GRAND VALLEY RIPARIAN AND FLOODPLAIN ACTION PLAN

PROTECTING AND RESTORING THE GRAND VALLEY'S VANISHING RIPARIAN CORRIDORS

Photo Credit: Joel Sholtes

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PROJECT SUMMARY

The Grand Valley River Corridor Initiative (GVRCI) formed in 2020 to promote enhanced coordination and collaboration on Colorado and Gunnison River corridor activities. The purpose of the GVRCI is "supporting and maintaining a healthy river corridor and its associated needs, uses, and values for generations to come"[1]. A first step towards improved river corridor management is to assess the current state of riparian and floodplain health. Evaluating conditions in the context of legacy and current land uses, as well as the complex overlapping regulatory overlays that promote or discourage specific development patterns and use types, can help communities understand what types of development strategies and policies are most and least beneficial to achieving the goals of the GVRCI. Highlighting the natural factors and use practices that contribute to the continued loss of functional and healthy riparian landscapes provides a path forward to improving management approaches in order to avoid continuing losses of riparian and floodplain functions and values.

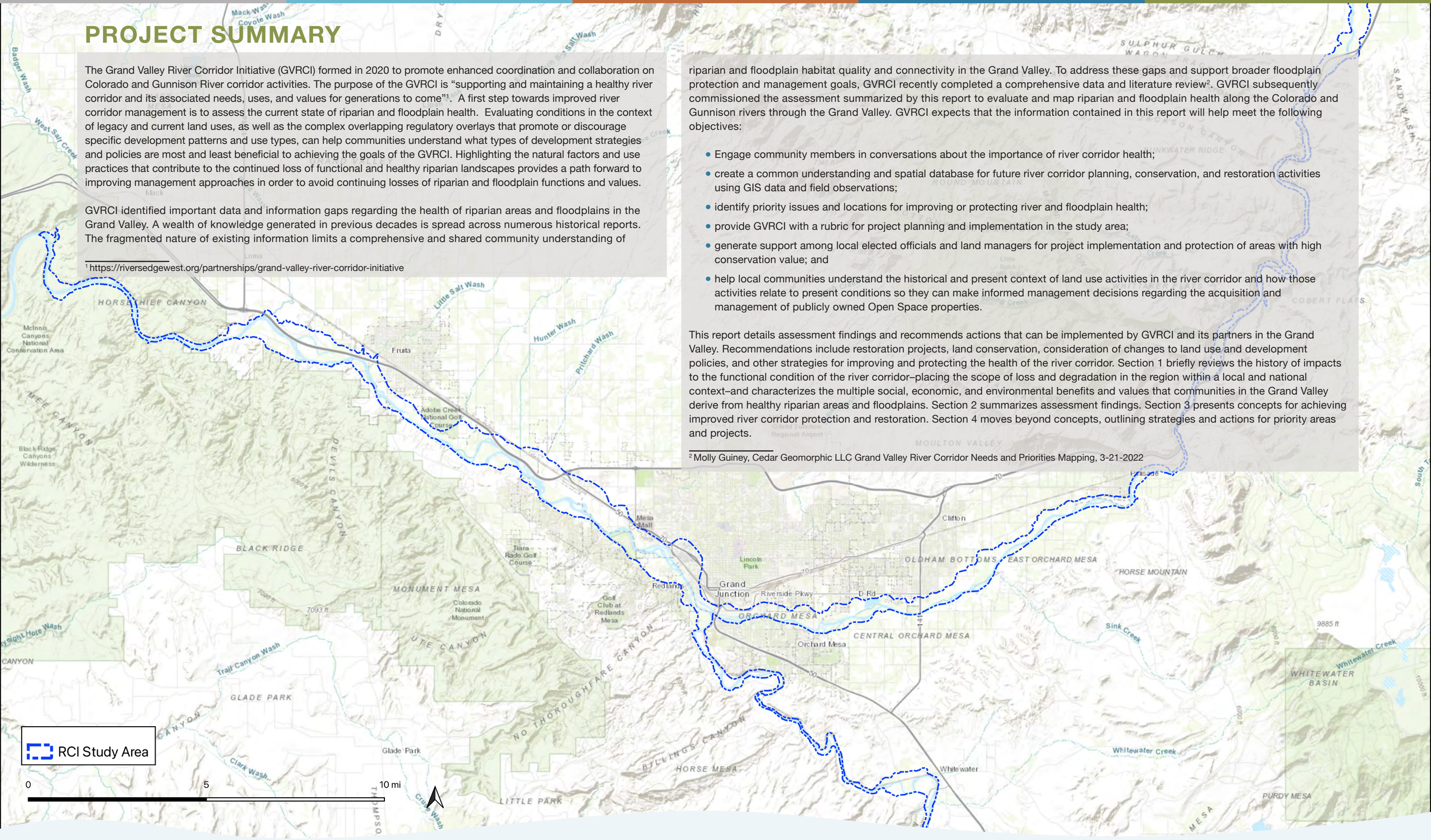
GVRCI identified important data and information gaps regarding the health of riparian areas and floodplains in the Grand Valley. A wealth of knowledge generated in previous decades is spread across numerous historical reports. The fragmented nature of existing information limits a comprehensive and shared community understanding of riparian and floodplain habitat quality and connectivity in the Grand Valley. To address these gaps and support broader floodplain protection and management goals, GVRCI recently completed a comprehensive data and literature review[2]. GVRCI subsequently commissioned the assessment summarized by this report to evaluate and map riparian and floodplain health along the Colorado and Gunnison rivers through the Grand Valley. GVRCI expects that the information contained in this report will help meet the following objectives:

- Engage community members in conversations about the importance of river corridor health;
- create a common understanding and spatial database for future river corridor planning, conservation, and restoration activities using GIS data and field observations;
- identify priority issues and locations for improving or protecting river and floodplain health;
- provide GVRCI with a rubric for project planning and implementation in the study area;
- generate support among local elected officials and land managers for project implementation and protection of areas with high conservation value; and
- help local communities understand the historical and present context of land use activities in the river corridor and how those activities relate to present conditions so they can make informed management decisions regarding the acquisition and management of publicly owned Open Space properties.

This report details assessment findings and recommends actions that can be implemented by GVRCI and its partners in the Grand Valley. Recommendations include restoration projects, land conservation, consideration of changes to land use and development policies, and other strategies for improving and protecting the health of the river corridor. Section 1 briefly reviews the history of impacts to the functional condition of the river corridor–placing the scope of loss and degradation in the region within a local and national context–and characterizes the multiple social, economic, and environmental benefits and values that communities in the Grand Valley derive from healthy riparian areas and floodplains. Section 2 summarizes assessment findings. Section 3 presents concepts for achieving improved river corridor protection and restoration. Section 4 moves beyond concepts, outlining strategies and actions for priority areas and projects.

[1] https://riversedgewest.org/partnerships/grand-valley-river-corridor-initiative

[2] Molly Guiney, Cedar Geomorphic LLC Grand Valley River Corridor Needs and Priorities Mapping, 3-21-2022



GRAND VALLEY'S VANISHING RIPARIAN CORRIDORS

Functional and intact river corridors provide a multitude of economically and environmentally valuable ecosystem services. These include flood flow buffering and attenuation, bank stabilization, water quality protection, reduction or attenuation of nutrient and fine sediment loading to streams, groundwater recharge, local microclimate regulation, instream temperature refugia, wildlife habitat and refugia, wildlife movement corridors, leaf litter and organic matter sources for instream food webs, and aesthetic buffering of human-built environments [Table 1]. Degradation of riparian vegetation communities and floodplain structure through removal or fragmentation significantly reduces or eliminates these free and valuable functions and services.

The Colorado and Gunnison river corridors in the Grand Valley support vibrant agricultural traditions and growing cities. Bottomlands along the river corridor feature rich, but frequently degraded and imperiled, natural assets. A century and a half of agricultural and urban land use change was accompanied by steep costs to the valley's natural heritage. As agricultural areas and urban zones expanded, riparian forest buffers were altered, degraded, or removed completely along significant portions of the river corridor. River flow regimes (the annual and seasonal timing and typical amounts of streamflow) have been significantly altered by both local water infrastructure and the construction of major upstream reservoirs and trans-mountain diversions. Natural channel maintenance and formation processes of sediment erosion, transport, and deposition have been cut off or severely constrained by floodplain alteration or filling, and channel training via bank armoring or other confinements[3]. Cumulative impacts have severely reduced the contemporary extent and health of riparian forests and in-channel habitat area and quality, with associated degradation of water quality, fisheries, and wildlife[4].

The challenges facing Colorado's river corridors, which include their floodplains, riparian vegetation communities, and additional fluvially influenced lands, are widespread. Despite better understanding the vital roles and services these unique ecosystems provide for both human communities and nature, as well as changing social values and ethics regarding habitat preservation and water quality protection especially since the 1960s, the historical pattern of degradation in river corridors continues today. Riparian forests and other wetlands make up approximately 1.5% of

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Colorado's surface area and are estimated to have declined by over 1,000,000 acres or close to 50% since statehood[5]. The Grand Valley corridor is no exception. Comparisons of estimated historical riparian corridor coverage to modern extents indicate losses approaching 50% since the 1930s and 65% since the Valley's early development in the late 1800s [Figure 1]. The challenge to riparian wetland preservation facing local communities in the present day is balancing the societal demands for land development with protection of the vital services that these remaining ecosystems provide.

Floodplains in the Grand Valley serve as critical habitat for native fish, including several species (e.g., Colorado Pike Minnow) listed on by the Endangered Species Act. These fish evolved over millennia to thrive in the habitats offered by dynamic river systems in the arid West. In addition to providing critical habitat to aquatic species, floodplains also serve important hydraulic and geomorphic functions, attenuating flood impacts and reducing erosive forces on downstream streambanks.

Riparian areas in the Grand Valley play an outsized and foundational role in the survival, sustainability, and resiliency of both state, national, and continental wildlife populations. Wildlife populations including riparian-dependent birds continue to face staggering losses at the national level as well as locally in Colorado. Migratory waterfowl populations including once common duck, geese, and crane species have declined by amounts estimated from 25% to 99% across different locales since the end of the 19th and early 20th centuries[6]. In general, habitat loss (by conversion and destruction of wetlands and riparian landscapes predominantly for agriculture use, but also commonly for urban development), unregulated market hunting, pervasive water quality degradation, and lead poisoning are reported as

[3] Valdez, R.A. and Nelson, P. (2006). Upper Colorado River Subbasin Floodplain Management Plan. Upper Colorado River Endangered Fish Recovery Program, Project Number C-6, Denver, CO.
[4] Irving, D. and Burdick, B. (1995). Reconnaissance Inventory And Prioritization Of Existing And Potential Bottomlands In The Upper Colorado River Basin. U.S. Fish and Wildlife Service.
[5] Dahl , T.E. (1990). Wetlands losses in the United States 1780's to 1980's.. U.S. Fish and Wildlife Service, Washington. D.C. 13pp.
[6] Banks, R.C., & Springer, P.F. (1994). A century of population trends of waterfowl in western North America.

Table 1: Functions and services provided by healthy floodplains riparian corridors[9]

[9] National Academy of Science (2002). Riparian Areas: Functions and Strategies for Management. ISBN 0-309012784.

FUNCTIONAL CATEGORY	RIPARIAN/FLOODPLAIN SERVICE	REQUIRED CONDITION FOR SERVICE DELIVERY
Hydrology and hydraulics	Flood attenuation	Floodplain intact and connected to channel during regular high-flow events. Short term storage of surface water on floodplains, side channels, and backwater during flood flows
	Infrastructure protection	Vegetated floodplain reduces flow velocities and erosive capacity of high flows.
	Alluvial aquifer supply and recharge	High degree of hydrological connectivity between river channel and adjacent floodplains.
	Sediment accumulation and transport	No development encroachments on floodplain, natural hydrological regime, lack of elevated sediment inputs from surrounding land uses.
Habitat and food web maintenance	Robust streamside vegetation communities	High abundance and diversity of native woody and herbaceous plants. Minimal presence of non-native species.
	Biogeochemical cycling: carbon and nutrients	Accumulation of organic matter, nutrients, etc. to underpin vegetation health, regular inundation of floodplains.
	Supports terrestrial wildlife	Appropriate native terrestrial small mammals, birds, insects and other species present in self-perpetuating communities.
	Supports aquatic wildlife	Sufficient supply of leaf litter and large woody material to stream systems. Appropriate native aquatic species present in self-perpetuating communities, able to move/migrate and use appropriate habitats throughout all life stages.
	Wildlife movement corridors	High degree of lateral and longitudinal connectivity of naturalized riparian buffers and floodplains. Lack of floodplain fragmentation.
Microclimate maintenance	Temperature and moisture regulation to animal and human communities	Diverse, multi-story canopy structure, regular recruitment of new woody vegetation, lack of development encroachment on floodplains.
	Aquatic temperature refugia	Overhanging bank vegetation, cutbank formation and other dynamic channel processes present.
Water quality protection	Reduction of fine sediment loading to streams from adjacent land uses	Sufficiently wide buffer of naturalized vegetation.
	Reduction/attenuation of nutrient loads to streams	Sufficiently wide buffer of naturalized vegetation.
Social/aesthetic buffering	Aesthetic buffering	Diverse, multi-story canopy structure present across broad, well-connected floodplains.
Recreation and community use	Naturalized open space	Diverse, multi-story canopy structure present across broad, well-connected floodplains. Public land access and protection.
	Community connection corridors	Publicly-owned/managed riparian corridors

the most consistent legacy and contemporary drivers. Lowland riparian areas, which include wetlands as well as a transitional patchwork of aquatic and upland habitats provide nesting, wintering, and breeding habitat for 75% of state birds[7]. Biologists with the Audubon Society designated the Grand Valley Riparian Corridor as an Important Bird Area, citing its use by nearly 300 species, including 70 breeding species and over 70 wintering species. Given their importance to most bird species during some portion of their lifecycles, preserving and restoring riverine and riparian habitats in the Grand Valley River Corridor are crucial to staving off further local, state, and national biodiversity loss.

[7] National Audubon Society. 2000. Important Bird Areas of Colorado. Compiled by K.A. Cafaro. Audubon-Colorado, Boulder, CO.

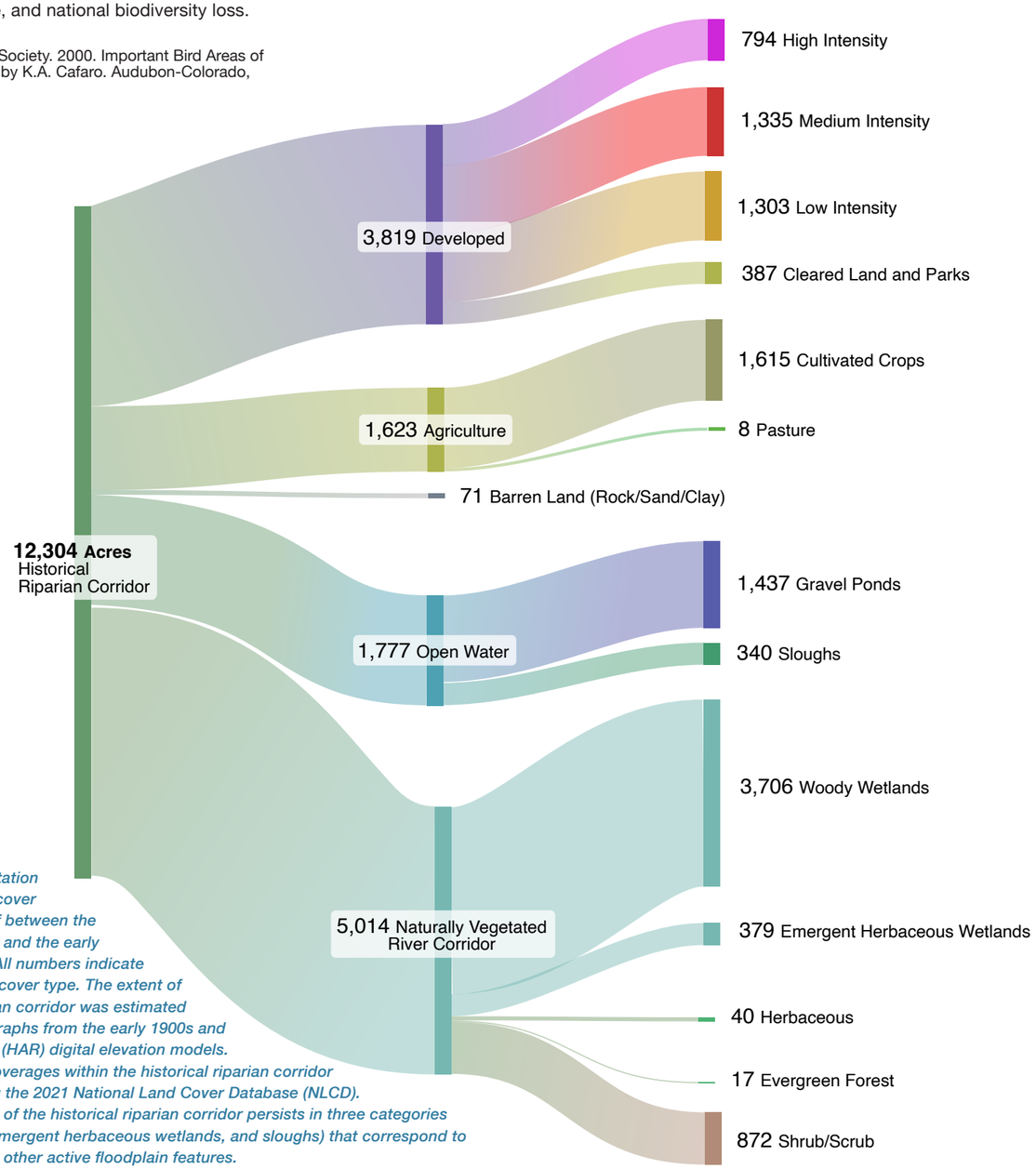


Figure 1: *Representation of changes in land cover types by acreage of between the mid-1880s (left bar) and the early 2020s (right bars). All numbers indicate acres within a land cover type. The extent of the historical riparian corridor was estimated using aerial photographs from the early 1900s and Height Above River (HAR) digital elevation models. Present day land coverages within the historical riparian corridor were mapped using the 2021 National Land Cover Database (NLCD). Approximately 35% of the historical riparian corridor persists in three categories (woody wetlands, emergent herbaceous wetlands, and sloughs) that correspond to riparian forests and other active floodplain features.*

Comparisons of estimated historical riparian corridor coverage to modern extents indicate losses approaching 50% since the 1930s and 65% since the Valley's early development in the late 1800s.

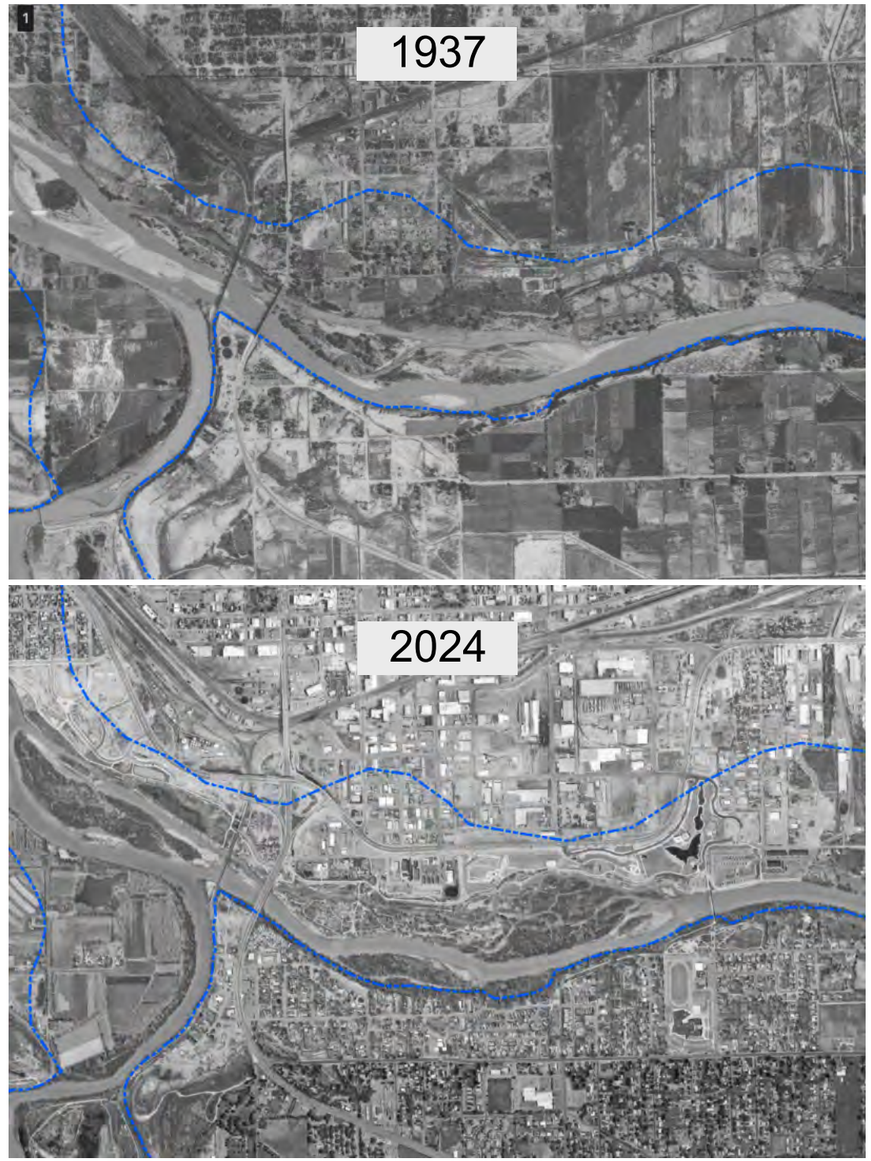


Figure 2: *Land use changes within the historical riparian corridor (blue lines) evident between 1937 and 2024 in the vicinity of the confluence of the Colorado River and Gunnison River.*

ONGOING DEVELOPMENT PRESSURES

As communities in the Grand Valley grew over the last century and a half, development progressively encroached the river corridor. The result of development-induced alteration to floodplain topography and vegetative cover is a heavily fragmented riverscape [Figure 2]. The Grand Valley river corridor is now fragmented by more than 100 miles of human-made berms and levees. These landscape changes degraded or eliminated huge acreages of functional wildlife habitat. Physical alteration of channels and floodplains (e.g., by way of bank armoring, gravel mining, and channel simplification) greatly reduced the river's natural ability to accommodate large flow events, maintain diverse aquatic habitats, and regenerate native riparian forests[8]. Simultaneously, water use and management activities, both locally and far upstream have significantly altered natural flow regimes, with major impacts to in-channel habitat quality and the functionality and resilience of adjacent river corridor landscapes [Figure 3 - 4].

Conflicting interests exist in Grand Valley communities between the desire to place commercial and residential development near the Colorado and Gunnison Rivers and the desire to protect these vitally important ecosystems. This dynamic is clear in historical patterns of residential and commercial development, especially in Grand Junction, and in the patchwork of municipal parks and Colorado Parks and Wildlife (CPW) State Wildlife Areas and other public lands.

Effective long-term management of riparian areas will require balancing the cultural and social demands on riparian resources while protecting vital ecosystem functions in ways that may not be reflected in current land use development patterns and review/approval processes.

Recognizing that few high-quality river corridor habitats remain and economic and population growth trends continue to strongly pressure river-adjacent lands, Grand Valley communities seek opportunities to stop further losses as well as address previous injuries to the system. Conserving remaining undeveloped river corridor segments, while attempting to enhance or restore other lands that are not degraded beyond redress may require new policy tools, strengthening existing partnerships, and securing long term financial and social resources. Existing development and regulatory frameworks enacted by local, state, and federal governments on lands adjacent to the river corridor may be insufficient, either in structure or application, to protect many of the functions and values associated with healthy river systems: clean water, flood attenuation, habitat protection, and infrastructure protection.

100+ miles of manmade berms and levees

[8] Sholtes, J. and Guiney, M. (2023). Fluvial Hazard Zone Mapping Addendum for the Colorado and Gunnison Rivers in the Grand Valley, Mesa County, Colorado. Prepared for RiversEdge West and the Grand Valley River Corridor Initiative. 66p.

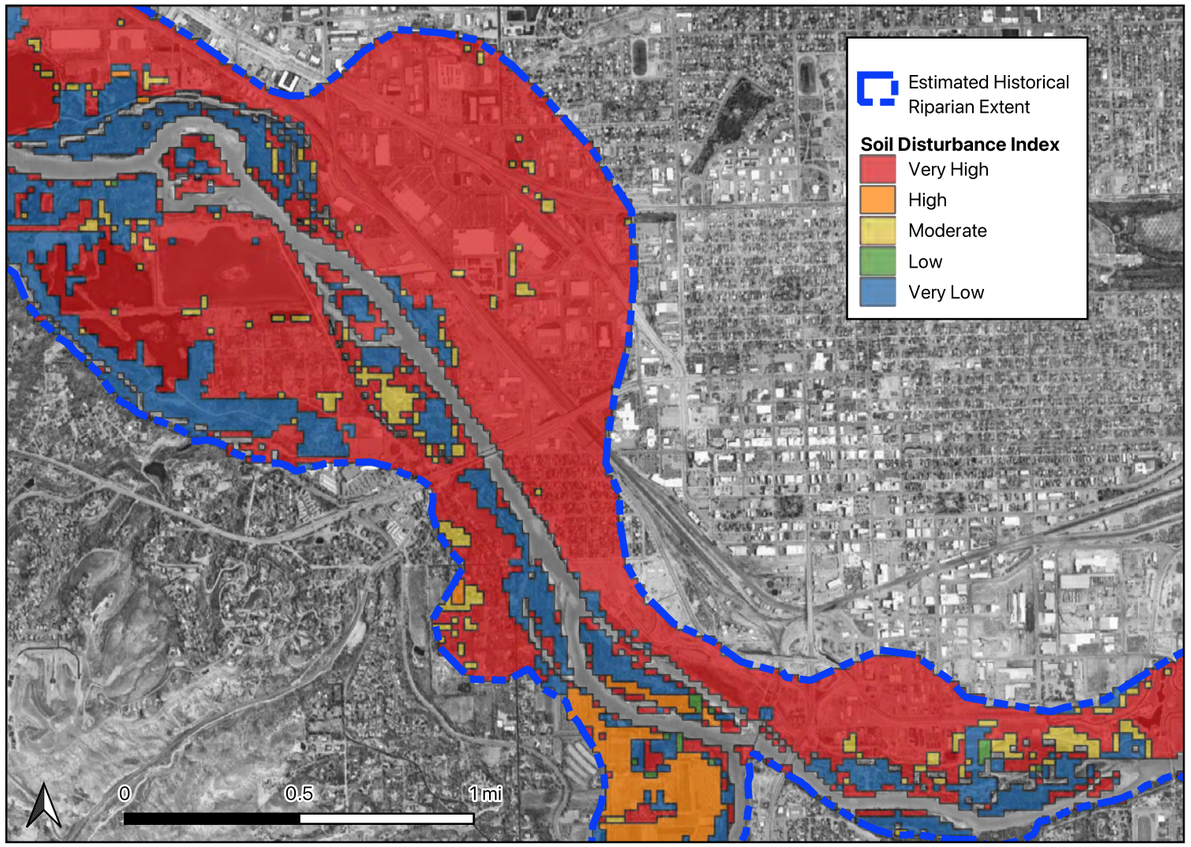


Figure 3: Soil disturbance due to development and other land use changes are evident across wide portions of the historical riparian corridor. Many areas that are highly disturbed are irrecoverably lost from the riparian ecosystem.

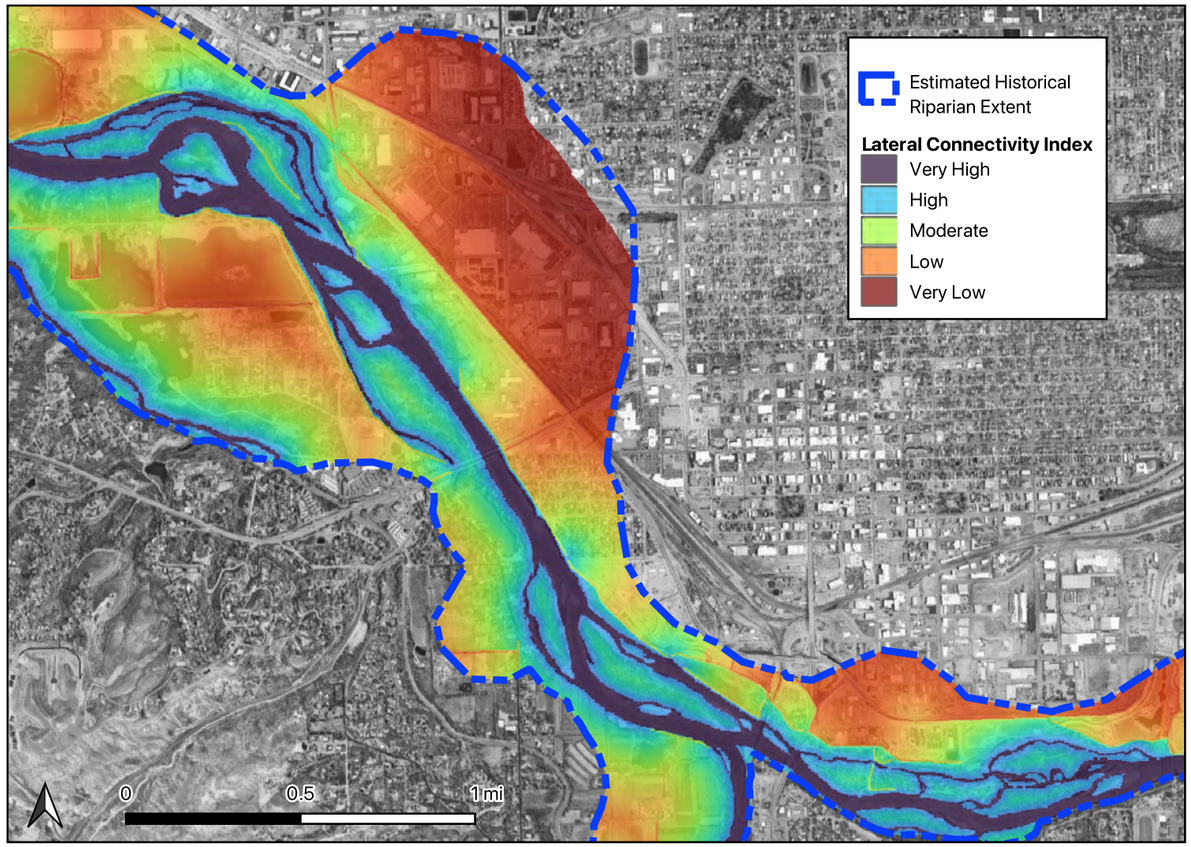


Figure 4: Lateral hydrological connections between the river and its adjacent floodplains are limited in many areas by the presence of berms and levees constructed to protect transportation corridors, gravel pits, structures, and other infrastructure. Reduced lateral connectivity significantly constrains the ability of riparian communities to persist on floodplains, since many species depend on high water tables and regular hydraulic disturbances to grow and reproduce.

THE GRAND VALLEY'S NATURAL HERITAGE AT A CROSSROADS

In a synthesis of 453 scientific publications, grazing, dams, land use change, and invasive species ranked as the top four contemporary threats to riparian ecosystems[10]. In the Grand Valley, the era of widespread livestock grazing on floodplains has past. New orchards and croplands are not being cultivated in the river corridor but the impact of agriculture remains. Significant upstream water diversions continue to affect habitat quality and dynamic channel processes. Invasive species, while more effectively managed than in previous decades, persist in many portions of the river corridor. Riparian land use conversion and urbanization is now the primary and imminent threat to the Grand Valley's remaining functional river corridor.

The Colorado Natural Heritage Program's *Survey of Critical Wetlands and Riparian Area in Mesa County* echoes national riparian inventories, noting:

"Wetland and riparian vegetation are the most threatened vegetation type in Mesa County."

"Although the rate of wetland loss in Mesa County is difficult to quantify, it is clear that many wetlands, especially on the valley floor, have been lost or profoundly altered from their pre-settlement state."

"Much of the riparian zone in the county has been invaded by non-native species"

"Floodplain dynamics along the rivers and smaller tributaries, which are necessary for continued development of wetland habitat, have been greatly altered... .New wetlands are not being created within the floodplains, non-native species (e.g. tamarisk) have thrived on this altered flow-regime, and aquatic habitat for endangered fish has been reduced."

"Habitat loss to development is considered irreversible and should therefore be channeled to areas with less biological significance. Since development tends to occur adjacent to watercourses, wetland and riparian habitats are highly susceptible to development stresses."

"It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered. However, the likelihood for human conflicts with biologically important wetlands is minimized if there is the opportunity to proactively plan for managing human activity or managing the species or habitat of interest."

[10] Poff , N. et al. (2010). The Ecological Limits of Hydrologic Alteration (ELOHA): A New Framework for Developing Regional Environmental Flow Standards. Freshwater Biology. 55. 147 - 170. 10.1111/j.1365-2427.2009.02204.x.

Photo Credit: Bill Haggerty

CURRENT RIPARIAN & FLOODPLAIN CONDITIONS

The Grand Valley River Corridor riparian and floodplain health assessment evaluated riparian and floodplain conditions along 46.4 miles of the Colorado River between Plateau Creek and Ruby-Horsethief Canyon below Fruita, Colorado and 15.2 miles of the Gunnison River between the Dominguez-Escalante National Conservation Area boundary and the confluence with the Colorado River. A subset of tasks also considered the area upstream of Plateau Creek to the town of De Beque. Assessment activities performed fell into three primary tasks. Task 1 included collation, review, and synthesis of available work in the project area (see Section 4). Outputs from Task 1 were presented to GVRCI stakeholders in meetings and workshops in summer and fall of 2024[11]. Results of Task 1 strongly informed the direction and content of Task 2: a desktop and field-based assessment of floodplain riparian and geomorphic conditions throughout the project area. Work performed under Task 2 relied primarily on desktop analyses of geospatial data and aerial photographs, with limited field verification to ground-truth desktop analysis. Field visits provided the opportunity 1) to generate impressions of ecological lift that may be achievable through restoration projects, and 2) verify the condition of areas identified as candidates for preservation. Locations selected for field visits were constrained to public property with good access to the riparian corridor. Task 3 included identification of high-priority floodplain restoration and riparian conservation opportunities in the project area. In its totality, the assessment provides GVRCI with a comprehensive view of riparian and floodplain conditions and a coherent strategy for protecting and improving the ecological integrity of the river corridor.

RIPARIAN AND FLOODPLAIN PATCH MAPPING AND ASSESSMENT

The primary goal of Task 2 was to identify and qualitatively characterize conditions on patches of existing riparian habitat and floodplain pockets. Mapping activities assessed the feasibility of protection, rehabilitation, or restoration on those patches. Contemplated actions are aspirational in nature and any future projects will need to respond to prevailing social, legal, and ownership contexts. Mapping was primarily conducted in a GIS environment using spatial data from Mesa County and additional spatial datasets developed by GVRCI. These were supplemented with data sourced from the U.S. Geological Survey, the U.S. Dept. of Agriculture, and other sources.

Due to the lack of datasets fully responsive to the task of delineating historical riparian extents, several qualitative and analytical approaches were used to estimate the pre-development riparian corridor bounds throughout the project area. Aerial imagery of sufficient resolution to support this task was available for the Grand Valley beginning in 1936. These aerial images helped identify the extent of the riparian corridor in some portions of the project area. Notably, significant land use conversion in the Grand Valley likely began around or before Grand Junction's founding in 1882; 1930s data represents an already significantly altered condition. Therefore, the riparian areas observable in historical aerial photography were deemed unlikely to reasonably approximate the pre-development condition without supplementation.

The review of historical imagery was augmented by coarse hydraulic inundation modeling. Research supports use of the 50-year (2% annual return probability) flood inundation boundary as generally coincident with the extent of riparian ecotones in many unconfined floodplain river systems[12]. Unfortunately, no viable means exists for accurately approximating the pre-development 50-year flood inundation zone because no data are available to characterize pre-development floodplain topography and river channel bathymetry. Extensive berm construction and other hydraulic modifications of the floodplains along the Colorado River and Gunnison River [Figure 5] preclude reliance on present-day topographic and bathymetric data for this purpose. By extension, Federal Emergency Management Administration (FEMA) regulatory flood mapping[13], which relies on present-day survey data, cannot be expected to represent or approximate historical hydraulic conditions through the project area.

Digital models of existing floodplain elevations characterized relative to the adjacent river channel, provide an approximate measure of inundation likelihood independent of the hydraulic impacts of levees. This approach allows areas that are relatively low lying but protected from flooding by artificial landscape operations to be 'visible' during image interpretation in GIS software. While this approach is still potentially impacted by the presence of fill material in the historical floodplain, it represents the best-available approach for approximating the extent of pre-development riparian forests. Close consideration of the available aerial imagery from the 1930s and the present day, and cross-referencing riparian forest locations with contemporary elevation models, helped identify the maximum height above the river where Grand Valley riparian communities were likely to persist. This approach indicated that historical riparian zones likely

[11] Presentation materials including slide decks and notes are available from GVRCI on request.

[12] Ilhardt, B. L., Verry, E. S., & Palik, B. J. (2000). Defining riparian areas. Forestry and the riparian zone, Orono, Maine, 7-14.

[13] https://www.fema.gov/flood-maps/national-flood-hazard-layer

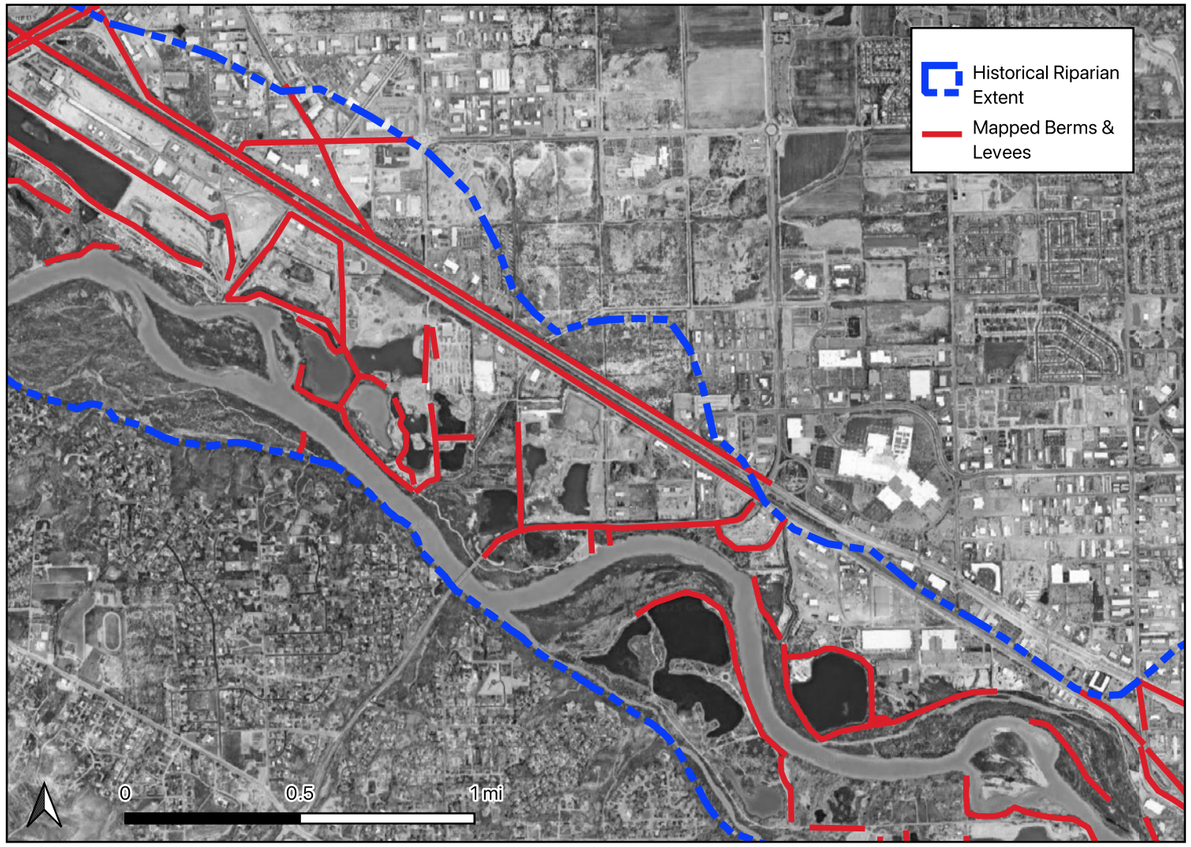


Figure 5: Over 100 miles of levees, berms, and other features that affect the movement of water within the Grand Valley's historical riparian zone. These structures, to varying degrees, limit hydrological connections between the river and its floodplains and fragment remaining riparian habitat.

extended to floodplain areas with elevations up to 12-15 ft. above the river [Figure 6]. This conforms to expectations for maximum rooting depths of woody riparian plant guilds in similar settings[14].

Other historical sources, such as photo archives[15] and the Mesa County Oral History Project[16], provided limited confirmation of riverside land uses or conditions in the pre-1936 period. For example, recorded interviews with residents of the Riverside and Pomona areas in the 1910s and 1920s reference recurrent flooding in those neighborhoods. This qualitative information helped confirm that the areas in the vicinity of the Mesa Mall and similar locals on the southwest side of Grand Junction were once floodplain bottomlands. These areas are now highly-developed commercial, industrial, and residential areas. Similar land use changes within the area delineated as historical riparian zones are evident in aerial photographs and National Land Cover Database (NLCD) spatial coverages[17].

Riparian and floodplain condition assessment activities focused only on the areas bounded by the delineated historical riparian zone. A review of past studies in the Grand Valley provided important context for riparian and floodplain patch mapping performed under this project. Notable conclusions are that 1) an overwhelming number of theoretically feasible projects exist on riparian and floodplain patches within the project area, and 2) all river reaches within the project area are a priority to at least one agency or stakeholder. As such, the adopted patch mapping approach was geared toward elimination of the least viable or least valuable sites from further consideration.

Patches selected for assessment generally met the following criteria:

1. Patches of natural or quasi-natural riparian habitat within the bounds of the historical riparian extent and adjacent to the river were generally mapped.
2. Islands were not mapped unless they appeared large enough to mine or develop.
3. Patches lacking conceivable threats (example: intact point bars) or lacking reasonable access were not mapped.
4. Sites currently under agriculture use were not mapped except for a limited number of special circumstances.
5. Mapping generally ignored land ownership and property boundaries, although these criteria were addressed during project identification and prioritization.
6. Very small patches were not mapped except under special circumstances.
7. Gravel ponds that seemed to be exemplary examples of aspirational restoration opportunities were mapped. Otherwise, gravel ponds and operations were not mapped.

All mapped polygons received additional data attribution to characterize aspects of current condition, conservation potential, and restoration potential[18]. The assessed condition of each mapped patch was assigned using an academic grading scale where an “A” represents a natural reference condition and an “F” indicates a severely degraded site that no longer resembles riparian habitat. [Figure: 7]. Areas assessed as a “C” or above are considered functional habitats. Areas assessed as a “D” or an “F” are considered non-functional habitats. Assigned grades reflect landscape scale interpretations of floodplain condition and opportunities for restoration. Consideration of noxious species management was ad hoc and not included as a specific mapping criterion. Field personnel collected some noxious species observations during ground truthing. This confirmed what is widely known: riparian zones in the Grand

[14] Stromberg, J. C., & Merritt, D. M. (2016). Riparian plant guilds of ephemeral, intermittent and perennial rivers. Freshwater Biology, 61(8), 1259-1275.
[15] https://www.unco.edu/hewit/doing-history/colorado-cities/large-cities/grand-junction.aspx
[16] https://mesacountylibraries.org/mcohp/
[17] https://www.usgs.gov/centers/eros/science/national-land-cover-database

[18] Data dictionaries are included in Appendix A. Spatial datasets are available from GVRCI on request.

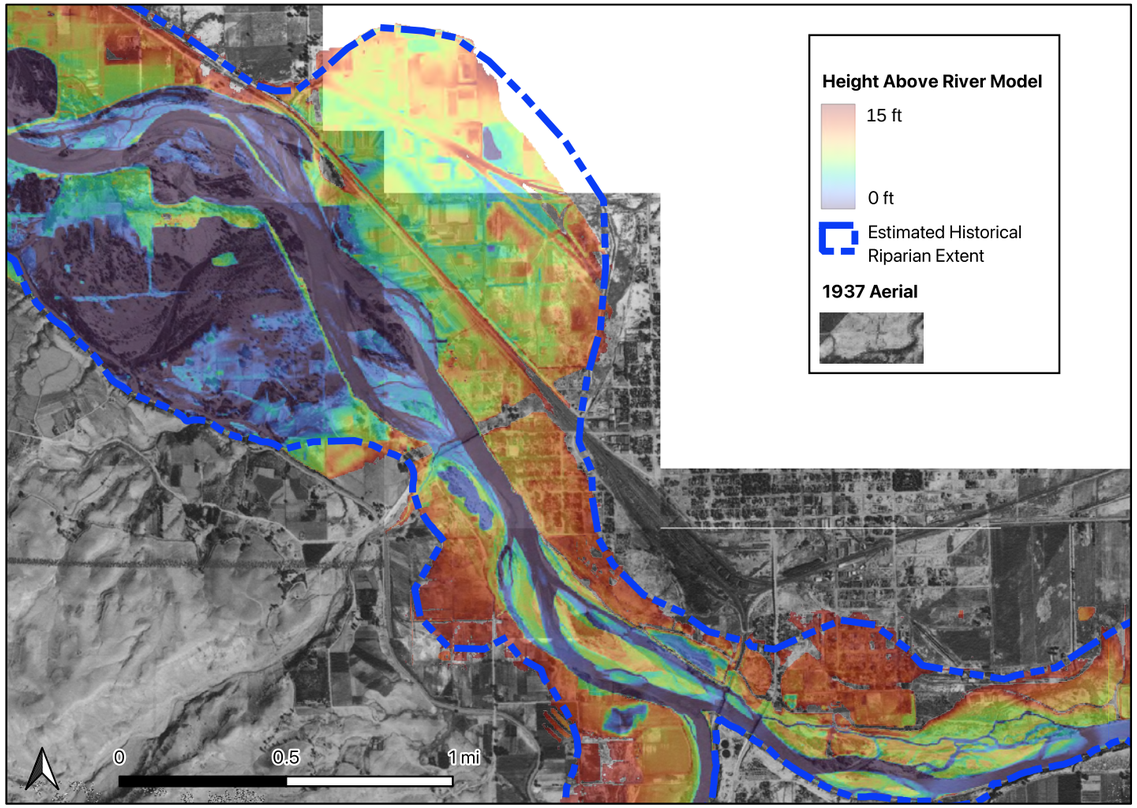


Figure 6: The delineation of the historical riparian extent included areas less than or equal to 15 feet of elevation above the river channel.

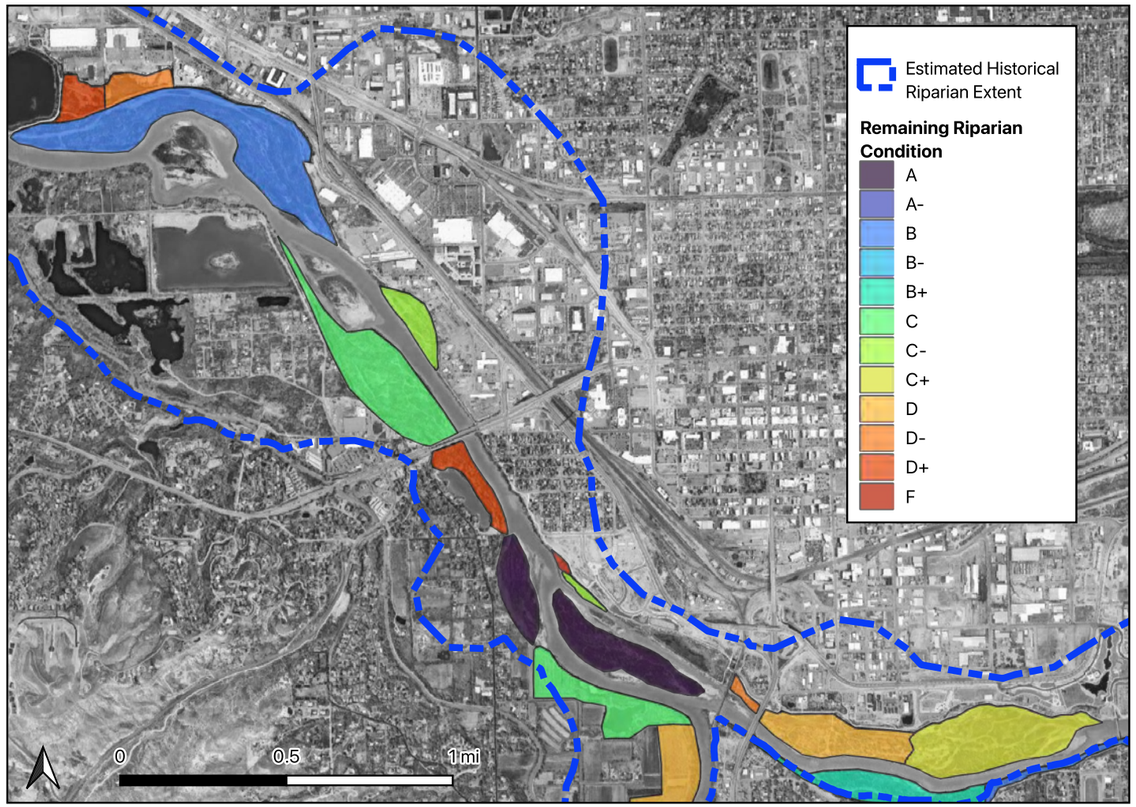


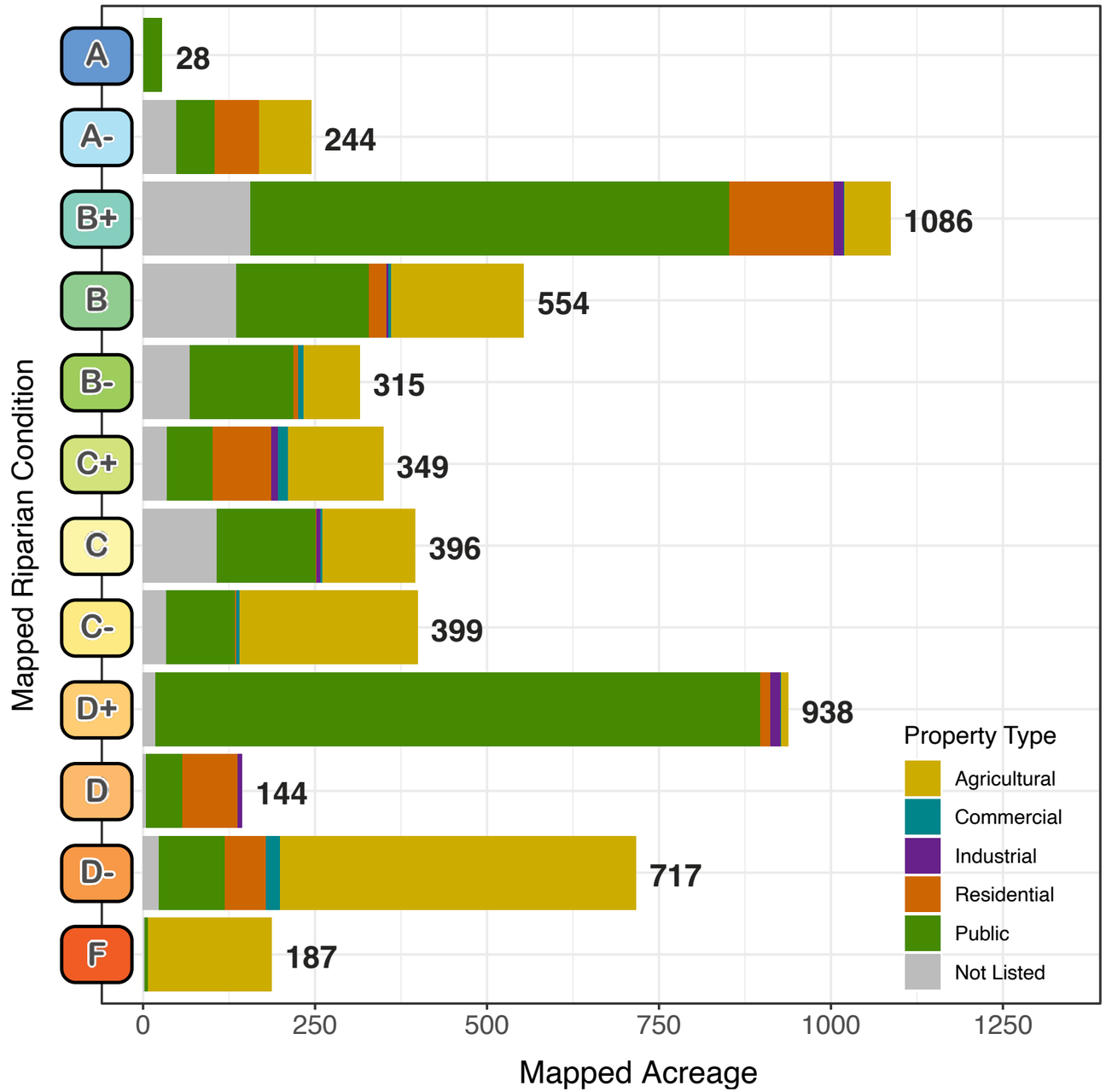
Figure 7: Example of mapped riparian and floodplain condition on patches near the confluence of the Colorado River and Gunnison River.

Valley are impacted, to varying degrees, by the presence of non-native and invasive woody (e.g., Russian Olive) and herbaceous (e.g., Kochia and Russian Thistle) plant species[19]. As a result, the condition scores provided in the mapping may present an overly-optimistic impression for some well-vegetated patches where ecological and/or geomorphological functions are otherwise degraded by invasive species. Mapped patches were intersected with property parcel data from the Mesa County Assessor to provide a view into the land uses and ownership regimes associated with remaining riparian and floodplain areas [Figure 8].

[19] Personal communications with CPW staff indicated that they essentially gave up on managing invasive herbaceous species in the various State Wildlife Areas and State Parks in the Grand Valley.

Photo Credit: Joel Sholtes

Figure 8: Riparian and floodplain patch condition associated with property types, as recorded by the Mesa County Assessor.



POTENTIAL FOR LAND CONSERVATION AND FLOODPLAIN RESTORATION

Attributes from the riparian and floodplain patch mapping exercise were used to assign qualitative rankings for land conservation and floodplain restoration opportunities. These rankings reflect the existing condition of each patch, expert-assessed opportunities for ecological lift, and consideration of criteria related to project feasibility (e.g., property ownership, presence of conservation easements, expected cost, equipment access constraints, etc.). **The approach presented here did not attempt to incorporate diverse stakeholder priorities, preferences for action, or other feedback from other critical parties (e.g., landowners) that may dictate whether a project is viable at any given location.** In some cases, final rankings for a patch were adjusted up or down based on expert opinion [Figures 9 - 10].

Mapped Restoration Potential =

- **Potential Ecological Lift**
  - High: +2
  - Medium: 0
  - Low: -1
- \+ **Land Ownership**
  - Public: +1
  - Private (1-2 owners): +0
  - Private (>2 owners): -1
- \+ **Expected Cost**
  - Low: +1
  - Moderate: +0
  - High: -1
  - Very High: -2
- \+ **Equipment Access**
  - Easy: +1
  - Difficult: -1
- \+ **Infrastructure Impacts**
  - None: +0
  - Moderate: -1
  - Significant: -3

Mapped Conservation Potential =

- **Habitat Quality**
  - High: +2
  - Medium: 0
  - Low: -1
- \+ **Land Ownership**
  - Private (1 owner): +3
  - Private (>1 owner): -1
  - Unsecured Public Land: +2
  - City Property: +3
  - Conservation Easement Status
    - Partial: -2
    - Full: Set score to 0
- \+ **Relative Parcel Size**
  - Large: +3
  - Medium: +1
  - Small: 0

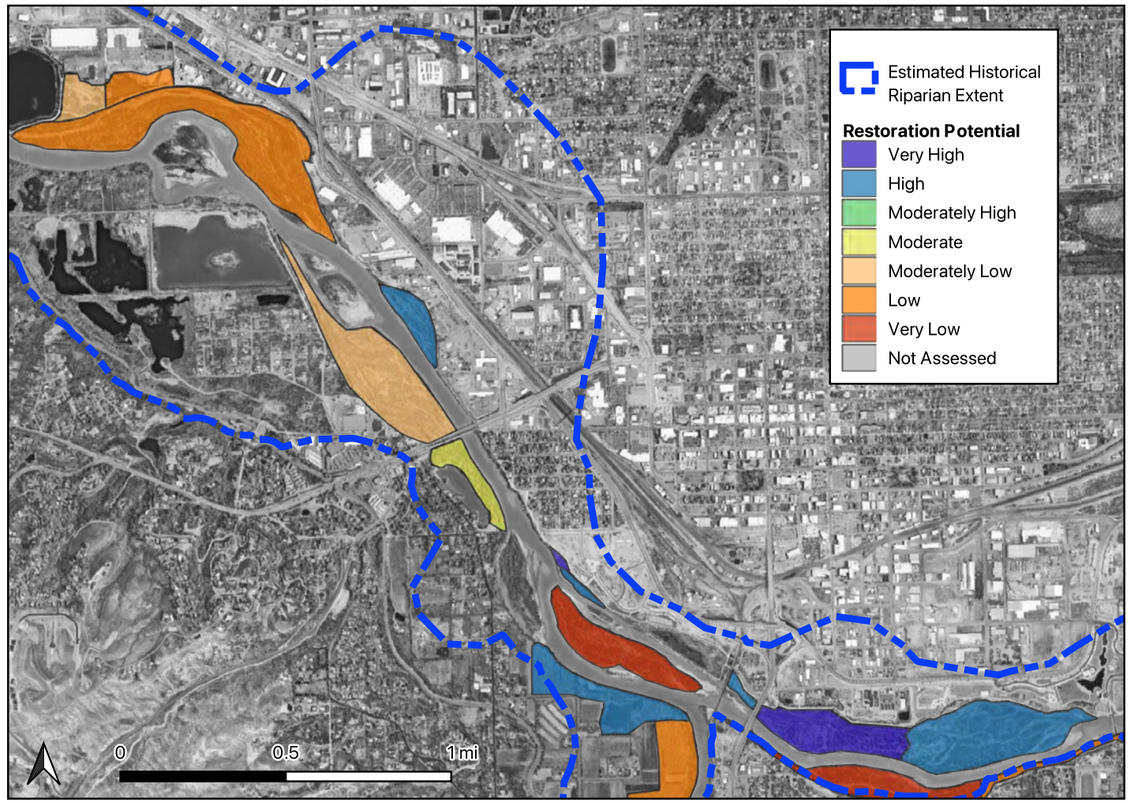


Figure 9: Mapped and qualitatively ranked restoration opportunities within the historical riparian corridor in the vicinity of the confluence of the Gunnison and Colorado rivers.

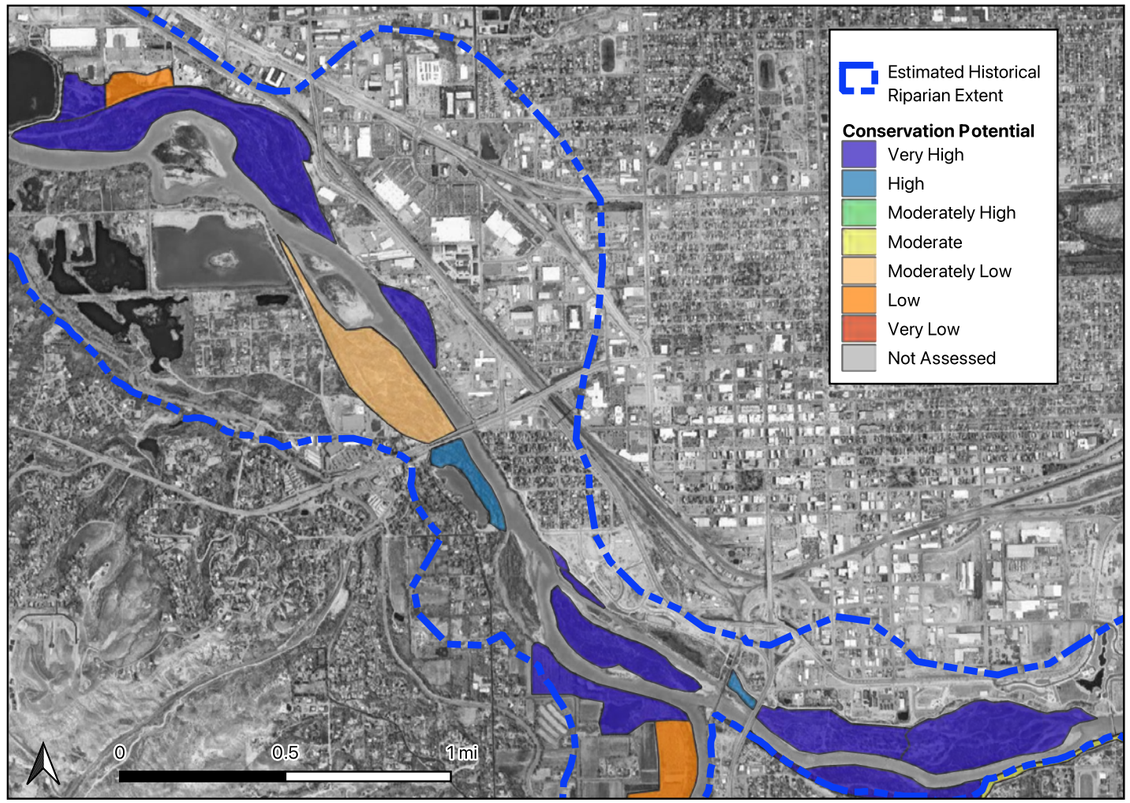


Figure 10: Mapped and qualitatively ranked conservation opportunities within the historical riparian corridor in the vicinity of the confluence of the Gunnison and Colorado rivers.

INTERSECTING OPPORTUNITIES FOR ACTION WITH CURRENT LAND USES

The qualitative rankings for restoration and conservation potential were aggregated by property types mapped by the Mesa County Assessor. This aggregation scheme supported visual representations of the proportion of mapped patch area that fell within five primary property types: public, agricultural, residential, commercial, and industrial. Unlisted property types were also included in the aggregation. The majority of mapped patches were assigned “Low”, “Very Low” or “Unknown” restoration potential [Figure 11]. Notably, a large fraction of the areas assigned “Low” restoration potential fell on public lands–a result reflective of the fact that many State Parks (SPs) and State Wildlife Areas (SWAs) persist in a relatively high functional condition, limiting the amount of lift that could be expected from restoration activities. A relatively small proportion of the mapped patches were assigned “High” or “Very High” restoration potential. Among these areas, public and agricultural lands dominated. These tended to be patches exhibiting good site accessibility and modest levels of anthropogenic impacts.

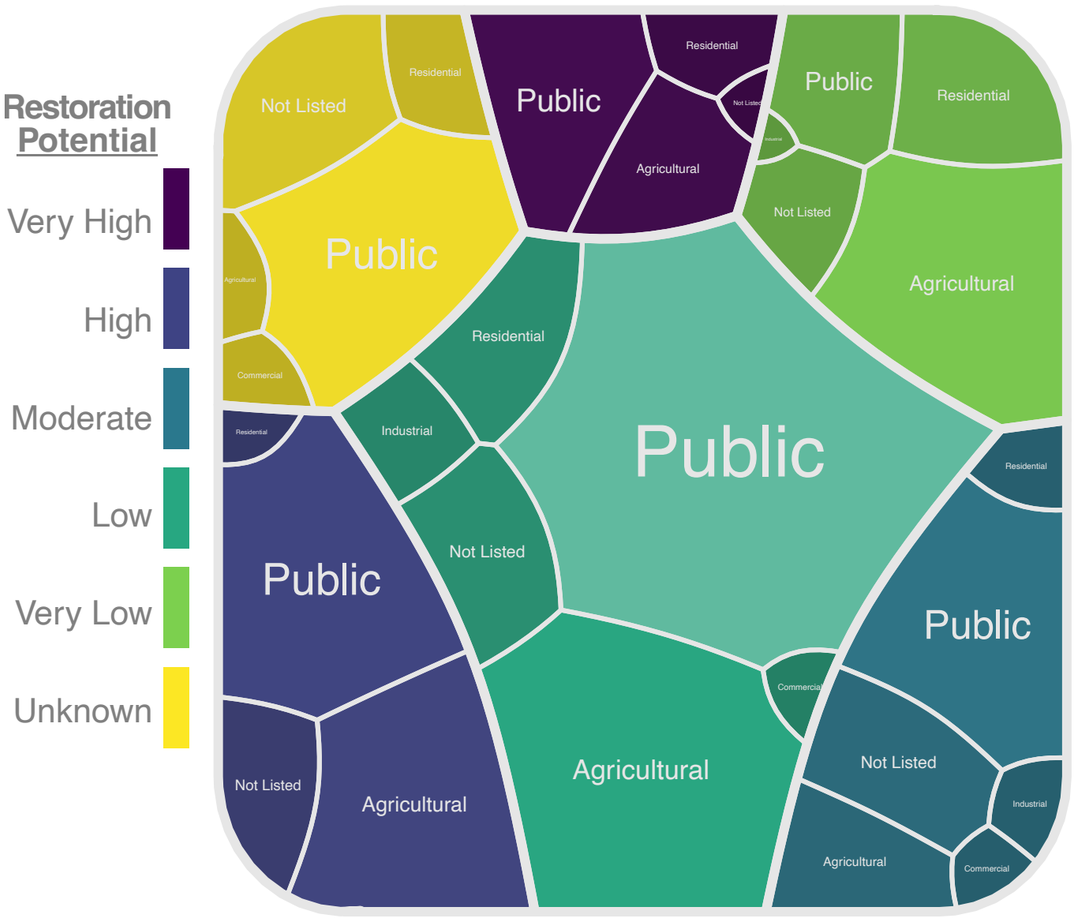


Figure 11: The relative proportion of mapped riparian and floodplain patches exhibiting varying degrees of restoration potential (color ramp) and assigned property types (polygon labels). The size of each polygon is proportional to the land area falling into that class.

A similar aggregation was performed for mapped conservation potential. The majority of mapped patches were assigned “Moderate”, “High” or “Very High” conservation potential [Figure 12]. A majority of the areas assigned “Very High” conservation potential fell on public lands. This result reflected the high proportion of public properties within the river corridor boasting somewhat-intact riparian zones but not afforded the specific protection of a conservation easement. Agricultural parcels dominated among those areas attributed with “Moderate” or “High” conservation potential, reflecting the dominance of this land use activity along large portions of the river corridor.

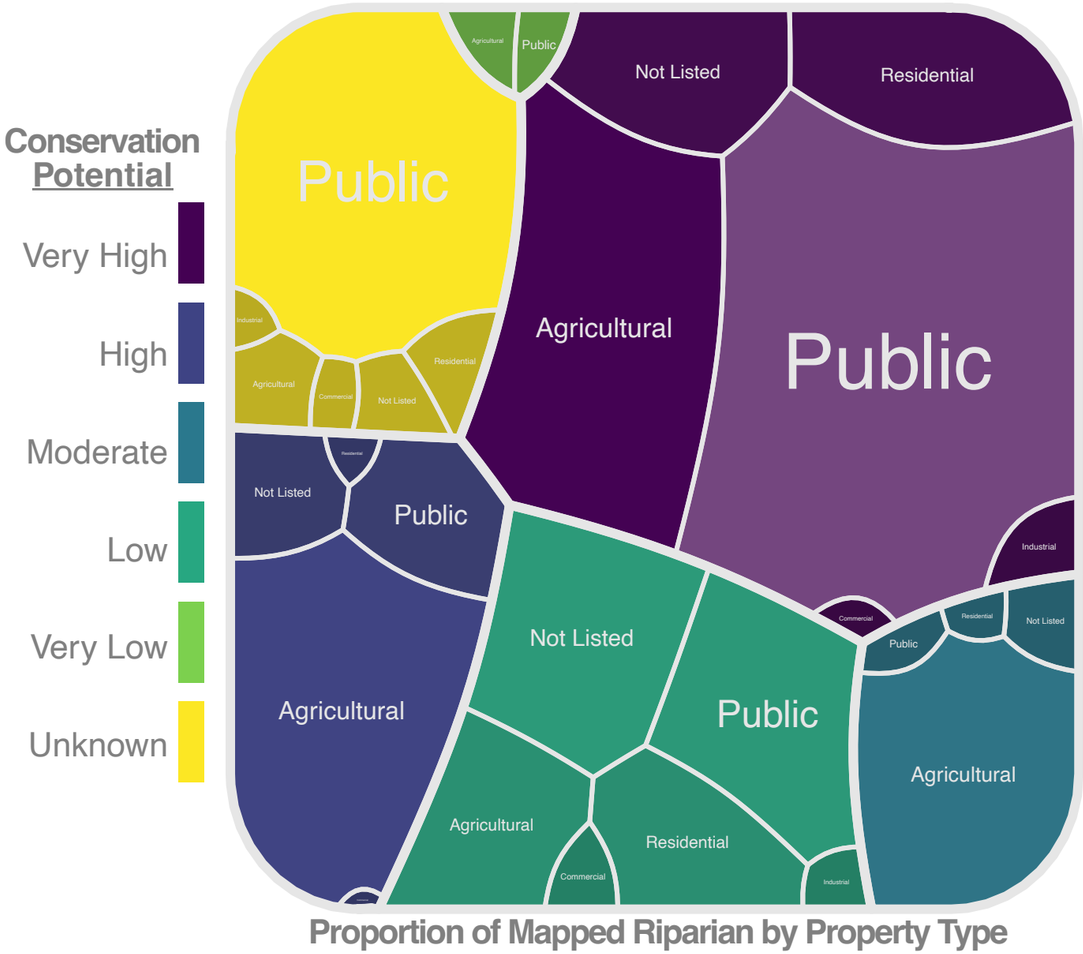


Figure 12: The relative proportion of mapped riparian and floodplain patches exhibiting varying degrees of conservation potential (color ramp) and assigned property types (polygon labels). The size of each polygon is proportional to the land area falling into that class.

A VISION FOR THE FUTURE

What is the next chapter in the story of the Grand Valley river corridor? Local communities face an important choice: continue existing development practices and habits that drive ecological losses and exact hidden social costs or chart an alternative path. An alternative path can focus attention on protecting remaining riparian habitats and floodplain patches, restoring marginal areas, and incentivizing new development and re-development patterns that respect the region's rich natural heritage and promote ecological viability of the river corridor.

Vegetated stream buffers offer innumerable benefits to human communities, including stream stability, water quality improvements, wildlife habitat conservation, and flood water conveyance. Due to their critical landscape position between developed hardscapes and waterways, riparian forests serve as an efficient and sustainable long-term solution to mitigate urban water quality impacts to streams and rivers[27]. Healthy functioning riparian buffers reduce stormwater loads by promoting infiltration and slowing the movement of sediment and other contaminants across the landscape. Deeply rooted woody vegetation helps maintain streambank stability during high flow periods. Falling leaf litter and other detritus provide the organic material inputs required to support aquatic ecosystems. Riparian forests provide critical habitats for innumerable terrestrial and avian species in semi-arid landscapes. Maintenance of stream buffers in urbanized settings helps reduce risks to human life and property, protecting infrastructure investments and other forms of economic development. Buffer preservation and maintenance also provides communities with aesthetically pleasing open spaces, opportunities for trail development, and outdoor classrooms where members of the community can learn about the ecological and social benefits of intact river corridors.

In this context, the continuation of urban and residential development patterns that alter, remove, and fragment riparian buffers and floodplains represents a damaging legacy behavior. In the long term, communities continuing this development pattern will degrade an open space and habitat resource the community highly values, incurring continuous and costly losses to both human and natural systems along the way. Cultivating new development norms that truly protect river corridor functions and processes will provide the Grand Valley river corridor with the resiliency necessary to generate the numerous social, economic, and natural goods and services that benefit local communities.

[27] National Research Council (NRC) (2002). Riparian Areas: Functions and Strategies for Management. National Academies Press, Washington, DC.

Photo Credit: Joel Sholtes

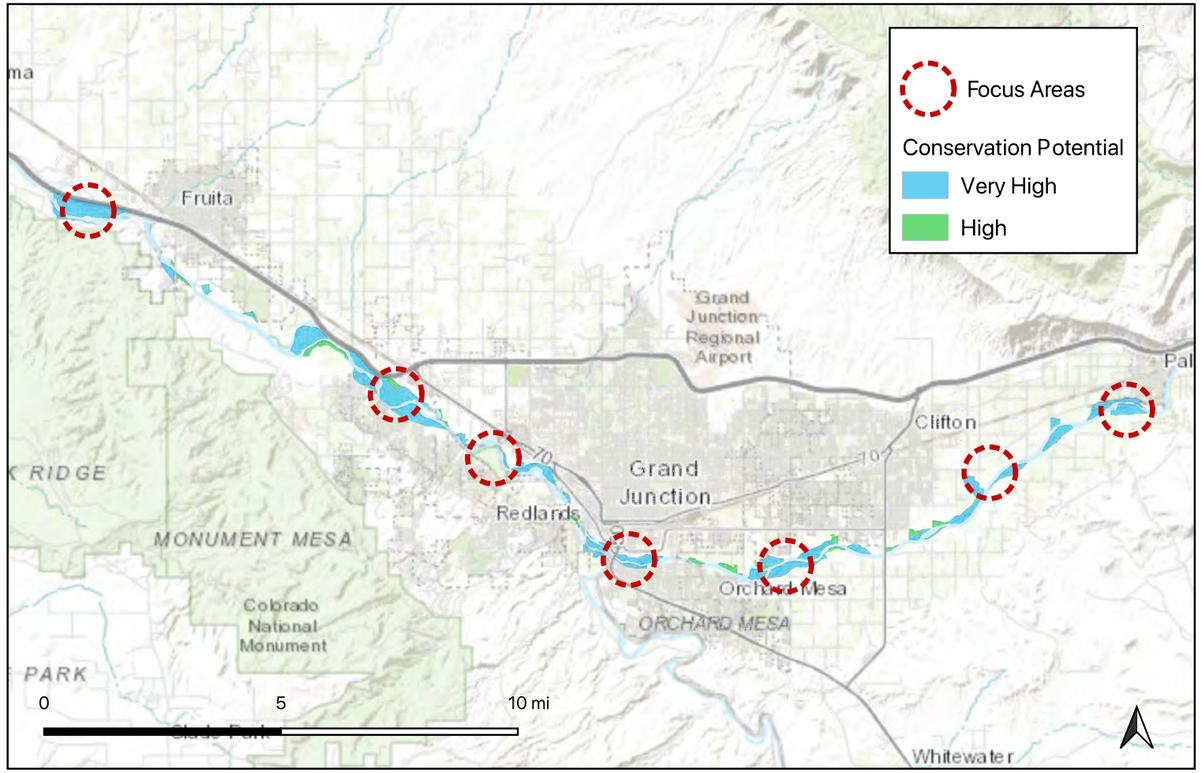


Figure 13: Recommended restoration and conservation strategy for the Grand Valley. Focus areas include public lands where barriers to large scale restoration activities were assessed to be somewhat lower than other positions on the landscape. Riparian patches intermediate the focus areas and mapped as either "Very High" (blue) and "High" (green) conservation potential represent the highest priorities for conservation action.

AN EMERGING STRATEGY

The assessment activities performed under this project identified an overwhelming number of opportunities for both conservation and restoration work throughout the Grand Valley. The large number of sites that could play host to conservation or restoration oriented work, and the wide range in the scale of work that could be completed at any one location (e.g., control invasive species vs. remove levees and restructure floodplain surfaces) presented a significant challenge to identifying a small number of priority projects. Instead, through discussions with GVRCI stakeholders, a strategy emerged for guiding strategic and opportunistic actions in a manner that intends to minimize barriers and maximize beneficial outcomes over the long-term. The strategy proposed here entails implementation of capital-intensive restoration projects on public lands and working to preserve connected vegetated corridors between these public lands through implementation of various conservation tools [Figure 13].

The network of public lands in the river corridor, primarily consisting of Colorado Parks and Wildlife State Wildlife Areas and State Park units, provides an effective backbone or scaffolding for GVRCI's future restoration and conservation campaigns. These lands serve as focus points of remaining large-acreage riparian habitats on the landscape. Barriers to both vegetation restoration activities and large-scale process-based restoration activities (e.g., levee/berm removal and floodplain reconnection) are expected to be considerably lower on these public lands than in other locations in the Grand Valley. Gravel pit restoration opportunities within or adjacent to these focus area locations provide a special subset of restoration opportunities that may offer some of the most significant habitat gains available in the Grand Valley, if technical, logistical, and cost barriers can be overcome. Where degradation exists, GVRCI should partner with CPW to implement restoration strategies at focus areas that work to promote dynamic floodplain processes. GVRCI should also promote and facilitate the adoption of long-term property management plans for these public lands that codify the commitment to accepting and promoting a dynamic river environment (see section below). The ecological value of these focus areas should be maximized by securing conservation

easements on them (if they do not already exist) and on adjacent private parcels. The management plans associated with these conservation easements will define management goals and actions appropriate to sustain the desired ecological landscape, wildlife values, vegetation, and/or any agricultural features and operations.

The long-term conceptual vision for the Grand Valley includes conservation or re-establishment of a relatively contiguous and uninterrupted vegetated river corridor between the focus areas. Although fiscal, physical, social, and/or legal feasibility constraints obviously exist to widespread implementation of conservation measures on private lands, this strategy intends to focus GVRCI's efforts to develop campaigns around specific geographies and develop the relationships necessary within those geographies to realize action. Meeting river corridor conservation objectives may be achieved via a combination of approaches that include conservation easements (riparian-specific easements or otherwise), public lands acquisitions, and/or implementation of land-use regulations that incentivize or require streamside landowners to implement some version of the 3-tier riparian buffer concepts outlined below.

Frameworks for Recognizing, Accepting, and Promoting Dynamic River Processes

Maintenance of dynamic river processes that create and maintain high-value habitat at focus areas and at intermediate landscape positions is a foundational condition to ensuring riparian functions will persist. Activities that seek to achieve a high degree of stability in channel and floodplain forms and limit the lateral extent of flood inundation work in direct opposition to the resilience of riparian forest ecosystems. Healthy river systems in settings like the Grand Valley are naturally dynamic–constantly reforming the landscape they flow through. In doing so, they generate a complex pattern of soil disturbance, vegetation recruitment, habitat creation, destruction and renewal. Poor understanding of natural processes at work in disturbance-mediated ecosystems and a desire to control or constrain river channels were common drivers of development patterns in the 19th and 20th centuries. Multi-threaded (multiple channel) river forms like those found historically among the constantly shifting islands, braids, and meanders of the sediment-laden Colorado River in the Grand Valley were viewed as undesirable and something to be eliminated. Development frequently centered on 'fixing' or 'controlling' the river and 'reclaiming' active bottomlands for other economic or social purposes. Floodplain filling, installation of flood defense structures like levees, and bank armoring greatly constrained lateral movements of the Colorado River (and, to a lesser degree, the Gunnison River) across its floodplain. As a result, the natural processes of erosion and sedimentation were restrained and a period of progressively diminished ecological function began.

Irregular, large-scale flood-driven disturbances of floodplains and riparian forests in the Grand Valley drive the process of sediment erosion and deposition that mediates and supports healthy riparian areas and creates and maintains critical rearing habitat for endangered fish. Unfortunately, the dynamic geomorphic settings necessary to sustain native riparian ecology in the Grand Valley were historically reduced or eliminated by stream bank stabilization, levee/berm creation, and encouragement of single-threaded static channel forms. Little opportunity for flood-induced disturbances of floodplain environments currently exists. Flow regulation of the Colorado and Gunnison rivers has reduced the frequency and duration of connectivity to their floodplains and is believed to be a major factor in the endangerment of the native fish[20]. In the absence of periodic disturbance events, the condition of floodplains, aquatic habitats, and riparian forests in the Grand Valley corridor is expected to continue along a trajectory of progressive degradation. Addressing this challenge is no trivial task.

Few good alternatives exist as substitutes for the restorative impact of natural dynamic floodplain processes. The scope and scale of restoration needs in the Grand Valley outstrip any known funding source. Large-scale mechanical alteration of floodplain topography and massive revegetation efforts are both impractical and would require a focused group of organizations several lifetimes to complete. Not to mention, once the process was complete, it would need to begin anew in order to mimic the periodic disturbance regime that riparian forests and native fishes in the Grand Valley co-evolved with. The most cost-effective approach available to GVRCI and its partners for promoting diverse native riparian forests and sustaining critical habitat for native warm water fish is to promote dynamic channel processes (and the spaces for them to occur in) along as much of the Grand Valley river corridor as possible. This is not an idea unique to the Grand Valley.

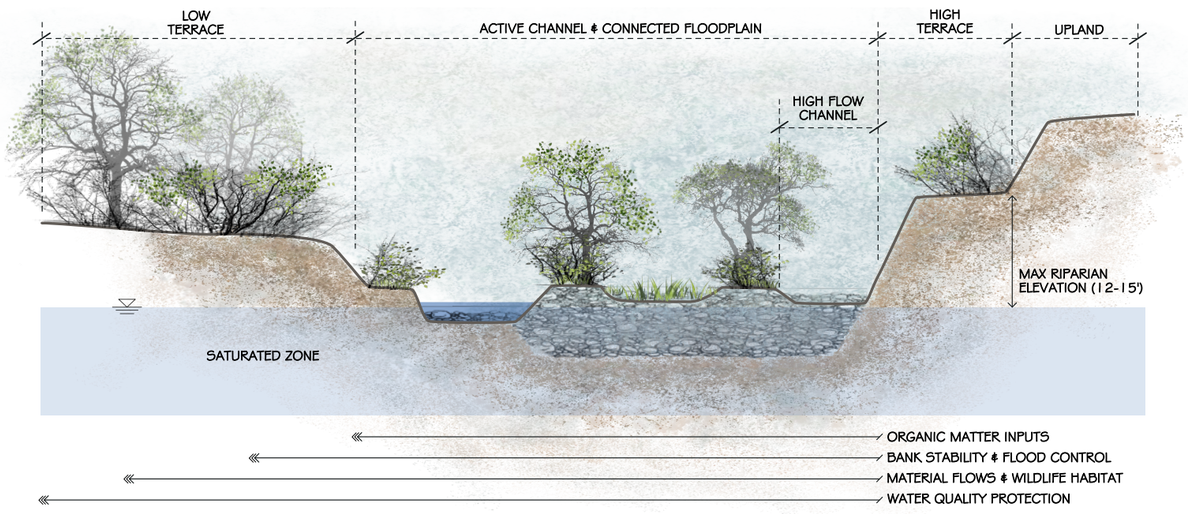


Figure 14: Cross-sectional representation of floodplains and riparian forests in the Grand Valley. The ecosystem goods and services provided by riparian buffers of varying relative widths are indicated at the bottom of the figure.

Elsewhere in the U.S. and Canada, communities are increasingly recognizing that granting space for rivers to move within their historical floodplains provides shared benefits to natural human communities. By pulling development away from floodplains and encouraging the rehabilitation of functional riparian forests in the floodplain corridor, significant reductions in risk to infrastructure can be achieved (and by extension, reductions in perpetual hazard mitigation costs). Washington State uses Channel Migration Zone (CMZ) mapping to help manage flood hazards and protect floodplain functions while reducing risk to life and infrastructure[21]. Quebec City introduced the concept of Freedom Space for rivers as a sustainable and cost-effective long-term approach to river management. Both the CMZ and Freedom Space concepts are grounded in an understanding of hydro-geomorphology and are focused on reducing risks, lowering costs, and making communities more resilient to climate and land use changes[22]. The Colorado Water Conservation Board published the Fluvial Hazard Zone (FHZ) framework in 2020 as a tool to help communities better understand risk from fluvial hazards[23].

A recently completed Grand Valley FHZ mapping effort identified multiple potential locations that may be amenable to a "room for the river" management strategy. While this approach to river management may appear burdensome either on a cost or regulatory basis from the view of an individual landowner over a short period of time (1-20 years), it is ultimately both 1) the most cost-effective and functional strategy for community hazard mitigation long term, and 2) the most effective and durable strategy for protecting and improving riparian corridors.

Frameworks for Protecting Vegetated Buffers

As discussed previously, decades of development in the Grand Valley resulted in the loss of significant portions of the vegetated riparian corridor. The width of vegetated riparian buffers is a primary determinant of their ability to protect streams against impacts of upland land use activities. Buffer width is most often measured as the horizontal distance from the high-water mark (or vegetation line) of a stream channel to the upland edge of the vegetated zone. A wide variety of ecosystem goods and services (e.g., water quality protection, flood attenuation, wildlife habitat, etc.) are associated with riparian buffers of increasing width from the river channel[24] [Figure 14]. While the benefits of riparian buffers to human communities and natural systems are well documented, the multipurpose character of riparian buffers and high diversity of landscape settings makes developing simple, prescriptive management approaches and rules a complex problem.

[20] Valdez, R.A. and P. Nelson. 2006. Upper Colorado River Subbasin Floodplain Management Plan. Upper Colorado River Endangered Fish Recovery Program, Project Number C-6, Denver, CO.

[21] Rapp, C.F., & Abbe, T.B. (2003). A framework for delineating channel migration zones. Ecology publication #03-06-027. Washington State Department of Ecology, Bellevue, Washington. 135 pp.
[22] Buffin-Bélanger, T. et al. (2015). Freedom space for rivers: An economically viable river management concept in a changing climate,Geomorphology, Volume 251, Pages 137-148.
[23] Blazewicz, M., Jagt, K. & Sholtes, J. (2020). Colorado Fluvial Hazard Zone Delineation Protocol v1.0. 10.13140/RG.2.2.10712.01284.
[24] USEPA (2005). Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations.

Consideration of the various social, economic, and ecosystem services provided by different portions of riparian corridors can provide a useful lens through which to contemplate riparian management strategies [Table 2]. Limiting certain land uses within each buffer zone can help to preserve hydrologic, riparian and wetland functions. Such recommendations should seek to balance ecosystem protection, social functions, and critical or non-critical development activities. Examples of necessary or allowable uses in riparian buffer zones may include stormwater infrastructure installation or maintenance, public utility crossings, agricultural activities, maintenance of public utilities and existing structures, and control of invasive vegetation. Discouraged or prohibited uses may include grading or re-sculpting of natural floodplain features, removal or disturbance of natural soils, removal or disturbance of native vegetation and trees, establishment of hardened landscaping and non-native turf grasses, or unrestricted use of landscaping treatments, including pesticides and herbicides.

The principles of a 3-tier riparian buffer system can guide land use planning and decision making in near-stream areas in the Grand Valley. The system delineates a nested set of buffer zones running parallel to the river. Each zone performs one or more important ecosystem services and is characterized by unique optimal widths, preferred vegetation community types, and unique land use management recommendations. Highlighting the individual functions of each zone allows land managers to efficiently maximize desired benefits of the buffer[25] by recommending land use activities with increasing distances from active river channels. Concepts contained in the 3-tier buffer can also be instrumental in detailing acceptable streamside activities and land uses, as they are defined in future conservation easement management plans. In this way, the 3-tier buffer system can support concepts identified in the Grand Valley FHZ mapping effort[26] and provide an operational framework for non-governmental organizations, land managers and elected officials to protect and maximize community benefits received from vegetated riparian corridors.

A draft set of riparian zone buffer widths and acceptable corresponding land uses within each zone are provided here [Table 3, Figure 15]. While these recommendations are tailored to the Grand Valley, they are intended as a starting point for ongoing conversations between GVRCI and other local stakeholders regarding opportunities for conservation of remaining riparian forests along the Colorado and Gunnison rivers. Additional modification, addition, or subtraction of buffer widths and land uses will likely result from these conversations.

Streamside Buffer (Zone 1)

Zone 1, the streamside buffer or overbank zone, protects the physical and ecological integrity of the channel and its associated floodplains. Riparian vegetation and wetlands in this zone slow the movement of water across the landscape, reducing pollutant loading to rivers via biological uptake or chemical transformation. This zone can encompass riverine wetlands on gently sloping banks, which are subject to state and federal Clean Water Act Section 404 permitting tied to any wetland filling activities. Recommended land use activities may be most restrictive in this zone, including strong prohibitions or permitting bias against alteration or removal of native vegetation communities and alteration of naturalized bank morphologies and substrates. A desired state is undisturbed, mature riparian forest and overbank vegetation; limited necessary social uses may include footpaths, stormwater infrastructure, and discrete relatively orthogonal transportation infrastructure crossings.

Intermediate Buffer (Zone 2)

Zone 2, the intermediate buffer or transitional zone, accommodates major vegetative and landform transitions from frequently inundated areas to dryer uplands. The extent of Zone 2 can vary strongly with stream size, channel geometry, and local topography (e.g., terrace slope and height). Zone 2 may include the regulatory floodway, connected slopes, and any connected wetlands. Within the urban context, the key function of Zone 2 is to cushion and shield Zone 1 from various effects of upland development, while simultaneously providing risk-reduction space between river channels and valuable built environments or costly infrastructure. Land use activities recommended for Zone 2 may be somewhat more permissive than Zone 1. Permitted uses should still only be low impact in nature, including limited tree clearing and removal of native species in some circumstances. Impervious surfaces of all types, hardened landscaping, levee/berm creation, bank armoring, septic, storage tanks, etc. should generally be avoided.

Outer Buffer (Zone 3)

Zone 3, the outer buffer or upland zone, acts as the “buffer’s buffer”, extending outward from Zone 2’s edge and providing important protections against sediment and other material entrained in urban runoff. This zone also supports terrestrial and avian habitat and provides important movement/dispersal corridors for terrestrial wildlife (deer, small mammals, etc.). Land use activities recommended for Zone 3 may be more permissive than the other two zones. Moderate impact uses like agriculture, lawns/gardens, stormwater BMPs, etc. are generally allowable, while impervious surfaces are for the most part still prohibited or allowed only under special circumstances.

[25] Hawes, E., & Smith, M. (2005). Riparian buffer zones: Functions and recommended widths. Eightmile River Wild and Scenic Study Committee, 15, 2005.
[26] Sholtes, J. and Guiney, M. (2023). Fluvial Hazard Zone Mapping Addendum for the Colorado and Gunnison Rivers in the Grand Valley, Mesa County, Colorado. Prepared for RiversEdge West and the Grand Valley River Corridor Initiative. 66p.

By pulling development away from floodplains and encouraging the rehabilitation of functional riparian forests in the floodplain corridor, significant reductions in risk to infrastructure can be achieved

Table 2: A range of recommended riparian buffer widths and associated ecosystem goods and services noted in scientific literature[28] [29] [30] [31].

OPTIMAL VEGETATED RIPARIAN BUFFER WIDTHS ASSOCIATED WITH THE FUNCTIONS LISTED BELOW						
SOURCE	**HABITAT FOR AQUATIC LIFE**	**TEMPERATURE MODERATION**	**NUTRIENT RETENTION & DETENTION**	**SEDIMENT CONTROL**	**BANK STABILIZATION**	**PESTICIDE RETENTION**
Range of recommended widths	**33 - 164 ft**	**33 - 230 ft**	**16 - 164 ft**	**30 - 328 ft**	**30 - 98 ft**	**49 - 328 ft**

[28] USDA (1998). Stream corridor restoration. Revised August, 2001. www.usda.gov/stream_restoration.
[29] Fischer, R., & Martin, C. (1999). Corridors and Vegetated Buffer Zones: A Preliminary Assessment and Study Design. U.S. Army Corps of Engineers.
[30] Fischer, R. & Martin, C. & Fischenich, C. (2000). Improving Riparian Strips and Corridors for Water Quality and Wildlife.
[31] Broadmeadow, S. and Nisbet, T.R. (2004). The Effects of Riparian Forest Management on the Freshwater Environment: A Literature Review of Best Management Practices. Hydrology and Earth System Science, 8, 286-305.

Table 3: The 3-zone system delineates vegetated areas in three nested zones parallel to the channel. Each zone performs one or more important water quality protection functions and is characterized by unique optimal widths, vegetative targets, and management objectives.

	ZONE 1: STREAMSIDE	ZONE 2: INTERMEDIATE	ZONE 3: OUTER
Critical Functions Provided	Bank stability, pollutant uptake and storage, wildlife habitat (terrestrial & aquatic)	Pollutant uptake, sediment control, runoff reduction via infiltration	Runoff reduction, sediment control, prevents encroachment prevention
Recommended Width	Historical (1937-Present) Colorado River channel bounds + 75 ft. Present Gunnison River Channel bounds +75 ft. Delineation not to exceed the mapped historical riparian extent in any area.	Max of: Zone 1 + 100 ft or mapped regulatory floodway. Delineation not to exceed the mapped historical riparian extent in any area.	Max of: Zone 2 + 100 ft or mapped regulatory 100-year floodplain. Delineation not to exceed the mapped historical riparian extent in any area.
Recommended Vegetation	Undisturbed, mature riparian forest and native overbank vegetation	Managed, mature native forest and vegetation	Native upland species or turf grass.
Recommended Use Restrictions	Highly Restricted. Uses limited to footpaths, stormwater facilities, and roadway crossings. Stream access for fishing and wildlife viewing allowed if function of stream buffer is maintained.	Restricted to Low Impact Uses. Only a limited amount of tree clearing is allowed, native vegetation and no-mow zones. No impervious surfaces/septic/UST permitted. Underground utility corridors permitted if fully vegetated.	Restricted to Moderate Impact Uses. No/little impervious surfaces. Lawn, garden, compost, yard wastes, and most stormwater BMPs are permitted. No more than 40% may be disturbed unless mitigation provided. No more than 50% disturbed where mitigation provided.

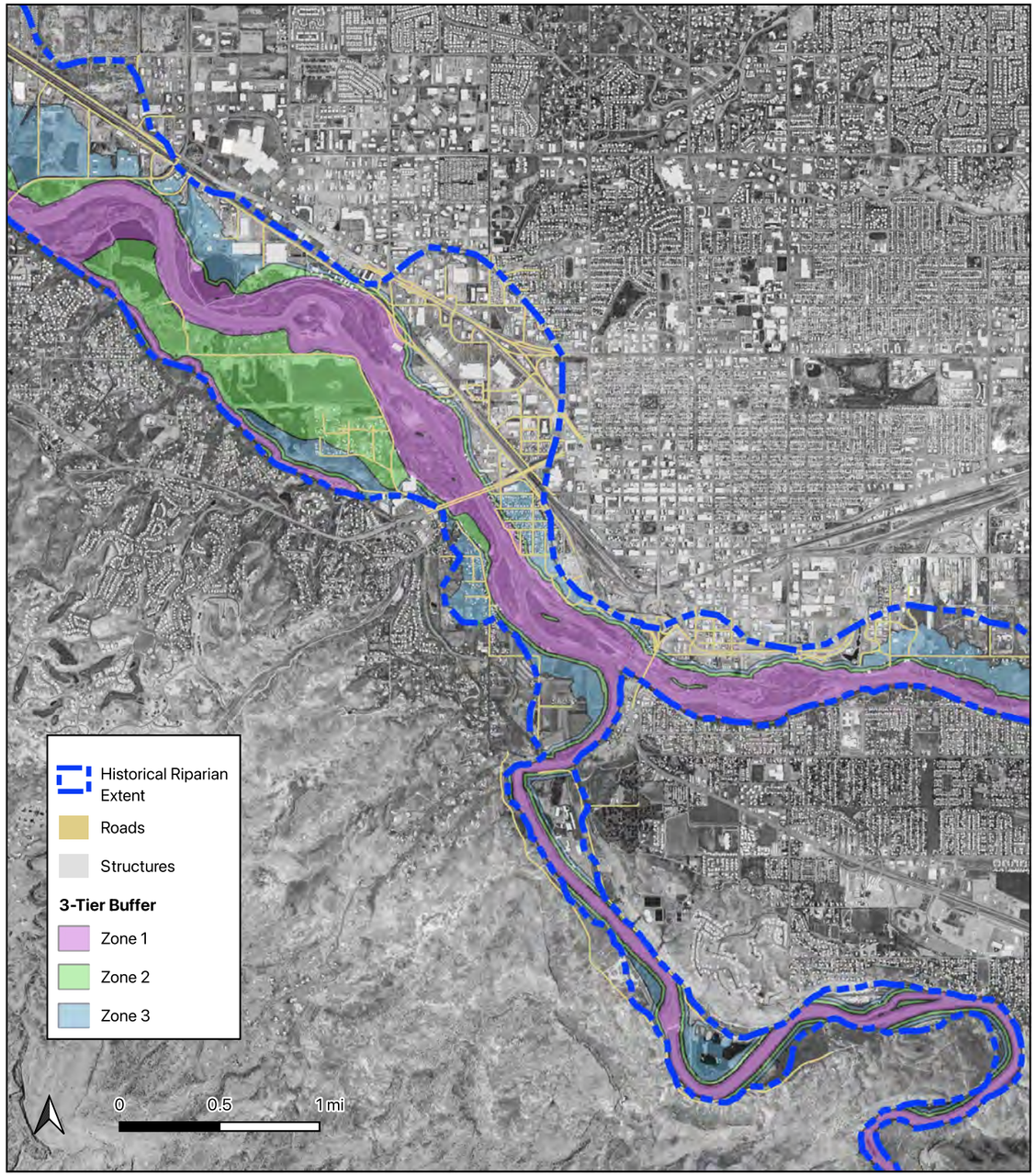


Figure 15: The 3-tier buffer system recommended for the Grand Valley and mapped along a portion of the Grand Valley surrounding the confluence of the Gunnison River with the Colorado River. Roads and structures within the historical riparian zone are highlighted for context.

GRAND VALLEY RIVER CORRIDOR MANAGEMENT TOOLBOX

Several strategies are available to support GVRCI's efforts to enact riparian and floodplain restoration. The principles promoted in the frameworks discussed above for enabling dynamic channel processes (i.e. the Fluvial Hazard Zone) and protecting vegetated riparian corridors (i.e. the 3-Tier Riparian Buffer) can be implemented in the Grand Valley through application of numerous tools and techniques: floodplain restoration, strategic land use management, and land conservation [Table 4]. Floodplain and channel restoration activities may scale from invasive species control and riparian plantings to levee/berm removal and alteration of non-functional floodplain topography. Influence over development activities in the river corridor may be exerted through revisions to local land use codes. Riparian corridor land conservation strategies may include the development of conservation easements and private lands acquisitions. The various tools associated with each strategy area are discussed below.

Tools for Floodplain & Channel Process Restoration

Many of the lands within or adjacent to the focus areas are degraded but not yet permanently altered or developed. These locations are ripe for restoration work. Restoration may include "light-touch" habitat work that includes invasive plant control, and where site conditions are likely for success, native plantings. In some settings, opportunities exist to remove or puncture berms and levees in controlled or discrete locations to improve hydrological connections between the river and adjacent floodplains. Significant process-based restoration activities may be appropriate at a smaller number of locations, given sufficient budget and collaboration among project partners. Such approaches may include full levee/berm removal, gravel pond reclamation, and large-scale- floodplain reconnection and/or backwater habitat creation. The aforementioned restoration strategies are non-exclusive. In many cases, the strategies outlined here may be implemented in an overlapping manner.

Vegetation management projects offer near-term opportunities that face few permitting and design obstacles, require relatively little funding, and may be implemented with the help of local volunteer engagement. Re-establishing native species requires considerable expertise in site assessment to ensure success. Government entities like the BLM and CPW, and conservation organizations like RiversEdge West, have accumulated significant experience controlling invasive plants and replanting native vegetation in floodplains and riparian zones. Invasive woody species mastication efforts were implemented by the City of Grand Junction some

Floodplain and channel restoration activities may scale from invasive species control and riparian plantings to levee removal and alteration of non-functional floodplain topography. Influence over development activities in the river corridor may be exerted through revisions to local land use codes. Riparian corridor land conservation strategies may include the development of conservation easements and private lands acquisitions.

Table 4: Recommended strategies for action intended to preserve, protect and improve floodplains and riparian areas in the Grand Valley.

STRATEGY AREA	AVAILABLE TOOLS
Floodplain and Channel Process Restoration	Floodplain reconnection (grading/ restoration), berm/levee removal, backwater reconnection/creation, planting plans and maintenance plans, invasive/noxious removal and maintenance, livestock management rules for riparian buffers
Strategic Land Use Management	Land use regulations responsive to river corridor health, development and redevelopment approval processes and opportunities, master/local planning special overlays
Riparian Land Conservation	Land acquisition and public dedication, conservation easements, riparian-specific (partial) conservation easements

floodplain areas in recent years[32]. These efforts were focused on removing fuels and reducing risks for wildfire but, in some cases, also provided opportunities for native plant reestablishment and competition. While vegetation management projects are relatively easy to implement, they may require non-trivial long-term maintenance. Successful invasive species suppression often requires multiple site treatments across multiple growing seasons. Invasive species eradication and revegetation projects implemented by GVRCI and its partners should contemplate the following guiding principles:

- Attempts to control invasive herbaceous species may be impractical on large acreages and yield only temporary results.
- Removal of woody invasive species like Russian Olive should be paired with native woody vegetation plantings at a ratio of at least 2:1 to improve the probability of success.
- Efforts to eradicate invasive woody species on SWAs and State Parks should be implemented using a phased, checkerboard approach where a maximum of 1-5 acres are treated in any one year. This recommendation reflects the limited CPW staff capacity for ongoing maintenance activities required on a treated parcel in the years following the initial treatment.
- Efforts to establish native woody vegetation on floodplain patches should prioritize areas with elevations less than 6 ft above the baseflow elevation of the river to help promote rooting into the saturated zone.
- Soil conditions, water table elevations and fluctuations, overbank flow frequencies, and other factors all play a role in the long term success of any revegetation effort. Multi-disciplinary teams should be engaged to develop site-specific plans at any location.

Maintaining and encouraging dynamic river processes that provide the regular and natural disturbances needed to maintain a diverse riparian habitat patchwork over time may prove to be the most-successful and cost-effective strategy to achieve region-scale preservation and restoration of degraded systems in the Grand Valley corridor. However, large scale process-based restoration activities carry considerable difficulties in the short-to-medium term, including permitting and design requirements, high costs, and social/political resistance. They may also necessitate consideration of unintended consequences. For example, efforts to restore some gravel ponds or reconnect backwater habitats to the river channel may pose short- or medium-term invasive species competition risks for native fish. Despite these potential pitfalls, large-scale restoration activities aimed at encouraging or enabling the creation of dynamic channel forms is expected to be the most effective approach to boosting the functionality and resiliency of riparian forests, floodplains, and aquatic habitats over the coming decades. Intensive restoration projects implemented by GVRCI and its partners should contemplate the following guiding principles:

- Significant ecological benefits may be achieved by puncturing levees on floodplains that are otherwise free from critical infrastructure.
- In some floodplain patches, mechanical excavation of backwater sloughs or high flow/overflow channels can provide the high volume of fill material required to partially or completely fill abandoned gravel ponds, reducing preferred habitat for invasive fish and making those areas a more functional component of the river landscape.
- Any project expected to reconnect the river to backwater habitats or abandoned gravel ponds should proceed in close coordination with CPW and the Upper Colorado River Endangered Fish Recovery Program.

Tools for Strategic Land Use Management

Effective conservation of remaining riparian habitats is one of the most important short-term actions available to GVRCI to improve or protect river corridor health. If Grand Valley communities desire the continued delivery of social and ecological goods and services derived from riparian zones, they first need to arrest the continued functional loss and destruction of these ecosystems in near-stream zones. Unless they are addressed, historical patterns of development that encroached upon riparian zones [Table 5] will likely continue in the decades to come. Conservation of remaining riparian zones may be achieved through multiple means.

Riparian areas and floodplains in the Grand Valley River Corridor are currently subject to a variety of overlapping local, state, and federal laws that guide development activities. For stream side landowners in the Grand Valley, the most relevant development regulations are likely those associated with the FEMA's Regulatory Floodway. While

[32] https://www.google.com/maps/d/u/0/viewer?mid=1Q_PIcP56AKgx8KKQGmqV4H_gxO57sKw&ll=39.03515936357499%2C-108.50440752982936&z=14

Table 5: Tabulation of the existing structures, gravel ponds, road infrastructure and berms/levees that fall within the mapped 3-tier buffer for the Grand Valley.

BUFFER ZONE	AREA (ACRES)	ENCROACHING STRUCTURES (COUNT)	GRAVEL PONDS (COUNT)	ROAD LENGTH (MILES)	LEVEE/BERM LENGTH (MILES)
1	6469	213	68	10.4	30.0
2	2496	728	122	11.4	17.5
3	3173	1330	171	14.7	18.5

2256 acres
Private land mapped as remaining riparian habitat

651 acres
fall within the regulatory floodway

1588 acres
fall within the regulatory floodplain but not the floodway

26 acres
fall outside the regulated areas

Photo Credit: Joel Sholtes

Table 6: Overview of the regulatory frameworks that impact riparian land uses in Grand Valley. Table 6 provides a qualitative assessment of local stakeholders' ability to influence each identified regulatory framework in an effort to better preserve and protect riparian areas and floodplains in the Grand Valley.

REGULATORY FRAMEWORK	IMPLEMENTING AGENCY	LANDOWNER RELEVANCY	LOCAL OPPORTUNITIES TO INFLUENCE REGULATION?
Clean Water Act Section 404	US Army Corps of Engineers (USACE) oversees permitting on behalf of EPA / CDPHE	Due to catastrophic wetland losses nationwide, the filling of wetlands is closely regulated, with potential requirements for compensatory mitigation. Small projects usually function under a nationwide permit, while larger projects may require individual permit acquisition.	No
Endangered Species Act	US Fish and Wildlife Service (USFWS), Colorado Parks and Wildlife (CWP)	ESA prohibits actions that can harm listed species and contains potentially broad powers regarding preservation of critical habitat. Landowner or project actions that may impact species are subject to an agency consultation.	No
CO Land Reclamation Act	State Division of Reclamation and Mining Safety (DRMS)	Operators and site owners of gravel pits are subject to reclamation requirements and controls on operations that occur in floodplains or influence groundwater.	No
Special Use Permits	Mesa County or local municipalities	In addition to state and federal level permits, certain activities (mining, industrial, other unique land uses) may be subject to unique stipulations as part of a Special Use Permit or similar permitting requirement.	Yes
Land use codes; general development standards and zoning	Mesa County or local municipalities	Specifies allowable uses, setbacks (if any), and site requirements such as landscaping and grading. Most Grand Valley community regulations/ development standards are focused on aesthetic considerations and compatibility of uses. Codes contain little or no specification regarding native vegetation preservation or preservation of riverine function; livestream setbacks and reasons for such are generally not present in municipal codes.	Yes
Land use codes; floodplain regulation	Mesa County or local municipalities	Restrictions on development in floodplains. Most Grand Valley community regulations are focused on protection of infrastructure and human safety. Local codes contain little or no specification regarding native vegetation preservation or preservation of riverine functions and river health functions of floodplains.	Yes
Land use codes; natural resource and sensitive lands regulations	Mesa County or local municipalities	These code sections focus on protecting the public from costs incurred by hazard control projects and relief. Most Grand Valley municipal codes are not responsive to protecting sensitive areas for intrinsic natural values or maintaining riverine corridor function and health.	Yes
Environmental Impact Statements/ Assessments	Mesa County or local municipalities	Certain developments based on size or type may be required to conduct environmental impact reviews and submit reports on anticipated impacts during public permitting processes.	Yes
Comprehensive Plans, Area Plans	Mesa County or local municipalities	Guidance plans (non-binding regulatory) identify sub-areas, special overlay districts, or other specific geographies that may have unique development goals or objectives. The associated use guidance or may be more or less restrictive than overall zoning and development regulations in the area.	Yes

these regulations do provide a measure of protection against development for some fraction of the remaining riparian corridor, significant portions of the floodplain remain exposed to development.

Local governments retain opportunities to use and modify existing regulatory overlays to more effectively manage the river corridor. Responsive development codes can efficiently preserve, maintain, and improve ecological function while better-protecting built environments over the long haul. This also reduces ongoing public hazard mitigation costs. Typical areas of municipal and county land use authority that have a nexus with improved river health include local floodplain regulations, lot setbacks and stream setbacks, water quality and vegetation management code, and creation of Special Development Zones or other overlay district types.

A comprehensive code review of Mesa County and local municipalities was not part of this assessment. A cursory investigation of county and municipal codes revealed that local regulations are focused heavily on preventing immediate loss of life or property damage, as well as incursion of significant costs to the general public for hazard mitigation and avoidance [Table 6]. Local regulations are generally not responsive or are mute with regard to achieving other river corridor management goals and purposes such as river health and riparian protection. While many communities in Colorado are moving towards better protection of natural resource health and function, Mesa County and Grand Junction's regulations remain more classically focused.

Where code changes fail to gain traction, programs or policy options that use permitting flexibility, tax structures, or other methods to incentivize riparian protection and dis-incentivize buffer destruction may also work. While these approaches tend to be less effective and less permanent than regulatory mechanisms, they can be more politically acceptable. Any effort made by GVRCI and its partners to encourage updates to land use development codes, develop Special Development Zone overlays, or otherwise influence future patterns of development through regulation should reflect the principles outlined in the 3-tier riparian buffer system.

Tools for Riparian Land Conservation

Conservation easements are the most common means by which riparian areas are protected. Many examples of this well-established tool are available in the Grand Valley. However, when envisioned for riparian protection, these easements require some specific considerations. Conservation easements most commonly apply to an entire property rather than being limited to the riparian corridor. This is due to the cost of putting the land under easement and the federal and state tax benefits that are associated with the value of the easement, which is based on the development potential of the land. There are, however, examples of riparian-only easements on State Land Board properties. Examples include federally-approved mitigation banks.

Standard conservation easements that cover an entire property typically include language that discusses use and protection of the riparian corridor and associated wildlife habitat. One effective strategy for bolstering habitat protection while maximizing flexibility is to supplement an easement with a management plan that can be updated periodically in response to changing conditions on the property. Importantly, in the Grand Valley, conservation easements and associated management plans can be placed on lands managed by Colorado Parks and Wildlife. An example from Tarryall Creek Ranch II is provided in Appendix B. The property is owned by Park County, managed by CPW, and the easement is held by Colorado Open Lands. The easement's management plan provides the current management goals and actions appropriate to sustain the desired ecological landscape, wildlife values, vegetation, and agricultural features and operations. A similar approach can be used on private lands in the Grand Valley. Supplementation of an easement on an agricultural, residential, or industrial property with a management plan can codify acceptable land use activities in near-stream areas (e.g., reflecting the concepts outlined in the 3-tier buffer system).

Several guidance documents and examples also exist for easements designed to protect riparian corridors and allow for natural processes such as channel migration. The Colorado Water Conservation Board recently developed a guidance on stream corridor easements as part of its Fluvial Hazard Zone program[33]. This guidance document defines the stream corridor easement (SCE) as a "management tool to preserve natural stream functions that benefit human and ecological communities while also reducing flood hazards by protecting stream and floodplain processes at crucial locations in our watersheds." The SCE is a voluntary legal agreement between a landowner and land trust or government entity that contains permanent restrictions on the use or development of the land under the easement. The goal of the SCE's management plan is to allow the stream to adjust naturally within the corridor, but the landowner may be able to use the land within the easement for agricultural, forestry, or recreational pursuits in a way that does not interfere with the underlying premise that the stream channel can move and access its floodplain. Fluvial hazard zone maps, already developed for the Grand Valley, may be used to identify likely areas for the deposition and storage of water, sediment, and organic material during a flood.

Examples of implemented stream corridor easement initiatives also exist in Vermont and Montana. The Vermont Rivers Program promotes protection of riverscapes through its River Corridor Easement Program[34]. "This program provides a financial incentive to landowners to allow for passive restoration of channel stability by allowing the natural erosive forces of the river to establish its least erosive form over time." Under a river corridor easement, river channel management rights are sold by the landowner to a land trust as part of a conservation easement. After management rights are transferred, the landowner is restricted from intervening with erosion

[33] https://www.coloradofhz.com/
[34] https://dec.vermont.gov/watershed/rivers/river-corridor-and-floodplain-protection/protection

✓20%

Private land mapped as functional riparian habitat and held under some form of conservation easement

✗80%

Private land mapped as functional riparian habitat not afforded this protection from development

and channel adjustments within the corridor, but agriculture and silviculture are still permitted within the easement area. The three primary components of a river corridor easement are (1) transfer of channel management rights to a land trust; (2) no new structures or development within the river corridor; and (3) minimum 50 ft. riparian buffer of native woody vegetation whose location floats with the river[35].

The State of Montana's Channel Migration Easement Program[36] shepherds a type of conservation easement that "transfers the property right of a landowner to channelize, harden, rip-rap, or stabilize the bankline and historical Channel Migration Zone in perpetuity in exchange for financial compensation. The landowner still maintains ownership of the land and retains all of the other property rights that are not explicitly limited in the easement. The purpose of a CME is to protect the river's ability to move freely across its floodplain and allow it to adjust to changes in hydrology and bed load with erosional and depositional processes." This type of easement can be used to accommodate and promote dynamic river processes within the river corridor.

Numerous municipal and county lands have riparian areas that can benefit from explicit conservation protections or management overlays to elevate and maintain naturalized vegetation preservation and floodplain functions above other potential public uses. It may appear confusing to assert that public lands are not already conserved. However, public lands serve multiple uses and many parcels home to functional riparian habitats are afforded no long term protection against development for infrastructure, recreation facilities, or actively managed public spaces. GVRCI should work with CPW, Mesa County, and local municipalities to pursue conservation easements on public lands in the river corridor.

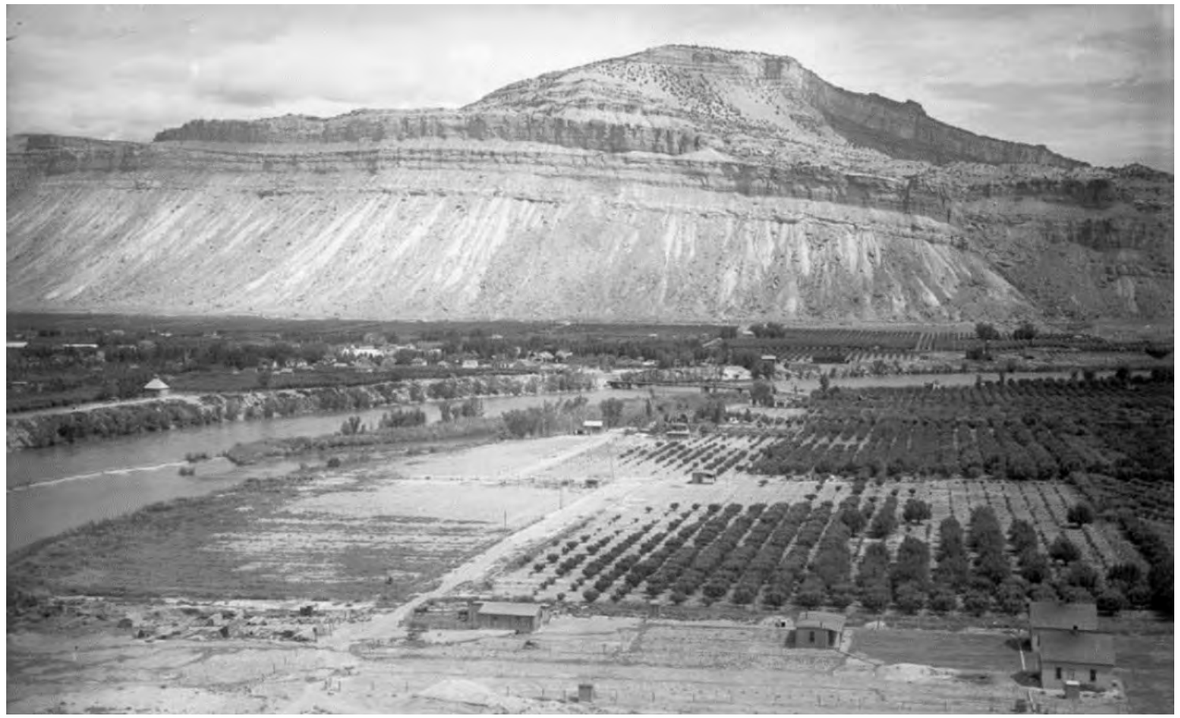
A large amount of the private land adjoining the Colorado and Gunnison rivers is under agricultural production. Conservation on agricultural lands can occur in multiple forms. Maintaining agricultural production and landscapes in the Grand Valley is a top priority of most communities. This strategy needs not preclude better management of river frontage on those lands. Conservation easements that cover either the entire parcel, or are partially applicable only to the river frontage, may both protect river functions and maintain productive landscapes. GVRCI should work with agricultural landowners alongside the Colorado West Land Trust, in an opportunistic manner, to secure conservation easements that are customized to protect traditional agricultural uses on uplands while maintaining or improving riparian functions and values on streamside portions.

Land acquisition may be a useful or appropriate tool in certain circumstances. Moving key, high-value riparian habitats or floodplains out of private ownership and into the public domain can greatly facilitate conservation of those lands. Land acquisition may be financially demanding. In addition, social attitudes towards new public land acquisition may vary strongly across communities. For these reasons, this tool will likely play a minor role in the strategies for conservation and restoration pursued by GVRCI. Private inholdings and parcels adjacent to, or contiguous with focus areas in the Grand Valley are an obvious first priority. Acquiring such properties would help leverage the investments made and benefits gleaned from projects implemented in focus areas. Any acquired lands should be fit with an appropriate conservation easement overlay, ensuring that investments in habitat and floodplain functions are permanently protected.

During processes tied to development or redevelopment of large land tracts that open and modify a parcel plat adjacent to the river, Grand Valley municipalities or Mesa County may consider moving a narrow portion of the streamside tract into public management, while the majority of the parcel may be approved for development. This approach may be appropriate for new subdivision development and PUD-based development applications frequently used for new residential or multi-use projects. The amount or width of stream tract suggested for public ownership and management may rely on the 3-tier buffer system concepts presented previously. The stream tract moved into public ownership and management may cover only the Zone 1 buffer, or both Zones 1 and 2, while Zone 3 remains in private ownership with permissible moderate impact land uses. Through implementation of this approach, the county or city can maintain control of critical riparian areas, while the property owner or developer is able to retain control of a majority of the developable property.

Numerous municipal and county lands can benefit from explicit conservation protections

[35] https:/dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_RiverCorridorEasementGuide.pdf
[36] https://freshwaterpartners.org/wp-content/uploads/2021/08/MARS-CME-Whitepaper-FINAL-DRAFT-20171004-v1.0.pdf



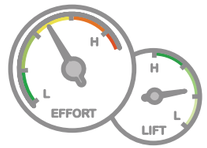
PROJECT CONCEPTS

Photo Credit: Joel Sholtes

The pages that follow present working project ideas at each of the seven focus areas identified in the Grand Valley. Three concepts are presented for each focus area that attempt to meet GVRCIs objectives across a range of implementation costs, legal and administrative complexities, and other project feasibility criteria. These concepts are not exhaustive, nor are they mutually exclusive. In fact, the best restoration outcomes will likely be achieved at a given site where all concepts are implemented.

The Grand Valley River Corridor holds vast opportunities for restoration and conservation, a vision that may take generations to fully realize. The challenge for the GVRCI lies not just in the scope of this work, but in the pursuit of strategic, multi-benefit projects that align with strong, committed partners

A set of criteria characterizing the feasibility of each project concept are provided in qualitative terms to help GVRCI and its partners identify a preferred course of action. Each criterion and its associated levels are defined below. Additional project scoping and preliminary project design will be required in most cases in order to provide a more robust characterization of project feasibility.

Level of Effort vs Expected Lift: General characterization of effort expected in moving project from conceptualization to implementation, referenced against the expected ecological benefit (or "lift") of the project.	 Low Effort: Low Lift	 Moderate Effort: Moderate Lift	 High Effort: High Lift
Order of Magnitude Costs: Order of magnitude costs associated with design (e.g., survey, site engineering, permitting) and implementation/construction (e.g., equipment, materials, labor).	$ Tens of Thousands	$ $ Hundreds of Thousands	$ $ $ Millions
Planning and Design Lead Time: Time required to develop alternative plans and preliminary and final (30%, 60%, 90%, 100%) designs, build coalitions around project, and secure legal agreements and approvals.	 < 2 years	 1-5 years	 5-10 years
Legal and Administrative Burden: Administrative and legal activities related to real estate transactions, intergovernmental MOUs, land titles, review and update of management plans, etc.	 Low	 Moderate	 High
Maintenance Requirements: Invasive species control, site irrigation, human/use management, monitoring, and adaptive management	 Periodic	 Semi-Annual	 Annual

The Grand Valley River Corridor holds vast opportunities for restoration and conservation, a vision that may take generations to fully realize. The challenge for the GVRCI lies not just in the scope of this work, but in the pursuit of strategic, multi-benefit projects that align with strong, committed partners.

Focus Area:

Horsethief Canyon

Project Area:

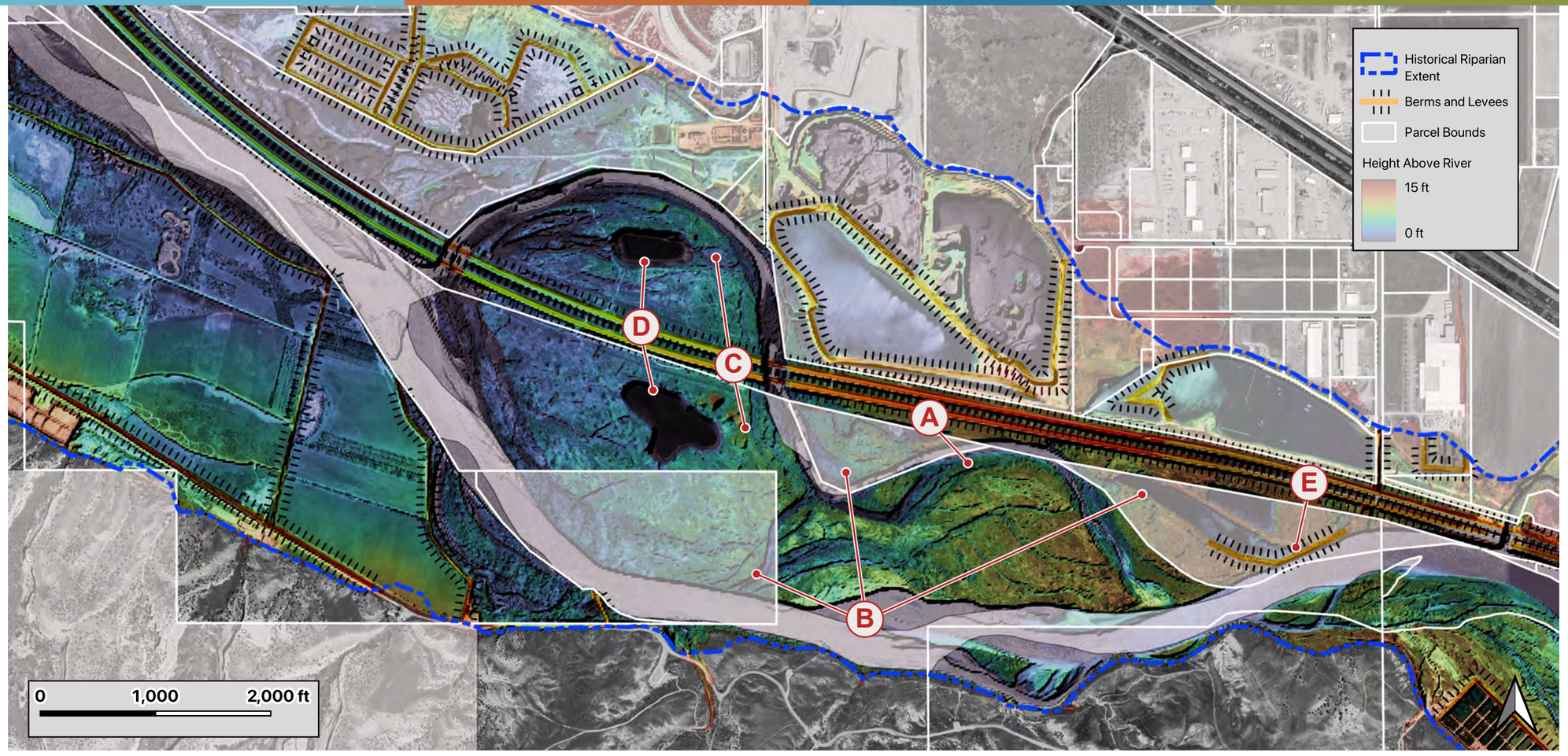
330 acres

Land Owners:

Bureau of Reclamation, Private

Site Description:

The Horsethief Canyon area contains opportunities both for conservation of functional riparian habitats and enhancement of hydrological connectivity with the floodplain. This site was burned in a recent wildfire. A large portion of the are is a CPW SWA. The area most amenable to restoration action lies on the north side of the Colorado River. Two private parcels adjoin the SWA between its northern boundary and the I-70 corridor. One private parcel falls within the bounds of the SWA. The site contains a backwater slough, two manmade ponds, and several high-flow side channels.



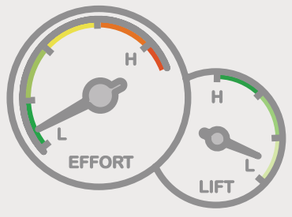
Concept 1

Anticipated Cost: $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Non-native woody vegetation removal and replacement with containerized stock or cuttings of cottonwood and willow with a focus on ensuring that Russian Olive and other invasive species do not gain a foothold on floodplain surfaces post-wildfire. Planting should prioritize use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations. This includes low lying areas adjacent to the backwater slough that runs along the northern SWA boundary (**A**). Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by deep pole planting in the early summer months and use of a temporary irrigation system.

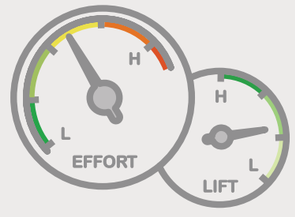
Concept 2

Anticipated Cost: $ $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Secure conservation easements on the portion of the SWA north of the Colorado River and on the three adjoining private land parcels (**B**). Supplement each conservation easement with a management plan that describes invasive woody species control, accommodates river movement across the floodplain, and restricts future development activity. Undesirable land uses for this focus area include hard-surface trails, boat ramps, park facilities and other types of more intensive development activities. A limited number of soft-surface trails may be acceptable, where construction and management of those trails does not depend on permanent structures, bank armoring, or other activities that would otherwise inhibit movement of the river channel across its floodplain.

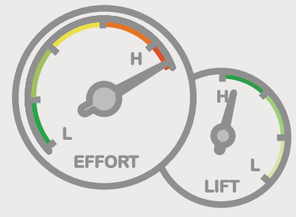
Concept 3

Anticipated Cost: $ $ $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Reshape floodplain topography to enhance hydrological connections with the floodplain and promote dynamic river behavior. Create high-flow channel connections between the slough on the northern boundary of the SWA and the two ponds within the SWA boundary (**C**). Use material cut from the floodplain to fill the man-made ponds and convert them to wetland meadow habitat (**D**). Remove or puncture the levee structure on the eastern private parcel (**E**). Use excavated material to fill adjacent gravel pond so that depth characteristics mirror downstream slough. Coordinate closely with Colorado Dept. of Transportation and CPW to ensure that project activities do not pose unnecessary risks to the I-70 corridor or enhance habitat availability and connectivity for non-native fish species.

HORSETHIEF CANYON: CONCEPT PLAN

Focus Area:

Walter Walker

Project Area:

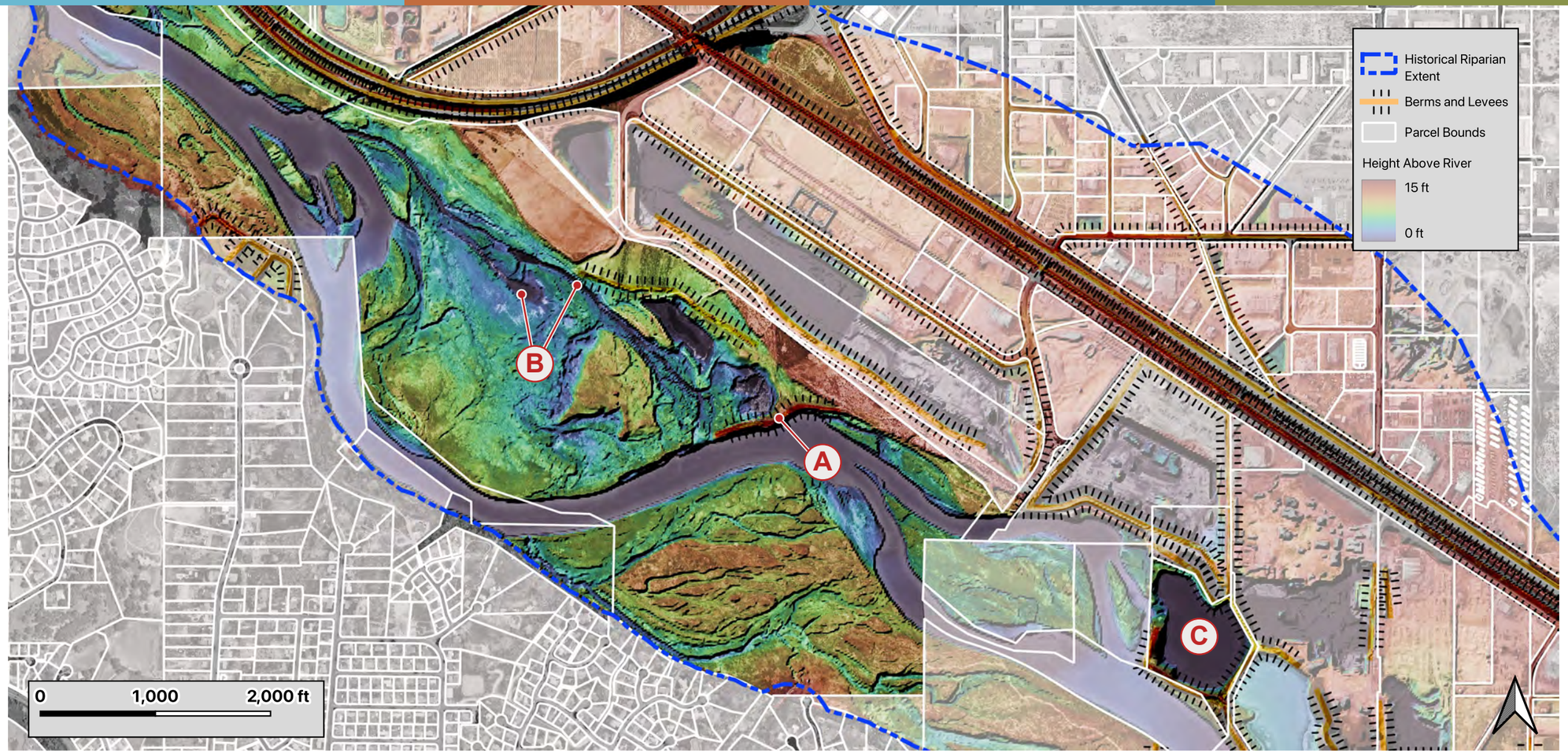
339 acres

Land Owner:

Colorado Parks & Wildlife

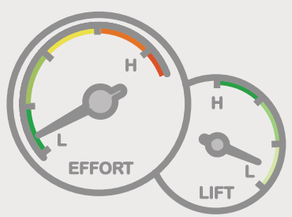
Site Description:

CPW manages this SWA as a wildlife refuge and for fishing and other forms of recreation. The northern portion of the SWA was an operational gravel mine prior to the 1983 flood on the Colorado River, which recaptured the gravel pits and filled them with sediment. The floodplain deck is among the youngest fluvial features in the Grand Valley. This location contains opportunities both for conservation of functional channel and riparian habitats, as well as enhancement of degraded ones.



Concept 1

Anticipated Cost: $
Planning & Design:
Legal & Admin:
Maintenance:

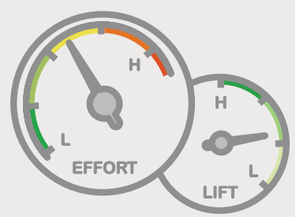


Project Description:

Plant new willow and cottonwoods on the large floodplain north of the Colorado River with the intention of shading out invasive Kochia on floodplain surfaces. Planting may make use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations, including relic fluvial surfaces and other depressional areas. Deep pole plantings with direct access to the water table may be more successful. Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by planting in the early summer months at or before peak water table elevation prior to natural recession. Temporary irrigation may be required for new plantings in many areas.

Concept 2

Anticipated Cost: $ $
Planning & Design:
Legal & Admin:
Maintenance:

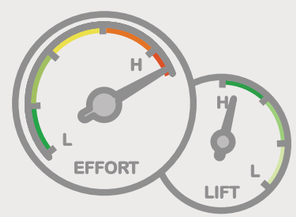


Project Description:

Partially breach the levee at the upstream edge of the floodplain to the north of the Colorado River adjacent to United Companies parcel on Railroad Ave. (**A**) to allow more flow into the depressional areas behind the levee during high flow periods. The breach may be constructed to include an armored sill, large box culvert, or mechanical flow control structure at an invert elevation associated with the 1-in-2 year peak flow event. Combine levee breaching with floodplain excavations that increase the areal extent of slough or shallow ponded backwater habitat (**B**) formed during regular high flow events. Restore existing wetlands. The existing slough along the northern edge of the SWA is heavily encroached by vegetation that reduces the likelihood of sediment mobilization and dynamic floodplain processes when it is inundated. Consider vegetation removal or thinning along the margins of the slough.

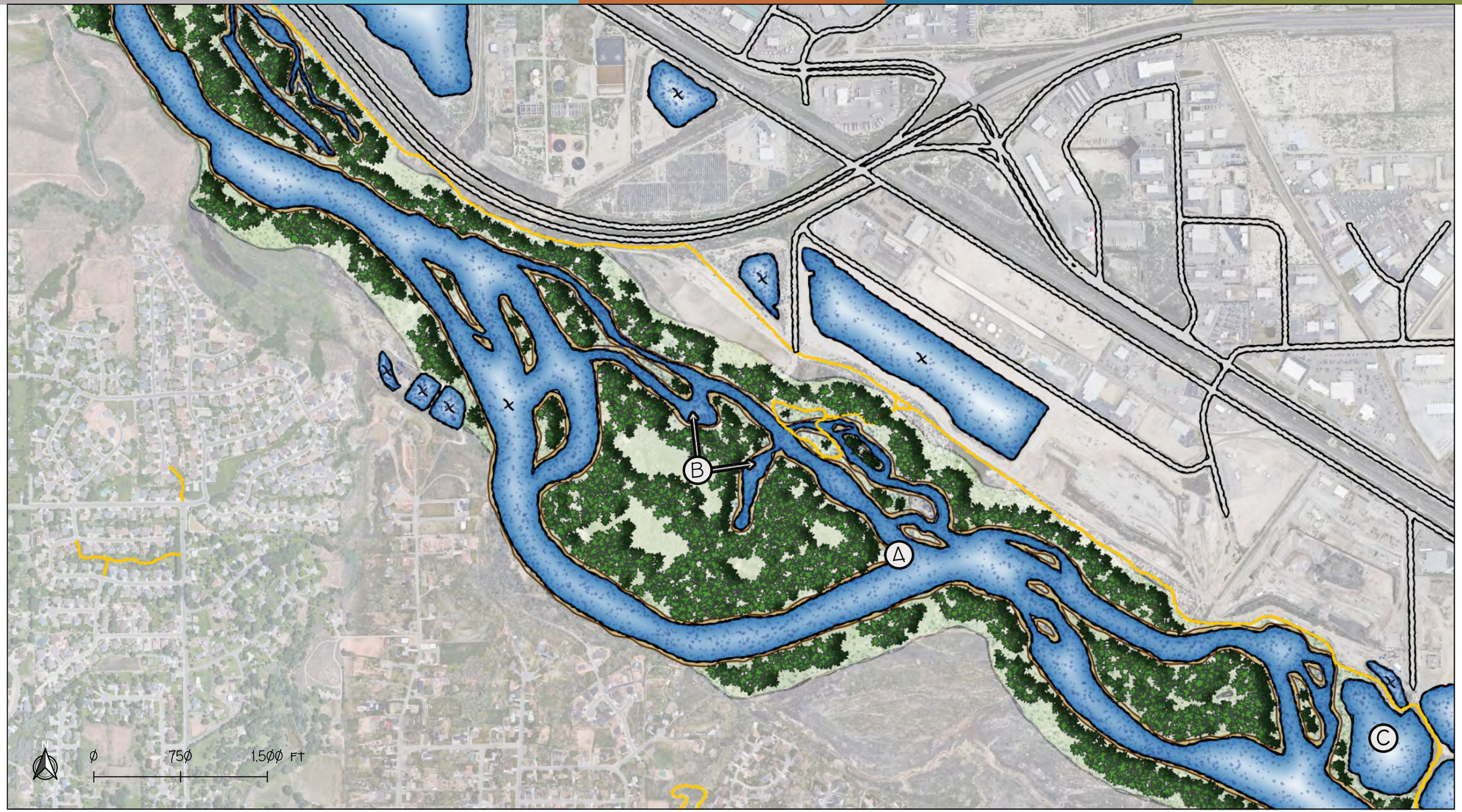
Concept 3

Anticipated Cost: $ $ $
Planning & Design:
Legal & Admin:
Maintenance:



Project Description:

Remove significant portions of the levee at the upstream edge of the floodplain to the north of the Colorado River and adjacent to United Companies parcel on Railroad Ave. (**A**). Bring levee grade down to the elevation of the floodplain deck behind it. Use excavated material to partially fill or improve the shallow vegetated fringe on a nearby gravel pond (**C**). Levee removal will increase flows through the slough that runs along the northern edge of the SWA and within other relic fluvial surfaces on the floodplain. Restore existing wetlands. Work with CPW to develop a long-term management plan for the property that accepts lateral migration, avulsion, or capture on any portion of the floodplain to the north of the Colorado River.



WALTER WALKER: CONCEPT PLAN

Focus Area:

Connected Lakes

Project Area:

240 acres

Land Owners:

Colorado Parks & Wildlife, Private

Site Description:

Perhaps the most challenging focus area due to legacy land uses and current patterns of ownership. This site was home to a historical gravel mine that left large, deep ponds on the property. Some of these ponds now contain non-native, invasive fish that pose a threat to the native warm-water fish in the Colorado River. However, these fish are treated as a favored recreational fishery by the local community. The Connected Lakes area is a State Park (SP) that is heavily used as a recreational amenity. Any work on the site will need to carefully consider the social impacts of restoration.

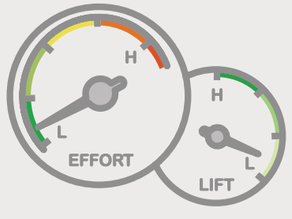
Concept 1

Anticipated Cost: $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Work with CPW management plan that includes the permanent removal of non-native, invasive fish species from all ponds in the SP (**A**). Opportunistically remove invasive woody plants and replace them with cottonwood and willow plantings throughout the SP. Planting may make use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations, including low lying areas adjacent to the backwater slough that runs along the northern SP boundary. Deep pole plantings with direct access to the water table may be more successful. Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by planting in the early summer months at or before peak water table elevation prior to natural recession. Temporary irrigation may be required.

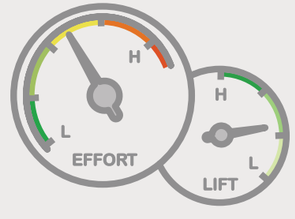
Concept 2

Anticipated Cost: $ $ $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Four private parcels sit along the southern bank of the Colorado River on the upstream end of the SP (**B**). These properties fall within a significant fluvial hazard zone. Acquire these parcels, consolidate them, and absorb them into SP or into City of Grand Junction parks property portfolio. Secure a conservation easement for the acquired parcels. Secure a conservation easement for the private parcels on the Blue Heron floodplain to the north (**C**) to protect valuable native fish habitat. Supplement the conservation easements with management plans that make allowances for continued channel migration across the subject parcels and within the adjoining portion of the SP currently under conservation easement. Implement a vegetation management and restoration plan aimed to promoting native woody vegetation.

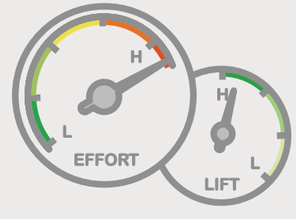
Concept 3

Anticipated Cost: $ $ $

Planning & Design:

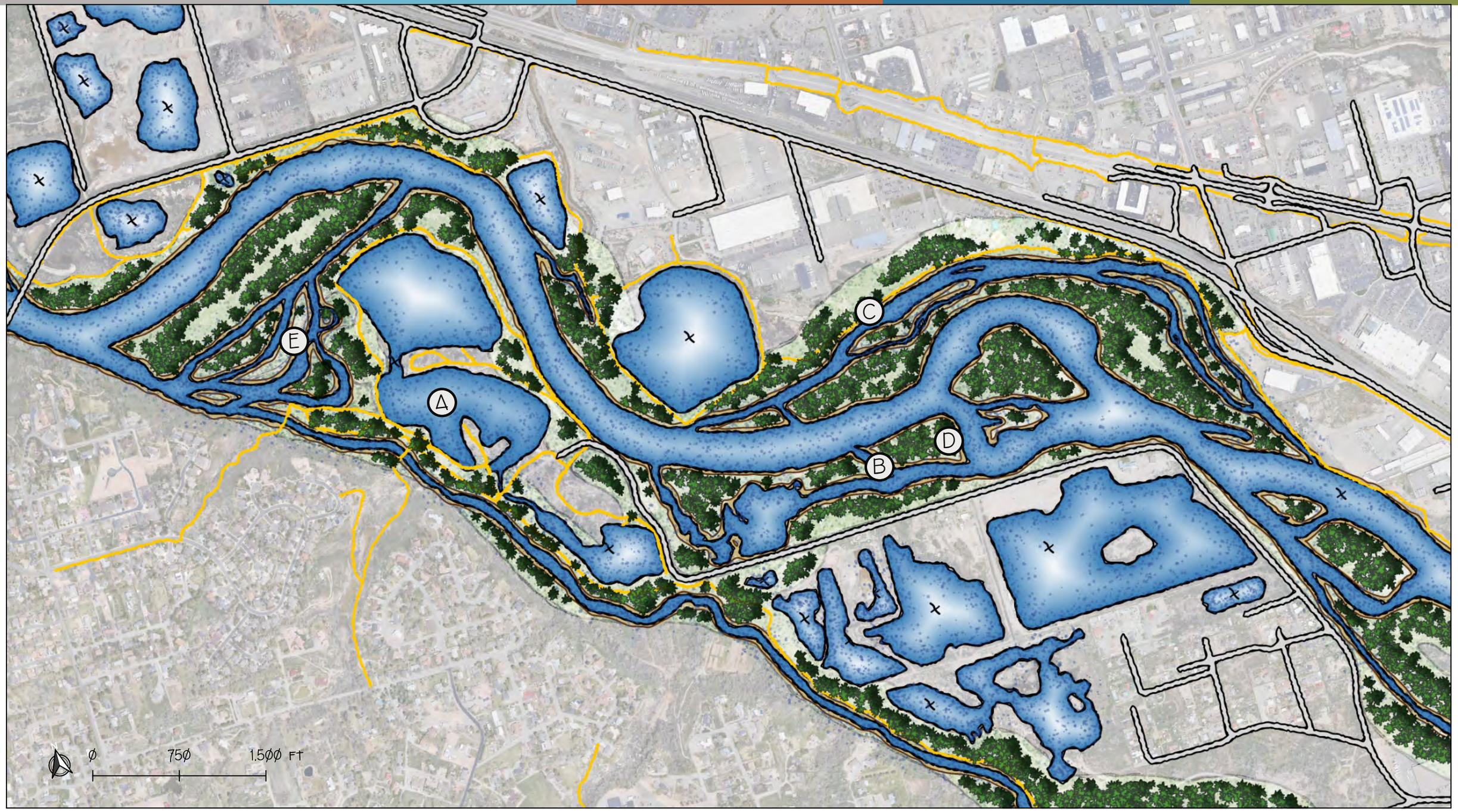
Legal & Admin:

Maintenance:



Project Description:

After securing the private parcels upstream of SP, remove bank armoring and berm near Dike Road to provide additional space for dynamic channel behavior (**D**). Partner with CPW and the Recovery Program to convert Endangered Fish Lake into a shallow backwater habitat and hydraulically connect it to the Colorado River. Remove hardscape portions of the Waterfowl Loop Trail. Regrade surrounding surfaces to provide fill material for Endangered Fish Lake (**E**) to create shallow, backwater habitat that favors native Colorado River fish species. Connect the regraded floodplain surface to the Colorado River or the Redlands Canal on the downstream end of the SP such that the newly created backwater is inundated during 1-in-2 year peak flow events.



CONNECTED LAKES: CONCEPT PLAN

Focus Area: :

Watson Island

Project Area:

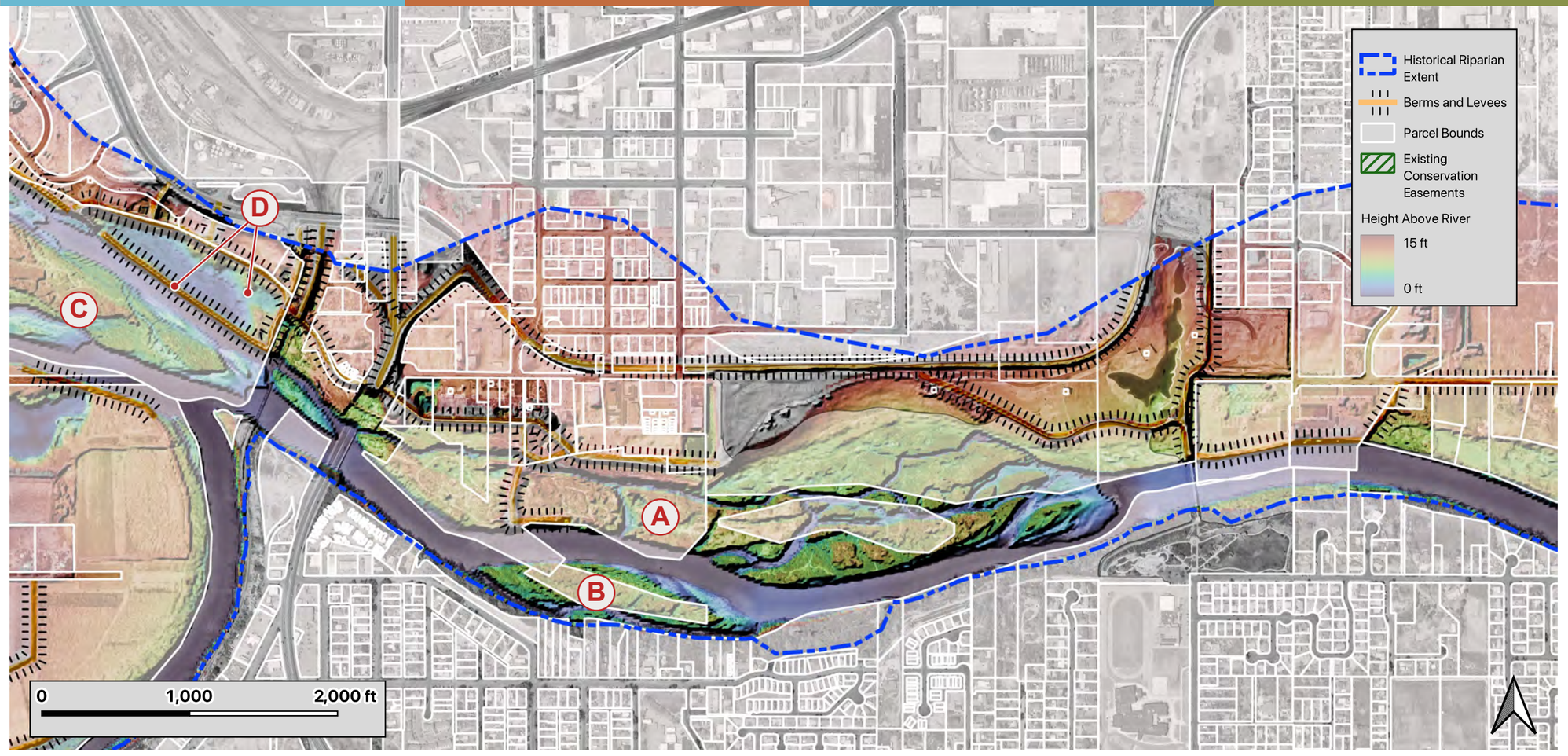
79 acres

Land Owner:

City of Grand Junction

Site Description:

This focus area comprises a complex of properties owned by the City of Grand Junction along the Colorado River immediately upstream and downstream of the confluence with the Gunnison River. Watson Island is a City park that hosts a surface trail and a frisbee golf course. Other floodplain and island areas are currently undeveloped but ongoing nearby development may result in additional construction of bridges, trails, and other recreational amenities. This site was recently impacted by fire.



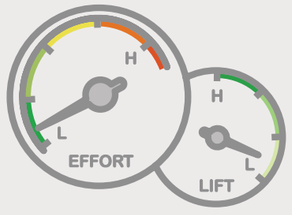
Concept 1

Anticipated Cost: $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Work with the City of Grand Junction to ensure that continued recreational development of Watson Island (**A**) does not necessitate or encourage activities like levee/berm construction or bank armoring intended to protect infrastructure. Convert hardscape paths and landscaping on Watson Island to soft surfaces. Develop a long-term management plan with the City of Grand Junction for the property that accepts the possibility of channel movement, bank erosion or deposition, or avulsion.

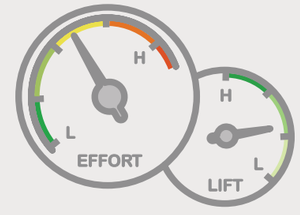
Concept 2

Anticipated Cost: $ $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Secure a conservation easement for Watson Island (**A**), the floodplain pocket on the south bank of the river (**B**), and Lot 10 of the Riverfront at Dos Rios property (**C**). Supplement the conservation easement with a management plan that describes invasive woody species control, accommodates river movement across the floodplain, and restricts future development activity. Undesirable land uses for this focus area include hard-surface trails, foot or vehicle bridges boat ramps, park facilities and other types of more intensive development activities. A limited number of soft-surface trails may be acceptable, where construction and management of those trails does not depend on permanent structures, bank armoring, or other activities that would otherwise inhibit movement of the river channel across its floodplain.

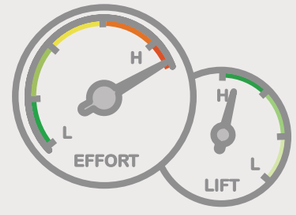
Concept 3

Anticipated Cost: $ $ $

Planning & Design:

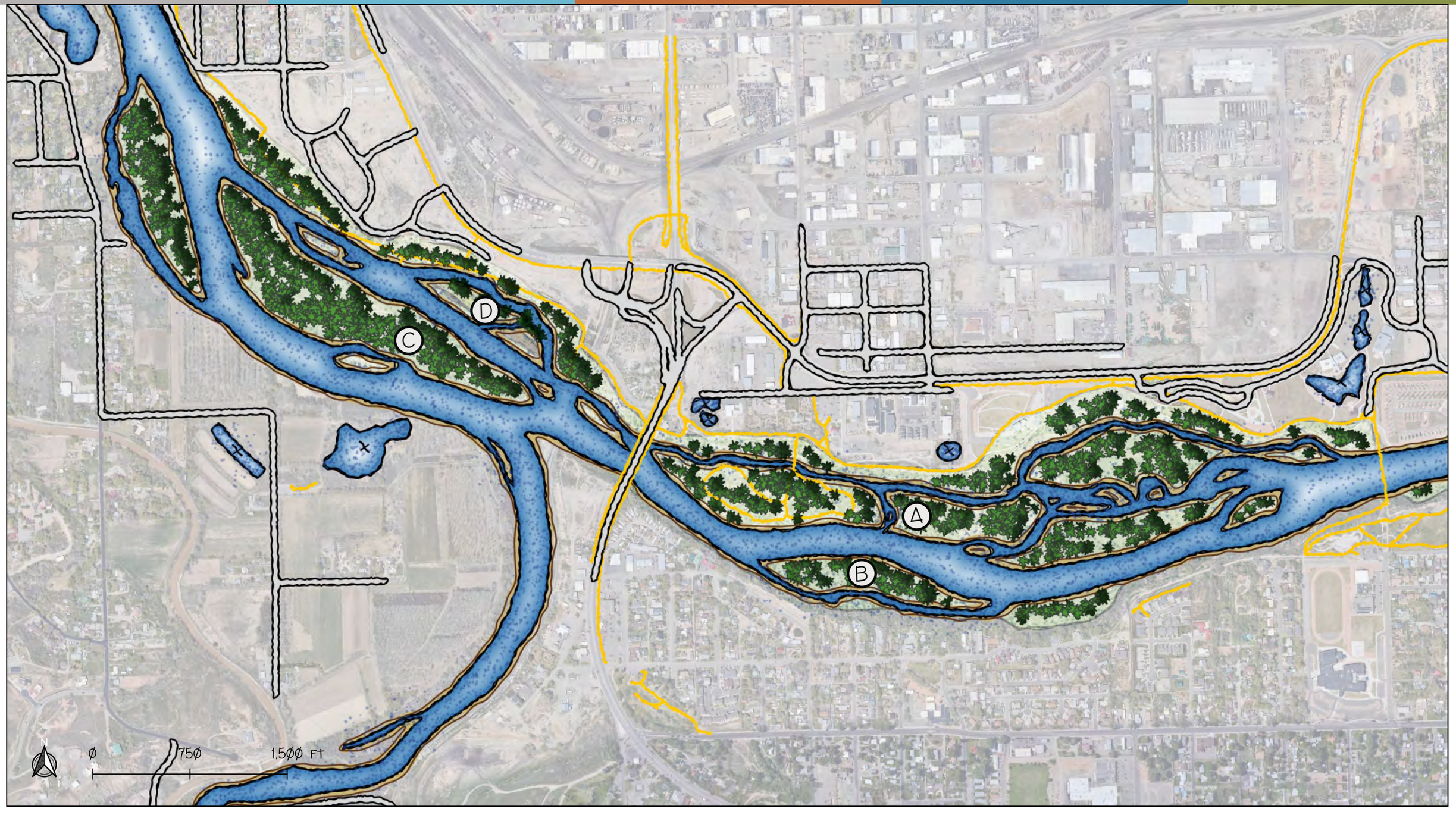
Legal & Admin:

Maintenance:



Project Description:

Remove the berm that bisects the floodplain pocket on the north side of the Colorado River, west of the Highway 50 bridge and railroad bridge (**D**). This was the site of a native fish habitat project implemented by City of Grand Junction and U.S. Fish and Wildlife Service. The site is an open pond with no shade and is of questionable habitat value in its current form. Use excavated material to reshape floodplain topography and create more complex backwater habitat for native fish. Alternatively, use berm material to enhance the shallow vegetated fringe in a nearby gravel pond. Plant regraded floodplain surfaces with native woody and herbaceous vegetation. Restore degraded wetlands.



WATSON ISLAND: CONCEPT PLAN

Focus Area:

Orchard Mesa

Project Area:

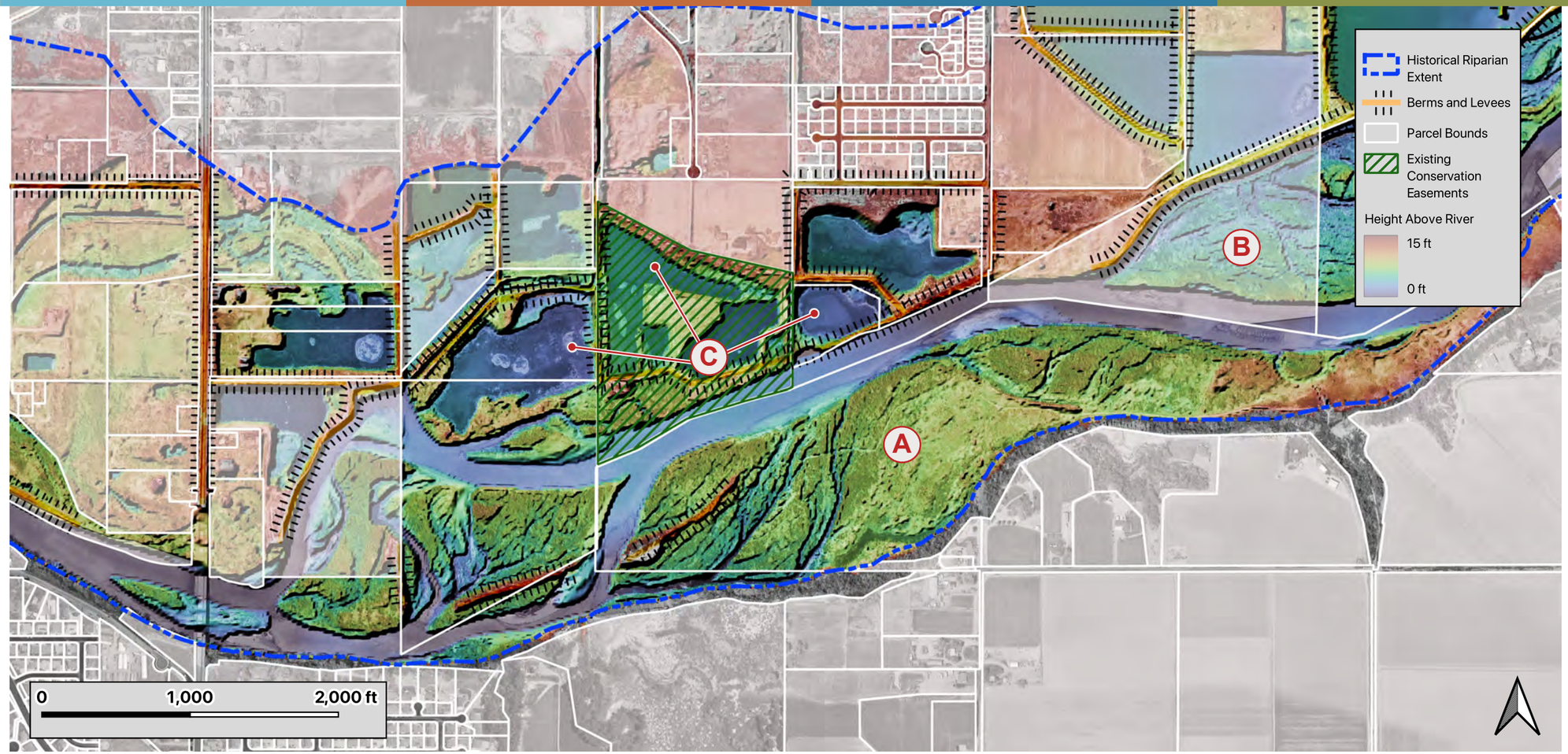
387 acres

Land Owners:

Colorado Parks & Wildlife; Bureau of Reclamation

Site Description:

This focus area comprises several parcels owned by Colorado Parks and Wildlife and the Bureau of Reclamation. One private parcel on the north side of the river includes a significant floodplain area. The floodplain pocket on the south side of the river is undeveloped and managed primarily for wildlife and waterfowl hunting. Vehicle traffic is prohibited. The parcels to the north of the river consist of abandoned gravel ponds that boast extremely high restoration potential. However, significant challenges must be overcome before work can proceed in this area.



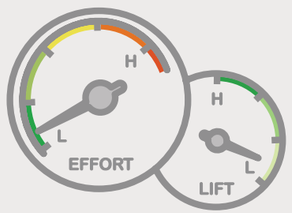
Concept 1

Anticipated Cost: $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Remove non-native woody vegetation and replace with native plants, including cottonwood and willow, on the large floodplain to the south of the Colorado River (**A**). Planting may make use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations, including low lying areas. Deep pole plantings with direct access to the water table may be more successful. Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by planting in the early summer months at or before peak water table elevation prior to natural recession. Temporary irrigation may be required for new plantings in many areas.

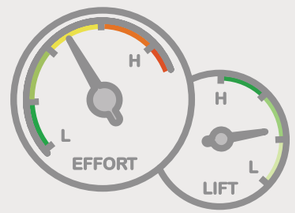
Concept 2

Anticipated Cost: $ $

Planning & Design:

Legal & Admin:

Maintenance:



Project Description:

Secure a conservation easement on the adjoining Colorado Parks and Wildlife and Bureau of Reclamation properties that comprise this focus area. Secure a separate conservation easement on the private floodplain parcel on the north side of the river (**B**). Supplement the conservation easements with a management plan that describes invasive woody species control, accommodates river movement across the floodplain, and restricts future development activity. Undesirable land uses for this focus area include hard-surface trails, boat ramps, park facilities and other types of more intensive development activities. A limited number of soft-surface trails may be acceptable, where construction and management of those trails does not depend on permanent structures, bank armoring, or other activities that would otherwise inhibit movement of the river channel across its floodplain.

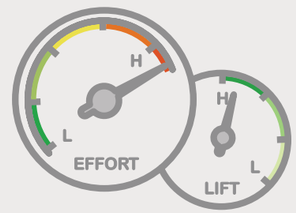
Concept 3

Anticipated Cost: $ $ $

Planning & Design:

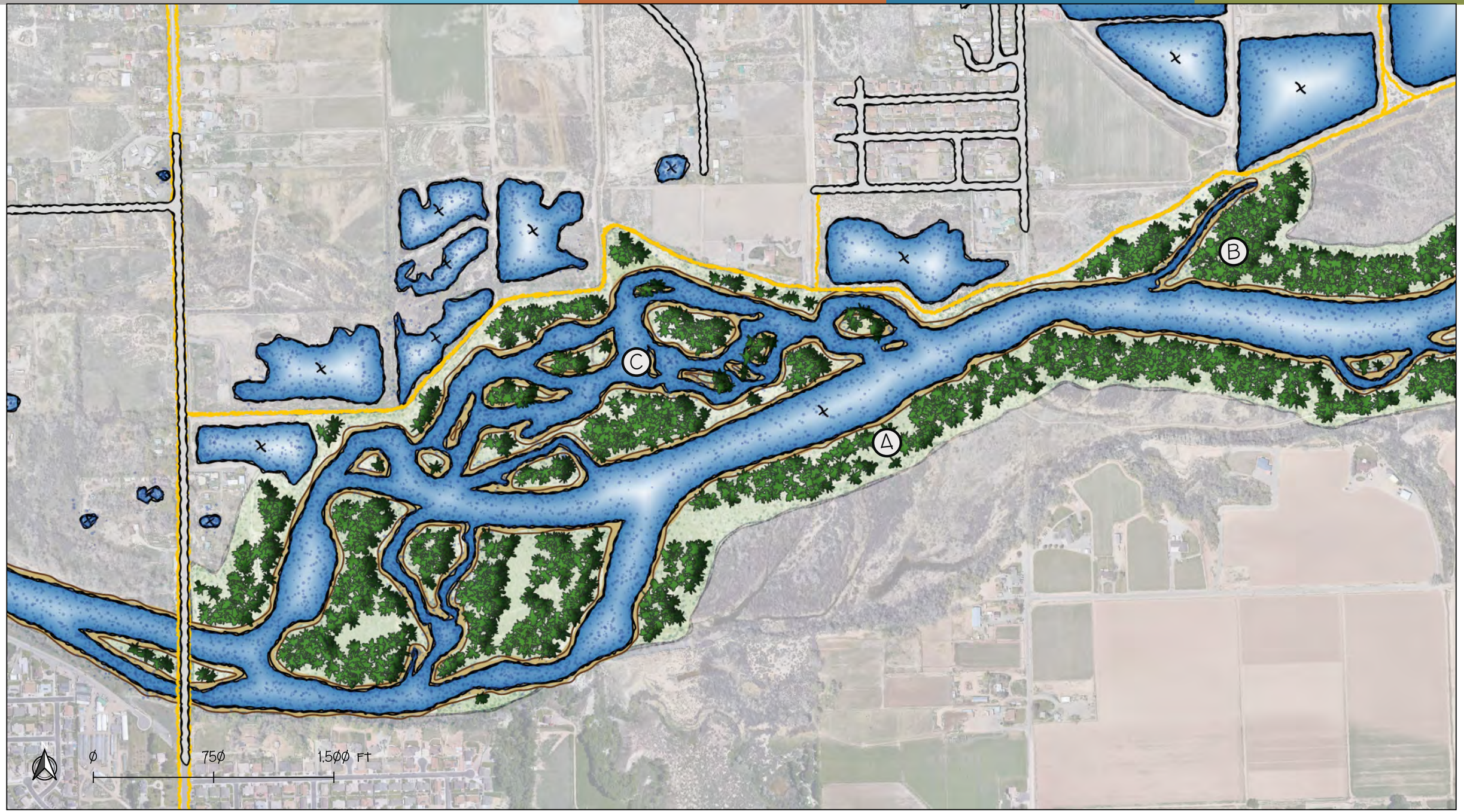
Legal & Admin:

Maintenance:



Project Description:

Work closely with CPW and the Recovery Program to fill and reconnect gravel ponds to the north of the Colorado River (**C**). Several ponds appear shallow and may be filled with material excavated from adjacent berms or spoils piles. Use excavated material to reshape floodplain topography and create complex backwater habitat preferred by native fish species for spawning and rearing. Reconnecting these areas to the active channel will help mitigate against a unplanned, and potentially catastrophic, capture of these areas by the river in a future flood event. Ensure that reclamation and reconnection of abandoned gravel ponds to the river does not inadvertently enhance habitat access for invasive fish species. Plant regraded floodplain surfaces with native woody and herbaceous vegetation. Restore degraded wetlands.



ORCHARD MESA: CONCEPT PLAN

Focus Area:

Clifton Water

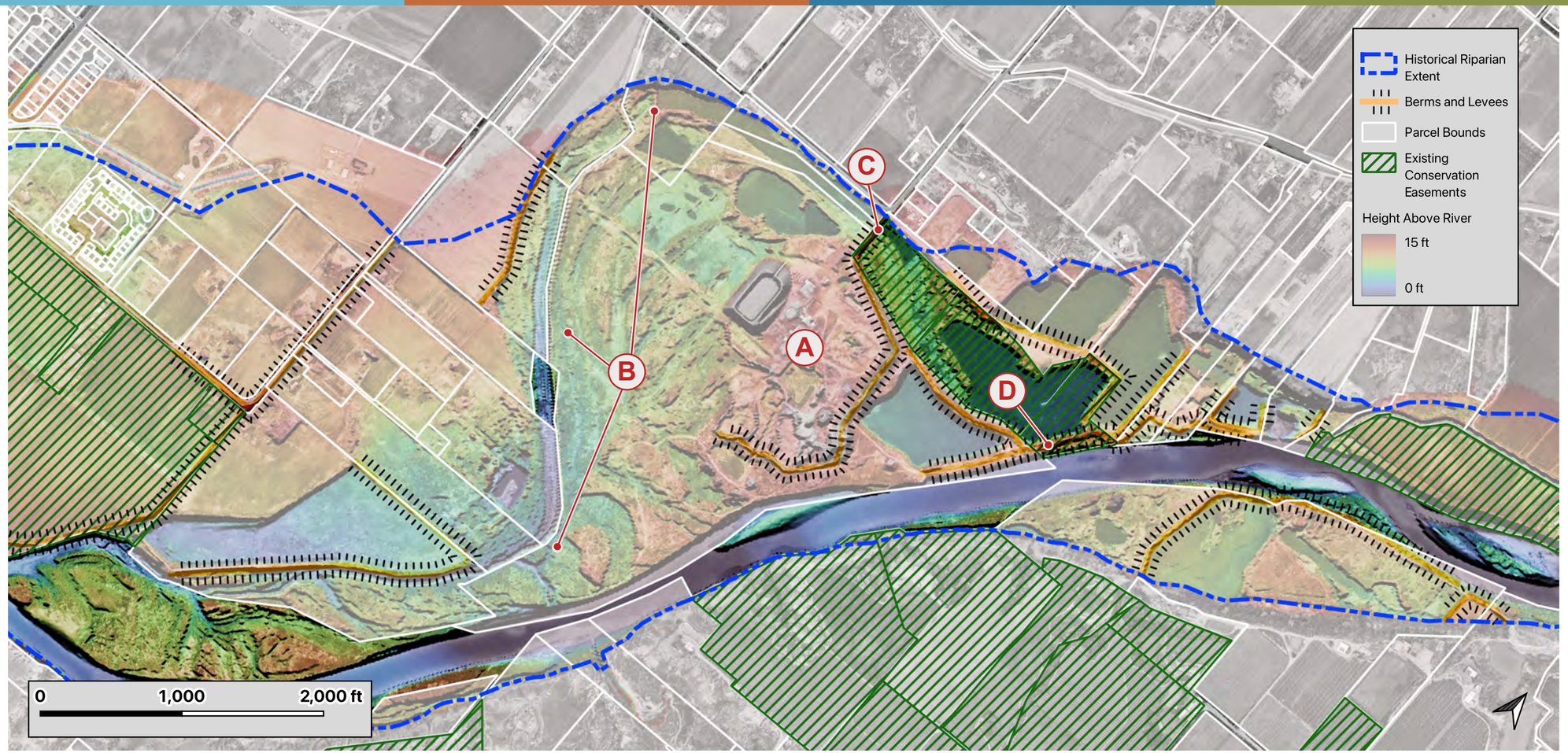
Project Area:

205 acres

Land Owners: Colorado Parks & Wildlife; Clifton Water District

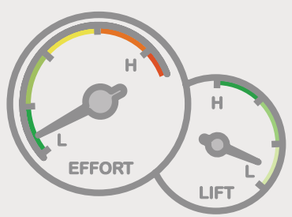
Site Description:

This focus area consists of a parcel owned by the Clifton Water District and an adjacent parcel owned and managed by CPW. Great potential exists to reconnect portions of this large floodplain to the river. The largest challenges to working at this location include the presence of critical infrastructure and the unknown status of invasive fish populations in the deeper of the two ponds on the State Park. If these challenges can be overcome, large scale work at this site may bring significant benefits to riparian/floodplain ecology, and reduce local flood stages and velocities, thereby improving the long-term hydraulic security of the Clifton Water Treatment Plant.



Concept 1

Anticipated Cost: $
Planning & Design:
Legal & Admin:
Maintenance:

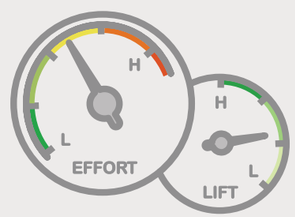


Project Description:

Remove non-native woody vegetation from the floodplain to the south and west of the Clifton Water Treatment Plant. Replace removed vegetation with native plants, including cottonwood and willow, at a ratio of at least 2:1. Planting may make use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations, including low lying areas. Deep pole plantings with direct access to the water table may be more successful. Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by planting in the early summer months at or before peak water table elevation prior to natural recession. Temporary irrigation may be required for new plantings in many areas.

Concept 2

Anticipated Cost: $ $
Planning & Design:
Legal & Admin:
Maintenance:

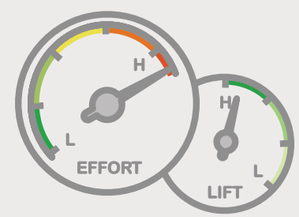


Project Description:

Secure a conservation easement on the periphery of the floodplain and wetlands parcel surrounding the Clifton Water Treatment Plant. Ensure the easement does not impact future critical activities at the Water Treatment Plant. Supplement the conservation easement with a management plan that describes invasive woody species control and restricts future development activity, excluding a high-elevation carve-out in the northeastern third of the floodplain where the the Water Treatment Plant is located (**A**). Undesirable land uses for conserved areas include hard-surface trails, boat ramps, park facilities and other types of more intensive development. A limited number of soft-surface trails may be acceptable, where construction and management of those trails does not depend on permanent structures, bank armoring, or other activities that would otherwise disturb riparian forests.

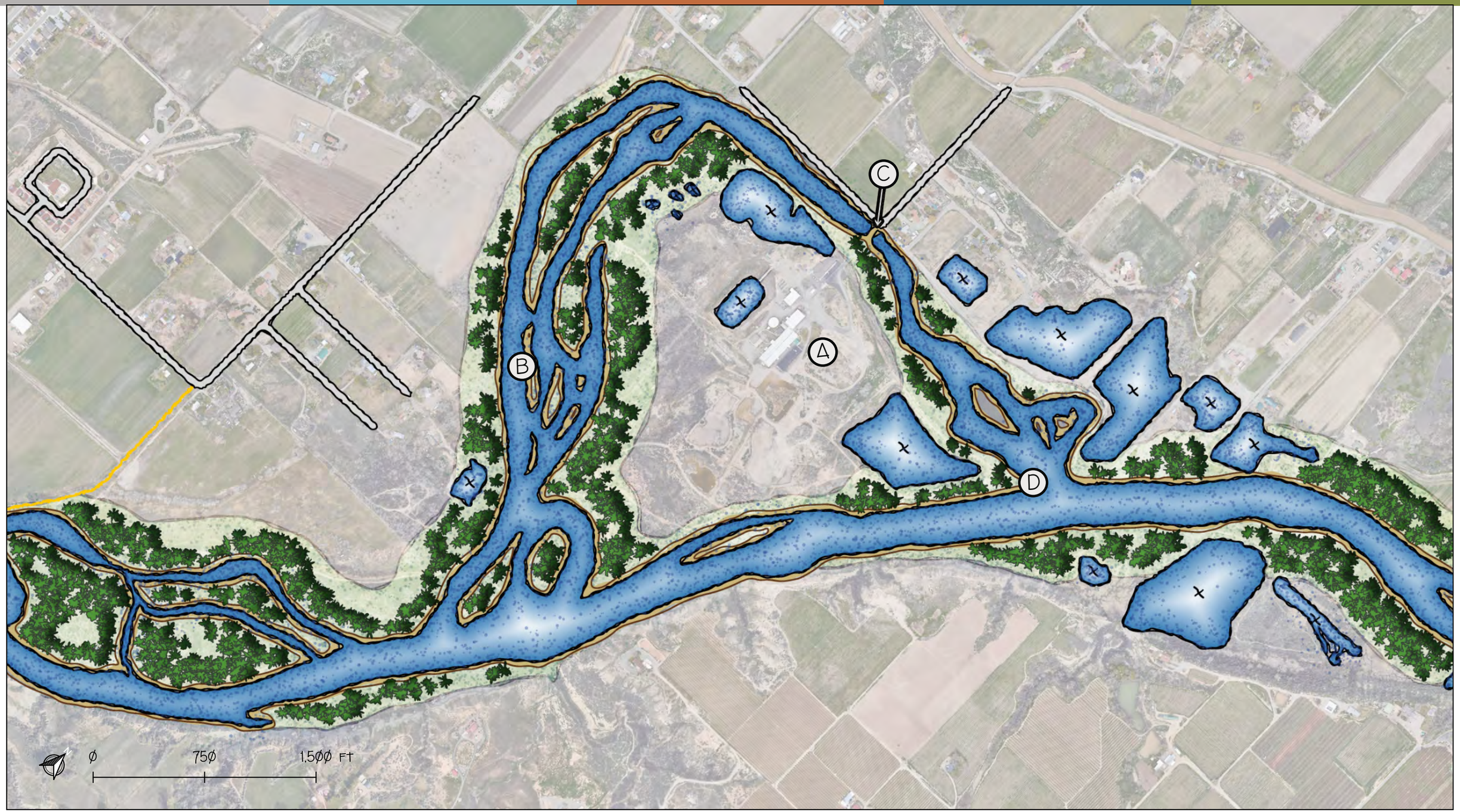
Concept 3

Anticipated Cost: $ $ $
Planning & Design:
Legal & Admin:
Maintenance:



Project Description:

Modify floodplain topography to enhance connections during high flow periods between the Colorado River and the slough that runs along the northern edge of the Clifton Water District parcel (**B**). Remove berms and excavate a small channel along the southwestern edge of the property to the point where it meets the River. Replace the causeway and culvert under Jeep Trail (**C**) with a single span bridge to facilitate hydrological connections between the shallow pond in the James M. Robb State Park and the slough. Work closely with the Recovery Program on a plan to breech the berm separating the Colorado River and the eastern-most pond in the State Park (**D**). An agreement for partial breaching currently exists between CPW and USFWS. Use excavated material to partially fill the pond to improve habitat for native species and degrade habitat for non-native species. Restore degraded wetlands.



CLIFTON WATER: CONCEPT PLAN

Focus Area:

Tillman Bishop

Project Area:

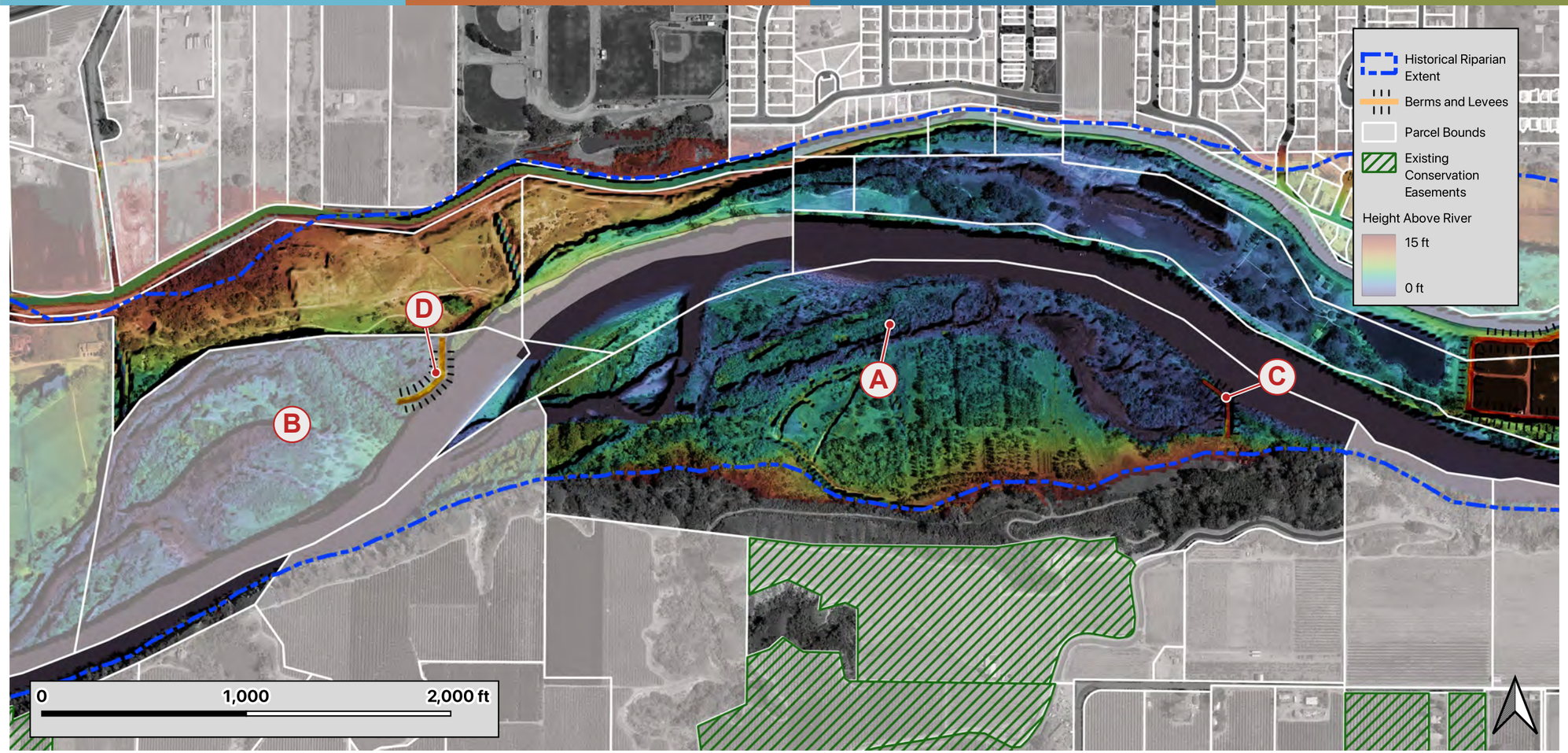
135 acres

Land Owner:

Colorado Parks & Wildlife

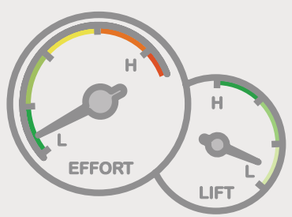
Site Description:

This focus area is centered on the Tillman-Bishop SWA. This site is managed primarily for wildlife and waterfowl hunting. Significant revegetation work in previous years aimed to improve habitat for waterfowl and other fauna; however, the site is still heavily impacted by Russian olive in near-channel areas. A private parcel across the river to the north exists in a similarly undeveloped state to the SWA. Small levees on the upstream end of both the SWA and the private parcel limit dynamic channel behavior.



Concept 1

Anticipated Cost: $
Planning & Design:
Legal & Admin:
Maintenance:

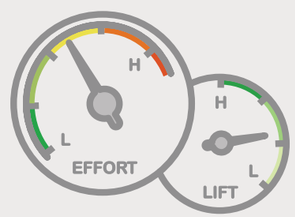


Project Description:

Remove non-native woody vegetation and replace with native plants, including cottonwood and willow, on the large floodplain to the south of the Colorado River (**A**). Replace non-native plants at a ratio of at least 2:1. Planting may make use of containerized stock in areas within 4-6 vertical feet of the baseflow water surface elevations, including low lying areas. Deep pole plantings with direct access to the water table may be more successful. Planting in higher elevation areas will place roots of new vegetation further from the saturated zone and risk desiccation prior to establishment. Establishment success in these zones may be boosted by planting in the early summer months at or before peak water table elevation prior to natural recession. Temporary irrigation may be required for new plantings in many areas.

Concept 2

Anticipated Cost: $ $
Planning & Design:
Legal & Admin:
Maintenance:

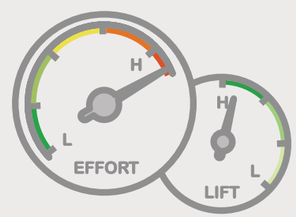


Project Description:

Secure a pair of conservation easements on the SWA. And on the private parcel on the north side of the river (**B**). Supplement with a management plan that describes invasive woody species control, accommodates river movement across the floodplain, and restricts future development activity. Undesirable land uses for this focus area include hard-surface trails, boat ramps, park facilities and other types of more intensive development activities. A limited number of soft-surface trails may be acceptable, where construction and management of those trails does not depend on permanent structures, bank armoring, or other activities that would otherwise inhibit movement of the river channel across its floodplain. A number of significant conservation easement-protected uplands exist west and southwest of the SWA. Consider delineating and managing a riparian-uplands wildlife connectivity corridor through these conserved lands.

Concept 3

Anticipated Cost: $ $
Planning & Design:
Legal & Admin:
Maintenance:



Project Description:

Remove the small berm on the upstream end of the SWA (**C**). Separately, work with the landowner on a plan to remove the berm on the private parcel on the north side of the river (**D**). Reconnect/regrade floodplain on the SWA and on the private parcel to encourage/facilitate overbanking conditions and water access to floodplain surfaces during regular high flow events. Focus regrading efforts on the reactivation of any back water sloughs and side channels. Manage the SWA to allow for active channel migration. This could make for a useful demonstration project for other areas in the Grand Valley.

TILLMAN BISHOP: CONCEPT PLAN

ANNOTATED BIBLIOGRAPHY


Photo Credit: Joel Sholtes

A wealth of information in the form of planning documents, reports, and spatial GIS layers already exists for the geographic scope encompassed by the Grand Valley River Corridor Initiative (GVRCI). These efforts identified conservation and restoration needs and opportunities through a variety of perspectives and management objectives. Consequently, the resulting plans and studies include different and overlapping project areas, varying recommendations for on-the-ground work, and disparate levels of detail in project planning.

Most of these reports and data layers—21 separate plans or studies published in the last 3 decades—were compiled and summarized in the 2022 document "Grand Valley River Corridor Needs and Priorities Mapping" prepared by Molly Guiney for GVRCI. An exhaustive search (primarily through contacting government officials and performing online searches) was conducted to acquire and review plans identifying and/or prioritizing areas for restoration or conservation within the Grand Valley river corridor. These documents were grouped by source entity, including local governmental entities such as the Mesa County and the cities of Fruita, Grand Junction, and Palisade; state entities including the Colorado Natural Heritage Program and Colorado Parks and Wildlife; and federal government partners including US Fish and Wildlife Service and the Bureau of Land Management. In addition, all available spatial data were compiled and incorporated into a geodatabase and displayed using GIS in order to identify data gaps. The GVRCI (2022) report compiles and contextualizes many of the existing Grand Valley planning documents that have been completed to date. Its companion GIS layers were used to identify data gaps as well as overlapping areas of restoration and protection interest.

For completeness, the list below provides brief summaries of all studies included in the GVRCI document, and also summarizes a number of additional publications that were not included in that document. Some of the summaries are taken directly or paraphrased from the GVRCI (2022) compilation. The sources included in this existing data summary are organized around 4 topic areas: geomorphology, riparian vegetation, aquatic habitat, and land management). Within topic areas, they are listed from newest to oldest. A brief description of the contents of each document is followed by some narrative that addresses whether the document is still relevant to planning and restoration discussions in the Grand Valley and how future land and resource managers might use or leverage the information contained in the document.

GEOMORPHOLOGY

GM1. Fluvial Hazard Zone Mapping Addendum for the Colorado River and Gunnison River in the Grand Valley (GVRCI, 2023): FHZ mapping was completed for the (may require salt treatment, irrigation), and improving floodplain connectivity by eliminating channel diversion structures and connecting gravel ponds. However, the report acknowledges the futility of reach-scale restoration, and ultimately provides general conservation recommendations, including developing PCA protection with prioritization of sites with most biological significance, education and outreach, and addressing the loss of wetlands.

GM2. Inventory of Abandoned Gravel Pits and Their Potential to Improve Waterfowl and Native Fish Habitat Along the Colorado River Corridor in Mesa County (CMU, 2020): An CMU ENVS capstone project completed by Dalton Baker, Gary Johnson, and Richard Plock, this report is the result of a project that remotely inventoried abandoned gravel mines along the Colorado River in Mesa County and categorized them according to their distance from the river, size, ownership, and hunting permissions to determine their viability as potential restoration sites. Of the several hundred pits in Mesa County, 86 sites were found to be in the Colorado River floodplain, and those were selected for assessment and characterization. This document supports ongoing planning in the river corridor by cataloguing and screening the large number of gravel pits–identifying a small number that can be considered as candidates for future restoration.

GM3. Assessment of Geomorphic Impacts of Vegetation Removal on the Colorado River: Final Report (CMU/RiversEdge West, 2018): This report summarizes the results of three survey studies related to tamarisk removal on the Colorado River in the Grand Valley, including an assessment of vegetative regrowth and channel change following tamarisk removal. Project outcomes described in this report can help restoration practitioners and land managers implement more effective invasive species management techniques in other locations in the river corridor.

RIPARIAN VEGETATION

RV1. James M Robb State Park Integrated Noxious Weed Management Plan (CPW, 2019): This plan presents an overview of the distribution of terrestrial invasive plants (noxious weeds) within the boundaries of the park to provide information, maps, tools, and management suggestions to aid park staff with ongoing weed management efforts.

RV2. Implementation Plan 2015-2020: Guidelines for Riparian Restoration Along the Colorado and Gunnison Rivers in Mesa and Delta Counties (Desert Rivers Collaborative, 2015): Prepared by the Tamarisk Coalition, the purpose of this document is to guide management of Grand Valley River Corridor restoration efforts with respect to controlling invasive species. The authors note that although substantial riparian habitat throughout the corridor has been treated for invasive species, additional treatment or revegetation may be required in these areas. Based on previous publications, this study designates 18 high priority target sites to target, many of which are similar to the Recovery Program report sites designated as part of the Upper Colorado River Subbasin Recovery Program (refer to the USFWS report below for high priority sites).

RV3. Colorado River Section 206 Aquatic Ecosystem Restoration, Mesa County, Colorado: Appendix B – Engineering Report (Tetra Tech and Tamarisk Coalition, 2012): This appendix synthesizes the existing data, conditions, and success of the Colorado River Ecosystem Restoration project for the US Army Corps of Engineers, with funding from the City of Grand Junction and partners. The goal of this report and associated restoration projects are to restore riparian habitat and function for endangered species through the removal of invasive species, particularly tamarisk and Russian olive, and replacement of these invasives with native vegetation. The report lists 15 sites for restoration (based mainly on the USFWS's site recommendations regarding endangered fish species in the river corridor (see USFWS report below for sites of high priority), as well areas with a large presence of tamarisk and Russian olive). All USFWS sites are rated as high priority, with the four additional sites rated as moderate priority. No sites were identified in the Gunnison River, downstream of Fruita, or upstream of Palisade.

RV4. Survey of Critical Wetlands and Riparian Areas in Mesa County (CNHP, 2002): This report documents a collaborative effort between CSU and CNHP to assist in better and proactive planning within the river corridor in Mesa County. CNHP surveyed river corridors in Mesa County for wetlands, as well as identified critical riparian and wetland habitats of high biological significance (i.e., hosts rare, threatened, or endangered species) that would be well suited for conservation efforts. A general description with survey results of each potential conservation area (PCA), as well as recommendations for restoration, are included. CNHP also includes a schematic of priority areas within the PCAs that are most critical, which are based on USFWS Recovery Program sites from Irving and Burdick (1995), as well as bird and fish data from the BLM and USFWS. Sites were delineated when three or more data layers overlapped, and scored on the amount and type of overlap. Restoration recommendations include invasive species removal (e.g., tamarisk, Russian olive), native species re-planting (may require salt treatment, irrigation), and improving floodplain connectivity by eliminating channel diversion structures and connecting gravel ponds. However, the report acknowledges the futility of reach-scale restoration, and ultimately provides general conservation recommendations, including developing PCA protection with prioritization of sites with most biological significance, education and outreach, and addressing the loss of wetlands.

RV5. Wetland Resources of Colorado River State Park (Colorado River Parks, 1995): This report summarizes wetland and riparian plant community surveys conducted in 1993-1994 at the Colorado River State Park. The publication includes community descriptions and a species distribution map. The study recommends that the most effective management approaches for wetland and riparian communities consist of protection, avoidance of impacts, education, repair of steep embankments, and weed control.

AQUATIC HABITAT

AH1. Flow Regimes for Restoration and Maintenance of Sufficient Habitat to Recover Endangered Razorback Sucker and Colorado Pikeminnow in the Upper Colorado River: Interim Recommendations for the Palisade-to-Rifle Reach (USFWS, 2021): Prepared by Douglas Osmundson in support of the Endangered Fish Recovery Program, this publication provides suitable flow regime recommendations based on the determination of what flow levels maximize the amount of habitats most used by razorback sucker and preferred by Colorado pikeminnow: between 1,600 and 2,500 cfs during summer and winter seasons, and that bankfull discharge be reached in all above-average and wet years.

AH2. Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-Billed Cuckoo (USFWS, 2021): This report documents the critical habitat of the yellow-billed cuckoo within the Western United States. Critical habitats were primarily identified within the Southwest, but some regions (including Colorado's Grand Valley) outside of the Southwest that

have physically- and ecologically-beneficial habitats for the cuckoo are also included. Critical habitats were identified based on varying criteria, but focus was placed on potential nesting and breeding habitat due to the abundance of research related to these habits. Because cuckoos typically enjoy riparian woodlands near rivers of low gradient, with cooler temperatures and higher humidity, such systems were prioritized. Approximately 3,100 acres of land along the Colorado River within and near Grand Junction, CO were identified as critical habitat. Nearly 900 acres of land along the Colorado River were excluded, potentially due to sufficient plans by other entities showing commitment to enhancing aquatic and riparian habitat (e.g., CPW). For the section of the Colorado River deemed critical, general recommendations for restoration include mimicking a natural hydrologic regime, preventing floodplain encroachment and development, and controlling invasive species where appropriate.

AH3. Bat Composition and Roosting Habits of Colorado National Monument and McInnis Canyons National Conservation Area: 2014 to 2016 (CPW, 2017): This report documents bat habitat and roosting areas within the McInnis Canyons National Conservation Area. Previous knowledge of bat habitat in the region was limited, and with various factors (climate change in particular) potentially threatening bat populations, a better understanding of bat activity was deemed critical for the purpose of future conservation efforts. Results highlight the critical relationship between water resources and future bat habitat. Recommendations for future conservation in this regard include removing invasive species (tamarisk) that consume substantial water resources, as well as conserving ephemeral ponds and other water resources close to canyons where bats may roost in crevices.

AH4. Grand Valley Listening Tour Notes (Audubon Society, 2017): This document summarizes tour notes by site from an Audubon listening tour conducted in December 2017. The purpose of the tour was to provide the Desert Rivers Collaborative with feedback on ideal bird habitat in the Grand Valley, where restoration efforts have and have not been successful, and other insights about restoration and revegetation recommendations from an avian perspective. The information captured would inform a best management practices document pertaining to riparian restoration outcomes for birds.

AH5-7. River Otter Surveys in the Colorado and Gunnison Rivers (CPW, 2013, 2003, and 2002): CPW has conducted and reported on three separate surveys of state-threatened river otters in the Gunnison and Colorado Rivers. Findings from these surveys suggest that the Grand Valley is an important habitat for otters that meets recovery criteria as designated by the Colorado River Otter Recovery Plan for delisting the river otter.

AH8. Upper Colorado River Subbasin Floodplain Management Plan (USFWS, 2006): A collaborative publication led by the Upper Colorado River Endangered Fish Recovery Program and authored by Richard Valdez and Patrick Nelson, this report provides strategies for floodplain management on the Colorado River to benefit the native razorback sucker.The report compiles several ecological, geomorphic, and hydrologic reports to inform recommendations for high-priority sites where floodplain management or restoration could occur/are beneficial to young fish. The study includes table of the top-ranked restoration or conservation sites within priority reaches, as recommended by Irving and Burdick (1995) and the Recovery Program (15 sites are identified for the 15-mile reach (with 8 sites provided by the ranking system of Irving and Burdick 1995), and 19 sites are identified for the 18-mile reach (with 5 sites ranked by Irving and Burdick 1995)). One site is located within the study region above Palisade along the Colorado River. However, the authors acknowledge that more work to understand where spawning sites are, as well as other fish dynamics, is necessary to better identify and prioritize sites.

AH9. Reconnaissance Inventory and Prioritization of Existing and Potential Bottomlands in the Upper Colorado River Basin (USFWS, 1995): Authored by Irving and Burdick, this report is a result of the Floodplain Habitat Restoration Program and was funded by the Recovery Program for the Endangered Fishes of the Upper Colorado, which is a collaboration between various federal, state, and local entities. The report inventoried floodplain sites with the goal of designating priority habitat for endangered fish species such as the razorback sucker. More than 150 sites were inventoried on the Colorado River, and each was scored and ranked by importance. The main four prioritization criteria included: land ownership, proximity to known or planned spawning sites/recent adult captures, hydrologic connection to the channel, and the potential for a network of floodplain sites. Their work resulted in eight sites located within the 15-mile reach along the Colorado River, five sites within the 18-mile reach along the Colorado River, one site within the study region upstream of Palisade along the Colorado River, and zero sites within the Gunnison study area of focus. The Walter Walker State Wildlife Area (SWA) was most highly ranked in the 18-mile reach, and Clifton Pond was ranked as priority #3.

AH10. Relationships Between Flow and Rare Fish Habitat in the 15-Mile Reach of the Upper Colorado River: Final Report (USFWS, 1995): Prepared by Douglas Osmundson, Patrick Nelson, Kathy Fenton, and Dale Ryden, this report presents results of a habitat evaluation study that refines instream flow recommendations for the endangered Colorado pikeminnow and razorback sucker for both summer/winter baseflows and spring peak flows.

AH11. Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Pikeminnow, Humpback Chub, and Bonytail Chub (USFWS, 1994): This report designates critical habitat for four species of native, endangered fish in the American Southwest: the razorback sucker, Colorado pikeminnow, humpback chub, and bonytail chub. These endemic fish have reached low populations due to various human activities, including active removal for the purpose of sport fishing. Critical habitat is primarily located within federal lands, though some habitats are also located in tribal, state, or private lands. The entirety of the Grand Valley River Corridor in the study region has been identified as critically important. Critical habitat was determined by considering areas where physical and biological elements are essential for the preservation of the species, including hydrologic conditions (e.g., temperature, hydrologic regime, contaminants), physical habitat available for various life stages, and biological environment (e.g., food availability, competition). Recovery plans for all fish but the razorback sucker (which is less understood compared to the other fish) are provided.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LAND MANAGEMENT

LM1. Colorado River State Park Final Stewardship Plan (Colorado State Parks, 2022): Prepared by WP Natural Resources Consulting, this report describes the significant resources held by the Colorado River State Parks in the Grand Valley (Island Acres, Corn Lake, Colorado River Wildlife Area, Connected Lakes, Fruita), including wetland and riparian communities, wildlife habitat for federal and state listed rare species, presence of state listed rare vegetation community, presence of a state listed rare plant, cottonwood galleries, and habitat for many amphibians. It also details significant threats to the ecology of the park such as invasive vegetation (tamarisk, Russian olive, Russian knapweed), water diversions, aging cottonwood stands, and difficult revegetation conditions. Finally, the plan highlights a number of stewardship goals, objectives, and recommendations for future management.

LM2. City of Grand Junction Parks, Recreation, and Open Space Master Plan (City of Grand Junction, 2021): This master plan compiles and describes the current status and plans of the Grand Junction Parks, Recreation, and Open Space Department. The plan was created with heavy citizen and stakeholder input and is meant to direct the department for the next 8-10 years. The department owns 1,842 acres of land, with approximately 280 acres designated as 'undeveloped park land' for future development and use. The main objectives of the plan are to maintain safe, accessible, and equitable spaces; foster community; and provide access along the urban/rural interface. Various plans (with varying temporal estimates) for development or renovation potentially exist within the river corridor, where main objectives include building a community center in Lincoln Park; renovating and redesigning other parks; and improve biking and pedestrian trails by creating trail connections and acquiring/developing remaining CO Riverfront trail sections. Another goal of note is the desire to increase and enforce greater buffer widths along streams and water bodies. The current buffer is based on the USFWS's critical habitat designation for various endangered fish, as well as the 100-year floodplain.

LM3. Fruita Parks, Health, Recreation, Open Space, and Trails Master Plan (City of Fruita, 2021): This master planning document consolidates existing City plans and community participation into a single document. The plan outlines goals of maintaining, expanding, and enhancing recreational opportunities, improving Fruita resident health, and preserving the natural features within the community. Fruita is a prime destination for mountain biking, road biking, and hiking via its 26.5 miles of trails within city limits. A major focus of the master planning strategy is to update parks and open spaces and improve and connect trail systems.

LM4. Mesa County Resource Management Plan (Mesa County, 2020): This plan designates Mesa County's preferred use and management of federal lands within county borders, and is a non-binding document. This plan details the history, geography, and land use of the county, as well as goals and objectives for areas within Mesa County, particularly around topics such as groundwater and surface water quality, water rights, and regulatory practices. Sections regarding wetlands and riparian areas, are included as well. Mesa County communicates general interest in managing watersheds for water quality, native and recreational fish protection, maintaining various human needs (agricultural, recreational, municipal), and promoting ecological function. The County supports management that would meet 'in-stream' flow requirements, allow users to continue using streams for their purposes, and improve or maintain ecological function within rivers. The County also supports the management,

conservation, and restoration of wetlands and riparian areas (which includes invasive species removal), as well as the collection of "credible data and scientific standards for wetland delineation." Maintaining agricultural and other practices, while conserving wetlands, is the ideal scenario.

LM5. Approved Resource Management Plan: Dominguez-Escalante National Conservation Area (BLM, 2017): This report is the result of a multi-agency collaborative effort to provide guidance for managing the Dominguez-Escalante National Conservation Area (NCA). Within this document, priority habitats and species are determined as being important. For example, the desert bighorn sheep and Colorado hookless cactus were both designated as priority species to conserve. Other areas were specially designated as: areas of critical environmental concern, national historic trails, wild and scenic rivers, wilderness study areas, wilderness, and watchable wildlife areas. Areas of critical environmental concern were determined by various criteria generally related to conserving and protecting rare or threatened organisms.

LM6. Fruita Lagoon Site Redevelopment Plan (City of Fruita, 2017): This plan describes a redevelopment strategy to connect trails between popular riverside spaces including the Lagoons, Snooks Bottom, and Riverfront spaces.

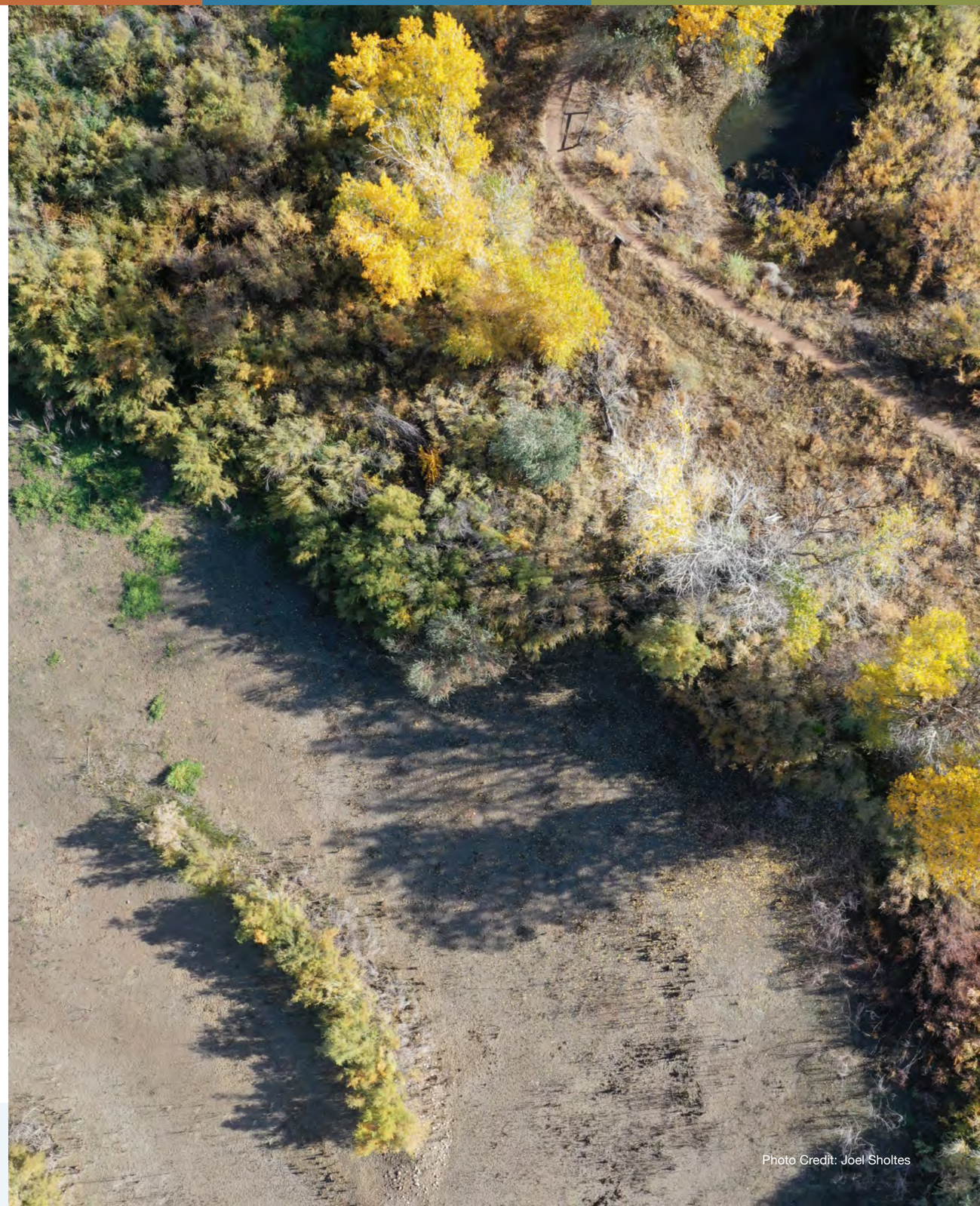
LM7. Riverbend Riparian Restoration Plan (City of Palisade, 2014): This plan was created to outline steps toward restoring riparian habitat and function in Riverbend Park in the City of Palisade. Riverbend Park is a popular festival and recreational location that been overrun by invasive species, particularly tamarisk and Russian olive. Primary goals of this document include understanding the scope of invasive species, groundwater hydrology, and sensitive nesting locations of birds that may require protection. The plan puts forth a framework for research and studies that will provide insight into site health.

LM8. Colorado Riverfront Commission Strategic Plan (Colorado Riverfront Commission, 2014): This document provides key strategies for the Riverfront Commission (RFC) in lieu of the Riverfront Trail connection completion between Grand Junction and Fruita in 2014. Three strategies are realized: (1) cultivate the economic, cultural, and ecological values of the riverfront corridor by supporting development and improvement of river nature spaces (parks, trails, open space, educational centers, etc.), promoting community engagement and education, supporting conservation and restoration efforts within the river corridor, and promoting compatible land use opportunities; (2) support multiple uses of the river corridor by promoting recreational activities and supporting, improving, and advertising the trail system and public access to the riverfront; and (3) inspire stewardship our river systems by facilitating and supporting community outreach and engagement regarding Riverfront parks, trails, and other projects.

LM9. Palisade Comprehensive Plan (City of Palisade, 2007): This plan documents future planning for the Palisade community. Generally, the Palisade community desires to preserve and expand the agricultural aspects of the region, while also revitalizing the town center. Agriculture is a key part of life in Palisade, but there is also a desire to expand the conservation easement program that is run by the Mesa Land Trust (which held 44,000 acres, or more than 90 properties, at the time of publication). Palisade plans to prioritize preserving prime agricultural parcels, as well as the town itself by maintaining the land buffer between Palisade and Grand Junction. Regarding parks and recreation, four parks exist and there are plans to create three additional parks. There are also plans to map and expand the trail system in Palisade, and to partner with the Bureau of Reclamation in a fish passage project that would create a Palisade Whitewater Park.

LM10. Resource Management Plan and Record of Decision for the Colorado Canyons National Conservation Area and Black Ridge Canyons Wilderness (BLM, 2004): This document provides a framework for conservation and enjoyment of BLM lands in the McInnis Canyons NCA, and reflects BLM goals of providing multi-use lands to citizens. This plan discusses various planning goals, such as cultural, paleontological, and biological objectives (e.g., invasive species control and native species support) within the different zones of McInnis Canyons. Of particular use is the Colorado River corridor zone, which is primarily used for camping, backpacking, horseback riding, and other such recreational activities. Objectives for the corridor include managing the camping and recreational activities to reduce impact, maintaining native vegetation (such as cottonwood), and reducing salt cedar and other invasive species within the corridor.

LM11. Grand Valley Audubon Society Environmental Summary Report: Nature Center Site (Audubon Society, 2003): This report summarizes site conditions and potential restoration or conservation opportunities for the location of the proposed Grand Valley Audubon Society (GVAS) Nature Center (adjacent to the Connected Lakes state park region).



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