

From: [Ken Brenner](#)
To: [dougmonger](#); [haskywild](#); [redmondjv](#); [Lyn Halliday](#); [Nicole Seltzer](#); [rmurphy100bc](#); [tom](#); [webster jones](#)
Cc: [Andy Rossi](#); [Bob Weiss](#); [Deb Bastian](#); [Holly Kirkpatrick](#)
Subject: YampaWhite Green BRT notes
Date: Tuesday, March 14, 2023 8:24:10 PM

Directors,

CWCB Planning Section Chief, Russ Sands and BRT coordinator. Jeff Rodriguez were both in attendance and gave an update.

Two new statewide events are planned for 2023, hosted by the CWCB.

First, there will be a Drought Summit, last held in 2012, tentatively scheduled for May 31 and June 1. Also, all of the Basin Roundtables will be invited to a summit in coordination with the November IBCC/CWCB meetings. A survey is available for BRT members to help craft the agenda, outcomes, and overall content and theme.

Next was review of the Grant Committee's recommended grant funding opportunities. After a discussion on the amount of funding that might be available in 2023, we discussed and approved both the Bear River and Service Creek data logger and telemetry proposal along with additional funding for Sheriff's Reservoir. Both Doug Monger and myself stepped down and recused ourselves on the Bear River discussion as UYWCD is financially involved with that proposal.

The other major topic for the evening was to look at the West Fork Dam and Reservoir project in the headwaters of the Little Snake River on Battle Creek. There were half a dozen members from the Conservancy and Conservation Districts in Carbon County.

A lively discussion ensued and no action was taken nor asked for.

Under committee reports, the Big River Committee's white paper on the Colorado river negotiations was discussed. Approval will be done by email as several members were not familiar and wanted a chance to review the proposal again before voting.

Finally, the PEPO (public education, Participation and Outreach) Committee presented the work being done by Yampatika with the K-12 school systems throughout Northwest Colorado. We also updated everyone on the status of the new special event canopies. We hope to have them ordered soon and ready for the summer season. The list of events and sign up for BRT members will be available at the May meeting.

That concludes my report, thank you for the opportunity to represent you.

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Ken Brenner
Upper Yampa Water Conservancy District, Director
Colorado Water Congress, Boardmember
Yampa White Green Roundtable, Boardmember/IBCC
FIS Alpine Technical Delegate
PO Box 772631
Steamboat Springs, Co 80477
970-819-6178

From: [Deb Bastian](mailto:Deb.Bastian)
To: [Deb Bastian](mailto:Deb.Bastian)
Subject: FW: Minor corrections and comments to DRAFT proposed new lease with CDPOR for Stagecoach State Park
Date: Tuesday, March 14, 2023 10:02:35 AM
Attachments: [DRAFT new lease prepared by staff March 2023\(TRS REDLINES\).docx](#)

From: tom@tomsharp.com <tom@tomsharp.com>

Sent: Monday, March 13, 2023 10:20 PM

To: Andy Rossi <arossi@upperyampawater.com>; dougmonger <dougmonger@gmail.com>; haskywild <haskywild@mail.com>; redmondjv <redmondjv@gmail.com>; kpbrennersteamboat <kpbrennersteamboat@gmail.com>; Lyn Halliday <lhalliday@environmentalsolutionllc.com>; 'Nicole Seltzer' <nseltzer@rivernetnetwork.org>; Bob Weiss <bweiss@wvsc.com>; 'Ron Murphy' <rmurphy@wreawildblue.org>; webster jones <hwebster@frii.com>

Subject: Minor corrections and comments to DRAFT proposed new lease with CDPOR for Stagecoach State Park

All:

I read carefully the proposed DRAFT of new lease with CDPOR for Stagecoach State Park. I converted the PDF to a WORD document, and then made some minor typographical corrections as REDLINE changes. I attach my REDLINED revisions to the Draft prepared by Staff and counsel and included in the March meeting packet.

All the changes in REDLINE are non-substantive and typographical EXCEPT for my proposed changes in Paragraph 9 which deals with the annual “subsidy” payments from the District to CDPOR. As you know, in my public statements I have urged that those “subsidy” payments be entirely eliminated. I sense that the views of staff and other board members likely varies in that regard. So, in order to potentially reach a compromise position, I urge my REDLINE changes to paragraph 9 as shown on the attached WORD document, which substantively limits the subsidy to \$15,000/yr instead of \$35,000/yr, and limits the maximum over the 20-year life of lease to \$300,000 of subsidy instead of \$700,000 of subsidy. The annual subsidy obligation would continue to require CDPOR to verify that it expended on a cumulative basis at or above that subsidy amount on capital improvements to Recreational Facilities during the Agreement, which is the same wording now in the current Lease.

We will likely discuss the DRAFT proposal both in open session and in executive session at the upcoming board meeting.

I am OK with my proposed changes to paragraph 9 being deemed a public document, and I am OK with CDPOR knowing that I am willing to compromise down from \$35,000 subsidy a year to \$15,000 subsidy a year instead of \$35,000 subsidy a year.

Tom

Thomas R. Sharp
Sharp, Sherman & Engle, LLC

Attorneys at Law
401 Lincoln Avenue
PO Box 774968
Steamboat Springs, CO 80477
Office: (970) 879-7600 ex 1
Fax: (970) 879-8162
Cell: (970) 846-8179
tom@tomsharp.com

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LEASE AGREEMENT

THIS LEASE AGREEMENT (“Agreement”), made effective as of this _____ day of _____, 20_, by and between the STATE OF COLORADO, acting by and through the Department of Natural Resources for the use and benefit of the Division of Parks and Wildlife and the Parks and Wildlife Commission (hereinafter referred to as the “State”), whose legal address is 6060 Broadway, Denver, Colorado 80216, and the UPPER YAMPA WATER CONSERVANCY DISTRICT (hereinafter referred to as the “District”), a public corporation and quasi-governmental entity organized pursuant to §37-45-101 to §37-45-153, C.R.S., acting by and through the Board of Directors of the Upper Yampa Water Conservancy District, whose legal address is P.O. Box 775529, Steamboat Springs, Colorado 80477.

WHEREAS, required approval, clearance, and coordination has been accomplished from and with appropriate agencies; and

WHEREAS, the District has been organized as a quasi-governmental entity pursuant to the provisions of §37-45-101 through §37-45-153, C.R.S., to operate, manage, and store water for irrigation and other beneficial purposes in a reservoir; and

WHEREAS, the District owns certain property upon which it has constructed water works and a water storage reservoir known as the Stagecoach Reservoir (hereinafter referred to as “Reservoir,” including any expansion or enlargement thereof); and

WHEREAS, the District has agreed and desires, pursuant to authority in §37-45-118, C.R.S., to make a portion of such property available to the State for public recreational purposes; and

WHEREAS, the parties hereto desire to define their respective rights and obligations regarding management, operation, maintenance, repair, and replacement of the Recreational Facilities as defined herein; and

WHEREAS, the State desires to lease the Reservoir Property, as hereinafter defined and as may be hereafter changed, from the District in order to manage and operate the Recreational Facilities thereon for public recreational purposes; and

WHEREAS, the District has constructed certain Recreational Facilities on the Reservoir Property and desires to lease the Reservoir Property and such Recreational Facilities to the State for public recreational purposes pursuant to the terms hereof; and

WHEREAS, the District has agreed to provide certain funds to the State for use by the State to defray in part the operation and maintenance cost of the Recreational Facilities subject to the terms and limitations set forth herein; and

NOW, THEREFORE, in consideration of the mutual covenants, terms conditions, restrictions, and requirements contained herein, it is hereby agreed that:

1. This Agreement is subject to and subordinate to the terms, covenants, and conditions of all agreements, licenses, permits, easements, reservations, covenants, restrictions, and water rights decrees now and hereafter entered, and all governmental licenses, permits, and approvals now or hereafter obtained or issued, pertaining to the Reservoir, the Reservoir Property, the Recreational Facilities, or the District's construction, operation, maintenance, repair, replacement, change, modification, enlargement, expansion, or use of the Reservoir and the waters stored therein and all appurtenant facilities including but not limited to the power plant at the dam of the Reservoir.
2. The District hereby leases to the State for recreational purposes only all that portion of the real property described in Exhibit A attached hereto excluding from such lease, however, any of the following: (1) water and water rights, (2) real property subject to a Conservation Easement in gross to the State of Colorado, (3) a 60-foot-wide strip of land whose centerline is the access roadway to Stagecoach Dam, the Dam itself, all appurtenances and facilities attached or related to the dam including the power plant (but excluding the trail across the Dam unless the trail is closed by the District for security or construction purposes by notice to the State), and such real property surrounding the Dam as is reasonably necessary for the operation, protection, maintenance, improvement, enlargement, and security of the Dam and Power Plant and delivery of water and power therefrom and being not less than 200 feet wide, (4) that portion of the real property located east of the north-south centerline of the Stagecoach Reservoir dam and south of a line 20 feet northerly of the north high water line of the Yampa River, (5) so much of the land and water surface of the Reservoir along and adjacent to the south shoreline of the Reservoir as are hereafter designated by the District in its sole discretion for a marina and related docks and facilities and/or commercial purposes, (6) any other conveyances, licenses or grants of easements for utilities and utility facilities, roads, fences, signs, drives, paths, wildlife or conservation purposes which the District, in its sole discretion, may hereafter grant to any other person or entity, (7) the surface of the reservoir adjoining the spillway in the dam and for a reasonable safe distance away from such spillway up to 200 feet as the District shall from time to time designate in writing to the State, and (8) such other real property as the District, from time to time in its sole and exclusive discretion, may withdraw and exclude from the real property subject to this Agreement by written notice to the State (hereinafter all of the real property subject from time to time to this Agreement shall be referred to as the "Reservoir Property"). No portion of the Reservoir Property shall be excluded or withdrawn from this Agreement or made subject to any conveyance, license or grant of easement under subparagraphs 2(5), 2(6), or 2(8) of this paragraph 2 except following written notice given by the District to the State no later than ninety (90) days prior to the effective date of such exclusion, withdrawal or other action. In addition, the District agrees to consult with the State regarding any such notice within thirty (30) days after such notice is given.
3. State shall have the use, control of, and responsibility for the Reservoir Property, including the surface of the Reservoir, and for the management, administration, and maintenance of permitted public recreational purposes and the Recreational Facilities existing thereon or hereafter constructed thereon as it deems necessary for the use of this Reservoir Property by the general public, such use to be exclusive for recreational

activities only, pursuant to the State's authority and discretion as set forth in §33-10-101 through §33-10-114, C.R.S., as may be amended, and in rules and regulations. The aquatic wetland habitat refuge located on the western portion of the Reservoir Property is included as part of the Recreational Facilities which shall be maintained by the State at its cost in the manner and to the degree required of the District in all obligations of the District regarding this refuge, including the irrigation system for the refuge, such maintenance obligation to include operation of the irrigation system and annual ditch cleaning and vegetation removal and minor repairs costing less than \$10,000 in any year, but ~~excluding~~ major repairs or replacement of the irrigation system ~~at a costing of~~ \$10,000 or more in any calendar year, which shall be the responsibility of the District. The State agrees that the District shall have no responsibility for livestock damage which occurs to Recreational Facilities or other facilities or property or equipment of the State or any portion of the Reservoir Property. No portion of the Reservoir Property shall be leased by the District for grazing without the prior written consent of the State.

4. The District shall have the use, control of, and total responsibility for the Reservoir Property for all other purposes not granted to CPW in paragraph 3, including (but not limited to) operation and expansion, modification, repair, replacement, protection, and maintenance of the Reservoir works, dam and appurtenances, water intake, outlet, and storage, power plant and appurtenances, the generation and delivery of electricity, the release and delivery of water, and compliance with all agreements, easements, reservations and restrictions, and all governmental licenses, permits, and approvals to which the Reservoir or Reservoir Property is now or hereafter becomes subject (except to the extent assumed by the State under this Agreement). The rights of the District in the preceding sentence shall at all times be senior and paramount to the rights of the State granted under this Agreement. Additionally, the District or its licensee, easement beneficiary, grantee, or designee, shall have the use, control of, and total responsibility for so much of the land and water surface of the Reservoir along and adjacent to the south shoreline of the Reservoir as are hereafter designated by the District in its sole discretion for a marina and related docks and facilities and/or commercial purposes, and may withdraw such area from the Reservoir Property under this Agreement in the sole discretion of the District. Further, the District reserves the right to make and grant any other conveyances, licenses or grants of easements for utilities and utility facilities, roads, drives, parking areas, paths, fences, gates, signs, boat ramps, or wildlife or conservation purposes which the District, in its sole discretion, shall determine, to any other person or entity, which shall be senior and paramount to the interests of the State under this Agreement. If the District enlarges the Reservoir, the District may in its sole discretion withdraw any Reservoir Property, and any Recreational Facilities located on such withdrawn Reservoir Property (which may include but not be limited to the swim beach, volleyball court, boat ramp, courtesy docks and fueling station), as may ~~be~~ in the sole discretion of the District be necessary or convenient for the enlargement of the Reservoir and the use, operation, and management of the enlarged Reservoir. The District may in its sole discretion withdraw portions of the Reservoir Property southerly of the Reservoir for adjusting the boundaries of the Reservoir Property. Any withdrawal or exclusion of property from the Reservoir Property pursuant to this paragraph, or the grant or license of any interest in the Reservoir Property by the District pursuant to this paragraph, is subject to the notice and

consultation requirements set forth in paragraph 2 hereof. If the enlargement of the Reservoir results in the inundation of any Recreational Facility, the District, at its cost, shall replace such facilities with equivalent facilities at the location or locations approved by the State, which approval shall not be unreasonably withheld. However, if the replacement cost of the inundated Recreational Facilities at the new location is greater than 125% of the estimated current replacement cost of such Recreational Facilities at the original location, the District shall not be required to replace such Recreational Facilities unless the State contributes toward the cost of such replacement an amount equal to the actual cost of replacement of the inundated Recreational Facilities at the new location less 125% of the estimated cost of replacement of the inundated Recreational Facilities at the original location. Any expenditure made by the State pursuant to the preceding sentence shall qualify as an expenditure for Capital Improvements under paragraph 9 of this Agreement.

5. The State has prepared and provided to the District a Management Plan dated May 19, 2011, that specifically identifies the Reservoir Property and designates and locates the type, location, and specifications of all of the existing Recreational Facilities thereon. Any change to the Management Plan shall be made only with the prior written approval of the District, which approval shall not be unreasonably withheld. The Management Plan includes the following facilities, which, together with any expansions, modifications, or replacements thereof, shall hereinafter be referred to as the “Recreational Facilities”:

1. 92 Individual Campsites and one Group Campsite.
2. 8 Seventy-five (75) car parking lots. 2 seventy-five (75) car parking lots and 11 eight to thirty car parking lots.
3. Swim beach, volleyball court, concrete patio.
4. One (1) marina concession with courtesy docks, wet storage docks, a Marina Store, long term dry storage, and fueling station along the north shore.
5. One (1) main boat ramp with courtesy dock along the north shore.
6. One (1) boat ramp with courtesy dock in Morrison Cove.
7. Picnic pavilion.
8. Park Headquarters building, including shop, visitors center, garage, and on-site employee housing.
9. Dump station.
10. Entrance station.
11. Fifty (50) picnic sites.
12. Four (4) campgrounds, two (2) with electrical outlets for RVs.
13. Concession building with showers and bathrooms.
14. Three (3) restrooms with water and 9 vault toilets.
15. Grills and picnic tables.
16. Eighty (80) acre wetland habitat refuge with trail and viewing deck.
17. Potable water and irrigation systems and the electric system.
18. Sanitary facilities including land treatment.

19. All roadways into and within the Reservoir Property including the entry/check-in building access road, except the Stagecoach Dam Powerhouse access road from the Tailwaters Parking Lot to Stagecoach Dam Powerhouse and any part of Routt County Road 18.

In addition, “Recreational Facilities” shall include the non-motorized hiking trail along the south shore and shall also include the existing parking lot and boat ramp on the south shore of the Reservoir near the South Shore Subdivision unless and except if the District shall in its sole discretion withdraw such parking lot and boat ramp from the Reservoir Property pursuant to paragraph 2(5) above. The non-motorized hiking trail may be relocated or modified by the District or its designee at the District’s cost at any time and shall not be fenced or gated without the prior written consent of the District. “Recreational Facilities” shall include any other facility or property interest which the State and the District hereafter mutually agree be added as Recreational Facilities hereunder.

6. In the administration, operation, and maintenance of the Reservoir Property and the Recreational Facilities for recreational purposes, and including any further development by the State of Recreational Facilities on the Reservoir Property, the State shall follow the Management Plan dated May 19, 2011, as may hereafter be amended (the “Management Plan”)._ Amendments to the Management Plan shall be prepared by the State pursuant to its statutory authority and discretion in cooperation with and subject to the written approval of the District and any other appropriate agencies, and shall comply with State recreational policies and procedures. All Recreational Facilities shall be managed, repaired, improved, replaced, maintained and operated in a manner that will not interfere with the rights of the District reserved in this Agreement, including (but not limited to) the operation and maintenance of the Reservoir Property by the District for power generation and water storage and delivery purposes and the expansion and enlargement of the Reservoir. The Management Plan shall not be amended without the prior written approval of the District, which approval shall not be unreasonably withheld.
7. The State shall be responsible for payment of all costs, including electrical utility bills, incurred by the State in the operation of all existing and future Recreational Facilities and support facilities constructed by the State or the District at the Reservoir Property pursuant to the terms of the Management Plan.
8. The District shall provide to the State up to 25 acre feet of water from the Reservoir annually at no charge for public use at the Recreational Facilities. Such water is allocated from the Preferred Remainder pool of the Reservoir and is not charged to any storage water now or hereafter allocated by the District for sale or lease from the Reservoir. The State shall be responsible for the maintenance, repair, and replacement of the entire potable water system and the quality and fitness of water for public use, domestic purposes, and human consumption. The water delivered pursuant to this paragraph shall be raw untreated water in the condition existing after diversion from the Reservoir and the District shall have no obligation with respect to water quality. The State shall provide only water that has been suitably treated as necessary for the purposes intended.

9. Subject to the limitations of this paragraph 9, the District shall provide a limited operational and maintenance subsidy to the State (“O&M Subsidy”). The O&M Subsidy provided by the District shall be paid to the State no later than December 31st of each year of this Agreement (May 1, 2044, is the end of the last year of this Agreement), provided that during such calendar year the State (a) has physically expanded, modified or replaced Recreational Facilities permanently on site as approved by the District in advance of construction in a manner consistent with the Management Plan at an actual out-of-pocket cost to the State equal to or no less than the amount of the O& M Subsidy otherwise payable at the end of that calendar year ~~less \$10,000~~ (the “Capital Improvements”), and (b) has certified such facts with detail of such costs by letter to the District given by no later than December 1 of such calendar year. The annual O&M Subsidy payable, if at all, on December 31 each year shall be the lesser of (a) ~~\$15,000~~35,000, or (b) the actual costs of the Capital Improvements made by the State that calendar year, or deemed to have been made by the State that calendar year as provided below in this paragraph 9, all as certified by the State to the District by the preceding December 1, ~~plus \$10,000~~. Costs of Capital Improvements shall not include “soft costs” such as office overhead, travel, planning work by State personnel, or staff time by State personnel other than actual on-site supervision and performance of construction activities. If the cost of the Capital Improvements performed by the State in any calendar year, plus the carry-forward “excess” Capital Improvements cost from the preceding year pursuant to this sentence, exceeds ~~\$15,000~~25,000 in any calendar year, such excess over ~~\$15,000~~25,000 shall carry over to the next calendar year, and shall be deemed in that year to be a Capital Improvement cost incurred in that succeeding year, the same as if actually expended by the State in that year, for purposes of calculating the State’s entitlement to the O&M Subsidy that year. However, the District’s O&M Subsidy obligation shall never exceed ~~\$700,000~~300,000 over the 20-year Agreement term. If the O&M Subsidy in any year is less than ~~\$15,000~~35,000 because the State has not spent ~~\$15,000~~25,000 or more in Capital Improvements for that year, then the deficiency from that year shall forever be waived and the District shall not be required to make up such deficiency in future years. If the District’s O&M Subsidy obligation of ~~\$300,000~~700,000 is not paid during the Agreement term, the District shall have no obligation to make up the difference at the end of the Agreement term.
10. The term of this Agreement shall be from May 1, 2024, to May 1, 2044, unless sooner renewed or terminated as herein provided.
11. Either party may terminate this Agreement without cause at any time. To terminate the Agreement, the party wanting to terminate shall give the other party written notice in the manner provided for in paragraph 23 below. Termination shall be effective one hundred eighty (180) days after said notice. Upon termination, a party’s rights and obligations under this Agreement shall cease, except that liability for acts or omissions occurring prior to termination shall survive termination.
12. The State may establish and collect use fees for the recreational purposes of the Reservoir Property in accordance with its rules, regulations, and Colorado law. Said fees shall

- belong exclusively to the State. The District shall not charge or collect fees for recreational purposes on the Reservoir Property.
13. Consistent with any budgetary constraints and with personnel availability, and within its lawful discretion, the State shall operate and manage the Reservoir Property for recreational purposes in accordance with the Management Plan, and enforce the laws, rules, and regulations relating to parks and recreation areas on the Reservoir Property in order to supervise and control the public recreational use of the Reservoir Property. The State shall consult with the District prior to the adoption of any new rules and regulations by the State regarding public use of the Reservoir Property, which are specific to the Reservoir Property. In addition, the State shall at all times maintain at its cost all Recreational Facilities and support facilities in good and safe order, condition, and state of repair, usable by the public.
 14. The State shall have the right to construct, operate, and maintain on the Reservoir Property Recreational Facilities, provided that such Facilities are in accordance with the Management Plan prepared and existing pursuant to paragraphs 5 and 6, as may be amended, such amendments to be as approved in writing by the District. All Recreational Facilities or improvements or structures constructed by the State or the District shall become the property of the District and shall not be removed by the State without the written consent of the District. After the termination of the Agreement, the District may remove such improvements and Recreational Facilities in its sole discretion.
 15. The State shall have the right to enter into any written contract or permit with a third party (“Agent”) to act as the agent of the State for the purpose of performing and carrying out any of the functions provided for in this Agreement which, in the State’s sole authority and discretion, it deems appropriate to delegate to such Agent, provided that (a) the State shall promptly provide a true copy of each such contract or permit to the District, (b) such contract or permit shall refer to and incorporate by reference this Agreement, and (c) no such contract or permit shall relieve the State from the full and complete performance of its obligations and responsibilities under this Agreement. Said contracts shall be subject and subordinate to this Agreement and to all matters referenced in paragraph 1 of this Agreement. Said contracts shall specifically include concession contracts, provided that concession contracts shall be subject to the prior written approval of the District. The District shall be named as an additional insured in all such contracts and agreements. Notwithstanding the above, the State shall not delegate by contract or permit to any Agent the obligation of the State to manage and operate the entry stations into Stagecoach State Park and the campgrounds, RV campgrounds, parking lots, swimming beach, picnic sites and pavilion, boat ramps, non-motorized hiking trail, and potable water and sanitary sewer buildings within the Recreational Facilities, all of which must be managed and operated by the State itself. The State’s obligation to provide copies of contracts to the District under this paragraph shall be limited to concession contracts and contracts for the construction of Capital Improvements exceeding \$10,000.
 16. To the greatest extent possible, the State and District shall cooperate with each other to assure that each is able to exercise its rights and perform its obligations under this

Agreement with minimum interference to the other party's activities. Further, each party shall use every reasonable effort to prevent damage to the property and facilities managed, operated, or maintained by the other party. The State's manager of Stagecoach State Park and the manager of the District shall meet at least annually to discuss issues of mutual concern to the parties.

17. The District shall have sole control in its sole discretion over the diversion, intake, storage, allocation, and release or disposal of water in and from the Reservoir, generation of power from the power plant at the dam, the enlargement and expansion of the Reservoir, the timing and rate of increase and drawdown of water, the water levels and fluctuations thereof, water temperatures, circulation of water in the Reservoir, dredging of the Reservoir, and prohibition of boats and persons on the water surface for a reasonable safe distance from the spillway and intake structure, and the State shall have no right, interest, or entitlement thereto whatsoever except as provided in the first sentence of paragraph 9. Further, the District, its agents, and employees shall have access at all times to structures, dams, headgates, and all of the Reservoir Property and Recreational Facilities in order to manage, control, protect, and administer the intake, diversion, storage, management, allocation, and release or disposition of water in and from the Reservoir, generation of power at the power plant, and the expansion or enlargement of the Reservoir. If the District intends to cause or is aware of the pending occurrence of a substantial reduction in the water level of the Reservoir resulting from the release through the dam turbin from storage at a rate of more than 200 cfs, excluding springtime overflows of Reservoir water down the spillway, it shall notify the State in writing at least 24 hours in advance of such fact in order that fish and wildlife may be salvaged and other necessary steps may be taken to ensure the safety of public recreation users unless such release is necessary for human health and safety. The District shall also have the right to raise the level of the dam at Stagecoach Reservoir for the purpose of expanding the storage capacity of the Reservoir and subject additional land area within and outside of the Reservoir Property and portions of the Recreational Facilities to inundation.
18. CRS §33-41-101, et seq., may provide for the District to enjoy limitations on its potential liability which arise from use of the Property by members of the public for recreational purposes. In accordance with the provisions of CRS Section 33-41-103(2)(e)(II.5), the District acknowledges that this paragraph constitutes notice of the right to bargain for indemnification from liability for injury resulting from use of the Property by members of the public for recreational purposes, as those terms are defined in CRS Section 33-41-103(2)(e), and the District is advised that such right can be exercised prior to the execution of this Agreement at the request of the District. The District has exercised this right as agreed to in paragraph 20.
19. Notwithstanding any other provision of this Agreement to the contrary, no term or condition of this Agreement shall be construed or interpreted as a waiver, either expressed or implied, of any of the immunities, rights, benefits, or protection provided to the parties under the Colorado Governmental Immunity Act, §§ 24-10-101, et seq., C.R.S., as amended or as may be amended (including, without limitation, any amendments to such statute, or under any similar statute which is subsequently enacted). The parties hereto understand and agree that liability for claims for injuries to persons or

- property arising out of the negligence of the State of Colorado, its departments, institutions, agencies, boards, officials, and employees is controlled and limited by the provisions of §§ 24-10-101, et seq., C.R.S., as amended or as may be amended, and §§ 24-30-1501, et seq., C.R.S., as amended or as may be amended. Any provision of this Agreement, whether or not incorporated herein by reference, shall be controlled, limited, and otherwise modified so as to limit any liability of the parties to the above-cited laws.
20. To the extent authorized by § 24-30-1510(3)(e), C.R.S., the State shall defend and hold harmless the District against claims arising from the alleged negligent acts or omissions of the State and its public employees which occurred or are alleged to have occurred during the performance of their duties and within the scope of their employment, except where such acts or omissions are willful and wanton. Such claims shall be subject to the limitations of the “Colorado Governmental Immunity Act,” §§ 24-10-101 to 24-10-120, C.R.S., as now or hereafter amended.
 21. It is an express condition of this ~~Lease~~ Agreement that the Colorado Parks and Wildlife Commission (“Commission”) shall not by resolution, motion or other official action of the Commission, approved at a duly authorized meeting of the Commission, oppose the enlargement and expansion of Stagecoach Reservoir or the storage, use, or release of additional water in such enlargement as may hereafter be proposed by the District, or to the design, permitting, or construction of such Reservoir expansion and enlargement by the District. If such condition is for any reason broken, violated, or in default, then at any time within one year thereafter the District may at its sole election and upon written notice to the State terminate and rescind this ~~Lease~~ Agreement and may re-enter and take possession of the Recreational Facilities as in the prior estate, without liability to the State or any concessionaire or licensee of the State or any third party beneficiaries or the public. It is the intent and purpose of the parties that the District shall have a valid and enforceable right of entry on condition broken under the provisions of the preceding sentences until termination of this ~~Lease~~ Agreement. The prohibition set forth in this paragraph shall not apply to any employee of the Colorado Division of Parks and Wildlife, Colorado Water Conservation Board, or other State agency, or any concessionaire of the State on the Reservoir Property, nor shall such prohibition apply to any employee of the State or member of the Commission who expresses such an opinion in his or her private ~~of official~~ capacity.
 22. This Agreement shall be binding upon the parties hereto, their successors, and assignees. However, the State shall not assign this Agreement without the prior written consent of the District. Time is of the essence of this Agreement. In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall conclusively be presumed to affect adversely all other provisions hereof, as one integrated Agreement, and therefore any such holding shall conclusively be deemed to be a complete termination of this Agreement. This Agreement may not be altered or amended, and no right under this Agreement may be waived, except by a written instrument executed by the parties (or, in the case of a waiver, by a written instrument executed by the party granting the waiver) to this Agreement. No waiver of any breach

of any portion of this Agreement shall be deemed a waiver of any preceding or succeeding breach of that provision. No extension of time for performance of any obligations or acts shall be deemed an extension of the time for performance of any other obligations or acts. This Agreement, and the Management Plan to which this Agreement refers, contain the entire agreement between the parties with respect to the subject matter of this Agreement and supersedes the prior lease between the parties and all prior understandings with respect to the subject matter of this Agreement and the Management Plan. The parties have made no prior representations and have given no warranties with respect to the subject matter of this Agreement except as specifically provided herein. The parties do not intend to confer any benefit on any person, firm or corporation other than the signatory parties to this Agreement.

23. Notices. Any notice required or permitted to be provided hereunder shall be deemed given when either personally delivered or mailed by certified mail, return receipt requested, to the parties at their following addresses or such other addresses as they may designate in a notice duly delivered:

If to the District: Upper Yampa Water Conservancy District
 P.O. Box 775529
 Steamboat Springs, CO 80477
 Attn: Manager

If to State: Colorado Division of Parks and Wildlife
 Attn: Stagecoach Lake Park Manager
 P.O. Box 98
 Oak Creek, CO 80467

24. The District warrants and represents itself to be the owner of the Reservoir Property in the form and manner as stated herein; that it has the authority to enter into this Agreement with the State and that it has taken appropriate action to approve this Agreement; and that during the term of this Agreement it covenants and agrees to warrant and defend the State in the quiet, peaceable enjoyment and possession of the premises against the adverse property claims of any person which arise by, through, or under the District.
25. **STATEWIDE CONTRACT MANAGEMENT SYSTEM.** If the maximum amount payable to the District under this Agreement is \$100,000 or greater, either when this Agreement goes into effect or at any time thereafter, this section shall apply. The District agrees to be governed by and comply with the provisions of §§24-106-103, 24-102-206, 24-106-106, and 24-106-107, C.R.S. regarding the monitoring of vendor performance and the reporting of contract performance information in the State’s contract management system (“Contract Management System” or “CMS”). The District’s performance shall be subject to evaluation and review in accordance with the terms and conditions of this Agreement, Colorado statutes governing CMS, and State Fiscal Rules and State Controller policies.

26. DIGITAL SIGNATURES. If any signatory signs this Agreement using a digital signature in accordance with the Colorado State Controller Contract, Grant and Purchase Order Policies regarding the use of digital signatures issued under the State Fiscal Rules, then any agreement or consent to use digital signatures within the electronic system through which that signatory signed shall be incorporated into this Agreement by reference.
27. COLORADO SPECIAL PROVISIONS (COLORADO FISCAL RULE 3-3). These Special Provisions apply to all contracts except where noted in italics.
- A. STATUTORY APPROVAL. §24-30-202(1), C.R.S.
This Agreement shall not be valid until it has been approved by the Colorado State Controller or designee. If this Agreement is for a Major Information Technology Project, as defined in §24-37.5-102(2.6), then this Agreement shall not be valid until it has been approved by the State’s Chief Information Officer or designee.
- B. FUND AVAILABILITY. §24-30-202(5.5), C.R.S.
Financial obligations of the State payable after the current State Fiscal Year are contingent upon funds for that purpose being appropriated, budgeted, and otherwise made available.
- C. GOVERNMENTAL IMMUNITY.
Liability for claims for injuries to persons or property arising from the negligence of the State, its departments, boards, commissions committees, bureaus, offices, employees and officials shall be controlled and limited by the provisions of the Colorado Governmental Immunity Act, §24-10-101, et seq., C.R.S.; the Federal Tort Claims Act, 28 U.S.C. Pt. VI, Ch. 171 and 28 U.S.C. 1346(b), and the State’s risk management statutes, §§24-30-1501, et seq. C.R.S. No term or condition of this Agreement shall be construed or interpreted as a waiver, express or implied, of any of the immunities, rights, benefits, protections, or other provisions, contained in these statutes.
- D. COMPLIANCE WITH LAW.
The District shall comply with all applicable federal and State laws, rules, and regulations in effect or hereafter established, including, without limitation, laws applicable to discrimination and unfair employment practices.
- E. CHOICE OF LAW, JURISDICTION, AND VENUE.
Colorado law, and rules and regulations issued pursuant thereto, shall be applied in the interpretation, execution, and enforcement of this Agreement. Any provision included or incorporated herein by reference which conflicts with said laws, rules, and regulations shall be null and void. All suits or actions related to this Agreement shall be filed and proceedings held in the State of Colorado and venue shall be in the county in which the Property is located. Venue shall be proper in any county in which the Property is located if it is situate in more than one county.
- F. PROHIBITED TERMS.

Any term included in this Agreement that requires the State to indemnify or hold the District harmless; requires the State to agree to binding arbitration; limits the District's liability for damages resulting from death, bodily injury, or damage to tangible property; or that conflicts with this provision in any way shall be void ab initio. Nothing in this Agreement shall be construed as a waiver of any provision of §24-106-109 C.R.S.

G. EMPLOYEE FINANCIAL INTEREST/CONFLICT OF INTEREST. §§24-18-201 and 24-50-507, C.R.S.

The signatories aver that to their knowledge, no employee of the State has any personal or beneficial interest whatsoever in the service or property described in this Agreement. The District has no interest and shall not acquire any interest, direct or indirect, that would conflict in any manner or degree with the performance of the District's services and the District shall not employ any person having such known interests.

H. VENDOR OFFSET AND ERRONEOUS PAYMENTS. §§24-30-202(1) and 24-30-202.4, C.R.S.

[Not applicable to intergovernmental agreements] Subject to §24-30-202.4(3.5), C.R.S., the State Controller may withhold payment under the State's vendor offset intercept system for debts owed to State agencies for: (i) unpaid child support debts or child support arrearages; (ii) unpaid balances of tax, accrued interest, or other charges specified in §§39-21-101, et seq., C.R.S.; (iii) unpaid loans due to the Student Loan Division of the Department of Higher Education; (iv) amounts required to be paid to the Unemployment Compensation Fund; and (v) other unpaid debts owing to the State as a result of final agency determination or judicial action. The State may also recover, at the State's discretion, payments made to the District in error for any reason, including, but not limited to, overpayments or improper payments, and unexpended or excess funds received by the District by deduction from subsequent payments under this Agreement, deduction from any payment due under any other contracts, grants or agreements between the State and the District, or by any other appropriate method for collecting debts owed to the State.

[Signatures on following page]

From: [Ken Brenner](#)
To: [Andy Rossi](#); [Doug Monger \(dmonger@co.routt.co.us\)](mailto:dmonger@co.routt.co.us); [webster jones](#); [Nicole Seltzer](#); [Lyn Halliday](#); [redmondjv](#); [rmurphy100bc](#); [haskywild](#); [tom](#)
Cc: [Deb Bastian](#)
Subject: Re: New Planning Application for SC Ski Development
Date: Tuesday, March 14, 2023 9:38:47 AM

Directors,

I wanted to share my thoughts regarding a comment letter to the Routt County Planning Department detailing concerns and areas to be addressed with their review of a proposal to expand the Stagecoach Ski Area and surrounding areas. This is not intended to begin an on-line debate, but instead share with you my ideas for our comment letter and hopefully save us some time tomorrow.

Good morning Andy,

Here are most of the concerns that I believe should be addressed in a pre-application review of proposed Stagecoach Ski Development. Please consider including them in the letter from the UYWCD Directors to the Routt County Planning Department.

1. Impacts to the County road transportation system, County Road 14 and the Lynx Pass road
2. Workforce housing, proposed housing mix, zoning through the PUD process, Stagecoach Master Plan amendment (the proposal will create many new jobs, where will those employees live?)
3. Water quality from the MCMWSD effluent and often heavy fertilizer use associated with golf courses (we are already having some issues)
4. Trails and recreation impacts to the surrounding area
5. Reservoir setback/buffer, water body setbacks, additional south shore marina?
6. Wildlife and wildlife habitat impacts
7. Wildfire Urban Interface (WUI) concerns
8. Explore pursuing a municipal incorporation, becoming the Town of Stagecoach, urban services, grocery... (CML might have both information on incorporation and areas to be addressed)

#8 is an important one as the SPOA organization will not be able to address all of the issues with the development of that number of new dwelling units and their associated impacts. An incorporated Stagecoach could then have their own local government and elected officials, a tax base, functional commercial district, law enforcement, roads and road maintenance, planning department...

Ken Brenner
Upper Yampa Water Conservancy District, Director
Colorado Water Congress, Boardmember
Yampa White Green Roundtable, Boardmember/IBCC
FIS Alpine Technical Delegate
PO Box 772631
Steamboat Springs, Co 80477
970-819-6178

From: [Deb Bastian](#)
To: [Deb Bastian](#)
Subject: RE: New Planning Application for SC Ski Development
Date: Thursday, March 16, 2023 12:12:38 PM

From: tom@tomsharp.com <tom@tomsharp.com>

Sent: Tuesday, March 14, 2023 10:43 AM

To: kpbrennersteamboat <kpbrennersteamboat@gmail.com>; Andy Rossi <arossi@upperyampawater.com>; 'Doug Monger' <dmonger@co.routt.co.us>; webster jones <hwebster@frii.com>; 'Nicole Seltzer' <nseltzer@rivernetnetwork.org>; Lyn Halliday <lhalliday@environmentalsolutionllc.com>; redmondjv <redmondjv@gmail.com>; rmurphy100bc <rmurphy100bc@gmail.com>; haskywild <haskywild@mail.com>

Cc: Deb Bastian <dbastian@upperyampawater.com>

Subject: RE: New Planning Application for SC Ski Development

Ken:

I read your thoughts on potential comments from UYWCD regarding the proposed ski area and golf course developments at Stagecoach.

Since I have been the attorney for the Morrison Creek District for 50+ years, I want to relate comments over the years from Stagecoach residents regarding your comment 8—incorporating Stagecoach as a municipality. Incorporation of a new town is governed by CRS Sections 32-2-101 et seq. Here are the issues that have popped up over the years when we have looked at incorporating:

1. The process begins by a petition of 40 or more qualified electors in the proposed town area filing a petition with the District Court, describing the population and the boundary of the proposed town. Any area of more than 40 acres cannot be included without the written consent of the land owner. Both the Wittemyers and the Stahls would have to support and consent to being included in a new town. Neither the Court nor the County can force a town creation on those property owners.
2. The statute requires that “The proposed area of incorporation has an average of at least fifty registered electors residing within the boundaries of the proposed area of incorporation for each square mile of area.” The ski area proposal is 6230 acres and the golf course proposal is 390 acres. That’s 10 acres. So there would have to be “pulled into” the proposed boundary enough of the housing area to have at least 500 electors (excluding children), plus 50 electors for each square mile of already developed area “pulled into” the proposed boundary to create voters. We used to estimate there would need to be a minimum electoral population of 750. When you exclude children, who are not electors, there aren’t enough voters in the entirety of Stagecoach to meet those requirements.
3. Even if a proposed town boundary could be gerrymandered much smaller in order to meet the minimum size/electors qualification (for example, by including only the ski base area and keeping 80% of the ski development outside in the County), the statute requires the County to hold hearings and determine whether to permit the incorporation, and requires notice to all residents of the proposed incorporation.
4. IF the Court and County decides to approve the petition, then the Court orders an

incorporation election for the qualified electors in the proposed town area. Can such an election be won? The problem is that, currently, all road maintenance and all security/policing services in Stagecoach are provided by the County. If a small portion of the populated north end of Stagecoach became a town, the County would love to unload the costs of road maintenance and sheriff's duties on the new town, which would have no sales tax base, so that the residents of the new town would have to impose a mill levy on the residential properties to afford to have a road and police departments. Over the years, the Stagecoach residents and the Morrison Creek District directors who have thought about all that have concluded that there is nearly zero chance that the electors of the District would vote to create a town and thereby significantly increase their property taxes. I agree with that. Twice, the Morrison Creek District tried to de-bruce its mill levy, and lost both times.

So, Ken, the idea of pushing a new town incorporation in Stagecoach would in my opinion be a non-starter, without the initiation and support of the idea by the Wittemyers and Stahls. They haven't proposed that, and given that they want private exclusive developments, I doubt that the applicants would want to create a different layer of governmental review which would be governed in its earliest years by their existing neighbors.

Tom

From: Ken Brenner <kpbrennersteamboat@gmail.com>

Sent: Tuesday, March 14, 2023 9:38 AM

To: Andy Rossi <arossi@upperyampawater.com>; Doug Monger (dmonger@co.routt.co.us) <dmonger@co.routt.co.us>; Webster Jones (hwebster@frii.com) <hwebster@frii.com>; Nicole Seltzer <nseltzer@rivernetnetwork.org>; Lyn Halliday <lhalliday@environmentalsolutionllc.com>; John Redmond <redmondjv@gmail.com>; Ron Murphy (rmurphy100bc@gmail.com) <rmurphy100bc@gmail.com>; Jim Haskins (haskywild@mail.com) <haskywild@mail.com>; Tom Sharp <tom@tomsharp.com>

Cc: Deb Bastian <dbastian@upperyampawater.com>

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Ken Brenner

Upper Yampa Water Conservancy District, Director

Colorado Water Congress, Boardmember

Yampa White Green Roundtable, Boardmember/IBCC

FIS Alpine Technical Delegate

PO Box 772631

Steamboat Springs, Co 80477

970-819-6178

Yampa River Scorecard Project:

- OVERVIEW
- Sustainable Funding
- Inclusive Process-Working, Technical, and Stakeholder Committees
- Objectivity of criteria, methods, scoring
- Alignment with other entities
- Agricultural Community Outreach
- DELIVERABLES



**YAMPA RIVER
SCORECARD
PROJECT**



The Yampa River Scorecard Project



**YAMPA RIVER
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OVERVIEW: What is the Yampa River Scorecard Project?

The YRSP is a long-term river health monitoring and evaluation program for the Yampa Basin that will rate the overall condition of different segments of the Yampa River and articulate results through a “scorecard”. A comprehensive long-term monitoring program has yet to exist in the Yampa Basin.



A+

A

A-

B+

B

B-

C+

C

C-

D

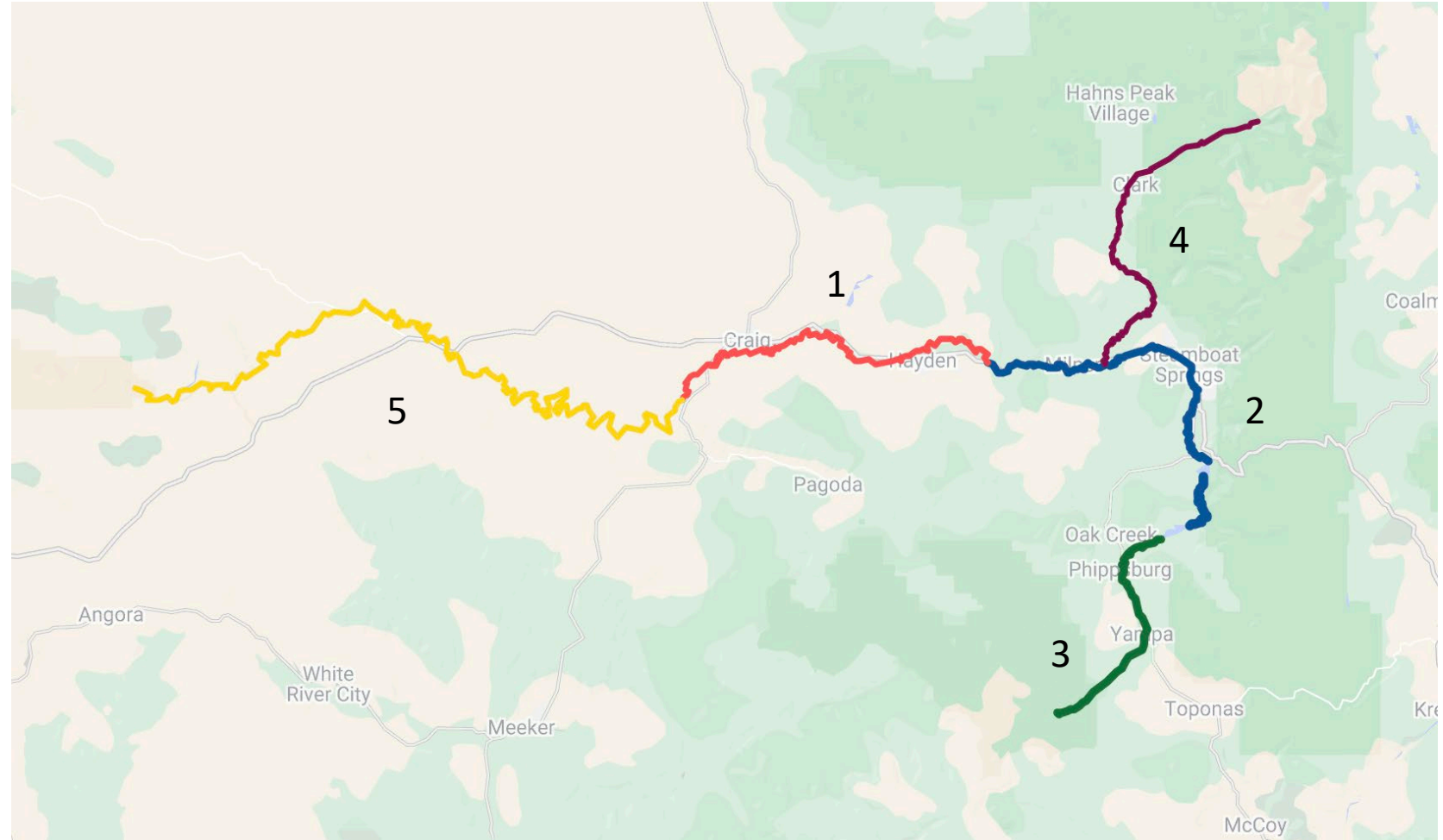
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YAMPA RIVER
SCORECARD
PROJECT

OVERVIEW: Process

- The river will be evaluated in its entirety one segment at a time, over the course of five years. The cycle will then repeat. The goal is for the YRSP to be a source of ONGOING data collection on the Yampa River.





OVERVIEW: Goals

1. Serve as a source of consistent long-term monitoring of river condition/attributes to track their changes over time for all interested parties including the public
2. Present data and science in an easily digestible and visually appealing, multimedia format to foster engagement and science education to everyone.
3. Provide a resource that helps inform future river management projects/decisions.





OVERVIEW: Problem Statement

These goals were based on the problem statement defined below.

Within the Yampa River Basin, the following conditions exist:

- Simultaneous ongoing and discrete projects and planning efforts.
- Data gaps related to river health and function, as well as community connection.
- A lack of accessibility to the data by all members of the community.
- A lack of a comprehensive understanding of the ecological health and community benefits of the river.





SUSTAINABLE FUNDING:

FOTY has a YRSP funding plan that identifies potential and likely sources of funding for each segment through 2026. Sources include:

- Partner NGOs
- Public Agencies
- Foundations
- Individual Donors

We will begin a funding plan for 2027-2031 next year. We expect costs per segment to decrease over time as we put systems in place that can be updated instead of created from scratch, and as we build expertise in house and thus decrease our reliance on contractors.





INCLUSIVE PROCESS:

The process involves regular meetings with three overlapping groups of local stakeholders:

- WORKING GROUP
- TECHNICAL COMMITTEE
- STAKEHOLDER COMMITTEE that met monthly in 2021 to discuss indicators and methods related to the river use and community benefits attribute areas.

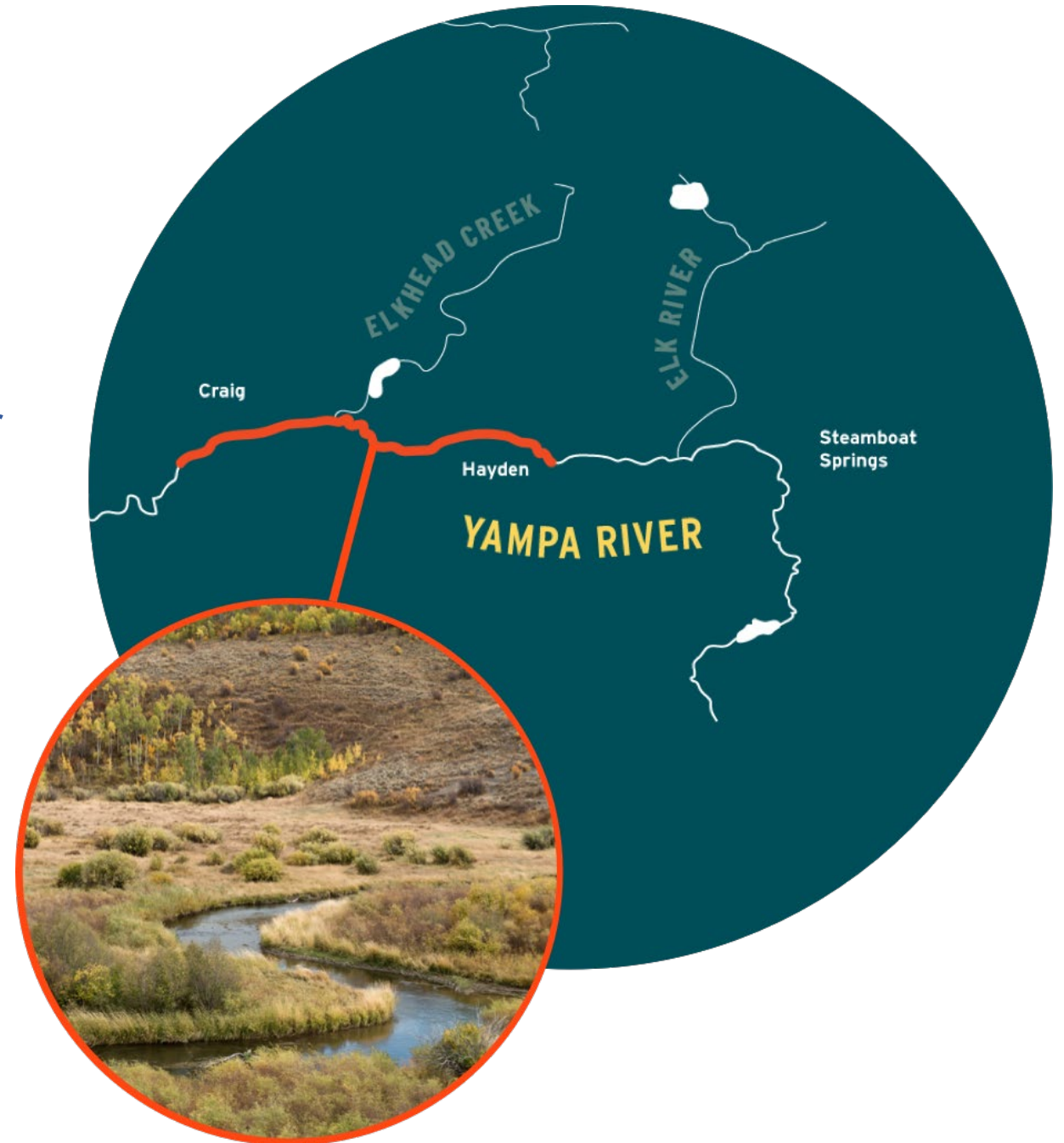


YAMPA RIVER
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YRSP Working Group:

A Working Group consisting of eight individuals was convened in December 2020 to determine the location of the initial focal river segment for the Yampa River Scorecard Project.

- Nicole Seltzer (The River Network)
- Michelle Stewart (Yampa Valley Sustainability Council)
- Kelly Romero-Heaney (City of Steamboat Springs)
- Brian Hodge (Trout Unlimited-Colorado)
- Andy Rossi and Holly Kirkpatrick (Upper Yampa Water Conservancy District)
- Jennifer Wellman (The Nature Conservancy)
- Lindsey Marlow (Friends of the Yampa)
- Kim Lennberg (Alba Watershed Consulting)





YRSP Stakeholder Group:

- Nicole Seltzer (The River Network)
- Brian Hodge (TU-Colorado)
- Michele Meyer (CAA)
- Scott Cowman (Routt County)
- Doug Monger (Land Owner, IWMP Chair)
- Peter Brixius (City of Craig)
- Melanie Kilpatrick (City of Craig)
- Nathan Stewart (CMC)
- Jackie Brown (TriState)
- Tamara Naumann (Yampa River Leafy Spurge Project)
- Baili Foster (NRCS)
- Tom Kleinschnitz (Moffat Co. Tourism Board)
- Jennifer Holloway (Craig Chamber of Commerce)
- Hattie Johnson (American Whitewater)

- Matt Rice(American Rivers)
- Jennifer Wellman (TNC)
- Andy Rossi (UYWCD)
- Holly Kirkpatrick (UYWCD)
- Andy Baur (Yampa River Fund)
- Tim Sullivan (YVSC)
- Michelle Stewart (YVSC)
- Maddy Muxworthy (YVSC)
- Joe Haines (Yampatika)
- John Kemper (CSU Geomorphology)
- Sara Rathburn (CSU Geomorphology)
- Sarah Jones (Steamboat Ski and Resort Corporation)
- Don Anderson (US Fish and Wildlife)
- Matthew Mendisco (Town Manager, Hayden)
- Dan Chovan (Yampa Valley Fly Fishers)
- Peter Skidmore (Walton Family Foundation)

- Alison Meyer Gould (CO Water Trust)
- David Graf (CO Parks & Wildlife)
- Jacob Dewhirst (Yampa River State Park)
- Eric Scherff (BLM)
- Josh Veenstra (Good Vibes River Gear)
- John Husband (Parrotheads, Legacy Group, Craig Resident)

Some members of this group met monthly in 2021 to discuss and select indicators and methods related to the river use and community benefits attribute areas.



YAMPA RIVER
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YRSP Technical Group:

The Technical Committee met bimonthly in 2021 to determine categories, indicators, monitoring methods, and scoring criteria for the ecological health and function attribute area. More were invited to be a part of the technical committee, but this list reflects actual participants.

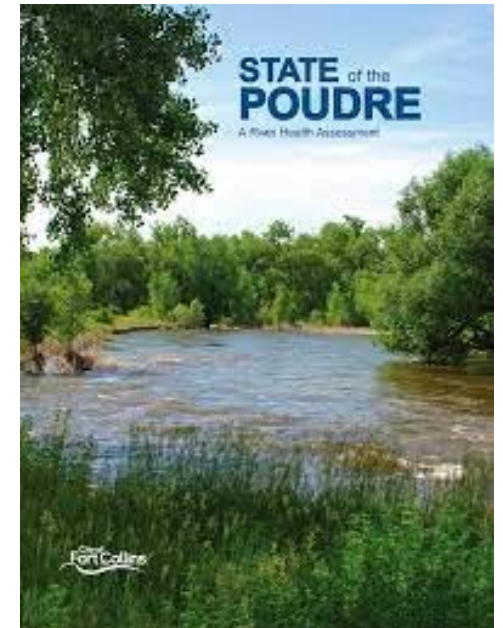
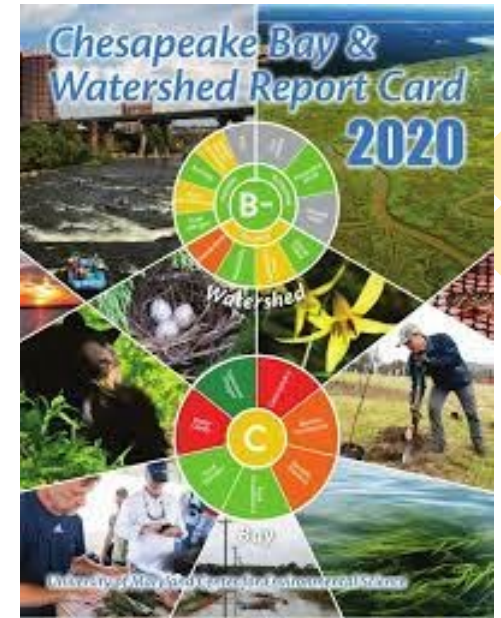
- Brian Hodge (Trout Unlimited: Fisheries)
- Nicole Seltzer (River Network)
- Andy Rossi (Upper Yampa Water Conservancy District)
- Holly Kirkpatrick (Upper Yampa Water Conservancy District)
- Nathan Stewart (CMC, Ecologist, Sustainability Sciences)
- Tim Sullivan (Yampa Valley Sustainability Council, Forestry, Riparian Habitat)
- Jennifer Wellman (The Nature Conservancy Hydrologist, Watershed Science)
- Madison Muxworthy (Yampa Valley Sustainability Council)
- Tamara Nauman (retired NPS Ecologist, Yampa River Leafy Spurge Project)
- John Kemper (CSU, PhD student Geomorphology)
- Sara Rathburn (CSU, Geomorphology)
- Brett Bruyere (CSU, Human Dimensions of Natural Resources)
- Abby Burk (Audobon, Ecologist, Birds)
- Kim Lennberg (Alba Watershed Consulting)
- David Graf (Colorado Parks and Wildlife)
- Don Anderson (US Fish and Wildlife Service)
- Brad Johnson (Johnson Environmental Consulting)



YRSP OBJECTIVITY:

The technical committee selected scoring criteria, methods, and scoring through a collaborative process that was informed by reputable and highly vetted work:

- University of Maryland Center for Environmental Science- **Eco Health Report Cards**
- City of Fort Collins- **State of the Poudre: A River Health Report Card**
- Eco Metrics and Colorado State University: **FACstream: A Functional Assessment of Colorado Streams**
- Brad Johnson, Johnson Env. Consulting, and Mark Beardsley, Ecometrics: **Colorado Stream Health Assessment Framework**
 - COSHAF informed the Yampa River Health Assessment and Streamflow Management Plan for the City of Steamboat Springs
 - COSHAF also informed river health assessments in the following basins: Crystal, Roaring Fork, San Miguel, Eagle, Middle Colorado, St. Vrain and Left Hand, Big Thompson, and South Boulder Creek



FACStream 1.0 (2015)
Functional Assessment of Colorado Streams



Eco Metrics Colorado State University



YAMPA RIVER
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PROJECT

YRSP OBJECTIVITY: Criteria, methods, and scoring:

- 1.Flow Regime
- 2.Sediment Regime
- 3.Water Quality
- 4.Habitat Connectivity
- 5.Riverscape Connectivity
- 6.Riparian Condition
- 7.River Form
- 8.Structural Complexity
- 9.Biotic Community



These criteria were agreed upon by the Technical Committee after extensive review of related work and attention to the Yampa Basin's unique qualities. Specific indicators, monitoring methods, and scoring criteria related to these categories were also decided upon by the technical committee.



YRSP ALIGNMENT with Other Entities:

- **YWGBR:** IWMP Recommendation #8- *“Utilize the Yampa River Scorecard Project (YRSP) to centralize collection & reporting of river ecosystem data: Develop a scorecard to fill data gaps, be a source of easily accessible information, and support a comprehensive understanding of the community benefits a healthy river provides for everyone who uses the river for whatever purpose.”*
- **City of Steamboat Springs:** YRSP provides data that aligns with each objective of the Yampa River Health Assessment & Streamflow Management Plan. The timing of the YRSP also aligns with the proposed recommended monitoring scheduled put forth by the City of SBS.





YAMPA RIVER
SCORECARD
PROJECT

YRSP ALIGNMENT with Other Entities:

UYWCD: The Board of Directors believes that the District's mission is related to the following statements. FOTY believes that the YRSP supports these ideals:

- 1. The District relies on healthy functioning reservoirs, rivers, and streams in the Upper Yampa Basin for its agricultural, environmental, municipal, commercial, industrial, domestic and recreational cultures, and thus, its economic future.*
- 2. The District is committed to serving the public in agricultural, municipal, commercial, domestic and industrial uses, and identifying opportunities to support water-based environmental and recreational values.*
- 3. Collaboration in watershed management is important to advancing the District's mission.*
- 4. The District recognizes the importance of science-based water quality programs in maintaining the chemical, physical, biological, and aesthetic integrity of the Basin's reservoirs, rivers, and streams.*





YRSP AGRICULTURAL COMMUNITY OUTREACH:

Outreach to the Agricultural Community related to the YRSP:

- Is ongoing
- Is happening in collaboration with CAA Water Coordinators Jeff Clyncke and Gena Hinkemeyer
- Includes outreach to fishing lease holders such as Steve Henderson, Paul Russell, and Johnny Spillane
- Hopes to integrate with outreach to non-agricultural landowners through RCCD and CAA
- Will benefit if more people are informed about the YRSP
- Needs help from community champions of this effort

Please reach out to Jenny Frithsen at jenny@friendsoftheyampa.com if you would like to help in outreach efforts.



YRSP DELIVERABLES:

1. User Interface

- [Scorecard Home Page Mock-up](#)
- [Score Breakdown Mock-up](#)
- [Indicator Detail](#)

2. Final Report- *see link in UYWCD Board Meeting Agenda*



YAMPA RIVER
SCORECARD
PROJECT

IN SUMMARY:



The YRSP is NOT:

Judgmental
Prescriptive
Regulatory



The YRSP is intended to:

Start conversations
Highlight opportunity
Inform decision-making

FINAL

Yampa River Scorecard Project Middle Yampa Segment Results and Scoring

February 2023



Prepared for:



Friends of the Yampa
Steamboat Springs, Colorado

Prepared by:



Alba Watershed Consulting
Boulder, Colorado

Colorado State University
Fort Collins, Colorado



**YAMPA RIVER
SCORECARD
PROJECT**

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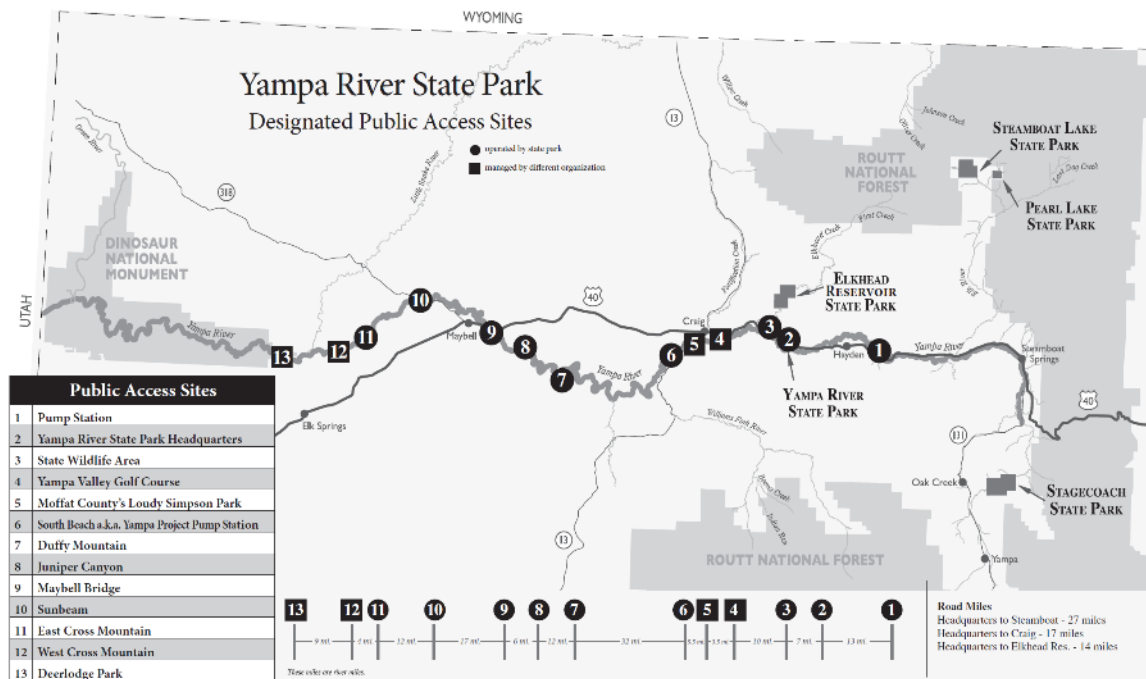
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- A Photo Compilation
- B Technical Memorandum: Yampa Scorecard Segment Riparian Mapping Methods and Results (December 10, 2021)

1.0 INTRODUCTION

Friends of the Yampa is leading a community-based process to implement a long-term river health monitoring and evaluation program for the Yampa Basin that rates the overall condition of different segments of the Yampa River and articulates results through a *Yampa River Scorecard*. The first iteration of the Yampa River Scorecard Project (YRSP) is focused on the Middle Yampa River segment of the Yampa main stem, a 39-mile segment from the Hayden pump station to South Beach. Figure 1-1 shows public access points along the Yampa River. The Scorecard focal segment corresponds to points #1 through #6 on this map. The Xcel Pump Station (sometimes referred to as Pumphouse) is a Colorado Parks and Wildlife (CPW) public river access site approximately 5 miles east of Hayden, just upstream of The Nature Conservancy’s Carpenter Ranch in Routt County. The segment flows through Morgan Bottom, the Town of Hayden, Yampa River State Park Headquarters, the Yampa River State Wildlife Area (also known as Dorsey), the City of Craig, the Yampa Valley Golf Course (also known as Pebble Beach), and Loudy Simpson Park in Moffat County. The downstream boundary of the segment is the South Beach (also known as the Yampa Project pump station) public river access site, located approximately 3 miles south of Craig upstream of Little Yampa Canyon.

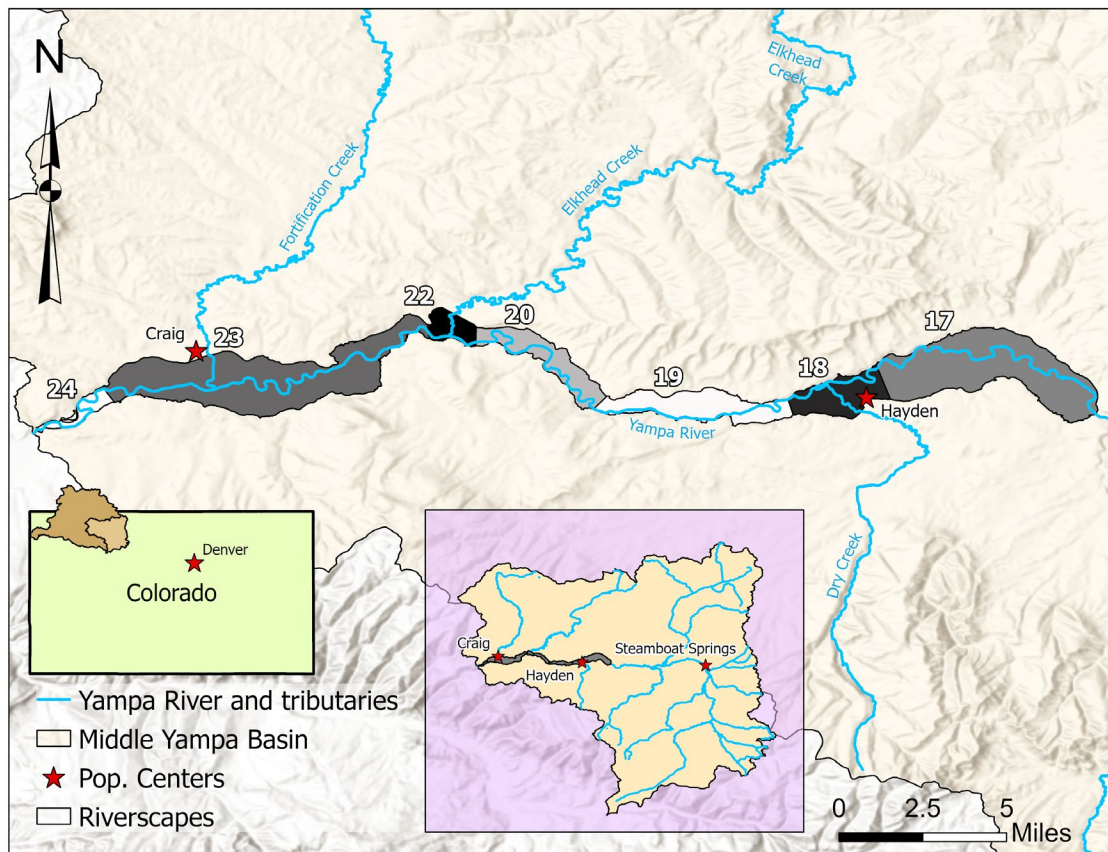
Figure 1-1. Yampa River Public Access Sites



Seven riverscapes identified in the Yampa Integrated Water Management Plan (IWMP) remote assessment are contained within this segment (Figure 1-2). A score for each indicator will be developed for each riverscape, and then averaged for an overall riverscape score (refer to Section 11 for more information). A weighted average across the seven riverscapes will then be calculated to generate an overall ecological health and function score for the Middle Yampa River Segment.

More information about the Yampa River Scorecard Project goals; background on determination of the focal segment for the first iteration of the Scorecard; information related to the three stakeholder-identified attribute areas that are to be evaluated as part of the Scorecard effort (river uses and management, people and community benefits, and ecological health and function); and details specific to the categories, indicators, monitoring methods, and scoring criteria used to assess the ecological health and function attribute area are provided in the Yampa River Scorecard Project Indicators and Methods Report (FOTY/Alba Watershed Consulting 2021). To encourage community-wide engagement and contribution to tracking river health, the monitoring and evaluation process is communicated using concise, clear, and visually appealing methods; visit <https://yampascorecard.org/> for the YRSP public interface.

Figure 1-2. Middle Yampa River Segment Riverscapes



This document details the results and rationale behind scoring of the ecological health and function attribute area for the Middle Yampa River scorecard focal segment. The YRSP Technical Committee agreed on a set of categories to evaluate river health and function, largely based on the Functional Assessment of Colorado Streams (FACStream, Beardsley et al. 2015), a reach-scale assessment tool developed for the US EPA and State of Colorado that rates stream health according to the degree of impairment of several ecological variables, and the Colorado Stream Health Assessment Framework (COSHAF), a stream health assessment framework based on the FACStream variables used in many stream management plans (SMP) across Colorado, including an SMP completed by the City of Steamboat Springs covering a 12-mile section of the Yampa River through the City (City of Steamboat Springs 2018). COSHAF uses 11 variables to: evaluate the key factors that determine the health and resilience of a stream reach, ensure that all relevant aspects

of stream health are considered, and serve as a guide for determining which monitoring parameters are most relevant. Other river-related report card efforts, particularly the Eco Health Report Cards undertaken by the University of Maryland Center for Environmental Science and its partners, were consulted as well. Based on these existing scorecards and ongoing input from the Technical Committee, the following categories were identified for evaluation:

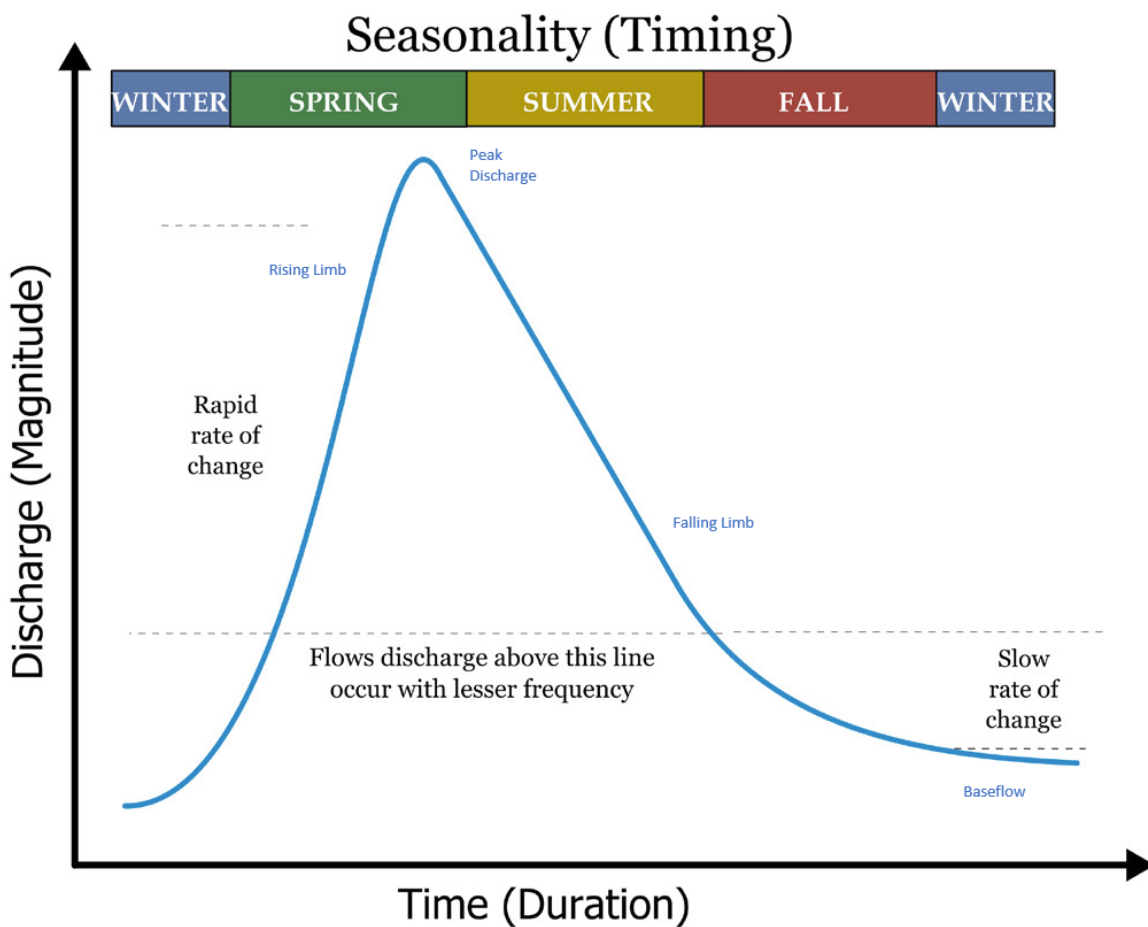
- Flow Regime (amount and timing of water supply);
- Sediment Regime (amount, timing, and type of sediment supply);
- Water Quality (physicochemical properties of water);
- Habitat Connectivity (aquatic and terrestrial habitat connectivity);
- Riverscape Connectivity (frequency, extent, and duration of riverscape saturation or inundation);
- Riparian Condition (riparian habitat condition, including vegetation structure, diversity, and invasive species);
- River Form (channel morphology including planform, dimension, and profile);
- Structural Complexity (physical habitat including water depth, velocity, structural components, and substrate); and
- Biotic Community (community and trophic structure of the organisms in the reach).

The remainder of this document describes the suite of categories and indicators that, when evaluated, provide a comprehensive understanding of river health and function across the Middle Yampa River segment. Each sub-section discusses one of the nine categories listed above, with further subdivisions by indicator. The discussion of each indicator contains a description of the indicator, the data sources and methods used to evaluate the indicator, the scoring criteria that are applied, the results and rationale for scoring, and associated scores. Existing data are used to the extent possible, supplemented by additional data analysis and field data collection where specified.

2.0 FLOW REGIME

Flow regime is defined as the characteristic pattern by which water is supplied to a river segment from its contributing watershed. It is often represented by a hydrograph, and is dictated by precipitation, inter- and intra-annual weather patterns, watershed characteristics, and human influences. Flow regime is a primary determinant of a river’s structure and function. In particular, the magnitude, duration, frequency, and timing of river flow interact with the landscape to determine the functions that the river performs. The Yampa River Scorecard evaluates two indicators within the flow regime category: the overall **hydrograph** and the annual **snowpack**. Figure 2-1 provides a schematic diagram of an annual hydrograph, illustrating important concepts such as peak discharge, base flow, and rising and falling limbs. The final flow regime score is calculated as 90% hydrograph indicator score and 10% snowpack indicator score. The Technical Committee decided on this uneven split to avoid double counting and consider the fact that snowpack is a driver of flow regime and exerts a major influence on the elements of the hydrograph indicator.

Figure 2-1. Hydrograph Schematic Diagram



2.1 HYDROGRAPH INDICATOR

The hydrograph indicator considers the following components of the Yampa River's flow regime:

- Magnitude, timing, and duration of **peak flows**. Adequate peak flows are essential to river health and function. Snowmelt-driven peak flows during spring runoff are important for numerous watershed services, such as fishery support, riparian habitat quality, sediment flushing, water quality maintenance, recreation, aesthetics, and groundwater connection and recharge.
- Magnitude, timing, and duration of **base flows**. Base flows are the low flows that occur after snowpack melt, during dry season, usually from late summer to early spring. They provide critical support of aquatic habitat and riparian connectivity when the stream needs it most after peak flows have receded. Sources of base flows are rainfall events and slowly percolating groundwater, and they can be augmented by reservoir releases and irrigation return flows in managed systems.

Please note that total annual volume (the amount of water delivered to the riverscape from its contributing watershed) and hydrograph form (the shape of the hydrograph, including timing and duration of rising and falling limbs) are also important components of flow regime in the Yampa River basin but are not included in the scoring for this indicator due to lack of available modeled data.

2.1.1 *Data Sources and Evaluation Methods*

Development of scores for this indicator relies heavily on existing USGS stream gauge data, augmented by local knowledge. As a holistic indicator, this variable uses expert judgement and review and analysis of available data to generate a single score for the hydrograph indicator. The rationale behind that score is heavily influenced by the peak flow and base flow components of the hydrograph discussed in the previous section.

The stream gauges within the Middle Yampa River segment are as follows:

- (1) USGS 09244410 YAMPA RIVER BELOW DIVERSION, NEAR HAYDEN, CO – This gauge is just upstream of Carpenter Ranch and no longer operational (1965-1986).
- (2) USGS 09244490 YAMPA RIVER ABOVE ELKHEAD CREEK NEAR HAYDEN, CO – This gauge is located just upstream of the confluence with Elkhead Creek (2004-2021).
- (3) USGS 09247600 YAMPA RIVER BELOW CRAIG, CO – This is an active gauge located below Craig (1984-2021).

The Wilson Water Group (WWG) conducted hydrology modeling for the Basin Implementation Plan Phase 3 (WWG 2018), where these and other stream gauge nodes within the Yampa Basin were used to explore the potential benefits and impacts of Yampa-White-Green Basin Roundtable projects under different hydrologic scenarios, including natural streamflows, baseline streamflows, and future scenario streamflows. The modeled natural flow regime is derived by removing the influence of human activities from current recorded streamflow to estimate natural,

undisturbed flows at locations on the Yampa River. Disturbance activities that can be accounted for include diversions, irrigated agriculture and return flows, storage and releases, and water rights administration. Existing streamflow conditions, referred to as baseline conditions, represent recorded diversions, current consumptive demands, administration, instream flow and recreational in-channel diversions (RICD), existing infrastructure, and reservoir operations, and include modifications based on water-user interviews. While the WWG modeling did not include pre-measurement changes to hydrology or paleohydrology in establishing “natural” streamflows, the authors of this report acknowledge the relative recency of the USGS stream gauge data.

The Yampa IWMP remote assessment’s Data Synthesis Report (Yampa IWMP 2021) applied these data to percent departure of baseline conditions from natural conditions for two metrics: (1) percent departure of high flows and (2) percent departure of low flows. The two metrics were used in the remote assessment to provide a high-level, holistic indication of flow regime alteration within the Yampa basin (Figure 2-2). A more detailed hydrologic analysis of more than 107 metrics is presented in the Yampa River Hydrologic Review and Needs Assessment Report (Lotic 2021). This report and its associated data are used to rate this indicator.

To rate the hydrograph indicator, streamflow data from the three gauges listed above, as well as additional streamflow nodes within the 39-mile Scorecard focal segment that are used in the Lotic (2021) hydrologic analysis, were used to determine the departure of existing flow regime from modeled natural flow conditions, as well as to compare the baseline (existing) hydrograph to the modeled natural hydrograph over the period of record. In particular, daily flow data for modeled baseline (modeled existing) and modeled natural flows for all gauges/nodes covering the years 1974-2013 are compared. Future iterations of the Yampa River Scorecard Project will explore acquiring similar modeled data that extends to more recent years (i.e., beyond 2013).

Additional data sources used to augment this review of historical modeled hydrographs are current local knowledge of dry-up points or significantly reduced flow locations that are not reflected in the existing stream gauge records, as well as a recent USGS publication investigating streamflow and water quality in the upper Yampa River Basin from 1992-2018 (Day 2021). This publication also conducts a streamflow trend analysis on the main stem Yampa River over a much longer time period (since 1910).

Figure 2-2. Yampa IWMP Remote Assessment Flow Regime Percent Departure Plots

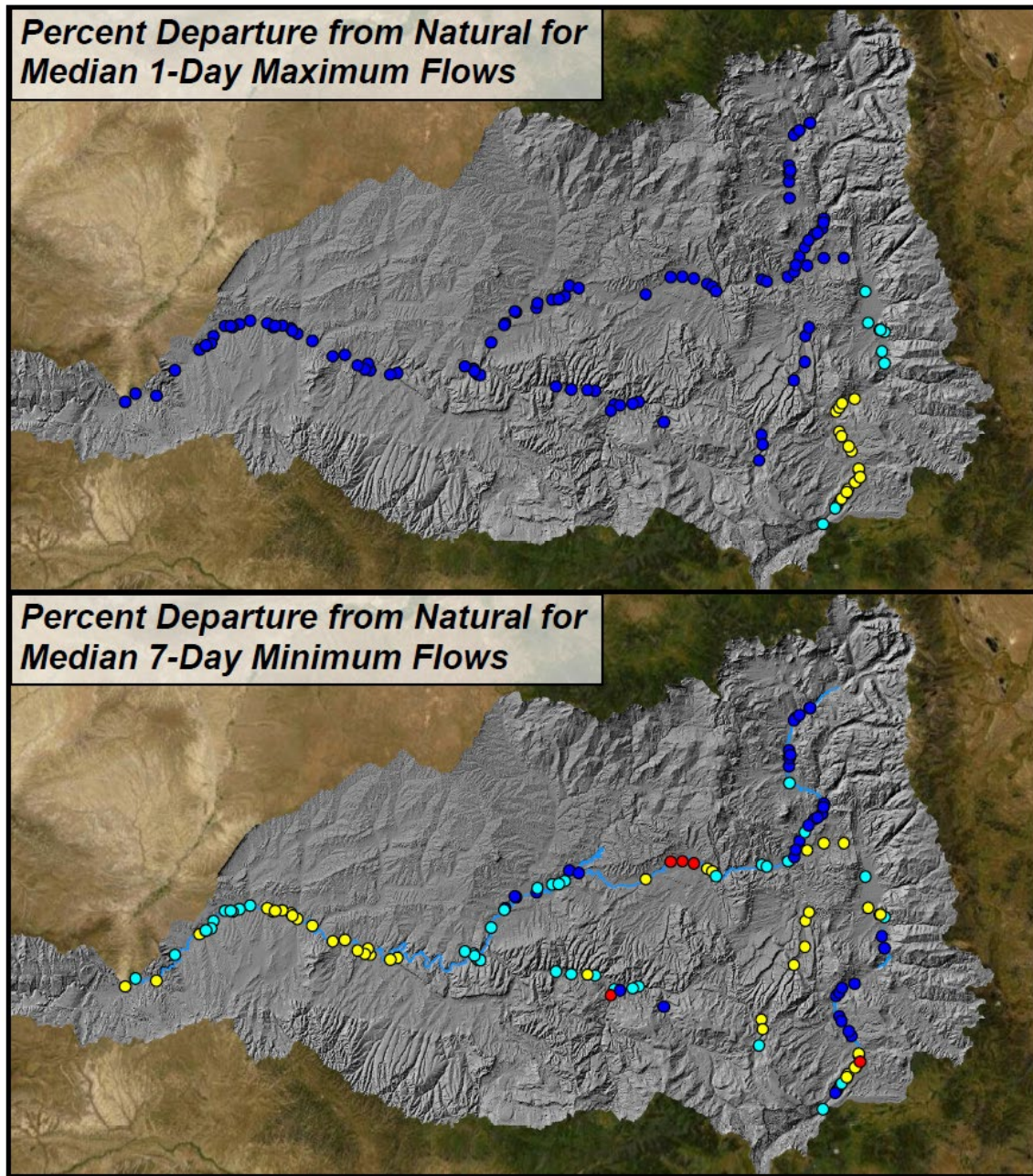


Figure 6-17. Percent Departure from Natural for Median 1-Day Maximum and 7-Day Minimum Flows

Percent Departure from Natural

- Intact (>0.85)
- Good (0.65-0.85)
- Moderate (0.4-0.65)
- Poor (<0.4)

— Yampa River IWMP Segments

0 5 10 15 Miles

2.1.2 Scoring Criteria

The descriptive and semi-quantitative scoring criteria outlined in Table 2-1 are used to rate the hydrograph indicator. Each sub-indicator (e.g., 1-day maximum flow) is given a grade and then sub-indicator scores are compiled to yield an overall score.

Table 2-1. Hydrograph Indicator Scoring Criteria

Grade	Description
A	Baseline hydrograph characteristics resemble the natural hydrograph. Magnitude and duration of annual discharge peaks and base flows closely resemble natural hydrograph. Departure from natural median 1-day maximum and 7-day minimum discharge estimated to be less than 10% and lack of observable temporal downward trends in the gage record exists. Lack of significant trend in mean flow.
B	Hydrograph has a near natural seasonal pattern, but peaks are attenuated, elevated, extended, or shortened, with departure from natural median 1-day maximum flow magnitude estimated to be 10-25%. Seasonal 7-day minimum discharge diminished approximately 10-25% or increased by 10-50% compared to natural flow. One-day maximum and 7-day minimum flows lack statistically significant downward trends over time, though some observable trends may be present. Impacts from artificial flow changes are minimal, if any. Mean flows resemble natural and display a lack of statistically significant downward trend over time.
C	Hydrograph has a natural seasonal pattern, but peaks are attenuated, elevated, extended, or shortened, with departure from natural median 1-day maximum flow magnitude estimated to be 25-50%. Periods of biologically critical low flows occur occasionally, and seasonal 7-day minimum discharge is diminished approximately 25-50% or increased by more than 50% compared to natural flow. One-day maximum and 7-day minimum flows display statistically significant downward trends for a given time period (e.g., April flows) but not at the overall annual scale. Rapid artificial flow changes occur occasionally. Mean flows are statistically significantly different through time for some portion of the flow year.
D	Disrupted seasonal hydrograph patterns and/or departure from natural median 1-day maximum flow magnitude greater than approximately 50%. Periods of biologically critical low flows are frequent, with seasonal 7-day minimum discharge diminished by more than 50%. One-day maximum and 7-day minimum flows display statistically significant downward trends for several given time periods (e.g., spring month flows) but not at the overall annual scale. Rapid artificial flow changes occur frequently.
F	Disrupted seasonal hydrograph patterns and/or departure from natural median 1-day maximum flow magnitude significantly greater than approximately 50%. Frequent and extended periods of biologically critical low flows and/or periods of no flow occur, with seasonal 7-day minimum discharge diminished by more than 50%. One-day maximum and 7-day minimum flows display statistically significant downward trends for a majority of given time periods (e.g., all but winter flows) but and at the overall annual scale. Mean flows are significantly different from the period of record at the annual scale. Artificially uniform hydrograph, or hydrographs in which rapid daily fluctuations, are common.

2.1.3 Results

Hydrograph analysis was largely completed from 2020-21 in conjunction with the Yampa IWMP (Wilson Water Group 2018, Lotic 2021, Yampa IWMP 2021). Additionally, relevant data and analyses also come from a USGS report on streamflow and water quality in the Upper Yampa Basin (Day 2021). Results and findings of previous reports regarding the health of the hydrologic regime on the Yampa have been refined and synthesized to integrate into the Scorecard framework. The methodology behind these analyses conducted as part of the Yampa IWMP is outlined above (Section 2.1.1); a more thorough explanation can be found in the body of the referenced reports. Analysis focuses primarily on peak flows and minimum flows, as these correspond most strongly with natural function: the magnitude of a high flow event controls how much of the floodplain is inundated, and for how long, and is therefore of substantial importance for maintaining riparian vegetation health, distributing sediment through and across the river corridor, building structural complexity, and enabling connectivity between in-channel and floodplain habitat; low flows, meanwhile, help to maintain essential aquatic habitat, riparian vegetation, and a healthy fishery, and also influence water quality and sediment transport. Secondary consideration is given to mean annual flow; total flow volume, though an important component of the natural flow regime, is not considered. The omission of this latter factor is chiefly because the parameters analyzed herein (maximum, minimum, and mean flows, as well as the timing of peak flow) encompass those flows that have the most substantial correlation to natural riverine functions. Additionally, selection of the metrics on which to concentrate this analysis was done to remain consistent in methodology; robust prior modeling and examination of minimum and maximum flows was done at fine temporal and spatial scales, as was analysis of mean discharge data and the timing of peak flows. Similarly extensive modeling and statistical analysis of trends in total flow volume required to be consistent with the robustness of prior analysis of other flow metrics would have been needed to be considered in this analysis.

Percent departure in median annual 1-day maximum flows is a metric that reflects the degree to which the magnitude of high flow events has changed during the period of record (1974-2013). The magnitude of a high flow event controls how much of the floodplain is inundated, and for how long. These events are thus of substantial importance for maintaining riparian vegetation health, distributing sediment through and across the river corridor, building structural complexity, and enabling connectivity between in-channel and floodplain habitat. In all riverscapes in which analysis was possible, the departure of the modeled baseline 1-day maximum flow is minimal. In riverscapes 17 and 19, baseline flows are 8% different than natural; in riverscapes 22-24, the departure is merely 5% (Yampa IWMP 2021, Lotic 2021). No modeling results are reported for riverscapes 18 and 20 due to the lack of modeling nodes (i.e., the points of the river at which flows are simulated) in these riverscapes.

In slight contrast, the magnitude of 1-day maximum flows as measured at USGS gages 09244490 (Yampa River above Elkhead Creek near Hayden, CO, located in riverscape 20) and 09247600 (Yampa River below Craig, CO, located in riverscape 24) displays a downward trend at the annual scale for the years 1992-2018, though the trend is not statistically significant (Day 2021). Additionally, at USGS 09244490, 1-day maximum flows have a similar downward trend at the monthly scale: flow magnitudes have trended downwards over the past 17 years in the late spring and mid-summer months (May and July), as well as in the fall thru mid-winter (September-January), though neither trend is statistically significant (Day 2021). At USGS 09247600, a similarly observable downward trend is seen in the winter months (November-March) and mid-to-late

summer (July-September), though only the February trend is significant. At both stations, it is likely that the downward trends are driven by reservoir operations at Stagecoach Reservoir (e.g., storage of winter and spring runoff), land-use (e.g., irrigation trends), and climate-related (e.g., changes in snowpack) alterations that have impacted streamflow basin-wide (Day 2021). Overall, while the majority of the above discussed trends are not statistically significant, the observable downward direction suggests that flows during these months may continue to decline in the future. Given the minimal departures in the modeling data and observable but not statistically significant trends in the gage data, each riverscape scores an A for the peak flow component of the hydrograph indicator (Table 2-2).

Percent departure in median annual 7-day minimum flow is a metric that reflects the degree to which low flows have been altered from natural conditions. Modeled departures of 7-day minimum flows from natural conditions are substantial for riverscapes in the vicinity of Hayden – differences are 68% and 57% in riverscapes 17 and 19, respectively. Below Hayden, alteration is notably more minimal; riverscapes 22, 23, and 24 have departures of 14%, 18%, and 14%, respectively (Yampa IWMP 2021, Lotic 2021). Though these differences between baseline (current) flow and natural flow are significant, they are of relatively low magnitude (Lotic 2021). As above, modeling results were not reported for riverscapes 18 and 20 due to the lack of modeling nodes located in these reaches.

In terms of recorded stream gage data, at USGS 09244490, 7-day minimum flows as measured from 1992-2018 show an observable downward trend at the annual scale and at the monthly scale for all months save April, though the trend is only significant for January (a lack of significance that may be attributable to the relatively short period of consideration) (Day 2021). At USGS 09247600, the downward trend is mostly evident in the mid-to-late winter months (January-March) and the summer (June-August), though the trend is only significant for March. Notably, there is an observable positive trend at the annual scale for this gage, though again the trend is not statistically significant. Again, while trends are not statistically significant, the observable downward direction in many months suggests that flows during these months may continue to decline in the future (Day 2021). Riverscape scores for the baseflow component of the hydrograph indicator are provided in Table 2-2.

Trends in modeled mean flows were not analyzed for the Yampa IWMP (Lotic 2021, WWG 2018) but were examined for the historical gage data by the USGS 2021 report (Day 2021) and by Lotic (2021) (though, in the latter, only at USGS 09247600). Findings of the former report are as follows: similar in pattern to those shown by the 1-day maximum flows, an observable downward trend is seen for both gages in the summer months (June, July, and August) at both gaging stations; notably, this downward trend continues at USGS 09264490 through the fall and into the winter, extending into January. As above, these trends are observable rather than statistically significant. A significant negative trend in mean flow does occur for USGS 09267600 in the month of February. There is a lack of trend seen in the data for both stations during the late winter and spring months (February-May). In terms of overall mean annual flow, both stations display an observable (but not significant) downward trend. Because of the more substantial correlation of maximum and minimum flows with natural functions (as presented above), mean flows were given relatively lesser weight in the scoring analysis, but were considered. No significant trends in mean flows were found by Lotic (2021) for USGS 9247600.

Regarding trends at longer timescales, data from outside the focal segment provide relevant and illustrative perspective. Examination of data from 1910-2018 at USGS stream gage 09239500 (Yampa River at Steamboat Springs, CO) reveals downward trends in mean and maximum streamflow at both the annual scale and for the spring and summer months (Day 2021). Significant downward trends in the magnitude of daily mean streamflow for the month of April and a lightly significant (p value = 0.06) shift in the date of peak flow to earlier in the year were also found. These trends, of earlier occurring peaks and declines in annual streamflow, are similar to those observed across the Colorado River Basin and reflect changes to temperature (warming) that have decreased winter snowpack and shifted snowmelt to earlier in the spring. Riverscape scores for the overall hydrograph indicator are shown in Table 2-2.

Table 2-2. Hydrograph Indicator Scores by Riverscape

Riverscape	Peak Flow Score	Base Flow Score	Mean Flow Score	Shifting Peak* Score	Hydrograph Score
Riverscape 17	A	D	B	C	C
Riverscape 18	A	C	B		B-
Riverscape 19	A	D	B		C
Riverscape 20	A	C	B		B-
Riverscape 22	A	B+	B		B+
Riverscape 23	A	B+	B		B+
Riverscape 24	A	B+	B		B+

*Analysis of the timing of peak flow was done for a gaging station outside (upstream) of the Middle Yampa Segment (the Yampa River at Steamboat). Because several major tributaries enter the Yampa between this gage location and the Middle Yampa segment, the shifting peak analysis was incorporated holistically into overall scores for all 7 riverscapes.

2.2 SNOWPACK INDICATOR

Much of the Yampa Basin is currently a snowmelt-driven system, meaning that the majority of river flows are derived from a melting snowpack in the springtime as opposed to rainfall or groundwater. In a snowmelt-driven system, snowpack characteristics have a direct effect on the basin's overall flow regime. This indicator considers maximum snowpack depth and associated maximum snow-water equivalent volume, timing of maximum snowpack, and timing from maximum snowpack to peak runoff.

2.2.1 Data Sources and Evaluation Methods

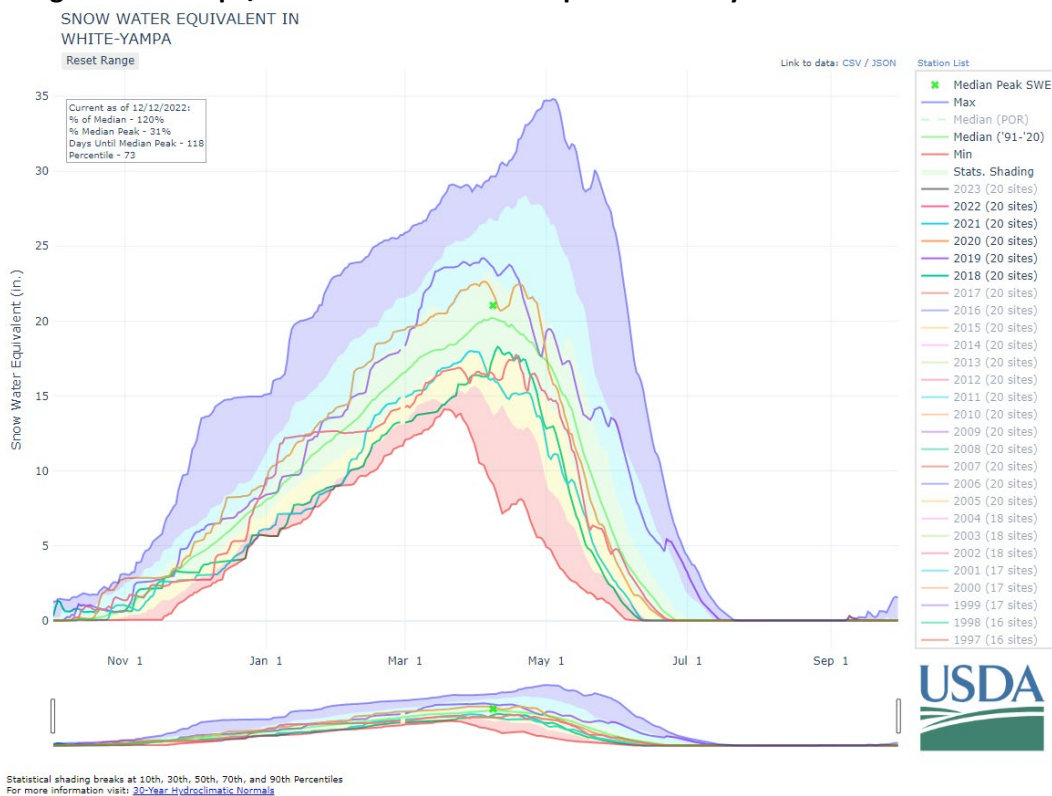
Snowpack data (in the form of snow water equivalent, or SWE) is collected and shared by the Natural Resources Conservation Service (NRCS) collectively for the Yampa and White River Basins. The NRCS typically compares SWE amounts and timing to the 30-year average and median curves (Figure 2-3). However, in using the NRCS dataset, the Yampa River Scorecard Project obtained data for the entire period of record instead of limiting the analysis to the most recent 30-year

average. It also reviewed the locations of SNOTEL sites that generate the SWE data to ensure they are located in the contributing watershed for the focal segment.

This indicator is evaluated as follows:

- (1) Calculate the mean, 95% confidence interval, and standard deviation for maximum SWE (inches) for the period of record;
- (2) Calculate the mean, 95% confidence interval, and standard deviation for timing of maximum snowpack (Julian date) for the period of record;
- (3) Calculate the date of peak runoff for the USGS 09247600 YAMPA RIVER BELOW CRAIG, CO stream gauge for each year since 1984, and calculate the number of days from maximum snowpack to peak runoff;
- (4) Calculate the mean, 95% confidence interval, and standard deviation for maximum snowpack to peak runoff (number of days) for the period of record; and
- (5) Review these statistics in light of scoring criteria to rate this indicator for the most recent 5-year period for which data are available.

Figure 2-3. Yampa/White River Basins Snowpack Summary for the 2022 Water Year



2.2.2 Scoring Criteria

The semi-quantitative scoring criteria outlined in Table 2-3 are used to rate the snowpack indicator. Current conditions are considered to be the last five years of data, and the entire period of record for each SNOTEL site used in the analysis is provided in Table 2-4.

Table 2-3. Snowpack Indicator Scoring Criteria

Grade	Description
A	Current snowpack is within the range of historical conditions. Maximum snow-water equivalent (SWE) volume is within the 95% confidence interval (CI) of the period of record. Timing of maximum SWE is within the 95% CI of the period of record. Timing from maximum SWE to peak runoff is within the 95% CI of the period of record.
C	Current SWE volume is within one standard deviation of the period of record. Timing of maximum SWE is within one standard deviation of the period of record. Timing from maximum SWE to peak runoff is within one standard deviation of the period of record.
F	Current SWE volume is greater than one standard deviation from the period of record. Timing of maximum SWE is greater than one standard deviation from the period of record. Timing from maximum SWE to peak runoff is greater than one standard deviation from the period of record.

2.2.3 Results

Eight SNOTEL sites that generate SWE data are located within the contributing watershed for the focal segment (Figure 2-4). Substantial heterogeneity exists in the length of the period of record for each station (Table 2-4), which ranges from 6 years at Elkhead Divide to 44 years at Elk River and Tower.

Figure 2-4. Locations of Middle Yampa River Segment Contributing Watershed SNOTEL Sites

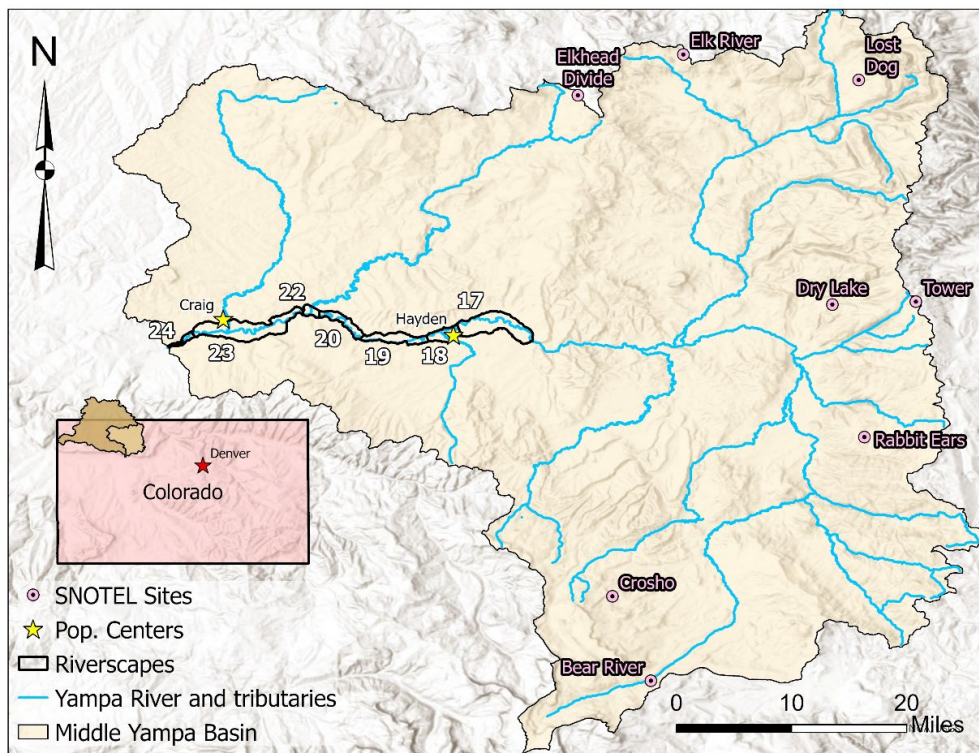


Table 2-4. Middle Yampa River Segment Contributing Watershed SNOTEL Site Details

Station	Start Year*	End Year	Elevation (ft)
Elkhead Divide	2016	2022	8,801
Bear River	2004	2022	9,113
Lost Dog	1998	2022	9,329
Crosho	1985	2022	8,975
Rabbit Ears	1985	2022	9,411
Dry Lake	1979	2022	8,273
Elk River	1978	2022	8,742
Tower	1978	2022	10,622

*Data begin with first snow of the denoted start year (generally in October)

Figure 2-5 compares the maximum annual SWE volume for the past 5 years of data (2018-2022) to the long-term mean (dashed line), 95% confidence interval (dark gray), and standard deviation (medium gray) generated from the period of record data. Maximum SWE volume over the last five years is generally within a single standard deviation of the period of record mean but outside of the 95% confidence interval (CI) (Figure 2-5). Over the last two years, SWE volume is significantly below the mean (i.e., outside the 95% CI) at all SNOTEL stations, though still within a single standard deviation of the mean at 6 of 8 stations (2021 at Rabbit Ears and Tower are the sole exceptions). SWE volume during the winter of 2019 and 2020 was within the 95% CI at half of the eight stations; for just 2020, this increases to 7 of 8 (Bear River was above the 95% CI), while for 2019 it is true of 5 of the 8, with SWE at the remaining eight significantly above the mean but still within a single standard deviation. Notably, all of these observed departures are greater than the mean trend. For 2018, all stations save Elkhead Divide and Bear River had maximum SWE volumes significantly below the mean though still within a single standard deviation. Scores range from A to C for a given station for a given year; the Elkhead Divide station earns the overall highest grade, but this is likely a function of the short-term dataset at this location rather than reflective of a healthier snowpack than average (Table 2-4). The overall lowest scores for SWE volume occur at Rabbit Ears, Dry Lake, and Tower. Notably, these sites are clustered fairly close together at the southern end of the Park Range.

Figure 2-5. Maximum Annual SWE Volume (2018-2022) Compared to Long-Term Data

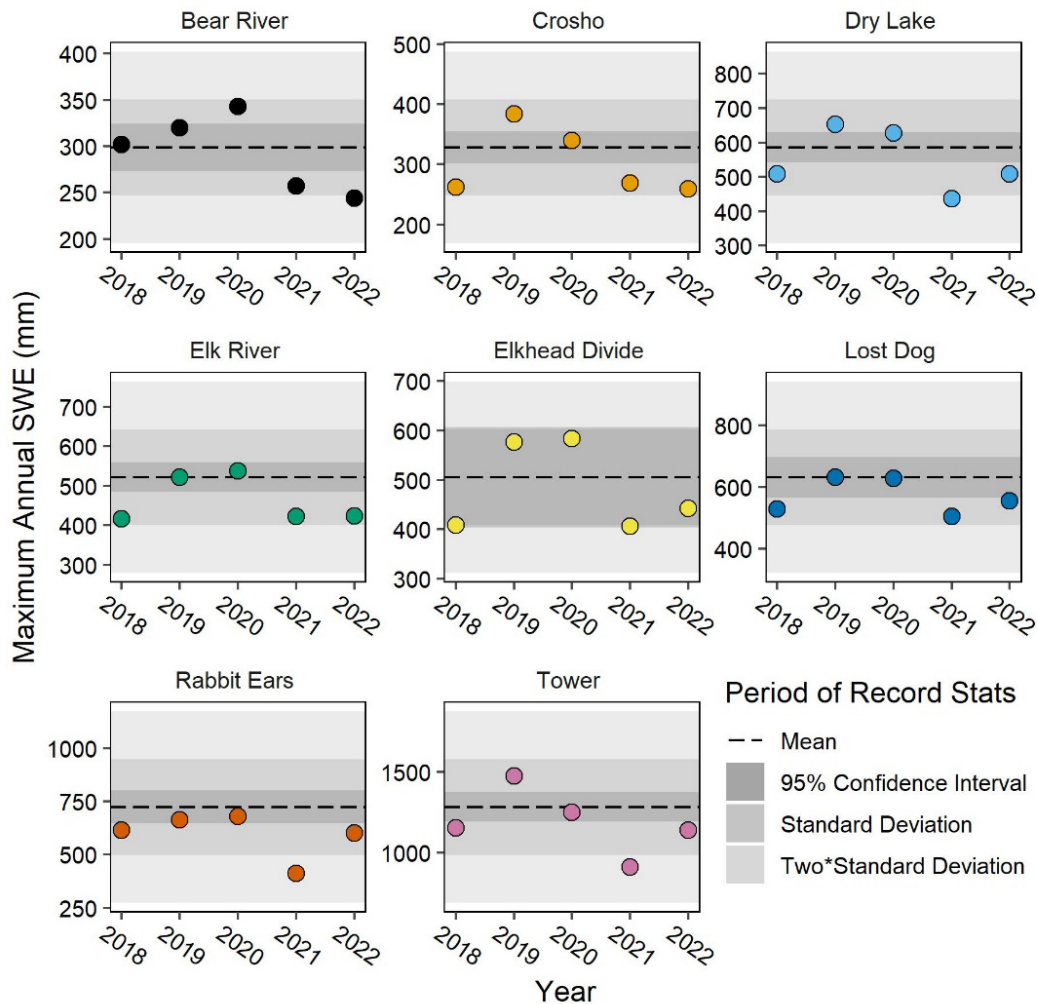
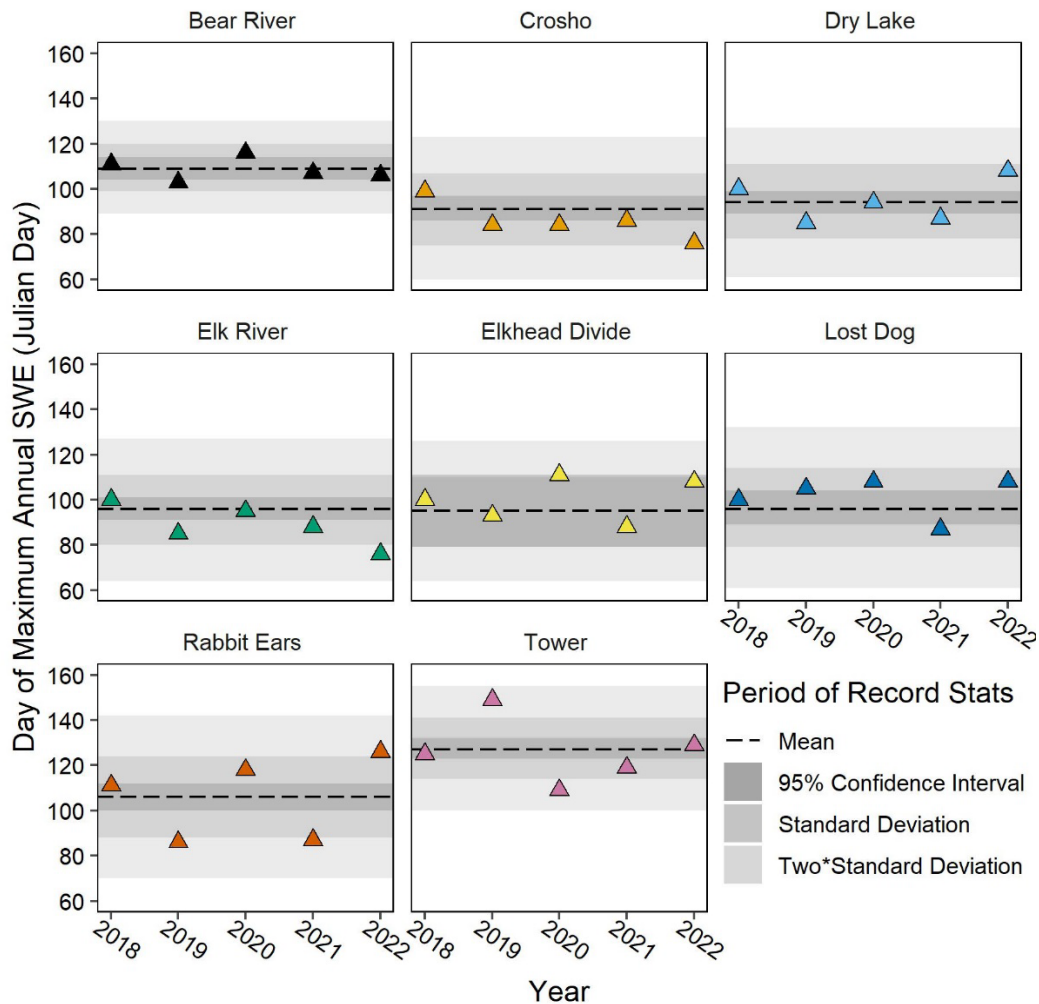


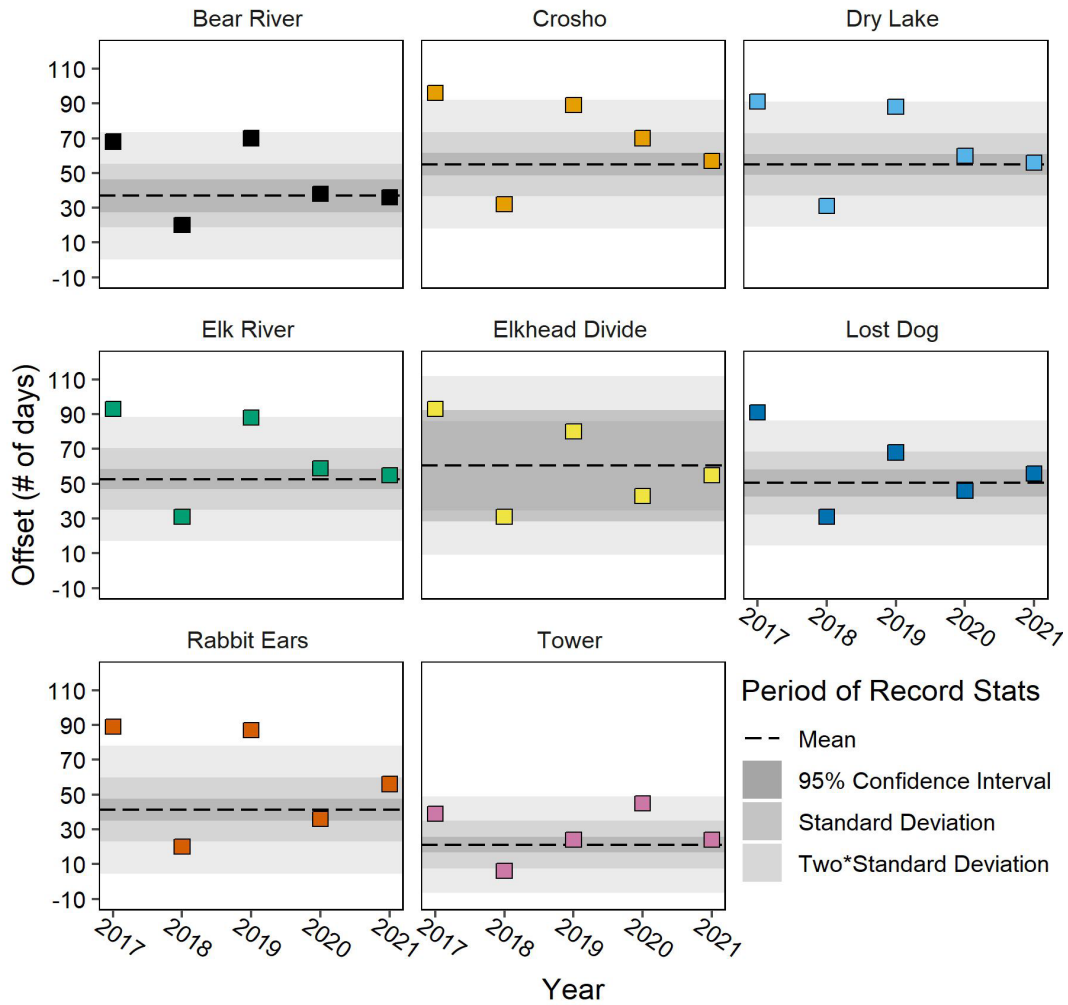
Figure 2-6 shows the timing of maximum annual SWE volume (day of year) for the past five years of data compared to the long-term mean (dashed line), 95% confidence interval (dark gray), and standard deviation (medium gray) generated from the period of record data. Timing of maximum SWE displays few observable patterns outside of 2018, when the day of maximum SWE was not significantly different than the overall mean at all stations (Figure 2-6). Overall, timing of maximum SWE is within a single standard deviation of the mean for all years at 5 of the 8 SNOTEL stations. The exceptions are Tower, Rabbit, and Elk River, which have one (Tower and Elk River) and two (Rabbit) years that fall below a single standard deviation (though within two standard deviations) of the mean. These stations thus earn the lowest grades (Table 2-5).

Figure 2-6. Timing of Maximum Annual SWE Volume (2018-2022) Compared to Long-Term Data



Finally, the length of time (i.e., offset) between the timing of peak SWE and the timing of peak streamflow is noticeably different over the most recent five years than the mean for the period of record at each site (Figure 2-7). In general, the offset in 2017, 2018, and 2019 was significantly different than the period of record at all stations; 2020 and 2021 were more similar. Scores for this indicator range between B+ and D. (Table 2-5).

Figure 2-7. Offset of Maximum Annual SWE Volume and Peak River Discharge (2018-2022) Compared to Long-Term Data



Despite variability between stations, the SNOTEL stations scored a C for overall score on average; as a result, the snowpack indicator overall receives a score of C for all riverscapes in the Middle Yampa River segment (Table 2-5).

Table 2-5. Snowpack Indicator Scores by SNOTEL Station

Station	Max Score	Timing Score	Offset Score	Overall Score
Bear River	B	A	B	B+
Crosho	C	B+	D	C
Dry Lake	C	B	C	C
Elk River	C	C	C	C
Elkhead Divide*	A-	A-	B+	A-
Lost Dog	C+	B+	D	C-
Rabbit Ears	C	D	C	C-
Tower	C	C	C	C
Middle Yampa Segment (All Riverscapes)	C			

*Note: The Elkhead Divide SNOTEL station has only a six-year period of record. It is thus considered with relatively lesser weight than the other stations with regards to the overall score.

3.0 SEDIMENT REGIME

Sediment regime is defined as the amount and timing of sediment that all sources, including land erosion in the contributing watershed and upstream channel erosion, supply to a reach, as well as patterns of sediment transport along and out of a reach. The production, transport, and deposition of sediment largely determines channel form and dynamics. Like changes to flow regime, an altered sediment regime can cause significant impacts to stream form and function, including aquatic habitat quality and long-term channel stability, and can damage infrastructure. The Yampa River Scorecard evaluates the system's sediment regime holistically, using a single indicator referred to as **sediment transport and continuity**.

3.1 SEDIMENT TRANSPORT AND CONTINUITY INDICATOR

The sediment transport and continuity indicator considers the ability of the system to maintain natural transport of sediment from its upstream and upgradient sources. In the Yampa River Scorecard Project, this indicator is scored holistically and qualitatively. While sediment transport capacity is predominantly controlled by stream discharge and slope, the number and size of natural and unnatural impediments to sediment transport and the proportion of the reach and watershed from which sediment transport is blocked have a significant impact.

3.1.1 *Data Sources and Evaluation Methods*

This indicator is scored using expert interpretation of stressors affecting sediment transport. Scoring is based on field observations, aerial imagery, and GIS spatial data (Appendix A). Signs of sediment aggradation or degradation include disproportionate bar formation, increased bar stabilization, embeddedness by fine-grained material, disproportionate erosion, rapid meander migration, an incised channel with collapsing banks, and/or development of an inset floodplain. Field assessments are completed where appropriate to gain information about streambed substrate composition, stream power, sedimentation, embeddedness, and armoring. The Scorecard public interface plans to explain in layperson terms that erosion and deposition are natural processes that are both critical to maintaining a healthy system, using examples of cottonwood and willow riparian galleries relying on bank erosion and its associated bar and substrate deposition, and bank stabilization practices to limit erosion that just propagate the impact downstream. The Scorecard also intends to present river stability as a continuum that can be affected by sediment loads, which may lead to either erosion or deposition, but may not necessarily make the river an "unhealthy" one.

3.1.2 *Scoring Criteria*

Table 3-1 includes the narrative criteria used to rate the sediment transport and continuity indicator. The criteria relate primarily to impediments to sediment transport, signs of sediment balance (or imbalance), and also to the presence of stressors and level of maintenance required to maintain functional river processes.

Table 3-1. Sediment Transport and Continuity Indicator Scoring Criteria

Grade	Description
A	The amount of sediment transported through the reach is optimized to maintain self-sustainable balance with no management or maintenance required. There are only limited, if any, impediments to sediment delivery or transport throughout the reach. Minimal signs of sediment imbalance or disequilibrium are evident.
B	Impediments to sediment transport may exist, but they are either insignificant or they impact sediment balance from only a small portion of the overall contributing area. Minor stressors are present and minimal management or maintenance is required to maintain functionality. Limited signs of sediment imbalance or disequilibrium are evident.
C	Impediments to sediment transport through the reach are notable and are impacting the sediment balance a moderate portion of the reach. Maintenance and management are required to maintain functionality. Moderate signs of sediment imbalance or disequilibrium are evident.
D	Major impediments to sediment transport exist, yet these impediments either pass a portion of the sediment downstream or block sediment from less than half of the reach. Stressors significantly alter the natural sediment balance, and extensive or consistent active management and maintenance are required. Ample signs of sediment imbalance or disequilibrium are evident.
F	Severe impediments to sediment transport are present and impact most or all of the reach. The sediment balance through the reach is severely altered to a level that results in an inability to support functional processes. Signs of sediment imbalance or disequilibrium are ubiquitous.

3.1.3 Results

The sediment transport and continuity indicator is evaluated through field observations and remote sensing analysis using aerial imagery and GIS spatial data. Review of additional documents, specifically a 2021 USGS report of water quality in the Upper Yampa Basin (Day 2021) and the Yampa River Basin Remote Assessment (Yampa IWMP 2021), was also completed in order to further augment the analysis.

To begin to investigate the state of the sediment regime of the Yampa River, historical aerial imagery spaced at regular intervals (Table 3-2) was analyzed in order to examine temporal trends in channel dimensions (Jagt et al. 2022). Because rivers are scaled to the water and sediment loads they carry, detectable trends in channel dimensions across time suggest perturbations in either component over that same time period. A significantly narrower channel today than in the past, for example, could potentially indicate a disruption in sediment supply that has resulted in observable channel adjustments as the river seeks to establish a new equilibrium. Channel widths were measured at regular spaced intervals of 0.5 miles (0.8 km) spacing; this was done for each year of historical imagery. Box plots of widths for each riverscape at each timestep were then constructed to examine temporal differences; this visual inspection was complemented by statistical tests (Welch's t-tests) to detect significant differences between years (Figure 3-1).

In all riverscapes except riverscape 17, no significant difference is observed in channel dimensions across the three twenty to twenty-five year intervals examined (1953 to 1977, 1977 to 1999, and 1999 to 2019) (Figure 3-1). In riverscape 17, the channel widened significantly (p -value = 0.02) from 1953 to 1999, but then subsequently narrowed to where present-day (2019) dimensions are not significantly different than those in 1953. Overall, the lack of significant temporal trends in channel width – especially in conjunction with the lack of observable change in peak flows – suggests that the Yampa River retains a healthy sediment regime. Similarly, few other obvious indicators of sediment disequilibrium exist; little evidence of disproportionate bank erosion or incision was found on the Colorado Mountain College field course float of the study segment that was conducted in June 2021. Deposition and erosion indicative of healthy river (e.g., meandering) were also observed in several locales (e.g., Appendix A, Figures A-10 through A-14). Embeddedness is additionally low (<10%) or moderate (10-20%) at sampling sites in six of the seven riverscapes (refer to Section 9.2 for more information).

Table 3-2. Historical Images Used in Width Analysis

Year	Image Count	Scale
1953	5	1:62540
1977	9	1:24000
1999	7	1:40000
2019	21	1:40000

However, several barriers to longitudinal (downstream) transport exist. Because such barriers may restrict the downstream movement of sediment, potentially starving the more downstream reaches, they represent a stressor to the health of the sediment regime. In-channel barriers are concentrated predominantly in the upper and lower riverscapes of the study segment (riverscapes 17 and 18; riverscapes 23 and 24) and generally take the form of either “push-up” dams for irrigation infrastructure or transportation (railroad/highway) bridge crossings (refer to Section 5.1 for more information). Scores for the sediment regime indicator in the upper and lower riverscapes thus are detrimentally impacted by the existence of these structures (Table 3-3). Riverscapes 23 and 24, where barriers to both downstream transport of sediment and lateral transport onto the floodplain are substantial (refer to Section 5.1), receive the lowest scores.

Finally, a USGS investigation of suspended sediment data at the Yampa River above Elkhead gage indicates that no temporal trend in sediment concentration exists for the period from 1990-2018 (Day 2021). Similarly, analysis associated with the Yampa River Remote Assessment suggests that there are no detectable trends in gravel bar densities for a roughly similar time period (Yampa IWMP 2021). Together, these analyses converge on the idea that the sediment regime through the Middle Yampa segment has remained steady over the better part of the last three decades; combined with the above analysis of historical imagery dating back to the 1950s, it can reasonably be concluded that such stationarity extends over roughly seventy years. Though the possibility does exist that appreciable changes to the sediment regime of the Yampa River occurred prior to the period of record analyzed here, the relative dearth of detrimental features (e.g., rapidly incision and collapsing banks) and lack of any recent generalizable temporal trends indicate that the Yampa River has a relatively healthy sediment regime.

Figure 3-1. Box Plots of Channel Widths for Each Set of Historical Aerial Images

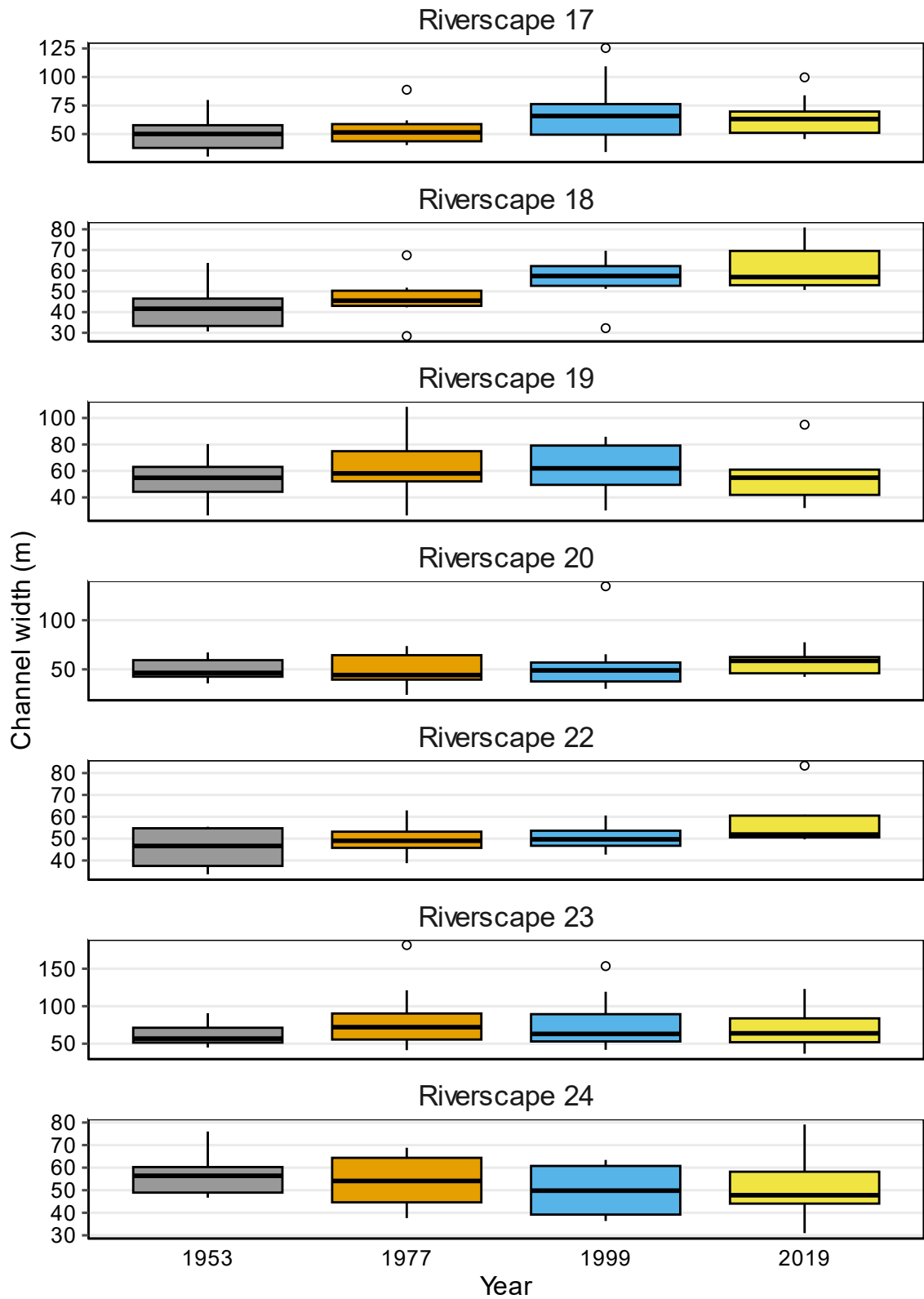


Table 3-3. Sediment Transport and Continuity Indicator Scores by Riverscape

Riverscape	Sediment Transport/Continuity Score
Riverscape 17	A-
Riverscape 18	A-
Riverscape 19	A
Riverscape 20	A
Riverscape 22	A
Riverscape 23	B-
Riverscape 24	B-

4.0 WATER QUALITY

Water quality is defined as the physico-chemical characteristics of water in a river segment, and it is influenced by natural geological weathering, biogeochemical processes, and human activities (upstream land and water uses). Suitable water quality in streams supports recreational uses, ensures public health, and supports wildlife and fish habitat. The Yampa River Scorecard uses several indicators to evaluate water quality. The list of indicators is based on feedback from the Technical Committee and contains parameters that are relatively easy to measure and/or for which data already exist. The six water quality indicators are **temperature, dissolved oxygen, pH, macroinvertebrates, nutrients, and metals**. The final water quality score is calculated as an average of the six indicator scores.

Water quality measurements that can be important for assessing stream health include parameters that fall into the following categories: (1) standard physical parameters that can be measured *in situ* with a handheld water quality instrument that provides instantaneous results (e.g., temperature, pH, conductivity, dissolved oxygen, oxidation-reduction potential, turbidity); (2) analytes that require water samples to be collected and sent to a laboratory for analysis (e.g., total and dissolved metals, nutrients); and (3) biological indicators of water quality (e.g., macroinvertebrates). This section provides more detail on the six indicators included in the Yampa River Scorecard.

4.1 TEMPERATURE INDICATOR

Water temperature is measured using a standard water quality meter or a thermometer. The ranges of many aquatic species are limited by temperature, so this parameter is an important measure of habitat quality. Shading from the riparian canopy, good hyporheic exchange, and seepage from spring-fed tributaries (in some cases) contribute to lower temperatures that support the cool- and cold-water fish species present in Colorado streams and rivers. The Scorecard focal segment is located in a transition zone between cold-water and warm-water fisheries, so temperatures are expected to increase naturally in a downstream direction. The CDPHE Stream Classifications for Aquatic Life are as follows:

- Yampa mainstem from Oak Creek to Elkhead Creek: Cold Water I with temporary modification
- Yampa mainstem below Elkhead Creek: Warm Water I

Instantaneous measurements of water quality taken manually have limited value when considering optimal conditions for resident aquatic species. Continuous temperature data loggers that collect temperature measurements at regular intervals provide a greater understanding of the conditions impacting aquatic habitat. These are relatively inexpensive but can be tricky to install in a system like the Yampa River Basin that sees large fluctuations in flows, freezing during winter months, visitation by curious individuals or animals, and other challenging conditions for field monitoring.

4.1.1 Data Sources and Evaluation Methods

Instantaneous temperature measurements are collected quarterly by USGS at the Yampa River above Elkhead Creek and Yampa River below Craig stream gage and monitoring locations, but otherwise continuous temperature measurements are not currently being collected in the focal segment. From March 2012 through December 2014, CDPHE maintained a continuous temperature monitor at the Dorsey boat launch location in the Yampa State Wildlife Area (Site #3 in Figure 1-1). For the Scorecard project, two continuous temperature monitoring devices, one upstream and one downstream of the Elkhead Creek confluence, were installed in July 2021 so that 2021-2022 temperature data can be used to score this indicator. Continuous temperature monitoring sensors were installed at the Dorsey boat launch upstream of Elkhead Creek, and at the Craig intake structure downstream of Elkhead Creek. Temperature data loggers deployed as part of the Scorecard effort follow the same protocols for equipment installation and retrieval as the City of Steamboat Springs in order to maintain consistency across the Yampa basin; additional details are provided in the Yampa River Scorecard Project Indicators and Methods Report (FOTY/Alba Watershed Consulting 2021).

4.1.2 Scoring Criteria

The temperature indicator scoring criteria outlined in Table 4-1 are based on regulatory standards. These criteria are not quantitative; rather, they rely on consulting current regulatory standards. This is because of the transition between aquatic use classifications of cold water and warm water upstream and downstream of the Elkhead Creek confluence, respectively, as well as the current (through 2024) temporary modification of the chronic temperature standard upstream of Elkhead Creek based on data collected by the City of Steamboat Springs.

Table 4-1. Temperature Indicator Scoring Criteria

Grade	Description
A	Temperature regime is natural and appropriate for a well-functioning river in its process domain.
B	Temperature regime is within the range of natural variability. Natural aquatic biota are minimally impaired. Regulatory standards are not exceeded.
C	Temperature regime is altered to a degree that could significantly affect natural aquatic biota. Regulatory standards are occasionally exceeded. CDPHE Monitoring and Evaluation (M&E) listed reaches fall in this category.
D	Temperature regime is altered to a degree that is known to affect natural aquatic biota. Regulatory standards are frequently exceeded. CDPHE 303(d) listed reaches fall in this category.
F	The temperature regime is fundamentally altered. Natural biota are severely impaired. Regulatory standards are chronically exceeded.

4.1.3 Results

The temperature indicator is evaluated through the analysis of approximately 13 months of temperature data collected at 30-minute intervals via continuous temperature sensors installed for this project on July 15, 2021 at two locations in the focal segment: the Yampa River at Dorsey,

located in riverscape 20, and the Yampa River at Craig Intake, located in riverscape 23. Data analyzed here run from July 15, 2021 to August 8, 2022. Results were evaluated against current regulatory standards, primarily the daily maximum (DM) temperature or acute standard, which regulates the maximum temperature that can occur over a 24-hr period, and the maximum weekly average temperature (MWAT) or chronic standard, which sets the maximum allowable temperature for the rolling 7-day mean of daily average temperature.

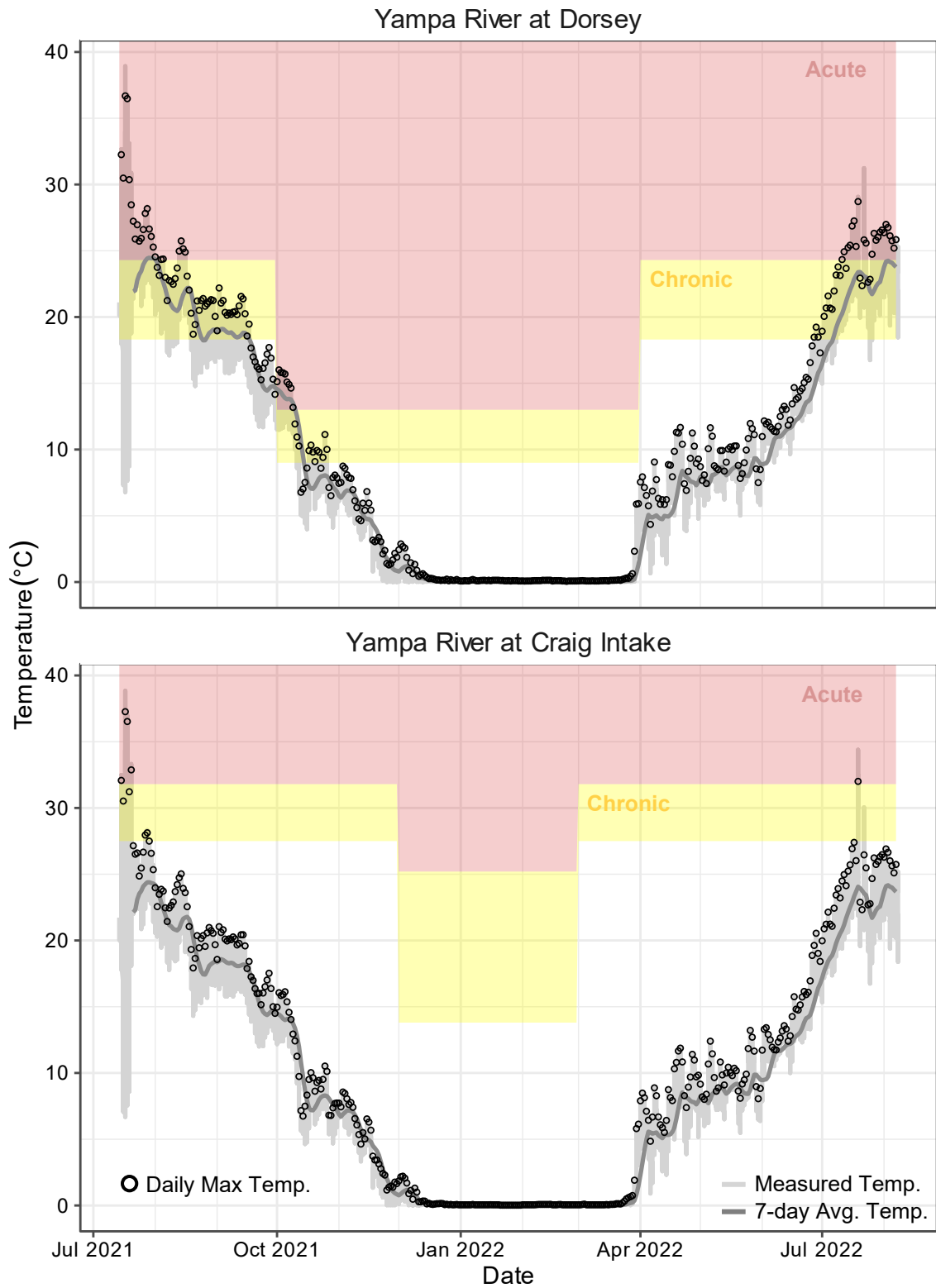
At Dorsey, maximum daily temperatures are consistently above regulatory DM standards in the late summer months (July and August) through mid-September and then again for the month of October (Figure 4-1). Similarly, average weekly temperature exceeds the MWAT temporary standard (18.3 °C for July-September) in July and much of August, as well as in early October. This is consistent with the 303(d) listing of this segment of the Yampa (i.e., riverscapes 17, 18, 19, and 20) for temperature. Riverscapes 17-20 earn a score of D (Table 4-2).

In contrast, maximum daily temperature as recorded at the Craig Intake only exceed the standard (31.8 °C from July-November) for five days in July (four in 2021 and one in 2022) (Figure 4-1). Average weekly temperatures likewise only exceeded the MWAT regulatory standard for four days and one day in mid-July 2021 and 2022, respectively. Riverscapes 22-24 earn a score of B (Table 4-2).

Table 4-2. Temperature Indicator Scores by Riverscape

Riverscape	Temperature Score
Riverscape 17	D
Riverscape 18	D
Riverscape 19	D
Riverscape 20	D
Riverscape 22	B
Riverscape 23	B
Riverscape 24	B

Figure 4-1. Continuous Temperature Data for Yampa River at Dorsey and Yampa River at Craig Intake Locations (July 2021 – August 2022)



4.2 DISSOLVED OXYGEN INDICATOR

Dissolved oxygen (DO) is the amount of free oxygen present in the water column and is important for the survival of fish and other aquatic species. To ensure accurate readings when using a water quality meter to record DO, the meter must be suspended in the water column and out of direct contact with the stream bed, which is sometimes difficult in shallow streams.

4.2.1 Data Sources and Evaluation Methods

Field-based water quality parameters including dissolved oxygen are measured quarterly by USGS as part of the Upper Yampa River Basin Water Quality Monitoring Program. Two locations in the Scorecard focal segment are part of this monitoring program: Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO. Data were downloaded from nwis.waterdata.usgs.gov. FOTY also collected two water quality samples at the Craig Intake location (riverscape 23) in 2022: one in June during high-flow conditions, and one in September during low-flow conditions.

4.2.2 Scoring Criteria

Similar to temperature, the dissolved oxygen scoring criteria outlined in Table 4-3 are based on regulatory standards.

Table 4-3. Dissolved Oxygen Indicator Scoring Criteria

Grade	Description
A	Dissolved oxygen concentrations are natural and appropriate for a well-functioning river in its process domain.
B	Dissolved oxygen concentrations are within the range of natural variability. Natural aquatic biota are minimally impaired. Regulatory standards are not exceeded.
C	Dissolved oxygen concentrations are altered to a degree that could significantly affect natural aquatic biota. Regulatory standards (6.0 mg/L or 5.0 mg/L) are occasionally exceeded. CDPHE Monitoring and Evaluation (M&E) listed reaches fall in this category.
D	Dissolved oxygen concentrations are altered to a degree that is known to affect natural aquatic biota. Regulatory standards (6.0 mg/L or 5.0 mg/L) are frequently exceeded. CDPHE 303(d) listed reaches fall in this category.
F	Dissolved oxygen concentrations are fundamentally altered. Natural biota are severely impaired. Regulatory standards are chronically exceeded.

4.2.3 Results

The dissolved oxygen indicator is evaluated through review of USGS Water Quality Monitoring Program data at the Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO monitoring locations. Because rivers integrate upstream inputs, data from the above Elkhead station (located in riverscape 20) are used to score riverscapes 17, 18, 19, and 20; data from the below Craig station (located in riverscape 24) are used to score the remaining riverscapes (22, 23, 24).

Dissolved oxygen concentrations at both the above Elkhead and below Craig station are well above the standard for aquatic life for each location (Figure 4-2). Given the relative lack of pollutants and despite observations of algal growth, this is relatively unsurprising, yet also encouraging. Each riverscape is scored an A in this regard (Table 4-4).

Figure 4-2. Dissolved Oxygen Concentrations from Quarterly Water Sampling at the Yampa River above Elkhead Creek and Yampa River below Craig, CO Locations (2010-2022)

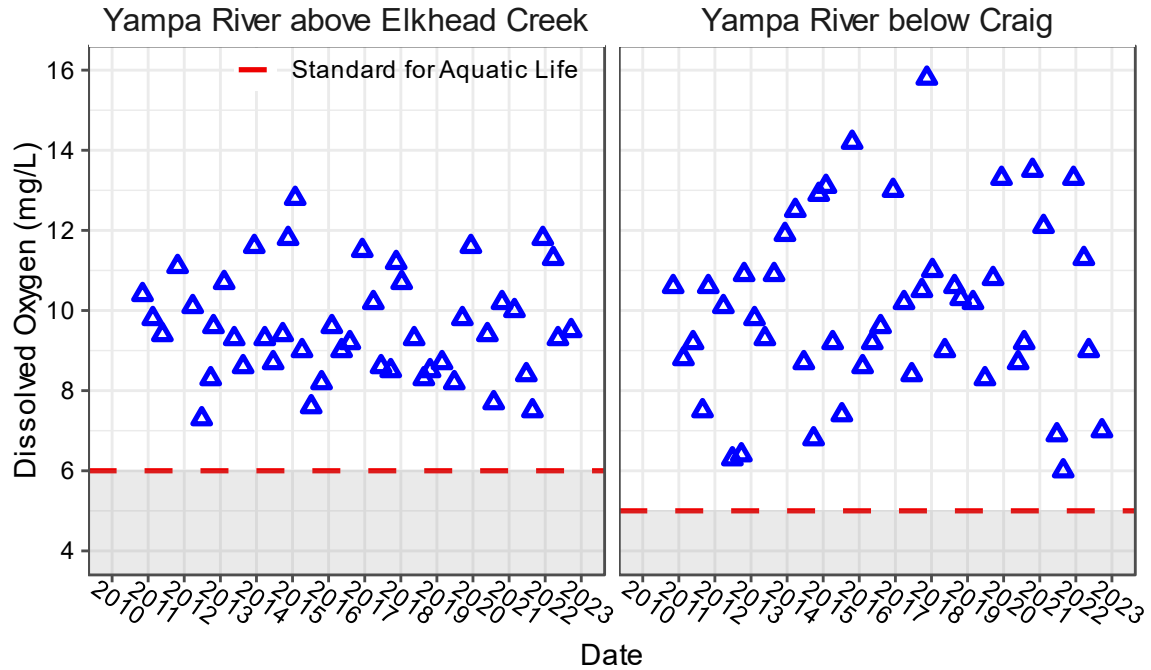


Table 4-4. Dissolved Oxygen Indicator Scores by Riverscape

Riverscape	Dissolved Oxygen Score
Riverscape 17	A
Riverscape 18	A
Riverscape 19	A
Riverscape 20	A
Riverscape 22	A
Riverscape 23	A
Riverscape 24	A

4.3 pH INDICATOR

pH is a measure of water acidity that runs on a scale from 0 to 14, where lower numbers indicate high acidity, pH 7 is neutral, and higher numbers indicate water that is more basic. The ranges of many aquatic species are limited by pH.

4.3.1 Data Sources and Evaluation Methods

Field-based water quality parameters including pH are measured quarterly by USGS as part of the Upper Yampa River Basin Water Quality Monitoring Program. Two locations in the Scorecard focal segment are part of this monitoring program: Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO. Data were downloaded from nwis.waterdata.usgs.gov. FOTY also collected two water quality samples at the Craig Intake location (riverscape 23) in 2022: one in June during high-flow conditions, and one in September during low-flow conditions.

4.3.2 Scoring Criteria

Similar to temperature and dissolved oxygen, the scoring criteria for pH outlined in Table 4-5 are based on adherence to regulatory standards.

Table 4-5. pH Indicator Scoring Criteria

Grade	Description
A	pH values are natural and appropriate for a well-functioning river in its process domain.
B	pH values are within the range of natural variability. Natural aquatic biota are minimally impaired. Regulatory standards are met.
C	pH is altered to a degree that could significantly affect natural aquatic biota. pH values occasionally fall outside the range of regulatory standards (6.5 - 9.0). CDPHE Monitoring and Evaluation (M&E) listed reaches fall in this category.
D	pH is altered to a degree that is known to affect natural aquatic biota. pH values frequently fall outside the range of regulatory standards (6.5 - 9.0). CDPHE 303(d) listed reaches fall in this category.
F	pH is fundamentally altered. Natural biota are severely impaired. pH values chronically fall outside the range of regulatory standards.

4.3.3 Results

The pH indicator is evaluated through review of USGS Water Quality Monitoring Program data at the Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO monitoring locations. Because rivers integrate upstream inputs, data from the above Elkhead station (located in riverscape 20) are used to score riverscapes 17, 18, 19, and 20; data from the below Craig station (located in riverscape 24) are used to score the remaining riverscapes (22, 23, 24).

Similar to dissolved oxygen, pH values at each monitoring location are within the standards for aquatic life (6.5 – 9) for nearly all samples collected from 2010-2022, though pH values in exceedance of 9 were detected in two samples (one each in late 2015 and 2018) (Figure 4-3).

Overall, regulatory standards are regularly and consistently met and each riverscape earns an A in this regard (Table 4-6).

Figure 4-3. pH Values from Quarterly Water Sampling at the Yampa River above Elkhead Creek and Yampa River below Craig, CO Locations (2010-2022)

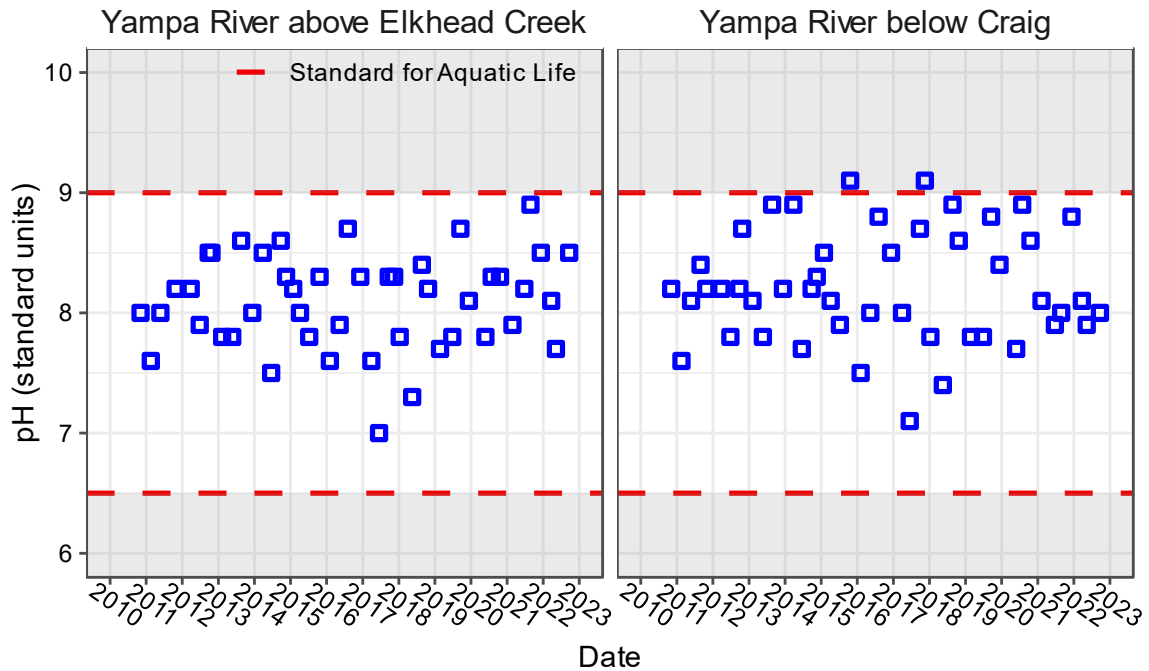


Table 4-6. pH Indicator Scores by Riverscape

Riverscape	pH Score
Riverscape 17	A
Riverscape 18	A
Riverscape 19	A
Riverscape 20	A
Riverscape 22	A
Riverscape 23	A
Riverscape 24	A

4.4 MACROINVERTEBRATES INDICATOR

Benthic macroinvertebrates are excellent indicators of the condition of lotic aquatic systems because macroinvertebrates are found in almost all freshwater environments, have a small home range, are relatively easy to sample and identify, and the different taxonomic groups show varying degrees of sensitivity to pollution and other stressors (CDPHE 2016a, Barbour et al. 1999). Benthic

macroinvertebrate community monitoring is a useful tool for river health monitoring, particularly if baseline data are available.

Many comparative metrics may be used to assess the health of the benthic community, including the number of individuals; total number of taxa; total number of pollution-sensitive Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa; ratios of different functional feeding groups or taxonomic groups; Shannon-Wiener Diversity Index (SDI); Hilsenhoff Biotic Index (HBI); and many others. The SDI is a mathematical measure of species diversity within a given community. For benthic macroinvertebrates, values range from 0-5, and higher values indicate higher species diversity (MacArthur 1965). The HBI reveals the relative abundance of pollution-tolerant species. Scores range from 0-10, where a higher value indicates more pollution-tolerant species are present (Hilsenhoff 1987).

The Colorado Department of Public Health and Environment (CDPHE) monitors streams throughout the state for assessment and protection of water resource quality. Their principal indicator is a multi-metric index (MMI) based on direct benthic macroinvertebrate sample data. By using five to six equally weighted metrics, the MMI combines measures of diversity, abundance, pollution tolerance, community structure, and other factors to generate a normalized score of 0-100 for each sample. Scores may then be compared to reference threshold scores for one of three generalized Colorado biotypes (mountains, transition, plains). In “grey” areas where the MMI alone is not sufficient, CDPHE also compares SDI and HBI results to attainment and impairment threshold values.

4.4.1 Data Sources and Evaluation Methods

Historical benthic macroinvertebrate data are scarce for the Yampa Scorecard focal segment. A small amount of data was collected in 2002 for Tri-State Generation and Transmission at two locations: upstream of Carpenter Ranch and in the vicinity of Craig. These data only include taxa identification and counts; no comparative metrics or summary statistics were calculated. Given the paucity of existing data, the relative ease of collecting and analyzing macroinvertebrate data, and the useful information that can be gleaned from these data, the Scorecard project provides a good opportunity for evaluating the macroinvertebrate community and tracking changes over time.

Seven benthic macroinvertebrate community samples were collected in the Middle Yampa segment for the Scorecard project effort: one in each of the seven riverscapes. Macroinvertebrate monitoring occurred during the low-flow period in early September 2022, and followed the SOP used by CDPHE for benthic macroinvertebrate sampling (CDPHE 2016). Detailed procedures for sample collection, processing, and preservation are provided in the SOP. Samples were collected with partners from River Watch and sent to Timberline Aquatics for taxonomic identification and data analysis.

4.4.2 Scoring Criteria

The scoring criteria outlined in Table 4-7 are currently based on adherence to regulatory standards set by CDPHE for the relevant biotype (biotype 1, transition) using mainly MMI scores and CDPHE-designated attainment and impairment thresholds. Because component metrics incorporated into the MMI are designed to detect water quality impairments and are less sensitive to changes

in habitat, results of other comparative metrics are also taken into account during the scoring process.

Table 4-7. Benthic Macroinvertebrate Indicator Scoring Criteria

Grade	Description
A	The reach is considered to be representative of the expected condition for aquatic insect communities and aquatic life use for a well-functioning river in its process domain. No management is needed other than protection of existing conditions. MMI score is 80-100 and the reach is in attainment for aquatic life use (CDPHE 2016).
B	Some detectable stressors are evident with minor alterations to aquatic insect communities. The ecological system retains its overall structure and supports a high level of function. Some management may be required to sustain or improve this condition. MMI score is 61-79 and the reach is in attainment for aquatic life use (CDPHE 2016).
C	The reach supports and maintains essential components of the unimpaired aquatic insect community, but exhibits measurable signs of degradation and less than optimal community parameters. Management is required (or recommended) to maintain and improve this condition. MMI score is 46-60 and meets the CDPHE (2016) attainment threshold for aquatic life use.
D	Detectable alterations or degradation of aquatic life use are present, but the system still supports a fundamental aquatic insect community structure and function. Active management is required (or recommended) to maintain and improve characteristic functional support. MMI score is 34-45 and is considered to be in the “gray area” between aquatic life use attainment and impairment (CDPHE 2016).
F	Clear impairment to the aquatic insect community and aquatic life is present. This level of alteration generally results in an inability to support characteristic aquatic organisms, or makes the stream segment biologically unsuitable. MMI score is < 34 and aquatic life use is thus considered “impaired” (CDPHE 2016).

4.4.3 Results

The macroinvertebrates indicator is evaluated through analysis of data collected via the Scorecard project at one location per riverscape within the Middle Yampa segment (Figure 4-4). All samples collected within the Middle Yampa segment exhibited healthy and diverse macroinvertebrate communities, with total taxa ranging between 30 – 45 taxonomic groups, percent of pollution-tolerant taxa greater than 50% at all locations, high scores for species diversity, a well-balanced array of functional feeding groups, and MMI scores between 69.8 and 76.6 (Table 4-8, Figure 4-5). Furthermore, all riverscapes received the same score for the macroinvertebrate indicator as the overall measure of benthic community health was similar across all 7 riverscapes, and all scores were within 10 percent of each other (Table 4-9).

Figure 4-4. Map of Macroinvertebrate Sampling Locations

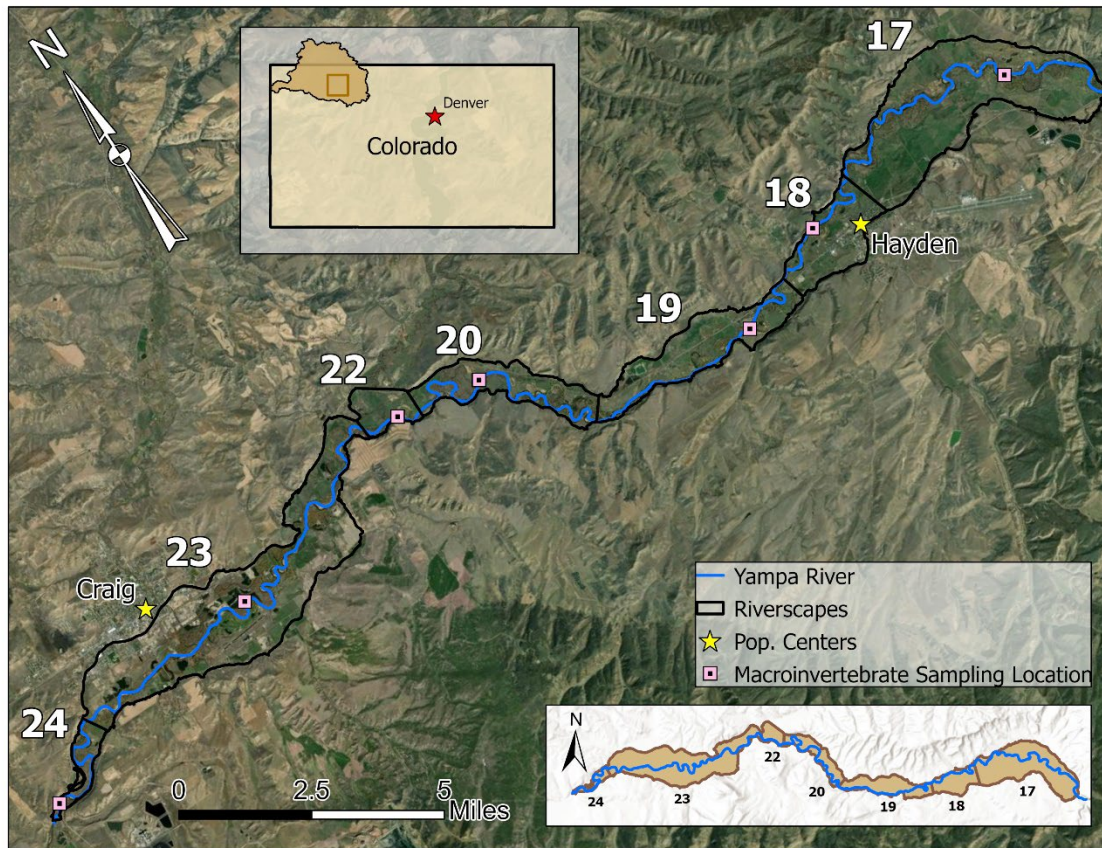


Table 4-8. Select Macroinvertebrate Metrics by Riverscape

Riverscape/Metric	RS 17	RS 18	RS 19	RS 20	RS 22	RS 23	RS 24
MMI v4	69.8	73.7	72.6	71.0	76.4	76.6	76.4
Diversity	4.32	3.74	3.81	3.23	3.53	3.30	3.39
Evenness	0.779	0.682	0.702	0.659	0.688	0.600	0.641
HBI	4.47	4.85	4.20	3.55	3.26	3.46	3.56
EPT	22	20	18	20	19	21	18
% EPT	64.4%	54.1%	62.1%	73.3%	73.2%	78.1%	77.9%
Total Taxa	47	45	43	30	35	45	39
% Chironomids	18.7%	23.0%	25.3%	5.5%	17.8%	10.7%	5.7%

Figure 4-5. Macroinvertebrate MMI Scores by Riverscape

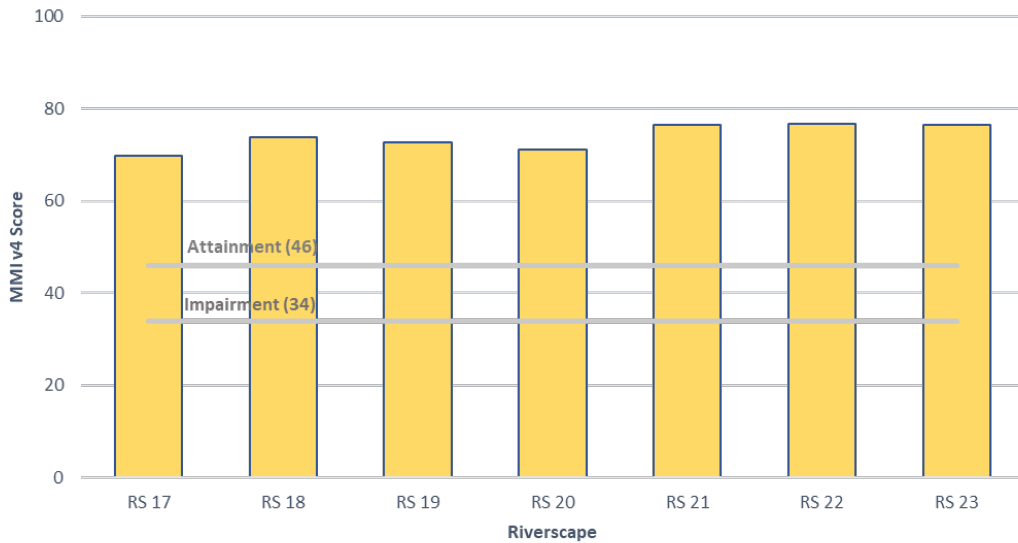


Table 4-9. Macroinvertebrate Indicator Scores by Riverscape

Riverscape	Macroinvertebrate Score
Riverscape 17	B+
Riverscape 18	B+
Riverscape 19	B+
Riverscape 20	B+
Riverscape 22	B+
Riverscape 23	B+
Riverscape 24	B+

4.5 NUTRIENTS INDICATOR

Nutrients in stream water are essential for plants and animals. They occur naturally due to processes such as weathering and erosion, breakdown of organic material, and atmospheric deposition, but high nutrient levels are not good for stream health. Elevated nutrient levels in surface waters can result from human activities such as fertilizer application, runoff from agricultural and urban areas, effluent from wastewater treatment, seepage from septic systems, detergent, animal waste, and fuel combustion. Elevated nutrient levels can also cause algal blooms. In the last decade, concerns about cyanobacteria and associated cyanotoxins have been expressed by stakeholders in the Yampa Basin as algal blooms have been reported in local lakes and reservoirs, so this indicator is of public interest and therefore important to evaluate for the Scorecard.

4.5.1 Data Sources and Evaluation Methods

Nutrients, including total nitrogen and phosphorus, are measured quarterly by USGS as part of the Upper Yampa River Basin Water Quality Monitoring Program. Two locations in the Scorecard focal segment are part of this monitoring program: Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO. Data were downloaded from nwis.waterdata.usgs.gov. FOTY also collected two water quality samples at the Craig Intake location (riverscape 23) in 2022: one in June during high-flow conditions, and one in September during low-flow conditions.

4.5.2 Scoring Criteria

The scoring criteria outlined in Table 4-10 based on adherence to interim regulatory standards set by CDPHE for nitrogen and phosphorus are used to rate the nutrients indicator.

Table 4-10. Nutrients Indicator Scoring Criteria

Grade	Description
A	Nutrient levels are natural and appropriate for a well-functioning river in its process domain.
B	Nutrient levels are within the range of natural variability. Natural aquatic biota are minimally impaired. Interim regulatory standards are not exceeded.
C	Nutrient levels are altered to a degree that could significantly affect natural aquatic biota. Interim regulatory standards (0.11 mg/L (cold) and 0.17 mg/L (warm) for total phosphorus; 1.25 mg/L (cold) and 2.01 mg/L (warm) for total nitrogen) are occasionally exceeded. CDPHE Monitoring and Evaluation (M&E) listed reaches fall in this category.
D	Nutrient levels are altered to a degree that is known to affect natural aquatic biota. Interim regulatory standards (0.11 mg/L (cold) and 0.17 mg/L (warm) for total phosphorus; 1.25 mg/L (cold) and 2.01 mg/L (warm) for total nitrogen) are frequently exceeded. CDPHE 303(d) listed reaches fall in this category.
F	Unnaturally eutrophic or oligotrophic conditions clearly affect the distribution and abundance of characteristic aquatic life. Interim regulatory standards have been exceeded consistently.

4.5.3 Results

The nutrients indicator is evaluated through review of USGS Water Quality Monitoring Program data at the Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO monitoring locations, where total phosphorus (TP), total Kjeldahl (organic) nitrogen (TKN), and total nitrogen T(N) have been measured quarterly since 2010. Because rivers integrate upstream inputs, data from the above Elkhead station (located in riverscape 20) are used to score riverscapes 17, 18, 19, and 20; data from the below Craig station (located in riverscape 24) are used to score the remaining riverscapes (22, 23, 24). A USGS analysis of nutrient data (both concentrations and loads) in the Upper Yampa Basin for the 1992-2018 period was completed in 2021; more specifically, this report analyzed nutrient data from 2010-2018 and 1999-2018 at the above Elkhead and below Craig sites, respectively. Scoring is based upon that analysis, the findings of which have been synthesized for the purpose of the Scorecard and are presented below (Day

2021), as well as additional examination of the data subsequent to the period covered in the USGS report (2019-2022). Particulars of the methodology used in the nutrient analysis that yielded the summarized results below can be found in the body of the referenced USGS report (Day 2021).

Total nitrogen (inorganic + organic nitrogen; TN) is measured quarterly by USGS at the sites mentioned above, as is Kjeldahl nitrogen (TKN). In the USGS report, daily concentrations of constituents are estimated from quarterly samples using linear regression models fit with R-LOADEST, a USGS-developed statistical program designed to calculate nutrient loads from periodic sampling data (see equation 1 of Day [2021] for mathematical explanation). Daily estimations of TN are not able to be made due to lack of the requisite number of samples; therefore, daily estimations of TKN are used as a surrogate for TN. Notably, daily estimations do not include quarterly sampling data from 2019-2022; rather, only the discrete data for this latter period were analyzed for the purposes of the Scorecard.

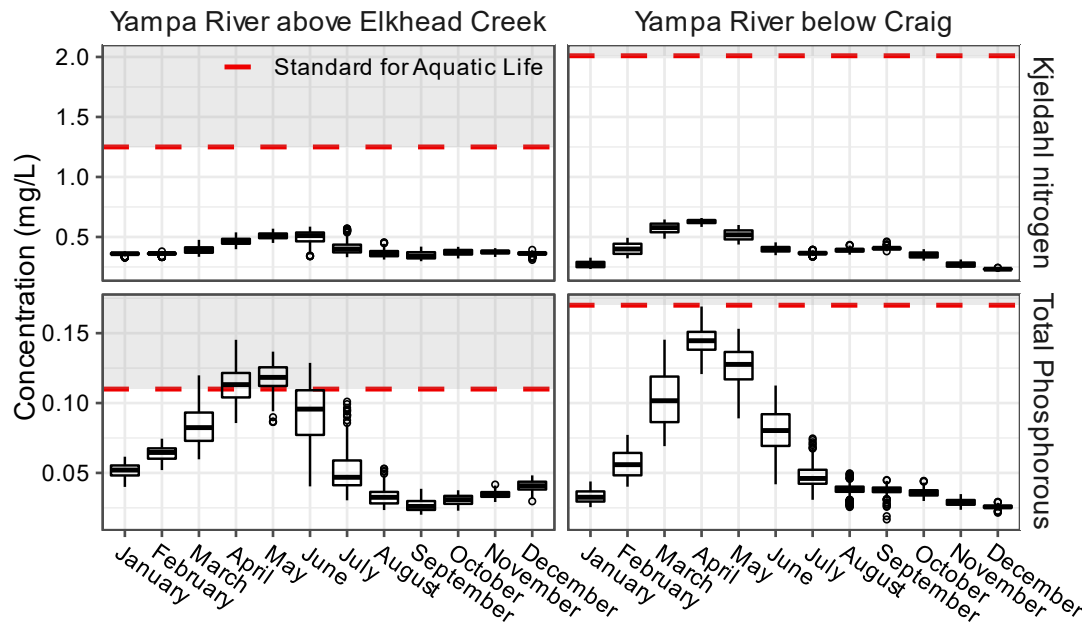
Estimated median annual TKN was well below the interim regulatory standard of 1.25 mg/L for cold water rivers (which applies to the above Elkhead station) and 2.01 mg/L for warm water rivers (which applies to the below Craig station) for all water years at both gaging stations in the study section (Table 4-11, Figure 4-6). Closer examination at a finer scale paints a similar picture: modeled daily and monthly median concentrations for TKN were also well below the regulatory standard for all days across the analysis period at both sites (Figure 4-6). Discrete TKN concentrations only exceeded the interim regulatory standard in the study reaches in one instance during the analysis period: once in April 2010 at the above Elkhead station (Figure 4-7). Notably, this exceedance took place in the month of April, when the onset of spring runoff commonly occurs (Day 2021). Discrete TN concentrations (Figure 4-7) exceeded the interim regulatory standard twice at the below Craig station (once in both 2000 and 2002) and once at the above Elkhead station (2010). Each of these exceedances occurred in either March or April during spring snowmelt events. In light of these infrequent exceedances – and especially the lack thereof for more than a decade – each riverscape scores an A with respect to nitrogen.

Table 4-11. Modeled Median Kjeldahl Nitrogen and Total Phosphorous Concentrations for Each Water Year and the Overall Period of Analysis (adapted from Day [2021])

Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010-18
Modeled Median Kjeldahl Nitrogen concentration (mg/L)										
Yampa River above Elkhead Creek	0.44	0.39	0.37	0.35	0.39	0.39	0.36	0.37	0.37	0.38
Yampa River below Craig	0.38	0.37	0.39	0.39	0.38	0.38	0.38	0.38	0.39	0.38
Modeled Median Total Phosphorous Concentration (mg/L)										
Yampa River above Elkhead Creek	0.059	0.056	0.046	0.044	0.053	0.054	0.049	0.052	0.045	0.050
Yampa River below Craig	0.042	0.047	0.039	0.040	0.044	0.042	0.040	0.042	0.039	0.042

Note: All years are water year (October-September) rather than calendar year

Figure 4-6. Modeled Kjeldahl Nitrogen and Total Phosphorus for the Yampa River above Elkhead and below Craig Gaging Stations from 2010 – 2018 (Adapted from Day [2021])



Like nitrogen, total phosphorous (TP) is measured quarterly at both stations in the study area, and these quarterly samples were used to estimate daily TP concentrations. Estimated median annual total phosphorous (TP) was below the interim regulatory standard of 0.11 mg/L for cold water rivers and 0.17 mg/L warm water rivers for all water years over the analyzed period for both sites (Table 4-11, Figure 4-6). However, summarizing the data at the annual scale obfuscates some trends; at closer examination, estimated daily concentrations exceeded the standard fairly frequently during the spring months. Median monthly values of TP for the period analyzed exceed the cold-water regulatory standard in both April and May at the above Elkhead station (Figure 4-6). Additional information is provided by examining the modeled data at the daily scale; exceedance occurs for a number of days in March-June. For the above Elkhead station, median number of days over the period of record in which the water quality standard is exceeded are 3, 21, 29, and 10.5 days for March, April, May, and June, respectively; however, at the below Craig site, the median number of days in exceedance are 0.

Measured discrete phosphorous concentrations also exceeded the standard fairly frequently during the spring months. At the above Elkhead station, TP in discrete samples was greater than 0.11 mg/L for six individual samples: March 2012, April 2010, May 2011, May 2016, and May 2022, and December 2010 (Figure 4-7). At the below Craig station, exceedance of 0.17 mg/L occurred five times in total from 1999-2022: all during the spring snowmelt months of April (2002, 2008, 2010) and May (2003 and 2011) (Figure 4-7). Given the fairly frequent exceeded of regulatory standards during the spring and early summer months – but only the spring and early summer – at the above Elkhead site, riverscapes 17, 18, 19 and 20 earn a score of C for phosphorous; conversely, due to the lack of frequent exceedances at the below Craig site, riverscapes 22, 23, and 24 earn a B score. Combined nutrient indicator scores are provided in Table 4-12.

Figure 4-7. Measured (Discrete) Kjeldahl Nitrogen, Total Nitrogen, and Total Phosphorus Values for the Yampa River above Elkhead and Yampa River below Craig Gaging Stations

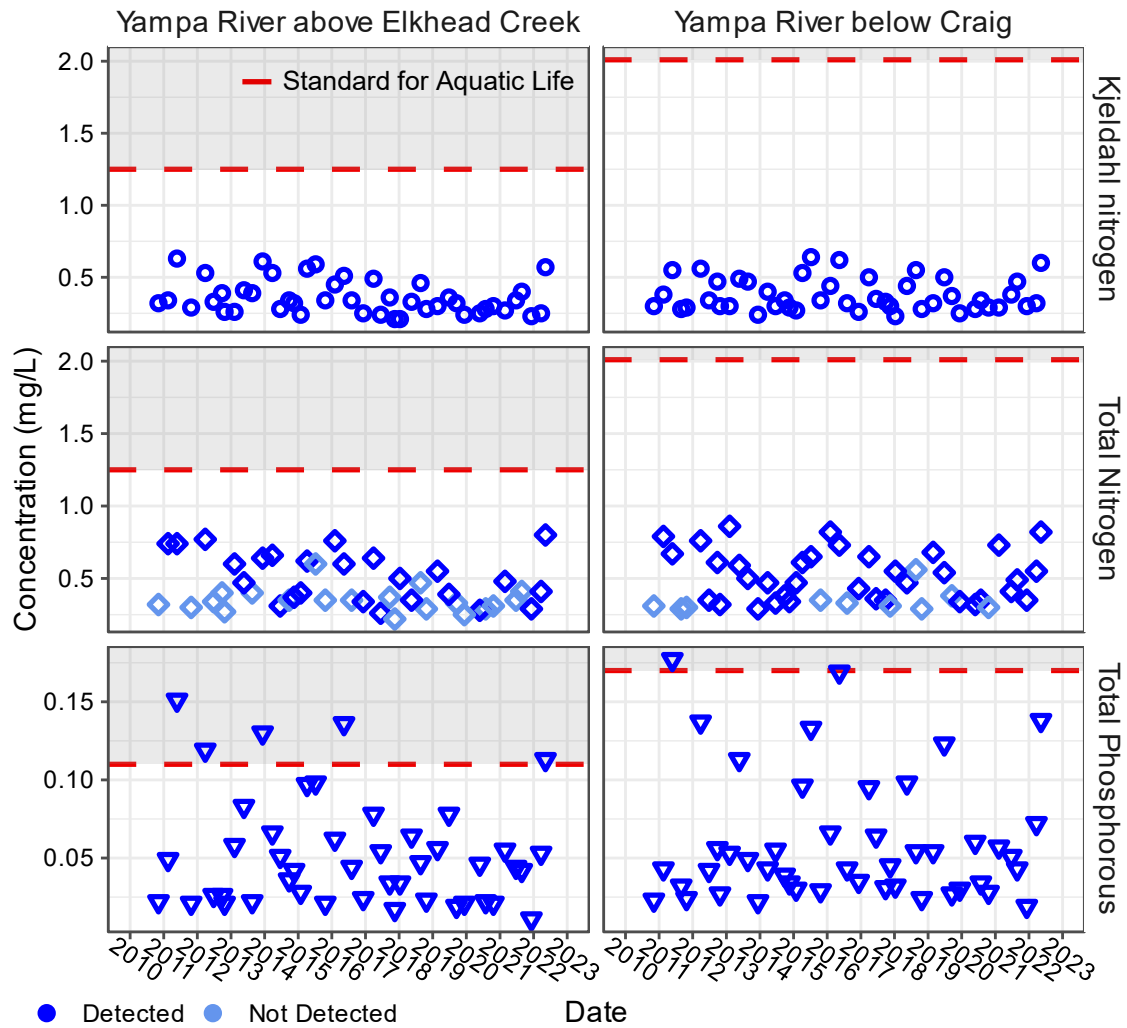


Table 4-12. Nutrients Indicator Scores by Riverscape

Riverscape	Nitrogen Score	Phosphorus Score	Nutrients Score
Riverscape 17	A	C	B
Riverscape 18	A	C	B
Riverscape 19	A	C	B
Riverscape 20	A	C	B
Riverscape 22	A	A-	A-
Riverscape 23	A	A-	A-
Riverscape 24	A	A-	A-

4.6 METALS INDICATOR

Metals generally occur at low concentrations in surface waters, and a number of them are essential nutrients to aquatic biota, but they are toxic at higher concentrations. CDPHE sets regulatory standards for most metals based on the uses identified for each stream segment (e.g., water supply, agriculture, recreation, aquatic life protection); if water quality samples frequently exceed these standards, the stream segment is placed on the State's 303(d) or M&E (monitoring and evaluation) list for that particular constituent.

4.6.1 Data Sources and Evaluation Methods

Select trace metals (total iron and manganese; dissolved cadmium, copper, lead, manganese, selenium, silver, and zinc) are measured quarterly by USGS as part of the Upper Yampa River Basin Water Quality Monitoring Program. Two locations in the Scorecard focal segment are part of this monitoring program: Yampa River Above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO. Data were downloaded from nwis.waterdata.usgs.gov. FOTY also collected two water quality samples at the Craig Intake location (riverscape 23) in 2022: one in June during high-flow conditions, and one in September during low-flow conditions.

4.6.2 Scoring Criteria

The scoring criteria outlined in Table 4-13 based on adherence to regulatory standards set by CDPHE are used to rate the metals indicator.

Table 4-13. Metals Indicator Scoring Criteria

Grade	Description
A	Chemical conditions are within ranges that are natural and appropriate for a well-functioning river in its process domain.
B	Chemical conditions are within the range of natural variability. Natural aquatic biota are minimally impaired even though background concentrations of certain metals may be elevated. Regulatory standards are not exceeded (except for metals with elevated background concentrations).
C	Chemical conditions are altered to a degree that could potentially limit natural aquatic biota. Stressors are present which create conditions that may warrant inclusion on State impaired waters lists. CDPHE Monitoring and Evaluation (M&E) listed reaches fall in this category.
D	Chemical conditions are altered to a degree that is known to be lethal or limiting to natural aquatic biota. Regulatory standards are frequently exceeded. CDPHE 303(d) listed reaches fall in this category.
F	The chemical environment is fundamentally altered. Natural biota are severely impaired. Regulatory standards have been exceeded consistently.

4.6.3 Results

The metals indicator is evaluated through review of USGS Water Quality Monitoring Program data at the Yampa River above Elkhead Creek Near Hayden, CO and Yampa River below Craig, CO monitoring locations, where total iron, total and dissolved manganese, dissolved cadmium, dissolved copper, dissolved lead, dissolved selenium, dissolved silver, and dissolved zinc are

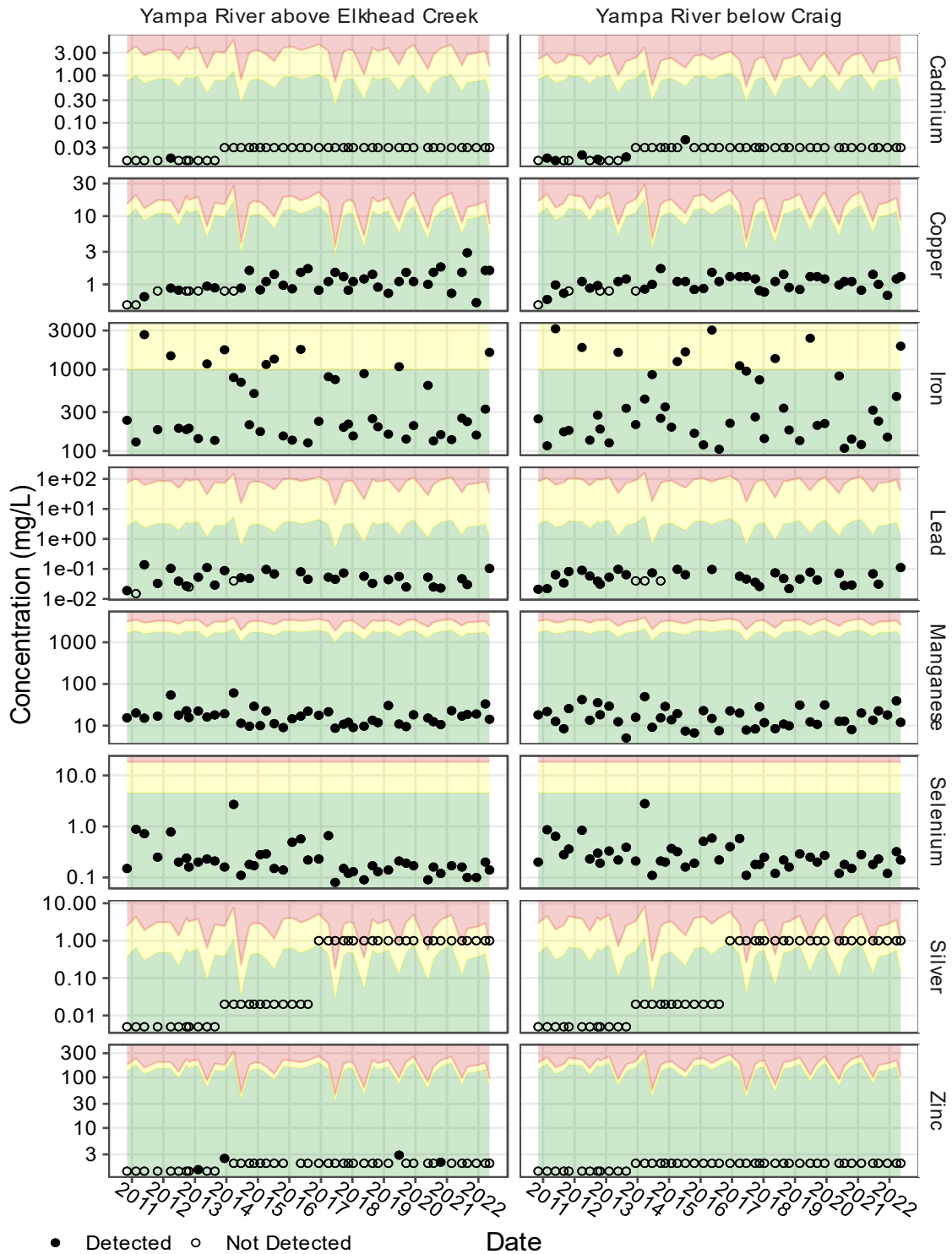
measured quarterly. As was done with the nutrients indicator, because rivers integrate upstream inputs, data from the above Elkhead station (located in riverscape 20) are used to score riverscapes 17, 18, 19, and 20; data from the below Craig station (located in riverscape 24) are used to score the remaining riverscapes (riverscapes 22, 23, 24). A USGS analysis of metals and other water quality data for the Upper Yampa Basin for the 1979-2009 period was completed in 2012; portions of this report that contain analysis and interpretation of data for the Yampa River above Elkhead site (the below Craig site was outside the area covered) were examined for additional context (Bauch et al. 2012).

Of the metal constituents analyzed, all except iron were consistently below CDPHE regulatory standards at both monitoring locations (though the detection limit of the method used to calculate silver concentrations post-2015 precludes stating this with certainty) (Figure 4-8). In the figure, open circles indicate that concentration was below the level of the position of the point (e.g., an open circle at 1 mg/L for silver suggests that silver concentration for that sample was < 1 mg/L). Red shading indicates acute contamination standard; yellow is chronic; green is acceptable the range for aquatic life. Elevated iron levels are likely lithologically driven; the sedimentary and igneous rocks in the Yampa Basin contain iron and iron-bearing minerals in relatively high concentrations (Bauch et al. 2012). Likely because of the high natural iron content in the surrounding rocks and because of the relatively few exceedances of the regulatory standard, the CDPHE monitoring segment of the Yampa River contained within the Scorecard riverscapes is listed as M&E or 303(d) (interestingly, however, lower portions of the Yampa are 303(d) listed for iron). Overall, the relatively low concentrations of metals in the riverscapes considered is not unexpected due to the recent cessation or overall lack of activities that generally enhance in-stream concentrations of metallic species (e.g., industrial production, mining of precious metals). Every riverscape therefore scores an A for the metals indicator (Table 4-14).

Table 4-14. Metals Indicator Scores by Riverscape

Riverscape	Metals Score
Riverscape 17	A
Riverscape 18	A
Riverscape 19	A
Riverscape 20	A
Riverscape 22	A
Riverscape 23	A
Riverscape 24	A

Figure 4-8. Total (Iron) and Dissolved Metals Concentrations from Quarterly Water Sampling at the Yampa River above Elkhead Creek and Yampa River below Craig, CO Locations (2010-2022)



5.0 HABITAT CONNECTIVITY

Habitat connectivity is defined as the interaction and interconnectedness between a river segment and its surrounding landscape, including pathways for movement of biological organisms and organic matter through the riparian corridor. This category includes connectivity of both terrestrial and aquatic communities and considers both longitudinal (upstream/downstream) and lateral (channel/floodplain/upland) directions. The Yampa River Scorecard evaluates two indicators within the habitat connectivity category: **aquatic connectivity** and **terrestrial connectivity**. The final habitat connectivity score is calculated as an average of the aquatic connectivity and terrestrial connectivity indicator scores.

5.1 AQUATIC CONNECTIVITY INDICATOR

The aquatic connectivity indicator addresses the ability for aquatic organisms to migrate and disperse in both longitudinal (upstream/downstream) and lateral (between the channel and floodplain, e.g., side channels) directions. This indicator looks at presence or absence of barriers to aquatic movement.

5.1.1 *Data Sources and Evaluation Methods*

Data to score this indicator are collected by floating the entire focal segment of the Yampa River and identifying (and marking with GPS) any in-channel barriers to aquatic species movement. This fieldwork was completed during a 10-day field course in June 2022 coordinated in partnership with Colorado Mountain College (Appendix A). To the extent possible, observers assessed the height of the barrier or dam, and the amount of time of the year and associated flow conditions where that structure poses a barrier to aquatic species movement (e.g., only passable during spring runoff, impassable during all flow conditions, etc.).

Field floats also identify the following features that are important to aquatic species migrating laterally for spawning and cover:

- Permanently inundated side channels;
- Seasonally inundated side channels;
- Backwater areas; and
- Split flows (i.e., two narrow channels versus one wide channel).

Fieldwork is augmented by review of historical aerial imagery to reflect the complexity and evolution of the riverscapes in terms of aquatic connectivity.

5.1.2 *Scoring Criteria*

The scoring criteria outlined in Table 5-1 based on presence and extent of barriers to aquatic species movement are used rate the aquatic habitat connectivity indicator.

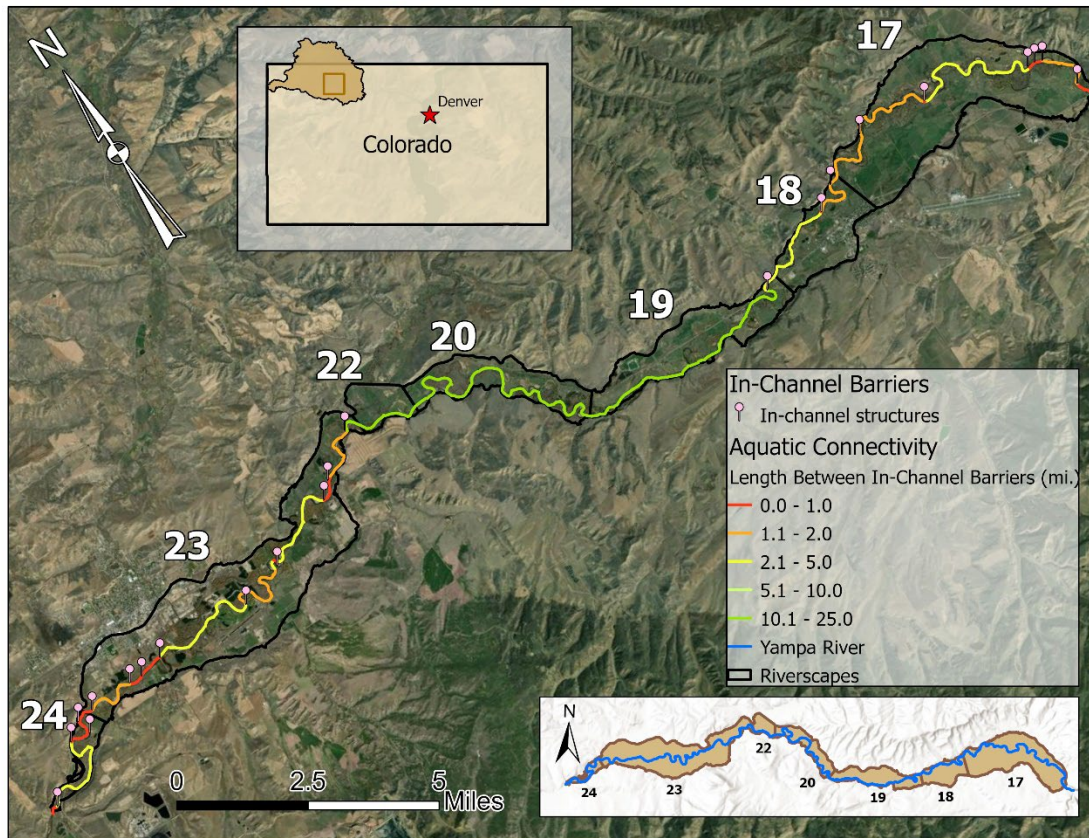
Table 5-1. Aquatic Habitat Connectivity Indicator Scoring Criteria

Grade	Description
A	No significant barriers exist that prevent migration or dispersal of aquatic organisms within the entire ecoregion and upstream headwaters.
B	Impermeable migration/dispersal barriers are at least 10 miles apart and/or there are minor migration/dispersal impediments on the reach or adjacent reaches. Mild loss of side channel and/or backwater area access may impact spawning and cover for certain species.
C	Impermeable migration/dispersal barriers are approximately 5 miles apart and/or there are multiple migration/dispersal impediments on the reach or adjacent reaches. Moderate loss of side channel and/or backwater area access may impact spawning and cover for certain species.
D	Impermeable migration/dispersal barriers are approximately 2 miles apart and/or migration/dispersal is severely impeded on the reach or adjacent reaches. Substantial loss of side channel and/or backwater area access may impact spawning and cover for certain species.
F	The reach is effectively isolated. Impermeable migration/dispersal barriers are approximately 1 mile apart or less and/or migration/dispersal is completely impeded on the reach or adjacent reaches. Access to side channel and/or backwater areas for spawning and cover is unavailable.

5.1.3 Results

The results of aquatic connectivity scoring are composed of two parts that together yield an overall score for this indicator: barriers to longitudinal connectivity (e.g., dams) and pathways for lateral connectivity (e.g., side channels).

In contrast with other rivers of the Colorado River Basin – and what makes the Yampa such a cherished treasure – in-channel barriers to upstream-downstream movement are minimal. Those that do exist generally take the form of “push-up” dams constructed to coerce water into a diversion structure or channel crossings such as bridges, but they are relatively dispersed throughout the study reaches and are generally clustered in the upper and lower riverscapes (Figure 5-1); the middle riverscapes (19, 20, and 22) notably lack such structures (Figure 5-1). The lack of in-channel barriers in riverscape 20 is not surprising given that the river flows within the boundaries of Yampa River State Wildlife Area for nearly the entirety; however, the scarcity of structures in riverscapes 19 and 22 is relatively surprising due to the substantial agricultural activity in these reaches. This condition may be attributed to the use of pumps for irrigation rather than gravity-fed ditches (two of the largest diversions in riverscape 19 are pump-driven, the [Yoast Pumping Plant](#) and the [Frentress Ditch and Pumping Plant](#)), diminishing the need for large push-up structures, as well as the preponderance of smaller livestock watering diversions in the middle riverscapes rather than the larger crop irrigation diversions seen elsewhere. Indeed, in-channel barriers are found with a relatively greater frequency in riverscapes 17, 18, 23, and 24, where agricultural activity is more prevalent. Several road crossings also exist in these upper and lower riverscapes that are not present in the middle reaches; the resulting relatively low scores regarding in-channel structures are therefore relatively unsurprising (Table 5-2).

Figure 5-1. In-Channel Barriers to Longitudinal Movement as Observed in the Field

Pathways for lateral movement (e.g., side channels) are commonly found along the Yampa throughout the study area. The presence of such features enables aquatic organisms to extricate themselves from the higher energy of the main channel into relatively sheltered and quiescent waters. Lateral connectivity pathways are thus important for spawning and rearing of several species of fish, as well as for other organisms that may move frequently between the main river channel and the neighboring floodplain (e.g., beaver). Lateral pathways scores were determined by (1) calculating the number of such features observed in the field and on imagery per river mile, and then (2) evaluating that number relative to what may be expected of a natural river in its process domain using the following rubric, which dovetails with the scoring criteria laid out in Section 5.1.2: No loss of side channel access (>4/mile); mild loss of side channel access (<4/mile); moderate loss of side channel access (<3/mile); substantial loss of side channel access (<2/mile); and full loss of side channel access (<1/mile). Lateral pathways were most frequent and widespread in riverscapes 17, 19, 20, and 23 (Figure 5-2); these riverscapes therefore earned the highest scores (Table 5-2). Inspection of aerial imagery suggests that high scores may be a function of the presence of substantial portions of intact riparian forest along these riverscapes, emphasizing the benefits of preserving such floodplain ecosystems for the river. A notably low score for the presence of lateral pathways occurred in riverscape 24, likely due to the fact that the river here is bounded by a large interstate highway and a railroad.

Figure 5-2. Locations of Pathways for Lateral Movement as Observed in the Field

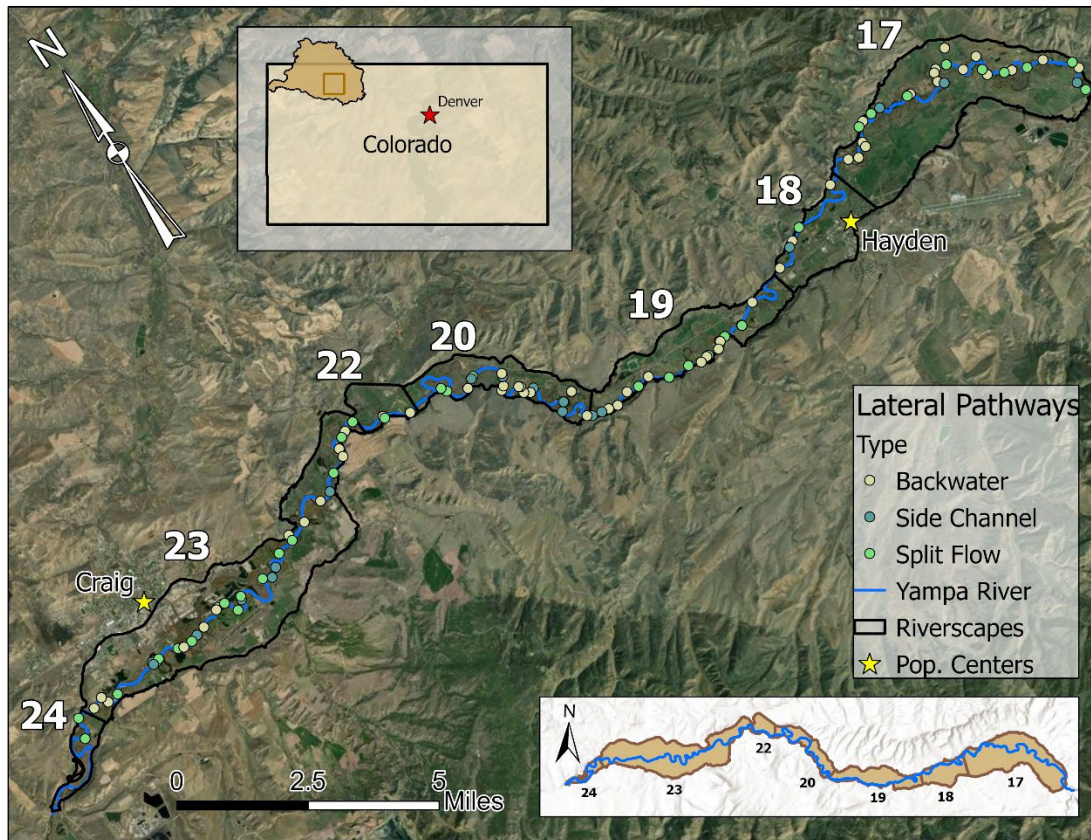


Table 5-2. Aquatic Connectivity Indicator Scores by Riverscape

Riverscape	Barriers Score	Lateral Pathways Score	Aquatic Connectivity Score
Riverscape 17	C-	A	B-
Riverscape 18	C	B	B-
Riverscape 19	A	A	A
Riverscape 20	A	A	A
Riverscape 22	A	B	A-
Riverscape 23	D	A	C
Riverscape 24	D	D	D

5.2 TERRESTRIAL CONNECTIVITY INDICATOR

The terrestrial connectivity indicator addresses the ability of terrestrial organisms to move both longitudinally (upstream/downstream) and laterally (between the channel and riparian zone, between riparian zone and upland areas). This indicator considers habitat fragmentation, including barriers created by roads, railroads, trails, bridges, fences, etc.

5.2.1 Data Sources and Evaluation Methods

The Scorecard relies on floodplain fragmentation metric results from the Yampa IWMP remote assessment that was conducted as part of the riparian condition evaluation (Yampa IWMP 2021). For context, the Yampa IWMP remote assessment evaluated riparian condition across the basin using the Riparian Condition Assessment Tool (RCAT) developed by Utah State University (MacFarlane et al. 2018). RCAT provides a holistic proxy measure of riparian condition by assessing and integrating three key metrics of riparian functions: (1) riparian vegetation departure from historical conditions, (2) land use intensity within valley bottoms, and (3) floodplain fragmentation by infrastructure (roads, railroads, levees, etc.). The floodplain fragmentation metric calculates the proportion of accessible versus inaccessible floodplain within a reach due to roads, railroads, levees, or other infrastructure. Scores range from one (fully accessible) to zero (inaccessible). The floodplain fragmentation statistic calculated for each riverscape (encompassing the lateral extent of the entire valley bottom) is coupled with review of aerial imagery to rate the terrestrial connectivity indicator.

5.2.2 Scoring Criteria

The terrestrial connectivity indicator scoring criteria outlined in Table 5-3 are based on floodplain fragmentation and severity and proximity of migration barriers to terrestrial species movement.

Table 5-3. Terrestrial Connectivity Indicator Scoring Criteria

Grade	Description
A	Negligible fragmentation of the floodplain by infrastructure and development, with a floodplain fragmentation score of > 91%. No significant barriers to migration or dispersal of terrestrial organisms.
B	Minor fragmentation of the floodplain by infrastructure and development, with a floodplain fragmentation score between 71-90%. Impermeable barriers affect a minor portion of surrounding habitat, but permeable barriers such as gravel roads, minor berms, ditches, or barbed wire fences may be present.
C	Moderate fragmentation of the floodplain by infrastructure and development, with a floodplain fragmentation score between 41-70%. Impermeable barriers affect a moderate portion of surrounding habitat, and semi-permeable barriers such as two-lane paved roads, rail lines, or widely scattered residential development may be present.
D	Significant fragmentation of the floodplain by infrastructure and development, with a floodplain fragmentation score between 21-40%. Impermeable barriers and/or permeable barriers affect a substantial portion of surrounding habitat.
F	Severe fragmentation of the floodplain by infrastructure and development, with a floodplain fragmentation score of < 20%. Impermeable barriers and/or permeable barriers affect almost all of the surrounding habitat.

5.2.3 Results

This indicator is scored through review of IWMP remote assessment results and confirmation from aerial imagery. Briefly, the Yampa River Remote Assessment delineated the floodplain using a variety of data sources and then overlaid various infrastructure layers (roads, levees, railroads, etc.) to calculate the fraction of the floodplain that was isolated by that infrastructure. See Section 6.2.1.1.3 in the Yampa River Remote Assessment Data Synthesis Report for further details on the methodology (Yampa IWMP 2021).

Floodplain fragmentation is, unsurprisingly, relatively highest – though still only moderate – in those riverscapes that contain the major population centers of Hayden and Craig (riverscapes 19 and 23, respectively), where infrastructure and development isolate substantial portions of the floodplain landscape (Table 5-4, Figure 5-3). Minor fragmentation occurs in riverscapes 17, 18, and 20, generally resulting from the railroad and surface roads (e.g., US-40); permeable barriers such as agricultural infrastructure (e.g., fencing, gravel roads) are also present. Negligible fragmentation is found in riverscapes 22 and 24, likely because of the relatively high degree of natural confinement that limits development and fragmentation “potential” (especially for riverscape 24) and potentially because of statistical idiosyncrasies wherein the relatively small areas of riverscapes 22 and 24 – the smallest in the Middle Yampa segment – lowers the probability of substantial fractionation (Table 5-4, Figure 5-3). The confluence with the tributary Elkhead Creek that occurs in riverscape 22 likely also results in a low degree of fractionation due to the orientation of the confluence (orthogonal) relative to infrastructure. Scores for the terrestrial connectivity indicator are presented in Table 5-5.

Table 5-4. Floodplain Fragmentation Percent by Riverscape

Riverscape	Floodplain Fragmentation
17	77%
18	80%
19	67%
20	85%
22	94%
23	65%
24	96%

* Adapted from the Yampa River Remote Assessment Data Synthesis Report (Yampa IWMP 2021); higher percentages correspond to minimal fragmentation and lower percentages correspond to greater fragmentation of the landscape.

Figure 5-3. Floodplain Fragmentation (Representing Terrestrial Connectivity) by Riverscape

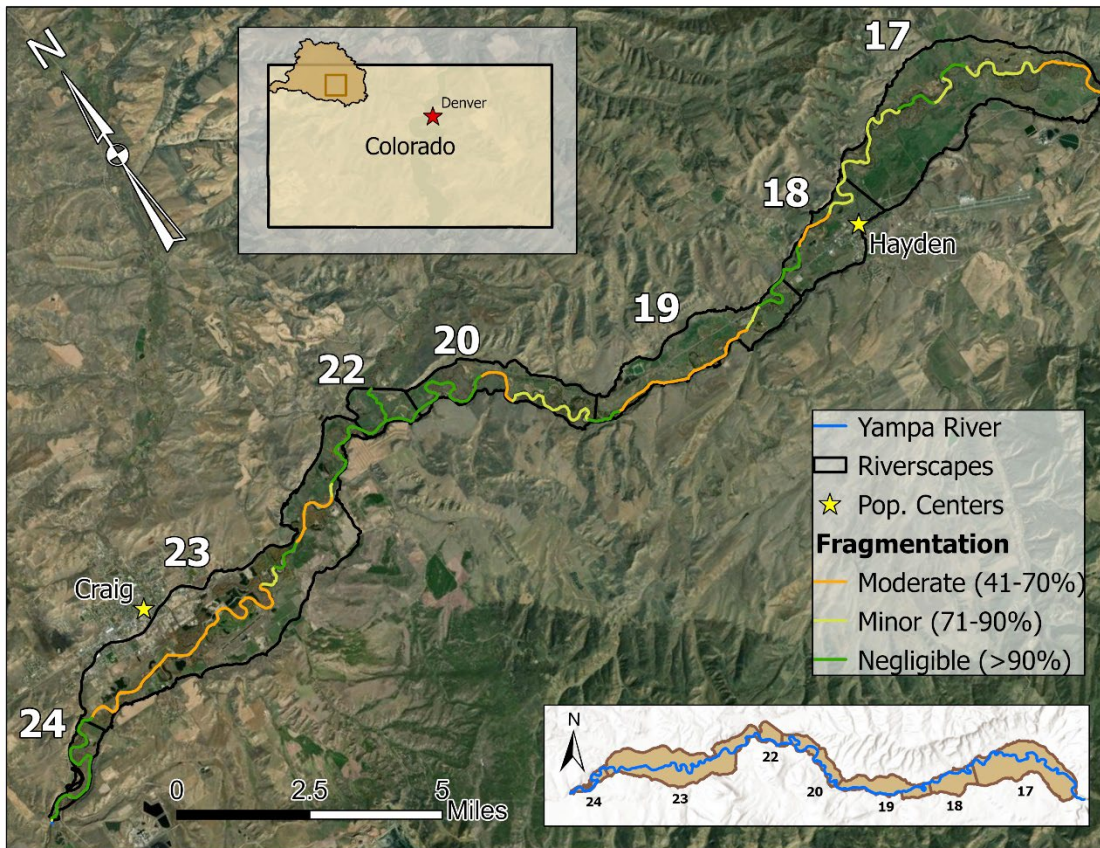


Table 5-5. Terrestrial Connectivity Indicator Scores by Riverscape

Riverscape	Terrestrial Connectivity Score
Riverscape 17	B
Riverscape 18	B
Riverscape 19	C
Riverscape 20	B
Riverscape 22	A
Riverscape 23	C
Riverscape 24	A

6.0 RIVERSCAPE CONNECTIVITY

Riverscape connectivity is defined as the degree to which water can access and hydrate the surrounding riverscape (channel and floodplain). In particular, riverscape connectivity reflects the ability of the valley bottom to be actively and routinely engaged by fluvial processes. Connectivity varies naturally based on geology, topography, and hydrology. It also reflects impediments due to hydromodifications, channel modifications (e.g., enlargement, entrenchment, channelization/stabilization), and/or anthropogenic land uses within the floodplain (e.g., levees, drainage ditches, development, fill), which limit hydrogeomorphic processes, dynamism of channel/floodplain interaction, and biological interactions between the channel and its floodplain. The Yampa River Scorecard evaluates riverscape connectivity using a single indicator referred to as **riverscape connectivity**.

6.1 RIVERSCAPE CONNECTIVITY

Riverscape connectivity for the Scorecard project is defined as the ratio of the active floodplain to the maximum possible floodplain extent, as was done for the Yampa IWMP remote assessment. The Yampa IWMP remotely evaluated a Floodplain Connectivity indicator across the entire basin, described as the ratio of the accessible extent of the active floodplain to the maximum potential accessible floodplain (Yampa IWMP 2021). The floodplain connectivity ratio is a proxy measure of the extent and frequency with which flows interact with the channel and adjacent floodplain. This interaction is critical for creating and maintaining a healthy stream corridor by helping establish and maintain riparian vegetation throughout the floodplain, which in turn extends inundation residence times by attenuating and slowing flows through the system.

For the Yampa IWMP remote assessment, floodplain connectivity was assessed across the entire basin, and reassessed using higher resolution data in a portion of the Scorecard focal segment, to characterize the capacity of water to inundate and activate the adjacent riparian corridor. The higher resolution data used for a section of the focal segment allow for better identifying and mapping fluvial features and more accurately delineating floodplain extents. It is important to note that a critical component of accurate floodplain and geomorphic delineations is field verification. While the remote assessment provides a good foundation, the Scorecard effort provides ground-truthing, field verification, and refinement of those results to the extent possible (described more in Section 6.1.5).

The active floodplain is defined as the extent to which flows can access the land adjacent to the river over frequent to moderate recurrence intervals. The active floodplain delineates the areas where inundation duration and frequency can maintain riparian vegetation and active fluvial processes. To determine the area occupied by active floodplain via remote sensing, two lines of evidence were used: (1) floodplain fragmentation by development and transportation infrastructure, which have disconnected low-lying areas from the active floodplain, and (2) topographic datasets to identify low-lying areas that have the potential to be inundated at frequent to moderate recurrence intervals. Integration of the floodplain fragmentation and the potentially active floodplain layers were used to delineate the active floodplain. The active floodplain is defined as land that is within the potentially active floodplain that has not been disconnected by development or transportation networks. Figure 6-1 shows some of the steps

taken to determine the floodplain connectivity ratios for the Yampa IWMP remote assessment (Yampa IWMP 2021).

Figure 6-1. Yampa IWMP Remote Assessment Floodplain Connectivity Metrics Example

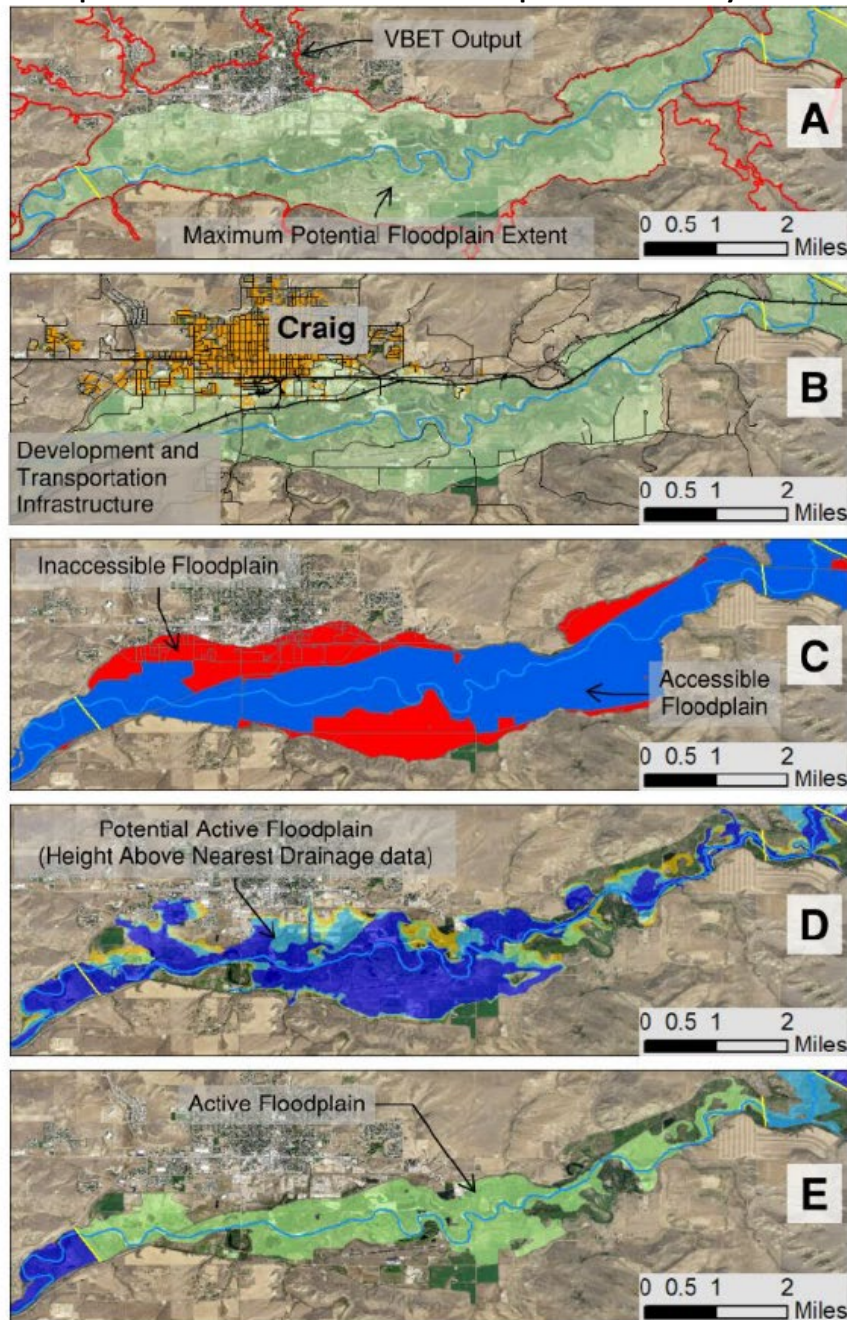


Figure 6-1. Example floodplain connectivity metrics for Riverscape 23 (see Figure 2-4 for context). A) VBET outputs and manually modified valley bottom representing the maximum potential floodplain extent. B) Development and transportation infrastructure overlain on valley bottom polygon. C) Floodplain fragmentation by development and transportation network. D) Potential active floodplain based on Height Above Nearest Drainage. E) Active floodplain.

6.1.1 Data Sources and Evaluation Methods

The Scorecard uses the results of the Yampa IWMP remote assessment floodplain connectivity evaluation to score the riverscape extent indicator. However, the remote assessment did not include a field verification component. For the Scorecard, the floodplain connectivity ratios for the seven relevant riverscapes in the focal segment were ground-truthed to the extent possible, particularly in unconfined reaches where the remote assessment may have overestimated the maximum potential floodplain extent, through site visits in areas with landowner access permissions. Select sites were visited for field verification by a geomorphologist, hydrologist, and watershed scientist team in September 2022. Where discrepancies were identified, the Scorecard provides explicit rationale and alters the IWMP evaluation as necessary based on the field verification exercise and uses an updated score for evaluation per the scoring criteria described in Section 6.1.3.

6.1.2 Scoring Criteria

The scoring criteria outlined in Table 6-1 based on Yampa IWMP remote assessment floodplain connectivity ratios are used rate the riverscape extent indicator.

Table 6-1. Riverscape Extent Scoring Criteria

Grade	Description
A	Natural pattern of floodplain activation over frequent to moderate recurrence intervals, with a floodplain connectivity ratio of > 90%.
B	Majority of riverscape extent is available for activation over frequent to moderate recurrence intervals, with a floodplain connectivity ratio of 75-90%.
C	Moderate amount of riverscape extent is available for activation over frequent to moderate recurrence intervals, with a floodplain connectivity ratio of 50-74%.
D	Small amount of riverscape extent is available for activation over frequent to moderate recurrence intervals, with a floodplain connectivity ratio of 25-49%.
F	Riverscape activation over frequent to moderate recurrence intervals is extremely limited, with a floodplain connectivity ratio of < 25%.

6.1.3 Results

This indicator is scored using a combination of review of IWMP remote assessment results and data collected during site visits with Scorecard partners. Adjustments to active floodplain polygons generated by the IWMP were edited using ground truthing and aerial photograph inspection for riverscapes 18, 19, 22, 23, and 24. Additionally, in place of the IWMP active floodplain delineation, fluvial hazard zone mapping of the active stream corridor (using high-resolution data) was used to replace the IWMP active floodplain delineation (using moderate-resolution data) for riverscape 17 (Jagt et al. 2022). Maximum floodplain extents are the same as those delineated in the IWMP report. Additionally, the floodplain connectivity multipliers determined by the IWMP assessment by comparison of floodplain mapping results in areas with high resolution elevation (1-m) data to those in areas with moderate resolution elevation (10-m) data were used here as well.

The highest floodplain connectivity scores are found in riverscapes 22 and 24, where 95% and 85% of the floodplain, respectively, is readily accessible by relatively frequent flows (Table 6-2, Table 6-3, and Figure 6-2). Both are somewhat surprising given the relatively poor scores in other indicators for these riverscapes. The high score for riverscape 24 likely arises from the natural confinement of the river in this stretch; opportunities for development or other human actions that render portions of the floodplain inaccessible are typically limited in a confined valley. The high score for riverscape 22 is perhaps primarily a function of the confluence with Elkhead Creek, which at high stage appears to access much of the northern portion of the floodplain through the riverscape. The high degree of connectivity may additionally be a function of the comparatively smaller size of riverscape 22 and natural barriers (e.g., Elkhead confluence) that inhibit extensive infrastructure development on the floodplain.

The next highest grade is for riverscape 20 (Table 6-3 and Figure 6-2). The score for riverscape 20 is unsurprising given the high grades in many of the other indicators for this riverscape, suggestive a well-connected river.

The lowest grades received are for riverscapes 17, 18, 19, and 23 (Table 6-3 and Figure 6-2). Again, the inclusion of riverscape 17 here is rather surprising; however, it likely stems from the unconfined character of this reach – one of only two truly unconfined riverscapes in the Middle Yampa segment (Table 6-2) – and the high degree of development (agriculture, transportation, etc.) in these areas. US Route 40 and the Union Pacific railroad, for example, cut large portions of the river off from its historically accessible floodplain in all three riverscapes. Further development, such as the campground in riverscape 19, additionally isolates the river from the floodplain. Of these four reaches with moderate or small amounts of connection, the two absolute lowest – 18 and 23 – are those where the largest population centers (Hayden and Craig, respectively) in the study segment are located.

Table 6-2. Confinement and Floodplain Connectivity Percentages by Riverscape

River-scape	Confinement	Max. Potential Floodplain (mi ²)	Active Floodplain IWMP (mi ²)	Active Floodplain YRSP (mi ²)	Floodplain Connectivity (%)	Multiplier	Adj. Floodplain Connectivity (%)
17	Unconfined	7.9	3.01	3.80	0.48	1.3	0.62
18	P. Confined	2.03	1.04	0.77	0.38	1.3	0.49
19	P. Confined	3	1.33	1.49	0.50	1.3	0.64
20	P. Confined	2.42	1.36	1.65	0.68	1.3	0.89
22	P. Confined	0.85	0.41	0.62	0.73	1.3	0.95
23	Unconfined	10.43	4.18	4.35	0.42	1.3	0.54
24	Confined	0.64	0.54	0.54	0.85	1	0.85

Figure 6-2. Floodplain Connectivity Scores for the Middle Yampa River Segment

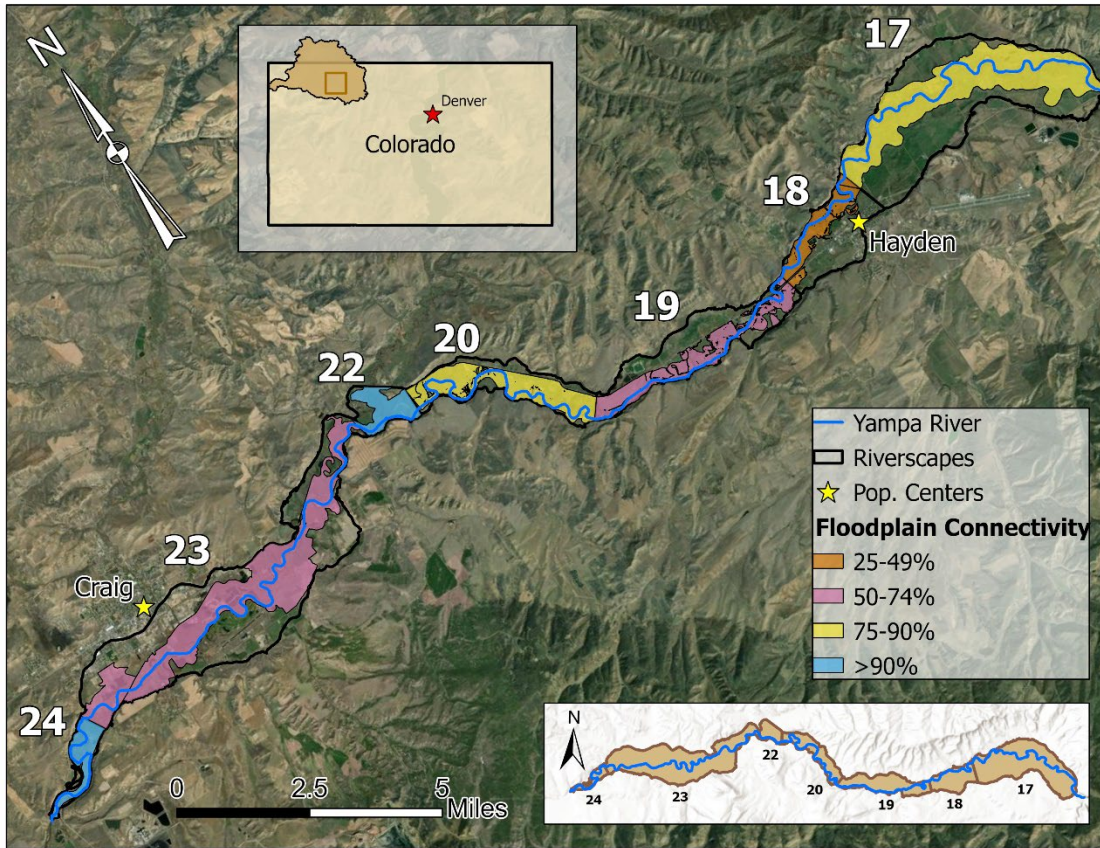


Table 6-3. Riverscape Connectivity Indicator Scores by Riverscape

Riverscape	Riverscape Connectivity Score
Riverscape 17	C
Riverscape 18	D
Riverscape 19	C
Riverscape 20	B
Riverscape 22	A
Riverscape 23	C
Riverscape 24	A

7.0 RIPARIAN CONDITION

Riparian areas, or lands that occur along and are influenced by watercourses, are a critical part of a healthy and resilient stream ecosystem, providing physical roughness that slows water velocities and mitigates the impacts of flood flows; bank stability through root system cohesiveness; habitat for a diversity of riparian plants, animals, and microbes; water quality improvement; shade for the stream corridor to maintain a healthy thermal regime; large wood to stream channels, which creates beneficial habitat complexity; organic matter to the water column; and off-channel habitats like backwaters, wetlands, and side channels that act as refugia for fish and other aquatic species. Well-established and connected riparian areas also link stream corridor and upland ecological processes. Riparian condition is defined as the degree to which riparian areas support river health and critical functions. The Yampa River Scorecard evaluates two indicators within the riparian condition category: **vegetation structure and complexity** and **invasive species**. The final riparian condition score is calculated as 90% vegetation structure and complexity indicator score and 10% invasive species indicator score.

7.1 VEGETATION STRUCTURE AND COMPLEXITY INDICATOR

The vegetation structure and complexity indicator describes riparian vegetation and its ability to support characteristic riparian functions. Healthy riparian zones are characterized by a high level of vertical and horizontal complexity, including a mosaic of habitat types and multiple vegetation layers. Included in these considerations are structure, height, cover, species diversity, complexity, age, and patchiness/interspersion of riparian vegetation. The character and complexity of riparian vegetation are primarily driven by above ground saturation and the associated disturbance caused by seasonal flooding, alluvial groundwater, and erosional and depositional changes that create bars and distribute overbank fine sediment. Complex riparian corridors in turn influence a spectrum of physical functions in the river ecosystem while providing critical wildlife habitat.

Riparian condition is evaluated within a limited portion of the maximum potential floodplain as defined in the riverscape connectivity category. In particular, it is evaluated out to a maximum of 100 meters from each channel bank. The maximum potential floodplain – and therefore potential extent of riparian vegetation – is typically considerably wider than 200 meters on the Yampa River, particularly in the Scorecard focal segment. The limited scope of the riparian condition category represents a compromise between data acquisition and available resources. The condition and extent of riparian vegetation is evaluated near the channel where it exerts the greatest control on river health, but the condition of riparian vegetation in the wider riverscape is not assessed. Future assessments will seek to expand the breadth of riparian vegetation mapping within the maximum potential floodplain in order to chart riverscape-scale changes in land cover and land use.

7.1.1 *Data Sources and Evaluation Methods*

Vegetation structure and complexity are evaluated using the remote polygon methodology applied in the City of Steamboat Springs SMP's river health assessment (City of Steamboat Springs 2018), with the lateral extent of the riparian zone defined as the edge of the natural floodplain or 100 meters from each river bank (200 meters total terrestrial width), whichever is narrower. This multi-step approach entails the following steps:

- (1) Create and classify cover type polygons within the riparian zone (e.g., cottonwood forest, agricultural field, wetland, bare ground, residential development, etc.);
- (2) conduct initial desktop grading on polygons created in step 1;
- (3) field verify and refine initial polygons, particularly for polygons with natural-looking riparian vegetation;
- (4) perform a calibrated grading based on information from field verification step 3;
- (5) grade each cover type polygon based on Table 13, below; and
- (6) calculate an area-weighted average of all polygon scores within each riverscape to produce a single vegetation structure and complexity indicator score for each riverscape.

More details regarding the methodology for this approach are provided in Appendix B.

7.1.2 Scoring Criteria

The scoring criteria outlined in Table 7-1 based on the ability of the riparian corridor to support river health functional attributes are used to rate the vegetation structure and complexity indicator.

Table 7-1. Vegetation Structure and Complexity Indicator Scoring Criteria

Grade	Description
A	Native riparian conditions exist that appear natural and appropriate for the Yampa River. Woody vegetation is present and commonly dominant, but patches and ribbons of meadow are typical. Vegetation is characteristically patchy, with strong interspersions of patches and overall good vertical structure driven by connection to the river. No evident effects of stressors – many stressors ameliorated by frequent flooding. Examples include cottonwood forest on well-connected surfaces such as vegetated point bars; young, characteristically willow-dominated, vegetation on recently formed surfaces; low, in-channel benches protected from human manipulation, typically scrub-shrub. Full support of river health.
B	Riparian habitat resembles native conditions but with detectable changes or mild, evident stressors. Vegetation appears self-sustaining and requiring little or no maintenance to preserve characteristic structural diversity. Habitat maintains a high degree of patchiness and interspersions, with little homogenization or loss of vertical structure. Small habitat patches can be relatively homogenous but contribute to the local mosaic of habitats. Common examples include river-connected cottonwood canopy and subcanopy forest with impacts such as grazing and primitive roadways. Minor reduction in the support of river health attributes.
C	Vegetated but with substantial departure from native conditions. Most commonly, alterations result in a loss of structural complexity, and/or homogenization of vertical structure, patchiness, and/or interspersions. Examples include cleared pastures that contain scattered trees and shrubs; fallow floodplain hayfields and cottonwood forests with substantial understory alteration; and palustrine emergent wetlands associated with ditches and sloughs. Riparian condition contributes to the degradation of one or more river health processes.
D	Dramatic loss of structural complexity, and/or homogenization of vertical structure, patchiness, and interspersions. Habitat commonly isolated from the river.

	Bare ground or impervious surfaces commonly makes up a significant portion of land cover. Vegetation tends to be very disturbed or actively cultivated. Examples include actively cultivated hay fields, old gravel mines, primitive roadways, and golf courses. Riparian land use contributes to river dysfunction.
F	Riparian area is developed or wholly converted with predominantly bare ground, impervious surfaces, or otherwise lacking in vegetation as a result of land use and management actions. Riparian habitat function is essentially extinguished, and land use contributes substantially to river dysfunction.

7.1.3 Results

The remote polygon desktop exercise with field verification was completed in fall 2021 in conjunction with the Yampa IWMP, and has been refined and incorporated into the Scorecard effort. Refer to Appendix B for a technical memorandum describing methods and results in more detail. A summary of results by riverscape is provided below.

The riparian zone for the middle Yampa River segment evaluated in this iteration of the Scorecard was divided into 858 polygons based first on land cover and then land use. Of the 11 cover types designated, herbaceous cover was by far the most common, accounting for more than 1,000 acres. Herbaceous areas were mostly hayfield and pasture lands. Subcanopy forest, cottonwood forest, and scrub-shrub were the three next most common cover types, which clearly illustrates the rural nature of the landscape. The cover types with the best mean condition were those in closest association with the river, including vegetated bars and scrub-shrub habitats. These areas are continually disturbed by natural processes and recover rapidly, so in most cases signs of human disturbance are quickly erased. Cottonwood and subcanopy forests are next in terms of condition, and excellent examples of both land cover types still exist on features shielded from intensive human use. Not surprisingly, developed polygons were assigned the lowest scores.

Following the pattern in land cover, ranchland and agricultural land uses are the most prevalent land uses in the middle Yampa River segment. It should be noted that there is little distinction between these two land uses, and they often overlap spatially or temporally. The agricultural land use implies that the polygon is under active cultivation, usually for hay. It is acknowledged that fields are continually taken in and out of production, and it is not always possible to determine whether an area is being actively hayed or simply has abundant herbaceous cover. With ranchlands encompassing several different land cover types, grades have a wide range (between A and D-), but it is interesting to note that many excellent examples of riparian habitat are held on ranchlands and the average grade for these habitats is a B.

Riparian condition scores based on land cover and land use were weighted by area to compute an overall riparian condition score for each of the seven riverscapes in the middle Yampa River Scorecard segment. Examples of the fine-scale riparian mapping that was completed for this assessment are provided in Appendix B, and final weighted averages by riverscape are shown in Table 7-2.

Table 7-2. Vegetation Structure and Complexity Scores by Riverscape

Riverscape	Riparian Condition Score
Riverscape 17	B-
Riverscape 18	C+
Riverscape 19	B-
Riverscape 20	B-
Riverscape 22	B-
Riverscape 23	C+
Riverscape 24	C

7.2 INVASIVE PLANT SPECIES INDICATOR

The invasive species indicator provides a measure of the presence and relative proportion of several invasive plant species that are common in the Yampa valley, including leafy spurge, Russian olive, and tamarisk.

Leafy spurge is a Colorado List B noxious weed species. It is a deep-rooted perennial that spreads explosively by seed and has extensive, creeping roots. Leafy spurge is adapted to a wide range of habitats and is very competitive with other plant species, crowding out nearly all other vegetation when it becomes established in rangeland, pasture, and riparian sites. Its white, milky sap is extremely toxic to cattle and horses, and damaging to sensitive human skin and eyes. The Yampa River Leafy Spurge Project (YRLSP) has been working to map and manage the infestation of leafy spurge in riparian areas in the valley since 2015.

Russian olive, another Colorado List B species, is a perennial tree or shrub that reproduces by seed or root suckers. Once thought to be a beneficial windbreak tree, Russian olive is detrimental to riparian zones because it outcompetes native plants, interferes with natural plant succession and nutrient cycling, and disadvantages several native animal species relative to native vegetation.

Tamarisk, or saltcedar, is also a Colorado List B noxious weed. It was introduced for ornamental purposes and streambank stabilization but is now widespread in the US and crowds out native stands of riparian and wetland vegetation. Tamarisk increases the salinity of surface soils, rendering them inhospitable to native plant species.

7.2.1 Data Sources and Evaluation Methods

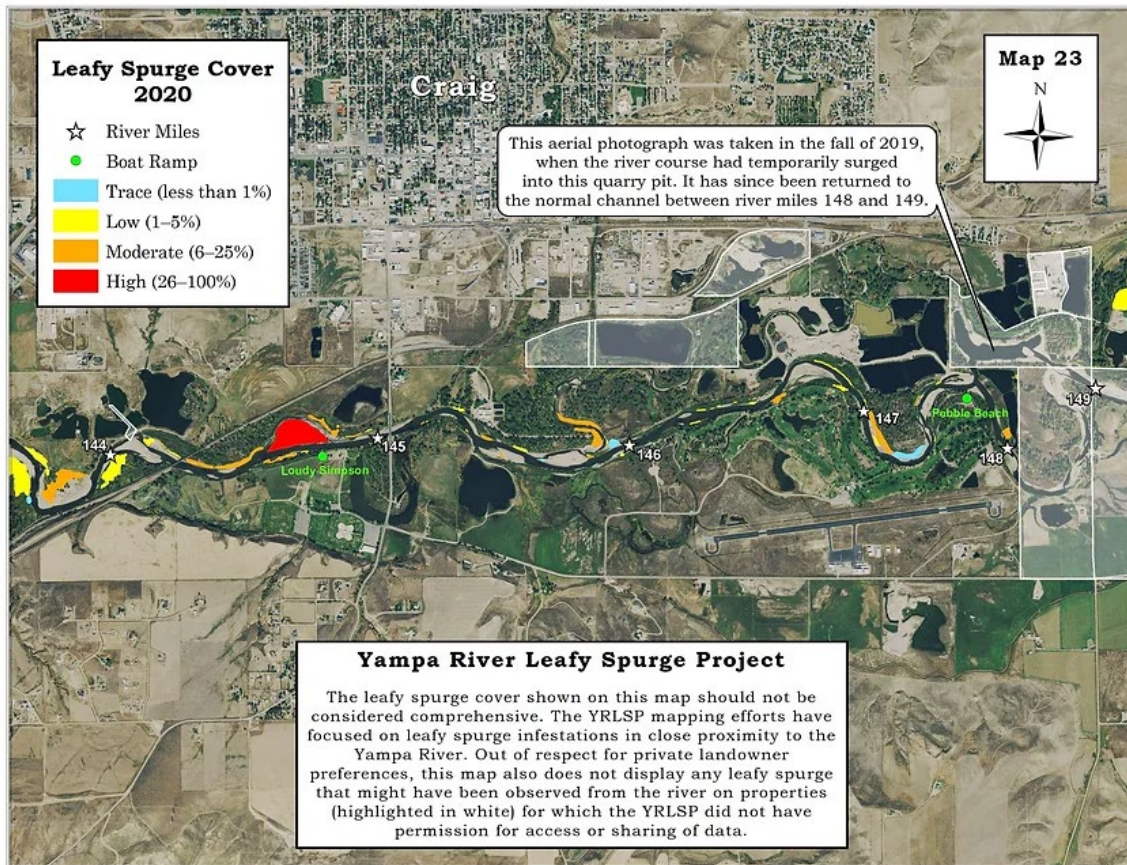
The Yampa River Leafy Spurge Project (YRLSP) conducted field mapping of leafy spurge along the Yampa River from Hayden to Cross Mountain in 2019-2021. This field data was used by a University of Wyoming graduate student to build a remote sensing model of leafy spurge infestation in the Yampa Valley. A presentation describing this project and explaining modeling

results is available at (<https://www.yampariverleafyspurgeproject.com/chloemattilio>) on the YRLSP website. Figure 7-1 shows an example of the field mapping conducted by YRLSP. The remote sensing project yielded > 83% confidence that leafy spurge is correctly detected by remote sensing methods, so the final remote sensing maps are used as the primary data source for scoring the invasive species indicator.

Data to score this indicator are also collected by floating the entire focal segment of the Yampa River and noting instances of Russian olive and tamarisk observed in portions of the riparian area that can be seen from the channel. These observations are documented via photographs and notes, and observations of Russian olive and tamarisk are scored based on presence/absence of either species. In particular, a score of 0 is assigned if no Russian olive or tamarisk is observed on either bank within a riverscape, and 1 point is assigned if at least one individual is observed on either the left or right bank for either species. For example, if Russian olive is observed on one of the two banks in a riverscape, but tamarisk is not observed, the score is 1. If both Russian olive and tamarisk are observed on one bank, the score is 2. If both species are observed on both banks, the score is 4. Scores for these invasives range from 0 to 4 points.

Because the data collection and modeling methods were more rigorous for the leafy spurge data, these results are weighted more heavily than the other invasives to derive a final invasive species indicator score.

Figure 7-1. YRLSP Map of Leafy Spurge Cover Across Scorecard Focal Segment in 2020



7.2.2 Scoring Criteria

The scoring criteria outlined in Table 7-3 based on YRLSP leafy spurge mapping and qualitative field observations of Russian olive and tamarisk are used to rate the invasive species indicator. Scoring is mainly driven by leafy spurge data.

Table 7-3. Invasive Species Indicator Scoring Criteria

Grade	Description
A	No or only trace amounts (<1%) of leafy spurge present in the riparian area. No observations of Russian olive and/or tamarisk noted (invasives score of 0).
B	Low coverage (1-5%) of leafy spurge present in the riparian area. Infrequent observations of Russian olive and/or tamarisk noted (invasives score of 0-1).
C	Moderate coverage (6-25%) of leafy spurge present in the riparian area. Moderate number of observations of Russian olive and/or tamarisk noted (invasives score of 0-3).
D	High coverage (26-50%) of leafy spurge present in the riparian area. Frequent observations of Russian olive and/or tamarisk noted (invasives score of 2-4).
F	Very high coverage (51-100%) of leafy spurge present in the riparian area. Consistent to constant observations of Russian olive and/or tamarisk noted (invasives score of 4).

7.2.3 Results

Observations of tamarisk and Russian olive were relatively minimal throughout the study reaches. In riverscapes 17, 19, 22, and 24, neither species was observed along the banks during data-gathering floats. Observations of infrequent occurrences of Russian olive were made in riverscapes 18 and 20, and moderate occurrence was observed in riverscape 23. Notably, tamarisk was not observed in the entirety of the study reach, though it is important to note that data gathering was limited to the area that could be observed from the channel. In this respect, grades for the tamarisk and/or Russian olive sub-indicator were relatively high (Table 7-4); only riverscape 23 scored a C, and the remaining riverscapes scored As and Bs.

Conversely, analysis of publicly available leafy spurge data suggested extensive occurrence of the invasive throughout the each riverscape, except for the upper half of riverscape 18 and all of riverscape 17. Data for these locations were not available, but communications with the YRLSP team indicate that the observations in the middle of riverscape 18 are the most upstream known populations of leafy spurge in the area (P. Williams, personal communication 2022). Maps of ground observations regarding leafy spurge occurrence from the Yampa River Leafy Spurge Project indicate several areas of moderate to high coverage in riverscapes 19, 20, 23, and 24 interspersed with areas of low or trace coverage. Additional perspective gleaned from remotely sensed data suggest that occurrence of leafy spurge is particularly pervasive in many of the study reaches. By calculating the relative percent area occupied by pixels indicating the presence of leafy spurge to total floodplain area, leafy spurge coverage was further analyzed in addition to the mapped data (Figure 7-2). Results suggest that percent coverage ranges between approximately 13-30% of the total floodplain area (Figure 7-2). Scores specific to leafy spurge are thus notably poor in all but the furthest upstream areas of the Middle Yampa segment; whereas

riverscape 17 and 18 earned A and B scores, respectively, no reach from 19-24 scored above a C, and reaches 20 and 22 earned D scores (Table 7-4).

Figure 7-2. Field Mapped and Remotely Sensed (RS) Leafy Spurge Coverage Across the Middle Yampa Segment

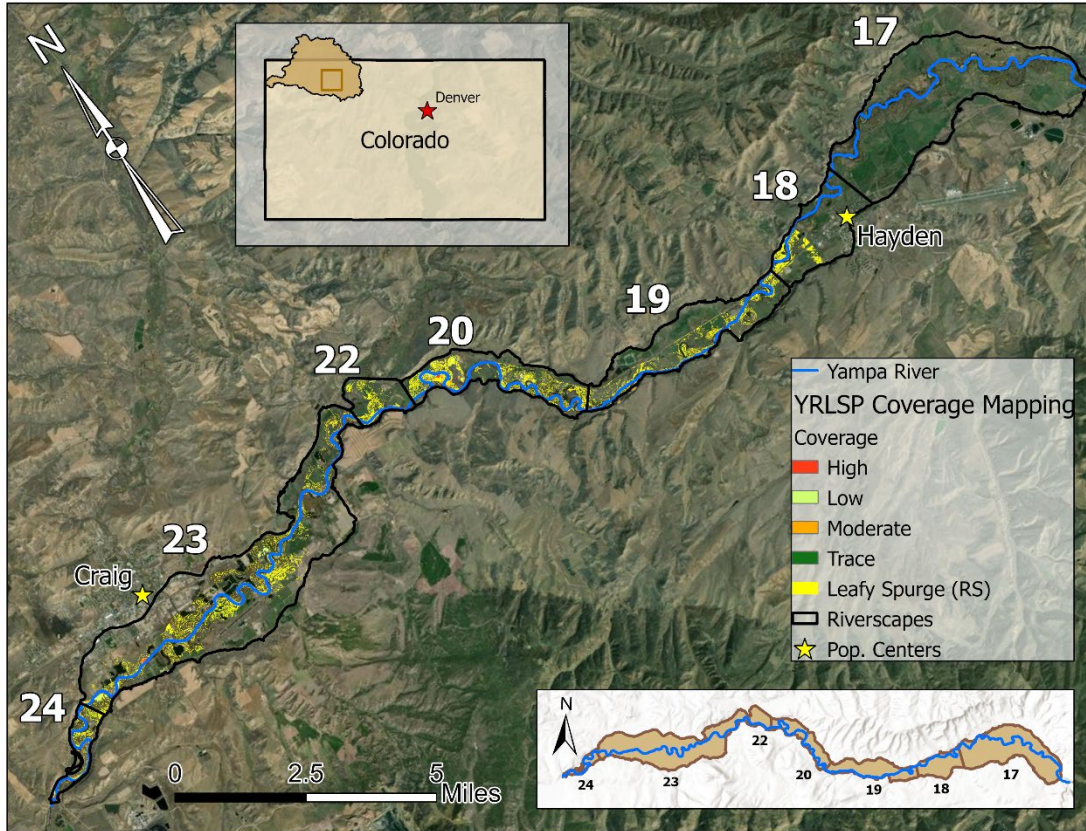


Table 7-4. Invasive Species Indicator Scores by Riverscape

Riverscape	Tamarisk/Russian Olive Score	Leafy Spurge Score	Invasive Species Score
Riverscape 17	A	A	A
Riverscape 18	B	B	B
Riverscape 19	A	C-	B-
Riverscape 20	B	D	C
Riverscape 22	A	D	C+
Riverscape 23	C	C-	C-
Riverscape 24	A	C-	C+

8.0 RIVER FORM

River form is defined as the river channel shape and geometry. It is directly influenced by the physical attributes of the watershed (e.g., geology, topography, hydrology), channel hydraulics, sediment transport, and local hillslope and floodplain uses (e.g., adjacent roadways, grazing). Biological drivers (e.g., riparian vegetation, large woody material, beaver activity, aquatic vegetation) influence river form as well, by altering hydraulics and erosional patterns. The Yampa River Scorecard evaluates river form holistically, using a single indicator referred to as **channel morphology**.

8.1 CHANNEL MORPHOLOGY INDICATOR

The channel morphology indicator is scored holistically and qualitatively considering planform shape (aerial shape), dimension (cross-sectional shape/size), and profile (slope). Quantitative measurements are used to inform qualitative scoring in some cases.

8.1.1 *Data Sources and Evaluation Methods*

A combination of remote sensing and field measurements are used to score the channel morphology indicator. Planform shape can be evaluated through remote measurement of valley confinement and parameters such as sinuosity. Comparison of historical and current aerial imagery can also be helpful. A stressor-based approach is also employed to evaluate channel morphology, with a component of the field floats that includes taking note of low-head dams, diversions, and bank and in-channel treatments that may impact grade (Appendix A).

The Scorecard effort acknowledges that channel morphology assessments that employ traditional metrics were conducted on river systems that had been long impacted by controls that reduce complexity, leading to the narrow view of rivers as channels having easily-measured forms. For the Scorecard, these metrics are used in the context of a progression from the past to the present, as well as evaluating where they fall on a continuum of stability. In this manner, channel form that falls outside of the natural continuum to be expected of a healthy river can be evaluated as indicative of a river that has some issues. The Scorecard public interface will explain these differences.

This indicator is scored using best professional judgement supported by the observations and measurements described above. Expert opinion is based on data collected and observed in the field, aerial imagery, and GIS spatial data to generate a single score for the channel morphology indicator.

8.1.2 *Scoring Criteria*

The descriptive, qualitative scoring criteria outlined in Table 8-1 are used to rate the channel morphology indicator. The criteria relate primarily to the presence of stressors and level of maintenance required to maintain functional river processes.

Table 8-1. Channel Morphology Indicator Scoring Criteria

Grade	Description
A	Planform, sinuosity, meander-wavelength to bankfull-width ratios, and variations are appropriate for a well-functioning river of this flow/sediment regime and landscape setting. There are no significant constraints to river planform or significant artificial changes in slope (e.g., dams, channelization, grade control structures). Channel geometry is within a range that is natural and appropriate for a well-functioning river in its process domain. The channel geometry is self-sustaining under natural channel processes and requires no maintenance.
B	Planform, sinuosity, meander-wavelength to bankfull-width ratios, and variations are within a range that is natural and suitable for a river of this flow/sediment regime and landscape position. Stressors are detectable but minimal management is needed to maintain functionality. Minor localized impacts exist that minimally affect channel entrenchment, capacity, or width-depth ratios.
C	Stressors on the river planform and/or sinuosity and/or wavelength-width ratios impact localized portions of the channel. Examples include reaches with short lengths of bank armoring (decreased sinuosity) or reaches that have been slightly straightened (decreased wavelength-to-width ratios). Stressors are common along the reach and management is likely required to maintain functionality. Moderate impacts exist that significantly affect channel entrenchment, capacity, or ratios.
D	Widespread stressors impact the river planform, such as floodplain encroachment, hardened banks, or planform straightening. Major bank armoring and/or significant changes to sinuosity or meander wavelength are present, such as reaches with large (>3 feet) grade control structures and moderate planform changes. Active management and maintenance are required to maintain functionality. Widespread impacts exist that severely affect channel entrenchment, capacity, or width-depth ratios.
F	Widespread stressors cause severe impacts or changes to the planform and slope. Examples include anastomosed or meandering streams that were straightened or channelized, rivers with severe floodplain encroachment or armoring of banks, and streams with very large (>6 ft) grade control structures. Stressors are extensive throughout the reach and the level of impairment results in an inability to maintain characteristic function. Profound impacts exist with near-complete alteration of channel entrenchment, capacity, or width-depth ratios. Intensive or consistent active management and maintenance are required. Severe changes to slope are evident.

8.1.3 Results

The channel morphology indicator is evaluated through remote sensing analysis using aerial imagery and GIS spatial data, as well as qualitative field observations. Various morphological calculations were made to evaluate planform in the context of what would be expected for a river in the process domain of the Middle Yampa segment, including sinuosity and meander wavelength to channel width ratios (l/w). Fieldwork completed for the entire Scorecard project included stressor-based observations that are relevant for channel morphology.

Channel morphology scores are highest in riverscapes 17 and 20. In both riverscapes, the riparian ecosystem retains much of its natural character and the river appears well connected to the floodplain. Inhibitions to natural channel processes in these reaches are fairly minor: in-channel barriers are relatively minimal (Figure 5-1), as is armoring (Figure 9-1), enabling the maintenance of a channel planforms consistent with what would be expected of a river like Yampa throughout these riverscapes. Additional complexity features such as side channels and split flows are moreover indicative of a well-functioning river system. Prior reports have furthermore indicated the high geomorphic complexity and degree of connection between the channel and floodplain area present in riverscape 20 (Yampa IWMP 2021). The presence of stressors in a few locations, however, exerts a slightly controlling influence at particular locales. Still, sinuosity values and I/w ratios (Table 8-2) are within the natural range of variability for a mixed-load river, though it must be stated that the former is on the relatively lower side for what one would predict for an unconfined river stretch such as riverscape 17 (Schumm 1985, Nicoll and Hickin 2010). The meandering planform observed in both riverscapes 17 and 20 is also in the range of what would be anticipated using the stream evolution triangle for the hydrologic, lithologic, and biotic character of these stretches (Castro and Thorne, 2019). These two riverscapes therefore earn a channel morphology score of A (Table 8-3).

Table 8-2. Confinement, Sinuosity, and Meander Wavelength to Bankfull Width Ratio (I/w) by Riverscape

Riverscape	Confinement	Sinuosity	I/w
Riverscape 17	Unconfined	1.52	13.4
Riverscape 18	Partly Confined	1.32	20.9
Riverscape 19	Partly Confined	1.15	19.9
Riverscape 20	Partly Confined	1.50	13.6
Riverscape 22	Partly Confined	1.09	19.8
Riverscape 23	Unconfined	1.32	11.8
Riverscape 24	Confined	1.61	13.6

River morphology in riverscapes 19 and 23 is comparatively more impacted than riverscapes 17 and 20. Presence of armoring in riverscape 23 exerts a substantial stressor on the river, preventing natural channel processes in several locations (Figure 9-1). However, a relatively intact riparian forest in several locations in this riverscape drives a fairly high occurrence of large wood (e.g., Appendix A, Figures A-15 through A-18) and a diversity of active in-channel bar features (Figure 9-2), suggesting that a degree of natural character is retained. A fairly high prevalence of features such as side channels and split flows (Figure 5-1) moreover suggests that the river has the freedom to maintain active processes such as migration in many stretches throughout riverscape 23. Though I/w ratios are within the range of natural variability (8-14) for freely meandering, unconfined channels, sinuosity is rather low for a reach of this character (Table 8-2). For these reasons, this riverscape earns a channel morphology score of B (Table 8-3). In riverscape 19, armoring in the upper portions adjacent to human infrastructure reduces the ability of the river to maintain a natural planform. This likely drives the relatively low sinuosity and relatively high

l/w ratios compared to natural ranges for partly confined rivers (Nicoll and Hickin 2010). However, in the lower parts of riverscape 19, the river is relatively more connected to its floodplain and stressors are more minimal, enabling morphological processes to retain more functionality. In these lower parts, a diversity of bar surfaces is present, as is relatively substantial large wood (Figure 9-2). Riverscape 19 therefore earns a channel morphology score of B- (Table 8-3).

The lowest morphology scores are for riverscape 18, 22, and 24. Stressors on morphology in riverscape 22, where the Elkhead Creek tributary enters the main stem Yampa River, are relatively minimal. Sinuosity values and l/w ratios here, however, are lower and higher, respectively, than natural ranges for a partially confined, mixed load river (Table 8-2). Complexity is also much lower than would be expected for a stretch of river containing a confluence with a major tributary; this likely speaks to a relatively high degree of alteration of the landscape surrounding the junction with Elkhead Creek. Riverscape 22 earns a channel morphology score of C for these reasons (Table 8-3). In contrast, the river in both riverscape 18 and 24 is substantially confined by human actions (armoring) (Figure 9-1), often to protect infrastructure (roads, railroads); features that are suggestive of a maintenance of natural processes are comparatively minimal. In the former, sinuosity and l/w ratios in the upstream portions are within predicted ranges; however, in the lower portions, the river is heavily modified, and l/w ratios are higher than the expected range of natural values for a partly confined river (Nicoll and Hickin 2010, Table 8-2). Riverscape 24 is the only naturally confined reach of the Middle Yampa segment, and sinuosity and l/w are within the range of natural variability. However, human stressors are present in a fairly extensive manner. These riverscapes earn a channel morphology score of C- (for riverscape 18) and a C (for riverscape 24) (Table 8-3).

Table 8-3. Channel Morphology Scores by Riverscape

Riverscape	Channel Morphology Score
Riverscape 17	A
Riverscape 18	C-
Riverscape 19	B-
Riverscape 20	A
Riverscape 22	C
Riverscape 23	B
Riverscape 24	C

9.0 STRUCTURAL COMPLEXITY

Structural complexity is defined as the degree of heterogeneity and physical composition of a stream that results from interactions between flow regime, sediment dynamics, and other factors. The more complex and heterogeneous the physical structure of a stream, the more enhanced the habitat for resident aquatic species. Structural complexity considers hydraulic characteristics (water depth and velocity patterns), bed and bank features, and substrate material. In scoring the indicators in this category, a concerted effort is made to integrate quantifiable records and observations from fieldwork conducted by educational partners. Two indicators are included in the structural complexity category: **macrohabitat** and **microhabitat**. The final structural complexity score is calculated as 75% macrohabitat and 25% microhabitat indicator scores.

9.1 MACROHABITAT INDICATOR

The macrohabitat indicator considers physical habitat relevant to fish and larger animals, including distribution and diversity of water depth, velocity, and physical cover, shape of bed and bank features, and other large physical structure provided by rock, wood, vegetation, etc. Macrohabitat includes cobble/sand bars, undercut banks, presence/absence of secondary channels/backwaters, and presence, extent, and quality of large wood.

9.1.1 *Data Sources and Evaluation Methods*

The following features that are important for heterogeneity and complexity within the channel are evaluated in the field, usually from a boat:

- Bedforms including riffles, runs, pools, and glides;
- Split flows (i.e., two narrow channels versus one wide channel);
- Secondary channels (count, GPS, presence of water yes/no);
- Point bars (characteristics: vegetated, cobble, gravel, sand; size);
- Residual pool depth (riffle crest depth minus deepest pool depth);
- Signs of beaver activity (chews, dams, side channel dams, bank dens);
- Presence, size, and quality of large wood;
- Reinforced bank length and type (GPS start and end of reinforced banks on both sides of channel and indicate material (concrete, car bodies, riprap, etc.);
- Undercut bank length; and
- Backwater areas.

Fieldwork to inform this indicator was completed during a 10-day field course in June 2022 coordinated in partnership with Colorado Mountain College. To the extent possible, these features were enumerated, representative photos are taken, and measurements are quantified and marked with a GPS device (Appendix A). These quantitative measurements feed into the quantitative scoring described in detail in Table 9-1.

9.1.2 Scoring Criteria

The scoring criteria outlined in Table 9-1 based on estimates of diversity of depth/velocity combinations, topographic complexity of beds and banks, and physical structure of the reach are used to rate the macrohabitat indicator.

Table 9-1. Macrohabitat Indicator Scoring Criteria

Grade	Description
A	Macro-scale structural heterogeneity is natural and appropriate for a well-functioning river in its process-domain. All velocity-depth combinations and structural components (features formed by wood, rock, vegetation, and debris dams/jams) are present in characteristic distribution.
B	Most typical velocity-depth combinations are present, but distribution of structural components (features formed by wood, rock, vegetation, and debris dams/jams) is slightly skewed due to dispersed stressors or minimal direct impacts. Pools provide adequate cover for fish and other aquatic organisms.
C	Some typical velocity-depth combinations or characteristic structural elements (features formed by wood, rock, vegetation, and debris dams/jams) are absent or limited. Pools provide some cover for fish and other aquatic organisms. Examples include reaches with increased pool/run habitat, lack of off-channel habitat, or skewed riffle-pool ratio. Reaches with artificial structure or hardened/revetted banks also fall into this category.
D	Some typical velocity-depth combinations or characteristic structural elements (features formed by wood, rock, vegetation, and debris dams/jams) are absent, making the reach uncharacteristically homogeneous. Pools may provide minimal cover for fish and other aquatic organisms. Examples include reaches with graded or heavily armored banks, or with features that are frequently limited by inundation or low flow.
F	Homogeneous form with uniform velocity-depth pattern, lack of physical structure, and lack of pools. Examples include reaches with severely homogenized physical characteristics such as unnatural plane-bed morphology.

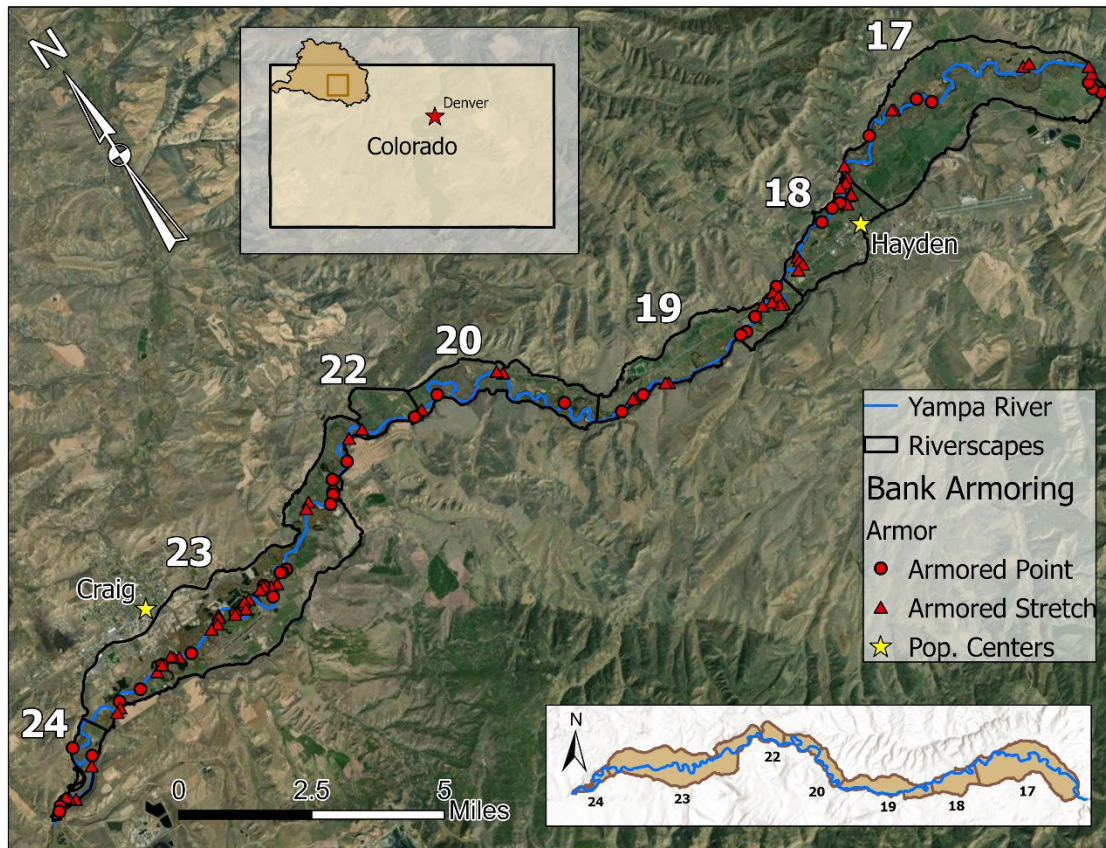
9.1.3 Results

Macrohabitat was scored holistically by the consideration of the variables outlined in the grading scheme above, several of which comprise criteria considered for additional indicators herein. Rather than an indicator of redundancy, this instead illustrates the broad, integrative nature of the river landscape in setting the habitat template. Data evaluated here was gathered from field floats of the riverscapes in consideration and informed by review of current and historical aerial imagery.

Bank armoring (e.g., Appendix A, Figures A-4 through A-9) is likely the most consistently detrimental factor with regards to relatively diminished structural heterogeneity (and thus macrohabitat). Bank armoring contributes to reach homogenization and increased resistance to the drivers of river complexity, mainly channel migration and the formation of secondary channels. Armoring is particularly pervasive in reaches 18, 23, and 24 (Figure 9-1), where 25-33% of the channel length is reinforced via a variety of mechanisms: traditional riprap using large rocks, emplacement of a mélange of concrete debris, or, on occasion, “Detroit riprap” – the lining of

riverbanks with old automobiles and appliances. The occurrence of relatively more extensive bank reinforcement in these riverscapes is not surprising given the proximity to population centers (Hayden, Craig) and related infrastructure. In contrast, riverscapes 17 and 20 are notably lightly armored; again, this is relatively unsurprising, as these are stretches of river that flow through conservation areas (The Nature Conservancy's Carpenter Ranch and Yampa River State Wildlife Area, respectively).

Figure 9-1. Bank Armoring Across the Middle Yampa Segment by Riverscape



Likely as a function of this relatively light armoring, riverscapes 17 and 20 also have extensive occurrences of features indicative of complexity such as backwaters and side channels/split flows (Figure 5-2). As mentioned above, this may result from the additional “freedom” of the river to migrate across the floodplain in these sparsely armored reaches. Interestingly, despite the fairly frequent occurrence of armoring in reach 23, complexity features are somewhat abundant; this is perhaps due to the preservation of the natural floodplain ecosystem in many areas. Relatedly, there is relatively extensive occurrence of large wood and bar surfaces in reach 23 (Figure 9-2), both indicators of comparatively natural riverine complexity.

Wood and bar surfaces are additionally extensive in riverscapes 19 and 20, and moderately so in riverscape 17. Similarly, signs of beaver activity are frequent in these riverscapes, as well as moderately frequent in riverscapes 22 and 23 (Figure 9-3, Appendix A Figures A-1 through A-3). Again, this is likely due to the occurrence of a fairly intact riparian ecosystem throughout areas. These various indicators of complexity (e.g., beavers, wood, side/split channels, backwaters, bars) are again notably low in riverscapes 18 and 24, the most highly armored of the areas in the Middle

Yampa River segment. All indicators of complexity in riverscape 22 are moderately frequent or relatively sparse despite low armoring; this is perhaps a function of this reach’s shorter overall length as well additional confounding factors presented by the confluence with Elkhead Creek (which occurs in riverscape 22). Scores for the macrohabitat in each riverscape are provided in Table 9-2.

Figure 9-2. Locations of Bar Surfaces and Large Wood by Riverscape

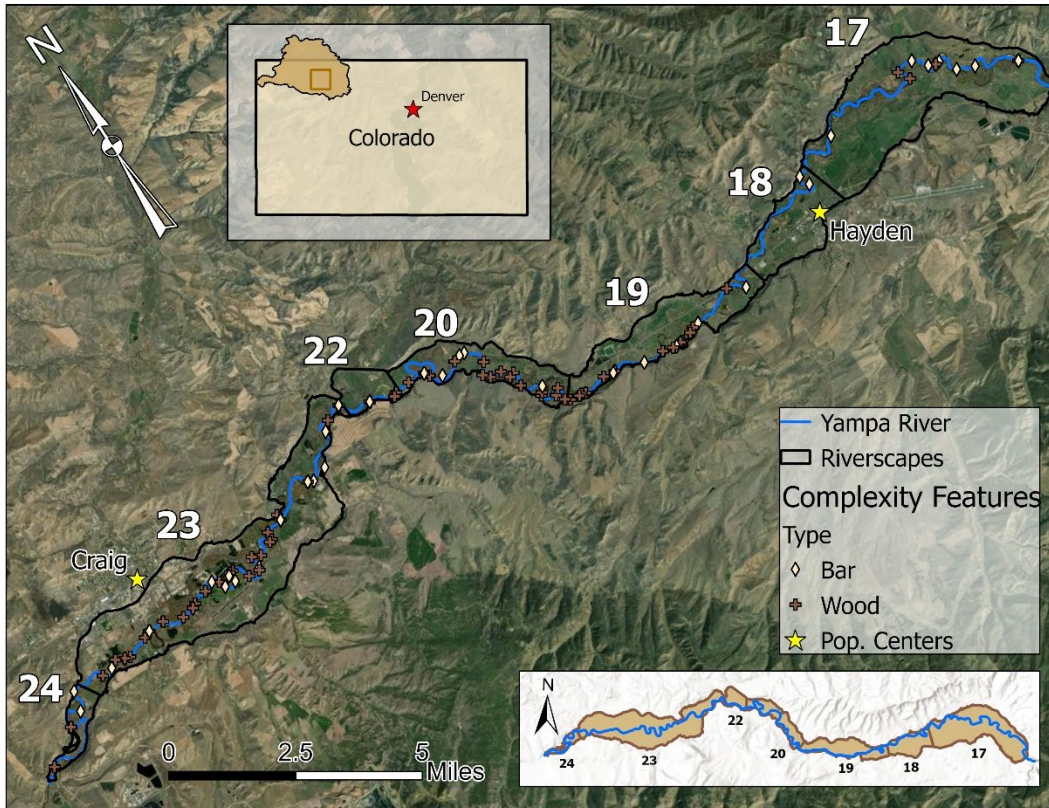
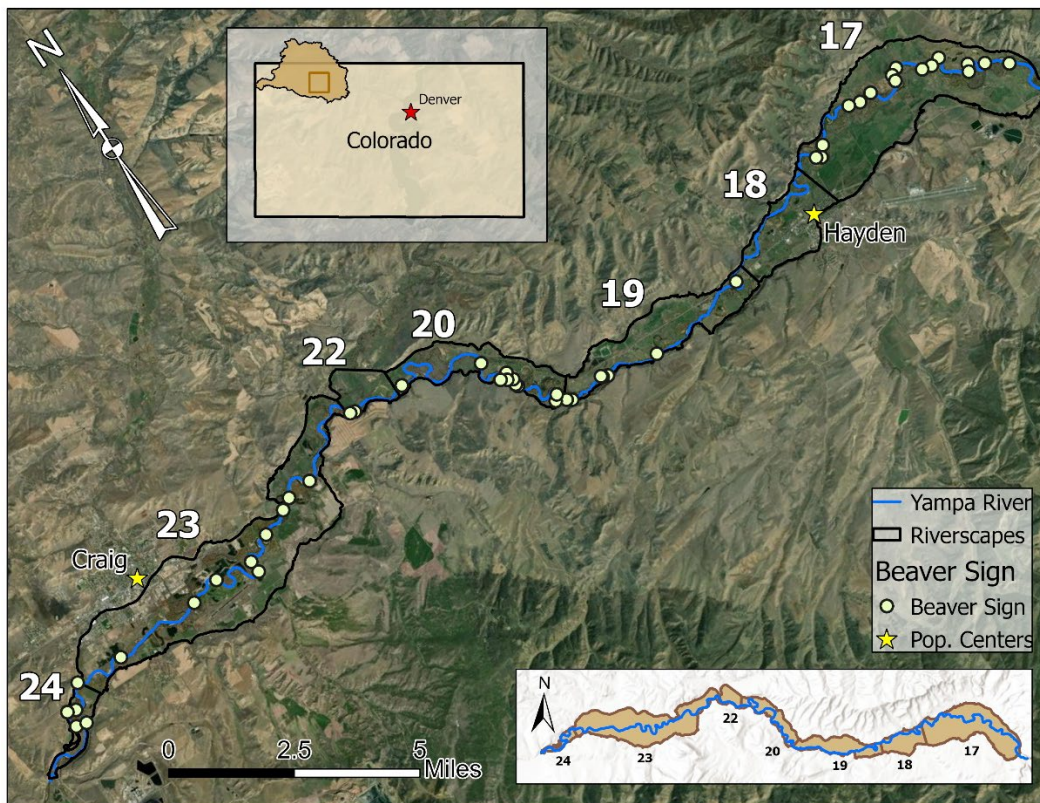


Table 9-2. Macrohabitat Scores by Riverscape

Riverscape	Macrohabitat Score
Riverscape 17	A
Riverscape 18	D
Riverscape 19	B
Riverscape 20	A-
Riverscape 22	B-
Riverscape 23	C+
Riverscape 24	D

Figure 9-3. Beaver Sign by Riverscape



9.2 MICROHABITAT INDICATOR

The microhabitat indicator considers physical habitat relevant to small aquatic species such as benthic macroinvertebrates and larval fish, particularly the availability of interstitial spaces among the river bed substrate, degree of embeddedness, armoring, proportion of fine sediment, algae cover, and patches of organic material or detritus accumulations.

9.2.1 Data Sources and Evaluation Methods

The microhabitat indicator is scored in the field through visual observations of embeddedness and presence/absence of algae cover. Embeddedness measures the degree to which gravel and cobble substrates are surrounded by fine sediment. It relates directly to the suitability of the stream substrate as habitat for macroinvertebrates, fish spawning, and egg incubation.

Embeddedness measurements occur in riffles only. Embeddedness is measured by picking up particles of gravel or cobble with the evaluator's fingertips at the fine sediment level. The particle is pulled out of the bed and the percent of that particle that was buried by sediment is estimated (NRCS 2017). All measurements of percent embeddedness within each riverscape are averaged for a final embeddedness percentage by riverscape.

9.2.2 Scoring Criteria

The scoring criteria outlined in Table 9-3 based on field observations of interstitial space availability, bed armoring, embeddedness, and algae in riffles are used to rate the microhabitat indicator.

Table 9-3. Microhabitat Indicator Scoring Criteria

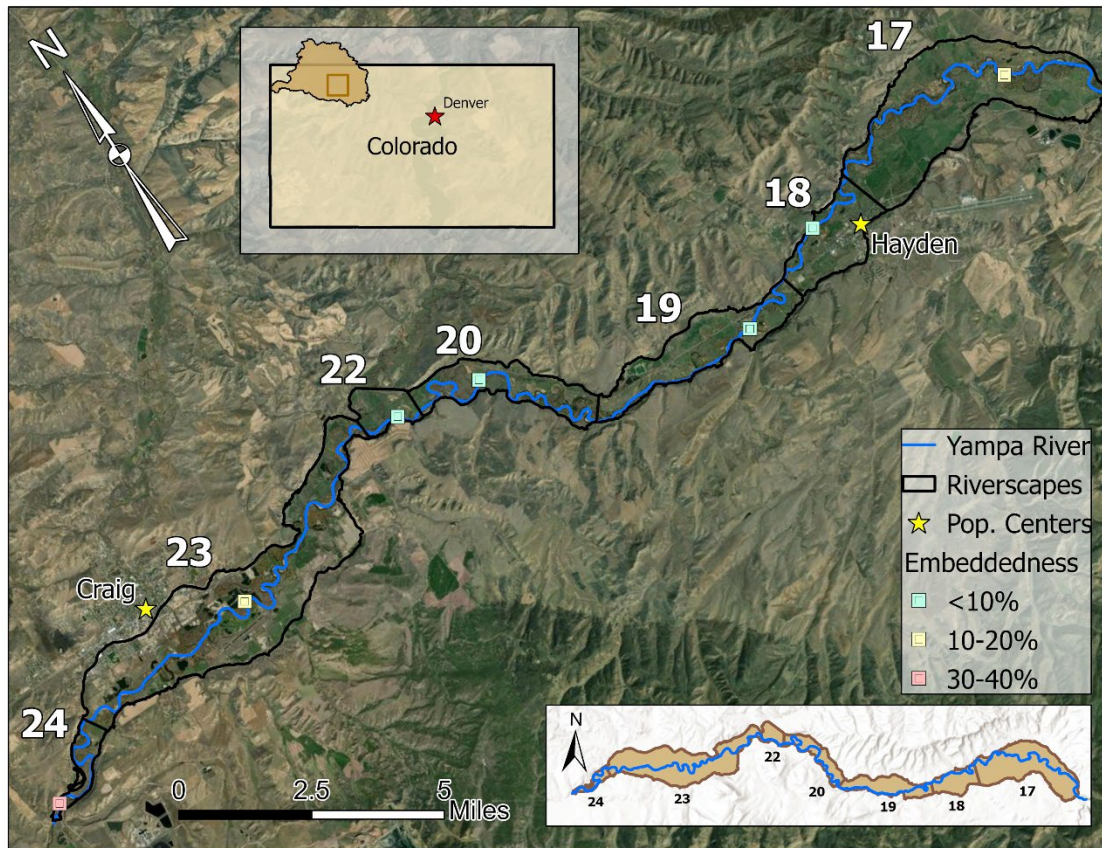
Grade	Description
A	Micro-scale structural heterogeneity is natural and appropriate for a well-functioning river in its process-domain. Interstitial spaces appropriate for natural geographic conditions.
B	All aspects of micro-scale structural diversity are present, but distribution of features is skewed due to dispersed stressors or minimal direct impacts. Examples include reaches with mild fine sediment deposition or slightly decreased interstitial space (mild embeddedness, 10-20%) for either cobble- or gravel-bed reaches, depending on natural geographic conditions.
C	Some aspects of micro-scale structural diversity are lacking or limited. Examples include reaches with altered bed material distribution, patches of armoring, increased cover of persistent algae/aquatic vegetation, decreased detritus/organic accumulation patches, or moderate embeddedness (20-30%) for either cobble- or gravel-bed reaches, depending on natural geographic conditions.
D	Some aspects of micro-scale structural diversity are lacking or severely limited, making the reach uncharacteristically homogeneous. Examples include reaches with widespread armoring, persistent algae/aquatic vegetation in riffles, lack of any detritus/organic accumulation patches, or severe embeddedness (30-40%) for either cobble- or gravel-bed reaches, depending on natural geographic conditions.
F	Completely static or homogeneous armored micro-scale physical structure. Examples include gravel- or cobble-bed streams that are aggrading with fine material (embeddedness >40%) or choked with algae, alluvial streams unnecessarily scoured to bedrock, or grouted/hardened artificial streambeds.

9.2.3 Results

Data to score this indicator were collected via field visits to illustrative locations with reliable access in each riverscape and observing presence/absence of algae cover, as well as evaluating embeddedness at riffles co-located with macroinvertebrate monitoring locations, plus a few additional opportunistic locations. Embeddedness is evaluated following the methodology described above.

Embeddedness was lowest at measured riffles in riverscapes 18, 19, and 20 (Figure 9-4). Given the relatively low scores for riverscape 18 in other indicators, its inclusion here is somewhat surprising; however, the location evaluated for embeddedness is in the upper reaches of 18, which is still within the boundaries of The Nature Conservancy's Carpenter Ranch. Low values of embeddedness in riverscapes 19 and 20 track with the preservation of these reaches within Yampa River State Wildlife Area. Relatively low embeddedness values of 10-20% were measured in riverscape 17 and 23, consistent with the relatively natural character of these reaches.

Figure 9-4. Embeddedness Locations and Ranges by Riverscape



The highest embeddedness scores were recorded in riverscape 24 and were 30-40%. This is in line with the similarly low scores in other indicators for this riverscape. Interestingly, embeddedness values are consistently low from riverscapes 18-22, then increase relatively in 23 and 24, a spatial trend that is perhaps reflective of the role of Elkhead Creek (which flows into the Yampa in riverscape 22) in supplying the excess fine sediment that results in higher embeddedness values.

Algal cover was substantial throughout the riverscapes within the Middle Yampa segment during low flow conditions (July through October), but slightly less prevalent in riverscapes 18 and 20. A river with significant algae growth in low water times is relatively typical; algae can take hold and establish when flows are low and then they are typically scoured away due to high flows in the spring. The high flows scour algae and act as a reset each year. During June fieldwork, algal cover was not as prevalent, indicating that this somewhat typical cycle is occurring on the Middle Yampa River. Scores for the microhabitat indicator are presented in Table 9-4.

Table 9-4. Microhabitat Scores by Riverscape

Riverscape	Microhabitat Score
Riverscape 17	B
Riverscape 18	A-
Riverscape 19	A-
Riverscape 20	A
Riverscape 22	A-
Riverscape 23	B-
Riverscape 24	D

10.0 BIOTIC COMMUNITY

Biotic community is defined as the health of resident aquatic biota including microbes, periphyton (attached algae), macrophytes (aquatic plants), macroinvertebrates (aquatic insects), fish, amphibians, and any other organism that is part of the aquatic biological community for all or part of its life history. There are two indicators within the biotic community category: **macroinvertebrates** and **native fish**. The final biotic community score is calculated as an average of the macroinvertebrates and native fish indicator scores. Information about sport fish is covered in the River Uses and Management attribute of the Scorecard.

10.1 MACROINVERTEBRATES INDICATOR

Benthic macroinvertebrates can be used as indicators of both water quality and the health of the biotic community. Refer to Section 4.4 for details and scores related to this indicator.

10.2 NATIVE FISH INDICATOR

Fish population monitoring, typically conducted via electrofishing surveys, is used to determine fish species composition (including relative abundances of species), density estimates, age or size class distribution, and other metrics related to the health of the fishery. Due to the paucity of comprehensive data in the Scorecard focal segment, the native fish indicator is focused on percent native fish and presence of Mountain Whitefish and the “Three Species.” The “Three Species” are Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub. These species are not currently listed under ESA, but they have similar ecological requirements and are imperiled throughout their collective geographic range.

10.2.1 Data Sources and Evaluation Methods

Many of the fish electroshocking efforts in this region, particularly those conducted by US Fish and Wildlife Service (USFWS), have been focused on invasive species removal (for species such as Northern Pike, Smallmouth Bass, and White Sucker). Colorado College professor Dr. Brian Linkhart obtains a permit through Colorado Parks and Wildlife (CPW) for electroshocking a long-term monitoring site in the Middle Yampa River segment that has been sampled for 14 years over a 17-year period (2003-2019), generally in the fall (early September), as part of an undergraduate class. Scoring the native fish indicator for the Scorecard relies mainly on this dataset. The long-term monitoring reach is located between Hayden and the confluence of Elkhead Creek in the vicinity of Yampa River State Wildlife Area (riverscape 19). Some historical data exist for riverscapes 17 and 20 as well, but these data are more focused on non-native fish removal efforts, and are therefore biased to record those species more frequently instead of providing some estimation of species abundance and diversity. A low level of confidence is associated with scores from all riverscapes except riverscape 19 for this reason.

10.2.2 Scoring Criteria

The scoring criteria outlined in Table 10-1 based on presence and proportions of native species are used to rate the native fish indicator. This scoring scheme is based on the fisheries evaluation conducted for the Yampa IWMP remote assessment (Yampa IWMP 2021). It acknowledges that

nearly all of the Yampa’s riverscapes contain impacted fisheries; any riverscapes that earn an “A” grade are still highly modified compared to historical conditions. However, the goal of this scoring system is to differentiate between riverscapes on a relative scale. Had the historical condition of robust, native fisheries been used for the “A” grade, no differentiation would be possible, because all riverscapes would have low scores. The use of an altered baseline condition allows the prioritization of riverscapes and the opportunity to select individual riverscapes for future adaptive management and research activities. In transitional riverscapes, the fish community is composed of coldwater and warmwater species, and the scoring is adjusted to reflect this. For example, a small proportion of salmonids does not indicate impairment in riverscapes in the transitional Scorecard focal segment (Yampa IWMP 2021).

Table 10-1. Native Fish Indicator Scoring Criteria

Grade	Description
A	The reach supports all of the expected native species for the given watershed location. In coldwater riverscapes, Colorado River Cutthroat Trout, Mountain Whitefish, Mottled Sculpin, and Mountain Sucker are expected. In warmwater riverscapes, The Three Species (Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub), Mountain Sucker, Colorado Pikeminnow, and Speckled Dace are expected. Nonnative species such as Northern Pike, Smallmouth Bass, and White Sucker are not common. The percentage of native species is generally greater than 50%.
B	The reach supports a majority of the expected native species for the given watershed location. In coldwater riverscapes, Colorado River Cutthroat Trout, Mountain Whitefish, Mottled Sculpin, and Mountain Sucker could be expected. In warmwater riverscapes, The Three Species (Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub), Mountain Sucker, Colorado Pikeminnow, and Speckled Dace are expected. Nonnative species such as Northern Pike, Smallmouth Bass, and White Sucker are present but not common. The percentage of native species is generally greater than 20%.
C	The reach supports some expected native species for the given watershed location. In coldwater riverscapes, some or all of the native salmonids may have been replaced with Brook Trout, Brown Trout, and/or Rainbow Trout, but the naturalized populations are robust. Mottled Sculpin are expected. In warmwater riverscapes, some of the native warmwater species listed above are present. Mottled Sculpin and Speckled Dace are also expected. Nonnative species are common, and native species comprise 10-20% of the fish community.
D	The reach supports few or no native fish, or the fishery exhibits a highly degraded condition. In coldwater systems, salmonids are expected, but in low densities. Mottled Sculpin or Speckled Dace may be present. In warmwater riverscapes, The Three Species (Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub), Mountain Sucker, and Colorado Pikeminnow are largely or entirely absent. Speckled Dace may be the only native warmwater species present. Nonnative species are common and abundant. Native species comprise less than 10% of the fish community.
F	The reach does not support native fish, and/or the fishery exhibits a highly degraded condition. In coldwater systems, salmonids are absent or present in low densities, and Mottled Sculpin and Speckled Dace are absent. In warmwater

	riverscapes, The Three Species (Bluehead Sucker, Flannemouth Sucker, and Roundtail Chub), Mountain Sucker, and Colorado Pikeminnow are absent. Nonnative species dominate, and native species comprise less than 5% of the fish community.
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10.2.3 Results

Results for the native fish indicator are provided in Table 10-2 and described here. Unfortunately, no data are available for riverscapes 18, 22, 23, and 24.

Data from just upstream of the Highway 40 bridge (riverscape 16) is used as a proxy for scoring riverscape 17. These data consist primarily of nonnative fish removal data from 2000, 2012, 2015, 2017, and 2019. Species reported are almost all nonnatives except Mottled Sculpin and Speckled Dace in 2000 and two Flannemouth Suckers in 2012. All trout are nonnative Brown Trout and Rainbow Trout. Recent (2019-2022) anecdotal reports of fishing directly upstream of this riverscape identified Northern Pike, Rainbow Trout, Brown Trout, Cuttbow Trout, and Mountain Whitefish, with trout being the most common salmonids but Mountain Whitefish also caught consistently. Based on these data, this riverscape earns a score of C-.

Riverscape 19 has the most data due to Professor Linkhart's class surveys. Species include some (though limited) instances of Flannemouth Sucker, Roundtail Chub, and Bluehead Sucker. Surveys also produced Mountain Whitefish, Mottled Sculpin, and Speckled Dace. The percentage native species is greater than 50% in most recent years, but is composed almost entirely of Mottled Sculpin and Speckled Dace, earning riverscape 19 a score of C+. However, as a result of collection methods, larger-bodied species such as trout and whitefish are likely underrepresented in the samples.

Data collected in riverscape 20 are exclusively the result of nonnative removal efforts between 1989-2003. Predominantly captured were northern pike and white sucker, and the only trout observed were rainbow trout. In late 1980s/early-mid 1990s, some flannemouth sucker and mountain whitefish were also observed. Smallmouth bass were observed in 2003. These data earn riverscape 20 a score of D.

It is possible that scores for riverscape 17 and riverscape 20 would improve slightly with data collection efforts tailored toward community characterization; however, the fishery in these riverscapes is significantly impaired due to an overabundance of nonnative species.

Table 10-2. Native Fish Indicator Scores by Riverscape

Riverscape	Native Fish Score
Riverscape 17	C-
Riverscape 18	NA
Riverscape 19	C+
Riverscape 20	D
Riverscape 22	NA
Riverscape 23	NA
Riverscape 24	NA

11.0 OVERALL RIVER HEALTH AND FUNCTION SCORE

Upon assigning scores for each indicator and category to each riverscape within the Scorecard focal segment, the individual category scores are integrated to derive a final river health and function score for each of the 7 riverscapes within the 39-mile segment of the Yampa River. The percent contributions of each river health and function category are provided in Table 11-1. A weighted average by riverscape area is then calculated to yield a final segment score for the River Health and Function attribute area.

Table 11-1. Percent Contribution to Overall River Health and Function Score by Category

Category	Percent
Flow Regime	20
Sediment Regime	5
Water Quality	15
Habitat Connectivity	5
Riverscape Connectivity	10
Riparian Condition	20
River Form	5
Structural Complexity	15
Biotic Community	5

The final river health and function scores for the Middle Yampa segment are provided in Table 11-2, organized by indicator and riverscape. **Weighting the cumulative scores for each riverscape by river length yields an overall ecological health and function score of B for the entire Middle Yampa River focal segment.**

The Middle Yampa River segment as a whole remains remarkably healthy in several aspects related to material transport, reflective of the lack of alteration to much of the river's natural ability to transfer sediment and nutrients through the landscape. Scores for sediment transport are consistently very good to excellent, as are many of the water quality parameters except temperature, especially pH, DO, nutrients, and metals. Excellent macroinvertebrate community scores further reflect the overall health of the river in terms of water quality and sediment transport.

Temperature, however, remains poor in the upper riverscapes of the Middle Yampa segment; poor fishery scores can perhaps be connected these poor temperature scores in the upper reaches. Opportunities for improvement exist and are being implemented by the City of Steamboat Springs and others.

Overall, the most extensive opportunities for improvement to the health of the Middle Yampa River segment are related to riparian condition and riverscape connectivity. As the former is rather dependent on the latter, improvements in connectivity – such as removal of floodplain infrastructure that reduces the ability of the river to access its floodplain or commitment to limiting future development of such infrastructure – may serve to improve riparian condition. Additional opportunities for improvement of riparian health may also exist such as the maintenance and/or restoration of a natural riparian buffer along the riverbanks.

In terms of patterns between riverscapes, it is clear that the Yampa River is most healthy in those reaches that are either preserved in one way or another, either by The Nature Conservancy (riverscape 17) or as a state wildlife area (riverscape 20), or where alterations to the floodplain have been minimal (riverscape 22, where all of the southern bank of the river retains much of its natural character). The best opportunities for improvement to riverine health exist in riverscapes that are home to the Middle Yampa's largest towns – Hayden in riverscape 18 and Craig in riverscape 23.

Overall, the Yampa remains a relatively healthy river, especially compared to its peers – both in the state of Colorado and throughout the Colorado River Basin. Despite this assessment, ample potential for improvement does exist – management that seizes such opportunities for progress will thus help to enable the Yampa to move forward into the future as a flagship river for riverine health. The authors of this report encourage you to visit <https://yampascorecard.org/> to learn more about the Yampa River Scorecard Project.

Table 11-2. Middle Yampa Segment Ecological Health and Function Scores by Indicator and Riverscape

		Segment	Middle Yampa River Segment						
		Riverscape	17	18	19	20	22	23	24
		Length (miles)	8.29	3.05	5.34	6.04	2.15	10.72	3.3
		Riverscape Area (square miles)	7.9	2.03	3	2.42	0.85	10.43	0.64
Indicator	Variable	Scoring Weight							
Flow Regime	Hydrograph		76	82	76	82	88	88	88
	Snowpack		76	76	76	76	76	76	76
	Flow Regime	20%	76	81	76	81	87	87	87
Sediment Regime	Sediment Transport and Continuity	5%	92	92	95	95	95	82	82
Water Quality	Temperature		65	65	65	65	85	85	85
	Dissolved Oxygen		95	95	95	95	95	95	95
	pH		95	95	95	95	95	95	95
	Macroinvertebrates		88	88	88	88	88	88	88
	Nutrients		85	85	85	85	92	92	92
	Metals		95	95	95	95	95	95	95
	Water Quality	15%	87	87	87	87	92	92	92
Habitat Connectivity	Aquatic Habitat Connectivity		82	82	95	95	92	76	65
	Terrestrial Habitat Connectivity		85	85	76	85	95	76	95
	Habitat Connectivity	5%	84	84	86	90	94	76	80
Riverscape Connectivity	Riverscape Connectivity	10%	76	65	76	85	95	76	95
Riparian Condition	Vegetation Structure and Complexity		82	80	80	81	80	79	77
	Invasive Species		95	85	82	76	78	72	78
	Riparian Condition	20%	83	81	80	81	80	78	77
River Form	Channel Morphology	5%	88	65	82	88	76	82	65
Structural Complexity	Macrohabitat		95	65	85	92	82	78	65
	Microhabitat		85	92	92	95	92	82	65
	Structural Complexity	15%	93	72	87	93	85	79	65
Biotic Community	Macroinvertebrates		88	88	88	88	88	88	88
	Native Fish		72		78	65			
	Biotic Community	5%	80	88	83	77	88	88	88
Weighted River Health Score		100%	84	79	82	85	87	83	82

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APPENDIX A
PHOTO COMPILATION



Figure A-1. Beaver bank lodge in riverscape 20.



Figure A-2. Beaver sign at the base of floodplain cottonwoods in riverscape 19.

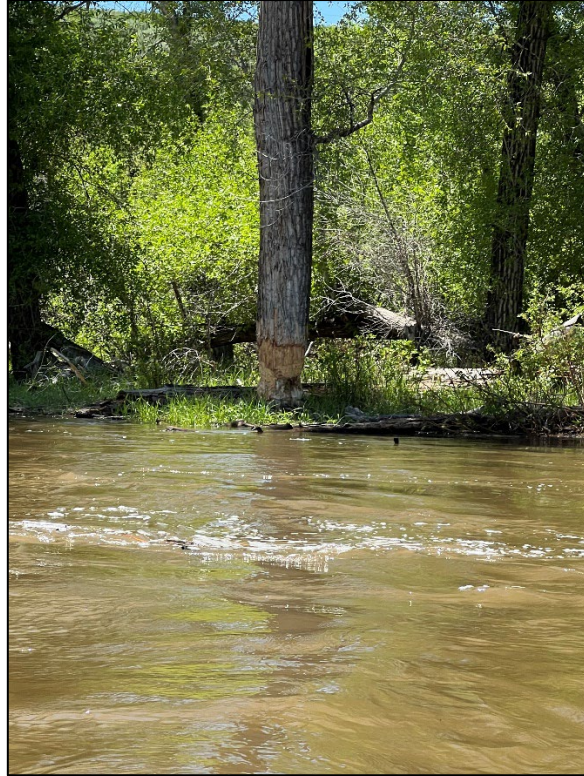


Figure A-3. Beaver sign.



Figure A-4. Bank armoring with large boulders.



Figure A-5. Bank armoring to protect railroad infrastructure.



Figure A-6. Bank armoring with old automobiles and other trash.



Figure A-7. Bank armoring with rootwads and large boulders.



Figure A-8. Bank armoring with concrete.



Figure A-9. Bank armoring with heavy plastic.



Figure A-10. Bank erosion on the outer bend characteristic of a health meandering river.



Figure A-11. More healthy bank erosion.



Figure A-12. Gravel bar indicative of a healthy sediment regime.



Figure A-13. Gravel bar (again, suggestive of a healthy sediment regime).



Figure A-14. Gravel bar.



Figure A-15. Large wood accumulation on a mid-channel bar.



Figure A-16. Large wood.



Figure A-17. Large wood accumulation.



Figure A-18. Large wood.

APPENDIX B

TECHNICAL MEMORANDUM: YAMPA SCORECARD SEGMENT RIPARIAN MAPPING METHODS AND RESULTS (DECEMBER 10, 2021)

From: [Deb Bastian](#)
To: [Deb Bastian](#)
Subject: RE: Thoughts/questions re: FOY grant application
Date: Thursday, March 16, 2023 12:12:09 PM

From: Lyn Halliday <lhalliday@environmentalsolutionllc.com>
Sent: Tuesday, March 14, 2023 11:02 AM
To: 'Doug Monger' <dmonger@co.routt.co.us>; webster jones <hwebster@frii.com>; 'Nicole Seltzer' <nseltzer@rivernetnetwork.org>; Lyn Halliday <lhalliday@environmentalsolutionllc.com>; redmondjv <redmondjv@gmail.com>; rmurphy100bc <rmurphy100bc@gmail.com>; haskywild <haskywild@mail.com>; tom <tom@tomsharp.com>; kpbrennersteamboat <kpbrennersteamboat@gmail.com>
Cc: Andy Rossi <arossi@upperyampawater.com>; Holly Kirkpatrick <HKirkpatrick@upperyampawater.com>
Subject: Thoughts/questions re: FOY grant application

Dear Fellow Board Members,

As you know the community grant application from FOY is on the UYWCD Board agenda again tomorrow. I wanted to elaborate on my views regarding this application. First I am very supportive of FOY doing river stewardship outreach and education and applaud their past and present efforts relative to community events and youth education in that vein (e.g. involving school children and CMC students in river appreciation exercises such as in the Middle Yampa River Scorecard project).

My concerns regarding continuing the Scorecard project in the upper reaches of the Yampa are two fold, one is that the grading from A-F seems subjective which is in contrast to the UYWCD strategic plan which specifically calls for "science-based" initiatives; and two, awarding UYWCD monies, especially if they are tax payer dollars, in my view constitutes an endorsement of the methodology and outcome which warrants extra caution and scrutiny.

I would prefer to see FOY use this effort and the significant funds tied to it to a) point out opportunities for improvements along the river corridor, and b) highlight data gaps that are in need of further attention. I believe scoring the various categories diverts attention from what could be a more valuable outcome and therefore would suggest that the A-F component be eliminated.

Finally, since the Yampa River segment from Chuck Lewis to the City of Steamboat Springs Wastewater Treatment Plant have already undergone a similar Stream Management Study, a question I would like to see answered is whether the projected cost is warranted (i.e. \$175,546). For example, much of the consultant scope of work in the Middle Segment project was a regurgitation of existing studies from USGS and those done as part of the IWMP. If this is the cost for each of the five segments, the total would exceed three quarters of a million dollars.

Thank you for the opportunity to air my thoughts and potentially save some time at the Board meeting tomorrow.

Kind regards,

Lyn



Lyn Halliday, CEP

President

970.879.6323

lhalliday@environmentalsolutionllc.com

www.environmentalsolutionllc.com