering Committee/Stakeholder Group, and project consultants from Martin & Nicholson Environmental Consultants. The following is a list of people who prepared or contributed to the development of these documents.

Table 17. List of Preparers

Agency	Name	Role/Responsibility
Ute Tribe	Jamie Arrive	Steering Committee / Stakeholder Group Member
Utah Reclamation Mitigation Conservation Commission	Richard Mingo	NEPA Agency Lead, Steering Committee / Stakeholder Group Member
	Jessie Stegmeier	Steering Committee / Stakeholder Group Member
	Melissa Stamp	Steering Committee / Stakeholder Group Member
	Michael Mills	Steering Committee / Stakeholder Group Member
	Mark Holden	Steering Committee / Stakeholder Group Member
Bureau of Reclamation	Tom Davidowicz	Steering Committee / Stakeholder Group Member
	Bruce Whiting	Steering Committee / Stakeholder Group Member
	Ben Woolf	Steering Committee / Stakeholder Group Member
U.S. Forest Service	Kristy Groves	District Ranger, Steering Committee / Stakeholder Group Member
	Ron Brunson	Steering Committee / Stakeholder Group Member
Bureau of Indian Affairs	Chris Secakuku	Steering Committee Stakeholder Group Member

Agency	Name	Role/Responsibility
Utah Division of Wildlife Resources	Pat Rainbolt	Project Manager, Steering Committee Stakeholder Group Member
	Randall Thacker	Steering Committee Stakeholder Group Member
	Garn Birchell	Steering Committee Stakeholder Group Member
	Bryan Engelbert	Steering Committee Stakeholder Group Member
Duchesne County	Mike Hyde	Steering Committee Stakeholder Group Member
Central Utah Water Conservancy District	Mike Rau	Steering Committee Stakeholder Group Member
Trout Unlimited	Mike Fiorelli	Steering Committee Stakeholder Group Member
Consultant Team	**Name**	**Role**
Martin & Nicholson Environmental Consultants	Brian Nicholson	Project Manager, Watershed Scientist, NEPA Writer
	R. Spencer Martin	Principal Ecologist, NEPA Lead
	Susan Martin	Plant Ecologist, NEPA Writer
	Sam Allen	Field Biologist, NEPA Writer
JW & Associates	Brad Piehl	Hydrologist, Upland Watershed Assessment Lead
	Abby McNamara	GIS Specialist
	Jessica Wald	Watershed Planner
Eco Logical Research, Inc.	Dr. Nicolaas Bouwes	Aquatic Ecologist, Geomorphic Assessment and Riverscape Restoration Lead
	Scott Shahverdian	Geomorphologist
	Dr. Joseph Wheaton	Fluvial Geomorphologist

Agency	Name	Role/Responsibility
Neatline, LLC	Tyson Schreiner	GIS Specialist
Certus Environmental Solutions, LLC	Sheri Ellis	Cultural Resource Specialist

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Appendix A- Dollar Ridge Fire Restoration Plan prepared by Eco Logical Research (ELR)

Includes the Dollar Ridge Fire Post-Fire Upper Watershed Hazard Analysis & Recommendations prepared by JW Associates (JWA) and the Geomorphic Assessment of the Strawberry Watershed within the Dollar Ridge Fire Project Area prepared by ELR as appendices

Appendix B- Activity Cards

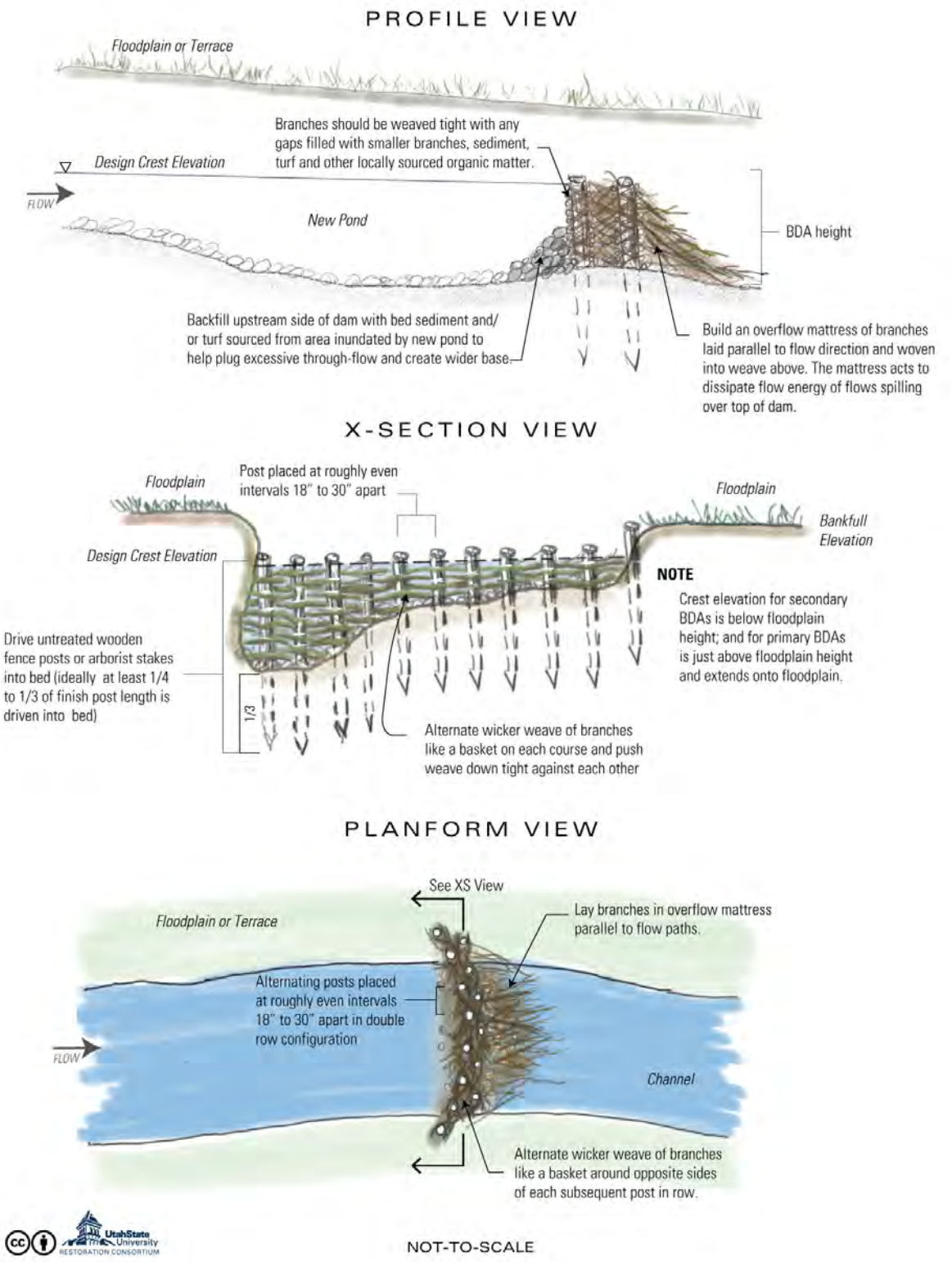
NEPA ACTIVITY CARDS

The following describes the types of management activities that would be conducted to accomplish the objectives of the project, as well as the conditions and/or locations where these activities could occur. These management activities would be accomplished incrementally. The activity cards are used as part of the NEPA analysis process. More specific information about how to apply these management activities is found in the Restoration Plan.

RIVERSCAPE ACTIVITY CARDS

Structure Addition

Description	Use low-tech process-based restoration, such as adding large boulders and/or large wood, including post-assisted log structures (PALS) and/or beaver dam analogs (BDAs) to mimic, promote, and sustain the processes of wood accumulation and beaver dam activity. Use boulders where appropriate to create fish passage barriers to keep nonnative fish out of native fish habitat.
Objectives	Increase the structural complexity of the stream which will lead to increased habitat complexity.
Condition /Situation Trigger	Areas with low channel complexity
Related Actions	LTPBR would be used in conjunction with other restoration efforts including floodplain reconnection, channel modification, and riparian planting.
Methods / Treatments	Build PALS using locally available wood sources and untreated wood posts to hold in place. Build BDAs by using untreated wood posts, branches, and substrate to mimic a natural beaver dam mainly in side channels or where immediate floodplain connection can occur. Use boulders where appropriate. All treatments will be used in areas where the risk to infrastructure is low.
Equipment	Hydraulic post-pounder, chainsaws, shovels, loppers, buckets, potentially a backhoe to move substrate, and additional hand tools and heavy equipment as necessary.
Timing	Construction would occur during low flow periods.
Duration	Consider building in phases with first phase meant to promote processes and subsequent phases to push restoration response in desired direction. Phases based on responses rather than set time but likely several years will be needed. Maintenance would likely be required in subsequent years to maximize the effectiveness of structures until natural processes take over.



Profile, cross-sectional, and planform views of typical beaver dam analog (BDA) (from Wheaton et al. 2019).

Channel Modification

Description	Construct side channels in floodplains and realign or increase structural complexity of channels that have been modified.
Objectives	To increase the length and area of side channels available to fish at multiple flows. This will provide flow refugia (e.g., backwater areas) and greater habitat complexity.
Condition /Situation Trigger	Use in areas where the main channel has been modified, straightened, or moved, or where the floodplain elevation is not too high above the main channel, i.e., where new channel bottom is connected to the floodplain during high flow releases, and one or both of the following situations is present: 1. Floodplain is wide enough to allow meandering and branching of new channels 2. LTPBR approaches are unlikely to create new side channels in the near term (5-10 years)
Related Actions	Low-tech process-based restoration may be used in new channel to divert water into other channels. Align riparian plantings to new water table elevations in frequently inundated areas.
Methods / Treatments	Excavate new channel(s) in the existing floodplain, lower floodplain or floodplain bench, open blocked historic channels, and/or increase geomorphic complexity, which includes channel complexity, where main channel has been heavily modified through previous work. Roads and property will be avoided/protected during channel modification activities.
Equipment	Backhoe, excavator, bulldozer
Timing	Construction would occur during low flow periods.
Duration	May require multiple phases (years) to allow for natural flow paths to become established.

Multi-thread channel

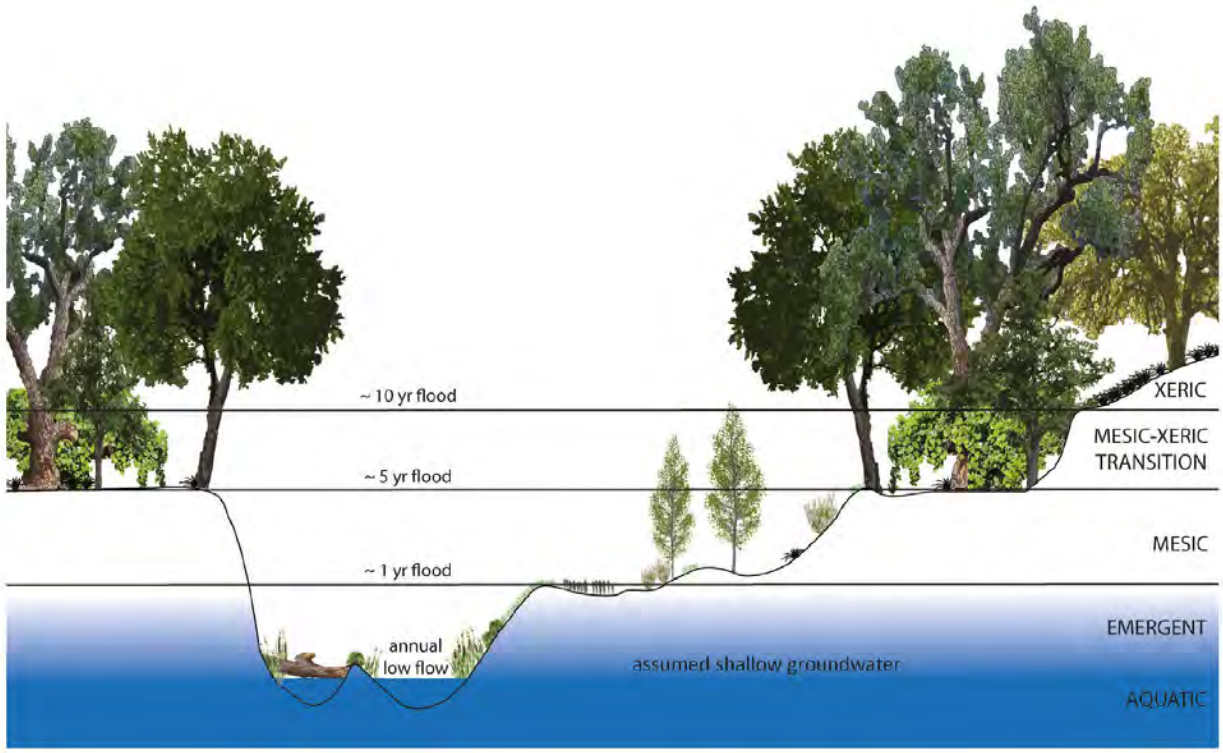
Floodplain Reconnection

Description	Raise water surface elevation and/or remove levees so that high flow events can spill onto the floodplain.
Objectives	To frequently inundate the floodplain to increase water, sediment, and wood retention during high flows, recruit riparian vegetation to provide flow refugia for fish to ensure long-term persistence, and provide improved habitat for other wildlife species.
Condition /Situation Trigger	Use in areas where levees are preventing high flows from accessing the floodplain and one or more of the following is true: 1. Floodplain can be accessed by river during high flow events 2. Irrigation canals are present that could potentially divert water onto the floodplain into newly created channels
Related Actions	Can be used in conjunction with channel modification. In some locations, low-tech process-based restoration might reconnect floodplains at high flows. Material from side channel construction might be used to fill in beaver dam analogs in the mainstem. Riparian plantings should be coordinated with areas likely to be connected hydrologically.
Methods / Treatments	Remove levees that might be preventing high flows from reaching the floodplain. Use large beaver dam analogs (BDAs) or post-assisted log structures to raise water surface elevations in main channel. Material from side channel construction or levee removal could potentially be used as fill in large BDAs or even to raise channel elevations in the main channel behind structures. Levees that are in place to protect property will not be removed.
Equipment	Backhoe, excavator, bulldozer, post-pounder, hand tools, chain saws
Timing	Construction would occur during low flow periods
Duration	Multiple phases (years) will likely be required based on the number of high flow events and responses to flow paths.

Levee removal in Sulphur Draw

Riparian Plantings

Description	Plant cottonwood, willows, and other native riverine and riparian species to accelerate riparian plant recruitment
Objectives	To increase diversity and abundance of native riparian plant species to benefit wildlife, mediate water temperatures, increase production, provide wood retention and wood source for aquatic habitat and riverine function.
Condition /Situation Trigger	Replant in areas where tree mortality from the fire was high and/or existing riparian vegetation density is low for other reasons.
Related Actions	Floodplain reconnection, channel modification, and LTPBR will be used to frequently inundate floodplains and raise water table elevations. Weed control associated with vegetation management.
Methods / Treatments	Use nursery seedlings and local cuttings for woody vegetation and grass and forb seeding where appropriate. These treatments should be used in areas where the water table is easily accessible, existing, or new irrigation infrastructure can deliver water high on the floodplain. May also require wildlife protection (temporary fencing or vented tree shelters around seedlings). Preferentially use in areas that get inundated or have raised water surfaces.
Equipment	Power and hand augers, and hand tools, heavy equipment (irrigation infrastructure)
Timing	Most appropriate for species planted (usually spring and fall).
Duration	Multiple years



Planting zones in riparian areas, defined by the relative height of the approximate flood recurrence interval and the surface elevation (from Bair et al. 2021).

UPLAND WATERSHED ACTIVITY CARDS

Soil / Hillslope Erosion Reduction

Description	Hillslope cover treatments can be very effective at reducing soil erosion, increasing soil infiltration and soil moisture, and reducing subsequent sediment yield from burned hillslopes (Robichaud et al. 2010, Wagenbrenner et al. 2006). It is more effective to reduce erosion onsite with hillslope treatments, than to collect it downstream via in-channel treatments. 1. Ground-based mulch application involves trucking materials to the site and then spreading them by hand. 2. Mastication involves the use of large equipment moving across the burned areas and basically chipping the burned trees into mulch that helps reduce erosion. 3. Log erosion barriers (LEBs) are burned trees that are felled, limbed and placed perpendicular to the slope. They are designed to function in combination with other LEBs both up and down slope. 4. Seeding native plants can be accomplished by hand or aerial application of seeds with helicopters or fixed wing aircraft. 5.
Objectives	Reduce post-fire hillslope erosion to reduce loss of soil on slopes and downstream sedimentation. Reduce surface runoff from hillslopes that leads to increased post-fire peak flows and subsequent damage downstream.
Condition /Situation Trigger	Bare soils; prioritize hillslopes with active erosion and high severity burned areas in identified high hazard areas. These areas can be identified by remote sensing, GIS analysis and field verification.
Related Actions	Vegetation management (seeding) and gully stabilization
Methods / Treatments	Apply mulch to bare soils to minimize soil erosion. Agricultural straw or wood mulch can be used and applied by hand, truck, or a combination of methods. Mastication of burned trees creates wood mulch. It can be accomplished on hillsides with a slope of less than 30%. Log erosion barriers (LEB) are burned trees that are felled, limbed and placed perpendicular to the slope. They need to be dug into the soil and staked to avoid surface runoff from eroding under the log. They also must be installed level so that surface runoff does not become concentrated on one side of the log and form a gully. Application of native seed can be used to speed native plant recovery.
Equipment	Ground based mulch application involves; trucks, OHVs, hand tools, and chippers Mastication involves; masticators, trucks, and support vehicles LEBs involves; chainsaws and hand tools Aerial Seeding involves; airplanes or helicopters, and trucks Ground based seeding involves; seed dispersal equipment (different for steeper slopes), trucks, ATVs, and hand tools.
Timing	Seeding is generally most successful in the fall just before winter snows cover the ground. Ground-based activities on bare soils need to be completed in the spring, summer and fall after soils have dried out enough to not cause soil disturbance. Mulch application can occur at any time, including winter, but if done in combination with seeding it should be done as soon as possible after the seeding.
Duration	These treatments can be accomplished in a season for small areas but are highly dependent on the area of application.

Mulch placed under a burned mixed conifer overstory

Gully stabilization

Description	1. Directional tree felling is cutting burned trees into actively eroding gullies to reduce erosion in the gully and subsequent deposition downstream. 2. Grade control structures are generally rock or log structures that are installed in gullies that are actively downcutting. These structures are designed to reduce channel incision and stabilize the gully. 3. Straw wattles are long wrapped tubes that are composed of agricultural straw or aspen stems. They are flexible and can be used in a variety of applications.
Objectives	Stabilize existing gullies and eroding areas that appear to be forming gullies to minimize post-fire erosion and peak flows being generated downstream.
Condition /Situation Trigger	Slopes with bare soils where gullies are forming in high severity burned areas in identified high hazard areas.
Related Actions	soil/hillslope erosion and surface runoff treatments to be most effective.
Methods / Treatments	1. Directional tree felling is accomplished by identifying gullies that would benefit from stabilization and have adequate burned trees available on the banks of the gully. These trees are felled using chainsaws, usually by hand crews. The trees are then cut into somewhat smaller pieces and large branches removed so that they have good gully contact and contact with other felled trees. In larger gullies, groups of interlocking felled trees can create a more stable situation. 2. Grade control structures are installed generally by hand crews using hand tools to dig rocks and trees into the gully bottom. Grade control structures can be installed with backhoes where access permits. Rocks and logs should be anchored into the gully banks to avoid runoff eroding the edges of the structures. 3. Straw wattles can be installed in gullies that are expected to have lower runoff volumes. They are secured in the gully with rocks and/or stakes pounded into the gully or gully banks. They fill with sediment sometimes quickly and should be installed in a series to be most effective.
Equipment	ATVs to access the sites Directional tree felling involves use of chain saws, hand saws, and ropes. Grade control structures involve; hand tools, backhoes (where access allows), chainsaws, and other hand tools. Straw wattles involves; hand tools, stakes, and rocks.
Timing	These treatments can be installed whenever access permits and the gullies are not wet. Working in wet gullies could cause additional ground disturbance that would be counterproductive.
Duration	These treatments could be installed in weeks to months depending on size of the gully. The duration of installation would depend on how many gullies needed treatment and what types of treatments.

Felled trees placed for gully stabilization

Vegetation Management

Description	Wildfires can change the vegetation cover to include noxious weeds and other non-native, invasive plant species. 1. Planting shrub and tree seedlings 2. Reseeding 3. Installing aspen exclosures 4. Non-native plant control followed by reseeding with native grasses and forbs
Objectives	To improve species composition and percent cover of native plant species To promote native plant community recovery.
Condition /Situation Trigger	Areas that have been identified as containing a higher percentage of noxious weeds or other invasive, non-native species or are not recovering to a desirable, native plant community.
Related Actions	
Methods / Treatments	Broadcast seeding, planting woody species seedlings, constructing exclosures, mulching, chemical and mechanical spot treatment of noxious weeds.
Equipment	Planting seedlings is generally accomplished with hand crews with simple hand tools. Aspen exclosures require installation of fences high enough to keep elk out. Posts need to be driven into the ground or post holes dug with equipment. Fencing materials need to be transported to the site via trucks, ATVs, or dropped via helicopter. Noxious weed and invasive, non-native plant control can involve; hand crews pulling weeds and/or using backpack sprayers to apply herbicide. Aerial application will not be used.
Timing	Planting seedlings usually is most successful as early in the spring as possible. Aspen exclosures can be installed anytime of the year as long as the ground is not wet.
Duration	Annually, as necessary to control weeds and reestablish a native plant community.

Aspen Exclosure

Road / Stream Crossing Improvements

Description	1) Improve road drainage by adding cross drain culverts, improving ditches and/or outsloping section of road. 2) Install larger culverts or other road-stream crossing structures with greater capacity for higher peak flows and debris 3) Install low water crossings where they are appropriate
Objectives	Increase the resiliency of road systems in the post-fire environment.
Condition /Situation Trigger	Roads that cross streams that have culverts, bridges, or other drainage structures that are not adequate for post-fire peak flows and debris. Also, roads that receive hillslope or gully erosion from hillsides that do not have adequate drainage to accommodate post-fire runoff.
Related Actions	Grading and gravel surfacing of roads may be required or needed to complete the drainage or stream crossing treatments. Gully stabilization upslope from roads.
Methods / Treatments	Stream/road crossings should be sized to pass a minimum of 5-year post-fire peak flow. If post-fire peak flows are not calculated the 100-year pre-fire peak flow can be used as an approximation. The road fill on both the upstream and especially the downstream side should be covered with large rock to reduce erosion. Trash racks or similar devices that prevent debris from clogging the culvert inlet should be installed in stream crossings that have a high potential for delivering debris to the crossing. Low water crossings constructed of concrete or road base should be used where levels and types of traffic support their use.
Equipment	Backhoes, graders, loaders, dump trucks, small excavators, hand tools
Timing	Projects that involve live stream crossings would be ideally completed at low flow conditions likely in the fall. However, anytime that the installations can be completed in a safe manner would be acceptable. Winter and spring when roads are soft and muddy should be avoided. Stream Alteration Permits and County Flood Zone Development Permits will address the timing of installation.
Duration	Stream crossing projects can generally be accomplished in a few days. The road will need to be closed or rerouted during this work so accomplishing the projects quickly is desirable. Road closures will need to be coordinated with the road department with jurisdiction.

Properly sized and placed culvert

Appendix C- Implementation Checklist

Dollar Ridge Fire Restoration Plan Implementation Approval Form

The Dollar Ridge Fire Restoration Plan Implementation Approval Form documents that site-specific factors have been considered and mitigation measures developed for each project implemented under the Dollar Ridge Fire Restoration Plan NEPA Decision. This form is intended to be a tool for aiding in determining the most effective treatments and supply the implementing agency with supporting documentation for the project file. The project lead will fill out the form and coordinate with land management agencies and adjacent landowners as necessary.

Site Specific Name/Identifier/River Miles: _____
Site Visit Date and Participants: _____

Insert ☑ or ☒ next to the item when completed. Add date completed, notes, and attach supporting documents as an attachment:

- ☐ Project Map. Clearly identify treatment area.
- ☐ Which condition/situation trigger on which activity card/s does this restoration action fit under?
- ☐ USFS Pre-treatment Restoration Area Assessment Field Forms, as needed.
- ☐ Desired treatment or silvicultural prescription:
- ☐ Surveys for FWS listed and/or sensitive plants or animals completed. Results:
- ☐ Surveys for migratory birds completed. Results:
- ☐ Mitigation measures:
- ☐ Surveys for cultural resources completed. Results:
- ☐ National Historic Preservation Act Section 106 compliance completed.
- ☐ Tribal Consultation completed.
- ☐ Mitigation measures:
- ☐ Clean Water Act permits completed.
  Note: Activities implemented below the Ordinary High Water Mark of a jurisdictional stream or in wetlands will require a Department of Army Permit while activities located in the channel and within twice the width of the active channel (up to 30 feet) are regulated by the Utah Division of Water Rights (State Engineer) under the Stream Alteration Program (This includes tree planting in riparian areas).