FINAL REPORT: Crystal River Management Plan Implementation
Contract Number: POGG1 PDAA 201700000911

Crystal River Management Plan (CRMP) Implementation built upon the results and stakeholder collaboration from the 18-month effort conducted by Roaring Fork Conservancy, in partnership with Lotic Hydrological and Public Counsel of the Rockies (CRMP team). This project worked to both benefit the Crystal River and share our experience with CRMP development and implementation as a model statewide. Through the successes and challenges presented here, we have furthered our own knowledge of Stream Management Plan coordination and implementation, and made significant progress in the many steps necessary to bring the plan to action.

Task 1: Implement key recommendations of the CRMP including Non-Diversion Agreements, irrigation efficiency improvements and targeted restoration of riparian resources to increase flows and benefit aquatic health of the Lower Crystal River.

- **Working with Colorado Water Trust and individual water right holders or diverters to expand a market–based Non-Diversion Agreements between the Sweet Jessup Canal and Carbondale Ditch.**
    - Over the past year, we have done extensive work with Colorado Water Trust (CWT) and local government representatives including Pitkin County, Pitkin County Open Space and Trails, Pitkin County Healthy Rivers Board, Town of Carbondale, and Mount Sopris Conservation District, around a proposed Non-Diversion agreement for 6cfs on the Helms Ditch, owned and operated by Cold Mountain Ranch. The Ranch owner/operator, Bill Fales, has been an active participant in the Crystal River Management Plan from the onset. We are pleased to report that in January 2018, a Diversion Rescheduling Agreement was signed by CWT and Cold Mountain Ranch. (see Attachment A)
    - The summer of 2018 was challenging. Even with a Diversion Rescheduling Agreement in place, there was not enough water in the Crystal River to implement the plan. (see Attachment B)
    - Implementing additional agreements proved challenging for CWT, even with the support of CRMP and RFC. Ranchers on the Crystal maintain significant skepticism and fear about impacting their water rights through conservation agreements generally. In addition, there are ongoing concerns about antiquated infrastructure. We have continued to keep up relationships with many irrigators, knowing that continuing to work together to better understand and trust each other will benefit both the community and the river. We hope that once conditions allow for the Cold Mountain Ranch Agreement to be implemented as a demonstration, we will see others more willing to participate.
    - In September 2018, the Pitkin County Healthy Rivers and Stream Board provided partial funding for Cold Mountain Ranch's proposal for improving ditch infrastructure and efficiency (see Attachment C), with support from CRMP team partners. We look forward to working with Mt. Sopris Conservation District and others to explore ditch headgate improvement projects and funding for other irrigators following the example of Cold Mountain Ranch.
- **Exploring options with the Town of Carbondale for headgate, diversion structure, and ditch efficiency improvements that lead to instream flow improvements; and conservation programs for municipal treated and raw water supply.**
    - Working closely with the Town of Carbondale and American Rivers, we have plans for a multi-phase project to increase efficiencies on Carbondale's Weaver Ditch beginning with an extensive survey of the existing ditch system. The instream portion of this project, namely upgrading the Weaver ditch diversion structure, has been coordinated with the restoration project (detailed below) because the ditch is located within the same reach.

- Phase 1 of this project, which includes an existing condition assessment and planning was funded by Pitkin County Healthy Rivers and is currently underway (see Attachment D). As we assess existing conditions, we will both gather valuable information for the Weaver ditch, and create a replicable pilot process for assessing and preparing other ditches both operated by the town of Carbondale and elsewhere in the Crystal Valley for efficiency upgrades.

- **Developing and implementing plans to restore riparian vegetation on property owned by the Town of Carbondale.**
  - Working in partnership with Aspen Valley Land Trust (AVLT) along with the Town of Carbondale, American Rivers, and River Valley Ranch (RVR), we have a detailed contractor proposal to evaluate restoration opportunities on an 18 acre parcel of park land owned by the town, within RVR boundaries, that has public access and is recommended for restoration in the CRMP. We have received grants from the CWCB's Restoration Fund ($100,000), Colorado Basin Roundtable's Water Supply Reserve Fund ($20,700), Colorado Healthy Rivers Fund ($15,000), Pitkin County Healthy Rivers Fund ($5,000), and Aspen Skiing Company's Environment Foundation ($9,300). RFC has contracted with River Restoration for Phase 1 of the project, which includes surveying and an initial targeted stakeholder meeting. Phase 1a. was contracted with the Town of Carbondale this summer. The remainder of the project will be contracted through the Town of Carbondale when CWCB grants are formally in place. We have worked diligently to ensure that the time we have spent securing funding has had minimal impact to the project's time line. At this time, we anticipate construction to begin in 2020. (see Attachment E and F)
  - In partnership with AVLT, Colorado Rocky Mountain School (CRMS), and Garfield County Weed Management, we were able to remove over 25 Russian Olive plants on CRMS property, which spans both sides of the lower Crystal River, in November 2017. CRMS followed up this effort in September 2018 by cutting and removing any regrowth through their all-school work day.
  - With support from RFC and NRCS, CRMS students and staff are leading a project to revise their watering system to exclude cattle from the confluence of the Crystal and Roaring Fork Rivers, an area recommended for restoration in the CRMP. As part of an inquiry class last fall, CRMS students studied the area and determined that an upland watering scheme and riparian cattle exclusion would be most beneficial to stream health. Unfortunately, this will require CRMS to re-drill their current well to ensure adequate water supply. CRMS was able to secure funding for this project through the Pitkin County Healthy Rivers Fund (see Attachment G), and work is currently underway.
  - Interest in restoration projects with AVLT, Town of Carbondale, and with CRMS, are opportunities to build resiliency within the Crystal River system. The pilot projects to improve ditch efficiency with the Town of Carbondale promise to serve as templates for other ditches on the Crystal.

- **Establishing plans for specific projects on properties owned or held under conservation easement by Pitkin County to reconnect the floodplain to the river, restore riparian vegetation, implement water leasing and/or diversion reduction strategies, and/or demonstrate irrigation efficiency-based flow restoration.**
  - In fall 2017, RFC and the CRMP Team worked with Pitkin County Open Space and Trails to evaluate the potential to replace flood irrigation with sprinkler irrigation on a property under conservation easement, with the goal of minimizing diversions from the river. Ultimately, the project was not deemed cost effective mainly because of power lines that would interfere with sprinkler rollers on the property. However Cold Mountain Ranch, which leases this property from Pitkin County, has plans in place for a sprinkler system and a grant application ready for when Farm Bill funding is re-instated.
  - In partnership with Pitkin County Open Space and Trails, Pitkin County Healthy Rivers, and local biologist John Emerick, RFC hosted a Crystal River Restoration Workshop on October 3, 2018. The workshop brought together over 30 participants, including technical experts, land and

water right owners, state and local government, and other local stakeholders to discuss and visit potential restoration areas on the Crystal. The workshop was very successful, prioritizing several areas for further investigation, and creating a working group to move the process forward. Based on the workshop results, we are currently in conversation with USFS and Pitkin County Open Space to investigate a jointly owned property where there is potential to re-water the historic floodplain and realize the benefits, including wildlife habitat, groundwater storage, dissipation of high flows, and natural sediment catchments.

Task 2: Continue and broaden stakeholder outreach and engagement, while facilitating collaboration and communication among project partners to ensure effective and efficient implementation of CRMP goals.

- **Continue conversations and meetings with Crystal Valley stakeholders to further implementation goals and increase awareness and understanding of the plan.**
    - In January 2017, RFC and the CRMP team hosted a large stakeholder meeting with over 30 people in attendance to discuss the early progress of the Town of Carbondale and the proposed Non- Diversion Agreements with CWT. The Colorado River District presented on water banking and other water conservation programs. We continue to stay in touch with stakeholders through smaller, informal communications regarding plan progress and implementation.
    - Another targeted stakeholder meeting was held in February of 2018. RFC shared an implementation update, and CWT presented the details of Diversion Rescheduling Agreements. We continue to field a variety of questions regarding the plan and its implementation in order to keep and build collaborative relationships.
- **Engage and expand stakeholder involvement by providing information about ongoing CRMP implementation efforts, and serve as a resource for other organizations.**
    - RFC has expanded stakeholder involvement to include members of the broader community and greater cooperation with the Town of Carbondale, including a presentations to their Environmental Board and Town Trustees.
    - RFC is working with River Network to provide information and serve as a resource for SMP technical methods, stakeholder engagement, organizational capacity, implementation process, and means to secure funding.
    - RFC served on the committee to select the Upper Roaring Fork Management Plan consultant and remains active as a key stakeholder in the technical advisory committee. We have also informally mentored several other watershed groups aspiring towards SMP creation.
    - Members of the CRMP team have presented to groups including the Colorado Agricultural Water Alliance, Colorado Foundation for Water Education, River Network, Aspen Skiing Company's Environment Foundation Board, Colorado Watershed Assembly, and the Future Forest Roundtable. In addition, we have brought students from Colorado College and the University of Santa Barbara's Bren School for site tours, discussion and demonstration of stream management planning using the Crystal as a case study example.
    - RFC staff has given presentations about the Crystal Management Plan and its implementation at the Colorado Watershed Assembly's Sustaining Colorado Watersheds Conference and Colorado Mesa University's Upper Colorado River Basin Water Forum.
    - RFC hosted a public meeting to introduce the Plan more broadly to the Carbondale and Roaring Fork Valley stakeholders in May 2018, with over 20 people in attendance including recreationalist, boaters and anglers, as well other interested community members. This discussion helped inform the local population about Stream Management Planning in general, and the Crystal Management Plan specifically, as on-the-ground projects, particularly with the Town of Carbondale, get underway.

- RFC presented to the Roaring Fork Watershed Collaborative in April 2018, with the goal of furthering the SMP conversation among community stakeholders and continuing to inform the public about the CRMP.
- At the River Center Grand Opening in July 2018, RFC presented on CRMP to local attendees, answering questions and detailing projects. This also gave the opportunity to share information about the Plan to important attendees including Bill Ritter, John Stulp, and Governor Hickenlooper, and thank them for their role in funding such projects.

- **Leverage results of the CRMP implementation to secure broader engagement and potential funding to support ongoing and future diversion reduction agreements by agricultural and municipal water users/water rights holders.**
  - With the first Diversion Rescheduling Agreement in place, we are continuing to support CWT in strategic planning and outreach to other irrigators to further plan implementation; engage Mt. Sopris Conservation District and NRCS; and involve Cold Mountain Ranch proprietor Bill Fales in speaking engagements and plan implementation.
- **Develop a prototype River Restoration Fund to enhance watershed protection that will raise and leverage private funds to help irrigators improve irrigation efficiency and restore flows, working through feasibility and initial design issues in a targeted workshop and training.**
  - The Crystal River Stream Management Project was selected to participate in a 3-day river restoration financing workshop hosted by The Nature Conservancy (TNC). TNC has developed a global water funds program and training to help develop financial tools to support investments in watershed health and stream restoration. Crystal River SMP team members joined with the Colorado River District to begin a feasibility assessment to develop a river restoration fund for the Crystal River.
  - Subsequent to a preliminary feasibility assessment, TNC and the CRMP Team are not convinced that the watershed includes sufficient private and municipal financial resources to secure financing for irrigation improvements in the upper watershed. Talks of next steps are ongoing.
- **Serve as the hub for communication and coordination of various projects involving strategic partners who are working in support of the CRMP implementation to maximize efficiency and resources, foster teamwork, and ensure the logical sequencing of projects to most effectively realize CRMP goals.**
  - We are coordinating with American Rivers, Colorado Water Trust, Aspen Valley Land Trust, Town of Carbondale, Pitkin County Open Space and Trails and Pitkin County Healthy Rivers and Streams on the various implementation efforts described in this report. The riparian restoration spearheaded by the Town of Carbondale and RFC and supported by AVLT and American Rivers, and headgate efficiency improvements proposed by the Town of Carbondale and American Rivers and supported by RFC occur on the same reach of the Crystal. We have helped bring these groups and projects together so that any instream work will happen cooperatively and coincidentally. RFC staff continues to work with the above listed groups and individual stakeholders to coordinate instream work and secure funding opportunities.
  - RFC has also worked with Cold Mountain Ranch and Colorado Rocky Mountain School to design projects and secure funds under the umbrella of CRMP.

Task 3: Install a series of gages on the Crystal River to monitor instream flows and temperature, as well as account for water in the stream from diversion reduction agreements.

- **Install strategically placed gages and archive data.**
  - Siting and permitting of gages required extensive outreach with homeowners associated with the (private) Thomas Road Bridge. We were also delayed by USFS permitting and the Carbondale Town Council. All sites are now secured with proper approvals and permitting in place.

    - Presently, two gages installed on the river are up- and downstream of the perennially dewatered reach of the lower Crystal. These gages were calibrated beginning spring of 2018 and were operational during summer 2018. The third gage was located at the Carbondale South Bridge, just downstream of the Town of Carbondale's Riverfront Park.
- **Work with CWCB and DWR to develop procedures for certifying gage installation, operation, data management and reporting protocols consistent with those used by the State of Colorado so data can be used for stream flow monitoring and reporting.**
    - Public Counsel of the Rockies, Lotic Hydrologic and American Rivers have met with CWCB and DWR to explore opportunities and constraints around collecting and publishing data collected by (private) Crystal River gages on the (public) DWR website. (memo initiating this effort was sent with 6 month report)
    - Lotic Hydrologic is working with hydrologists at the DWR to develop a work plan for gage calibration and data collection that will allow DWR to publish privately collected data on the State website. RFC and Public Counsel are leading the effort to secure 5 years of private funding to demonstrate the potential for more cost-effective gages and monitoring, while generating data consistent with DWR protocols and useful to state water managers. (see Attachment H)

The significant accomplishments and learning thus far are paving the way for future work on the Crystal and other places in Colorado, demonstrating the value of Stream Management Planning where sound science and community values lead to cooperative and creative problem solving with multiple benefits to both the community and water resources. Thank you for your continued support as we work towards implementation goals.

ATTACHMENTS:
Attachment A: Cold Mountain Ranch Voluntary Diversion Coordination Agreement
Attachment B: Colorado Water Trust Editorial
Attachment C: CMR Grant Proposal (partially funded)
Attachment D: Wright Water Engineering Scope of Work
Attachment E: River Restoration Scope of Work
Attachment F: River Restoration Draft Report
Attachment G: CRMS Grant Proposal (funded)
Attachment H: Lotic Hydrological Gauging Memo

VOLUNTARY DIVERSION COORDINATION AGREEMENT

This Voluntary Diversion Coordination Agreement ("Agreement") is entered into this 18th day of January, 2018, between Cold Mountain Ranch LLLP ("CMR"), a Colorado limited liability limited partnership, whose address is 4239 Highway 133, Carbondale, CO 81623, and Colorado Water Trust ("Water Trust"), a Colorado nonprofit corporation, whose address is 1420 Ogden St., Suite A2, Denver, CO 80218 (collectively the "Parties").

RECITALS

A. CMR owns land and water rights in the Crystal River valley, used primarily for agricultural purposes ("Property"). In 2009, CMR conveyed a Deed of Conservation Easement on the Property to the Board of County Commissioners of Pitkin County, Colorado, and to the Colorado Cattlemen's Agricultural Land Trust, recorded on July 31, 2009 at Reception No. 561545 of the records of the Pitkin County Clerk and Recorder ("Conservation Easement") and on August 3, 2009 at Reception No. 772576 of the records of the Garfield County Clerk and Recorder. The Conservation Easement preserves the agricultural use of the Property and limits other future uses.

B. CMR relies on the Crystal River and its tributaries for irrigation water. The Conservation Easement encumbered water rights historically used on the Property. The subject water rights of this Agreement are the Helms Ditch, decreed in Civil Action No. 1012 by the District Court for Garfield County for 2.93 cfs under Priority No. 213A and enlarged in Civil Action No. 3082 by the District Court for Garfield County for 3.07 under Priority No. 420. which CMR owns in its entirety; and the Low Line Ditch (aka Lowline Ditch), decreed in Civil Action No. 1007 by the District Court for Garfield County for 19 cfs under Priority No. 208C, and enlarged in Civil Action No. 3082 by the District Court for Garfield County for 21.5 cfs under Priority No. 417, of which CMR owns 5.22 cfs in Priority No. 208C and 8.2 cfs in Priority No. 417 ("Water Rights").

C. Water Trust's mission is to restore streamflows to Colorado's rivers in need. Water Trust accomplishes its mission by using voluntary, market-based means of putting water back into Colorado's rivers and streams at critical times. During the drought years of 2012 and 2013, local entities and Water Trust opened discussions on flow restoration with water users in the Crystal River basin. During those meetings, water users asked a number of important questions regarding the state of the Crystal River, and which, if any, new water and river management and restoration techniques would prove effective for improving the Crystal River.

D. At the close of 2015, Lotic Hydrological ("Lotic") released an ecological model of the Crystal River designed to answer water user's questions. After grading the Crystal River's health, Lotic examined four alternative management strategies, including diversion coordination agreements. Using Lotic's

conclusions, Water Trust developed a flow restoration strategy to use market-based strategies with water users upstream of Prince Creek to provide water for the Crystal River in one-in-five and one-in-ten drought years. Water Trust would provide incentives for enhancement of Crystal River flows at critical times, and monitor to confirm whether such agreements do result in additional water in the Crystal River. Enhancement of Crystal River flows can be accomplished under a variety of methodologies, such as ceasing water application, installing new infrastructure, or coordinating irrigation demands with the needs of the Crystal River.

E. CMR wishes to coordinate its water diversions under the Water Rights pursuant to the terms of this Agreement to improve the health of the Crystal River. In Section 19 of the Conservation Easement, CMR retained flexibility to use the water rights to maintain and improve the conservation values of the Property as well as the ability to assist in the improvement of river flows in the Crystal River and its tributaries. The Parties have received the necessary approvals to enter into this Agreement from Pitkin County and Colorado Cattlemen's Agricultural Land Trust.

F. It is the intent of the Parties to, on an annual basis, maintain historical diversions of the Water Rights described herein and associated with Cold Mountain Ranch and maintain the historical consumptive use of the Water Rights by CMR during the term of this Agreement, acknowledging that historical diversions and historical consumptive use of the Water Rights is based off a representative study period during which diversions and consumptive use have varied by year. It is the intent of the Parties that through this Diversion Coordination Agreement the timing and relaxation of diversions for different agricultural activities, such as irrigation or hay cutting, will be modified in order to maximize the benefits of this historical relaxation of diversions for the benefit of Crystal River flow volume. Further, under this Agreement the Parties will coordinate the diversion of water by CMR for its normal agricultural operations in a manner that supports the need for enhancement of Crystal River flows, without conflicting with CMR's continued agricultural operations in accordance with the conservation values articulated in the Conservation Easement. CMR intends to only operate coordinated diversions under the Agreement in a manner that continues the historical agricultural productivity of CMR.

G. In 2013, Colorado's Governor signed into law Senate Bill 19, a piece of legislation designed to protect the underlying water rights of a water right owner who wishes to reduce use pursuant to an approved water conservation program. Codified in § 37-92-305(c), C.R.S. (2016), that legislation complemented abandonment protections provided in §37-92-103(2), C.R.S (2016), and together they provide a safe harbor for water right owners enrolled in approved conservation programs to change or reduce their water use ("Water Conservation Program"). The Parties may seek approval for a Water Conservation Program before implementation.

H. Water Trust wishes to support agricultural production on CMR and improve the health of the Crystal River by compensating CMR for coordinating its on-ranch water management, particularly in drier years.

NOW, THEREFORE, in consideration of the foregoing recitals, the mutual promises contained herein, and other good and valuable consideration, the Parties hereby agree to the following:

1. Term of Agreement. This Agreement will be in effect from the date of execution through October 31, 2020 ("Term").

2. CMR Coordinated Diversions.

2.1 Trigger Gage Installation. Water Trust will cause to be installed a gage on the Crystal River within the reach between the Ella Ditch headgate and Thomas Creek ("Trigger Gage").

2.2 Agreement Activation. This Agreement becomes active only during the months of August and/or September when streamflows at the Trigger Gage drop to or below 40 cfs. In any year, once becoming active, the Agreement remains active through September 30.

2.3 Verified Diversion Coordination. "Verified Diversion Coordination" means for each Water Right, the difference between the lesser of (1) the Water Right or (2) the amount of water physically and legally available to the Water Right as determined by Lotic, and the actual diversion amount attributable to the Water Right as measured by Lotic at the Water Right's headgate. Verified Diversion Coordination does not include reduced diversions because of maintenance.

2.4 Annual Meeting. Before CMR is eligible for compensation for Verified Diversion Coordination in any year, Water Trust or Lotic or both shall meet with CMR to discuss and agree upon CMR's Water Rights' Historical Baselines.

2.5 Notice. CMR shall give Water Trust forty-eight hours notice before coordinating diversions that CMR expects to be eligible as Verified Diversion Coordination. Water Trust shall give CMR notice when the Agreement is activated. When the Agreement is active, Water Trust shall give CRM notice when streamflows are 55 cfs or greater at the Trigger Gage.

2.6 Limits to Duration of Coordinated Diversions. When CMR decides to coordinate diversions that CMR expects to be eligible as Verified Diversion Coordination, CMR shall coordinate diversions for a minimum of five days. This minimum does not apply when one of the limitations in Section 3.3 occurs. The maximum number of days Water Trust may compensate CMR for Verified Diversion Coordination is 20 in any given year.

3. Compensation.

3.1 Price. Once the Agreement is active, and subject to the limitations herein, Water Trust shall pay CMR $175 per cfs per day of Verified Diversion Coordination made by CMR. For the purposes of sample calculation only, if CMR provides four cfs of Verified Diversion Coordination, the Water Trust would pay CMR $700 for each day of that reduction.

3.2 Payment Schedule. Water Trust shall make each year's total payment owed to CMR by October 31 of the same year.

3.3 Limitations.

3.3.1 Streamflow. Water Trust shall not compensate CMR for Verified Diversion Coordination once streamflows average 55 cfs or above at the Trigger Gage for three days.

3.3.2 Funding. By July 1 of each year during the Term of the Agreement, Water Trust shall notify CMR of the funds available for the program for that year. Accrual of Water Trust's payment obligations under this Agreement, combined with other similar agreements entered into with other water users on the Crystal River, will not exceed the amount of funds raised for the program. Water Trust will track the amount owed to CMR on a daily basis by computing the Verified Diversion Coordination. Water Trust will notify CMR when payments are anticipated to exceed program funding. If the Water Trust raises no money in a given year, Water Trust will not compensate any Verified Diversion Coordination.

3.4 Incentive Payments. On days when (1) the Agreement is active as defined in Section 2.1, (2) CMR is currently accruing compensation for Verified Diversion Coordination, and (3) streamflow reaches 50 cfs at the Trigger Gage solely because of any and all Verified Diversion Coordination from other water right owners also contracting with Water Trust, as determined by Lotic, Water Trust will make additional payments to CMR of $20 per cfs per day of CMR's Verified Diversion Coordination for each day average streamflows exceed 50 cfs at the Trigger Gage, subject to the other limitations herein.

4. Voluntary. CMR has no obligation to coordinate diversions in any year, even when the Agreement is active under Section 2.2.

5. Water Rights Protections. CMR and Water Trust may enroll CMR's Water Rights into the Colorado River Water Conservation District's Senate Bill 19 Water Conservation Program to avail the Water Rights of protections from allegations of diminished consumptive use and/or abandonment. Water Trust will work with the water commissioner and the division and state engineers to ensure

water use is coded properly for the Water Rights. Nothing hereunder indicates any abandonment or intention to abandon any portion of the Water Rights whatsoever.

6. Grant of Limited License. CMR grants Water Trust, Lotic, and their contractors and agents an irrevocable limited license for the Term of the Agreement to inspect the Water Rights and associated infrastructure at reasonable times and with adequate prior notice in order to perform diversion measurements. Water Trust or Lotic shall provide CMR with at least twenty-four (24) hours' notice before exercising the license rights granted under this section. This Agreement does not create any rights in the general public.

7. Costs. Water Trust shall bear all costs associated with the measurement and implementation of this Agreement. Implementation means activities and infrastructure that are required to fulfill the tasks under this Agreement. CMR shall bear any costs related to ranch operations.

8. Termination. This Agreement terminates at the end of the Term.

9. Good Faith Discussions for Future Implementation. This Agreement is a pilot project to demonstrate private, market-based, voluntary flow restoration on the Crystal River. The Parties agree to informally evaluate the success of this Agreement and in good faith to explore longer-term agreements or other mechanisms to improve the health of the Crystal River. Any future agreements between CMR and Water Trust regarding the Water Rights will require separate approval from Pitkin County and Colorado Cattlemen's Agricultural Land Trust in accordance with the terms of the Conservation Easement.

10. Remedies. Specific performance is the sole remedy of this Agreement.

11. Attorney's Fees. If a suit, action, or alternative dispute resolution is instituted in connection with any controversy arising out of this Agreement or to enforce any rights hereunder, the Parties shall bear their own costs and fees associated with such proceeding.

12. Copies of Notices. CMR and the Water Trust shall provide copies of all notices provided under this Agreement to Pitkin County and Colorado Cattlemen's Agricultural Land Trust.

13. Governing Law. This Agreement will be governed by and construed in accordance with the laws of the State of Colorado.

14. No Assignment Without Consent; Binding Effect. Neither this Agreement, nor any of the rights or obligations hereunder may be assignable by any Party without the written consent of the other Party and the written approval of Pitkin County and Colorado Cattlemen's Agricultural Land Trust. This Agreement will be binding upon the Parties hereto and their permitted successors and assigns.

15. No Third Party Beneficiaries. With the below exception, this Agreement is for the benefit of the Parties only. The Agreement does not and is not intended to confer any rights or remedies upon any person or entity other than the Parties, except for Lotic as described in Section 6.

16. Amendments. This Agreement may be amended only upon the execution by each Party of a written amendment to this Agreement and with the written approval of Pitkin County and Colorado Cattlemen's Agricultural Land Trust.

17. No Waiver. Failure of either Party at any time to require performance of any provision of this Agreement does not limit such Party's right to enforce such provision, nor does any waiver of any breach of any provision this Agreement constitute a waiver of any succeeding breach of such provision or a waiver of such provision itself.

18. Complete Agreement. This Agreement contains the entire agreement and understanding of the Parties and all prior negotiations, discussions, or agreements related thereto are merged herein.

19. Severability. If any term or provision of this Agreement is invalid, illegal or unenforceable, such invalidity, illegality or unenforceability does not affect any other term or provision of this Agreement or invalidate or render unenforceable such term or provision.

20. Execution in Counterparts. This Agreement may be executed in counterparts, each of which when executed and delivered shall constitute a duplicate original, but all counterparts together shall constitute a single agreement.

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Executed as of the date first set forth above.

Cold Mountain Ranch LLLP,
a Colorado limited liability limited partnership

By: _____
William E.L. Fales, General Partner

Cold Mountain Ranch LLLP
a Colorado limited liability limited partnership

By: _____
Marjorie Perry, General Partner

Colorado Water Trust
a Colorado nonprofit corporation

By: _____
Andy Schultheiss, Executive Director

Reviewed and Approved by Pitkin County

By: _____

Title: _____

Reviewed and Approved by Colorado Cattlemen's Agricultural Land Trust

By: Erik L. Glenn

Title: Executive Director, 1/18/18

Executed as of the date first set forth above.

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a Colorado nonprofit corporation

By: _____
Andy Schultheiss, Executive Director

Reviewed and Approved by Pitkin County

By: _____

Title: COUNTY ATTORNEY

Reviewed and Approved by Colorado Cattlemen's Agricultural Land Trust

By: _____

Title: _____

Colorado Water Trust Crystal OpEd

2018 has shaped up to be a historically tough year for Colorado's rivers. In the northwest region of the state, the Yampa River basin's measured snowpack peaked at over 80% of average, well above the dismal 2012 snow year, yet runoff ended early and subsequent low flows have impacted water users across the basin. So little water remained in the late summer that the state administered the first ever "call" on the mainstem of Yampa, shutting off junior water rights in order to meet the needs of more senior users downstream.

Streamflow in the Roaring Fork basin didn't fare any better. The Roaring Fork River suffered flows similar to the recent drought years of 2002 and 2012, low enough for the City of Aspen to activate its Wheeler Ditch streamflow restoration agreement with the Colorado Water Trust. Meanwhile, the Crystal River saw unprecedented levels of administration. The Colorado Water Conservation Board placed a call for its 1975 instream flow water right (as it had in 2010, 2016, and 2017). Although this junior instream flow water right call does not free up a huge amount of water, it protects existing flows against future development. More unusual than the CWCB's call was another call on the Crystal River, this time from one of the agricultural ditches. As far as the state records indicate, this was another first and more evidence of how dry it has been.

Yet the Colorado Water Trust's pilot project with Cold Mountain Ranch lay dormant. Given how dry it was, why? The answer requires revisiting 2012, when the Water Trust first proposed water right leasing as a voluntary, compensated option to bolster flows in the Crystal during that dry year. In addition to ranchers' operational concerns with water right leasing (including the effects of dry up on grasses and herd sizes), we were also asked how much water would be needed to make a difference in the Crystal. The underlying basis for the question made sense – if the Crystal is totally dry, and we were able to secure 5 or 10 cubic feet per second, would that small amount of water simply disappear into the exposed rocks of the riverbed?

That question, among others, spurred Roaring Fork Conservancy and Public Counsel of the Rockies to hire Lotic Hydrological and embark on the Crystal River Management Plan. The Management Plan's ecological model tells us that if the river is below 17 cfs, small increments of added water do not restore river health. However, there is a sweet spot between roughly 30 cfs and 55 cfs where additional water produces measurable benefits for the river in moderate drought years. We baked those numbers into our agreement with Cold Mountain Ranch so that we know when we're paying for added water in the river, that increased flow is providing real benefits.

By the time our agreement activated in August, flows at the fish hatchery had already dropped to 8 cfs. Water available to Cold Mountain Ranch's Helms Ditch water right had dropped to 2 cfs – limiting its restorative effect. Although there

were short stretches of flows above 20 cfs, we did not have confidence the river would stay at that level – and it didn't.

There is another critical reason these target streamflows determine project implementation. From the beginning of our outreach in the Crystal River basin, we committed to respecting both the water needs of the river and the water needs of sustainable agricultural production. In the driest years, the Crystal River basin does not produce much water. Flows coming into the valley above Avalanche Creek have been running half of average, or around 50 cfs. Under these conditions, just securing the base threshold of 17 cfs at Thomas Road bridge, water users above would need to reduce their diversions by a *third* of what they're already limited to by physical supply and administrative calls. To put it simply, we believe this community values both agriculture and environment. To ask for sacrifice amongst agriculture without showing measurable environmental benefit is not in line with the Crystal River Management Plan's mission.

For these reasons, Colorado Water Trust's pilot project with Cold Mountain Ranch focuses on moderate drought years, not the severe, and so we did not operate the project in 2018. There are two more years remaining under the agreement, and although we always hope for snow, we continue to do our best to prepare for the opposite.

Cold Mountain Ranch lllp
4239 Highway 133
Carbondale, Colorado 81623

Pitkin County Healthy Rivers and Stream Board
530 East Main Street, suite 301
Aspen, Colorado 81611

August 29, 2018

RE: Request for Funding of the Helms Ditch Piping project

Dear Board Members,

I am pleased to attach Cold Mountain Ranch's application for funding the piping of 700 feet of the Helms Ditch. This project is located on the county owned Thompson Creek Open Space parcel on the west side of the Crystal River, 1.75 miles south of the Garfield- Pitkin county line. The completion of this project will result in a modern, efficient, and sustainable ditch which can be showcased and replicated throughout the Crystal and Roaring Fork Valleys.

Cold Mountain Ranch is requesting $ 47,268 for this project.

I look forward to meeting with you to discuss this worthwhile project and answer any questions that you might have.

Thank you for your consideration,
Sincerely,

William E.L. Fales

William E.L. Fales
General Partner

CMR grant Application to Pitkin County Healthy Rivers

A. Goals of the Healthy Rivers Board

Cold Mountain Ranch (CMR) requests funding to pipe and slightly modify the alignment of the Helms Ditch. CMR owns 100% of the water rights in this ditch comprised of 6cfs. The original right is for 2.93 cfs with an appropriation date of 1899 and an enlargement dated1924 for an additional 3.07 cfs. In 2009, these water rights were tied to the land by a conservation easement granted to Pitkin County and the Colorado Cattlemen's Agricultural Land Trust. This water can never be sold off of the ranch. The only exception is for a temporary lease for instream flow.

Similar to most of the ditches in our watershed, the Helms ditch has been maintained to enable the full use of the water rights; however this section has not had any substantial improvements made to it since it was originally built in 1899. Today, the bank separating the ditch and the Crystal River is only 6 to 24 inches wide. Earlier this summer, water was leaking out the ditch bottom endangering the ditch and causing erosion directly into the Crystal. I was able to fix that leak with a temporary patch but the overall condition and minimal width of the bank is unsustainable.

I have inspected the ditch with Derek Wyle from the NRCS and formulated a plan that will both improve the ditch and the bank of the Crystal and the associated riparian habitat. The plan is to pipe 700 feet of the ditch immediately downstream of the headgate in 36 inch ADS watertight pipe. At the same time, we will move the ditch slightly to the west, getting it further away from the river and straightening out its alignment resulting in a more efficient delivery of water and giving increased land for the riparian habitat. The project will require the following resources:

Materials for this project:

700 feet 36 inch ADS watertight pipe @ 45.38/ft	$31,768
Miscellaneous materials and concrete	$ 500
Tax	$ 3,000
Total materials	$35,268

Excavation and Labor

Bid from Gilbert Ramirez, Sierra Excavation	$12,000
Total Project cost	**$47,268**

This project will both complete the upgrade of the Helms Ditch utilizing today's technologies and meet many of the goals of the Healthy River's program. The ditch will become more

sustainable and the danger of a blowout will be dramatically reduced. Specifically, this project meets Healthy River's goals 1,3,4,5.

This project will increase the efficiency of the diversion and delivery of water thereby preventing potential ditch blowouts and the damage to the river from such an event and potentially reduce excess diversions by delivering all the water that is diverted to the fields to be irrigated, thereby improving both the quality and quantity of water in the Crystal, goal #1.

In 2010, the next 3,000 feet of ditch was piped. As a result, when this project is completed all but a short section, to allow for a measuring flume, will piped from the headgate to the irrigated land. Adjusting the ditch alignment away from the immediate edge of the river will benefit that riparian area by allowing a more natural condition to exist and preventing future ongoing disturbances caused by annual ditch cleaning. This will ensure the river's ecological health, wildlife and riparian habitat, goal #3.

Increasing the efficiency of the delivery of water will promote water conservation, goal #4.

Finally, this is a shovel ready project to improve capital facilities, goal #5. Securing funding is the only remaining component of the project.

This project brings the Helms ditch up to date with today's technologies thereby helping maintain the viable agricultural operation and thus protecting these valuable older water rights.

B. Viability of the Project

This project is a straight forward, practical, and common sense solution which will be easily completed within a short construction time frame. Derek Wyle of the NRCS has surveyed the grade of the existing ditch bottom and the proposed alignment and calculated the grade to make certain the pipe size is sufficient.

The project is an essential need as the current condition of this ditch is precarious. The narrowness of the bank and the fact that the bank is primarily comprised of roots makes a blowout a matter of when not if.

Paul Holsinger, Ted O'Brien , and Bill Griggers, from Pitkin's Open Space and Trails program have all looked at the ditch, approved this proposal, and have all agreed that it is an intelligent plan. Their approval is necessary as the Helms ditch headgate is located on the Thompson Creek Open Space owned by the county.

The only other necessary resources to complete the project are my own labor and seed for revegetating the site.

C. Public Need, Accessibility and Appreciation

I am not aware of any existing services or programs that this project might duplicate.

The Helms ditch water rights and every acre of Cold Mountain Ranch are protected by a conservation easement. Consequently, the land will never be developed and the water rights will remain with this property in perpetuity, creating a durable investment. The existing bike trail adjacent to Highway 133 parallels CMR's hay fields and irrigated pastures. Countless users of this trail and the highway enjoy the view of this irrigated land. Improving the ditch makes this view more secure.

I constructed a new headgate on the Helms ditch in 1986. When this project is completed, the ditch will be a model of efficiency helping to meet the goal of the Crystal River Management Plan. I will be happy to have tours of the ditch to showcase how ditches can be brought up to date to comply with today's environmental ethics and values.

D. History of Requesting Party

Cold Mountain Ranch is a 610 acre cattle ranch owned and operated by Marj and I. We are a certified GAP step 4 operation, attesting to our humane treatment of our livestock and allowing this livestock to be sold to Whole Foods Markets

Marj and I have significant experience operating an agricultural operation and have been dedicated stewards of the land. I have previously successfully completed many other projects on our ditches. In 1986, I built a new headgate for the Helms ditch. In 1989, I installed a gravity pressurized sideroll sprinkler system for much of our land between the Crystal River and Highway 133, increasing CMR's irrigation efficiency. In 2010, I designed and oversaw the construction of a new headgate and several hundred feet of pipe for the Lowline ditch which also serves Cold Mountain Ranch. In 2016, I constructed a project to change from flood irrigating with dams to a gated pipe system for a pasture under the Pioneer ditch.

Marj and I are dedicated community members and work tirelessly to promote conservation and model a conservation ethic. I served on the county's wildlife task force in the early 1990s. From 1993 until 2006, I was on the Open Space and Trails board of trustees. In 1993, I joined with others to help create the Colorado Cattlemen's Agricultural Land Trust. I served on the board of directors from its creation until 2015. Marj spends her summers eliminating weeds from CMR and the Snowmas Falls ranch and the adjacent USFS land. She was a long time member of the Thompson Divide board. Marj is currently on the Mount Sopris Nordic Council board of directors. We have planted willows, cottonwoods and ponderosa pine trees on CMR's riparian land. In 2014, Marj and I were awarded the Riparian Stewards of the year award by the Colorado Riparian Association.

E. Budget, Measurements and Accountability

Cold Mountain Ranch is requesting the cash expenses for this project, which total approximately $47,268. I plan to limit the costs associated with the excavation and labor portion of this by contributing a significant amount of labor and my own machinery. Copies of all

invoices for all materials and work will be submitted. The completion of the ditch piping will be the measure of progress and success. I will report when the pipe is delivered, when excavation commences, and when the project is completed. Gilbert Ramirez estimated a 1 week construction time period.

August 28, 2018

Healthy Rivers and Streams Program
Lisa MacDonald
530 East Main Street, Suite 300
Aspen, Colorado 81611

Via Email; lisa.macdonald@pitkincounty.com

Healthy Rivers and Streams Board and Staff,

Thompson Creek Open Space is located just four miles south of Carbondale in Pitkin County between Highway 133 and the Crystal River. Pitkin County purchased the property in 2005 with the Pitkin County Open Space and Trails fund. Pitkin County Open Space and Trails (OST) leases approximately 50 acres for grazing to Bill Fales. The other 36 acres is managed for riparian habitat conservation and public access.

Bill recently contacted OST staff to discuss improvements that would benefit the Helms Ditch and the County owned open space. The Helms Ditch headgate and the first several hundred yards of the ditch are located on Thompson Creek Open Space. After discussing and walking the ditch with Bill, OST staff are in full support of the ditch improvement. If this project is funded and completed OST will also have the opportunity to fence more of the riparian edge of the Crystal River.

OST staff have already begun working with the Pitkin County Attorney's office to develop a ditch modification agreement to allow the improvement. Please contact me if you have any questions or concerns.

Sincerely,

Paul Holsinger

Paul Holsinger
Agriculture and Conservation Easement Administrator
Paul.Holsinger@Pitkincounty.com

2018 Combined Scoresheet	Wille		Jochems	Hudson	Tasker	Taylor	Neubecker	Combined Average
Cold Mountain Ranch 2018 Helms Ditch Project							did not submit scoresheet	
Goals of the River Board **0-100 possible points** The extent to which the proposed grant request/project meets the stated goals, objectives and on-going projects/priorities of the River Board. 1. Must be complete, clear and concise, with specific dollar amounts in total and for each element of the project; 2. Must fulfill the intent of the ballot language.	**60**		**5**	**100**	**25**	**80**		**54**
Vialbility of the Project **0-100 possible points** The extent to which the proposed grant request/project is practical, will be completed as proposed and/or may require other resources to be fully completed, and the extent to which the project can be repeated in other locations such that it will not be limited to a single event. 1. Must address an essential need; 2. Demonstrates collaboration and/or partners with other agencies.	**50**		**60**	**100**	**25**	**90**		**65**
Public Need Accessibility and Appreciation **0-100 possible points** The extent to which the proposed grant request/project will be seen, appreciated and/or used by the public. 1. Does not duplicate existing services or programs; 2. Must serve and be appreciated people who live and/or work in Pitkin County & the Roaring Fork Watershed; 3. Includes a specific Public Relations strategy; 4. Demonstrates an appropriate need for public funding.	**50**		**5**	**85**	**50**	**50**		**48**
History of the Requesting Party **0-100 possible points** The extent that the requesting individual/entity has been successful in other projects or efforts and is known in the community.	**100**		**100**	**90**	**100**	**75**		**93**
Budget, Measurements and Accountability **0-100 possible points** The extent to which the proposed grant amount is appropriate to the project scope and includes other appropriate sources of funding. The extent that the project includes specific measures for success and reporting of progress and results to the Healthy Rivers Board. 1. Demonstrates financial stability and presents accurate budgets and financial reports, measurements and accountability; 2. Specific measures of progress and success; 3. Reporting plan to Healthy Rivers Board/others.	**100**		**75**	**95**	**50**	**50**		**74**
Totals	**360**		**245**	**470**	**250**	**345**		**334**

CenturyLink Webmail **wjochems@centurylink.net**

From : WILLIAM D JOCHEMS Owner <wjochems@centurylink.net> Mon, Sep 24, 2018 08:22 AM

Subject : <No Subject>

To : wjochems <wjochems@centurylink.net>

Goals of the Board
2 Applicant claims 700 feet of piping will met our goal of "improving ....water quantity, but there was no promise to divert less at the headgate, and I don't see any other way that quantity in the Crystal River will be improved. In fact the opposite may occur if, as applicant said, consumptive use may be increased. This voters asked us to protect water rights, but they didn't ask us to increase consumptive use at the expense of water quantity in the Roaring Fork watershed.

Public Need
4, The applicant's effort to "demonstrate an appropriate need for public funding" was based entirely on this year's low cattle prices but this is a capital expenditure, and as such the capital assets, ab;out which nothing was said,should be considered. Applicant is not seeking funds from any agency except the taxpayers of this county, who have already invested more than $7,000,000 in this property.

Since the Healthy Rivers Board is merely an adviser on this matter, I feel free to express my misgivings about my vote to approve and the advice that might have implied. Applicant scores well otherwise, but the major shortcomings above described, weigh against approval, and makes me regret that I voted as I did.

PITKIN COUNTY HEALTHY RIVERS

WILLE

GRANT CRITERIA SCORE CARD

Application Review Criteria — Helms Ditch Cold Mountain Ranch	Points Possible
Goals of the Healthy Rivers and Streams Board	**0-100**
The extent to which the proposed grant request/project meets the stated goals, objectives and on-going projects/priorities of the River Board. 1. Must be complete, clear and concise, with specific dollar amounts in total and for each element of the project; 2. Must fulfill the intent of the ballot language. Push Water Sprinkler Eff. "Damage Control" to prevent Hayout	60
Viability of the Project	**0-100**
The extent to which the proposed grant request/project is practical, will be completed as proposed and/or may require other resources to be fully completed, and the extent to which the project can be repeated in other locations such that it will not be limited to a single event. 1. Must address an essential need; – Not clear on benefits to River 2. Demonstrates collaboration and/or partners with other agencies. – Needs more	50
Public Need Accessibility and Appreciation	**0-100**
The extent to which the proposed grant request/project will be seen, appreciated and/or used by the public. 1. Does not duplicate existing services or programs; 2. Must serve and be appreciated people who live and/or work in Pitkin County & the Roaring Fork Watershed; 3. Includes a specific Public Relations strategy; 4. Demonstrates an appropriate need for public funding.	50
History of the Requesting Party	**0-100**
The extent that the requesting individual/entity has been successful in other projects or efforts and is known in the community.	100
Budget, Measurements and Accountability	**0-100**
The extent to which the proposed grant amount is appropriate to the project scope and includes other appropriate sources of funding. The extent that the project includes specific measures for success and reporting of progress and results to the Healthy Rivers Board. 1. Demonstrates financial stability and presents accurate budgets and financial reports, measurements and accountability; 2. Specific measures of progress and success; 3. Reporting plan to Healthy Rivers Board/others. Help from O.S.T.?	100
	360

PITKIN COUNTY
HEALTHY RIVERS

TASKER

GRANT CRITERIA SCORE CARD

Application Review Criteria - COLD MOUNTAIN RANCH - ~~$43,268~~ $25,000	**Points Possible**
Goals of the Healthy Rivers and Streams Board	**0-100**
The extent to which the proposed grant request/project meets the stated goals, objectives and on-going projects/priorities of the River Board. 1. Must be complete, clear and concise, with specific dollar amounts in total and for each element of the project; 2. Must fulfill the intent of the ballot language. EXCEPT FOR SOME PHYSICAL BENEFITS TO STREAMBANKS AND KEEPING A DITCH FROM "BLOWING OUT", IT IS EXTREMELY UNCLEAR HOW THIS PROJECT ADDRESSES THE GOALS OF THE HEALTHY RIVERS BOARD AS OF THIS DATE.	25
Viability of the Project	**0-100**
The extent to which the proposed grant request/project is practical, will be completed as proposed and/or may require other resources to be fully completed, and the extent to which the project can be repeated in other locations such that it will not be limited to a single event. 1. Must address an essential need; 2. Demonstrates collaboration and/or partners with other agencies. WHILE THE PIPING OF DITCHES AND INSTALLATION OF NEW HEADGATES CAN CERTAINLY BE REPEATED IN OTHER PROJECTS, THE CONNECTION BETWEEN IMPROVING A RIVER'S HEALTH AND INCREASING REAL WATER, REAL RIVER FLOWS IS STILL NOT ENTIRELY DEMONSTRATED AND THEREFORE DUPLICATION, AND REPEATABILITY ARE IN QUESTION STILL.	25
Public Need Accessibility and Appreciation	**0-100**
The extent to which the proposed grant request/project will be seen, appreciated and/or used by the public. 1. Does not duplicate existing services or programs; 2. Must serve and be appreciated people who live and/or work in Pitkin County & the Roaring Fork Watershed; 3. Includes a specific Public Relations strategy; 4. Demonstrates an appropriate need for public funding.	50
History of the Requesting Party	**0-100**
The extent that the requesting individual/entity has been successful in other projects or efforts and is known in the community.	100
Budget, Measurements and Accountability	**0-100**
The extent to which the proposed grant amount is appropriate to the project scope and includes other appropriate sources of funding. The extent that the project includes specific measures for success and reporting of progress and results to the Healthy Rivers Board. THERE WAS LITTLE EFFORT PUT INTO SECURING OTHER SOURCES OF FUNDING; EMERGENCY CIRCUMSTANCES STATED 1. Demonstrates financial stability and presents accurate budgets and financial reports, measurements and accountability; 2. Specific measures of progress and success; ∅ 3. Reporting plan to Healthy Rivers Board/others.	50

250/500

TASKER

Cold Mountain Ranch Grant Request, comment continued:

I see the HRSB getting into a conundrum regarding funding ditch work. Without measurable benefits to either water quantity or quality issues and river ecology, I feel we will be doing the taxpayers of Pitkin County a disservice as the intent in the ballot language that created us is to help river health. Funding o the East Mesa Ditch improvements was our first step in creating a relationship with diverters in our watershed and we knew we were being lax in not asking for measurable river benefits. But we also knew we could not do that again. I believe future monies towards improving ditch efficiencies need to have a clear nexus to improved river flows in order to fulfill the intent of Pitkin County voters and taxpayers. I believe we need to revisit our Grant Criteria Scoresheet to better reflect those objectives.

Wright Water Engineers, Inc.
818 Colorado Avenue, Suite 307, P.O. Box 219
Glenwood Springs, Colorado 81602
(970) 945-7755 TEL
(970) 945-9210 FAX
www.wrightwater.com
e-mail: sschreiber@wrightwater.com

October 19, 2018

Via Email: KNeubecker@americanrivers.org

Ken Neubecker
American Rivers Colorado Project Director
24 South Meadow View Court
Glenwood Springs, Colorado, 81601

Re: Weaver Ditch Improvement and Efficiency Project

Dear Mr. Neubecker:

Wright Water Engineers, Inc. (WWE) and Sopris Engineering LLC (Sopris) are pleased to submit this proposal to provide support for surveying and engineering work on the Town of Carbondale's Weaver Ditch. Our team enjoyed working with American Rivers on the Deep Creek Instream Flow recommendation and we look forward to supporting another great project with American Rivers, the Roaring Fork Conservancy and the Town of Carbondale. These are the kinds of projects that really pull on the heart strings in developing a more resilient and sustainable ecosystem for future generations, which aligns with our goals personally and professionally.

Our team has a great number of resources to benefit this project. WWE and Sopris will work together to develop creative solutions to meet the goals of the project. Our teaming effort will allow for multiple layers of quality control and quality assurance, as that is paramount in evaluating flows throughout a ditch carrying water rights. It also brings more experience to address challenges that might arise now or on future phases. Both our firms are very aligned when it comes to technical expertise in our fields along with work ethic and pride in the work product we generate.

Furthermore, since we have worked together on a very similar project with even tougher constraints, we will be able to hit the ground running. Sopris' close proximity to the project area will allow for great efficiency in performing the survey and meet the timeline proposed. Sopris has already started to evaluate the system and has put a plan together to tie the ground survey into LiDAR and other projects being conducted by American Rivers, the Roaring Fork Conservancy and the Town of Carbondale. By choosing the WWE & Sopris team you will be working the best surveying, civil engineering and water resource engineering firms in the valley.

WRIGHT WATER ENGINEERS

WWE will utilize a full suite of water resources professionals to support this project. While the initial phase of this work is mostly surveying, understanding the bigger picture and the next steps are paramount in ensuring the correct information is acquired at the onset of the project. This will also allow for efficiencies in developing future phases. WWE also has a background in the design of diversion structures and implementing data telemetry at these diversions to remotely monitor flows in ditches and creeks. We have also worked on ditch efficiency projects and understand the design elements included with those. We are also able to help secure grants and funding to help

pay for these types of projects. Our staff has water rights specialist that can be leveraged as needed for questions involving the diversion and the ditch. And our connections with other non-profits in the area can also work to help this kind of project.

The project manager for this work will be Scott Schreiber who has a great relationship with the stakeholders involved. Scott is experienced in full topographic survey development with RTK-GPS and Trimble GPS units as well as measuring cross sections and longitudinal profiles of a reach with a rod and level. This background will be useful in understanding the survey required to property evaluate the Weaver Ditch. We are skilled in processing and analyzing these data to develop hydraulic models necessary to provide recommendations for gage locations. Scott also has a knack for explaining technical information to the public in a way they can understand and appreciate if required of this project or future phases.

WWE is an industry leader in the field of water rights. Our staff of hydrologists, water resource engineers, and modelers provide a complete array of water rights services such as hydrologic investigations, valuation, augmentation planning, and substitute water supply plans. WWE performs water rights analyses efficiently with the use of the latest Geographic Information Systems (GIS) mapping and data management techniques. Our experience in this area might be useful as the project progresses.

SOPRIS ENGINEERING

Sopris Engineering LLC (SE) is a locally owned and operated Roaring Fork Valley company providing Consulting, Land Surveying, Civil Engineering and Geographic Information Systems services to individual landowners, corporations and public entities across the state of Colorado. Since incorporating in November 1994, SE has been involved in the development of many large-scale projects in the Roaring Fork and Colorado River valleys, including projects generated by public entities and school districts, as well as private groups and individuals. Principals Yancy Nichol and Mark Beckler each hold more than 20 years of experience in project planning and management. Our staff of 27 employees includes seasoned engineers, technicians, and field surveyors using state-of-the-art software and surveying equipment to produce exacting designs, informative presentations, professional submittal drawings and real confidence on the jobsite.

SE's experience and longevity, working in cooperation with town councils and county boards here in the Roaring Fork Valley, has given us a direct knowledge of local development processes, from application to occupancy. Our dedicated GIS department ties together an unlimited depth and breadth of information on any given building or site – from legal documents, photos and recordings, to three-dimensional survey data (before, during and after construction), geo-political and environmental data, mechanical specifications and maintenance information – all geographically referenced and accessible from one user-friendly database.

With the WWE/Sopris team you are getting more than just a survey and recommendation for gage location. You are getting a robust team, that works great together, has a proved track record in the valley for more than 40 years. But the most paramount aspect is that we have the fortitude and knowledge to understand what the big picture is and what next steps are. Therefore, while we are

developing the survey and gage locations, we understand how it might be used, and can ensure all information is acquired efficiently.

KEY PERSONEL

Scott Schreiber, P.E. – Project Manager. Scott is a water resources engineer with 12 years of experience in water resource engineering design work specializing in stream restoration and watershed health. Scott has worked on stream restoration planning and design projects across the state with municipalities, non-profits, and private entities. Many of the projects he has worked on have required cross sections and thalweg or full topographic surveys. Scott has also been involved with projects for the placement of remote telemetry that can be used to evaluate flow rates in different water courses. He also has experience in designing diversion structures, therefore understands the design constraints and criteria placed on these structures and how they function. Along with stream restoration, his work includes stormwater management design, corridor planning studies, drainage infrastructure design, LOMR submittals, LID and LEED designs, trail development, pedestrian bridges, boulder retaining walls, trail/roadway drainage, and land development. Scott has focused on sustainability, which has spilled over into other areas of interest such as serving on the Colorado Water Conservation Board's roundtables and as the President of the Denver branch of Trout Unlimited. He has been the driving force in a number of non-profit projects by providing the philanthropic work necessary to get a project off the ground. Scott is proficient with HEC-RAS, SWMM, Civil 3D, RiverCAD, StormCAD CUHP, and HY-8.

Mark Beckler, P.L.S – Mark Beckler has a solid reputation in the Valley for providing the highest quality survey services ranging from single-family residential lots to multi-phased, mixed-used, commercial and industrial developments. Mark manages five survey teams whom he will assign according to their level of expertise. As Principal with Sopris Engineering, Mark has more than twenty-five years of experience in land surveying and construction surveys. Mark is responsible for overseeing all survey projects and each of the five survey crews, and performs as the responsible licensed surveyor for all projects. Mark meets with clients and finalizes project proposals and project budgets.

Geoffrey Keller, P.L.S – Geoff Keller assesses and analyzes jobs, ensuring job efficiency and completion. He trains and leads the field staff, and assigns field staff to tasks. Geoff handles client relations, meeting with the client to identify the scope or work and fulfill the land use application. He is trained in all aspects of map production along with GPS fieldwork applications. Geoff is well versed in AutoCAD, Legal-Aid, and numerous other survey technologies. He is also proficient in courthouse research on record documents and plats as well as title work. Geoff also screens office packages for errors or omissions.

APPROACH

At the onset of the project, a kick-off meeting will be conducted to allow all parties involved to understand various roles and to start brainstorm unique ideas for the project. Our team has previously been on walking tours of the ditch and understands the unique situation facing the Town of Carbondale. This will also allow us to develop a schedule to meet the requested timeline as well as intermediate meetings.

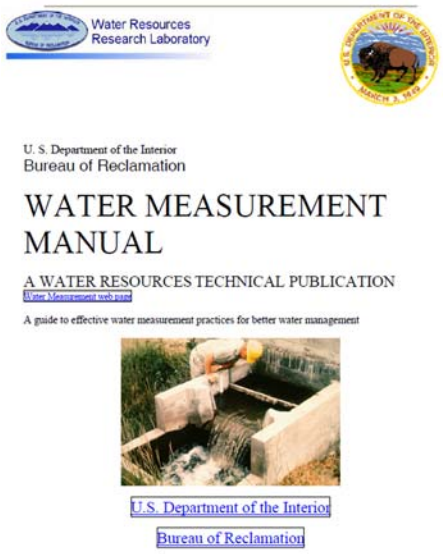

Figure 1. USBR Water Measurement Manual

Our first task for the project will be to acquire a longitudinal survey of the entire ditch thalweg. This survey will be acquired in NAD83 State Plane Central, Foot and NGVD83. This will allow the entire survey to be located spatially and coordinated with any other surveys that might be available. This will also allow the work to be superimposed onto an aerial to better understand spatial locations of various aspects. During the longitudinal profile survey, photographs of each section will also be acquired and geotagged to allow for a spatial representation of the information. This will allow for documentation of the ditch during the survey to understand changes that might occur over time. During the survey, we will also set benchmarks that can be used and document the locations of survey points in the field.

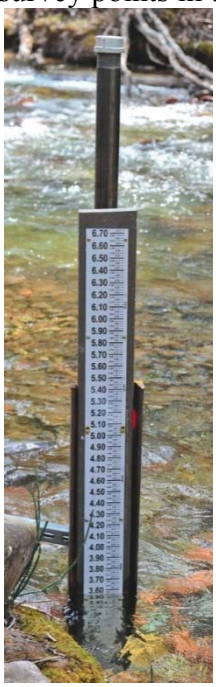

Figure 2. USGS Staff Gage

This profile survey will also include survey of culverts with inlet and outlet elevations along with surrounding topography. This information will be very useful based on discussions we have had with telemetry companies that have devices that can read water depth and velocity within culverts. Further discussion on the telemetry will be presented later in the approach. The survey will also include access ports, lateral ditches, weirs, control gates, irrigation pump stations, and street crossings. All of this information is very useful in understanding the constraints influencing potential gage locations.

Performance of the longitudinal survey will be completed by WWE and Sopris. This is primarily to allow efficiencies in the surveying process, and to also allow for additional reconnaissance for the placement of the gages. Once the longitude survey is complete we will meet with American Rivers to discuss the information acquired and move forward with recommending locations for the gages.

Our approach to recommending locations for the gages is three-fold. First, we need to investigate the longitudinal profile. This will be key in understanding the best location for potential gages based on consistency and changes in ditch slope. Secondly, we need to understand the location of the gages in relationship

to the ditches' planform, diversion, town, roads, infrastructure and users. We want to ensure the recommend gage locations are at places that will not be modified or changed in the future.

Our approach for the survey will be to hold off on acquiring the cross-sectional information until the profile can be evaluated. The majority of the information affecting the recommended locations of gages along the ditch will be determined by the ditch parameters. It is very important to understand potential hydraulic implications of a gage location at certain places. It is also very important to understand the capabilities and limitations of the gages being evaluated for this type of work. Therefore, discussion on the type of gage to be used will be necessary in determining actual placement of the gage.

Figure 3. Sontek-IQ Flow Measuring Device

To address the first aspect for the location of the gage: hydraulics; there are a few key ideas to be evaluated. Some of these aspects might not be necessary to be adhered to depending on the type of gage chosen, but still should be understood. WWE's history in development of stream gages will help in this process. Below is a list of items that must be considered when determining a gage location.

- Planform
- Profile
- Location of infrastructure
- Potential flow depths and velocities
- Sediment fluxes
- Type of gage
- Telemetry needed
- Power needed

Once recommendations for the gage locations have been developed, then cross sectional surveys will also be acquired. This will allow for a supplementary site visit to the ditch to gather cross sectional information but to also increase amount of data points in the location of the proposed gage. It will be the goal to acquire very accurate one-foot topo in the area of the recommended gages. This also might include any other planform features int eh area that might affect hydraulics.

Once all survey is acquired and recommended gage locations finalized our team will move into map production. Our team will develop maps that show plan and profile views of the ditch. These maps will also include the recommended gage locations and actual cross sections shown in a section view. These maps will also display pictures of the gage locations to fully understand the recommended locations. All this information will be superimposed on LiDAR as well as background aerial for the site.

*Our team also has the ability to perform drone surveys for aerials and surrounding topography if requested and also provide initial hydraulic calculations of the ditch at the gage locations if requested with the use of hydraulic modeling software.

Our team is eager to start work on this project and will be able to meet the schedule as laid in the request for proposals.

ESTIMATED COST

WWE proposes to undertake the above scope of work on an hourly-rate basis in accordance with the attached Rate Schedule. Our team can complete the task outlined in the request for proposals between the range of $19,000 to $21,000. If this proposal is acceptable, please sign the attached Project Agreement and return to us. We will execute the agreement and return a copy to you for your records.

We appreciate the opportunity to assist you with this project. Please feel free to contact us if you have any questions.

Very truly yours,
WRIGHT WATER ENGINEERS, INC.

By _____
Scott Schreiber, P.E.
Water Resources Engineer

Figure 4. Sopris Crew During Deep Creek Survey

Proposal for Crystal River Restoration and Weaver Ditch Efficiency Project

Prepared by

River Restoration.org

DHM Design

lōtic hydrological

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September 22, 2017

Matt Annabel
Aspen Valley Land Trust
320 Main Street
Suite 204
Carbondale, CO 81623

RE: Request for Proposal/Information for Crystsal River Restoration and Weaver Ditch Efficiency Project.

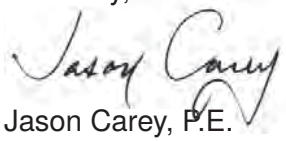
Dear Matt,

Thank you for the opportunity to submit our proposal for planning and design of the Crystal River Restoration and Weaver Ditch Efficiency Project. RiverRestoration is pleased to present a comprehensive team for the project. RiverRestoration will lead the project and provide expertise in the planning and design of the in-channel and floodplain components. DHM Design, Inc. will also play a major role in the project, leading the planning and design effort for improvements associated with Riverfront Park, including trails, public gathering space, educational opportunities and vegetation management. Lotic Hydrological rounds out this all-star team, providing continuity from the Crystal River Management Plan, review of conceptual alternatives and participating in the stakeholder coordination and public involvement.

The project team members are all based out of Carbondale, Colorado. We are intimately familiar with the Crystal River and the project reach, having fished and paddled these waters for years. This local presence and knowledge is augmented with decades of experience working on rivers throughout the state and county. We have a proven track record of creating places that introduce and encourage stewardship of our river ecosystems. We are excited about the chance to be a part of this transformative and placemaking project in our home community.

The following proposal provides a detailed overview of the experience and approach of the RiverRestoration team in completing planning and design for Crystal River Restoration and Weaver Ditch Efficiency project. We are available to begin work immediately and will work effectively and efficiently to complete the project. We look forward to the opportunity to discuss our ideas with you directly. Thank you for being dedicated to the river community and moving this exciting project forward. Be sure to contact us with any questions or comments.

Sincerely,



Jason Carey, P.E.
Principal River Engineer
RiverRestoration
PO Box 248
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970.947.9568
jason.carey@riverrestoration.org

Stephen Ellsperman
Principal/Director of Ecological Planning
DHM Design
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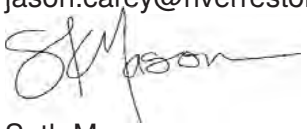
970.369.6520
sellsperman@dhmdesign.com



Seth Mason
Principal Hydrologist
Lotic Hydrological, LLC
PO Box 1524
Carbondale, CO 81623
970.903.7561
seth@lotichydrological.com

TABLE OF CONTENTS

01 FIRM OVERVIEWS

The following pages provide a brief introduction of the firms making up this project team. Our team provides an unequivocal wealth of local knowledge and intimacy with the Crystal River and its riparian environment. RiverRestoration will lead an expert team of engineers, ecologists, watershed scientists, and landscape architects to seamlessly integrate aquatic habitat with the riparian ecology it supports.

Established in 2004, RiverRestoration is a river engineering firm with a mission to make rivers better places. We have the insight to enhance the social, economic, and environmental values flowing in the river every day. Our team of river engineers, watershed scientists and passionate river stewards is dedicated to creative solutions and new thinking for our rivers. With a track record including implementation of over 90 river centric projects, RiverRestoration provides the creative planning, engineering and technical support required for a successful river project. Our goal is for whole system design that includes restoration, preservation, enhancement and beneficial use of river and riparian ecosystems. We employ a collaborative approach that balances the functional needs of water users, recreation and the environment for long-term, sustainable solutions. Our applied philosophy is that healthy rivers can exist as an integral part of our human environment.

At RiverRestoration we apply state of the art technology and science as an analytical approach to design of natural channels. This results in acurate predictions of channel response that leads to sustainable riparian and aquatic habitat regeneration. We examine projects on broad time and spatial scales. Long-term function of geomorphology and sediment transport is central to our design. We connect communities to their rivers by designing river interaction as a central theme. These plans take into account habitat-function, recreation use, non-point source pollution reduction, low impact stormwater design and water rights. We establish a vision with clients and guide strategies to bring that vision to implementation, including assistance with grants and funding opportunities.

Our multi-purpose designs have widespread benefits. These benefits attract a broad coalition to support the project merits. We communicate with stakeholders and agencies to minimize impacts, build support, and enhance habitat. Agency insight informs our designs and our designs turn regulators into advocates. Our planning work with natural resource agencies have not only aided in improved designs, but been a source of funding for the projects involved. We perform technical engineering including hydrographic surveys, multi-dimensional hydraulic modeling, sediment modeling, and flood hazard remapping to solve river issues. Often times our projects require FEMA map revisions. We are experienced in the CLOMR/LOMR process. We prepare native riparian landscape plans, soil and planting specifications, wetland delineations, and assessments of riparian and aquatic habitat conditions. We design environmentally sensitive diversion structures, or reduce or remove existing dams, while restoring aquatic and geomorphic processes and integrating passage for fish, sediment and boats. We appropriately locate and design recreation and whitewater enhancement projects without degrading ecology or conflicting with other uses. Our finished products are often complimented as being organic, as well as state of the art.

Main office: 818 Industry Place, Carbondale, CO 81623

Branch office: 1234 South 900 East; Ste. 200, Salt Lake City, UT 84105

Years in business: 13 years

Size of firm: 8 employees

Primary contact: Jason Carey, 970.947.9568x101, jason.carey@riverrestoration.org

Our core competencies include:

- natural channel design
- hydraulic design
- river stability analysis
- floodplain determination
- reservoir capacity analysis
- dam removal design
- sediment and erosion control
- diversion structure design
- aquatic habitat design
- whitewater park design
- topographic and hydrographic survey
- construction management
- fish and boat passage design
- aquatic barrier design

DHM Design is a story of innovation and growth.

Established in 1975, we are an internationally recognized leader in landscape architecture, land planning, urban design and ecological planning. Our experience embraces a diverse portfolio of planning and design projects:

National Park Service
Resorts and Communities
Historic and Civic Facilities
Parks, Open Space, and Greenways
Ecological Restoration
Mixed-use Developments
Urban Transportation Systems
Private Estates and Rural Properties

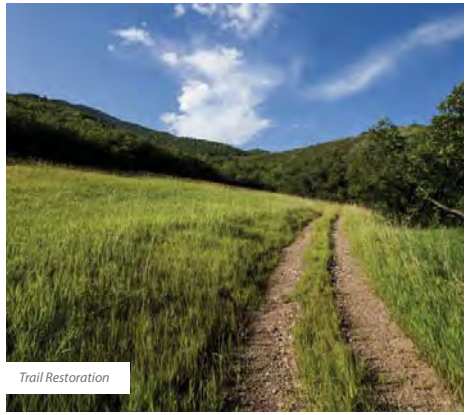
Gold Medal Waters of the Frying Pan River
River, Wetland, & Stream Restoration

ECOLOGICAL SERVICES
Planning | Analysis | Restoration

DHM Design is passionate about enhancing the interconnection between natural systems and human development and is dedicated to protecting the integrity of the land and ecosystem in every aspect of the planning and design processes.

The DHM Design Team has spent 40 years developing an important understanding of how connections and relationships to the natural environment can be communicated through master planning processes. DHM Design is unique in that it offers in house solutions that emphasize ecological planning and natural resource management in every aspect of the planning and design processes. Our ecological team members are not outside consultants, but principals within our firm and work carefully with our design staff on all aspects of our projects. Our approach to natural area master planning is to first understand the resource carefully with dedicated analysis of the ecological components of a site. All decisions must come from this careful understanding, and through this process, sustainable and creative opportunities emerge.

DHM Design considers ecological planning the true intersection of landscape architecture, planning, and ecological services. We make a commitment to include ecological planning into how we approach all projects, from large-scale private ranches to small urban parks. These are not considered external services, but rather integrated into each of our projects. We pride ourselves in discovering unique ecological opportunities that connect landscape architecture and our design approach with the greater natural world around us.

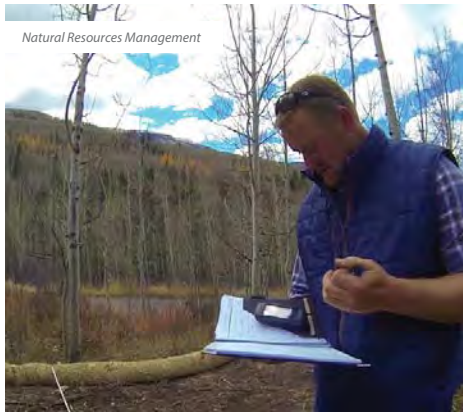


Trail Restoration

Parks, Open Space, & Greenways

Wetland Restoration

Private Estates, Ranch, and Rural Properties



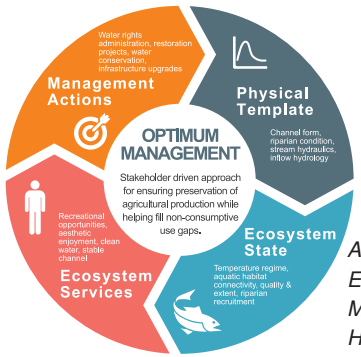
Natural Resources Management

Owner:	**Seth Mason**
Location:	**Carbondale, CO**
Firm Established:	**2011**
Size of firm:	**4 employees**
Website:	**www.lotichydrological.com**

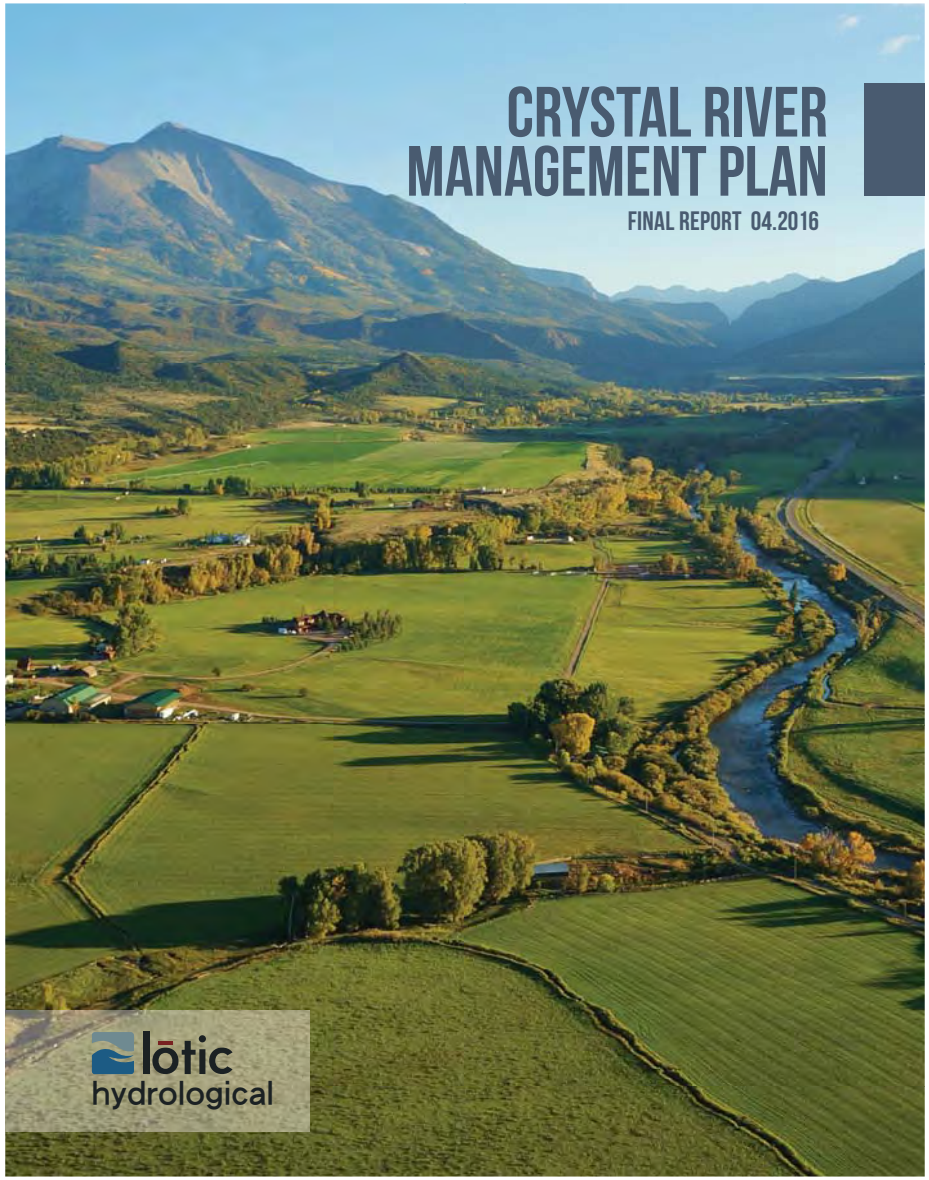
Lotic Hydrological, LLC provides technical expertise, water resource engineering services and a firm commitment to scientific problem solving when engaged in both field data collection and complex quantitative analysis. We generate the high quality data tools and interpretations necessary to inform science based decision-making in public policy development and natural resource management. Our goal is to help clients implement strategies that protect diverse water uses, while maintaining high levels of environmental quality and contributing to the long-term stewardship of our regional water resources. Our firm employs a diverse technical skill set, strong leadership, interpersonal, and communication skills, and a broad knowledge base for considering the multi-faceted nature of natural resource management issues. We are practiced and effective at engaging stakeholders and presenting technical material to diverse audiences in a variety of formats. We work independently or collaboratively to implement various phases of natural resource project management, including: problem identification, environmental data collection and management; quantitative data analysis; synthesis of results; and technical reporting. We work with city and county governments, State and Federal agencies, nonprofit organizations, and specialized subcontractors. A small staff and flexible business model allow us to remain highly responsive to clients as we execute projects. These characteristics and our focus on producing high-quality and timely work products also help us create and maintain long-term relationships with the clients we serve.

Firm Capabilities:

- **Hydrological, Ecological, and Hydraulic Data Collection and Analysis**
- **Water Resources Planning and Program Management**
- **High Impact Data Visualization**
- **Water Resources Engineering**
- **Data Life-cycle Management**
- **Remote Data Acquisition Network Development and Maintenance**
- **GIS Services and Geostatistical Analysis**
- **Stakeholder Engagement**
- **Dialogue Facilitation**



Alternative Management Strategy Effectiveness for the Crystal River Management Plan written by Lotic Hydrological



PROJECT RESPONSIBILITIES

RIVERRESTORATION

«Project Management/Administration
«Stakeholder Coordination
«Hydrographic and Topographic Survey
«River Assessment and Hydraulic Analysis
«Sediment Transport Assessment
«Weaver Ditch Headgate Assessment and Design
«In-channel Habitat Features Assessment and Design
«Bank Stability Assessment and Design
«Permitting
«Fundraising
«Plans, Specifications and Cost Estimation
«Bid and Construction Support

DHM DESIGN

«Stakeholder Coordination
«Public Process
«Vegetation Mapping and Restoration Design
«Trails Assessment and Design
«Garthering Spaces/Outdoor Classroom «Assessment and Design
«Interpretive Features Design
«Permitting
«Fundraising
«Plans, Specifications and Cost Estimation
«Bid and Construction Support

STAKEHOLDER GROUP

Town of Carbondale
Aspen Valley Land Trust
Roaring Fork Conservancy
American Rivers
Colorado Parks and Wildlife
Public Council of the Rockies

INTERESTED PARTIES

River Valley Ranch
Ranchers/Agricultural
General Public

LOTIC HYDROLOGICAL

«Project Continuity
«Public Process
«Review Concept Alternatives
«QA/QC




Our project team specializes in a wholistic approach to river restoration projects. This section discusses the team's vision for the project site, enhancing the site's valuable resources with a light, system-integrated approach.The team is experienced in working with this broad field of stakeholders and plans to involve them throughout the design process.

02 PROJECT PHILOSOPHY

PROJECT PHILOSOPHY

The assembled team of RiverRestoration, DHM and Lotic Hydrological has participated in planning, design, and implementation of dozens of river corridor improvement projects. The team knows what is needed to make these projects a success and an asset for both the community and for the river. The project team strongly believes in a scientific, quantitative approach to the planning and design of these projects.

Without going through the rigorous and scientific process of developing the project, we are hesitant to provide a specific, proposed solution. The data collection phase could uncover a previously unknown constraint, the stakeholder coordination and public meeting process could reveal new needs of the community and the hydraulic and engineering analysis could render a proposed project element infeasible.

RiverRestoration performed comprehensive hydrologic survey of the Crystal River to develop 2D hydraulic models for the Crystal River Management Plan.

Having disclosed this hesitation, the project team assembled is tailor made for this project. The project team has a combined +100 years of working with rivers and riparian corridors. This includes years of work and study on the Crystal River, understanding not only the physical, ecological, and hydraulic characteristics of the corridor, but also the relationships associated with the complex irrigation system that relies on Crystal River water. The team is made up entirely of Roaring Fork Valley residents who have floated, fished and explored this reach of the Crystal River many times. We know this river and are excited about the opportunity to develop the project as an amenity for our community and as a benefit for the Crystal River and its ecosystem.

The following pages describe our project “philosophy”, describing potential improvements associated with the river channel and the upland areas that will help meet the project’s goals and objectives. These concepts and ideas will be used as a starting point for a successful project the Stakeholder Group and the public will be proud off.

River improvements

The Crystal River through the project reach is a fairly stable channel, both laterally and vertically. At low flows the reach is characterized by a series of riffle and pools, which becomes more of a continuous run at higher flow rates. There is a large cobble deposit immediately upstream of the Crystal Bridge Drive bridge, likely due to the constriction caused by the bridge abutments and piers. Overall the banks are stable through the project reach, with large cobble toes and vegetation. However, in the downstream third of the project there is some minor bank erosion occurring in areas. As documented in the Crystal River Management Plan, this reach of the Crystal River sees extremely low flows during the late summer and early fall months, primarily due to diversions upstream. During these low flows the channel is over-widened, resulting in shallow flow conditions, particularly through the riffles. The Weaver Diversion, owned by the Town of Carbondale, is located approximately half-way up the project reach on the opposite side of the river from Riverfront Park. The diversion utilizes a partial channel spanning boulder structure to maintain water surface elevations in the river for the diversion. The headgate itself includes a concrete flume to minimize sediment and debris entering the ditch. The project team contacted Mark O’Meara at the Town of Carbondale to discuss the diversion. He stated that this particular diversion requires little maintenance on an annual basis, especially when compared to the Town Ditch, which required maintenance 2-3 times a year. He did mention that the Town is hoping to automate the headgate in the future and the existing structure is inadequate for attaching telemetry and actuating equipment. A State of Colorado fish hatchery is located further upstream, also on the opposite bank from Riverfront Park. The hatchery’s outfall is located within the project reach.

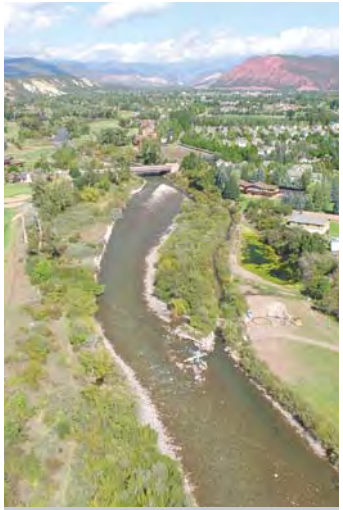
Aerial view of south end of project reach. Image by RiverRestoration

The Crystal River Management Plan identified a number of watershed, reach and channel-level variables that are degraded through the project reach. These include flow regime, water quality (temperature), floodplain connectivity, riparian vegetation, debris supply, and physical structure. Some of the factors, including flow regime and water quality are difficult to address in a site-specific project of this nature. Factors such as floodplain connectivity, riparian vegetation, debris supply and physical structure can be at least partially addressed through improvements associated with this project.

The team proposes a light-handed, science based approach to improvements in the Crystal River through the project reach. Based on the project's goals, four primary in-channel components will be addressed: the Weaver Diversion, banks stability, aquatic organism habitat features, and floodplain connectivity.

Weaver Diversion

The Weaver Diversion will be a primary focus, as identified in Foal 3 of the RFP. Here the team will survey the headgate area during low water and model the diversion extensively using 1D and 2D hydraulic models. These models will allow the team to evaluate existing conditions and develop some alternatives that meet the needs of the Town of Carbondale while improving habitat opportunities, channel stability and reducing maintenance requirements. The team will strive to develop solutions that minimize impacts to the Crystal River, using only natural materials and limiting structure size and extents. Proposed solutions could include a reconfiguration of the current boulder structure that is more precisely designed to maintain diversion water surface elevations and channel stability long term without impacting fish passage through the reach. There can also be an opportunity to include fish habitat elements in the diversion improvements. There is also a potential for the preferred alternative to be maintain the status quo. Through the detailed evaluation and analysis process, the project team will provide the stakeholder group with data and recommendations for making an informed decision on Weaver Diversion requirements.

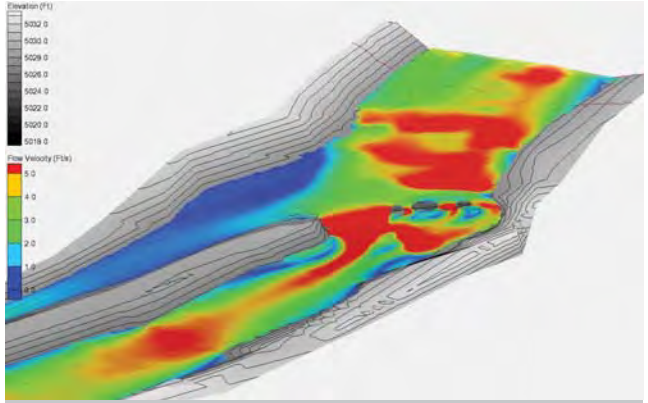


Looking north at the Weaver Diversion head gate

There is not a structural engineer currently on the team. If through alternative selection process, the stakeholder group would like to include a rebuild of the Weaver headgate structure in preparation for future automation infrastructure, the team will bring on Glenwood Structural and Civil to perform the design work of the concrete structure.

Bank Stability

The team will take a similar, light-handed approach to the bank stability improvements. As part of the River Assessment, the team will walk the entire bank of the Crystal River through the project reach documenting existing bank conditions. Proposed bank repair will be focused on areas that are showing significant erosion and on areas where proposed park improvements such as trails, designated river access points, outdoor classrooms and other infrastructure are proposed adjacent to the bank. The bank repairs will be founded upon a boulder toe with footer placed below the calculated scour depth. Above the boulder reinforced toe the bank repair will consist of either a bouldered slope or a laid back slope with riparian vegetation. The team has also used log crib walls with great success elsewhere in Colorado and these will be considered as well. The bank repair options will be dependent based on location. River access points would be incorporated into areas of boulder stabilization where applicable.



2D Model result of the Petz Smith Diversion Structure on the Weber River near Morgan. UT

Aquatic Habitat Improvements

Fish and macroinvertebrate habitat elements will be incorporated throughout the project where appropriate. These elements will typically take the form of sets of large boulders placed in the river, which will increase the diversity of hydraulic conditions, and provide fish holding areas adjacent to food supply. These "fish" boulders tend to create localized scour holes around them, so the boulders at the surface will be placed on additional boulder buried below the scour depth. The boulder placement will be chosen based on how these small structures interact with the existing river dynamics. The detailed hydraulic modeling of the project reach will guide the decision making process as to where these habitat features make the most sense.

The project will also look at the incorporation of small coves graded into the river bank and rock vanes attached to the river bank. Both these options provide additional aquatic habitat but are more impactful to the river and may negatively affect channel hydraulics. The team will evaluate the potential for these features in the 2D hydraulic model.

Additional bank vegetation through the project reach is another element that will improve fish habitat potential in the project reach by providing shade along the riverbanks. The riverside trees will also contribute leaf litter and other debris, contributing to macroinvertebrate health, which will make its way up the food chain. Vegetation and upland improvements are discussed in more detail below.

The team also has extensive experienced with the design and placement of large woody debris. These structures can be used for bank stabilization as well as aquatic habitat. Placement of wood structures should be carefully considered, as they can trap floating debris more easily and become a navigation hazard. The team will work with the stakeholder group to determine if large wood habitat structures are appropriate for the project reach.

Floodplain connections

Interpretive signage of a gravel pit reclamation and floodplain reconnection project at the Ela Wildlife Sanctuary on the Colorado River in Grand Junction.

Finally in regards to in-channel improvements, the team will analyze the potential for lowering pockets of the existing flood plain bench to allow these areas to inundate more frequently. In addition to the seasonal flooding, the lowered land will be closer to the groundwater table. Floodplain connectivity will provide hydrologic and soil conditions for additional wetlands and riparian vegetation in the park. These connected floodplains also provide additional food sources for the aquatic world, with both food for macroinvertebrates and fish. Upland animal and insect species will also benefit from these additional wetter areas. These changes to the floodplain bench will be incorporated in the design process for the Riverfront Park improvements.

Reconnection of the Audubon Ela Sanctuary ponds to high flows in the Colorado River

Wetland boardwalk rendering by DHM Design

Upland Area Improvements

Riverfront Park is a narrow, half mile long strip of area between the Crystal River and the RVR golf course. With the exception of a few educational signs, a primitive trail and a couple of picnic benches, the park is a natural open space area. The majority of the project area is on a historic floodplain bench of the river with a wide diversity of riparian and wetland plant species. The park has two wider sections at the northern and southern ends with a narrow piece of land connection the two.

Existing riparian corridor at the project site

The project team agrees with the stakeholder's stated goal of keeping the park's wild nature intact. Through input from the stakeholder group and the public the team will develop alternatives that minimize impacts to the project area's healthy riparian corridor while meeting the stated goals of the project. Ideas for the main project elements are discussed in detail below.

Riparian and Wetland Vegetation Restoration

Restoration of the riparian and wetland vegetation in Riverfront Park will be very selective. The decision to revegetate an area will be based on a couple of key factors: other improvements being made in the vicinity (trails, bank stabilization, public spaces, etc.), changes in hydrology due to floodplain benching or side channel connections and areas of heavy invasive species infestation, such as the area at the far southern end of the park. Overall, the existing riparian community is fairly health and diverse, so large scale changes are not recommended. The existing cottonwood trees on site tell an interesting story. There are a number of older cottonwoods nearing the end of their lifespan and very young cottonwoods. There are very few middle aged trees because of a history of grazing on the site. The elimination of grazing on the site will help these existing young trees establish. The team will propose planting additional cottonwood in select areas to further enhance the presence of this important member of the riparian community. Supplemental planting with Alders, River Birch, dogwood and a variety of willow species in order to improve the overall diversity of the plant community may also be recommended. The team will also evaluate the existing wetland vegetation. Recommendations may include supplemental planting with a greater diversity of native wetland plant species, particularly in areas adjacent to a potential boardwalk and educational and interpretive areas. Areas impacted as a part of any bank stability or trail access work would also be a focus for vegetation restoration along these same lines.

Side channel connection

A prominent feature of the existing park is a remnant channel of the Crystal River that runs along the west side of the park. It is especially prevalent on the south half of the site, highlighted by a healthy strip of more wetland based vegetation. The team will develop alternatives for reconnecting this side channel during a broader range of flow events, enhancing the potential for wetland creation through the site. The side option will be evaluated from a hydraulic perspective, modeling the system and determine at what flows water could be routed to the enhanced side channel withough further exacerbating low flow conditions in the Crystal during the summer and fall months. There are potential sources of groundwater for the enhanced wetland areas, including irrigation runoff/percolation from the golf course and leakage from the adjacent irrigation ditch. These wetlands could be the focus of education opportunities discussed in more detail below, including boardwalks and overlooks.

Outdoor classroom and river connection on the Roaring Fork River as a part of the Basalt River Restoration by DHM Design

Public Gathering Spaces

Through site visits and a discussion with stakeholders, two locations have been identified for outdoor classroom and public gathering spaces. The first of these is on the north end of the project, near Crystal Bridge Drive. The area along the river bank is degraded here, reducing impacts to healthy riparian area elsewhere. The space would be placed right along the bank with multiple access points down to the river to provide visitors with an opportunity to get to the water. This access could be for educational purpose, such as studying macroinvertebrates, or for recreational opportunities such as angling.

The second public gathering space would be near the existing cottonwood grove at the south end of the park. This space would be more focused on the wetland and upland areas. Amenities may include: a boardwalk and overlook of the enhanced wetland created by the reconnected side channel and an interactive exhibit describing ecological benefits of riparian features such as downed nurse logs and understory vegetation.

As with all other project elements, final locations for public gathering space will be developed through a collaborative process with the project team, stakeholder group and general public.

At the Pilot Project site, residents of Helper CIty, UT learning about the river restoration planned for the Price River

Education/interpretive opportunities

The proximity to schools, residential neighborhoods, and existing trail networks such as the Crystal Valley Trail create an ideal opportunity for educational and interpretive elements that could reach a large and diverse segment of the community. We believe that every site has a unique story to tell and this parcel is no exception. An outdoor classroom area will be a key feature in the site design. The proposed trails will link together places on the site that help create a unique narrative. Topics for interpretation and signage may include, wetland and riparian ecology, river ecosystems, macroinvertebrates, water rights, irrigation and agriculture. Our team has worked together with the Roaring Fork Conservancy on similar local projects and we see them as playing an integral role as we move forward with the educational and interpretive programming. Our team will also work with an interpreter to translate all of the signage into Spanish in order to reach a broad range of users, consistent with the diversity in our community.

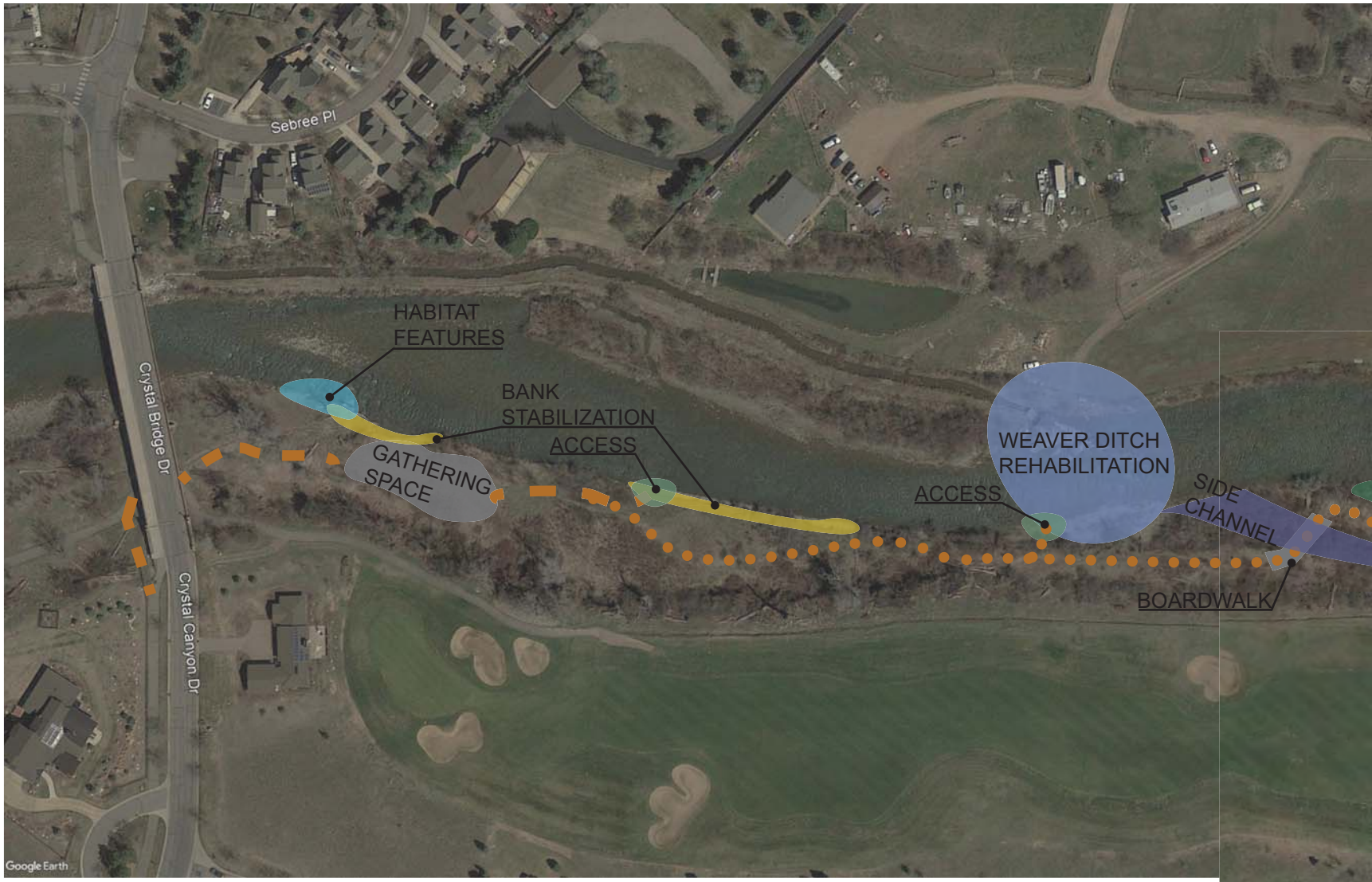
Boardwalk access provides a unique opportunity to school groups

Native sturgeon are released into the Grand River as a part of the Grand Rapids River Revitalization project

Stormwater retuwn wetland and boardwalk from the Ogden River Restoration provides and opportunity for public education on green infrastructure principles

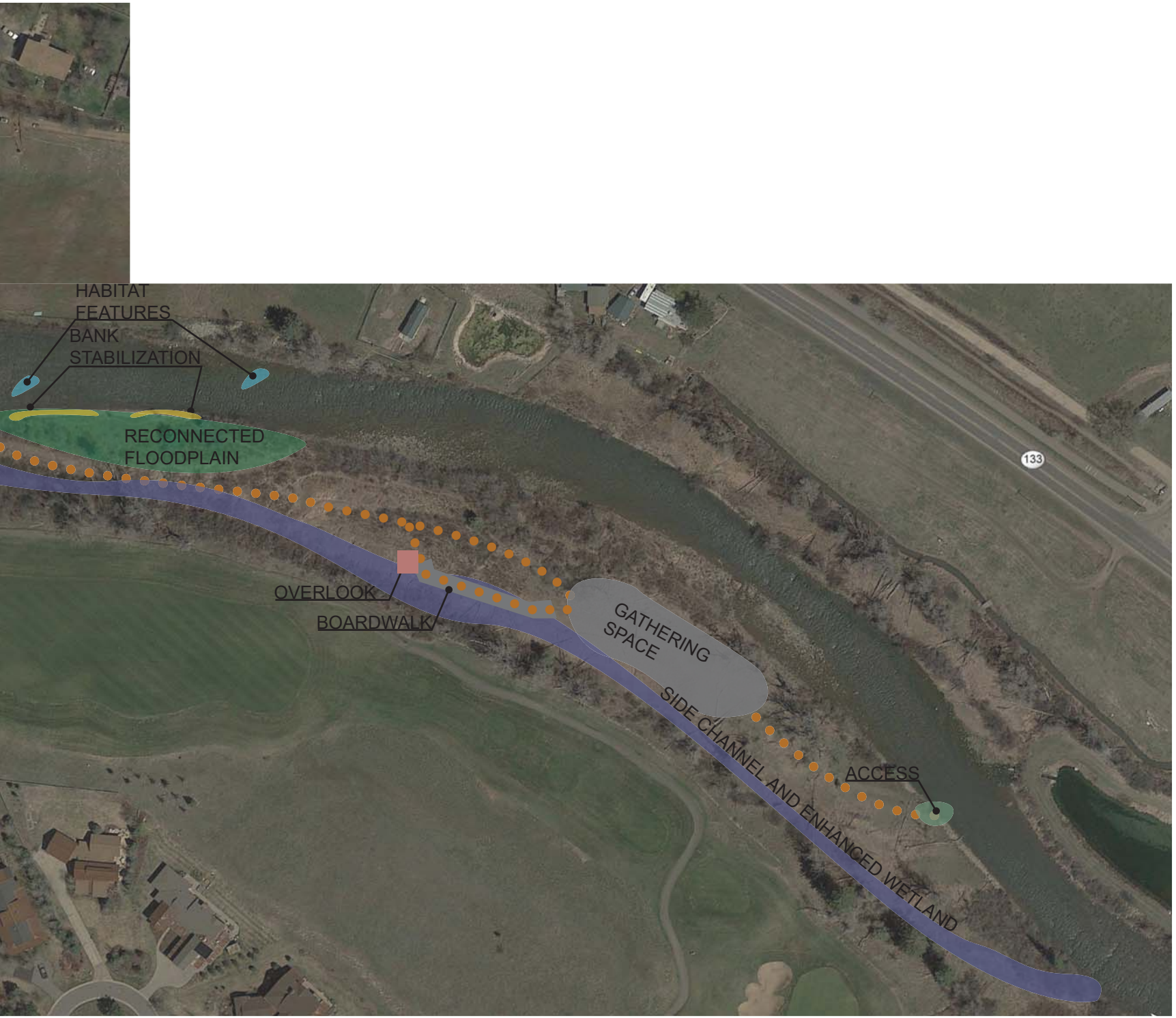
Trail improvements

An improved trail system will provide connectivity for park visitors to the different planned amenities, as well as allow them to experience the wilder sections of the riparian corridor. These trails will follow existing trail corridors were possible to minimize impact to healthy vegetation areas. The trails will take two forms. A primary trail, with a wider, firmer surface will connect to the public gathering space and interpretive, educational areas located at the north edge of the project. This trail will be more accessible for less mobile individuals. Visitors will take a more primitive, narrower trail as they travel south through the park towards the second public gathering space near the cottonwood grove. The trails will pass through several existing and healthy riparian areas. A low boardwalk could be used in a few areas as is pass by wetter areas such a floodplain connection areas and the re-established secondary channel. As will all other project element, alternatives for the trail system configuration will be developed through a collaborative process with the project team, stakeholder group and general public.



PROJECT PHILOSOPHY SCHEMATIC

We will work with the Stakeholder Group to develop a range of conceptual alternatives that incorporate these project elements. See next page for north portion of the site.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STABILIZATION
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03 PROJECT APPROACH

Drawing on experience from over 100 river projects, the team has a tried and true approach to successful implementation. This section will describe the tasks we have identified to complete the planning and design to develop construction documentation.

PROJECT APPROACH

Task 1 - Project Management and Coordination

For the duration of the project, the team is fully prepared to provide quality project management and oversight. This will include hosting kick-off and coordination meetings, tracking and monthly reporting of project status and budgets, communicating regularly with Aspen Valley Land Trust (AVLT) and implementing QA/QC procedures. Regular and consistent interaction with the Stakeholder group will greatly benefit the project. A communication feedback loop will allow for continuous input from the Stakeholder group, helping to eliminate surprises associated with the project's progress, and save time and costs associated with redoing work because a design goal or constraint changed. The project team will quickly respond to emails and phone calls. The team is entirely based in Carbondale and will be available for in-person meetings upon request.

On-site coordination with stakeholders in Grand Rapids, Michigan

Task 2 – Site Inventory and Assessment

This task will be vital to the project, by identifying opportunities and constraints associated with the project. The information collected during this task will be key in developing a feasible, sustainable project that meets the Stakeholder's four main goals.

Stakeholder input and Existing Data Review – Prior to performing a site inventory and assessment, the project team will solicit input from project stakeholders. The long term corporate knowledge provided by the stakeholder group will be invaluable during the data collection phase, helping the team to focus their efforts and highlighting known areas of concern not to be overlooked. The team will also review existing documentation available for the project reach, including prior studies, historical photographs, maintenance records and development plans. This information will provide further insight into the project area and how it has changed over time.

River and Trails Assessment – The project team will visit the site and perform a detailed assessment of the river and trails through the project. The river assessment will include documentation of existing conditions at Weaver Diversion, bank conditions and overall geomorphological characteristics of the project reach. Trail assessment will include locating existing trails, both planned and social trails and documenting their locations and conditions.

Field Inventory and Analysis and Vegetation Mapping – Our goal is to gain a deep understanding of the existing environmental conditions, opportunities and challenges. Our environmental and ecological inventory, site analysis and assessment will be comprehensive, and include all existing natural resource and ecological systems through a thorough field investigation. We will investigate and define key characteristics of the ecology of the site and document them carefully on a specific plan, while communicating the findings of the investigation in a report. In addition to traditional methods of site surveying, the project team also plans to utilize drone technology to survey and record data from an aerial perspective which we have also found to be an effective communication tool. As a part of this task we will complete the following investigations and incorporate the findings into the plan and text narrative description:

A. *Rapid Wetland Community Survey and Assessment*
Our team will investigate the wetland communities (riverine and off-channel) and document their locations. We will rate each of these communities for importance and function throughout the corridor and present findings on a site plan, and describe them as a part of the findings. This effort will assist the design effort by identifying important wetland opportunities and constraints. This process is not a wetland delineation, as defined by the US Army Corps of Engineers, because we feel this effort is not cost effective at the concept development level. A specific jurisdictional determination of wetland boundaries will be completed if a selected project is identified during the design phase that includes a potential wetland impact.

A rapid wetland survey and riparian community assessment was performed in Delta, CO on the Gunnison River. Flag delineated sensitive riparian vegetation and it was recorded via hand held GPS to be input into work site plans.

B. *Riparian Systems and Habitat Assessment*
Our team will investigate the riparian systems found along the Crystal River Project area and document their locations. We will rate each of these riparian systems for importance and function and present findings on a site plan and describe them as part of the findings.

C. *Environmentally Sensitive Lands*
Our team will work with staff and stakeholders, as well as the greater team, to identify environmentally sensitive lands within the project area boundaries. We will describe and document these landscapes on a site plan and describe the specific environmental attributes attributed to the designation.

D. *Wildlife and Plant Species*
Our team will compile a list of species known to occur or likely to occur within the project limits. We compile this list utilizing a suite of resources and field site analysis to provide an accurate picture of the wildlife and plant species associated with the project area. The lists will inform the design effort in terms of identifying specific protections or opportunities/constraints from a wildlife or plant standpoint.

E. *Fisheries Habitat Assessment*
Our team will investigate the River for fisheries habitat, including location and function, and document their locations. We will rate each of these fisheries habitat systems for importance and present findings on a site plan and describe them as part of the findings. We will also identify key fisheries habitat gaps or improvement opportunities and include them as part of the finding.

F. *Restoration Opportunities Survey*
Our team will provide an investigation and analysis of restoration opportunities within the project boundaries. This restoration opportunity survey will incorporate specific locations identified within the riverine or riparian locations throughout the site which should be incorporated and documented within the plans. The restoration opportunities survey will classify the type of restoration identified and prioritize the restoration zones in terms of importance and cost/benefit.

G. *Corridor Recreation, Education and Interpretation* Opportunities Survey/Documentation
Our team will identify, as a part of the process, likely locations for recreational, educational and interpretive amenities in the terms of interface with the natural resources and ecology of the site. This process will help the team to understand where likely locations for trail or amenity improvement would be least likely to affect natural processes or environmentally sensitive locations. This process will also help to identify the unique features of the site that can serve as the basis for and interpretive and educational programming elements. In addition, the team will provide important information about where local, state, and federal permitting would be easiest accomplished within the natural resource protection framework.

Survey - RiverRestoration performs hydrographic and topographic surveys in-house for its projects and we have found that this allows our designers to become familiar with the river and the site. RiverRestoration conducted the hydrographic survey used for the Crystal River Management Plan and is knowledgeable with the Crystal River and the project reach. In-channel, the project team will augment this prior survey effort with detailed mapping of the Weaver Ditch diversion area as well as banks along Riverfront Park that are showing signs of erosion. The team uses a total station and survey grade GPS to collect data and will process the information in AutoCAD Civil 3D.


RiverRestoration collecting hydrographic and topographic data.

For the Riverfront Park area of the project, the team contacted the Garfield County GIS department about the availability of LiDAR through the project reach. Through a partnership with Colorado Geological Survey, the County recently flew and received LiDAR data for the entire County, including the project reach. The data has not yet been processed, but the team is confident that it will be available by Notice to Proceed, either through the general processing of the data or through special request for this project. This LiDAR data will greatly reduce the cost of on-the-ground survey in the park. On-the-ground survey will be utilized to field verify the LiDAR's accuracy and support the vegetation mapping effort discussed above.

Task 3 – Hydrologic and Hydraulic Analysis

The hydraulic and hydrologic analysis phase is where the success of the project will be determined. The most clear and detailed plans and thorough construction support is irrelevant if the project is not initially designed with the river in mind. A surprising amount of in-channel work is completed without this critical component and, as a result, these types of projects typically require the heavy use of unnatural materials such as grout and concrete. The Crystal River is in a developed area with infrastructure adjacent to the channel. Understanding how the river functions and how the proposed work will affect these functions is crucial to the success of the project.

Hydrology - The project team will review and verify existing hydrologic studies and determine the flow regime for which to design the in-channel features. The team will include the Stakeholders Group in the decision making process about Weaver Ditch function and in-channel habitat function at various flow rates.

Hydraulics - Using hydrographic survey data and hydrologic analysis, the team will develop 1-dimensional (1D) (using HEC-RAS) and 2D (using SRH-2D) hydraulic models of existing conditions to establish a baseline for comparison purposes. Water surface elevation measurements taken during the hydrographic survey will be used for boundary conditions and calibration of the hydraulic models. The existing conditions hydraulic models will be used for understanding the river, providing insight into ditch operations, fish passage, angling opportunities and habitat conditions. The existing conditions models will also help the team quantify existing bank erosion and bed scour potential as well as current sediment transport characteristics.

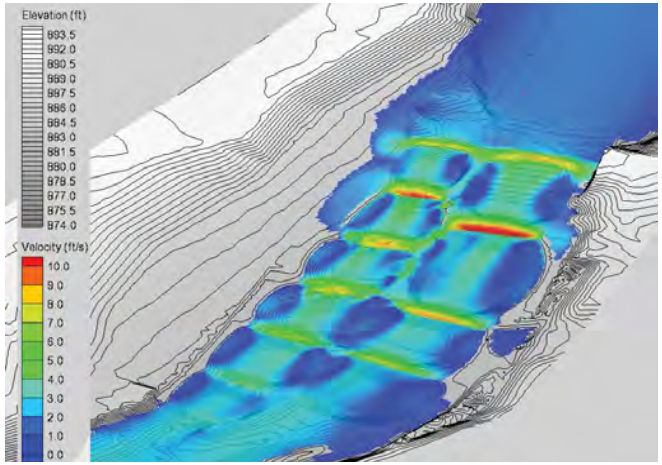


Figure output from 2D modeling of dam mitigation at the North River Valley Park in Ames, Iowa.

Using an iterative approach, the team will develop conceptual alternatives that meet the project goals and constraints from a hydraulic and physical standpoint. 1D and 2D hydraulic models will be used to evaluate the performance of proposed concepts, including impacts to water surface elevations, water depths, velocities and flow patterns. Modeling results such as water surface elevations, water depths and flow velocities will influence design decisions made in regards to flood plain impacts, side channel connections, fish passage/aquatic habitat, angling opportunities, and access points.

Sediment transport and erosion/scour models will also be developed using the hydraulic model output. Shear stress modeling results and sediment data collected will allow the team to evaluate how proposed changes will affect sediment transporting through the reach and develop designs that effectively handle sediment inputs over the long term.

Task 4 – Public Meetings and Stakeholder Involvement

We value the input of the project stakeholders and feel that it is important to provide a variety of opportunities for stakeholders and members of the community to become involved in the design process. The team will conduct a series of one-on-one meetings with interested stakeholders including Aspen Valley Land Trust, The Roaring Fork Conservancy, American Rivers, Town of Carbondale, River Valley Ranch, etc. Our goal is to understand their goals, ideas, concerns and issues and support for the project. The team will also conduct two public workshops that will be scheduled during the concept development and preliminary design process. The goal of the first public workshop would include: informing the public about the project, sharing draft goals to ensure alignment with public needs, sharing of initial concept plans to stimulate conversations, gather ideas and concerns. We recommend an open house format with display boards to allow us to conduct informal one on one conversations with the public over the course of 2 hours +/-. The goal of the second public workshop would include: updating the public about the project (review of process for those who may not have attended the first workshop), sharing draft goals to ensure alignment with public needs, presentation of a draft plan to gather final input or concerns. We want the public to feel that they had a meaningful role in the planning process and that we have listened to their ideas and concerns. We want enough information and possible consensus in order to feel comfortable completing a final Design.

Task 5 – Conceptual Alternatives Development

The alternative concepts will include possible options for the in-channel and riverside amenities, and provide the opportunities, constraints and costs associated with each. The team RiverRestoration has assembled was chosen for the expertise in their respective fields, experience on similar projects and local knowledge. At the conclusion of this phase, the team will provide a detailed and comprehensive study of the project reach that allows the Stakeholder Group to make smart decisions about the project's future direction.

Public meeting lead by DHM Design on the Bohn Park and Lyons Valley River Park in Lyons, CO.

Alternatives development – Using stakeholder input and data collected as a guide, the project team will develop 3 alternatives for improvements to the Crystal River through the project reach and to Riverfront Park. These alternatives will consider:

- Ability to meet the Project's four identified goals.
- Impacts to riparian corridors, wetlands and other sensitive areas.
- Construction Costs.
- Long-term maintenance requirements and costs.

As part of this effort, the team will generate graphics that will clearly communicate the concepts to the Stakeholder group and the general public. The alternatives will be developed in such a way that components can be mixed and matched (e.g. alternative 1's river work with alternative 3's educational and interpretive plan)

Illustrative section of boardwalk through the healthy riparian woodland habitat that surrounds the Rocky Mountain Institute in Basalt, CO to communicate design intent and alternative options.

Construction Cost Estimate – The project team will develop construction cost estimates for each of the conceptual alternatives. The Stakeholder group relies on the project team to provide an estimate of project costs at various stages throughout the design process. The costs are used to make decisions on the scope of the project, fundraising efforts, and budgets. The project team is skillful at developing accurate costs for construction and has a wide range of resources at their disposal, including past projects, contractors, vendors, and manufacturers. The team knows how important these numbers are to the Stakeholder group and will take the time and effort to get them right.

Design Report – The project team will author an Alternatives Report, documenting the design process and providing the stakeholder team with a complete and concise source of information for making project decisions. The design report will summarize the evaluation of each alternative in regards to the project's four primary goals. The amount of information and variables that will be generated as part of this study can be overwhelming without a strong plan to evaluate alternatives objectively. The team will work with the Stakeholder Group to develop a procedure for evaluating and ranking the alternative concepts.

Presentation to stakeholders and the public – The project team will present the conceptual alternatives to the Stakeholder group and the general public, providing a detailed breakdown of the pro's and con's of each alternative and answering any questions that may arise.

Exhibit to supplement a study report for low head dam mitigation at North River Valley Park in Ames. These exhibits have been used in City Council meetings, public meetings, and grant applications

Upon completion of this task, the Stakeholder Group will have the details needed to make an informed choice about which alternative should be selected for construction. This decision making process is especially important for this project, as the various stakeholders have been conflicted in the past as to which direction the project should head. A consensus amongst the group is needed to confidently move the project into the design and permitting stage.

Task 6 – Preliminary Design

Once the preferred alternative is chosen, the team will refine the design and create a preliminary construction plan set and construction cost estimate. The preliminary plan set will be critical for the permitting process as this is the level that communicates the project to the regulatory agencies. The updated cost estimate will allow the Stakeholder group to further focus their budgeting and fundraising efforts.

Preliminary Construction Plan Set –The creation of a quality plan set takes attention to detail and a strong understanding of what is needed to successfully build a project. They inspire confidence with the regulatory and permit agencies, knowing that they are reviewing will be what is constructed. They give contractors confidence that they are bidding on what they will have to construct, reducing bidding price increases associated with risk. The design team has standardized, rigorous drafting and QA/QC procedures that minimizes errors and generates a quality product.

Task 7 – Permitting

There are a number of permit requirements associated with working in a waterway. Most critical are the US Army Corps (USACE) 404 permit, Clean Water Act 401 Certification, and National Flood Insurance Program compliance. The project team has successfully permitted numerous in-channel projects throughout Colorado and the rest of the country. The scope includes coordination with regulatory agencies in the pre-design stage of the project in order to limit the potential for project delays and obtain permits in a timely manner, as well as uncover concerns so that they can be addressed in preliminary and final design. We have found that starting this process as early as possible often has the added benefit of creating project proponents out of regulators.

The project team has a strong relationship and extensive experience working with the USACE Grand Junction regulatory office that holds jurisdiction over this site and all of our other work in Western Colorado. We have experience in coordination with Colorado Parks and Wildlife (CPW) to ensure the passage of fish through any proposed in-stream structure. The project team understands what CPW wants to view the project favorably and knows how to design the project to meet these requirements.

Floodplain impacts are always a factor when designing and constructing in-channel work. The team will strive to design the project so that it will not raise the 100-year flood elevation. By doing so, the project will only need a floodplain development permit from Garfield County and will not require a Letter of Map Revision (LOMR) with FEMA. To do this successfully, a strong background in hydraulic modeling and the understanding of how in-channel structures affect water surface elevations at different flow levels as needed.

Because of the in-channel and riparian nature of the work, the project will require a wetland delineation for the 404 permit application with the USACE. The project team has a qualified wetland ecologist on staff with over 20 years of experience identifying and delineating wetlands. The findings of the field work will be flagged for inclusion in the survey and will be documented in a wetland delineation report for submittal with the permit application. Having the wetland boundaries included in the base map will allow the design team to minimize impacts to existing wetlands. This will help streamline the permitting process and help the Stakeholder group avoid expenses associated with wetland mitigation.

Task 8 – Fundraising

Many of our projects have had successful fund raising campaigns of which we have played a leading role. Fundraising and coalition building on projects is a big part of RiverRestoration's approach. We often work with clients at project inception to help local groups in building a project from the ground up. We have helped clients raise millions of dollars in funding for projects throughout the west. The team can communicate the technical merits and costs of designs for a wide variety of fundraising opportunities. The Project team has the experience, knowledge and relationships to help the Stakeholder Group develop a fundraising strategy for the project and to develop a plan for building local and regional support for the project.

Future funding opportunities that the team can assist with for construction of the project include: GOCO for the Riverfront Park Improvements, Colorado Basin Round Table for the river and diversion work, the Pitkin County Health River and Streams Board, and any others the Stakeholder Group identifies and viable.

School group in Helper, Utah assisting with revegetation effort on the Price River

Interpretive sign at the Avon Whitewater Park in Avon, CO

School group in Basalt, UT assisting with revegetation effort on the Roaring Fork River

Task 9 – Final Design

Once the permitting effort and stakeholder review and coordination are complete, the project team will put the finishing touches on the design and construction documents, preparing the project for bid and construction.– The project team follows the mantra “the devil is in the details”, and this will be reflected in the quality of the construction plans set and supporting documents. The team will update and finalize the construction plan set, update the cost estimate and produce technical specifications for the project work.

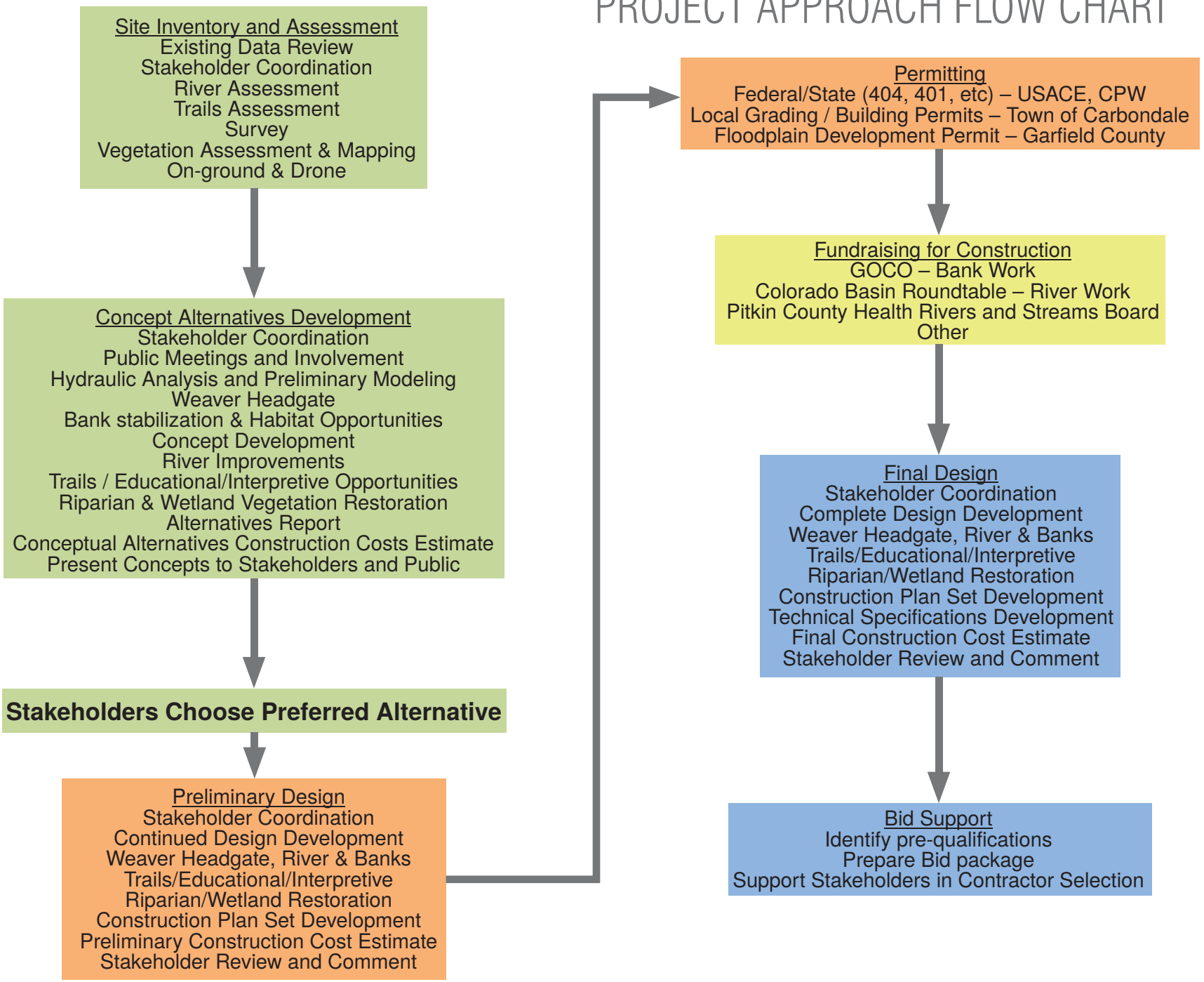
Construction Specifications – Specifications often do not get looked at until something goes wrong. Then this important document becomes a key factor in the decision of liability. A strong set of specifications will protect the Stakeholder group from additional costs associated with errors made during construction. In-channel work is unique work and it is not covered extensively in CDOT or APWA standards that are relied upon for most civil projects. The project team has spent many years developing a thorough set of specifications that would be tailored and utilized for this project.

Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR)- As part of the final design process, the project team will develop a OMRRR report that details maintenance requirements and anticipated costs of the various project elements. This will provide the Stakeholder group with a framework to develop future budget and staffing needs for the constructed project.

Task 10 – Bid Support

The project team’s job is not complete once the plans are stamped and signed. This is particularly true in the dynamic environment of river projects. The project team will help the Stakeholder group through the bid process to select a qualified contractor. The team will review submitted bids and provide the Stakeholder Group a memo explaining our opinion of which contractor to select. The team has been through the bid-construction process many times and knows how to set pre-qualification and screen out the typical “dirt” contractor from those who know how to work in rivers. Selecting the right contractor will reduce headaches and construction costs for the project.

PROJECT APPROACH FLOW CHART



DESIGN FEE BREAKDOWN

Our project approach and fees included in this proposal are an estimate based on our extensive experience on similar projects. We are trying to provide a realistic picture of potential costs in order to help the Stakeholder Group move forward with the process. The team understands the budgetary constraints associated with raising funds to plan and build a project on the scale of the Crystal River Restoration and Weaver Ditch Efficiency Project and made every attempt to reduce planning costs while still providing the services the team feels are needed for a successful project.

The project approach can easily be phased, adjusted, or tailored to the specifics of this project as decisions are made by the stakeholders regarding the overall scope and the preferred level of site programming. To reflect this phasing potential, the project approach flow chart and fee sheet have both been color coded to represent a possible 3 phases of the design process.

The first phase, colored in green, will take the project through the data collection, analysis and conceptual alternatives development phase. At the conclusion of this phase the Stakeholder Group will have selected a preferred alternative, with a strong understanding of the level of effort and construction costs associated with implementing that alternative. The total estimated fees for this first phase are $88,486.

The second phase, colored in orange, will take the preferred alternative through the preliminary design and permitting process. At the conclusion of this phase the Stakeholder Group will have a preliminary plan set for the selected alternative, an updated and detailed construction cost estimate and permits in hand from the US Army Corps of Engineers plus state and local permitting agencies. The total estimated fees for the second phase are $49,774.

The third phase, colored in blue, will take the project through final design, bid documents, and contractor selection. At the conclusion of this phase the Stakeholder Group will have a final set of construction documents, including plans and specifications and a contractor selected for construction. The total estimated fees for the third phase are $61,043.

This third phase total includes a $7,290 fundraising task for raising funds for construction. This task could be a standalone phase or removed from the project scope entirely. It is colored in yellow.

Planning costs for Phases 2 and 3 are best estimates based on our experience on similar projects and the Stakeholder's prior comments that the group is looking for an approach that minimizes impacts to the Crystal River and its riparian corridor. These totals will be partially dependent on the stakeholder-selected preferred alternative and may need to be adjusted once a preferred design is chosen.

Please see the design fee summaries on the following pages for more details about planning costs for each of the three phases.

ESTIMATED CONSTRUCTION COSTS

Estimating construction costs at this point in the project's progression would be little more than an educated guess. It may actually be a detriment, setting unrealistic expectations with the stakeholder group and the general public. The project team's approach will be to begin estimating construction costs at the conceptual design level, providing the stakeholder group with a detailed construction cost estimate for each of the alternatives. The concepts will intentionally be placed at different pricing levels to provide the stakeholders with a wide range of budgeting options as the project moves forward into the permitting and final design stages. In addition the conceptual alternatives will be set up to where the stakeholder group can pick and choose project elements to create the project that best meets the project's goals and the project's budgetary constraints. The construction cost estimate will be updated again at the preliminary and final design level, providing the stakeholder group with the information needed to properly plan and budget construction of the project.

We've provided two example cost estimates from prior projects to demonstrate the level of detail the project will provide to the stakeholder group. The first is Pentz-Smith Diversion repair, a similar sized diversion project on the Weber River near Morgan, Utah. The second is from a phase of the Basalt River Restoration project.

The team anticipates that the proposed project can be complete in 1 construction year. The in-channel portion of the project will need to be completed within the in-water work window for the Crystal River, which is from mid-August through the end of September. If the selected alternative includes a large amount of in-channel work, an extension may be applied for with the US Army Corps of Engineers. The upland area work can be constructed in a similar timeframe. Revegetation may be delayed depending on the construction start date in order to plant new vegetation at the optimal time. Ecological factors such as heron and eagle nesting periods may also affect the construction timing. All constraints that may affect the timing of construction will be identified during the data collection phase and incorporated into the design process.

Construction of the in-channel work will require the use of heavy machinery, such as excavators and dump trucks. The construction materials will consist of large boulder, some weighing several tons. Access to the Weaver Diversion can be made from the east side of the river at the current maintenance access point adjacent to the diversion. Access to the bank stabilization and habitat feature can also likely be made from the east side of the river, though coordination with the USACE and CPW will be required as this will result in equipment crossing the river. West side access points will be more challenging, though doable, especially towards the north end of the project. As part of the design process, the project team will develop construction staging, construction access and temporary river management plans for the proposed design to show the stakeholder group and the permitting agencies how construction will occur.

Construction of the upland areas, including vegetation enhancement, trails, public gathering and interactive elements will also be designed with construction access in mind. Much of the proposed project elements in the southern portion of the park may be installed by hand or with the use of a small vehicles. Access from the golf course may also be negotiated. The larger project elements, including the accessible trail may be able to take advantage of larger equipment that can access the north end of the park through already degraded areas.

As a point of emphasis, construction access and level of impact will be factored into the alternatives evaluation. Concepts that result in large impacts to Riverfront Park's healthy riparian and wetland vegetation will likely not make the cut.

PROJECT IMPLEMENTATION

Project implementation will largely depend on the selected alternative and the available construction budget. The project team is skilled at managing these scenarios, dividing the project into constructible phases as funding allows. And the project lends itself to a phased approach.

As an example, the Weaver Diversion could be improved as a standalone project, receiving money from a CWCB grant. The remainder of the in-channel work, including bank stabilization and habitat features could be built as a separate project, funded through a fish habitat related funding source. The upland work could be divided into separate projects as well. Dependent on the location, removal of invasive species and restoration of native riparian and wetland plants could be performed prior to the installation of the public gathering spaces

and improved trails, allowing the vegetation to become more established prior to seeing greater number of park visitors. This would also prevent the new trails from being damaged by the landscape contractor.

There are a myriad of ways the project could be implemented, and the project team is ready to guide the stakeholder group through this process.

LONG TERM MAINTENANCE

As part of the project development, the team will develop an Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRRR) Plan. Produced as part of the final design process, the OMRRR plan will provide the stakeholder group insight and detail into inspection procedures and maintenance needs. The narrative below describes expected inspection and maintenance requirement based on the project teams experience with similar projects.

In-channel improvements

Weaver Diversion – Of the in-channel project elements, the Weaver Diversion will likely need regular inspection, similar to programs established for the Town of Carbondale's other diversions. This will likely be on an annual or six-month basis. Inspection items would include shifting or scouring of the boulder grade control in the river, bank erosion adjacent to diversion, accumulation of sediment at the headgate or within the ditch, and damage to the concrete structure or the headgate itself. During low water periods the diversion should be inspected to verify adequate water delivery is being made to the ditch. Repairs to the Weaver Diversion would be made with heavy equipment and access would occur from the existing access road to the structure. Minor maintenance items such as sediment removal or repositioning boulders could be made in the river. More complete repairs would potentially require work area isolation.

Bank Stabilization – The team does not anticipate that scheduled maintenance will be required for bank stabilization measures installed in the project. Park staff would be expected to inspect bank stabilization measures on an annual basis, in late June or early July after runoff. In the unlikely scenario that damage or settling of the structure was found during inspection, the structure would be evaluated and repaired on a case by case basis. The repair could likely be made with an excavator in the river. Access could be made from the Weaver Diversion access on the east side of the river.

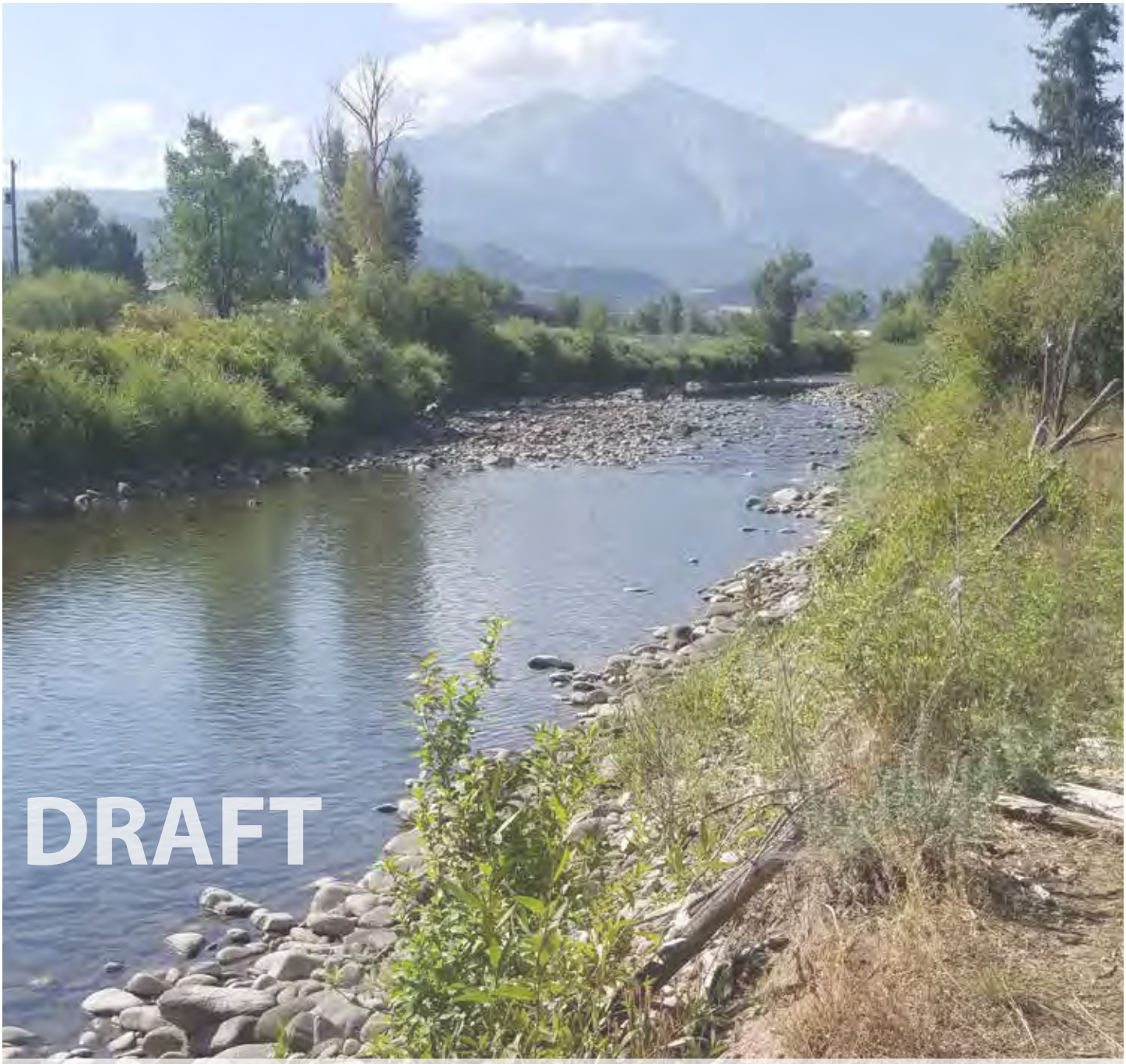
Aquatic Habitat Elements – Similar to the bank stabilization measures, the team does not anticipate that scheduled maintenance will be required for aquatic habitat elements installed in the project reach. Slight movement of features such as the fish rock is acceptable and the feature would continue to function. Habitat features attached to the riverbank would benefit from a cursory inspection every couple of years to check for stability. Damage, while unlikely, would be repaired on a case by case basis. Again, the repair could likely be made with an excavator in the river and access could be made from the Weaver Diversion access on the east side of the river.

Upland Areas

Trails – inspection and maintenance of the trail system will be identical to other trails in the Town of Carbondale's park system. Work will include vegetation trimming and removal of trash and debris left by park visitors. Downed trees across the trails will need to be removed or cut and pushed aside. As the trails will be fairly flat, erosion will be less likely of a concern, but still may cause damage to the trails over time, necessitating repair. The surface of the accessible, primary trail will likely need to be augmented with new material (likely either crushed rock or wood chips) every couple of years. All of this maintenance can be done using hand tools or small, portable power tools. The primary trail may be able to support a UTV or other small vehicle.

Outdoor Classrooms/public spaces and interpretive areas – Similar to the trails discussion above, the outdoor classroom and interpretive areas will likely need vegetation management on a regular basis. Items such as benches and tables will need to be inspected and maintained. Damage could occur from vandalism, a fallen tree, decay over time, or even an extreme flood event. Erosion in high traffic areas should be monitored and treated if bare spots form. Treatment may be moving the attraction that's causing the high traffic or planting additional vegetation.

Vegetation Restoration – The project's existing and new planted riparian and wetland corridor will benefit greatly from regular removal of invasive species. This could be done as part of an annual or semi-annual volunteer day. Hazard branches and trees should be removed if in the vicinity of public gathering spaces or frequently used trails. Depending on the location and type of vegetation, two to three years of temporary establishment irrigation may be required for new vegetation. Irrigating certain part of the site could be challenging, so this requirement will be minimized. The temporary irrigation system could be a design-build system developed in conjunction with landscape contractor. A likely source of irrigation water would be an agreement with the golf course who's irrigation system is immediately east of the project.



DRAFT

CRYSTAL RIVER RESTORATION

RIPARIAN RESTORATION PLAN & ECOLOGICAL INTEGRITY ASSESSMENT
GARFIELD COUNTY, COLORADO

DHM DESIGN
LANDSCAPE ARCHITECTURE
URBAN DESIGN + LAND PLANNING
ECOLOGICAL PLANNING

RIVER RESTORATION.ORG

TOWN OF CARBONDALE ESTABLISHED 1887

DRAFT

Prepared for: The Town of Carbondale
Prepared by: DHM Design Corp. and River Restoration
311 Main Street, Suite 102, Carbondale, Colorado 81623

November 2018

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1.0 Introduction

The Town of Carbondale in partnership with Roaring Fork Conservancy, Aspen Valley Land Trust, American Rivers, Colorado Parks & Wildlife, Public Counsel of the Rockies, and Trout Unlimited are developing a riparian restoration plan for in-stream and riparian improvements to the Carbondale Riverfront Park along the Crystal River. The parcel is owned by the Town of Carbondale and is approximately 14-acres, situated south of Crystal Bridge Drive. This parcel (Project Area) encompasses the 0.5 miles of the Crystal River and includes the west side of the riparian corridor to the boundary of River Valley Ranch and portions of the east bank including the Weaver Ditch (See Figure 1).

The riparian restoration plan proposes in-stream and riparian improvements. This report provides an evaluation of the existing riparian ecological conditions within and around the Project Area and identifies ecological system intervention recommendations and opportunities for amenity improvements within the project area (see figure 1). All of the proposed restoration/enhancement and recreation/educational opportunities are located on the east side of the river. Due to private property ownership and access, it is recommended that the riparian habitat on the west side of the river be preserved as is.

The following report details site survey and data collection, existing environmental and wildlife constraints and makes recommendations for stakeholder consideration. This report also provides recommendations on restoration, recreation, education and interpretation opportunities throughout the Project Area.

Figure 1-1 Overview map of Project Area

Image 1-1 A family plays in the Crystal River, near the Crystal River Bridge.

2.0 Methods

As part of this report a site survey, channel stability assessment, Ecological Integrity Assessment and a professional site analysis were conducted. Existing conditions are defined and recommendations are founded on the findings and data from these studies.

2.1 Site Survey

Hydrographic survey data were collected on April 27 and 30, May 4 and 7 and July 20, 2018. The project team collected the data using a Total Station and a survey grade RTK GPS unit. Information collected included water surface elevations, bank topography, channel bathymetry, and existing infrastructure. Local control points were used to tie the data into the North American Datum 1983 (NAD-83) State Plane Coordinate System, Colorado Central Zone, North American Vertical Datum 1988 (NAVD-88) vertical datum. This current data collection effort was supplemented with channel bathymetry collected via boat and sounders as part of the Crystal River Management Plan project in in 2014 and 2015. All data were compiled and combined with LiDAR data obtained from State of Colorado Geological Survey to create a continuous digital terrain model (DTM) was generated of the project reach, including the channel, floodplain and upland areas.

2.2 Channel Stability Assessment

The project team also evaluated bank and channel stability of the Crystal River through the project reach. This was accomplished through a detailed look at the channel and the banks. This process began with a desktop study of current and past aerial images and concluded with field study of channel and bank conditions. Potential issues such as channel deposition and scour areas and bank erosion or bank failure were documented and surveyed.

2.3 Ecological Integrity Assessment for Colorado Wetlands

To evaluate the ecologic condition of the Project Area an Ecological Integrity Assessment (EIA) for Colorado Wetlands Field Manual, Version 2.1 as developed Colorado Natural Heritage Program, Colorado State University, 2016 was used. This is an assessment method, that measures overall wetland condition with an emphasis on biological integrity. The method combines quantitative vegetation metrics with qualitative metrics that evaluate landscape context, hydrology, soils, water quality, and size into a multi-metric index. Final EIA scores rank a riparian systems condition on a four-tiered scale (excellent/good/ fair/ poor), as compared to unaltered wetlands of the same type. This methodology was chosen because it has the ability to provide baseline data to establish existing conditions and evaluate restoration efforts over time. The EIA method provides land managers with a tool to measure the ecological integrity of riparian habitats and wetlands, and could be used to target sites for restoration or further protection.

2.3.1 Existing Conditions Analysis

A Level 2.5 EIA Assessment was conducted for the site on July 26 and July 27, 2018 by Jeremy Allinson of DHM Design, Corp. In accordance with the Field Manual, Version 2.1 (Lemly et al., 2016). Major ecological factors scored included landscape context, buffer, vegetation condition, hydrological condition, and size, and the ratings are based on deviation from "natural" reference benchmarks. The Project Area was divided into to Assessment Areas (AA-1 and AA-2) and an Ecological Integrity Assessment (EIA) was conducted for each. The scores for each assessment area were added together and the average was used for the overall Project Area.

The results of the EIA for Crystal River Project Area show the site has an Overall Ecological Integrity Score of 2.31, which represents a C+ letter grade, or a fair riparian condition. The major factors leading to the

score include the lack of hydrological input; i.e., low flows reduce groundwater influence and wetland hydrology; the moderately high cover of non-native plants and invasive noxious weeds, and the adjacent land use activities. In addition, the size was determined to be a negative factor as the natural extent of good quality riparian habitat has been relegated to a narrow band along the Crystal River. See Appendix B for the EIA data form and EIA scorecards.

2.3.2 Post-Restoration Assessment

A proposed condition EIA was prepared assuming completion of the recommended restoration activities. Over time, the EIA rating of the Crystal River Restoration Project riparian habitat will likely increase to a 3.12 score, which represents an B letter grade, good condition. The major factors leading to the increase in ecological health include an increase of all vegetation metrics including restoration of the native plant species community, structural diversity, and elimination of noxious invasive weeds. In addition, size and connectivity scores would be increased once the riparian habitat is restored.

2.4 Recreational, Educational and Interpretive Field Analysis

Professional landscape architects and designers conducted a field visit, site inventory and analysis to establish the recreational, educational and interpretive opportunities on the site. Recommendations are based on projects of similar type and scale, a familiarity with the surrounding community and amenities and stakeholder goals and priorities that were communicated during meetings with the project team.

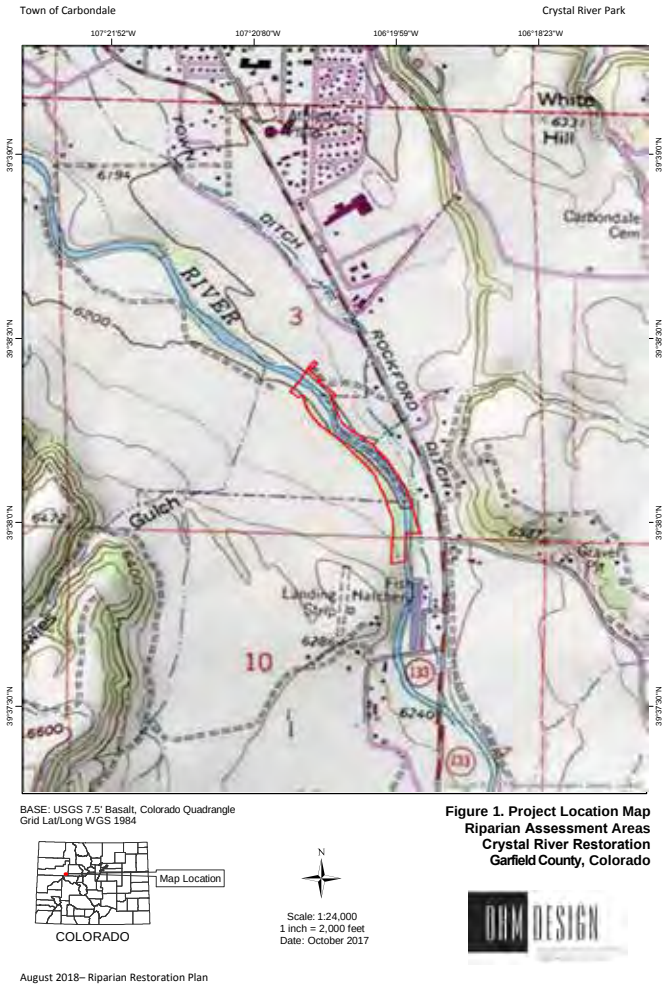

Figure 1-2 Project location map, riparian assessment areas

3.0 Existing Conditions

The existing conditions of the Project Area are diverse. The ecologic health and communities vary by location on site. In general the site ranges from hosting very intact riparian communities to areas of high degradation with opportunities for restoration.

3.1 Landform, Elevation and Size

The Project Area is located on a relatively flat terrace along an unconfined section of the Crystal River at an elevation of 6,288 feet. The Project Area encompasses the east and west side of the Crystal River and is located in parts of Sections 9, 16, and 19 of Township 88 West and Range 8 South in Garfield County, Colorado, see figure 3.1. The assessment areas also encompass both sides of the Crystal River and takes into consideration the hydrological influence of the river. See maps "Existing Conditions - Study Area A" and "Existing Conditions - Study Area B" at the end of this section.

3.2 Land Use

Historically, the Project Area was a working ranch with an agricultural land use component. This is evident by the presence of European pasture grasses and apple trees. Today, as part of the Crystal River Park, the riparian corridor provides habitat for wildlife and is used for recreational activities which likely include fishing in the Crystal River, hiking/walking and wildlife observation. Adjacent land uses include River Valley Ranch Golf Course to the west and private residential land ownership to the east.

3.3 Channel Characteristics

The Crystal River from the Roaring Fork River confluence through the Town of Carbondale was analyzed through aerial imagery from 1993 - 2015 to resolve geomorphic characteristics and trends over time. The selected channel reach has exhibited minimal migration over the duration of the aerial photography record, primarily due to entrenchment within quaternary terraces. Overall the river through Carbondale maintains a moderately steep slope, SO, of approximately 0.008 ft/ft and an overall sinuosity of 1.2. Quantitative observations of the meander characteristics correspond well with empirical observations of unconfined alluvial channels made by Leopold et al. (1960). The river has been observed as relatively stable in planform over time and the values of the radius of curvature to top-width ratio and sinuosity index indicate a high potential for erosion (Biedenharn et al., 1989; Nanson and Hickin, 1986; Brice 1984). Overall, the channel is classified as a stable, sinuous system confined within a paleo channel with strong potential for erosion and bed load transport.

Image 3-1 Alluvium dam, boulder grade control, concrete headgate structure, and the beginning of the Weaver Ditch.

The project area itself has similar characteristics to the overall river reach and is typified by a general bend of the river from a north flowing direction to a

northwest direction. The Crystal River has a sinuosity of 1.06 and a bed slope of S=0.006 ft/ft through the project area. A review of the past 25 years of aerial photos depicts a laterally stable channel that has not exhibited sign of meander. As would be expected from the gradual bend to the northwest, the right (east) bank is fairly steep and high with no floodplain bench. Much of this bank has been reinforced with riprap. The left (west) bank is lower with period connections to the narrow floodplain bench. Areas where vegetation has established have stable banks and areas where vegetation has been removed exhibit erosion. The banks are characterized by 3 to 4 feet of fine material overlaid on a coarse gravels and cobbles. In areas where bank erosion is occurring, the fine material is sloughing into the river, leaving vertical faces of fine material on top of the underlain cobble/gravel.

At low flows the project reach exhibits a riffle-pool geomorphology. There are currently 5 distinct riffles in the project reach. The pools between these riffles are fairly shallow. At higher flows the pools wash out and the project reach exhibits a riffle run geomorphology.

The most prominent in-channel feature is the Weaver Diversion headgate, located approximately 1,000 feet upstream of the Crystal Bridge Drive bridge. The diversion consists of a boulder and cobble grade control structure placed in the river to maintain water surface elevations and a concrete headgate structure with sluice gate and return channel on the east bank. During low flow periods, such as in the summer of 2018, the alluvium dam will be raised and extended upstream by Town of Carbondale staff. Image 3-1 shows the alluvium dam, boulder grade control, concrete headgate structure, and the beginning of the Weaver Ditch.
There is significant cobble deposits in the channel below the diversion point. This material is likely old alluvium push up dams washed down during past runoff events. This deposition area is also likely enhanced by the high flow constriction of the Crystal Bridge Drive bridge, which creates a backwater section upstream of the bridge at high flows. The deposit has created a wide, long riffle with no thalweg formation. During low flow periods this results in a channel wide, very shallow flow depth through this section of the project. Photo 3-2 shows the alluvium deposition area upstream the Crystal Bridge Drive bridge.

3.4 Vegetation

The vegetation within the Project Area is consistent with that typically found within riverine riparian systems and is characterized by cottonwood trees, shrublands and herbaceous zones with sedges and forbs. The vegetative composition and diversity is generally healthy throughout the property. The vegetative diversity and resilience is intimately tied to the hydrological regime within the riparian system. When the river overflows it's banks, it feeds water into the surrounding plants and soils, creates natural levees,

Image 3-2 Alluvium deposition area

Image 3-3 Example of the riparian shrublands within the project area

Image 3-4 Palustrine emergent wetland in the foreground with riparian forest in the background

and deposits sediment which have a direct impact on plant species and composition. The combination of a historical frequent disturbance regime and being situated adjacent to development and agriculture has increased the presence of non-native and noxious vegetation on the property.

A detailed vascular plant species list is included in Appendix A, Table 1, and vegetative species associated with the mapped ecological system types on pages 9 and 10.

3.5 Soils

The restoration areas are characterized by three soil mapping units including the Atencio-Aseltine Complex (unit 13), Dahlquist-Southace Complex (unit 28) and Fluvaquents (unit 42), as described and illustrated in the Soil Survey of Aspen-Gypsum Area, Colorado, Parts of Eagle, Garfield and Pitkin Counties (Soil Conservation Service, 1992). Each unit is briefly described below.

The Atencio-Azeline Complex, which occurs on alluvial fans and terraces, formed in alluvium derived predominantly from sandstone and shale. Typically, the surface layer is a sandy loam about 6 inches thick. The next layer is a sandy loam about 4 inches thick. The subsoil is about 10 inches of a sandyloam over about 4 inches of a gravelly sandy loam. The upper 6 inches of the substratum is a gravelly sandy loam. The lower part to a depth of 60 inches is a very gravelly sandy loam. Permeability is moderate to a depth of 30 inches and rapid below that depth. The available water capacity is low, runoff is slow and the hazard of erosion is slight. This soil is deep and well drained.

The Dahlquist-Southace Complex, which formed in alluvium and colluvium derived from mixed mineralogy, occurs on terraces, alluvial fans and side slopes. Typically, the surface layer is brown cobbly sandy loam and is about 6 inches thick. The upper 7 inches of the subsoil is very cobbly sandy clay loam. The lower 10 inches is very cobbly sandy loam. The

Image 3-5 Upland area of the site bordering the River Valley Ranch Golf Course

Image 3-6 Regulatory sign informing visitors of seasonal wildlife closures and present fishery pressure

Image 3-7 The wide shallow course of the river through the project area seasonally limits fish habitat and angling potential

substratum to a depth of 60 inches is calcareous extremely cobbly sandy lome. The permeability is moderately rapid and the available water capacity is low. Runoff is rapid and the hazard of water erosion is moderate to severe on steeper slopes. This soil is deep and well drained.

Fluvaquents are poorly drained and somewhat poorly drained soils that occur along floodplains of rivers. Typically, the surface layer of the Fluvaquents is grayish brown loamy sand about 5 inches thick. The underlying material extends to a depth of 80 inches or more.

3.6 Hydrology

The entire project area is located immediately adjacent to the Crystal River below the 100-year floodplain (see Figure 1-1). The alluvial aquifer of the river likely extends to the toe of the slope on both sides of the river. Hydro geological influences from the toe on the west side of the river increase groundwater availability and influence on the Palustrine Emergent Wetland areas located on the southwest side of the river. On the east side, the Weaver Ditch and the small agricultural ditch located further to the south, saturate subsoils in some areas of the terrace. The elevation of the Weaver Ditch is higher than the riparian vegetation and seepage occurs to the terrace as evidenced by the large stands of sandbar willows, alders, and other riparian vegetation.

Large flood event flow rates from the current Effective Flood Insurance Study will be used for the floodplain analysis. Listed flow rates for various flood events from the 10-year to the 500-year event are summarized in Table 3.6.1 below. Major flood flows on the Crystal River within the study area result from the rapid melting of mountain snow pack in the basin during the period from late May through early July. Snowmelt floods are characterized by moderate peak flows, large volumes and long durations and are marked by diurnal fluctuation in flow (FEMA, 1986).

Table 3.6.1 – Effective Flood Insurance Study Flows	
Recurrence interval	Flowrate (cfs)
10-year	5,310 cfs
50-year	6,510 cfs
100-year	7,410 cfs
500-year	11,210 cfs

Annual peak runoff flows at the project reach were determined from the USGS gauge at Avalanche Creek (#09081600). The gauge has 63 years of daily average flow records available. The peak flow range from a high of 4,840 cubic feet per second (cfs) in 2010 to a low of 953 cfs in 2012. 2018 was the third lowest peak on record with a flow of 1,200 cfs. The average for the last 5 years is 2,216 cfs, The percentiles of these peak flow rates is summarized in table 3.6.2. These flow rates will differ from the flowrate at the project site due to inputs and diversions downstream of Avalanche Creek.

Table 3.6.2 – Peak Runoff Percentiles at Avalanche Creek Gauge	
Percentile	Flowrate (cfs)
10	1,414
25	1,770
50	2,220
75	2,690
90	3,152

There is also a stream gauge at the fish hatchery, immediately upstream of the project site, which is operated by the Colorado Division of Water Resources. The gauge has been operated seasonally on and off since 2006. A continuous 12-month record began in 2017. Table 3.6.3 compares the peak flow at Avalanche Creek versus the peak flow at the fish hatchery for 2017 and 2018. There is approximately a 15-percent increase between the two gauge for the two years with data currently available.

Table 3.6.3 – Peak Flow Comparison between the Avalanche Creek and Fish Hatchery stream gauges		
Year	Avalanche Ranch Flowrate (cfs)	Fish Hatchery Flowrate (cfs)
2017	2,300 cfs	2,700 cfs
2018	1,200 cfs	1,450 cfs

As discussed in the Crystal River Management Plan, determining historical low flows at the project site is difficult due to the network tributary inputs and surface water diversion located between the Avalanche Gauge and the site. As part of the hydraulic modeling process the project team will look at a wide range of low flow events from 5 cfs through 500 cfs.

The recent addition of the real-time and full-time fish hatchery gauge removes much of this uncertainty moving forward. The low flow for 2017 was approximately 30 cfs. For the low water year of 2018, flow dipped as low as 5 cfs in mid-September.

3.7 Growing Season

The growing season is defined as that part of the year when soil temperatures at 50 cm (20 inches) below the soil surface are higher than biologic zero (5 degrees C, 41 degrees F). As this quantitative determination requires in-ground instrumentation which is not usually available, growing season can be estimated by approximating the number of frost free days. The growing season can be approximated as the period of time between the average date of the last killing frost in the spring to the average date of the first killing frost in the fall. This represents a temperature threshold of 28 degrees F or lower at a frequency of 5 years in 10.

The closest WETS weather station with information on the growing season is the Eagle County AP located near Eagle Colorado at an elevation of 6,497 feet. The mean high temperature of 85.5°F occurs in July and the mean low of 4.7°F occurs in January. The growing season length as defined by 39°F air temperature, is 94 days with a 50% chance of occurring between June 5 and September 12 (USDANRCS, 2017).

3.8 Ecologic Communities Definitions

The Project Area characterized as ecological system type of Rocky Mountain Lower Montain-Foothill Riparian Woodland and Shrubland. The major vegetative zones that occur within the Project assessment areas include Riparian Shrubland and Scrub Shrub Wetland, Riparian Palustrine Emergent, Forested Riparian and Upland.

3.8.1 Riparian Scrubland / Scrub Shrub Wetland

The Riparian Scrubland / Scrub Shrub Wetland zone within the project area is dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. The most dominant vegetative class of within the Project Area at 10.3 acres, this system occurs on both sides of the river and includes the following dominant vegetation types: Silver buffaloberry (*Shepherdia argentia*), Alder (*Alnus incan subsp. tenifolia*), Twinberry/bush honesuckle (*Distegia involucrata (Lonicera*), Redosier dogwood (*Cornus sericea (C. alba*), Red haw (*Crataegus erythropoda*), Sandbar willow (*Salix exigua*), Mountain willow (*Salix monticola*), Green rabbitbrush (*Chrysothamnus viscidiflorus*).

3.8.2 Palustrine Emergent Wetland

This emergent wetland class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens (USFWS, 2018). With vegetation present for most of the growing season, these wetlands are dominated by perennial plants. This wetland type occurs primarily in two areas within the Project Area:

along the toe of the slope at the north side of the Project Area and again towards the south side, where the wetland is large and is of very high quality, with significant vegetative composition, diversity and structure. The total acreage for this type of wetland is 2.7 acres. Dominant vegetative species for this type of system within the project area include: Wooly sedge *(Carex pellita)*, Nebraska sedge (*Carex nebrascensis*), Beaked sedge (*Carex rostrata*), Nodding rush (*Isolepis cernua*), Baltic rush (*Juncus articus subs. Ater(=J.balticu*), Colorado rush *(Juncus confusus)* and Alpine bluegrass *(Poa alpina)*.

3.8.3 Forested Riparian

This vegetative zone includes mature trees over 6 meters (20 feet) tall and is found along the periphery of the west side of the Project Area. The dominant tree species within the project area includes the Narrow-leaf Cottonwood *(Populus angustifolia)*, other tree species occurring within the project area include: Rocky Mountain Juniper *(Juniperus scopulorum)*, Blue Spruce (*Picea pungens*), Siberian elm *(Ulmus pumila)*, Russian Olive (*Elaeagnus angustifolia)*, and cultivated Apple trees *(Malus domestica)*.

3.8.4 Upland

On the hillside of the site, a small strip of upland occurs on the periphery of the forested riparian zone and is limited to 1.2 acres. The upland zone extends to the golf course and consists primarily of European pasture grasses including various species of brome, timothy and ryegrass. Cheatgrass *(Bromus tectorum)* is present in abundance in various locations.

3.9 Wildlife and Threatened and Endangered Species

The Project Area provides habitat for a variety of wildlife species. A complete list of threatened and endangered species and known and likely species to occur, is included in Appendix A, Table 2, Project Area Wildlife Species List. The Project Area provides good quality habitat for various avian species, from waterfowl to raptors and a variety of other bird species in between. The many dead trees and snags throughout provide excellent hunting perches for a variety of raptor species and cavity nesting opportunities. An active osprey (*Pandion haliaetus*) nest is located approximately 900 feet to the south of the Project Area (see figure 3, Wildlife Map). Colorado Parks and Wildlife (CPW)recommend no surface occupancy (beyond that which historically occurred in the area) within 1/4 mile (1,320 feet) of active nests from April 1 through August 31. Some osprey populations have habituated and are tolerant to human activity in the immediate vicinity of their nests, coordination with CPW on seasonal closures is recommended. The Crystal River Park is currently closed from December 15 to March 15, to allow for bald eagle (*Haliaeetus leucocephalus*) winter foraging activities. Bird nesting boxes exist on the parcel. Additional nesting boxes for variety of species could increase nesting opportunities and provide additional birding opportunities for visitors. The Project Ecologist on site also noted a high incidence of great blue heron (*Ardea herodias*) within the Project Area.

Mammal habitat is limited due to the size and surrounding land use. Mapped habitat within the project area includes overall range and winter range for larger ungulates such as Mule deer (*Odocoileus hemionus*), Elk (*Cervus canadensis*), and Black bear (*Ursus americanus*). The project area is located within a black bear human conflict area. Additional potential mammal species likely to occur within the project area are listed in Appendix A, Table 2.

Fish species likely to occur within the Project Area include Rainbow trout (*Oncorhynchus mykiss*), Brown trout (*Salmo trutta*), Brook trout (*Salvelinus fontinalis*), Colorado Cutthroat trout (*Oncorhynchus clarki pleuriticus*), and Mountain whitefish (*Prosopium williamsoni*). Fish habitat is limited throughout the reach, and due to extremely low water conditions during certain times of the year which constrains fishing opportunities. There is a Colorado Parks and Wildlife (CPW) operated fish hatchery located immediately upstream of the project on the east bank.

Per the CPW website, the hatchery raises rainbow trout and Snake River cutthroat trout (*Oncorhynchus clarkii bouvieri*) brood fish. The eggs generated by these brood fish as shipped to other hatcheries for hatching, raising and stocking.

No Threatened or Endangered Species (T&E) were observed within the Project Area. State and federal T&E species likely to occur in the project area include: U.S. Fish and Wildlife (USFWS) threatened and endangered tiger salamander (A*mbystoma tigrinum stebbinsi*), state listed species of concern northern leopard frog (*Lithobates pipiens*) and the peregrine falcon (*Falco peregrinus*), which is also a state listed species of concern. Colorado Parks and Wildlife Species Activity Mapping (SAM) data and USFWS Information for Planning and Consultation (IPAC) data was utilized for desktop review and to create the Existing Wildlife Conditions Map on page 13. Some T&E species listed under the USFWS IPAC report are unlikely to occur within the project area, consultation with a local biologist is recommended prior to any proposed project development.

Image 3-8 Interpretive sign at the project site describing seasonal closures to protect Bald Eagle Habitat and information on bird watching.

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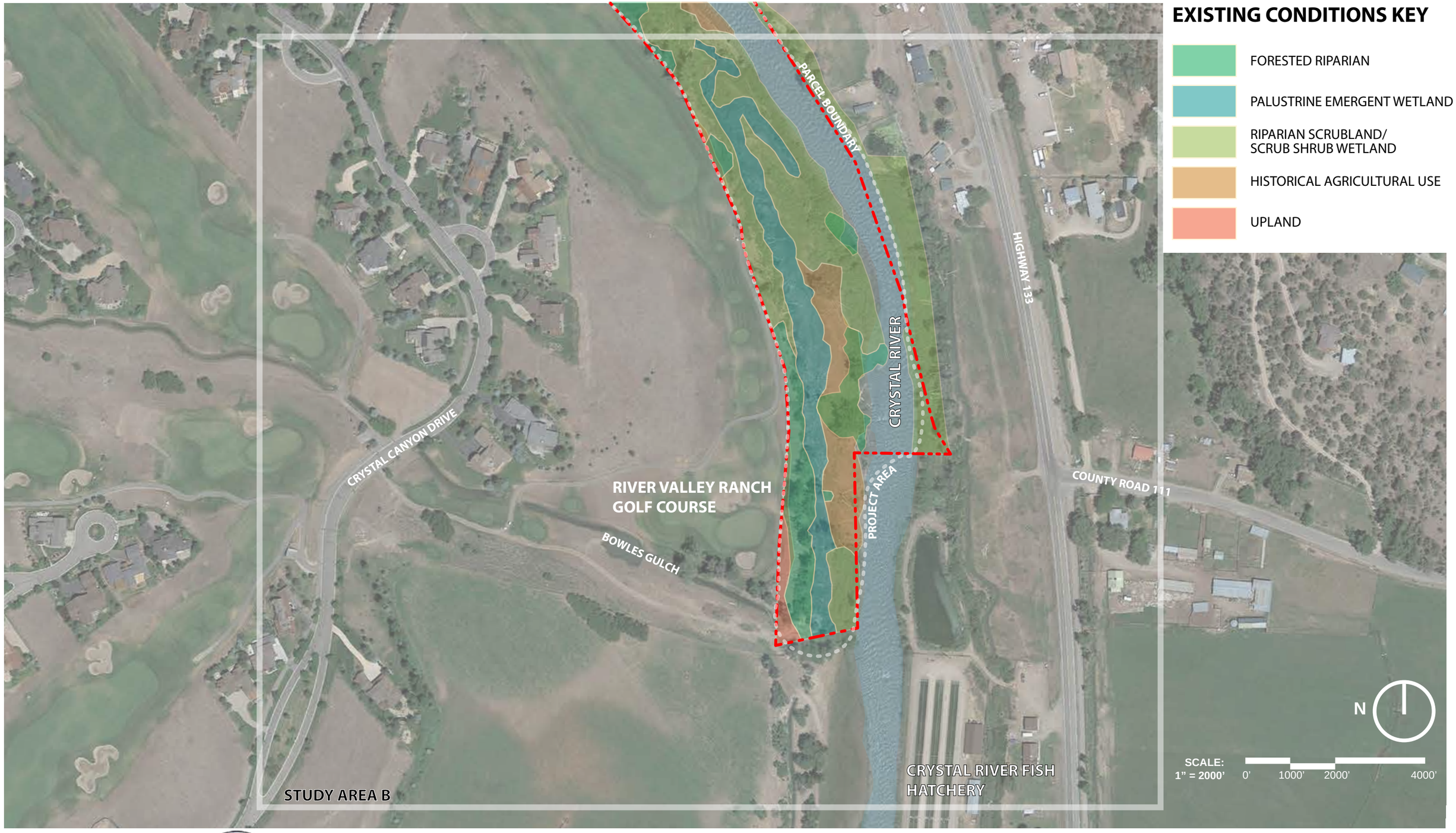
DHM DESIGN

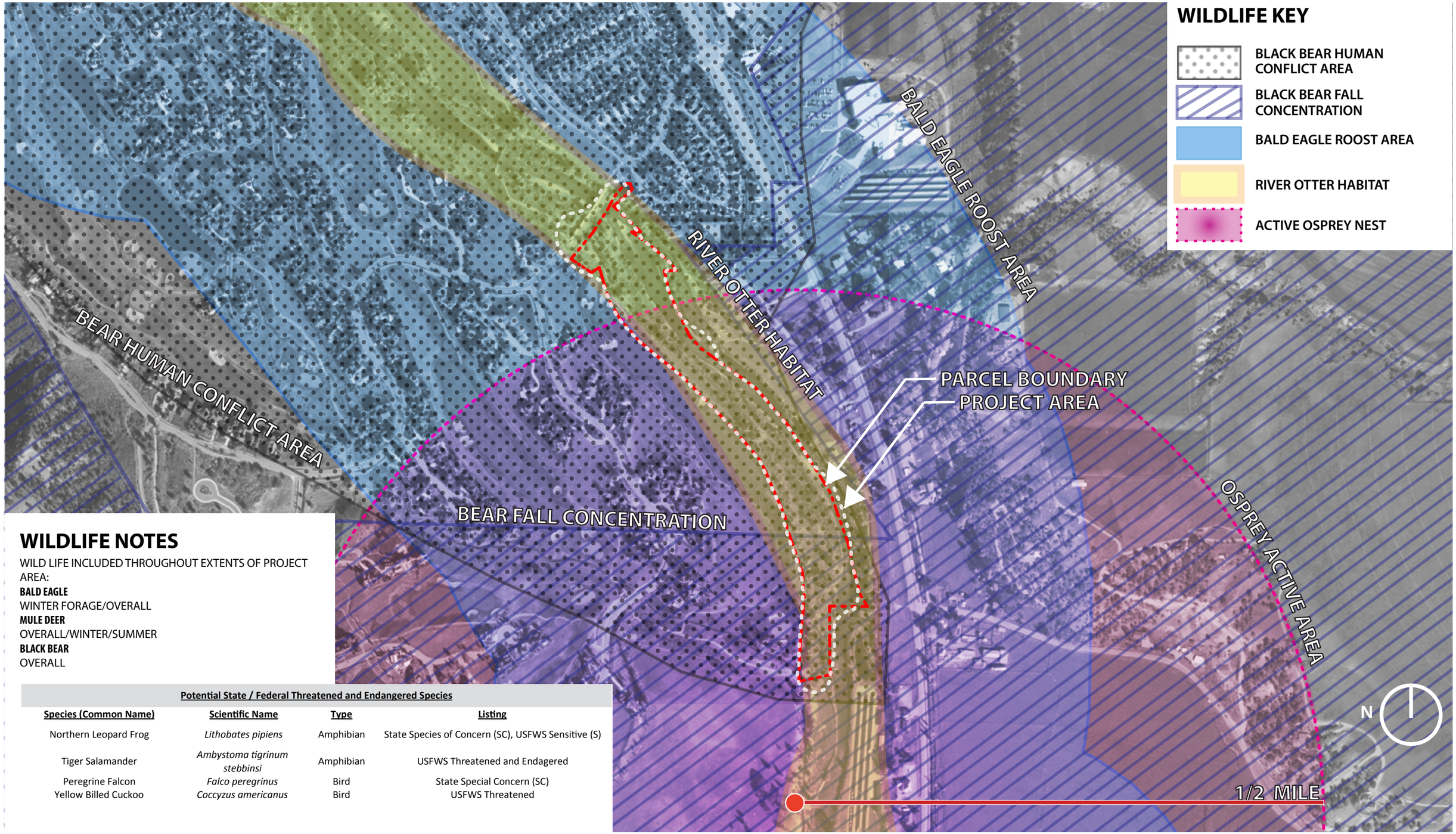
CRYSTAL RIVER RESTORATION | EXISTING CONDITIONS - STUDY AREA A

GARFIELD COUNTY. COLORADO
November 2018



EXISTING CONDITIONS KEY

- FORESTED RIPARIAN
- PALUSTRINE EMERGENT WETLAND
- RIPARIAN SCRUBLAND/ SCRUB SHRUB WETLAND
- HISTORICAL AGRICULTURAL USE
- UPLAND



WILDLIFE KEY

- BLACK BEAR HUMAN CONFLICT AREA
- BLACK BEAR FALL CONCENTRATION
- BALD EAGLE ROOST AREA
- RIVER OTTER HABITAT
- ACTIVE OSPREY NEST

WILDLIFE NOTES

WILD LIFE INCLUDED THROUGHOUT EXTENTS OF PROJECT AREA:

BALD EAGLE
WINTER FORAGE/OVERALL

MULE DEER
OVERALL/WINTER/SUMMER

BLACK BEAR
OVERALL

Potential State / Federal Threatened and Endangered Species

Species (Common Name)	Scientific Name	Type	Listing
Northern Leopard Frog	*Lithobates pipiens*	Amphibian	State Species of Concern (SC), USFWS Sensitive (S)
Tiger Salamander	*Ambystoma tigrinum stebbinsi*	Amphibian	USFWS Threatened and Endagered
Peregrine Falcon	*Falco peregrinus*	Bird	State Special Concern (SC)
Yellow Billed Cuckoo	*Coccyzus americanus*	Bird	USFWS Threatened

DHM DESIGN

TOWN OF CARBONDALE ESTABLISHED 1887

4.0 Restoration Opportunities

There are ample opportunities for riparian habitat preservation, enhancement and restoration across the Project Area. The project ream has developed a restoration concept which addresses the existing conditions with four types of interventions by ecologic community type:

- Preserve
- Enhance
- Create
- Future Restoration Opportunities

These opportunities are conceptual in nature and based on initial field visits and data collection. The project team anticipates further collaboration with stakeholders groups to develop the presented opportunities into two (2) comprehensive concept alternatives.

4.1 Restoration Concept

The Project Area restoration concept focuses on three main ecologic communities, riparian, wetland and in channel. For the purpose of this report and based on stakeholder goals, upland communities are reserved for future restoration opportunities. The surveyed riparian and wetland communities are recommended for preservation, enhancement or creation.

- Preservation - The protection of intact and functioning wetland or riparian through ecologic and landscape planning and site development.
- Enhancement - The restoration of partially functioning healthy wetlands and riparian areas. This can include noxious weed elimination, planting, seeding, and other restoration techniques.
- Creation - Identifying and re-establishing areas that are heavily degraded but have the opportunity due to location and surrounding vegetation for full restoration activities resulting in the creation of a new wetland or riparian area.

The in-channel restoration opportunities are discussed in Section 4.1.3.

Maps of these opportunities can be found at the end of this section. All priorities and decisions about restoration actions should be guided by stakeholder goals and values.

4.1.1 Riparian Restoration Opportunities

As discussed in the existing conditions section, the health and quality of the riparian environment within the Project Area is good. **The project team recommends 10.1 acres for preservation, 0.45 acres for enhancement, and 1.1 acres for creation.**

4.1.1.1 Riparian Preservation
Riparian preservation would include developing a regular monitoring and maintenance plan to preserve the high quality riparian habitat. Monitoring noxious and native vegetation will preserve and sustain current riparian conditions. By limiting access to sensitive areas and minimizing disturbance by directing human traffic through way-finding and the creation of designated, formalized paths impacts can be reduced. The project team recommends preserving approximately 10.4 acres of high quality riparian habitat.

4.1.1.2 Riparian Enhancement
Riparian enhancement will improve existing conditions to increase habitat value. This is done through the development and implementation of a weed management plan to control noxious vegetation, identifying arboricultural maintenance needs/plans and increasing plant diversity through planting and seeding. The resulting enhancement will provide increased habitat value for wildlife and improve overall ecological conditions. The project team recommends that Project Area Stakeholders consider interventions to enhance approximately .45 acres of Riparian habitat.

Image 4-1 This image demonstrates highly degraded ecologic conditions near the river on the left side of the photograph. This is an area recommended for riparian creation. Near the center of the photo, healthy forbes indicate an intact wetland which could be enhanced.

Image 4-2 A high quality wetland can be seen on the right side of the image. This area would be recommended for wetland preservation. On the left side of the image, closer to the Crystal River there is an area recommended for wetland creation

4.1.1.3 Riparian Creation
Riparian creation is the most intensive of the three types of restoration. This involves grading the topography to create elevations with the appropriate available water to support native riparian vegetation plantings. Areas identified within the report are immediately adjacent to the river bank and are located in close proximity to the river water table. Areas identified for bank stabilization as part of river improvements are ideal locations for this recommended intervention as bank stabilization and riparian creation are both interventions with overlapping goals. The project team recommends 1.1 acres of Riparian Creation.

4.1.2 Wetland Restoration Opportunities

As discussed in the existing conditions section, the health and quality of the wetland environment within the Project Area is good to excellent. The project team recommends 1.6 acres for preservation, .076 acres for enhancement, and .17 acres for creation.

4.1.2.1 Wetland Preservation
Wetland preservation includes regular monitoring and maintenance of plant species, the percent cover of the plants, and the hydrological conditions on site. Monitoring can assist with understanding overall wetland health, identify trends, and allow for short term and long term preservation planning. The construction of boardwalks in these areas would dramatically reduce human impacts and provide excellent learning and wildlife viewing opportunities. The project team recommends 1.6 acres for wetland preservation.

4.1.2.2 Wetland Enhancement
Wetland Enhancement including noxious and invasive species control, selective planting and maintenance can enhance what is already considered a high quality wetland within the Project Area. The project team recommends that at the Project Area Stakeholders consider .076 acres within the Project Area for wetland enhancement.

Image 4-3 This location of the assessment area has mature trees and shrubs suitable for riparian preservation. The herbaceous ground cover is mostly noxious weeds making it a candidate for riparian creation

4.1.2.3 Wetland Creation
Appropriate hydrological conditions to support wetland plant species can be created by grading the topography of appropriate sites within the Project Area. The location of the proposed wetland creation sites (See maps "Restoration Opportunities - Study Area A" and "Restoration Opportunities - Study Area B" at the end of this section) allows for ease of colonization of adjacent wetland plant species. Minimal grading would be required to achieve successful wetland creation in this area. The project team recommends that at the Project Area Stakeholders consider approximately 7,225 square feet for wetland creation.

Image 4-4 An example of healthy PER wetlands and riparian shrublands. Both areas are recommended for preservation

4.1.3 Bank and Channel Restoration Opportunities

Several locations along the west bank of the river have been identified as opportunities for restoration. This restoration work can take several forms depending on the location and other project goals such as river access, angling locations and educational

Image 4-5 The shrubs in this image are in good health and these woody vegetated zones are recommended for preservation. The wide swaths of brome in the foreground of the photograph are an opportunity for riparian enhancement.

opportunities. In higher traffic and access areas, the bank restoration will be comprised of boulders. Lower traffic area restoration activities will utilize vegetation and large wood, with boulders only used for toe reinforcement. Examples of this type of restoration are shown in Images 4-6 and 4-7. Proposed locations are shown on the maps at the end of this section.

The Weaver Ditch diversion structure will be the primary focus of the in-channel improvements. Proposed modifications will create a stable boulder structure in the river that allows for proper function at a wide range of flows with reduced maintenance requirements. The headgate structure itself will also be modified to allow for reduced maintenance needs and the ability to add an automated system in the future.

The team will also look at the section of the channel downstream of the diversion which is experiencing higher sediment accumulation. Options here include the creation of a thalweg and potentially a localized, slight narrowing of the channel to increase sediment transport capacity. Sections of river upstream of the Weaver Diversion will likely be unmodified with the exception of bank work. This area of the river is highlighted on the Existing Conditions maps in section 3.

Image 4-6 An example of a bank repaired with boulders and steps

Image 4-7 An example of a bank repaired with vegetation

4.2 Ecological Performance Standards (Success Criteria)

Ecological performance standards and success criteria for riparian enhancement and creation opportunities should be established and agreed upon by all stakeholders, designers, and agencies to provide a clear road map for success. Vegetative success criteria can include the identification of thresholds for percent cover, vegetative composition, and native vs. non native species. New plantings and seeded areas should be monitored on a regular basis to ensure success. Areas where hydrological conditions are necessary for growth should be monitored regularly. For creation and enhancement areas, adjustments to site conditions may be necessary to allow for optimal success.

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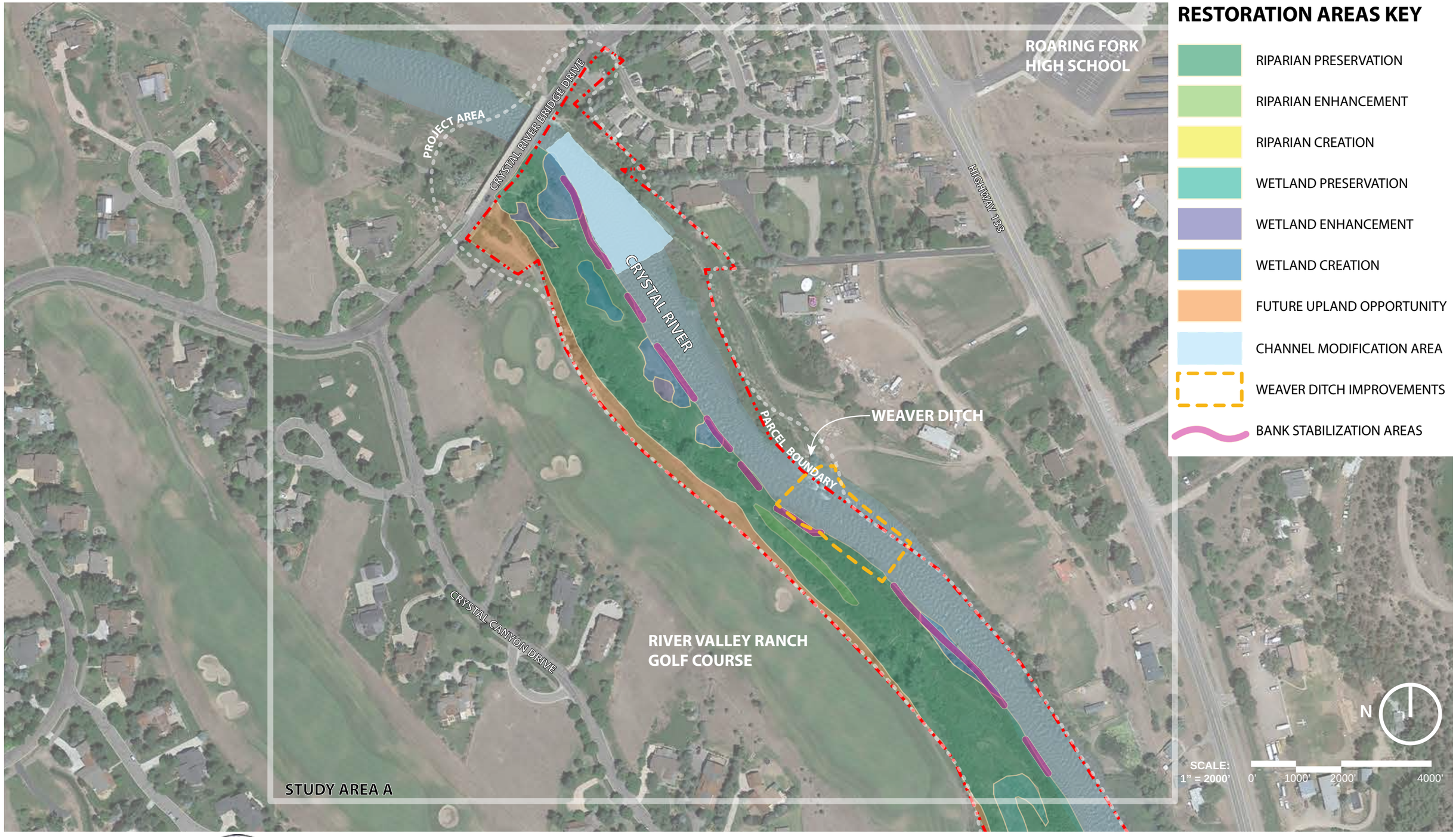


DHM DESIGN

CRYSTAL RIVER RESTORATION | RESTORATION OPPORTUNITIES - STUDY AREA A

GARFIELD COUNTY. COLORADO
November 2018


RESTORATION AREAS KEY
RIPARIAN PRESERVATION
RIPARIAN ENHANCEMENT
RIPARIAN CREATION
WETLAND PRESERVATION
WETLAND ENHANCEMENT
WETLAND CREATION
FUTURE UPLAND OPPORTUNITY
PARCEL BOUNDARY
HIGHWAY 133
CRYSTAL RIVER
RIVER VALLEY RANCH
GOLF COURSE
CRYSTAL CANYON DRIVE
COUNTY ROAD 111
PROJECT AREA
BOWLES GULCH
CRYSTAL RIVER FISH
HATCHERY
STUDY AREA B
N
SCALE:
1" = 2000'
0'
1000'
2000'
4000'

5.0 Recreation, Education and Interpretation Opportunities

5.1 Existing Conditions

The current on-site opportunities for people to engage with the ecology and nature of the Project Area are limited while human use of the Project Area is evident. Existing amenities such as the trail, river access, interpretive and regulatory information and gathering places have become degraded and weathered overtime. These spaces are generally in disrepair and are no longer as effective as they once were.

The main trail along the site is heavily overgrown and can be difficult to locate and navigate. Areas of the trail have eroded into the river and navigation through the overgrowth is difficult in sections. This trail overgrowth and degradation has resulted in informal "social trails" winding through the site and degraded river banks from informal access points contributing to erosion and bank destabilization.

The Project Area contains a number of interpretive signs, however these signs have become worn over time and are dated. Many signs are no longer visible due to vegetation overgrowth and do not describe the ecologies of the locations where they stand. Instructional and regulatory signs are not concentrated or clearly placed near the main access point near the bridge.

The current inventory of sign topics include:

- Bald eagle closure area notice
- No dogs or glass containers regulation
- Riverfront Park entrance sign
- 8 Interpretive Signs
    - "River Valley Ranch Wetlands"
    - "Riparian Woodland"
    - "Fisheries"
    - "Wetland Plants - What herb is this?"
    - "Aquatic Plants"

Image 5-1 View of the proposed southern gathering area with views of Mount Sopris

Image 5-2 Example of an outdoor classroom with seating and naturalized elements

Image 5-3 Navigating the overgrown trail

Image 5-4 Example of current interpretive signage

Image 5-5 Picnic benches on South end of Project Area

Image 5-6 Informal river access with visable erosion

- "Wetland Plants"
- "Willows"
- "Birds of the Wetlands"

There are no formal gathering places with the exception of two picnic tables near the south end of the site (see Image 5-5). The area is both hard to locate and in disrepair due to age and lack of maintenance. Several informal gathering spaces exist and are evident in areas where the vegetation has been disturbed.

Additional challenges existing on site are the small parking area, lack of alternative transportation options such as a bike rack, lack of designated pedestrian crossing area and a visual disconnect resulting in difficulty locating the site. The access point beneath the bridge is difficult to find, is steep and the stairs are in disrepair. The site is currently not universally accessible.

Opportunities for new recreational, educational and interpretive amenities have been identified. There are many unique features of the site that have the potential to serve as the basis for recreational, interpretive and educational programming elements for diverse audiences. There are a wealth of opportunities to program the site building on interactive, recreational, and interpretive experiences, while simultaneously improving, restoring and protecting the health and ecology of the Crystal River and its riparian corridor.

This tandem approach of creating recreational amenities that also provide ecological benefits is the recommended method to bring cultural and ecological value to the site simultaneously. The following sections identify opportunities for; public gathering spaces, educational and interpretive sites, trail and way-finding improvements, access and recreation. No significant local, state or federal permitting challenges are anticipated for the recreation, education and interpretive opportunities.

These opportunities are conceptual in nature and

Image 5-7 An apple tree in the Project Area hints at the past land uses and history of the area

Image 5-8 Example of an interactive interpretive site element, this map is both tactile and informative

based on initial field visits and data collection. The project team anticipates further collaboration with stakeholders groups to develop the presented opportunities into two (2) comprehensive concept alternatives.

5.2 Public Gathering Spaces

Through site visits and a discussion with stakeholders, two locations have been identified for outdoor classroom and public gathering spaces (see maps at the end of this section). One at the north end of the park near Crystal Bridge Drive and one at the south end of the park. As with all other project elements, final locations for public gathering space will be developed through a collaborative process with the project team, stakeholder group and general public.

- North end near Crystal Bridge Drive: The area along the river bank is degraded, reducing impacts to healthy riparian areas elsewhere. Optimally, gathering space would be placed along the bank with multiple access points down to the river to provide visitors with an opportunity to access the river and bank. This access could serve as an educational opportunity and/or for recreational opportunities such as angling. This gathering space could also serve as an area to inform the public about regulations or special information about the park. This is the most ideal site for a universally accessible gathering space.

- South End: The second public gathering space would be near the existing cottonwood grove at the south end of the park. This space could be more focused on the wetland and upland areas or the park. Amenities may include: a boardwalk and overlook of the enhanced wetland created by the reconnected side channel and an interactive exhibit describing ecological benefits of riparian features such as downed nurse logs and understory vegetation. This location also has the potential to serve as an outdoor classroom with seating, shade and interactive interpretive elements.

Constraints of these two sites include the limited amount of parking available near the bridge and access to the area for people of different abilities and mobility types. Stakeholders should consider what the target audience is for these gathering places and what additional amenities will need to be on site to facilitate those user types.

5.3 Educational and Interpretive Opportunities

Many interpretive elements have already been introduced to the site. The proximity to schools, residential neighborhoods, and existing trail networks such as the Crystal Valley Trail create an ideal opportunity for educational and interpretive elements that could reach a large and diverse segment of the community. The project team recommends expanding and updating the current interpretive materials and making them more accessible and interactive. These interventions could include bilingual signage, the inclusion of tactile elements, view platforms and three dimensional exhibits.

Every site has a unique story to tell and this parcel is no exception. Identifying additional interpretive opportunities and communicating a larger, more engaging story is a goal moving forward. Interpretive elements to consider are as follows:

- Updating and expanding current interpretive topics
- Hydrology and river morphology
- Expanded information about variety of birds and their habitats
- Human history including indigenous populations, European settlers, ranchers and farmers
- Water infrastructure in our communities as it pertains to the Weaver Diversion
- Understanding place through landmarks such as Red Hill and Mount Sopris
- The water cycle and our local watersheds
- Insects and macro invertebrates in wetlands and riparian areas
- Angling
- Water rights and irrigation

The proposed new amenities would link together

Image 5-9 Navigating the trail can be tricky, the surface material changes through out the site

Image 5-10 Example of a boardwalk through an ecologically sensitive area

Image 5-11 Bird houses have been installed in the Project Area. Enhancing wildlife habitat would encourage passive recreation such as birding

Image 5-12 Example of a durable surface used for river access, helping to prevent erosion, fisheries health and bank destabilization

places on the site that help create a unique narrative. The project team recommends ongoing collaboration to create the educational and interpretive programming. In conjunction with the interpretive elements, an outdoor classroom area is a is a key recommendation of this report.

5.4 Recreational Opportunities

Currently the Project Area supports many passive recreation activities such as angling, walking, hiking, bird watching, picnicking, and nature play. All of these activities could be enhanced by improving, updating and programing the Project Area. A dual benefit of the proposed enhancements is that they would help to protect the restored ecology by directing people into areas specifically designed for recreation and intentionally directing people away from ecologically sensitive areas.

Angling opportunities would be greatly improved by the recommended river bank restorations and in-stream restorations proposed in Section 4.0. Fishing and fishing access could also be greatly improved and made more standardized by formalizing river access points to places along the bank which are safe, stable and offer opportunities to interact with the river.

Walking and hiking through the site could be improved in a host of ways. Trail improvements and access are discussed in the following section. Hiking and walking offer low impact exercise to many people. The gentle grade of the Project Area makes this site ideal for people of many ability levels and provides access to a wide range of people.

The existing bird watching opportunities on the site have the potential to be expanded. Wetland and riparian areas host some of the greatest bird life of any ecosystem type. The ecological restorations recommend in section 4.0 would improve the habitat of bird populations and provide birding enthusiasts with an incredible in-town amenity. Focusing on this recreation type also gives the project team an opportunity to collaborate and work with other specialty groups such as the local Audubon Society chapter. Furthermore, focusing on bird watching as a major element of recreation on the site will encourage users to protect the ecosystem and respect the Project Area.

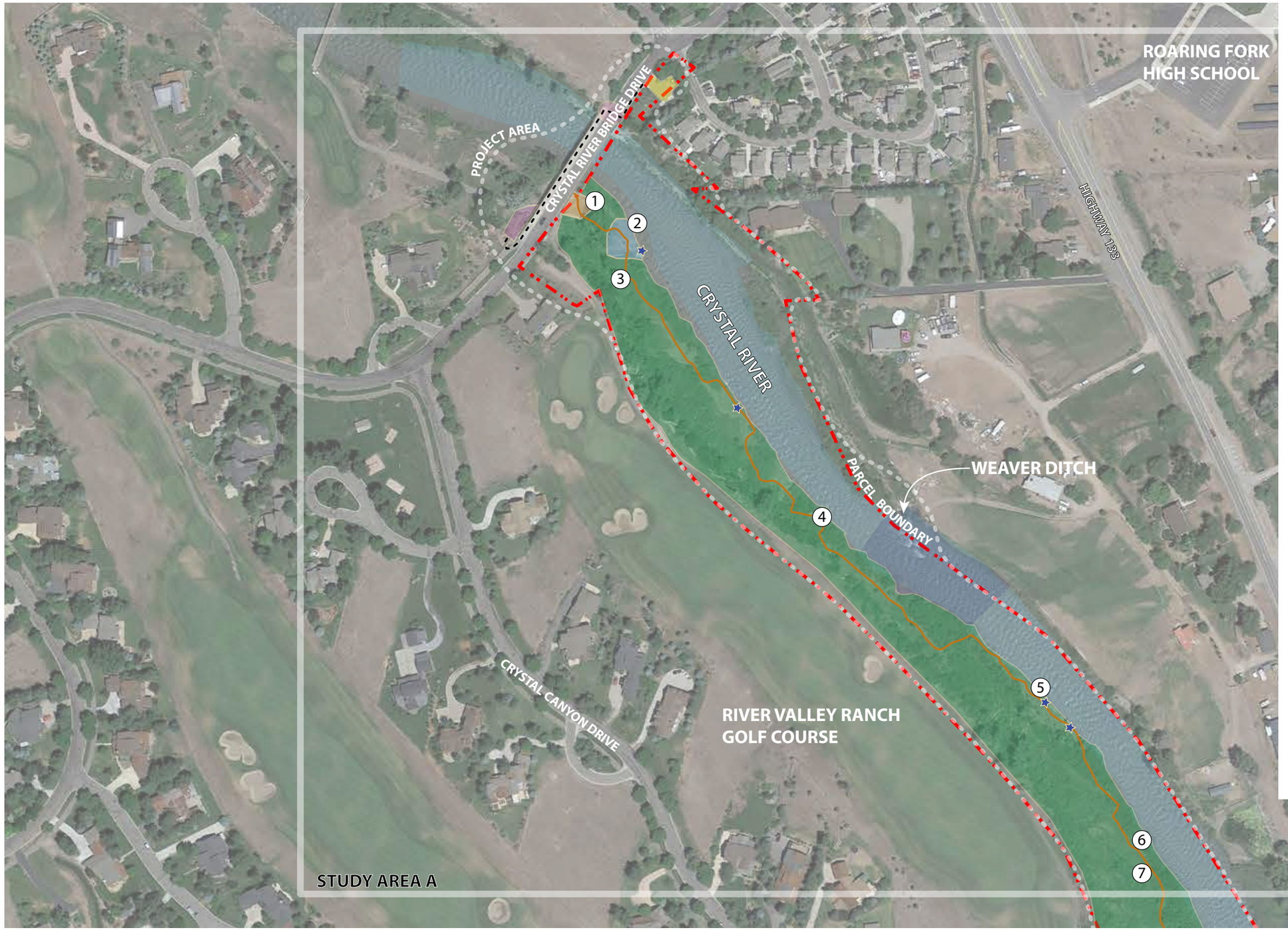
Finally picnicking, nature play and exploration are recreation objectives that can be easily met by formalizing public gathering areas. A focus on these types of recreation gives families, school groups and people of all ages a passive and enjoyable way to experience the natural environment. These elements can easily and imaginatively be incorporated through seating, shade and interactive interpretive elements.

5.5 Trail Improvements and Access

The project team advocates for an improved trail system that provides access and connectivity for park visitors. An ideal trail system would lead visitors to the different planned amenities, as well as allow them to experience the riparian corridor. The recommendation is for the trail to follow existing trail corridors, where possible, to minimize impact to healthy vegetation areas. The incorporation of a small loop trail could be a valuable asset allowing visitors to engage with unique places within the Project Area. Importantly, the existing trail needs to be cleared of obtrusive vegetation, undergo over-due maintenance, be reinforced in areas where it is eroding and have way finding practices such as clear lines of sight and signage.

There are three types of trails which would be most appropriate for the site. The primary trail type would be composed of a wide, firm surface and would connect to the universally accessible public gathering spaces and interpretive, educational areas. This trail would be accessible for less mobile individuals. The second type of trail would be more primitive and narrow. This trail could pass through several existing and healthy riparian areas. Finally, low boardwalks could be used in a few areas such as floodplains, connection areas and the re-established secondary channel.

As with all other project elements, alternatives for the trail system configuration will be developed through a collaborative process with the project team, stakeholder group and general public.

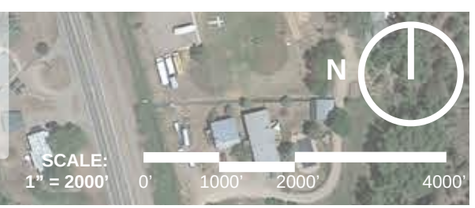


RECREATION AREAS KEY

- EXISTING PARKING AREA
- PROPOSED IMPROVED PEDESTRAIN CROSSING AND BIKE RACK
- PROPOSED IMPROVED ACCESS AND RAMP
- PROPOSED PUBLIC GATHERING AREA
- ECOLOGIC PRESERVATION ZONE
- PROPOSED WEAVER DITCH REHABILITATION
- PROJECT AREA ACCESS ROUTE
- PROPOSED TRAIL FOLLOWING EXISTING ALIGNMENT
- PROPOSED FORMALIZED RIVER ACCESS POINT

INTERPRETIVE OPPORTUNITIES

1. WELCOME INFORMATION, MONUMENT SIGN, AND SITE REGULATIONS
2. ANGING AND FISHERIES
3. RIPARIAN WOODLAND COMMUNITIES
4. WATER INFRASTRUCTURE AND WATER RIGHTS
5. RIPARIAN PLANTS, IDENTIFICATION
6. HUMAN HISTORY
7. SCRUB AND SHRUB HABITATS



DHM DESIGN

CRYSTAL RIVER RESTORATION | RECREATION OPPORTUNITIES - STUDY AREA A

GARFIELD COUNTY. COLORADO
November 2018

RECREATION AREAS KEY

- PROPOSED PUBLIC GATHERING AREA
- ECOLOGIC PRESERVATION ZONE
- PROPOSED BOARDWALK LOOP
- PROPOSED TRAIL FOLLOWING EXISTING ALIGNMENT
- PROPOSED BOARD WALK TRAIL
- PROPOSED FORMALIZED RIVER ACCESS POINT

INTERPRETIVE OPPORTUNITIES

- (8) BIRDS
- (9) ORIENTEERING
- (10) HYDROLOGY AND RIVER MORPHOLOGY
- (11) WATER CYCLE AND LOCAL WATERSHEDS
- (12) INSECTS AND INVERTEBRATES
- (13) WILDLIFE
- (14) WETLAND PLANT IDENTIFICATION

Appendix A: Species Lists

TABLE 1
Vascular Plant Species List
Crystal River Restoration

Scientific Name	Common Name	Family	Origin*
Trees			
Juniperus scopulorum	Rocky Mountain Juniper	Cupressaceae	N
Malus domestica	Apple tree (cultivated)	Rosaceae	I
Picea pungens	Blue spruce	Pinaceae	N
Populus angustifolia	Narrowleaf cottonwood	Salicaceae	N
Ulmus pumila	Siberian elm	Ulmaceae	I
Elaeagnus angustifolia	Russian Olive	Salicaceae	I
Shrubs/Subshrubs			
Alnus incana subsp. Tenuifolia	Alder	Betulaceae	N
Shepherdia argentia	Silver buffaloberry	Sherpherdia	N
Amelanchier alnifolia	Serviceberry	Rosaceae	N
Chrysothamnus nauseosus	Rubber rabbitbrush	Asteraceae	N
Chrysothamnus viscidiflorus	Green rabbitbrush	Asteraceae	N
Cornus sericea (C. alba)	Redosier dogwood	Cornaceae	N
Crataegus erythropoda	Red haw	Rosaceae	N
Distegia involucrata (Lonicera)	Twinberry, Bush honeysuckle	Caprifoliaceae	N
Prunus virginiana var. melanocarpa	Native chokecherry	Rosaceae	N
Quercus gambelii	Gambel oak	Fagaceae	N
Ribes inerme	Whitestem gooseberry	Grossulariaceae	N
Prunus americana	American plum	Rosaceae	N
Rosa woodsii	Wood rose	Rosaceae	N
Salix exigua	Sandbar willow	Salicaceae	N
Salix fragilis	Crack willow	Salicaceae	I
Salix amygaloides	Peach willow	Salicaceae	N
Salix monticola	Mountain willow	Salicaceae	N
Betula occidentalis	Water Birch	Betulaceae	N
Perennial Graminoids			

Bromus inermis	Smooth brome	Poaceae	I
Dactylis glomerata	Orchardgrass	Poaceae	I
Elytrigia repens	Quackgrass	Poaceae	I+
Festuca pretensis	Meadow fescue	Poaceae	I
Carex nebrascensis	Nebraska sedge	Carex	N
Carex rostrata	Beaked sedge	Carex	N
Carex pellita	Wooly sedge	Carex	N
Isolepis cernua	Nodding rush	Cyperaceae	N
Juncus articus subs. Ater(=*J. balticu*)	Baltic rush	Juncaceae	N
Juncus confusus	Colorado rush	Juncaceae	N
Pascopyrum smithii (Agropyron)	Western wheatgrass	Poaceae	N
Phalaris arundinacea	Reed Canarygrass	Poaceae	I/[N]
Poa pratensis	Kentucky bluegrass	Poaceae	I
Poa alpina	Alpine bluegrass	Poaceae	N
Perrenial Forbs			
Apocynum cannabinum	Indian dogbane	Apocynaceae	N
Asclepias speciosa	Showy milkweed	Asclepiadaceae	N
Asparagus officinalis	Asparagus	Liliaceae	I
Barbarea orthoceras	Wintercress	Brassicaceae	N
Cicuta maculata	Spotted water hemlock	Apiaceae	N
Cirsium arvense (Breea)	Canada Thistle	Asteraceae	I+
Clematis ligusticifolia	Western white clematis	Ranunculaceae	N
Convolvulus arvensis	Field bindweed	Convolvulaceae	I+
Epilobium angustifolium (Chaemerion)	Fireweed	Onagraceae	N
Heracleum sphondylium subsp. Montanum	Cow parsnip	Apiaceae	N
Leucanthemum vulgare	Ox-eye daisy	Asteraceae	I+
(Chrysanthemum leucanthemum)		Fabaceae	I
Medicago lupulina	Black medic	Fabaceae	I
Medicago sativa	Alfalfa	Fabaceae	I
Penstemon strictus	Rocky Mountain penstemon	Scrophulariaceae	N
Solidago velutina	Threenerve goldenrod	Asteraceae	N
Taraxacum officinale	Dandelion	Asteraceae	I

Trifolium pratense	Red clover	Fabaceae	I
Urtica gracilis subsp.gracilis	Stinging nettle	Urticaceae	N
Veronicastrum serpyllifolia	Thyme leaf speedwell	Scrophulariaceae	N
Maianthemum racemosum	False soloman's-seal	Maianthemum	N
Vicia americana	American vetch	Fabaceae	N
Ferns and Fern Allies			
Equisetum arvense	Field horsetail	Equisetaceae	N
Hippochaete hyemalis	Scouring rush	Equisetaceae	N
Annual/Biennial Forbs			
Arctium minus	Common burdock	Asteraceae	I+
Carduus acanthoides	Plumeless thistle	Asteraceae	I+
Chenopodium album	Lambs quarters	Chenopodiaceae	I
Cynoglossum officinale	Houndstongue	Boraginaceae	I+
Lactuca serriola	Prickly lettuce	Asteraceae	I
Lepidium campestre	Field cress	Brassicacae	I
Melilotus albus	White sweet clover	Fabaceae	I
Melilotus officinalis	Yellow sweet clover	Fabaceae	I
Sisymbrium altissimum	Tumble mustard	Brassicacae	I
Tragopogon dubius	Salsify	Asteraceae	I
Verbascum thapsus	Common mullein	Scrophulariaceae	I+
Bromus tectorum	Cheatgrass, Downy brome	Poaceae	I+

*Origin

N=Native, I=Introduced, I+ Colorado State listed Noxious Weed

Table 2 – Potential State / Federal Threatened and Endangered Species

Species (Common Name)	Scientific Name	Type	Listing
Peregrine Falcon	*Falco peregrinus*	Bird	State Special Concern (SC)
Northern Leopard Frog	*Lithobates pipiens*	Amphibian	State Species of Concern (SC), USFWS Sensitive (S)
Tiger Salamander	*Ambystoma tigrinum stebbinsi*	Amphibian	USFWS Sensitive (S)
	Known or Suspected Animal List		
American dipper	*Cinclus mexicanus*	Bird	N/A
American kestrel	*Falco sparverius*	Bird	N/A
American robin	*Turdus migratorius*	Bird	N/A
Bald eagle	*Haliaeetus leucocephalus*	Bird	N/A
Black-billed magpie	*Pica hudsonia*	Bird	N/A
Black-capped chickadee	*Poecile atricapillus*	Bird	N/A
Blue wing teal	*Anas discors*	Bird	N/A
Blue-gray gnatcatcher	*Polioptila caerulea*	Bird	N/A
Canada goose	*Branta canadensis*	Bird	N/A
Chipping sparrow	*Spizella passerina*	Bird	N/A
Cinnamon teal	*Anas cyanoptera*	Bird	N/A
Common raven	*Common raven*	Bird	N/A
Cooper's hawk	*Accipiter cooperii*	Bird	N/A
Cordilleran flycatcher	*Empidonax occidentalis*	Bird	N/A
Common snipe	*Gallinago gallinago*	Bird	N/A
Dark-eyed junco	*Junco hyemalis*	Bird	N/A
Downey woodpecker	*Picoides pubescens*	Bird	N/A
Dusky flycatcher	*Empidonax oberholseri*	Bird	N/A
Fox sparrow	*Passerella iliaca*	Bird	N/A
Great blue heron	*Ardea herodias*	Bird	N/A
Great horned owl	*Bubo virginianus*	Bird	N/A
Green-tailed towee	*Pipilo chlorurus*	Bird	N/A
Green-winged teal	*Anas carolinensis*	Bird	N/A
Hairy woodpecker	*Leuconotopicus villosus*	Bird	N/A
House finch	*Haemorhous mexicanus*	Bird	N/A
House wren	*Troglodytes aedon*	Bird	N/A
Lewis' woodpecker	*Melanerpes lewis*	Bird	N/A

Lincoln's sparrow	*Melospiza lincolnii*	Bird	N/A
MacGillivray's warbler	*Geothlypis tolmiei*	Bird	N/A
Mallard	*Anas platyrhynchos*	Bird	N/A
Mountain dove	*Spilopelia chinensis*	Bird	N/A
Mountain bluebird	*Sialia currucoides*	Bird	N/A
Mountain chickadee	*Poecile gambeli*	Bird	N/A
Peregrine falcon	*Falco peregrinus*	Bird	N/A
Plubeous vireo	*Vireo plumbeus*	Bird	N/A
Northern flicker	*Colaptes auratus*	Bird	N/A
Red-tailed hawk	*Buteo jamaicensis*	Bird	N/A
Red-winged blackbird	*Agelaius phoeniceus*	Bird	N/A
Ruby-crowned kinglet	*Regulus calendula*	Bird	N/A
Song sparrow	*Melospiza melodia*	Bird	N/A
Spotted sandpiper	*Actitis macularius*	Bird	N/A
Stellars jay	*Cyanocitta stelleri*	Bird	N/A
Townsend's solitaire	*Myadestes townsendi*	Bird	N/A
Tree swallow	*Tachycineta bicolor*	Bird	N/A
Vesper sparrow	*Pooecetes gramineus*	Bird	N/A
Western tanager	*Piranga ludoviciana*	Bird	N/A

Table 2 – Potential State and Federal Threatened and Endangered Species (cont.)

Species (Common Name)	**Scientific Name**	**Type**	**Listing**
White-breasted nuthatch	*Sitta carolinensis*	Bird	N/A
White-crowned sparrow	*Zonotrichia leucophrys*	Bird	N/A
Yellow warbler	*Setophaga petechia*	Bird	N/A
Yellow-rumped warbler	*Setophaga coronata*	Bird	N/A
American beaver	*Castor canadensis*	Mammal	N/A
Big brown bat	*Eptesicus fuscus*	Mammal	N/A
Black bear	*Ursus americanus*	Mammal	N/A
Bobcat	*Lynx rufus*	Mammal	N/A
Bushy-tailed woodrat	*Neotoma cinerea*	Mammal	N/A
Common muskrat	*Ondatra zibethicus*	Mammal	N/A
Squirrel	*Sciuridae*	Mammal	N/A
Common porcupine	*Erethizon dorsatum*	Mammal	N/A
Coyote	*Canis latrans*	Mammal	N/A

Deer mouse	*Peromyscus*	Mammal	N/A
Elk	*Cervus canadensis*	Mammal	N/A
Ermine or short-tailed weasel	*Mustela erminea*	Mammal	N/A
Golden-mantled ground squirrel	*Callospermophilus lateralis*	Mammal	N/A
Hoary bat	*Lasiurus cinereus*	Mammal	N/A
Least chipmunk	*Tamias minimus*	Mammal	N/A
Little brown myotis	*Myotis lucifugus*	Mammal	N/A
Long-legged myotis	*Myotis volans*	Mammal	N/A
Long-tailed weasel	*Mustela frenata*	Mammal	N/A
Meadow vole	*Microtus pennsylvanicus*	Mammal	N/A
Montane vole	*Microtus montanus*	Mammal	N/A
Mountain lion	*Puma concolor*	Mammal	N/A
Mule deer	*Odocoileus hemionus*	Mammal	N/A
Northern pocket gopher	*Thomomys talpoides*	Mammal	N/A
Raccoon	*Procyon lotor*	Mammal	N/A
Silver-haired bat	*Lasionycteris noctivagans*	Mammal	N/A
Striped skunk	*Mephitis mephitis*	Mammal	N/A
Rainbow trout	*Oncorhynchus mykiss*	Fishes	N/A
Brown trout	*Salmo trutta*	Fishes	N/A
Brooke trout	*Salvelinus fontinalis*	Fishes	N/A
Colorado Cutthroat Trout	*Oncorhynchus clarki pleuriticus*	Fishes	N/A
Mountain Whitefish	*Prosopium williamsoni*	Fishes	N/A

Table 2 – Potential State / Federal Threatened and Endangered Species			
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American kestrel	Falco sparverius	Bird	N/A
American robin	Turdus migratorius	Bird	N/A

Bald eagle	Haliaeetus leucocephalus	Bird	N/A
Black-billed magpie	Pica hudsonia	Bird	N/A
Black-capped chickadee	Poecile atricapillus	Bird	N/A
Blue wing teal	Anas discors	Bird	N/A
Blue-gray gnatcatcher	Polioptila caerulea	Bird	N/A
Canada goose	Branta canadensis	Bird	N/A
Chipping sparrow	Spizella passerina	Bird	N/A
Cinnamon teal	Anas cyanoptera	Bird	N/A
Common raven	Common raven	Bird	N/A
Cooper's hawk	Accipiter cooperii	Bird	N/A
Cordilleran flycatcher	Empidonax occidentalis	Bird	N/A
Common snipe	Gallinago gallinago	Bird	N/A
Dark-eyed junco	Junco hyemalis	Bird	N/A
Downey woodpecker	Picoides pubescens	Bird	N/A
Dusky flycatcher	Empidonax oberholseri	Bird	N/A
Fox sparrow	Passerella iliaca	Bird	N/A
Great blue heron	Ardea herodias	Bird	N/A
Great horned owl	Bubo virginianus	Bird	N/A
Green-tailed towee	Pipilo chlorurus	Bird	N/A
Green-winged teal	Anas carolinensis	Bird	N/A
Hairy woodpecker	Leuconotopicus villosus	Bird	N/A
House finch	Haemorhous mexicanus	Bird	N/A
House wren	Troglodytes aedon	Bird	N/A
Lewis' woodpecker	Melanerpes lewis	Bird	N/A
Lincoln's sparrow	Melospiza lincolnii	Bird	N/A
MacGillivray's warbler	Geothlypis tolmiei	Bird	N/A
Mallard	Anas platyrhynchos	Bird	N/A
Mountain dove	Spilopelia chinensis	Bird	N/A
Mountain bluebird	Sialia currucoides	Bird	N/A
Mountain chickadee	Poecile gambeli	Bird	N/A
Orange-Crowned warbler	Vermivora celata	Bird	N/A
Osprey	Pandion haliaetus	Bird	N/A
Peregrine falcon	Falco peregrinus	Bird	N/A
Plubeous vireo	Vireo plumbeus	Bird	N/A
Northern flicker	Colaptes auratus	Bird	N/A
Red-tailed hawk	Buteo jamaicensis	Bird	N/A
Red-winged blackbird	Agelaius phoeniceus	Bird	N/A

Ruby-crowned kinglet	Regulus calendula	Bird	N/A
Song sparrow	Melospiza melodia	Bird	N/A
Spotted sandpiper	Actitis macularius	Bird	N/A
Stellars jay	Cyanocitta stelleri	Bird	N/A
Townsend's solitaire	Myadestes townsendi	Bird	N/A
Tree swallow	Tachycineta bicolor	Bird	N/A
Vesper sparrow	Pooecetes gramineus	Bird	N/A
Western tanager	Piranga ludoviciana	Bird	N/A
Table 2 – Potential State and Federal Threatened and Endangered Species (cont.)			
Species (Common Name)	Scientific Name	Type	Listing
White-breasted nuthatch	Sitta carolinensis	Bird	N/A
White-crowned sparrow	Zonotrichia leucophrys	Bird	N/A
Wild turkey	Meleagris gallopavo silvestris	Bird	N/A
Yellow warbler	Setophaga petechia	Bird	N/A
Yellow-rumped warbler	Setophaga coronata	Bird	N/A
American beaver	Castor canadensis	Mammal	N/A
Big brown bat	Eptesicus fuscus	Mammal	N/A
Black bear	Ursus americanus	Mammal	N/A
Bobcat	Lynx rufus	Mammal	N/A
Bushy-tailed woodrat	Neotoma cinerea	Mammal	N/A
Common muskrat	Ondatra zibethicus	Mammal	N/A
Squirrel	Sciuridae	Mammal	N/A
Common porcupine	Erethizon dorsatum	Mammal	N/A
Coyote	Canis latrans	Mammal	N/A
Deer mouse	Peromyscus	Mammal	N/A
Elk	Cervus canadensis	Mammal	N/A
Ermine or short-tailed weasel	Mustela erminea	Mammal	N/A
Golden-mantled ground squirrel	Callospermophilus lateralis	Mammal	N/A
Hoary bat	Lasiurus cinereus	Mammal	N/A
Least chipmunk	Tamias minimus	Mammal	N/A
Little brown myotis	Myotis lucifugus	Mammal	N/A
Long-legged myotis	Myotis volans	Mammal	N/A
Long-tailed weasel	Mustela frenata	Mammal	N/A
Meadow vole	Microtus pennsylvanicus	Mammal	N/A
Montane vole	Microtus montanus	Mammal	N/A

Mountain lion	Puma concolor	Mammal	N/A
Mule deer	Odocoileus hemionus	Mammal	N/A
Northern pocket gopher	Thomomys talpoides	Mammal	N/A
Raccoon	Procyon lotor	Mammal	N/A
Silver-haired bat	Lasionycteris noctiva-gans	Mammal	N/A
Striped skunk	Mephitis mephitis	Mammal	N/A
Rainbow trout	Oncorhynchus mykiss	Fishes	N/A
Brown trout	Salmo trutta	Fishes	N/A
Brooke trout	Salvelinus fontinalis	Fishes	N/A
Colorado Cutthroat Trout	Oncorhynchus clarki pleuriticus	Fishes	N/A
Mountain Whitefish	Prosopium williamsoni	Fishes	N/A
Source: Hanks, Bill. An Inventory and Assesssment of Wildlife Habitat, Crystal River Valley, May 2007.			

Appendix B: 2015 Colorado Wetland Ecological Integrity Assessment (EIA)

2015 COLORADO WETLAND ECOLOGICAL INTEGRITY ASSESSMENT (EIA) – SITE INFORMATION

LOCATION AND GENERAL INFORMATION

Site ID: CR - 1 Site Name: Crystal River Restoration LEVEL 2.5 ASSESSMENT

Date: July 26, 2018 Surveyors: Jeremy Allinson

General Location: Near the Town of Carbondale (1.15 miles south) County: Garfield County

General Ownership: Town of Carbondale Specific Ownership: Town of Carbondale

Directions to Point:

From the Town of Carbondale proceed south on Highway 133, go east southeast on Crystal Bridge Drive, cross bridge and site is located upstream on both sides of river.

Access Comments (note permit requirements or difficulties accessing the site):

Contact the Town of Carbondale prior to visit for access constraints.

GPS COORDINATES OF TARGET POINT AND ASSESSMENT AREA

Dimensions of AA:

____40-m radius circle

✓ Freeform polygon, limited to 0.5 ha

____Wetland boundary, other (note in comments)

Elevation (m): 1893 m or 6,200 ft

Slope (deg): 1 deg (2%)

Aspect (deg): 320 deg

	WP #	UTM E	UTM N	Error (+/-)
AA-Center (Circle AAs Only)		309726	4362009	13.2 ft.
AA-1		392308	4361916	11.8 ft
AA-2		392309	4361711	11.5 ft.
AA-3		310102	4361499	11.5 ft
AA-4				12.2 ft

AA-Track Track Name: Assessment Area 1 and AA 2 Area: 13.96 acres

AA Placement and Dimensions Comments:

AA 1-4 represent degraded riparian habitat of the area. AA includes the entire Assessment Area on the west side of the river.

PHOTOS OF ASSESSMENT AREA (Taken at four points on edge of AA looking in. Record WPs of each photo in table above.)

	Photo #	Aspect
AA-1	162	180 deg
AA-2	163	180 deg
AA-3		
AA-4		

Photo Range: 3884 - 4309

Comments: None

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

ENVIRONMENTAL DESCRIPTION AND CLASSIFICATION OF ASSESSMENT AREA

Wetland / riparian / upland inclusions: *(should = 100%)*

5 % AA with true wetland and/or water

95 % AA with non-wetland riparian area

n/a % AA with upland inclusions

Wetland origin: *(if known)*

____ Natural feature with minimal alteration

✓ Natural feature, but altered or augmented by modification

____ Non-natural feature created by passive or active management

____ Unknown

Ecological System: (see manual for key and pick the *best match*) Fidelity: High Med Low

Cowardin Classification Fidelity: High Med Low

(see manual and pick *one each* of System, Class, Water Regime, and optional Modifier for dominant type)

Palustrine Forested / Scrub Shrub / Emergent

HGM Class: (pick *only one*) Fidelity: High Med Low

✓ Riverine* ____ Lacustrine Fringe

____ Depressional ____ Slope

____ Flats ____ Novel (Irrigation-Fed) Riverine / Slope

**Specific classification and metrics apply to the Riverine HGM Class*

***RIVERINE SPECIFIC* CLASSIFICATION OF THE ASSESSMENT AREA**

Confined vs. Unconfined Valley Setting

_____ Confined Valley Setting (valley width < 2x bankfull width)

✓ Unconfined Valley Setting (valley width ≥ 2x bankfull width)

Stream Flow Duration

✓ Perennial

_____ Intermittent

_____ Ephemeral

Proximity to Channel

_____ AA includes the channel and both banks

✓ AA is adjacent to or near the channel (< 50 m) and evaluation includes one or both banks

_____ AA is > 50 m from the channel and banks were not evaluated

Stream Depth at Time of Survey (if evaluated)

✓ Wadeable

_____ Non-wadeable

MAJOR ZONES WITHIN THE ASSESSMENT AREA (See manual for rules and definitions. Mark each zone on the site sketch.)

Zone 1 Description Scrub Shrub Riparian Dom spp: UPDATE % of AA: _____

Zone 2 Description Forested Riparian Dom spp: UPDATE % of AA: _____

Zone 3 Description Palustrine Emergent Dom spp: UPDATE % of AA: _____

Zone 4 Description _____ Dom spp: _____ % of AA: _____

Zone 5 Description _____ Dom spp: _____ % of AA: _____

ENVIRONMENTAL AND CLASSIFICATION COMMENTS

Classification Issues (important for sites with medium or low fidelity to one or more classification systems):

The vegetation has been modified in some areas from it's pre-disturbance condition.

AA REPRESENTATIVENESS

Is AA the entire wetland/riparian area? ☑ Yes ☐ No

If no, is AA representative of larger wetland/riparian area? ☐ Yes ☐ No ☐ NA (*if AA is the entire wetland*)

Comments:

ASSESSMENT AREA DRAWING

Add north arrow and approx. scale bar. Document **habitat features** and **biotic and abiotic zones** (particularly open water), inflows and outflows, and indicate direction of drainage. Include location of **AA points, soil pits,** and **water chemistry** samples. If appropriate, add a **cross-sectional diagram** and indicate slope of side.

ASSESSMENT AREA DESCRIPTION AND COMMENTS

Overall site description and details on site hydrology, soil, and vegetation.

LEVEL 2.5 VEGETATION, SOILS & BASIC WATER CHEMISTRY

VEGETATION PLOT SPECIES TABLE

Cover Classes 1: trace **2:** <1% **3:** 1–<2% **4:** 2–<5% **5:** 5–<10% **6:** 10–<25% **7:** 25–<50% **8:** 50–<75% **9:** 75–<95% **10:** >95%

Scientific Name or Pseudonym	Coll #	Press (√)	Photos	Cover Class	Workspace
INSERT VEGETATIVE PLOT SPECIES TABLE					

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

VEGETATION PLOT SPECIES TABLE

Cover Classes **1:** trace **2:** <1% **3:** 1–<2% **4:** 2–<5% **5:** 5–<10% **6:** 10–<25% **7:** 25–<50% **8:** 50–<75% **9:** 75–<95% **10:** >95%

Scientific Name or Pseudonym	Coll #	Press (√)	Photos	Cover Class	Workspace

GROUND COVER BY HABITAT TYPE

Estimate cover of each ground cover by habitat type. Estimate cover based on 1% or 5% increments (not cover classes).

Cover (unless otherwise noted) →	C	Comments
Actual cover of water (any depth, vegetated or not, standing or flowing) (A+B+C below)		minimal surface water present
Actual cover of open water zone and no vegetation (or only algae) (A)		
Actual cover of water zone with emergent vegetation (B)	<1%	
Actual cover of water zone with submergent / floating vegetation (C)		
Actual predominant depth of water (cm)		
Actual max depth of water (cm)		
Potential cover of water at ordinary high water		
Potential predominant depth at ordinary high water (cm)		
Stability of water level *(Pick one:* A: permanent and stable / B: permanent but fluctuates / C: intermittent or ephemeral)	B	
Cover of exposed bare ground (any substrate, can have algae cover)	<5%	
Cover of litter (all cover, including under water or vegetation)	15%	
Depth of litter (cm) – average of four non-trampled locations where litter occurs	2-5cm	
Count of standing dead trees (>25 cm diameter at breast height)	13	
Cover of standing dead shrubs or small trees (<25 cm diameter at breast height)	0**	
Cover of downed coarse woody debris (fallen trees, rotting logs, >25 cm diameter)	9	
Cover of downed fine woody debris (<25 cm diameter)	0**	
Cover bryophytes (all cover, including under water, vegetation or litter cover)	<3%	
Cover lichens (all cover, including under water, vegetation or litter cover)	0%	
Cover algae (all cover, including under water, vegetation or litter cover)	0%	

VERTICAL STRATA BY HABITAT TYPE

Estimate cover of each vertical strata by habitat type. Estimate height using classes. Estimate cover base on 1% or 5% increments (not classes).

Height Classes 0: <0.2 m 1: 0.2–0.5 m 2: 0.5–1m 3: 1–2 m 4: 2–5 m 5: 5–10 m 6: 10–15 m 7: 15–20 m 8: 20–35 m 9: 35–50 m 10: >50 m

Vertical Vegetation Strata (live or very recently dead)	Height / Cover →	H	C	Comments
(T1) Dominant canopy trees (>5 m and >~ 30% cover)	Populus angustifolia	7	15%	
(T2) Sub-canopy trees (> 5m but < dominant canopy height) or trees with sparse cover	Elaeagnus angustifolia	5	8%	
(S1) Tall shrubs, tree saplings or seedling (>2 m)	Alnus incana subsp. Tenuifolia, Salix exigua	5	40%	
(S2) Short shrubs (<2 m)	Ribes inerme	3	30%	
(HT) Herbaceous total	Variety of species	1	42%	
(H1) Graminoids (grass and grass-like plants)	Variety of species	1	38%	
(H2) Forbs (all non-graminoids)	Variety of species	1	2%	
(AQ) Submergent or floating aquatics		--	0	

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

SOIL PROFILE DESCRIPTION – SOIL PIT 1 ☐ **Representative Pit?** **WP # _____ Photo #s _____ (mark on site sketch)**

Depth to saturated soil (+/-cm): _____ Depth to free water (+/-cm): _____ ☐ Pit dry and groundwater not observed Settling Time: _____

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	%	Secondary Redox Features Color (moist)	%	Texture	Remarks (*note % visible salts in each layer)*

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Features (S5/F6/F8/S6/F7)
____**No Hydric Indicators**

Major Soil Type:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

SOIL PROFILE DESCRIPTION – SOIL PIT 2 ☐ **Representative Pit?** **WP # _____ Photo #s _____ (mark on site sketch)**

Depth to saturated soil (+/-cm): _____ Depth to free water (+/-cm): _____ nd groundwater not observed Settling Time: _____

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	%	y Redox Features (moist)	%	T	Remarks (*note % visible salts in each layer)*

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Features (S5/F6/F8/S6/F7)
____**No Hydric Indicators**

Comments:

Major Soil Type:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

SOIL PROFILE DESCRIPTION – SOIL PIT 3 ☐ **Representative Pit?** **WP # _____ Photo #s _____ (mark on site sketch)**

Depth to saturated soil (+/-cm): _____ Depth to free water (+/-cm): _____ ☐ Pit dry and groundwater not observed Settling Time: _____

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	%	Secondary Redox Features Color (moist)	%	Texture	Remarks (*note % visible salts in each layer)*

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Features (S5/F6/F8/S6/F7)
____**No Hydric Indicators**

Major Soil Type:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

BASIC WATER CHEMISTRY - PH, EC, AND TEMPERATE MEASUREMENTS ☐ **No water observed**

Take pH, EC, and water temperature recording at up to four locations within the ... the appropria... istics. Take measurements within representative examples of the water within or adjacent to the AA, including channels, pools, and/or groundwater. T... ypoints at each loca... te water depth in cm, + for surface water, - for groundwater.

#	GPS WP#	Time of day	Location	D... (...	Surface OR Ground	Standing ... (NA for g...	Clear OR Turbid (NA for ground)	Open OR Shade (NA for ground)	pH	EC	Temp
1					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			
2					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			
3					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			
4					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			
5					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			
6					Surface / Ground	Standing / Flowing	Clear / Turbid	Open / Shade			

Water chemistry measurement comments:

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

2015 COLORADO WETLAND ECOLOGICAL INTEGRITY ASSESSMENT (EIA) – METRICS

LANDSCAPE METRICS

L1. CONTIGUOUS NATURAL LAND COVER

Select the statement that best describes the **contiguous natural land cover** within the 500 m envelope surrounding the AA. See list of natural land covers in the field manual.

Intact: AA embedded in 90–100% contiguous natural land cover.	**A**
Variegated: AA embedded in 60–90% contiguous natural land cover.	**B**
Fragmented: AA embedded in 20–60% contiguous natural land cover.	**C**
Relictual: AA embedded within <20% contiguous natural land cover.	**D**

L2. LAND USE INDEX

Select the statement that best describes the intensity of surrounding land use. Use the **Land Use Index** Worksheet (last page) to calculate the Land Use Index score.

Land Use Index = 9.5–10.0	**A**
Land Use Index = 8.0–9.4	**B**
Land Use Index = 4.0–7.9	**C**
Land Use Index = <4.0	**D**

Landscape comments:

BUFFER METRICS

B1. PERIMETER WITH NATURAL BUFFER

Select the statement that best describes the **perimeter of the AA with natural buffer**. Buffer land covers must be ≥ 5 m wide and extend along ≥ 10 m of the AA perimeter. See list of buffer land covers in the field manual.

Natural buffer surrounds 100% of the AA perimeter.	**A**
Natural buffer surrounds 75–99% of the AA perimeter.	**B**
Natural buffer surrounds 25–74% of the AA perimeter.	**C**
Natural buffer surrounds <25% of the AA perimeter.	**D**

B2. WIDTH OF NATURAL BUFFER

Select the statement that best describes the **width of the natural buffer**. Estimate the width of buffer land covers along eight lines radiating out from the AA at the cardinal and ordinal directions (N, NE, E, SE, S, SW, W, NW) and average their width. Estimate up to 100 m.

Average buffer width is 100 m	**A**
Average buffer width is 75–99 m	**B**
Average buffer width is 25–74 m	**C**
Average buffer width is <25 m	**D**

B3. CONDITION OF NATURAL BUFFER

Select the statement that best describes the **natural buffer condition**. Select one statement per column. Only consider the actual natural buffer measured in metrics above. *Remember to look for **non-native hay grasses** when evaluating native / non-native vegetation in the buffer.*

Abundant (≥95%) relative cover native vegetation and little or no (<5%) cover of non-native plants.	**A**	Intact soils, no water quality concerns, little or no trash, AND little or no evidence of human visitation.	**A**
Substantial (75–95%) relative cover of native vegetation and low (5–25%) cover of non-native plants.	**B**	Intact or minor soil disruption, minor water quality concerns, moderate or lesser amounts of trash, AND/OR minor intensity of human visitation or recreation.	**B**
Low (25–75%) relative cover of native vegetation and moderate to substantial (25–75%) cover of non-native plants.	**C**	Moderate or extensive soil disruption, moderate to strong water quality concerns, moderate or greater amounts of trash, AND/OR moderate intensity of human use.	**C**
Very low (<25%) relative cover of native vegetation and dominant (>75% cover) of non-native plants OR no buffer exists.	**D**	Barren ground and highly compacted or otherwise disrupted soils, significant water quality concerns, substantial amounts of trash, extensive human use, OR no buffer exists.	**D**

Buffer comments:

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

VEGETATION COMPOSITION METRICS

V1. NATIVE PLANT SPECIES COVER (RELATIVE)		V2. INVASIVE NONNATIVE PLANT SPECIES COVER (ABSOLUTE)	
Select the statement that best describes the relative cover of **native plant species** within the AA.		Select the statement that best describes the absolute cover of **invasive nonnative plant species** within the AA. Use list provided in the manual.	
AA contains >99% relative cover of native plant species.	**A**	Invasive nonnative species are absent from all strata.	**A**
AA contains 95–99% relative cover of native plant species.	**B**	Invasive species present, but sporadic (<4% absolute cover).	**B**
AA contains 85–95% relative cover of native plant species.	**C**	Noxious weeds somewhat abundant (4–10% cover).	**C**
AA contains 60–85% relative cover of native plant species.	**C-**	Noxious weeds abundant (10–30% cover).	**C-**
AA contains <60% relative cover of native plant species.	**D**	Noxious weed very abundant (>30% cover).	**D**

V3. NATIVE PLANT SPECIES COMPOSITION

Select the statement that best describes the **native plant species composition** (species abundance and diversity) within the AA. Look for native species diagnostic of the system vs. native increasers that may thrive in human disturbance.

Native plant species composition with expected natural conditions: i) Typical range of native diagnostic species present, AND ii) Native species sensitive to anthropogenic degradation are present, AND iii) Native species indicative of anthropogenic disturbance (i.e., increasers, weedy or ruderal species) absent to minor.	**A**
Native plant species composition with minor disturbed conditions: i) Some native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with low cover.	**B**
Native plant species composition with moderately disturbed conditions: i) Many native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with moderate cover.	**C**
Native plant species composition with severely disturbed conditions: i) Most or all native diagnostic species absent, a few remain in low cover, OR ii) Native species indicative of anthropogenic disturbance are present with high cover.	**D**

Vegetation composition comments:

VEGETATION STRUCTURE METRICS

V4. VEGETATION STRUCTURE (VERTICAL AND HORIZONTAL)

Select the statement below that best describes the **overall vertical and horizontal structure** within the AA. Vertical structure relates to the number of vertical vegetation strata. Horizontal structure relates to the number and complexity of biotic and abiotic patches within the wetland/riparian area. See reference card for potential structural patches. Assess each site based on the expected conditions within its Ecological System type. For woody systems, rate regeneration and woody debris individually on next page, then consider those ratings in the overall assessment of structure.

Herbaceous systems: Marsh, Meadow, Playa	***Woody systems: Riparian and Floodplain***	
General: Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.		
Structural patches/zones are appropriate in number and type for the system (can be few in playas, fens, meadows). There is diversity in vertical strata within the herbaceous vegetation (some tall and some short layers and/or low cover of shrubs or trees, where appropriate). Litter and other organic inputs are typical of the system (i.e., playas should have low litter while meadows and marshes should have moderate amounts of litter).	AA is characterized by a complex array of nested or interspersed patches. Canopy (if present) contains a mosaic of different ages or sizes, including large old trees and obvious regeneration. Number of live stems is well within expected range. Shrub and herbaceous layers are complex, providing a diversity of vertical strata. Woody species are of sufficient size and density to provide future woody debris to stream or floodplain. Litter layer is neither lacking nor extensive.	**A**

General: Vegetation structure shows minor alterations from natural conditions.		
Marshes: cattail and bulrush density may prevent animal movement in some areas of the wetland, but not throughout. ***Meadows:*** grazing and mowing have minor effects. ***Playas:*** natural areas of bare ground are still prevalent, though non-native or weedy species may be encroaching.	AA is characterized by a moderate array of nested or interspersed zones with no single dominant zone, though some structural patches (especially open zones) may be missing. Canopy still heterogeneous in age or size, but may be missing some age classes. Vertical strata may be somewhat less complex than natural conditions. Woody debris or litter may be somewhat lacking.	**B**
General: Vegetation structure is moderately altered from natural conditions.		
Marshes: cattail and bulrush density may prevent animal movement in half or more of the wetland. ***Meadows:*** grazing and mowing have moderate effects. ***Playas:*** natural areas of bare ground are present, but non-native or weedy species have filled in many area.	AA is characterized by a simple array of nested or interspersed zones. One zone may dominate others. Vertical strata may be moderately less complex than natural conditions. Site may be denser than natural conditions (due to non-native woody species) or may be more open and decadent. Woody debris or litter may be moderately lacking.	**C**
General: Vegetation structure is greatly altered from natural conditions.		
Marshes: cattail and bulrush density prevent animal movement throughout the wetland. ***Meadows:*** grazing and mowing greatly affect the structure of the vegetation and prevalence of litter. ***Playas:*** natural areas of bare ground are absent due to an abundance of non-native or weedy species.	AA is characterized by one dominant zone and several expected structural patches or vertical strata are missing. Site is either extremely dense with non-native woody species or open with predominantly decadent or dead trees. Woody debris and/or litter may be absent entirely or may be excessive due to decadent trees.	**D**

V5. REGENERATION OF NATIVE WOODY SPECIES		**V6. COARSE AND FINE WOODY DEBRIS**	
Select the statement that best describes the **regeneration of native woody species** within the AA.		Select the statement that best describes **coarse and fine woody debris** within the AA.	
Woody species are naturally uncommon or absent.	**NA**	There are no obvious inputs of woody debris or woody species are naturally uncommon.	**NA**
All age classes of *native* woody species present. Native tree saplings /seedlings and shrubs common to the type present in expected amounts and diversity. Regeneration in obvious.	**A**	AA characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. There is wide size-class diversity of standing snags and downed logs in various stages of decay. For riverine wetlands, debris is sufficient to trap sediment, but does not inhibit stream flow. For non-riverine wetlands, woody debris provides structural complexity, but does not overwhelm the site.	**A/B**
Age classes of *native* woody species restricted to mature individuals and young sprouts. Middle age groups appear to be absent or there is some other indication that regeneration is moderately impacted.	**B**		
Native woody species comprised of mainly mature individuals OR mainly evenly aged young sprouts that choke out other vegetation. Regeneration is obviously impacted. Site may contain Russian Olive and/or Salt Cedar.	**C**	AA characterized by small amounts of woody debris OR debris is somewhat excessive. For riverine wetlands, lack of debris may affect stream temperatures and reduce available habitat.	**C**
Native woody species predominantly consist of decadent or dying individuals OR are absent from an area that should be wooded. Site may be dominated by Russian Olive / Salt Cedar.	**D**	AA lacks woody debris, even though inputs are available.	**D**

Vegetation structure comments (including regeneration and woody debris):

HYDROLOGY METRICS

H1. WATER SOURCE

Check off all *major* water sources in the table to the right. Select the statement below that best describes the **water sources** feeding the AA during the growing season.

✓	Overbank flooding	_____	Irrigation via direct application
✓	Alluvial aquifer	_____	Irrigation via seepage
_____	Groundwater discharge	_____	Irrigation via tail water run-off
_____	Natural surface flow	_____	Urban run-off / culverts
_____	Precipitation	_____	Pipes (directly feeding wetland)
_____	Snowmelt	_____	Other:

Water sources are natural. Site hydrology is fed by precipitation, groundwater, natural runoff, or natural flow from an adjacent freshwater body. The system may naturally lack water at times, even for several years. There is no indication of direct artificial water sources, either point sources or non-point sources. Land use in the local watershed is primarily open space or low density, passive use with little irrigation.	**A**
Water sources are mostly natural, but also include occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic sources include developed land or irrigated agriculture that comprises < 20% of the immediate drainage area, some road runoff, small storm drains or other minor point source discharges. No large point sources control the overall hydrology.	**B**
Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage area or moderate point source discharges into the wetland, such as many small storm drains or a few large ones or many sources of irrigation runoff. The key factors to consider are whether the wetland is located in a landscape position that supported wetlands before irrigation / development *AND* whether the wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers or natural stream channels that now receive substantial irrigation return flows).	**C**
Water sources are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or another artificial hydrology). Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises > 60% of `the immediate drainage basin of the AA, or the presence of major drainage point source discharges that obviously control the hydrology of the AA. The key factors to consider are whether the wetland is located in a landscape position that likely never supported a wetland prior to human development *OR* did support a wetland, but is now disconnected from its natural water source. The reason the wetland exists is because of direct irrigation, irrigation seepage, irrigation return flows, urban storm water runoff, or direct pumping.	**D**

Water source comments:

H2. HYDROPERIOD

Select the statement below that best describes the **hydroperiod** within the AA (extent and duration of inundation and/or saturation). Search the AA and 500 m envelope for hydrologic stressors (see list on following pages). Use best professional judgment to determine the overall condition of the hydroperiod. For some wetlands, this may mean that water is being channelized or diverted away from the wetland. For others, water may be concentrated or increased. *Please add comments on next page.*

Hydroperiod is characterized by natural patterns of inundation/saturation and drawdown and/or flood frequency, duration, level and timing. There are no major hydrologic stressors that impact the natural hydroperiod. Riparian channels are characterized by equilibrium conditions with no evidence of severe aggradation or degradation indicative of altered hydrology.	**A**
Hydroperiod inundation and drying patterns deviate slightly from natural conditions due to presence of stressors such as: flood control/water storage dams upstream; berms or roads at/near grade; minor pugging by livestock; small ditches or diversions removing water; or minor flow additions from irrigation return flow or storm water runoff. Outlets may be slightly constricted, but not to significantly slow outflow. Riparian channels may have some sign of aggradation or degradation, but approach equilibrium conditions. Playas are not significantly impacted pitted or dissected. *If wetland is artificially controlled,* the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).	**B**
Hydroperiod inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: flood control/water storage dams upstream or downstream that moderately effect hydroperiod; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; shallow pits within playas; ditches or diversions 1–3 ft. deep; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. Riparian channels may show distinct signs of aggradation or degradation. *If wetland is artificially controlled,* the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.	**C**

Hydroperiod inundation and drawdown patterns deviate substantially from natural conditions from high intensity alterations such as: significant flood control / water storage das upstream or downstream; a 4-lane highway; large dikes impounding water; diversions > 3ft. deep that withdraw a significant portion of flow, deep pits in playas; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be significantly constricted, blocking most flow. Riparian channels may be concrete or artificially hardened. *If wetland is artificially controlled,* the site is actively managed and not connected to any natural season fluctuations.	**D**

Hydroperiod comments:

H3. HYDROLOGIC CONNECTIVITY

Select the statement below that best describes the degree to which **hydrology within the AA is connected to the larger landscape** throughout the year, but particularly at times of high water. Consider the effect of impoundments, entrenchment, or other obstructions to connectivity that occur within the surrounding landscape, if those impoundments clearly impact the AA.

Marsh / Meadow variant	***Playa variant***	***Riverine / Riparian variant***	
No unnatural obstructions to lateral or vertical movement of surface or ground water. Rising water in the site has unrestricted access to adjacent upland, without levees, excessively high banks, artificial barriers, or other obstructions to the lateral movement of flood flows.	Surrounding land cover / vegetation does not interrupt surface flow. No artificial channels feed water to playa.	Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain. Channel is not entrenched.	**A**
Minor restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Up to 25% of the site may be restricted by barriers to drainage. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.	Surrounding land cover / vegetation may interrupt a minor amount of surface flow. Artificial channels may feed minor amounts of excess water to playa.	Minimally disconnected from floodplain. Up to 25% of stream banks may be affected by dikes, rip rap, and/or elevated culverts. Channel may be somewhat entrenched, but overbank flow occurs during most floods.	**B**
Moderate restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Between 25–75% of the site may be restricted by barriers to drainage. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.	Surrounding land cover / vegetation may interrupt a moderate amount of surface flow. Artificial channels may feed moderate amounts of excess water to playa.	Moderately disconnected from floodplain due to multiple geomorphic modifications. Between 25-75% of stream banks may be affected by bikes, rip rap, concrete, and/or elevated culverts. Channel may be moderately entrenched and disconnected from the floodplain except in large floods.	**C**
Essentially no hydrologic connection to adjacent landscape. Most or all stages may be contained within artificial banks, levees, or comparable features. Greater than 75% of the site is restricted by barriers to drainage.	Surrounding land cover / vegetation may dramatically restrict surface flow. Artificial channels may feed significant amounts of excess water to playa.	Channel is severely entrenched and entirely disconnected from the floodplain. More than 75% of stream banks may be affected by dikes, rip rap, concrete and/or elevated culverts. Overbank flow never occurs or only in severs floods.	**D**

Hydrologic connectivity comments:

PHYSIOCHEMICAL METRICS

S1. SUBSTRATE / SOIL DISTURBANCE

Select the statement below that best describes disturbance to the substrate or soil within the AA. For playas, the most significant substrate disturbance is sedimentation or unnaturally filling, which prevents the system's ability to pond after heavy rains. For other wetland types, disturbances may lead to bare or exposed soil and may increase ponding or channelization where it is not normally. For any wetland type, consider the disturbance relative to what is expected for the system.

No soil disturbance within AA. Little bare soil OR bare soil areas are limited to naturally caused disturbances such as flood deposition or game trails OR soil is naturally bare (e.g., playas). No pugging, soil compaction, or sedimentation.	**A**
Minimal soil disturbance within AA. Some amount of bare soil, pugging, compaction, or sedimentation present due to human causes, but the extent and impact are minimal. The depth of disturbance is limited to only a few inches and does not show evidence of altering hydrology. Any disturbance is likely to recover within a few years after the disturbance is removed.	**B**
Moderate soil disturbance within AA. Bare soil areas due to human causes are common and will be slow to recover. There may be pugging due to livestock resulting in several inches of soil disturbance. ORVs or other machinery may have left some shallow ruts. Sedimentation may be filling the wetland. Damage is obvious, but not excessive. The site could recover to potential with the removal of degrading human influences and moderate recovery times.	**C**
Substantial soil disturbance within AA. Bare soil areas substantially degrade the site and have led to altered hydrology or other long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock pugging and/or trails are widespread. Sedimentation may have severely impacted the hydrology. The site will not recover without active restoration and/or long recovery times.	**D**

Substrate / soil comments and photo #'s:

S2. SURFACE WATER TURBIDITY / POLLUTANTS

Select the statement that best describes the **turbidity or evidence or pollutants** in surface water within the AA.

No open water in AA	**NA**
No visual evidence of turbidity or other pollutants.	**A**
Some turbidity in water (such as turbidity caused by high flows or naturally occurring in playas) OR presence of other pollutants, but limited to small and localized areas within the wetland. Water may be slightly cloudy.	**B**
Water is cloudy or has unnatural oil sheen, but the bottom is still visible. *Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution.*	**C**
Water is milky and/or muddy or has unnatural oil sheen. The bottom is difficult to see. *Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution.*	**D**

S3. ALGAL GROWTH

Select the statement that best describes **algal growth** within surface water in the AA. Exclude *Chara* (multicellular algae) in cover estimate.

No open water in AA or evidence of open water.	**NA**
Water is clear with minimal algal growth.	**A**
Algal growth is limited to small and localized areas of the wetland. Water may have a greenish tint or cloudiness.	**B**
Algal growth occurs in moderate to large patches throughout the AA. Water may have a moderate greenish tint or sheen.	**C**
Algal mats are extensive, blocking light to the bottom. Water may have a strong greenish tint and the bottom is difficult to see.	**D**

Water quality comments and photo #'s:

Turbidity and algal growth may be natural depending on recent weather patterns and flow timing (i.e., higher flows are often more turbid). Please rank the system as you see it, regardless of whether the conditions are natural. Include good notes and take photos.

SIZE METRICS

Z1. COMPARATIVE SIZE

Select the statement below that best describes the **absolute size** of the wetland, as compared with others of its type.

Meadows and Marshes	*Playas and Fens*	*Riparian Areas*	
>10 hectares (>25 acres)	>2 hectares (>5 acres)	>5 km (>3 miles)	**A**
2–10 hectares (25 acres)	0.5–2 hectares (5 acres)	1–5 km (3 miles)	**B**
0.5–2hectares (5 acres)	0.1–0.5 hectares (1 acre)	0.1–1 km (0.6 mile)	**C**
<0.5 hectare (<1 acre)	<0.1 hectare (<0.25 acre)	<0.1 km (<0.06 mile)	**D**

Comparative size comments:

Z2. CHANGE IN SIZE

Select the statement below that best describes the **change in size** of the wetland.

Occurrence is at, or only minimally reduced (<15%) from its original, natural extent, and has not been artificially reduced in size.	**A**
Occurrence is only somewhat reduced (15-10%) from its original natural extent.	**B**
Occurrence is modestly reduced (10-30%) from its original, natural extent.	**C**
Occurrence is substantially reduced (>30%) from its original, natural extent.	**D**

Change in size comments:

Land Use Index Worksheet

Land Use Categories[1]	*Coefficient*	*500 m Envelope*	
		% Area	*Score*
Paved roads, parking lots, domestic, commercial, and industrial buildings	0	15	0
Gravel pit operation, open pit mining, strip mining, abandoned mines	0		
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	1	.03	.03
Resource extraction (oil and gas)	1		
Tilled agricultural crop production (corn, wheat, soy, etc.)	2	10	20
Intensively managed golf courses, sports fields, lawns	2	65	130
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	3		
Heavy grazing by livestock	3		
Logging or tree removal with 50-75% of large trees removed	4		
Intense recreation (ATV use / camping / popular fishing spot, etc.)	4		
Permanent crop agriculture (hay pasture, vineyard, orchard)	4	10	40
Dam sites and disturbed shorelines around water storage reservoirs. Include open water of reservoir is there is intensive recreation, such as boating.	5		
Old fields and other disturbed fallow lands dominated by non-native species	5		
Moderate grazing on rangeland	6		
Moderate recreation (high-use trail)	7	.004	.028
Selective logging or tree removal with <50% of large trees	8		
Light grazing on rangeland	9		
Light recreation (low-use trail)	9	.001	.009
Natural area / land managed for native vegetation	10	0.65	6.5
*Percentages estimated based of aerial imagery	Total Land Use Score		196.57

Buffer Width Worksheet

1: 78	5: 103
2: 135	6: 89
3: 102	7: 92
4: 96	8: 96
Average width: 98.88 m	

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

2015 COLORADO ECOLOGICAL INTEGRITY ASSESSMENT (EIA) –STRESSOR CHECKLIST

Stressors: *direct threats*; "the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes" or altered disturbance regime (e.g. flooding, fire, or browse).

Some Important Points about Stressors Checklists:

1. The Stressors Checklist must be completed for the 500 m envelop surrounding the AA (Landscape) and for the 0.5 ha AA (Veg, Hydro, Soils). Rely on imagery in combination with what you can field check.
2. Assess stressors in the 500 m envelope for their effects on land surrounding the AA (*NOT how they may impact the AA*)
3. Stressors for Vegetation, Soils, and Hydrology are assessed across the full 0.5 ha assessment area (AA)
4. Severity has been pre-assigned for many stressors. If the severity differs from the pre-assigned rating, cross it out and note the true severity. If there is more than one pre-assigned value, circle the appropriate value.
5. To comment, note the stressor number before writing comments.

SCOPE of Threat (% of AA or Buffer affected by direct threat)	
1 = Small	Affects a small portion (1-10%) of the AA or landscape
2 = Restricted	Affects some (11-30%) of the AA or landscape
3 = Large	Affects much (31-70%) of the AA or landscape
4 = Pervasive	Affects all or most (71-100%) of the AA or landscape
SEVERITY of Threat within the defined Scope (degree of degradation to AA or Buffer)	
1 = Slight	Likely to only slightly degrade/reduce
2 = Moderate	Likely to moderately degrade/reduce
3 = Serious	Likely to seriously degrade/reduce
4 = Extreme	Likely to extremely degrade/destroy or eliminate

UPDATE

		500 m Envelope Landscape			ASSESSMENT AREA (0.5 ha)									
					Vegetation			Soil / Substrate			Hydrology			
	STRESSORS CHECKLIST	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Comments
	1. Residential, recreational buildings, associated pavement	3	3	2										
D	2. Industrial, commercial, military buildings, associated pavement		4											
E	3. Oil and gas wells and surrounding footprint		4											
V	4. Roads (gravel=2, paved=3, highway=4), railroad=3	2	2, 3, 4	2										
E	5. Sports field, golf course, urban parkland, expansive lawns	3	2	3										
L	6. Row-crop agriculture, orchard, nursery	1	3	1										
O	7. Hay field, fallow field	2	2, 3	2										
P	8. Utility / power line corridor	1	1, 2, 3			1, 2, 3								
	9. Other [specify]:													
R	10. Low impact recreation (hunting, fishing, camping, hiking, bird-watching, canoe/kayak)	1	1	1	1	1	1							
E	11. High impact recreation (ATV, mountain biking, motor boats)		3			3								
C	12. Other [specify]:													
	13. Tree resource extraction (clear cut=3 or 4, selective cut= 2 or 3)		2, 3, 4			2, 3, 4								
	14. Vegetation management (cutting, mowing)		2			2								
V	15. Livestock grazing, excessive herbivory by native species (ungulates, prairie dogs) (low=1, mod=2, high=3)		1, 2, 3			1, 2, 3								
E	16. Insect pest damage (low=1, mod=2, high=3)		1, 2, 3			1, 2, 3								
G	17. Invasive plant species (see noxious weed list)		3		3	3	7							
	18. Direct application of agricultural chemicals, herbicide spraying		2, 3			2, 3								
	19. Other [specify]:													
N	20a. Evidence of recent fire (low=1, mod=2, high=3)		1, 2, 3			1, 2, 3								
A	20b. Recent beaver dam blowout		1, 2			1, 2								
T	21. Other [specify]:													

Site ID / Name: CR-1 AA1 and AA2 Date: 7/27/2018

		500 m Envelope Landscape			ASSESSMENT AREA (0.5 ha)									
					Vegetation			Soil / Substrate			Hydrology			
	STRESSORS CHECKLIST	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Comments
	22. Excessive sediment or organic debris (inputs from recently logged sites, sedimentation in playas)													
	23. Excessive erosion or loss of organic matter (gullying, decay of organic soils)													
	24. Trash or refuse dumping													
S	25. Filling or dumping of sediment (spoils from excavation)													
O	26. Substrate removal (excavation)													
I	27. Indirect soil disturbance (compaction or trampling by livestock, human use, vehicles)	1	1	1										
L	28. Direct soil disturbance (grading, compaction, plowing, discing, deeply dug fire lines)	1	1	1										
S	29. Physical resource extraction (rock, sand, gravel, minerals, etc.)													
	30. Obvious excess salinity (dead or stressed plants, salt crusts)													
	31. Other [specify]:													
	32. PS discharge (waste water treatment, factory discharge, septic)													
	33. NPS discharge (urban / storm water runoff)													
H	34. NPS discharge (agricultural runoff, excess irrigation, feedlots, excess manure)										1	1	1	
Y	35. NPS discharge (mine runoff, discharge from oil and gas)													
D	36. Large dams / reservoirs													
R	37. Impoundments, berms, dikes, levees that hold water in or out													
O	38. Canals, diversions, ditches, pumps that move water in or out				✓									
L	39. Excavation for water retention (gravel ponds, pitted playas)													
O	40. Groundwater extraction (few small wells=2, extensive extraction cause a lowered water table=4)													
G	41. Flow obstructions (culverts, paved stream crossings)													
Y	42. Engineered channel (riprap, armored channel bank, bed)													
	43. Control of flow and energy (weir/drop structure, dredging)													
	44. Other [specify]:													
Stressors Very Minimal or Not Evident (check box, if true)		☐			☐			☐			☐			
STRESSOR RATING BY CATEGORY (Envelope, Veg, Soils, Hydro)		Score: 16	Rating: VH		Score: 8	Rating: M		Score: n/a	Rating:		Score: 1.2	Rating: L		HIS Score: 9.6 / HIS Rating: High
OVERALL HUMAN STRESSOR INDEX (HSI) – use category weights		**0.3**			**0.3**			**0.1**			**0.3**			

Threat Impact Calculator		Scope			
		Pervasive = 4	Large = 3	Restricted = 2	Small = 1
Severity	Extreme = 4	VERY HIGH = 10	High = 7	*Medium = 4*	Low = 1
	Serious = 3	High = 7	High = 7	*Medium = 4*	Low = 1
	Moderate = 2	*Medium = 4*	*Medium = 4*	Low = 1	Low = 1
	Slight = 1	Low = 1	Low = 1	Low = 1	Low = 1

Category / HSI Roll-up Formulas	
Score	Rating
10+	Very High
7 – 9.9	High
4 – 6.9	Medium
1 – 3.9	Low
0 – 0.9	Absent

COLORADO ECOLOICAL INTEGRITY ASSESSMENT (EIA) SCORECARD

Made by: Colorado Natural Heritage Program, Version: August 31, 2015

Site ID: Crystal River Restoration
Site Name: Assessment Area 1
Project: Baseline EIA Data for Riparian Health Assessment
Date 7/27/2018

Ecol System: Rocky Mt. Lower Montane-Foothill Riparian Woodland
HGM: Riverine
Cowardin: Palustrian Forested Intermittently Flooded

	Wt	Field Rating	Field Points	Calc Points	Calc Rating
Overall Ecological Integrity Score and Rank				**2.26**	**C+**
Overall Ecological Integrity + Size Score and Rank				**2.51**	**B-**
Rank Factor: LANDSCAPE CONTEXT	0.30			**1.48**	**D**
LANDSCAPE METRICS	0.33			**2.00**	**C+**
L1. Contiguous Natural Land Cover	1	c	2		
L2. Land Use Index	1	c	2		
BUFFER METRICS	0.67			**1.22**	**D**
B1. Perimeter with Natural Buffer	n/a	d	1		
B2. Width of Natural Buffer	n/a	d	1		
B3.1. Condition of Natural Buffer - Veg	n/a	d	1		
B3.2. Condition of Natural Buffer - Soils	n/a	c	2		
Rank Factor: CONDITION	0.70			**2.59**	**B-**
VEGETATION METRICS	0.55			**2.50**	**B-**
V1. Native Plant Species Cover	1	c	2		
V2. Invasive Nonnative Plant Species Cover	1	c	2		
V3. Native Plant Species Composition	1	c	2		
V4. Vegetation Structure	1	b	3		
V5. Regen. of Native Woody Species **(opt.)**	1	b	3		
V65. Coarse and Fine Woody Debris (**opt.**)	1	b	3		
HYDROLOGY METRICS	0.35			**2.33**	**C+**
H1. Water Source	1	d	1		
H2. Hydroperiod	1	b	3		
H3. Hydrologic Connectivity	1	b	3		
PHYSIOCHEMISTRY METRICS	0.10			**4.00**	**A+**
S1. Soil Condition	1	a	4		
S2. Surface Water Turbidity / Pollutants **(opt.)**	0.5	a	4		
S3. Algal Growth **(opt.)**	0.5	a	4		
Rank Factor: SIZE	n/a			**3.00**	**B+**
SIZE METRICS	1			**3.00**	**B+**
Z1. Comparative Size **(opt.)**	1	a	4		
Z2. Change in Size **(opt.)**	1	c	2		

Input field metric ratings into empty boxes to calculate Rank Factor and Final EIA Scores. Fill in all metrics that are not marked as optional. Optional metrics depend on method used and wetland type.

COLORADO ECOLOICAL INTEGRITY ASSESSMENT (EIA) SCORECARD

Made by: Colorado Natural Heritage Program, Version: August 31, 2015

Site ID: Crystal River Restoration
Site Name: Assessment Area 2
Project: Baseline EIA Data for Riparian Health Assessment
Date 7/27/2018

Ecol System: Rocky Mt. Lower Montane-Foothill Riparian Woodland
HGM: Riverine
Cowardin: Palustrian Forested Intermittently Flooded

	Wt	Field Rating	Field Points	Calc Points	Calc Rating
Overall Ecological Integrity Score and Rank				**2.36**	**C+**
Overall Ecological Integrity + Size Score and Rank				**2.61**	**B-**
Rank Factor: LANDSCAPE CONTEXT	0.30			**1.65**	**C-**
LANDSCAPE METRICS	0.33			**2.50**	**B-**
L1. Contiguous Natural Land Cover	1	b	3		
L2. Land Use Index	1	c	2		
BUFFER METRICS	0.67			**1.22**	**D**
B1. Perimeter with Natural Buffer	n/a	d	1		
B2. Width of Natural Buffer	n/a	d	1		
B3.1. Condition of Natural Buffer - Veg	n/a	d	1		
B3.2. Condition of Natural Buffer - Soils	n/a	c	2		
Rank Factor: CONDITION	0.70			**2.66**	**B-**
VEGETATION METRICS	0.55			**2.50**	**B-**
V1. Native Plant Species Cover	1	c	2		
V2. Invasive Nonnative Plant Species Cover	1	c	2		
V3. Native Plant Species Composition	1	c	2		
V4. Vegetation Structure	1	b	3		
V5. Regen. of Native Woody Species **(opt.)**	1	b	3		
V65. Coarse and Fine Woody Debris (**opt.**)	1	b	3		
HYDROLOGY METRICS	0.35			**2.67**	**B-**
H1. Water Source	1	d	1		
H2. Hydroperiod	1	b	3		
H3. Hydrologic Connectivity	1	a	4		
PHYSIOCHEMISTRY METRICS	0.10			**3.50**	**A-**
S1. Soil Condition	1	b	3		
S2. Surface Water Turbidity / Pollutants **(opt.)**	0.5	a	4		
S3. Algal Growth **(opt.)**	0.5	a	4		
Rank Factor: SIZE	n/a			**3.00**	**B+**
SIZE METRICS	1			**3.00**	**B+**
Z1. Comparative Size **(opt.)**	1	a	4		
Z2. Change in Size **(opt.)**	1	c	2		

Input field metric ratings into empty boxes to calculate Rank Factor and Final EIA Scores. Fill in all metrics that are not marked as optional. Optional metrics depend on method used and wetland type.

Colorado Rocky Mountain School
Elevating Education Since 1953

August 28, 2018

Pitkin County Healthy Rivers Board
via: email to Lisa MacDonald (lisa.macdonald@pitkincounty.com)

Re: CRMS Confluence Riparian Zone Restoration / Stock Water Project

Dear Healthy River Board Members,

We are writing on behalf of CRMS to request grant funding in the amount of $16,250 for a student-led project that aims to restore the riparian zones that have been damaged by the presence of cattle. We must first provide a water source for 100 head cattle to keep them away from the Crystal and Roaring Fork Rivers. Our project has come a long way from an idea in the classroom, as we have now set our sights on a definitive solution to drill a new well and to provide more plumbing to alternative water sources for the cattle, thus keeping them off the banks and out of the rivers.

Our project meets the HRS Board criteria in the following ways:

A. The goal of the project is to redrill a dry well that has run dry on the North Pasture at CRMS to establish winter stock water for the cattle, as well as inserting plumbing for two recycled rubber tire watering stations with float switches to provide the cattle with a specific place to get their water. We intend to use our current DC solar powered pump to support the new well, but we will need to install backup electricity in case of a failure of the solar pump during winter months. Lastly, we will be doing fencing work to keep animals from the water in the rivers, and we will provide revegetation to the riparian zone, as well as debris cleanup from the rivers and banks. Once the project is complete on the front end, we will ensure that there is frequent monitoring of the new system to keep it running and to provide student learning opportunities for the future.

Project Budget:

$ 8,000	Re-drill CRMS Well No. 4
10,250	Excavation (1,200 linear feet), plumbing, float valves)
2,750	Two watering stations (recycled tractor tires, concrete work)
750	Fencing materials (work by CRMS Student Ranch Crew)
1,000	Revegetation (willows planted by CRMS students, consulting)
3,500	Excavation/conduit (270 feet) for backup pump electricity source
$26,250	

Our project fulfills the intent of the ballot language by improving the water quality of the Crystal and Roaring Fork Rivers downstream of the confluence due to decreased cattle activity in the rivers and on the banks. The project includes the construction of several capital facilities that will be the reason for the improvements listed above, as the new well, watering stations, and backup service installments will all be financially supported by this project. The Crystal River Management Plan recommends "conservation and protection of limited high-quality floodplain habitats" (Section 2.3.1), as well as for "small-scale riparian restoration on Town of Carbondale stream tract" (Sections 2.3.2 & 2.3.3). While the reach to be restored is downstream of the Town of Carbondale tract, our project meets the goals of the Management Plan.

B. Watering the cattle is essential to maintain the viability of active agriculture on the historic Bar Fork Ranch, home to the campus of Colorado Rocky Mountain School. Keeping livestock out of the Crystal River riparian zone is essential for the health of the river and the overall riparian ecosystem, as we have found manure down by the banks. This excrement can potentially leach into the rivers and cause cultural eutrophication, which will lead to algal growth and an oxygen deprived environment. While this is merely a possibility, it is known for a fact that the impact of the cattle is detrimental to many species in the river, as well as to the health and happiness of patrons who wish to recreate on the river via kayaking, fly fishing, swimming, etc.

Throughout the planning stages of this project, CRMS has collaborated with Aspen Valley Land Trust (the Kea Hause R3 Fund in particular), The Roaring Fork Conservancy, Natural Resource Conservation Service of the USDA, the Mt. Sopris Soil Conservation District, and our local agricultural partners (Nieslanik Beef, LLC). We have secured $5,000 of funding from the Mt. Sopris Soil Conservation District and an undetermined grant amount from the R3 Fund held at AVLT.

C. While our project is going to have a direct effect on private land, the river still has a potential to be impacted downstream, where it is used by the public. It is important to prevent downstream algal blooms, and to just keep the rivers healthy in general for downstream recreators. This project will have a subtle but crucial impact on the river that will be very beneficial for the public. Not only that, but it will serve as an important learning opportunity for many science classes at CRMS, as well as a working opportunity for community service crews (fencing repair, revegetation, etc.), and will thus be a great resource for the school.

   Our public relations strategy will be to engage local and regional media outlets in partnership with the collaborators referenced above. In addition, the CRMS Communications Department will include an article in the CRMS newsletter and will promote the project via CRMS social media outlets.

   Public funding is appropriate due to the public benefits described above. Additionally, CRMS is a non-profit independent school with many needs and demands for funding for other capital projects and annual philanthropic support. This project depends on support from organizations specifically interested in the river ecosystem and sustainable, responsible agriculture.

D. The historic Bar Fork Ranch, home to the CRMS Campus, has been in operation since 1883. CRMS has maintained a connection to its agricultural roots since its founding in 1953 and we are proud to continue implementing projects that connect agriculture to environmental responsibility. It is clear that the Healthy Rivers Board has a commitment to agriculture, as it is described as a "historic component of Pitkin County's vibrant rural community" (Ag. Water Use Policy Statement, 2016). In recent years, CRMS has partnered with the Roaring Fork Conservancy to eradicate Russian Olive plants and we have participated in the River Watch Program since 2004. Additionally, with support from the Healthy Rivers Board, Alpine Bank, and Xcel Energy, CRMS students planned and executed the relocation of an osprey nest from the Xcel substation to the bank of the Crystal River (osprey.crms.org).

E. The total project cost of $26,250 far exceeded our initial projections. We did not expect to re-drill CRMS Well No. 4 which had not been used in the winter for nearly 25 years; it is recharged by irrigation ditches in the summer. However, establishing winter stock water is essential to the restoration of the riparian zone. We believe the investment to permanently remove livestock from watering in the rivers will pay handsome dividends for many years.

   We will know when our project has been successful once there are no longer any cows down by the river. The project has great potential to achieve this goal, and we are willing to update the Healthy Rivers Board periodically once the project is

completed. Students will continue to learn and study the project after it is completed, so it will be easy to measure progress throughout and send information by request.

We appreciate your time! Thank you for considering our application.

Sincerely,

Riley Padgett
CRMS Class of 2019

Joe White
Director of Finance

2018 Combined Scoresheet	Wille		Jochems	Hudson	Tasker	Taylor	Neubecker	Combined Average
CRMS 2018 Confluence Riparian Project							did not turn in scoresheet	
Goals of the River Board **0-100 possible points** The extent to which the proposed grant request/project meets the stated goals, objectives and on-going projects/priorities of the River Board. 1. Must be complete, clear and concise, with specific dollar amounts in total and for each element of the project; 2. Must fulfill the intent of the ballot language.	**100**		**90**	**80**	**100**	**100**		**94**
Vialbility of the Project **0-100 possible points** The extent to which the proposed grant request/project is practical, will be completed as proposed and/or may require other resources to be fully completed, and the extent to which the project can be repeated in other locations such that it will not be limited to a single event. 1. Must address an essential need;	**90**		**90**	**85**	**100**	**100**		**93**
Public Need Accessibility and Appreciation **0-100 possible points** The extent to which the proposed grant request/project will be seen, appreciated and/or used by the public. 1. Does not duplicate existing services or programs; 2. Must serve and be appreciated people who live and/or work in Pitkin County & the Roaring Fork Watershed; 3. Includes a specific Public Relations strategy; 4. Demonstrates an appropriate need for public funding.	**90**		**80**	**70**	**90**	**90**		**84**
History of the Requesting Party **0-100 possible points** The extent that the requesting individual/entity has been successful in other projects or efforts and is known in the community.	**100**		**80**	**95**	**100**	**100**		**95**
Budget, Measurements and Accountability **0-100 possible points** The extent to which the proposed grant amount is appropriate to the project scope and includes other appropriate sources of funding. The extent that the project includes specific measures for success and reporting of progress and results to the Healthy Rivers Board. 1. Demonstrates financial stability and presents accurate budgets and financial reports, measurements and accountability; 2. Specific measures of progress and success; 3. Reporting plan to Healthy Rivers Board/others.	**80**		**80**	**85**	**100**	**100**		**89**
Totals	**460**		**420**	**415**	**490**	**490**		**455**

HEALTHY RIVERS

TASKER

GRANT CRITERIA SCORE CARD

Application Review Criteria CRMS - $16,250 FULL	Points Possible
Goals of the Healthy Rivers and Streams Board	**0-100**
The extent to which the proposed grant request/project meets the stated goals, objectives and on-going projects/priorities of the River Board. 1. Must be complete, clear and concise, with specific dollar amounts in total and for each element of the project; 2. Must fulfill the intent of the ballot language.	100
Viability of the Project	**0-100**
The extent to which the proposed grant request/project is practical, will be completed as proposed and/or may require other resources to be fully completed, and the extent to which the project can be repeated in other locations such that it will not be limited to a single event. 1. Must address an essential need; STUDENTS WILL HAVE AN EXCELLENT EXAMPLE PROJECT TO DEMONSTRATE TO OTHERS/RANCHERS. 2. Demonstrates collaboration and/or partners with other agencies.	100
Public Need Accessibility and Appreciation	**0-100**
The extent to which the proposed grant request/project will be seen, appreciated and/or used by the public. 1. Does not duplicate existing services or programs; 2. Must serve and be appreciated people who live and/or work in Pitkin County & the Roaring Fork Watershed; 3. Includes a specific Public Relations strategy; 4. Demonstrates an appropriate need for public funding.	90
History of the Requesting Party	**0-100**
The extent that the requesting individual/entity has been successful in other projects or efforts and is known in the community.	100
Budget, Measurements and Accountability	**0-100**
The extent to which the proposed grant amount is appropriate to the project scope and includes other appropriate sources of funding. The extent that the project includes specific measures for success and reporting of progress and results to the Healthy Rivers Board. 1. Demonstrates financial stability and presents accurate budgets and financial reports, measurements and accountability; → YES 2. Specific measures of progress and success; ~~TAKING~~ TAKING CATTLE OUT OF RIPARIAN AREAS IS SUCCESS!! 3. Reporting plan to Healthy Rivers Board/others.	100

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MEMORANDUM

TO: **Heather Tattersall-Lewin, Roaring Fork Conservancy**

FROM: **Seth Mason, Principal Hydrologist, Lotic Hydrological**

DATE: **11/27/2018**

SUBJECT: **CWCB Grant Deliverables**

Over the summer of 2018, Lotic Hydrological (Lotic) endeavored to assemble, install, calibrate, and publish streamflow data collected at three gauges operated by Roaring Fork Conservancy (RFC) on the Crystal River near Carbondale (Figure 1, Table 1). These gauges were installed to assist RFC and the Colorado Water Trust implement non-diversion agreements as recommended by the Crystal River Management Plan.

Figure 1. Stream gauge locations along the Crystal River near Carbondale, CO.

Table 1. Stream gauge WDIDs, descriptions, and locations along the Crystal River near Carbondale, CO.

WDID	Description	Latitude	Longitude
CRYNETCO	Crystal River below Nettle Creek	39.298412	-107.21432
CRYTHOCO	Crystal River below Thomas Creek	39.349421	-107.20818
CRYCRMCO	Crystal River near Colorado Rocky Mountain School	39.408091	-107.22985

Each gauge was assembled using components acquired from Campbell Scientific. Specifically, each station consists of a CR300 measurement and control datalogger, a CS475 Radar Water Level Sensor, an AirLink Raven RV50 4G/LTE cellular gateway, a 10W solar panel, and a 12V 20 Ah sealed battery (Figures 2-3). Each unit is installed in a fiberglass enclosure and mounted to a bridge rail or abutment (Figures 4-6). Stage and discharge data are measured at each station on 15-minute intervals. Data is transmitted via a cellular network to a Colorado Division of Water Resources (CDWR) server once per hour via HTTP protocols.

Figure 2. Typical instrumentation wiring and housing.

Figure 3. Typical instrumentation mounting.

Figure 4. Stream gauge CRYNETCO.

Figure 4. Stream gauge CRYTHOCO.

Figure 4. Stream gauge CRYCRMCO.

Calibration and maintenance procedures for each stream gauge follow the protocols outlined by the USGS in the following documents:

- Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (Also available at https://pubs.usgs.gov/tm/tm3-a8/.)
- Sauer, V.B., and Turnipseed, D.P., 2010, Stage measurement at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A7, 45 p. (Also available at https://pubs.usgs.gov/tm/tm3-a7/.)
- *Suggested Citation:* Sauer, V.B., 2002, Standards for the Analysis and Processing of Surface-Water Data and Information Using Electronic Methods: U.S. Geological Survey Water-Resources Investigations Report 01–4044, 91 p.

Gauge calibration and rating curve development for each gauge occurs only during the irrigation season and at flows equal to or below the Colorado Water Conservation Board's 100 cfs Instream Flow water right on the lower Crystal River. Calibration across higher flows was deemed unnecessary to meet the needs of RFC and CWT and support non-diversion agreement execution and verification. Each gauging station will be powered down for the duration of the winter and spring seasons.

We initially intended to publish all streamflow data in near real-time to a custom webpage hosted by RFC. In the early late spring of 2018, we began a series of discussion with CDWR about the option of publishing data to the CDWR surface water conditions website. We spent significant time over the summer discussing procedures for rating curve development and maintenance with CDWR staff. We wanted to ensure that our procedures were sufficiently rigorous to meet CDWR standards for streamflow data publication. In the fall of 2018, we became one of the first third-party data providers to publish data to the CDWR streamflow data repository via the CDSS REST web services. All data collected by RFC's three gauging stations on the Crystal River will be publicly available during the irrigation season at the following links:

- http://www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=CRYNETCO
- http://www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=CRYTHOCO
- http://www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=CRYCRMCO

Data produced from these stations will be used to trigger non-diversion agreements with volunteer participants in the CWT ISF support program on the Crystal River. Data will also be used the verify the effectiveness of those agreements at meeting stated flow targets. Discussions with CWCB and CDWR staff regarding opportunities for use of data collected at each station for water rights administration is ongoing.