

**BEFORE THE COLORADO WATER CONSERVATION BOARD
DEPARTMENT OF NATURAL RESOURCES, STATE OF COLORADO**

**IN THE MATTER OF PROPOSED INSTREAM FLOW APPROPRIATION
DIVISION 6: MILK CREEK**

PREHEARING STATEMENT OF WESTERN RESOURCE ADVOCATES

Western Resource Advocates hereby submits this Prehearing Statement in the matter of the proposed instream flow (“ISF”) appropriation on Milk Creek (“Milk Creek ISF Appropriation”) before the Colorado Water Conservation Board (“Board”).

I. Introduction and Statement of Position

Western Resource Advocates (“WRA”) is a nonprofit conservation organization dedicated to fighting climate change and its impacts on the West’s land, air, and water. WRA engages with water providers, districts, and utilities, state and federal government agencies, and Colorado irrigators to find solutions to promote river restoration and water conservation, while protecting stream flows for fish, wildlife, and recreation. WRA has experience helping western communities meet their legitimate water needs and extensive knowledge of water delivery systems in the Colorado River Basin.

WRA supports the Board’s proposed Milk Creek ISF Appropriation. The ISF recommendations for Milk Creek (“BLM Recommendation,” pre-filed as WRA Exhibit 5) prepared by the United States Bureau of Land Management (“BLM”), ISF recommendation (“CPW Recommendation,” pre-filed as WRA Exhibit 2) prepared by Colorado Parks and Wildlife (“CPW”), and ISF recommendation (“CWCB Staff Recommendation,” pre-filed as WRA Exhibit 1) prepared by Staff for the Colorado Water Conservation Board (“CWCB Staff”) conclusively

establish that appropriation of an ISF on Milk Creek in the proposed amounts is justified pursuant to Rule 5i of the Board's Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, 2 CCR 408-2 ("ISF Rules"). The analysis provided by the BLM Recommendation, CPW Recommendation and CWCB Staff Recommendation is further supported by written testimony ("Woodling Testimony") prepared by Dr. John Woodling on behalf of WRA to further assist the Board in its deliberations. Dr. Woodling is a fish biologist with more than 59 years of experience, including with CPW and the Colorado Water Quality Control Division, who has focused much of his work on the native fish found in Milk Creek.

II. Statement of Factual and Legal Claims Asserted

Rule 5i of the ISF Rules sets forth the following findings the Board must make with respect to an ISF Appropriation:

- (1) There is a natural environment that can be preserved to a reasonable degree;*
- (2) The natural environment will be preserved to a reasonable degree by the water available for the appropriation; and*
- (3) Such environment can exist without material injury to water rights.*

WRA agrees with, and incorporates by reference, the conclusions reached on these factors by experienced staff at BLM, CPW and CWCB, inside the BLM Recommendation, CPW Recommendation and CWCB Staff Recommendation, as well as the corroborating conclusions reached by Dr. Woodling in the Woodling Testimony. Those conclusions are as follows:

Rule 5i(1): *There is a natural environment that can be preserved to a reasonable degree.*

The CWCB Staff, BLM, and CPW Recommendations and the Woodling Testimony conclusively establish that there is a natural environment on Milk Creek that will be preserved to a reasonable degree by the proposed Milk Creek ISF Appropriation. As described in detail in the CWCB Staff Recommendation, BLM Recommendation, and CPW Recommendation and the Woodling Testimony, Milk Creek is an important tributary of the Yampa River that supports native Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub, all Colorado native fishes referred to as the “Three Species.” The Three Species are listed in the Colorado State Wildlife Action Plan as a Tier 1 Species of Greatest Conservation Need or “species which are truly of highest conservation priority in the state.”

The reach of Milk Creek that would be protected by the proposed Milk Creek ISF Appropriation has a stable channel with a mix of riffle, run, and pool habitat known to provide important spawning and rearing habitat for the Three Species. Milk Creek supports a riparian community comprised primarily of willows, sedges, cottonwoods, and rushes, and the macroinvertebrate community is healthy and diverse. The water quality, water temperatures, and available food sources are suitable for the Three Species. Fishery surveys indicate that Milk Creek provides habitat for the Three Species and other native species, including the Speckled Dace.

Rule 5i(2): *The natural environment will be preserved to a reasonable degree by the water available for the appropriation.*

The natural environment on Milk Creek will be preserved to a reasonable degree by the proposed acquisition. As described in their Recommendations, CPW and BLM utilized professional judgement and past experiences in deciding to use the Instream Flow Incremental

Methodology (“IFIM”), a widely accepted method for quantifying suitable hydraulic habitat as a function of discharge for specific species and life stages of fish. This methodology is species-specific and can be tailored to assessing flow and habitat relationships specific to Flannemouth Sucker and Bluehead Sucker. In 2023, CWCB hired Freshwater Consulting LLC to provide field support and technical training necessary to complete a hydraulic habitat model on Milk Creek using the System for Environmental Flow Analysis (“SEFA analysis”), an updated version of the Physical Habitat Simulation (PHABSIM) software historically used for all of Colorado’s instream flow evaluations that were developed using the IFIM framework.

The SEFA analysis established that a flow rate of 40 cubic feet per second (“cfs”) from April 1 through June 30 provides an appropriate habitat for adult Flannemouth Suckers that also approximates the habitat response of Bluehead Sucker. Preserving this flow rate during the spring runoff period (including the rising and receding limb of the hydrograph) will support native fish by providing the appropriate depth, velocity, and substrate conditions to enable spawning migrations, as well as optimal overall habitat conditions for adult species.

The SEFA analysis further recommends a flow rate of 8 cfs from July 1 to July 31 to maintain longitudinal connectivity of habitat and will enable large-bodied adult fish to move throughout Milk Creek to find suitable habitat or to emigrate into the Yampa River without being stranded. Additionally, this flow rate will support larvae development and emergence by maintaining wetted area in the channel and channel margins.

The analysis recommends a flow rate of 4.5 cfs from August 1 through September 30 based on limited water availability during the late irrigation season. Despite low flow conditions and limited mobility between habitat types, native species will use available habitat within Milk

Creek during this period. Preserving this flow rate is important because it enables rearing of juvenile and young-of-the-year fish. Growth during this late summer period is critical to their survival over the winter period.

The analysis recommends a flow rate of 5.2 cfs from October 1 through December 31. based on limited water availability during the baseflow period. Baseflow during the winter months is necessary to provide enough habitat variety to overwinter resident native fish.

The analysis recommends a flow rate of 7.8 cfs from January 1 through February 29 based on slight water availability limitations during the baseflow period. This flow rate will provide conditions to enable longitudinal movement of resident fish to find more advantageous habitat.

Finally, the SEFA analysis recommends a flow rate of 18.0 cfs from March 1 through March 31 to provide enabling conditions during the beginning of the spawning period for native fish, a critical period for completing their life cycle. These flows allow longitudinal movement between habitat types to reach suitable spawning areas.

Rule 5(i)(3): *Such environment can exist without material injury to water rights.*

The proposed Milk Creek ISF Appropriation would be a new water right, therefore junior to existing rights. Further, because the Milk Creek Appropriation is for instream flow purposes, there is no associated consumptive use. Under section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water on the date this ISF water right is appropriated. Thus, the Appropriation can exist without material injury to other water rights.

The proposed Milk Creek ISF Appropriation is also consistent with maximum utilization. Colorado's doctrine of maximum utilization is intended to "spread the benefits of the public's

water resources to as many uses as possible” and that “optimum use can be achieved only through proper regard for all significant factors, including environmental and economic concerns.” *Pagosa Area Water and Sanitation Dist. v. Trout Unlimited*, 170 P.3d 307, 314 (Colo.2007). The Milk Creek ISF Appropriation furthers this doctrine of maximum utilization, by retaining water to protect important environmental concerns while protecting vested water rights. Maintenance of flows in Milk Creek for ISF purposes will benefit stream flows and water users further downstream of the proposed Milk Creek ISF Appropriation.

III. Witness List

John Woodling, Consultant – John Woodling is a fish biologist with more than 59 years of experience. John was an aquatic biologist for what is now CPW in various positions for 23 years and has represented various non-profit entities as a fishery biologist for more than 20 years. Much of Dr. Woodling's work has focused on the native fish found in Milk Creek, including authorizing a book, “Colorado’s Little Fish,” that includes life history, range, and habitat descriptions for more than 40 fish species, including the Three Species and the Speckled Dace. Dr. Woodling will testify to his support of the methods and findings in the BLM, CPW, and Staff Recommendations. Dr. Woodling’s resume was pre-filed as WRA -6.

IV. Statement of Open Legal Questions

WRA has not identified any open legal questions relevant to this Hearing. WRA reserves the right to address such issues as they may arise in this proceeding.

V. Statement of Relief Requested

WRA strongly supports the BLM Recommendation, CPW Recommendation, and CWCB Staff Recommendation for the proposed Milk Creek ISF Appropriation. The Recommendations and Woodling Testimony provide ample evidence satisfying the Board's statutory requirements and ISF Rules and support a finding that the proposed Milk Creek ISF appropriation will preserve the environment to a reasonable degree.

VI. Time Requested at Hearing

WRA requests 40 minutes total for the testimony of Dr. Woodling and for responding to assertions made by other parties to this proceeding.

VII. Exhibit List

WRA identifies the following exhibits that WRA may rely on at the Hearing. WRA reserves the right to use as an exhibit any exhibit introduced by any other party and any exhibit necessary for rebuttal purposes.

1. CWCB Staff Milk Creek Instream Flow Recommendation (WRA Exhibit 1)
2. CPW Milk Creek Instream Flow Recommendation (WRA Exhibit 2)
3. Miller, William J., *Final Milk Creek Instream Flow Study Report* (September 30, 2024) (WRA Exhibit 3)
4. Miller, William J., *Proposed Habitat Suitability Criteria for Flannelmouth Sucker and Bluehead Sucker for use in Milk Creek Instream Flow Study* (January 6, 2024) (WRA Exhibit 4)
5. BLM Milk Creek Instream Flow Recommendation (WRA Exhibit 5)
6. Woodling, John, *An analysis of the relationship of Miller (2024a) Milk Creek proposed instream flows to habitat requirements of native fishes* (February 20, 2025) (WRA Exhibit 6)
7. Resume for Dr. John Woodling (WRA Exhibit 7)

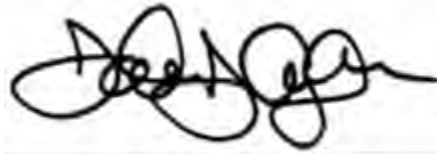
VIII. Contact Person.

For this hearing only, Bart Miller, Healthy Rivers Program Director, Western Resource Advocates and John Cyran, Senior Staff Attorney, Western Resource Advocates, are the

contacts for WRA. Mr. Miller's and Mr. Cyran's mailing addresses, phone numbers, and email addresses are listed below.

Respectively submitted this 9th day of September 2025.

WESTERN RESOURCE ADVOCATES

A handwritten signature in black ink, appearing to read 'John Cyran', is positioned above a horizontal line.

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On behalf of Western Resource Advocates

CERTIFICATE OF SERVICE

I, John Cyran, hereby certify that I have duly served copies of the foregoing **Prehearing Statement** upon all parties by email, this 9th day of September 2025, addressed as follows:

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**BEFORE THE COLORADO WATER CONSERVATION BOARD
DEPARTMENT OF NATURAL RESOURCES, STATE OF COLORADO**

**IN THE MATTER OF THE HEARING FOR THE PROPOSED INSTREAM FLOW APPROPRIATION
DIVISION 6: MILK CREEK**

**SUBMITTAL OF WRITTEN TESTIMONY OF DR. JOHN WOODLING ON BEHALF OF WESTERN
RESOURCE ADVOCATES**

I. Introduction

I am providing this testimony, which is based on my professional expertise. I am a fish biologist with more than 59 years of experience. I operated a mobile lab for the Colorado Water Quality Control Division doing river studies across Colorado for five years. I was an aquatic biologist for what is now the Colorado Parks and Wildlife (CPW) in various positions for 23 years, and have represented various non-profit entities as a fishery biologist for more than 20 years. Much of this work has focused on the native fish that are found in Milk Creek. I authored a book, "Colorado's Little Fish" that includes life history information, range description, habitat, etc. for more than 40 fish species, including the Three Species and the Speckled Dace. I am currently working with CPW biologists on a book titled "Fishes of Colorado" as an editor and co-authored most of the chapters on various fish species including the chapters on Flannemouth Sucker, Roundtail Chub and Speckled Dace.

I reviewed the Colorado Water Conservation Board (CWCB) Staff's Milk Creek Executive Summary (CWCB 2025, WRA-1) provided to the CWCB Board for item 5c of the March 19, 2025 Board meeting and the following supporting information linked to in that document:

- CPW Instream Flow Recommendations for Milk Creek in Moffat County (CPW 2025a, WRA-2)
- Final Milk Creek instream flow study report. Prepared for the Colorado Water Conservation Board. (Miller 2024a, WRA-3)
- Proposed habitat suitability criteria of Flannemouth Sucker and Bluehead Sucker for use in Milk Creek instream flow study. Prepared for the Colorado Water Conservation Board. (Miller 2025b, WRA-4)
- U.S. Bureau of Land Management Instream Flow Recommendation for Milk Creek. February 2025. (BLM 2025, WRA-5)

I also developed a report, “An analysis of the relationship of Miller (2024a) Milk Creek proposed instream flows to habitat requirements of native fishes” (Woodling 2025, WRA-6), which was also included in the March 2025 board meeting packet for item 5c. My testimony here is based on my February 2025 analysis, a review of the documents listed above, and the literature cited throughout this testimony. Additional details on the topics addressed in this testimony can be found in my earlier report (Woodling 2025, WRA-6).

My review of these materials and professional experience have led me to support the BLM and CPW’s proposed instream flows (ISF) for Milk Creek (Table 1) and the sampling and analyses that went into developing the Milk Creek flow instream flow proposal.

Table 1: Milk Creek Proposed ISF Rates (BLM 2025, CPW 2025a)

Dates	Instream Flow Rate
1/1 – 2/29	7.8 cfs
3/1 – 3/31	18 cfs
4/1 – 6/30	40 cfs
7/1 – 7/31	8 cfs
8/1 – 9/30	4.5 cfs
10/1 – 12/31	5.2 cfs

cfs = cubic feet per second

II. Population Decline in Colorado Native Fish Species that Utilize Milk Creek

Only 13 fish species are native to the Colorado River basin in Colorado. All but perhaps one of these species has declined in distribution in Colorado. Many factors have contributed to the decline of native fish species in Colorado, including reduced stream flows.

The U.S. Government, Colorado River basin states, and other interested entities consider three fish species, the Flannemouth Sucker (*Catostomus latipinnis*), Bluehead Sucker (*Catostomus discobolus*) and Roundtail Chub (*Gila robusta*) to be “sensitive.” The Flannemouth Sucker, the Bluehead Sucker and the Roundtail Chub are often treated as a single management unit, commonly referred to as the “Three Species”. The Three Species are the object of interstate and Colorado-specific efforts designed to halt the decline in range and numbers of the fish.

The Three Species are listed as Tier 1, “the species, which are truly of highest conservation priority in the state”, in the 2015 Colorado State Wildlife Action Plan (CPW 2015) and the draft 2025 plan revision (CPW 2025b). The Three Species, which utilize Milk Creek, are declining in distribution and now occupy less than 50% of their historic native range in the Colorado River Basin (Bezzarides and Bestgen 2002). The goal of all entities involved in management and protection of the Three Species is to avoid the petitioning of these taxa for

federal protection. Protecting the aquatic habitat (including flows) is important in sustaining populations of the Three Species in Colorado and other states in the Colorado River basin (Fraser et al. 2017).

The Three Species are managed as one unit in part because these three taxa are often found in the same sampling sites. Water depth is a crucial aspect of habitat. Bluehead Sucker are often associated with riffles, where the species feeds. Flannelmouth Sucker and Roundtail Chub are typically collected in deeper waters: runs, glides, and pools. Habitat (depth) appropriate for Bluehead Sucker is generally taken as appropriate for all three taxa.

The Speckled Dace (*Rhinichthys osculus*) is another native fish found in Milk Creek (Woodling 2025). This small bodied species is found throughout all major river systems in the Colorado River basin. The Speckled Dace has disappeared from some Colorado waters, including most of the Gunnison River basin upstream of the North Fork of the Gunnison River and parts of the mainstem Colorado River.

III. Importance of Milk Creek to the Protection of the Three Species

The Three Species share a rather remarkable life cycle characteristic that makes protection of existing populations extremely difficult. These species may be highly mobile, although many individuals may not move much at all. Individual fish can have a large home range, with some fish moving hundreds of miles in the course of a year (Woodling 2025). Protecting these mobile species requires providing adequate habitat and connectivity over a large geographic area and in more than one stream or river. Mainstem and tributary reaches such as Milk Creek are all important.

Seasonal movements by the Three Species are often associated with spawning migrations. Large numbers of the Three Species seasonally move into small tributaries to spawn and then return to larger rivers such as the Yampa River. Tributaries to larger mainstem rivers play an important role in the life history of the Three Species (Fraser et al. 2017), with many fish returning to the same tributaries over multiple years (Hooley-Underwood et al. 2019). Milk Creek was identified by BLM (BLM 2009) as “important” tributary where native fish species spawn.

Protecting flows in Milk Creek is especially important to the Three Species because this stream is one of the few consistently flowing tributaries of the Yampa River from Hayden, Colorado to the Utah/Colorado border. The proposed ISF reach includes fast, shallow riffles and larger deeper pools (BLM 2009). As such, Milk Creek is an important component of CPW’s management program for the Three Species in the Yampa River basin. The CPW stocks juvenile Bluehead Sucker into Milk Creek. These juvenile fish can grow in Milk Creek and then migrate out into the mainstem Yampa River, mature and spawn during the spring months, protected by

the instream flow in the proposed ISF reach. Milk Creek also provides spawning habitat for the Flannemouth Sucker and Roundtail Chub, just as do other smaller tributaries throughout the Colorado River basin in Colorado.

The instream flow proposal for Milk Creek would protect four different subsets of the Three Species:

1. Migratory individuals of the Three Species whose home range includes the proposed ISF reach of Milk Creek and the mainstem Yampa River on a seasonal basis. These individuals move into Milk Creek in the spring to spawn and then return to the mainstem Yampa River for the remainder of the year,
2. Resident individuals of the Three Species that inhabit the proposed ISF reach on a year-round basis,
3. The Bluehead Sucker that are stocked by the CPW into the proposed ISF reach of Milk Creek, with the objective of increasing the number of these fish in the mainstem Yampa River. By remaining in Milk Creek, these Bluehead Suckers stocked by CPW may avoid predation from the larger non-native piscivorous species that inhabit the mainstem Yampa River. These stocked Bluehead Sucker may well move out into the Yampa River to mature and then return to Milk Creek in a subsequent spawning season, or when water levels increase due to significant storm events.
4. The larvae and age-0 fingerlings of all the first three groups that may be found in the proposed ISF reach each spring, summer and fall. Longitudinal connectivity must be maintained from the proposed ISF reach to the mainstem Yampa River for portions of the year to allow fingerlings to migrate to the mainstem Yampa River from nursery areas in lower Milk Creek.

IV. Appropriate Use of the System for Environmental Flow Analysis (SEFA) Model

The Milk Creek ISF proposal was developed using the System for Environmental Flow Analysis (SEFA) model which has taken the place of the Physical Habitat Simulation model (PHABSIM) used in some past ISF recommendations. PHABSIM is now considered to be a legacy software that is no longer supported (Jowett et al. 2023). The SEFA model is part of the widely used Instream Flow Incremental Methodology (IFIM). CPW, BLM and the CWCB staff chose the SEFA model for its ability to develop flow recommendations specific to the habitat needs of Flannemouth Suckers and Bluehead Suckers. The SEFA model is capable of the same hydraulic and habitat simulation analyses as PHABSIM, but also has additional functionalities including modeling fish passage based on specific criteria. SEFA calculates both width available for fish passage as well as the maximum depth at cross sections at different flows rates. The model can also calculate minimum flows that will maintain longitudinal connectivity in a reach. CPW, BLM

and CWCB staff undertook a robust field data collection effort for input into the Milk Creek SEFA model (BLM 2025).

In my opinion the use of the SEFA model is an appropriate and robust methodology to use in developing the Milk Creek ISF. The use of the SEFA model was appropriate because connectivity is extremely important in fishery management. Connectivity describes the ability of fish to move through a stream reach or between stream reaches. Roadway culverts, dams and other man-made barriers can restrict or remove access for fish in streams throughout their range. Likewise, low stream flows that leave only isolated pools while connecting riffles and runs are dry reduces or eliminate connectivity along a stream reach. The issue of connectivity is especially important in the arid Colorado River basin, where native fish populations often can be impacted by extended periods of drought, resulting in low flows or dry stream channels where only isolated pools may remain.

V. Proposed ISF Rates Will Preserve Fish Habitat and Passage to a Reasonable Degree

The Milk Creek ISF rates proposed by BLM and CPW were developed based on Miller (2024a) incorporating additional field studies of Milk Creek from 2023 and 2024 (BLM 2025, CPW 2025a), and modified Habitat Suitability Curves for the Three Species (Miller 2024b). Water depths at the various proposed ISF rates are part of the output of the analyses utilized by the BLM and CPW in creating the flow proposals for Milk Creek. The accuracy and applicability of the proposed ISFs in the ISF reach can be assessed by comparing the water depths preferred by the Three Species to water depths that are part of the output of the SEFA output. As explained below, it is my professional opinion that the proposed ISF flows will provide flows needed to protect the Three Species to a reasonable degree in Milk Creek and, thus, the larger Yampa River basin and perhaps beyond.

The optimum water depth for Flannemouth Suckers appears to be a depth between 1.3 feet to 6.6 feet (Anderson and Stewart 2003) or 1.6 feet to 3.3 feet in depth (Sweet 2007). The optimum depth for Bluehead Suckers ranges from 1.6 feet to 5 feet (Anderson and Stewart 2003) or 1.6 feet to 3.3 feet in depth (Sweet 2007). Miller (Miller 2024b) calculated that a depth of 0.91 feet to 4.0 feet are appropriate for Flannemouth Sucker and Bluehead Sucker in the reach, values similar to the published literature noted above. Specific information regarding Roundtail Chub and water depth is lacking. Adult and juvenile Roundtail Chub are usually taken in comparatively deep water with low water velocity (Rees et al. 2005).

An average water depth of 1.0 foot and a flow velocity of 1.3 feet per second (ft/sec) provides “marginally suitable” habitat for Bluehead Suckers (Anderson and Stewart 2003), or what I interpret to be the same as a “reasonable” protection as used in the instream flow program. Thus, the instream flow rates proposed for Milk Creek can be compared to the

marginally acceptable water depths and velocities for Bluehead Sucker to determine if the flow recommendation is appropriate to provide the fishery with adequate habitat.

Lower water depths will not necessarily eliminate the Three Species from Milk Creek. However, adults that are present in waters with lower water depths may well be smaller fish (Anderson and Stewart 2003, Woodling personal observation). Water depths may also become so low that the Milk Creek fish populations are eliminated.

The water depth in riffles is especially important. Water too shallow in riffles may restrict movement of large adult fish in a stream reach. Adequate depths are needed to provide longitudinal connectivity along a stream reach so that fish can move freely through pool, runs and riffles. In Milk Creek, longitudinal connectivity is needed to allow the Three Species to move through the proposed ISF reach but also to access the Yampa River at the lower terminus of the reach. Mature adult Bluehead Sucker and Flannemouth Sucker can move through riffles at a water depth of 0.6 feet (Zack Hooley-Underwood, CPW, personal communication). Thus, these two species would be able to move into and through the proposed ISF reach at a flow of 8 cfs in the months of August through March. This represents a low flow where only a narrow pathway (two feet) would be found through the riffles in the proposed ISF reach with water depths greater than or equal to 0.6 feet (Miller 2024a).

Protection for the Speckled Dace must also be considered when analyzing the proposed instream flow rates. The Speckled Dace is a small bodied native fish that is not known to migrate long distances. Speckled Dace occupy a wide range of water depths from 2 inches (Moyle and Baltz 1985) to 5.1 feet (Batty 2010), but prefer shallow, low velocity habitats.

The proposed flows in ISF reach include considerations for water availability and recognize that not all life stages of the Three Species are protected at all times. The water depths and flows discussed above can be used to determine if the ISF rates proposed for the ISF reach are adequate. Additional data and details regarding the following information can be found in Woodling 2025.

January 1 - February 29, Proposed ISF = 7.8 cfs

Miller (Miller 2024a) determined that at a flow of 8 cfs a continuous pathway of water at least 0.6 feet deep and two feet wide will be present through riffle areas in the proposed ISF reach. Adult Flannemouth Sucker and Bluehead Sucker will be able to migrate into, through, and out of the proposed ISF reach from the mainstem Yampa River at this flow. This water depth and flow will also maintain connectivity for juvenile Bluehead Sucker stocked by the CPW, and larvae and age-0 fingerlings from natural spawning.

The proposed ISF at this time of the year, which was limited by the CWCB Staff's water availability analysis, is a fair representation of the flow that will provide reasonable protection of the Three Species in Milk Creek.

March 1 - March 31, Proposed ISF = 18 cfs

A flow of 18 cfs has been recommended for the month of March. If appropriate conditions are present, Bluehead Sucker and Flannemouth Sucker can be found spawning in March (Barkalow et al. 2016, Woodling 2025). If not actually spawning, mature adults can be found migrating into small tributaries from mainstem waters (such as the Yampa River) in the month of March. Appropriate instream flows for Milk Creek in March are needed to protect the mature adults that may well be migrating from the Yampa as well as Bluehead Sucker and Flannemouth Sucker that may spawn in Milk Creek in March. While adult sucker migrating into Milk Creek in March may not actually spawn at that time, adult habitat is needed to protect and shelter these fish. At the proposed ISF of 18 cfs, water levels in riffles are deep enough for the three species, with water depths in runs, pools and backwaters that is appropriate as holding and resting areas for these mature adult fish.

The proposed ISF flow of 18 cfs for the month of March will provide reasonable access through riffles for any of the Three Species that move into Milk Creek or that spawn in Milk Creek in the month of March.

April 1 - June 30, Proposed ISF = 40 cfs

Adequate flows through the proposed ISF reach of Milk Creek are critical in April through June because this is spawning season for the Three Species and Speckled Dace. These species spawn in riffles and relatively shallow runs. Residents to the proposed ISF reach and adults that migrate to Milk Creek from the mainstem Yampa River will all spawn in this part of the year, as hopefully will the Bluehead Suckers stocked by the CPW, which is part of the reason for requesting an instream flow for Milk Creek.

Miller (Miller 2024a) analyzed the habitat in the proposed ISF reach of Milk Creek for the spring spawning period from April through June using the SEFA model which incorporates water velocity, depth and substrate type data collected in different seasons, including the spring and early summer spawning period, to help determine appropriate instream flows. One model output is "Average Weighted Suitability" (AWS). AWS is utilized to create the instream flows for the proposed ISF reach (Miller 2024a). Adult Bluehead Suckers and Flannemouth Suckers need both holding habitat and spawning habitat in the proposed ISF reach.

The interaction of these variables is such that the highest AWS index value occurs at a flow of 40 cfs in Milk Creek (Miller 2024a), with the amount of suitable habitat decreasing at lower and at higher flows. The proposed April through June instream flow regime in Milk Creek

protects large adult suckers and spawning. Protection of spawning is important in Milk Creek where the production of young enhances the population in the mainstem Yampa River as well. Protection of the young of the Three Species can be assisted by providing appropriate flows through as much of spawning season as possible. Miller (Miller 2024a) noted that, “protecting a minimum flow during snow melt runoff (April - June) of 40 cfs would provide unimpeded fish passage for fish migrating into Milk Creek and the most spawning habitat.”

Adoption of the March ISF proposal of 40 cfs (which is much less than peak flows) is appropriate and would provide reasonable protection for the Three Species during the spring and early summer spawning period.

July 1 - July 31, Proposed ISF = 8 cfs

Miller (Miller 2024a) determined that at a flow of 8 cfs a continuous pathway of water at least 0.6 feet deep and two feet wide will be present through riffle areas in the proposed ISF reach. Adult Flannelmouth Sucker and Bluehead Sucker will be able to migrate through and out of the proposed ISF reach from the mainstem Yampa River at this flow. This water depth and flow will also maintain connectivity for juvenile Bluehead Sucker stocked by the CPW, and larvae and age-0 fingerlings from natural spawning.

The proposed ISF flow of 8 cfs for July is a fair representation of the flow that will provide reasonable protection of the Three Species in Milk Creek.

August 1 - September 30, Proposed ISF = 4.5 cfs, and
October 1 - December 31, Proposed ISF = 5.2 cfs

The maximum depth analysis showed that a maximum depth of 0.6 feet was present at some point in all cross sections at an average flow 4.6 cfs except for one of the seven shallowest cross sections (Miller 2024a). I would not expect that such shallow depths would provide shelter from predators such as Great Blue Herons, racoons and coyotes but relatively small, adult Bluehead Suckers inhabit small streams where the depth of riffles can be less than 0.6 feet. This flow does not provide adequate protection for large adults of the Three Species that migrate into Milk Creek to spawn. However, these large adults leave smaller tributaries after spawning in the spring so lower flows such as 4.5 cfs and 5.2 cfs can be seasonally appropriate in months where large adult members of the Three Species may well not be present.

The ISF rates proposed for August through December, which were limited by the CWCB Staff's water availability analysis, provide connectivity to mainstem from Milk Creek for the juvenile Bluehead Sucker stocked by CPW and any age-0 fish from natural reproduction.

VI. Conclusion

I would like to conclude by noting that I have been sampling and studying fish professionally in Colorado for more than 52 years. Adoption and implementation of the instream flow program by the CWCBC was one of the most consequential actions by Coloradoans during these 52 years. Across the state, these flows assure the continued presence of both fish native to the state and species brought into Colorado to create fishing opportunities for citizens and visitors. Two of these instream flow appropriations have been adopted specifically to help protect the Three Species in the lowest portion of the San Miguel River and the lower section of the Dolores River. Both appropriations are working to protect populations of the Three Species, and to help prevent federal listing of the Three Species.

I urge the Board to adopt the proposed ISFs to not only protect the Three Species in Milk Creek but to help protect the Three Species throughout the Yampa River basin and perhaps for Flannelmouth Sucker and Roundtail Chub that may roam far into the Green River basin and Upper Colorado River basin.

I declare the above to be true and correct to the best of my knowledge.

John Woodling, Ph.D.

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Milk Creek Executive Summary



CWCB STAFF INSTREAM FLOW RECOMMENDATION March 18-19, 2025

UPPER TERMINUS: confluence with Wilson Creek at
UTM North: 4470717.77 UTM East: 265448.43

LOWER TERMINUS: confluence with Yampa River at
UTM North: 4475273.74 UTM East: 265917.99

WATER DIVISION/DISTRICT: 6/44

COUNTY: Moffat

WATERSHED: Lower Yampa

CWCB ID: 18/6/A-002

RECOMMENDER: Bureau of Land Management (BLM), Colorado Parks & Wildlife (CPW)

LENGTH: 4.1 miles

FLOW RECOMMENDATION: 7.8 cfs (01/01 - 02/29)
18 cfs (03/01 - 03/31)
40 cfs (04/01 - 06/30)
8.0 cfs (07/01 - 07/31)
4.5 cfs (08/01 - 09/30)
5.2 cfs (10/01 - 12/31)



COLORADO

**Colorado Water
Conservation Board**

Department of Natural Resources

BACKGROUND

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level (NLL) water rights. Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: <https://cwcb.colorado.gov/2024-isf-recommendations>.

RECOMMENDED ISF REACH

BLM recommended that the CWCB appropriate an ISF water right on a reach of Milk Creek at the ISF Workshop in January, 2017. CPW became a co-recommender for Milk Creek in 2023. Milk Creek is located within Moffat County and is approximately 14 miles southwest from the City of Craig, CO (See Vicinity Map). The stream originates near the Sleepy Cat Peak and flows northwest and north until it reaches the confluence with the Yampa River. The proposed ISF reach extends from the confluence with Wilson Creek downstream to the confluence with the Yampa River for a total of 4.1 miles. Sixty-one percent of the land on the proposed reach is BLM property and the remaining 39% is privately owned (See Land Ownership Map).

Agency Goals

BLM and CPW are interested in protecting Milk Creek because it provides known spawning and rearing habitat for native Flannemouth Sucker, Bluehead Sucker, and Roundtail Chub (known as the Three Species). The Three Species are large-bodied native fishes endemic to rivers and streams of western Colorado. The Three Species are exhibiting a downward trend and collectively occupy less than half of their native range in the Colorado River Basin (Bezzarides and Bestgen, 2002). The importance of this reach of Milk Creek for native fishes led to cooperation between the BLM and CPW to document use by native species, implement fish stocking programs, and complete cooperative studies to determine the flow rates needed to support the natural environment.

CPW is a signatory, along with the BLM, other federal agencies, and multiple tribes to the Range-Wide Conservation Agreement and Conservation Strategy for the Three Species (UDWR, 2019). The goal of the Conservation Strategy is to ensure the persistence of populations of the Three Species throughout their respective ranges. CPW and BLM seek to reduce the imperiled status of these species across their historic range in Colorado in order to protect the species and to reduce the risk of a federal listing as threatened or endangered under the Endangered Species Act (ESA). Factors contributing to their decline include hydrologic alteration, lack of connectivity, and predation by and hybridization with non-native species.

CPW and BLM have dedicated significant resources to bolstering these populations through non-native fish control, reservoir screening projects, research on movement patterns and spawning behavior in tributaries like Milk Creek, and supplemental stocking to augment populations. From 2015 to 2024, CPW has proactively stocked over 20,000 Bluehead Sucker and over 3,500 Flannelmouth Sucker in Milk Creek to bolster populations in both Milk Creek and the Yampa River. This effort was the first of its kind to stock small numbers of Bluehead and Flannelmouth Suckers with the goal of augmenting the Milk Creek population and hopefully reestablishing populations of these species throughout the Yampa River basin via dispersal from Milk Creek. By boosting populations in unique tributary environments like Milk Creek, additional populations may also become established in the Yampa River mainstem where non-natives are suppressed by non-native fish control efforts. In addition, CPW tags stocked native fish with Passive Integrated Transponders, also known as PIT tags, to track annual movement patterns throughout the Upper Colorado River Basin, as well as growth rates.

Milk Creek provides unique habitat characteristics such as sporadic high-flow events, appropriate water temperature, suitable geomorphology, and high turbidity that support native fish populations. Protecting flows in a unique tributary environment like Milk Creek is complementary to other agency actions. Both CPW and BLM believe working with the CWCB to secure an ISF water right is an appropriate tool for protecting streamflows that are critically important for the persistence of the Three Species.

OUTREACH

Stakeholder input is a valued part of the CWCB staff's analysis of ISF recommendations. Currently, more than 1,100 people subscribe to the ISF mailing list. Notice of the potential appropriation of an ISF water right on Milk Creek was sent to the mailing list in November 2024, March 2024, March 2023, March 2022, March 2021, March 2020, March 2019, March 2018, and March 2017. A public notice about this recommendation was also published in the Craig Press on 12/11/2024. Staff spoke with former District 44 Water Commissioner, Kathy Bower, on 05/17/2017 regarding water availability and water rights on Milk Creek. CWCB staff also talked with Sarah Myer on 4/6/2023 when she was the District 44 Water Commissioner about water rights and water administration.

Staff presented information about the ISF program and this recommendation to the Moffat County Board of County Commissioners and the Moffat County Land Board on 8/14/2017 where members of the public as well as representatives of Tri-State Generation and Transmission Association (Tri-State) were also in attendance. Staff discussed this recommendation with the Moffat County Land Use Board again on 9/10/2024. Staff also worked extensively with representatives of Tri-State to inform them about the proposal, update them on studies, and tour the proposed reach on 04/20/2022 and 06/09/2023. Staff discussed the proposed ISF on Milk Creek with Colorado River Water Conservation District staff on 1/6/2024; their staff followed up with local landowners and no issues were raised.

NATURAL ENVIRONMENT

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information provides the Board with a basis for determining that a natural environment exists.

Physical Habitat

Milk Creek is the largest tributary to the Yampa River between the confluence of the Williams Fork and Little Snake Rivers. The proposed reach on Milk Creek is a low to moderate gradient stream in a canyon approximately 0.5 miles in width. In some locations, there is sufficient width in the canyon bottom for the stream to meander over time. In other locations, stream movement is confined by bedrock. The creek has a stable channel but has a highly variable substrate size, including fine sediment, gravels, and large 2-foot diameter boulders. The stream has a good mix of riffle, run, and pool habitat to support native fish populations. Water quality, water temperatures, and food sources are also suitable for native species.

Native Fishery

Fishery surveys indicate that the lowest 4.1 miles of Milk Creek provides habitat for native species, including Flannemouth Sucker (*Catostomus latipinnis*), Bluehead Sucker (*Catostomus discobolus*), Roundtail Chub (*Gila robusta*), and Speckled Dace (*Rhinichthys osculus*), see Table 1. The Three Species are considered sensitive species by the BLM. Criteria that apply to BLM sensitive species include the following: 1) species under status review by the U.S. Fish and Wildlife Service; or 2) species with numbers declining so rapidly that federal listing may become necessary; or 3) species with typically small and widely dispersed populations; or 4) species inhabiting ecological refugia or other specialized or unique habits. The Three Species meet the first two of the criteria listed above, qualifying them as BLM “sensitive species” (BLM, 2025). The Three Species are also listed in the Colorado State Wildlife Action Plan (2015) as Tier 1 Species of Greatest Conservation Need, or “species which are truly of highest conservation priority in the state.”

Table 1. List of native fish species identified in Milk Creek.

Species Name	Scientific Name	Status
flannemouth sucker	<i>Catostomus latipinnis</i>	State - Species of Greatest Conservation Need BLM - Sensitive Species
bluehead sucker	<i>Catostomus discobolus</i>	State - Species of Greatest Conservation Need BLM - Sensitive Species
roundtail chub	<i>Gila robusta</i>	State - Species of Greatest Conservation Need BLM - Sensitive Species
speckled dace	<i>Rhinichthys osculus</i>	None

As a significant low elevation perennial tributary to the Yampa River, Milk Creek provides important year-round and seasonal habitat for the Three Species. Very few similar tributaries enter the Yampa River in this area, so it is critical for restoring native fish populations in the Yampa River watershed. Tributary habitats provide unique refugia for juvenile native fish where threats of predation and hybridization with non-native species may be substantially lower than those in the mainstem Yampa River.

Based on CPW data, there is heavy use by adult Three Species during the spring high-flow period and receding limb, specifically Bluehead Sucker and Flannelmouth Sucker. Flannelmouth Suckers and Bluehead Suckers have been known to travel long distances toward habitual spawning areas. During the rising limb of the hydrograph when the water temperature reaches approximately 13°C, Flannelmouth Sucker migrate into tributaries to spawn. Bluehead Suckers follow shortly after, once water temperature reaches 16°C. In Milk Creek this window typically occurs between April to mid-May annually but can vary significantly from year-to-year. Roundtail Chub can be found in Milk Creek and its tributary Stinking Gulch, but their densities are low near the Yampa River confluence. This is likely driven by low densities of Roundtail Chub in the Yampa River. Most of the Roundtail Chub in lower Milk Creek are juveniles. Roundtail Chub of all life stages are present higher in the drainage above Axial Basin. For additional information about fish movement patterns and research in Milk Creek please see CPW's recommendation letter and attached report.

Nonnative Fishery

Non-native fish species that utilize Milk Creek include Black Bullhead (*Ameiurus melas*), Brook Stickleback (*Culaea inconstans*), Brown Trout (*Salmo trutta*), Common Carp (*Cyprinus carpio*), Creek Chub (*Semotilus atromaculatus*), Fathead Minnow (*Pimephales promelas*), Green Sunfish (*Lepomis cyanellus*), Iowa Darter (*Etheostoma exile*), Northern Plains Killifish (*Fundulus kansae*), Red Shiner (*Cyprinella lutrensis*), Sand Shiner (*Miniellus stramineus*), Smallmouth Bass (*Micropterus dolomieu*), White Sucker (*Catostomus commersonii*), White x Bluehead Sucker Hybrid, and White x Flannelmouth Sucker Hybrid.

Macroinvertebrate Community

Aquatic macroinvertebrates are an important component of aquatic food webs and serve as an important food source for fish. In October 2023, CPW staff collected macroinvertebrate samples at two sites within the proposed ISF reach. Analysis of the macroinvertebrate data results show both sites are attaining and meeting the state standards for macroinvertebrate health and biodiversity. Other metrics indicate that Milk Creek has relatively few pollution tolerant species. Both sites also had a high number of unique species demonstrating a community that is species rich with relatively high biodiversity. Additional details on the macroinvertebrate sampling and results are available in CPW's recommendation letter.

Riparian Community

Milk Creek supports a riparian community comprised primarily of willows, sedges, cottonwoods, and rushes. The riparian community has been impacted by historical grazing practices but is now on an upward trend in lower portions of the reach and is static farther upstream. This reach also hosts mature cottonwood trees and substantial cottonwood regeneration has been observed.

ISF QUANTIFICATION

CWCB staff relies on the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

Quantification Methodology

Instream Flow Incremental Methodology (IFIM) using System for Environmental Flow Analysis (SEFA)

CPW and BLM utilized professional judgement and past experiences to determine the appropriate methodology for the Milk Creek ISF recommendation. The BLM and CPW decided to use a methodology that is species-specific and can be tailored to assessing flow and habitat relationships specific to Flannemouth Sucker and Bluehead Sucker. BLM and CPW used IFIM, a widely accepted method for quantifying suitable hydraulic habitat as a function of discharge for specific species and life stages of fish. In 2023, CWCB hired Bill Miller to provide field support and technical training necessary to complete a hydraulic habitat model on Milk Creek using SEFA. The SEFA software is a modern version of the Physical Habitat Simulation software (PHABSIM), a program which was historically used for all of Colorado's ISF evaluations using the IFIM framework. As legacy software, PHABSIM was not updated for compatibility to Windows Operating System 11. The SEFA software is the modern equivalent with additional features, one of which is the predicting fish passage across transects. Bill Miller trained BLM, CPW, and CWCB staff in field methods and use of the SEFA software, developed the models, and completed a summary report (Miller, 2024a).

Habitat Suitability Criteria (HSC)

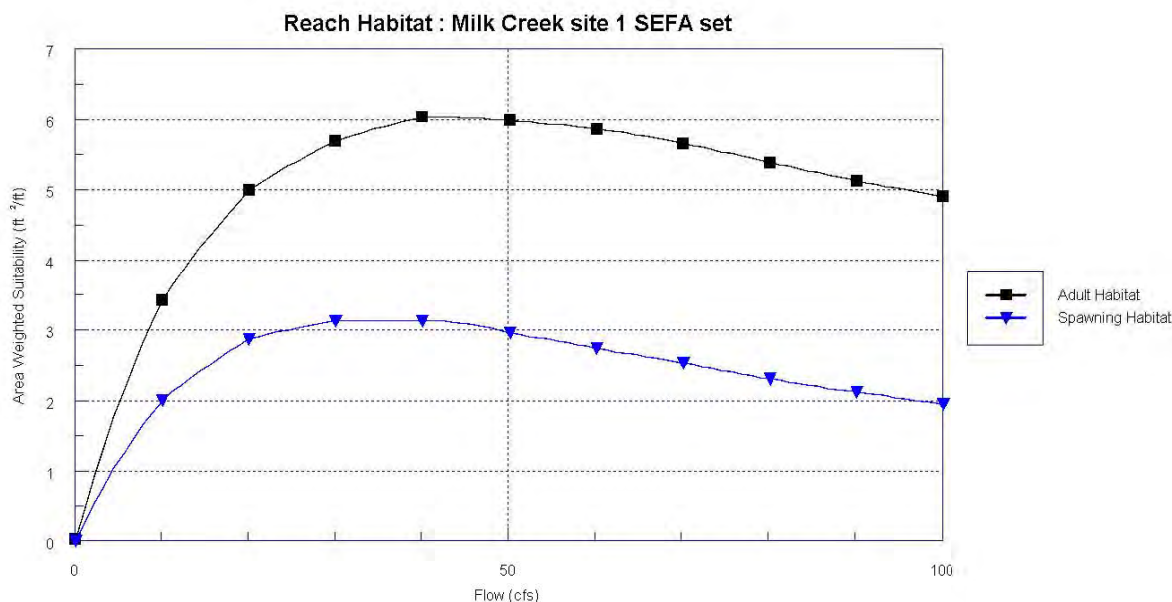
HSC represent a fish species' preference for habitat variables such as depth, velocity, substrate, or cover. For this ISF evaluation, HSC for adult Flannemouth Sucker and Bluehead Sucker were updated in early 2024 (Miller, 2024b). A combination of data was used including radio telemetry studies on the Colorado River near Grand Junction, existing occupancy data from a range of rivers, and a literature review of habitat and population studies. There is relatively limited habitat suitability data specific to Bluehead Sucker, so HSC for Flannemouth Sucker were used as a surrogate. Bluehead Sucker have different feeding preferences than Flannemouth Sucker and are known to feed by scraping algae and periphyton from cobble-sized substrates in faster riffle habitats. Flannemouth Sucker tend to feed on aquatic invertebrates and detritus found in finer substrates in habitats with relatively low velocities. Given these differences, the habitat response shown for Flannemouth Sucker approximates habitat response to flow for Bluehead Sucker but will not fully depict all areas suitable for Bluehead Sucker. The suitability indices used in the hydraulic-habitat modeling are a combination of the data from Flannemouth Sucker and Bluehead Sucker studies on the Colorado River and literature from the U.S. Fish and Wildlife Service (Miller, 2024b).

Flannemouth Sucker and Bluehead Sucker spawn in riffle habitat over gravel and cobble substrate. Spawning habitat use is generally restricted to shallower depths and higher velocity than the broader habitat types used by adults. The spawning HSC for both species were based on a combination of literature review and existing habitat suitability criteria from the U.S. Fish and Wildlife Service (Miller, 2024b). Suitable spawning substrate material was restricted to gravel and cobble substrate types in the model to accurately reflect the use of these sites during spawning.

Data Collection and Analysis

In fall of 2023, Bill Miller, BLM, CPW, and CWCB staff performed site selection and field data collection to build a hydraulic habitat model for the Milk Creek ISF reach in SEFA. After assessing the four-mile ISF reach, a study area was selected that is representative of the ISF reach. Two study sites were surveyed on BLM lands - Site 1 was approximately 0.5 miles above the confluence with the Yampa River and Site 2 was approximately 0.9 miles above the confluence. The two study sites include a variety of riffle, run and pool habitat types with bed substrate that ranges in size from fine silt to large cobble. Surveys were conducted in October 2023 to establish bed topography. An initial hydraulic habitat-discharge relationship was analyzed under baseflow conditions (approximately 6 cfs). In spring 2024, two additional sets of measurements were made to calibrate the model over a range of flows, these include measurements at a mid-flow (approximately 45-50 cfs in April) and a high flow (approximately 127 cfs in June). Streamflow and habitat were modeled from 5 cfs to 300 cfs.

In SEFA, the amount of suitable habitat computed at various flow rates is referred to as Area Weighted Suitability (AWS). The AWS is the Combined Suitability Index (CSI) for depth, velocity and substrate for each measurement point weighted by the area the point represents. Results for combined AWS for depth, velocity, and substrate are shown below for the two study areas (Figure 1).



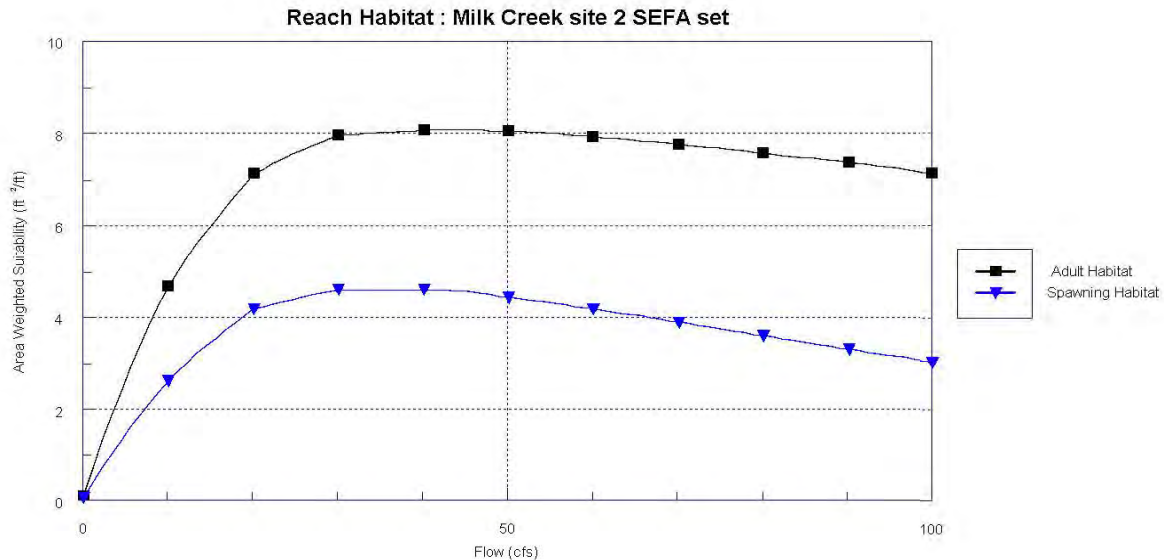


Figure 1. Hydraulic Habitat Modeling Results Graphs for site 1 (top) and site 2 (bottom)

The hydraulic habitat modeling results for both sites were comparable with maximum AWS for occurring at a flow of 40 cfs for adult sucker species. For spawning habitat, the maximum AWS occurs from 30 cfs to 40 cfs for both sites. For both general adult habitat and spawning habitat, AWS decreases rapidly below 40 cfs, indicating that additional increments of discharge provide significant habitat response benefits as flows approach 40 cfs. At flows greater than 40 cfs, additional increments of discharge provide smaller habitat benefits.

Fish Passage

Longitudinal connectivity is important in riverine systems to allow migration and localized movement required by fish and other aquatic biota. Flannemouth Sucker and Bluehead Sucker migrate from larger rivers into smaller tributary streams such as Milk Creek for spawning, and habitat connectivity is critical for that life stage. Analysis of fish passage is one means to assess connectivity and evaluate the flows needed to allow fish migration.

A fish passage assessment was conducted using a depth criteria of 0.6 feet (7 inches). This was chosen based on professional judgment as this depth is approximately double the body depth of an adult Flannemouth Sucker. This is protective of Bluehead Sucker because Flannemouth Sucker is the larger of the two species. The SEFA fish passage connectivity evaluation showed that at a flow of 8.0 cfs, all cross-sections measured show a continuous pathway for fish passage that is at least 2 feet in width and at least 0.6 feet in depth at both study sites.

ISF Recommendation

Using the approach and results summarized above, biological expertise, and staff's water availability analysis, CPW and BLM developed the following instream flow recommendations.

7.8 cfs - January 1 through February 29

This recommended flow rate is based on limited water availability during the baseflow period. This flow rate will provide conditions to enable longitudinal movement of resident fish to find more advantageous habitat.

18.0 cfs - March 1 through March 31

A flow rate of 18 cfs will provide enabling conditions during the beginning of the spawning period for native fish, a critical period for completing their life cycle. As low elevation snowmelt runoff begins in the early part of spring, it is important to preserve flows that begin to cue native fish and allow longitudinal movement between habitat types in order to reach suitable spawning areas.

40.0 cfs - April 1 through June 30

A flow rate of 40 cfs supports preferred habitat for adult Bluehead and Flannelmouth Sucker across both sites. This flow rate also supports preferred spawning habitat for these species. Preserving this flow rate during the spring runoff period (including the rising and receding limb of the hydrograph) will support native fish by providing optimal depth, velocity, and substrate conditions to enable spawning migrations, as well as optimal overall habitat conditions for adult species. The snowmelt runoff peak can occur anytime between April and June on Milk Creek and is critically important in cueing native fish species to spawn, as well as providing geomorphic functions that support life cycle requirements of these fish. The higher flow rate supports sediment mobilization in the stream which supports habitat diversity and healthy spawning beds by flushing fines from interstices to support clean cobble and gravel substrate in the channel (the preferred spawning substrate for these species). Higher flows also support recruitment of woody debris and organic materials that can facilitate healthy stream function as well as a robust macroinvertebrate food base for fish. Protecting this flow rate over this extended spring runoff time period will provide a ramp during and after peak flows that helps with drift, dispersal, and incubation of eggs in the channel.

8.0 cfs - July 1 through July 31

The SEFA fish passage evaluation showed that 8 cfs will preserve a pathway for fish that is at least 2 feet wide and 0.6 feet deep across all modeled cross-sections at both study sites. The recommended flow rate (8 cfs) will maintain longitudinal connectivity of habitat and will enable large-bodied adult fish to move throughout Milk Creek to find suitable habitat or to emigrate into the Yampa River without being stranded. Additionally, this flow rate will support larvae development and emergence by maintaining wetted area in the channel and channel margins. This flow rate will support both fish passage for all life stages of native fish and habitat for larvae development and young-of-the-year fish to grow and mature in channel margins, creating refuge habitat for larvae, young-of-the-year, and juvenile fish.

4.5 cfs - August 1 through September 30

This recommended flow rate is based on limited water availability during the late irrigation season. Despite low flow conditions and limited mobility between habitat types, native species will use available habitat within Milk Creek during this period. Preserving this flow rate is important because it enables rearing of juvenile and young-of-the-year fish. Growth during this late summer period is critical to their survival over the winter period. There is reduced occupancy by non-native species and less competition foraging in Milk Creek than in the mainstem Yampa River.

5.2 cfs - October 1 through December 31

This recommended flow rate is based on limited water availability during the baseflow period. Baseflow during the winter months is necessary to provide enough habitat variety to overwinter resident native fish.

WATER AVAILABILITY

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for determining that water is available.

Water Availability Methodology

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc.). This approach focuses on streamflow and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) are used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and regression-based models are used when long-term gage data is not available. CSUFlow18 is a multiple regression model developed by Colorado State University researchers using streamflow gage data collected between 2001 and 2018 (Eurich et al., 2021). This model estimates mean-monthly streamflow based on drainage basin area, basin terrain variables, and average basin precipitation and snow persistence. Diversion records are used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available from gage records; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics

The contributing basin of the proposed ISF on Milk Creek is 223 square miles, with an average elevation of 7,336 feet and average annual precipitation of 21.4 inches. The drainage basin is snowmelt driven. Snowmelt runoff can initiate early relative to other basins due to the generally low elevation of the watershed. Baseflow conditions are low, while runoff can be several orders of magnitude higher.

Water Rights Assessment

There are no active water rights within the proposed reach on Milk Creek. There are a large number of water rights influencing hydrology in the drainage basin upstream. This includes 338 cfs in active direct flow diversions, 2,606 acre-feet in storage, 152 springs totaling 5.9 cfs, and a number of wells. A significant portion of the water rights in the lower portion of the basin are owned by Tri-State which then lease the water rights to farms and ranches. Private ranches and water right owners are generally located higher in the basin. There is one transbasin import, the Highline Ditch (WDID 4400814, 3.3 cfs with a 1897 appropriation date, and 3.0 cfs with a 1914 appropriation date) that brings water to Milk Creek from the basin to the east (diversion point is on Deer Creek which is a tributary to Morapas Creek) which is used to irrigate lands along Stinking Gulch, a tributary of Milk Creek just above the proposed upper terminus. There is also a large conditional right on the Yampa River at the mouth of Milk Creek for a potential pipeline (Yampa River Milk Ck PL WDID 4402029, 400 cfs appropriated in 1975)

Data Collection and Analysis

Representative Gage Analysis

There is not a long-term gage within the proposed reach on Milk Creek. There was a historic gage (USGS 0925000, Milk Creek near Thornburg) which was located about 14 miles upstream from the proposed reach and operated from 1952-1986. This gage was determined not to be suitable to evaluate water availability due to the large percentage of the basin area and water rights located downstream from the gage. There were short-term historic gages on several of the tributaries that join Milk Creek within a few miles of the proposed upper terminus (Jubb Creek near Axial, CO (USGS 09250610, 1975-1981; Morgan Gulch near Axial, CO, USGS 09250700, 1980-1981; Wilson Creek near Axial, CO, USGS 09250600, 1974-1980). Staff explored these datasets but determined that there was insufficient data on enough of the system to understand water availability in the proposed reach.

Due to insufficient representative streamflow data, CWCB staff installed a temporary gage on Milk Creek in July of 2017 (See the Site Map). This gage was subsequently moved a short distance upstream in 2018 and remains in operation. The gage consists of a staff plate, HOBO MX2001 pressure transducer which recorded water level in 15 min intervals, and a camera. There are a number of data gaps due to several high streamflow events that disrupted the gage equipment, equipment failures, and ice affected data.

The CWCB gage record was compared to a nearby climate station to evaluate how the historical record compares to a longer record. The closest climate station was located approximately 14 miles to the northeast at the Craig Airport (USC00024046 Craig Moffat CO Airport). Daily precipitation data was available through CDSS from 4/1/1998 to 7/31/2024 with full years of data missing in 2003, 2007, and 2013 and partial years of data missing in 1998 and 2024. Over the CWCB gage record that could be evaluated (2018-2023), three years had below 25th percentile annual precipitation (2020, 2021, and 2023), two years were just under the median (2018 and 2022), and 2019 was above the 75th percentile. Therefore, the CWCB gage data likely includes a range of low flow conditions and higher flow conditions, but most of the data is during years when the precipitation in the area was less than median.

Based on the CWCB gage data, streamflow typically begins to increase in March and recede by late June. Most years of data show peak flows above 50 cfs and in 2019 the instantaneous peak was above 500 cfs. The Milk Creek gage data from 7/14/2024 to 12/19/2024 was used to

calculate mean-monthly streamflow. No adjustments were made for the small change in gage location or to extrapolate flow slightly downstream to the lower terminus.

Site Visit Data

CWCB staff made 41 streamflow measurements on the proposed reach of Milk Creek as part of operating the CWCB Milk Creek gage (Table 3).

Table 3. Summary of streamflow measurements for Milk Creek.

Visit Date	Flow (cfs)	Collector
07/13/2017	3.92	CWCB
08/01/2017	4.66	BLM
08/14/2017	2.43	BLM
10/05/2017	14.13	BLM
11/27/2017	9.77	BLM
05/08/2018	170.01	CWCB
06/04/2018	6.63	CWCB
08/15/2018	0.34	BLM
09/13/2018	0.57	CWCB
11/14/2018	3.83	BLM
04/19/2019	105.50	BLM
05/07/2019	263.26	CWCB
07/12/2019	22.08	BLM
07/30/2019	11.33	CWCB
10/08/2019	4.72	BLM
12/05/2019	13.10	CWCB
11/19/2020	6.31	CWCB
04/05/2021	17.13	CWCB
05/13/2021	17.47	CWCB
06/16/2021	1.31	CWCB
07/22/2021	1.24	CWCB
08/19/2021	3.08	CWCB
09/15/2021	1.15	CWCB
11/01/2021	5.11	CWCB

04/20/2022	38.46	BLM, CPW, CWCB
05/24/2022	47.20	CPW, CWCB
08/18/2022	1.82	CWCB
11/01/2022	6.63	CWCB
06/07/2023	146.00	CWCB
07/25/2023	5.73	CWCB
08/16/2023	8.24	CWCB
10/10/2023	4.84	CWCB
10/24/2023	5.72	CPW, CWCB
11/10/2023	4.99	CWCB
03/28/2024	28.21	CWCB
04/12/2024	52.22	CPW
05/29/2024	127.60	CWCB
06/27/2024	13.13	CWCB
08/06/2024	4.37	CWCB
10/09/2024	2.27	CWCB
12/18/2024	5.34	CWCB

Water Availability Summary

The hydrograph shows mean-monthly streamflow for the CWCB Milk Creek gage and the proposed ISF rate (See Complete Hydrograph). The proposed ISF flow rate is below the mean-monthly streamflow. Staff concludes that water is available for appropriation on Milk Creek.

MATERIAL INJURY

If decreed, the proposed ISF on Milk Creek would be a new junior water right. This ISF water right can exist without material injury to other senior water rights. Under the provisions of section 37-92-102(3)(b), C.R.S., the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

ADDITIONAL INFORMATION

Common Acronyms and Abbreviations

Term	Definition
af	acre feet
BLM	Bureau of land management
cfs	cubic feet per second
CWCB	Colorado Water Conservation Board
CPW	Colorado Parks and Wildlife
DWR	Division of Water Resources
HCCA	High Country Conservation Advocates
ISF	Instream Flow
NLL	Natural Lake Level
USGS	United States Geological Survey
USFS	United States Forest Service
XS	Cross section

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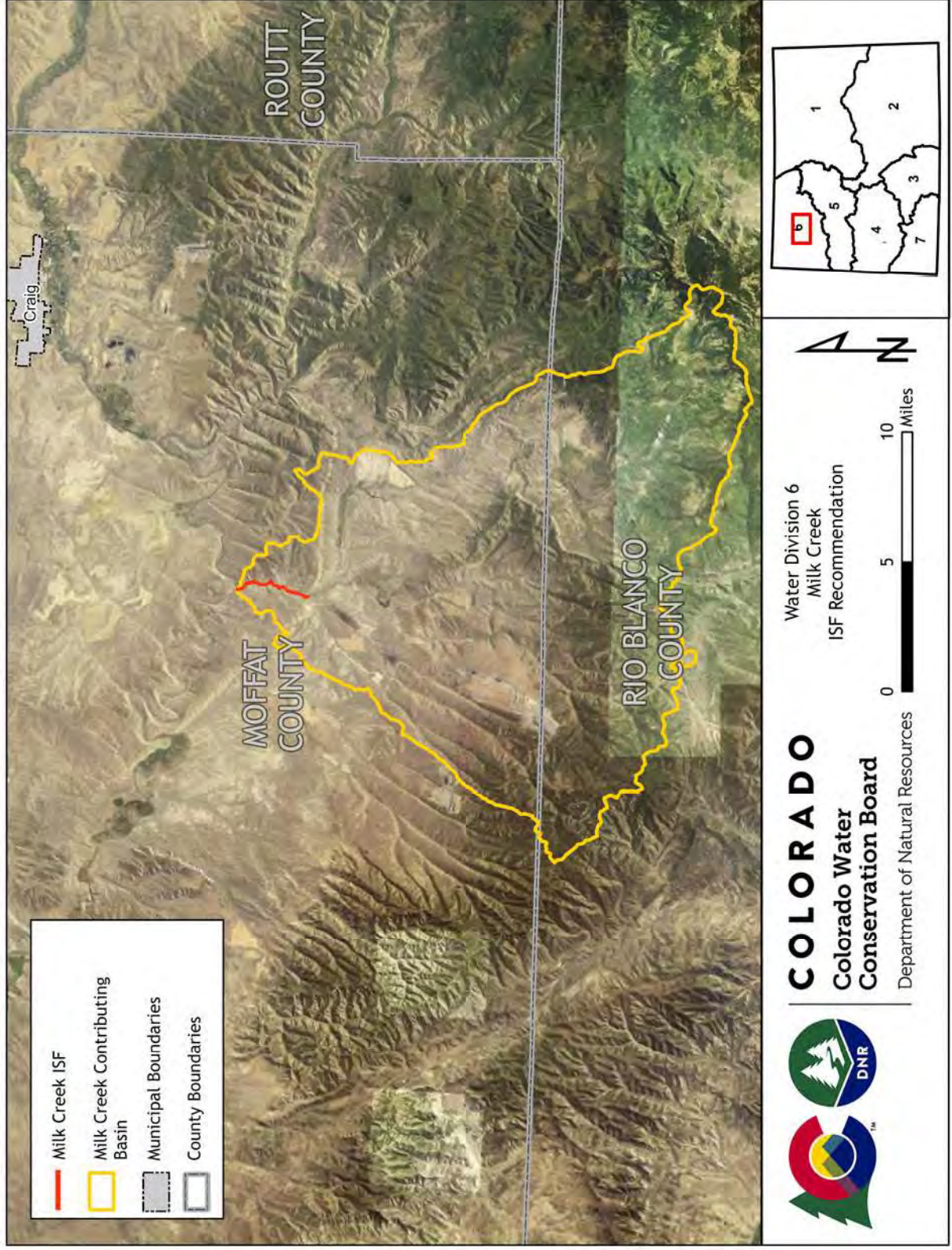
Utah Division of Wildlife Resources (UDWR), 2019, Range-wide conservation agreement and strategy for Roundtail Chub, Bluehead Sucker, and Flannemouth Sucker. Publication Number 06-18. Prepared for Colorado River Fish and Wildlife Council. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah

Metadata Descriptions

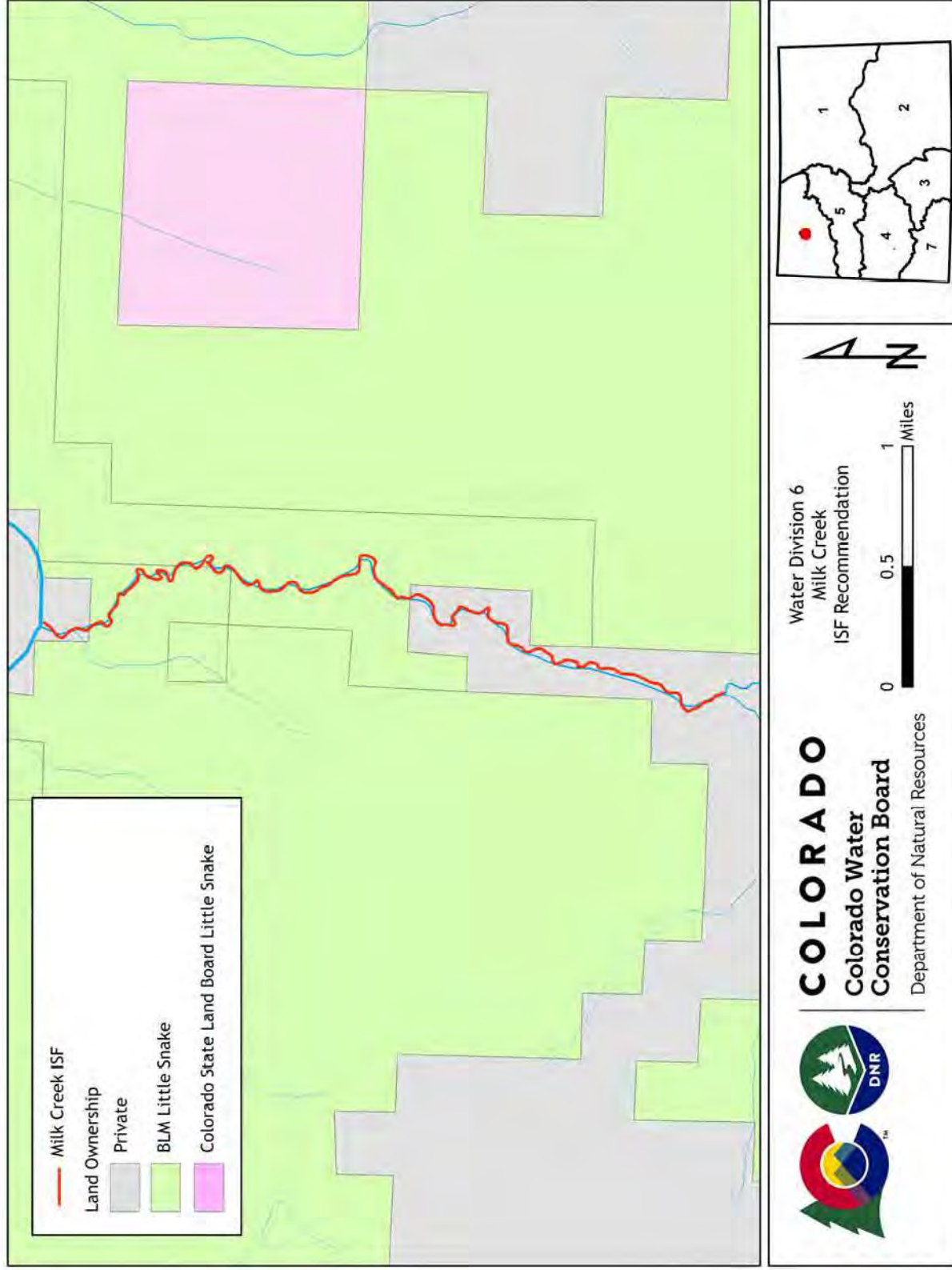
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

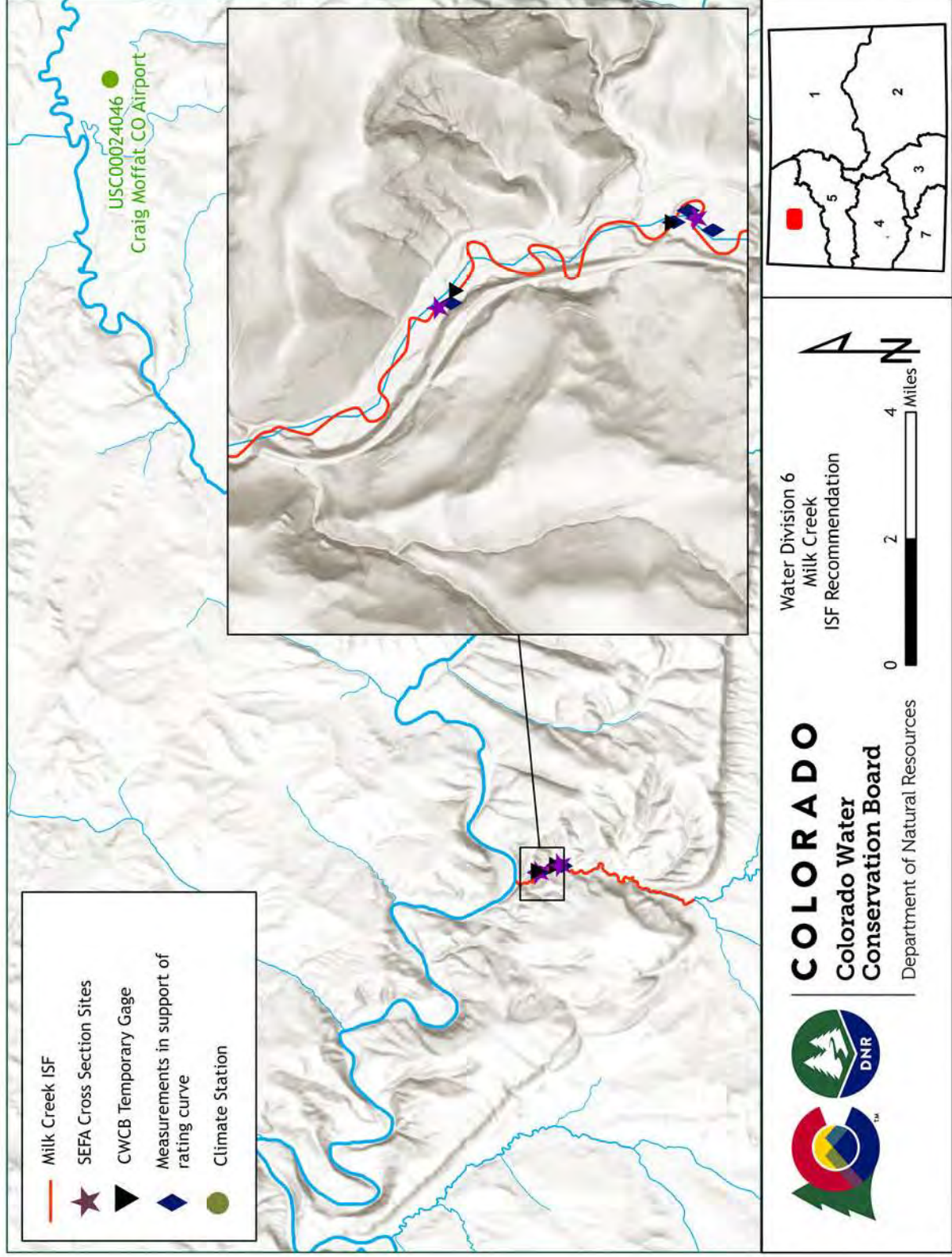
VICINITY MAP



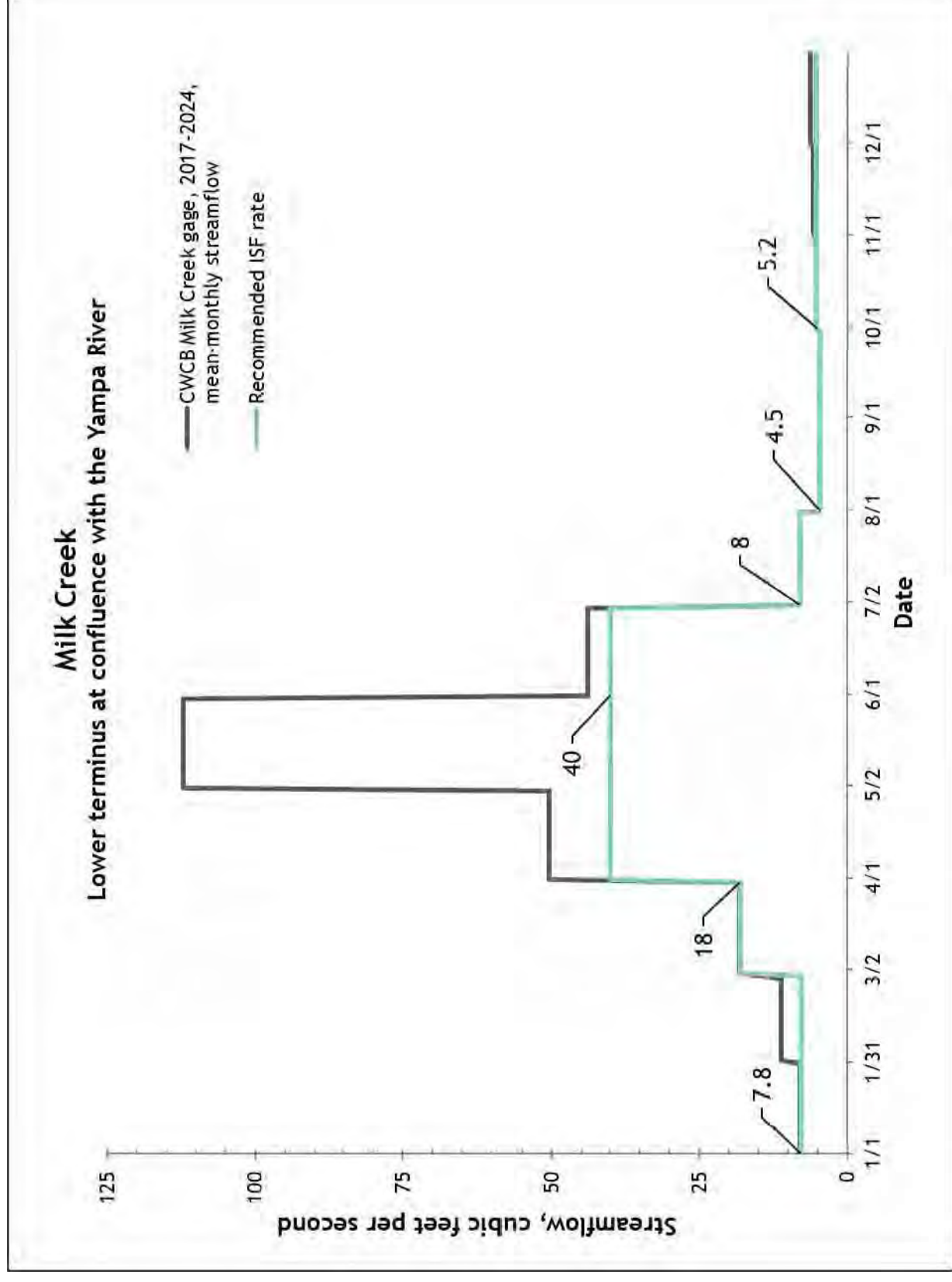
LAND OWNERSHIP MAP



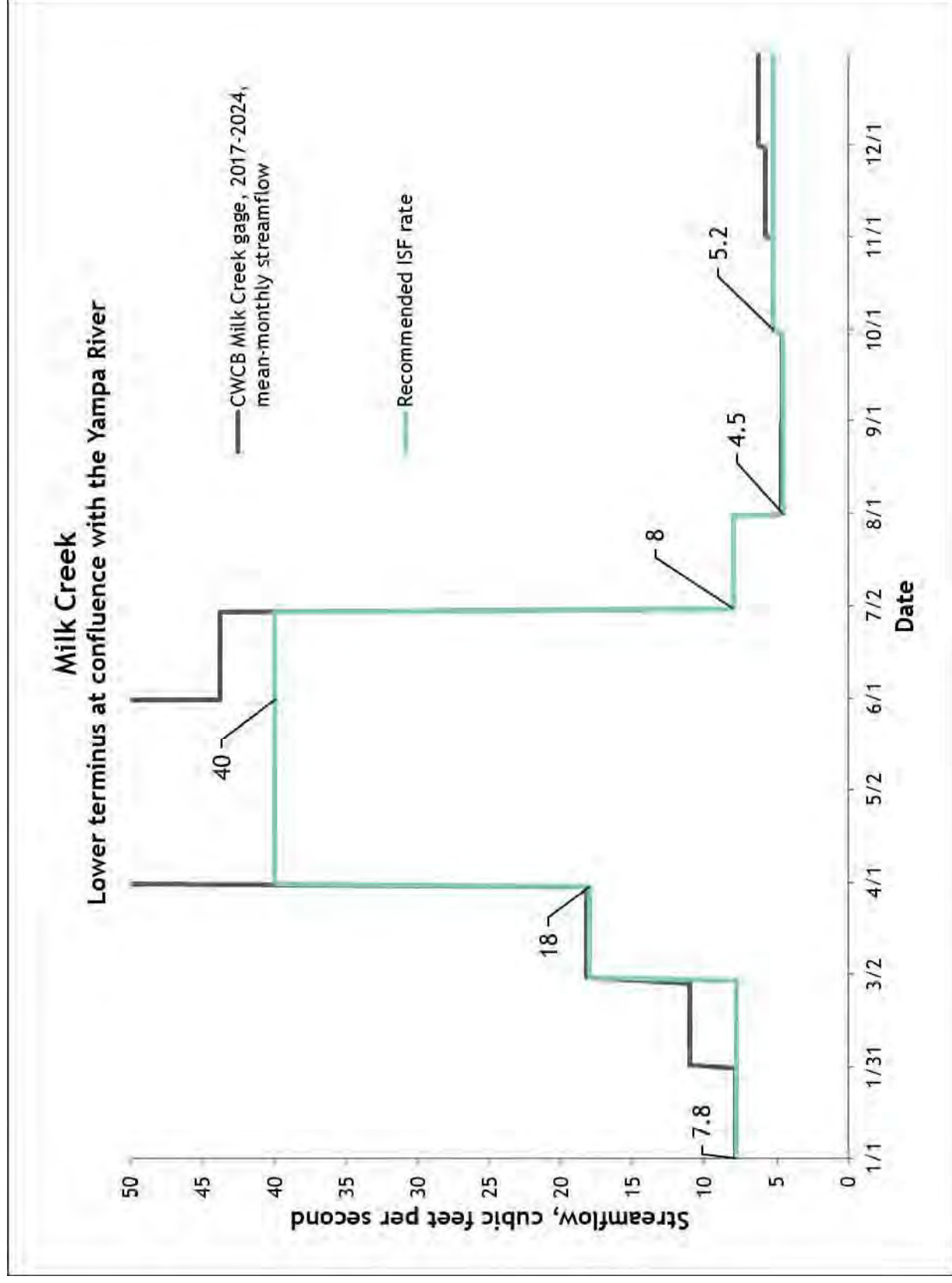
SITE MAP



COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH





Water Resources Section – Aquatics
Branch
6060 Broadway
Denver, CO 80216

March 7, 2025

Rob Viehl, Section Chief
Colorado Water Conservation Board (CWCB)
Stream and Lake Protection Section
1313 Sherman Street, 7th Floor
Denver, CO 80203

Re: Colorado Parks and Wildlife and Bureau of Land Management Instream Flow
Recommendations for Milk Creek in Moffat County

Dear Mr. Viehl:

The purpose of this letter is to formally transmit Colorado Parks and Wildlife's (CPW) instream flow (ISF) recommendations for Milk Creek in Water Division 6. This ISF recommendation is a joint recommendation from CPW and the Bureau of Land Management (BLM). BLM initially began work on this ISF recommendation in 2016. Milk Creek is an important tributary of the Yampa River that supports native Flannemouth Sucker, Bluehead Sucker, and Roundtail Chub, an assemblage of native fishes often referred to as the "Three Species." The Three Species are listed in the Colorado State Wildlife Action Plan (SWAP) as a Tier 1 Species of Greatest Conservation Need or "species which are truly of highest conservation priority in the state." The Three Species are exhibiting a downward trend and collectively occupy less than half of their native range in the Colorado River Basin. Milk Creek is known to provide spawning habitat and unique refugia for the Three Species which makes it an important tributary supporting their overall persistence in the Yampa River basin. In light of these factors, CPW became involved in the ISF recommendation in 2023 to support the BLM and co-recommend ISF water right protection for a segment of lower Milk Creek near the confluence with the Yampa River.

CPW and BLM are recommending an ISF reach on Milk Creek from the confluence with Wilson Creek to the confluence with the Yampa River, a distance of approximately 4.1 miles. This segment is in Moffat County. Land ownership over the proposed ISF reach is a combination of BLM-managed lands and lands under private ownership. This segment of Milk Creek is important to CPW for a number of reasons. Most importantly, it is known to provide spawning and rearing habitat for the Three Species. CPW is a signatory, along with the BLM, other federal agencies, and multiple tribes, to the Range-Wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannemouth Sucker¹. The goal of the Conservation Strategy is to ensure the persistence of populations of the Three Species

¹ Utah Division of Wildlife Resources (UDWR). 2019. Range-wide conservation agreement and strategy for Roundtail Chub, Bluehead Sucker, and Flannemouth Sucker. Publication Number 06-18. Prepared for Colorado River Fish and Wildlife Council. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City, Utah.

Jeff Davis, Director, Colorado Parks and Wildlife
Parks and Wildlife Commission: Dallas May, Chair · Richard Reading, Vice-Chair · Karen Bailey, Secretary · Jessica Beaulieu
Marie Haskett · Tai Jacober · Jack Murphy · Gabriel Otero · Murphy Robinson · James Jay Tutchton · Eden Vardy



throughout their respective ranges. CPW seeks to reduce the imperiled status of these species across their historic range in Colorado in order to protect the species and to reduce the risk of a federal listing as threatened or endangered under the Endangered Species Act (ESA). Factors contributing to their decline include hydrologic alteration, lack of connectivity, and predation by and hybridization with non-native species.

CPW has dedicated significant resources to bolstering these populations through non-native fish control, reservoir screening projects, research on movement patterns and spawning behavior in tributaries like Milk Creek, and supplemental stocking to augment populations. Protecting flows in a unique tributary environment like Milk Creek is a complementary action to these efforts. From 2015 to 2024, CPW has proactively stocked Bluehead Sucker and Flannemouth Sucker in Milk Creek to bolster populations in both Milk Creek and the Yampa River. This effort was the first of its kind to stock small numbers of Bluehead and Flannemouth Suckers with the goal of augmenting the Milk Creek population and hopefully reestablishing populations of these species throughout the Yampa River basin via dispersal from Milk Creek. Milk Creek provides unique habitat characteristics that support Bluehead and Flannemouth Sucker, namely spring high-flow events that are beneficial for spawning, appropriate water temperature, suitable geomorphology, and high turbidity. Spring-time and sporadic high-flow events also discourage establishment of non-native species in Milk Creek. By boosting populations in important tributary environments like Milk Creek, additional populations may also become established in the Yampa River mainstem where non-natives are suppressed by non-native fish control efforts. Working with the Colorado Water Conservation Board (CWCB) to secure an ISF water right is an appropriate tool for protecting streamflows that are critically important for the persistence of the Three Species.

Natural Environment

Milk Creek is a tributary to the Yampa River downstream from the City of Craig, Colorado. It is the largest tributary to the Yampa River between the confluence of the Williams Fork and Little Snake Rivers and provides important seasonal spawning habitat for the native Three Species. The lower segment of Milk Creek has a low to moderate gradient, approximately 0.5 percent². The creek has a stable channel with variable substrate ranging from silt to large boulders. The stream has a good mix of riffle, run, and pool habitat. The macroinvertebrate community is healthy and diverse. Water quality, water temperatures, and food sources are suitable for native species. Fishery surveys indicate that lower Milk Creek provides habitat for native species, including Flannemouth Sucker, Bluehead Sucker, Roundtail Chub, Mountain Sucker, and Speckled Dace. Non-native fish species have also been sampled by CPW in the creek and include Smallmouth Bass, Creek Chub, Sand Shiner, Red Shiner, White Sucker, Brook Stickleback, Fathead Minnow, Black Bullhead, Johnny Darter, Plains Killifish, Green Sunfish, and Bluegill. The creek supports a riparian community comprised primarily of willows, sedges, cottonwoods, and rushes. The riparian community has been impacted by

² Freshwater Consulting LLC. September 30, 2024. Milk Creek Instream Flow Study Report.

historical grazing practices but is improving in lower portions of the reach. The ISF reach includes mature cottonwood trees and notable cottonwood regeneration has been observed.

Native Three Species Usage of Milk Creek

As mentioned above, Milk Creek provides year-round and seasonal habitat for the Three Species. Milk Creek experiences a snowmelt-driven hydrograph, with peak flows occurring as spring temperatures begin to rise. The area also can experience monsoonal rains in the late summer, which can dramatically raise the water level in the creek. There is heavy use by adult Three Species during the spring runoff period and receding limb, specifically Bluehead Sucker and Flannelmouth Sucker. The Three Species have been known to travel long distances toward habitual spawning areas. During the rising limb of the hydrograph when the water temperature reaches approximately 13°C, Flannelmouth Sucker migrate into tributaries to spawn. Bluehead Suckers follow shortly after, once water temperature reaches 16°C. In Milk Creek this window typically occurs between April to mid-May annually but can vary significantly from year-to-year. Roundtail Chub can be found in Milk Creek and its tributary Stinking Gulch but their densities are low near the Yampa River confluence. This is likely driven by low densities of Roundtail Chub in the Yampa River. Most of the Roundtail Chub in lower Milk Creek are juveniles. Roundtail Chub of all life stages are present higher in the drainage above Axial Basin.

Due to deep water and swift flows, typical fishery survey methods are not efficient in Milk Creek during the spring runoff period when adult native fish occupy the creek. CPW uses submersible Passive Integrated Transponder (PIT) tag antennas deployed in Milk Creek to evaluate Three Species usage in the creek. PIT tags are used to track both stocked Bluehead Sucker and Flannelmouth Sucker and wild captured Three Species that are routinely encountered in both Milk Creek and the Yampa River. When individuals are recaptured or detected on submersible antennas, CPW can evaluate annual movement patterns throughout the Upper Colorado River Basin. Growth rates can also be tracked on recaptured individuals. Since 2015, approximately 20,949 Bluehead Suckers and 3,549 Flannelmouth Suckers were stocked by CPW in Milk Creek as sub-adults to supplement populations in the Yampa River. Antenna data shows that native suckers from Milk Creek mature in the creek and move into the Yampa River as flows in Milk Creek recede to baseflows. Many adults, both wild and hatchery-reared, return to Milk Creek to spawn in the spring. Milk Creek offers unique habitat refugia where there is less predation from non-native fish species in the Yampa River and less opportunity for hybridization with non-native sucker species.

Because of inclement weather conditions in northwestern Colorado during early spring and unmaintained dirt road access to Milk Creek, deploying PIT tag antennas during this critical window can be challenging. Some years CPW staff are only able to capture the tail-end of the spawning migration with antenna data, as demonstrated by detection data from 2023. However, 2022 is a good example of a spawning migration captured with antenna detections with a majority of the wild native fish species using Milk Creek between April and June (see Milk Creek Fish Community and Movement Summary Figures 6 and 7).

Macroinvertebrate Community

Aquatic macroinvertebrates are an important food source for fish and can serve as a biocriteria to evaluate the overall health of the aquatic ecosystem. In October 2023, CPW staff collected macroinvertebrate samples using CPW's River Watch kick-net sampling procedure. Two samples were collected at different locations within the ISF reach and analyzed using a 500-count sub-sample. Taxa identified from the two samples were odonata, ephemeroptera, plecoptera, tricoptera, decapoda, coleopteran, diptera, and amphipoda. Additionally, hemiptera taxa were also visually identified at both sites but were not captured in the kick-net surveys. CPW staff ran macroinvertebrate results in Colorado Department of Public Health (CDPHE) Ecological Data Application System (EDAS) program. Based on these results summarized below, both sites are attaining and meeting the state standards for macroinvertebrate health and biodiversity.

The multimetric index (MMI) scores were above the state Policy 10-1³ thresholds. In fact, the upper site is a "High Scoring Water" with an MMI score greater than 56. Two auxiliary metrics in addition to MMI scores are considered by the state when assessing macroinvertebrate communities - the Hilsenhoff Biotic Index (HBI) and Shannon Diversion Index (SDI). HBI is an indicator of pollution tolerant insects occupying the creek where higher scores indicate a pollutant-tolerant community. The HBI scores for Milk Creek are below the state threshold of 5.8 which indicates relatively few pollution tolerant species. The SDI metric shows how biodiverse the community is with higher scores indicating more biodiversity. Both sites have fairly high SDI scores that are well above the state threshold of 2.1 (note, a maximum SDI score is 5).

Station	Waterbody	Location	Date	Biotype	MMI	HBI	SDI
WQCC Policy 10-1 Thresholds				1 - Transition	> 45	< 5.8	> 2.1
RW-3870	Milk Cr	Upper Milk Creek	16-Oct-23	1	68.2	4.9	3.1
RW-3871	Milk Cr	Lower Milk Creek	16-Oct-23	1	54.1	3.9	3.8

Additional metrics evaluated by CPW staff are focused on sensitive macroinvertebrate species – ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly). These orders are also known as "EPT" taxa. The metric "% EPT non Baetidae" evaluates how many insects belong to the EPT orders excluding Baetidae. Baetidae are a type of mayfly that is tolerant of pollution so they are intentionally excluded from this metric. At both sites, almost half of the

³ CDPHE. August 10, 2020. Policy Statement 10-1. Aquatic Life Use Attainment Methodology to Determine Use Attainment for Rivers and Streams

insects belong to pollution intolerant EPT orders which is a sign of an overall healthy aquatic ecosystem. Similarly, the “% Intolerant taxa” category involves pollution intolerant taxa not limited to EPT taxa. At both sites, there is a strong presence of pollution intolerant taxa with samples containing 36% and 21.7% pollution intolerant taxa. At both sites, there was a high number of unique species with Total Taxa of 25 and 23. This demonstrates a community that is species-rich with relatively high biodiversity.

Station	Waterbody	Location	EPT % non Baetidae	% Intolerant Taxa	Total Taxa
RW-3870	Milk Cr	Upper Milk Creek	45.9	36	25
RW-3871	Milk Cr	Lower Milk Creek	48.4	21.7	23

ISF Quantification

Methodology - Instream Flow Incremental Methodology (IFIM) using System for Environmental Flow Analysis (SEFA)

CPW and BLM utilized professional judgement and past experiences to determine the appropriate methodology for use in the Milk Creek ISF recommendation. The BLM and CPW decided to use a methodology that is species-specific and can be tailored to assessing flow and habitat relationships specific to Flannemouth Sucker and Bluehead Sucker. BLM and CPW decided to use the Instream Flow Incremental Methodology (IFIM), a widely accepted method for quantifying suitable hydraulic habitat as a function of discharge for specific species and life stages of fish. In 2023, CWCB hired Freshwater Consulting LLC to provide field support and technical training necessary to complete a hydraulic habitat model on Milk Creek using the System for Environmental Flow Analysis (SEFA). The SEFA software is a modern version of the Physical Habitat Simulation software (PHABSIM), a program which was historically used for all of Colorado’s instream flow evaluations using the IFIM framework. As legacy software, PHABSIM was not updated for compatibility to Windows Operating System 11. The SEFA software is the modern equivalent with additional features, one of which is the predicting fish passage across transects. Freshwater Consulting trained BLM, CPW, and CWCB staff in field methods and use of the SEFA software, developed the models, and completed a summary report (Freshwater Consulting, 2024).

In fall of 2023, Freshwater Consulting, BLM, CPW, and CWCB staff performed site selection and field data collection to build a hydraulic habitat model for the Milk Creek ISF reach in SEFA. After assessing the four-mile ISF reach, a study area was selected that is representative of the ISF reach. Two study sites were surveyed on BLM lands – Site 1 was approximately 0.5 miles above the confluence with the Yampa River and Site 2 was approximately 0.9 miles above the confluence. The two study sites include a variety of riffle, run and pool habitat

types with bed substrate that ranges in size from fine silt to large cobble. Surveys were conducted in October 2023 to establish bed topography. An initial hydraulic habitat-discharge relationship was analyzed under baseflow conditions (approximately 6 cfs). In spring 2024, two additional sets of measurements were made to calibrate the model over a range of flows, these include measurements at a mid-range flow (approximately 45-50 cfs in April) and a high flow (approximately 127 cfs in June).

Habitat Suitability Criteria (HSC)

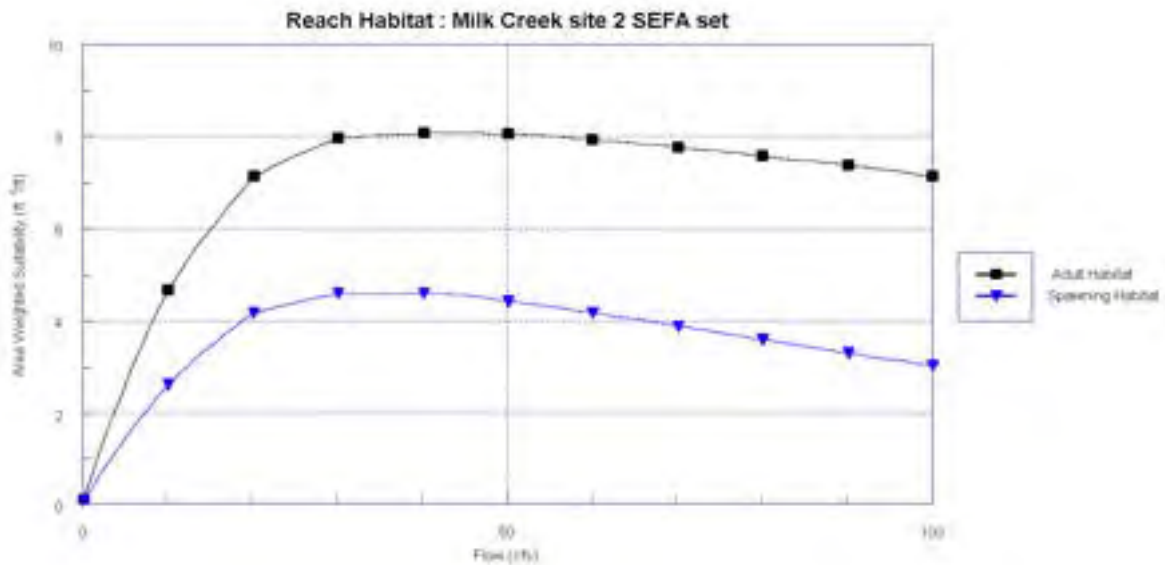
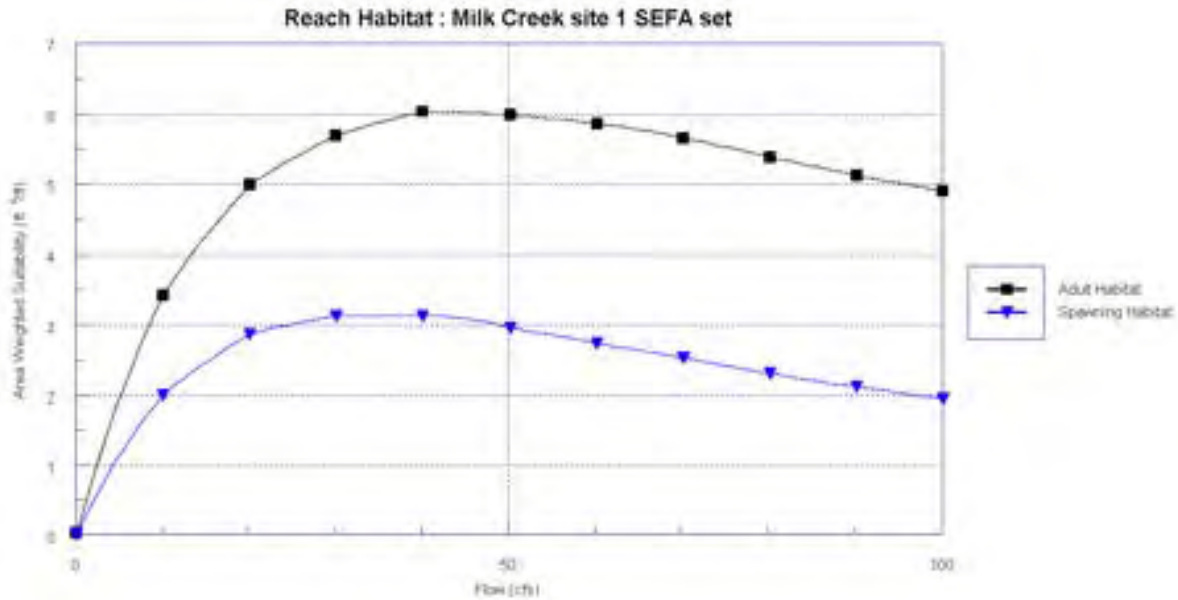
Habitat suitability criteria (HSC) represent a fish species' preference for habitat variables such as depth, velocity, substrate, or cover. For this ISF evaluation, HSC for adult Flannemouth Sucker and Bluehead Sucker were updated in early 2024 by Miller Ecological Consultants⁴. A combination of data was used including radio telemetry studies on the Colorado River near Grand Junction, existing occupancy data from a range of rivers, and a literature review of habitat and population studies. There is relatively limited habitat suitability data specific to Bluehead Sucker, so HSC for Flannemouth Sucker were used as a surrogate. Bluehead Sucker have different feeding preferences than Flannemouth Sucker and are known to feed by scraping algae and periphyton from cobble-sized substrates in faster riffle habitats. Flannemouth Sucker tend to feed on aquatic invertebrates and detritus found in finer substrates in habitats with relatively low velocities. Given these differences, the habitat response shown for Flannemouth Sucker approximates habitat response to flow for Bluehead Sucker but will not fully depict all areas suitable for Bluehead Sucker. The suitability indices used in the hydraulic-habitat modeling are a combination of the data from Flannemouth Sucker and Bluehead Sucker studies on the Colorado River and literature from the U.S. Fish and Wildlife Service, as summarized by Miller Ecological Consultants (Miller, 2024).

Flannemouth Sucker and Bluehead Sucker spawn in riffle habitat over gravel and cobble substrate. Spawning habitat use is generally restricted to shallower depths and higher velocity habitats than the broader habitat used by adults. The spawning HSC for both species were based on a combination of literature review and existing habitat suitability criteria from the U.S. Fish and Wildlife Service (Miller, 2024). Suitable spawning substrate material was restricted to gravel and cobble substrate types in the model to accurately reflect the use of these sites during spawning.

Area Weighted Suitability (AWS) and Fish Passage Criteria

In SEFA, the amount of suitable habitat computed at various flow rates is referred to as Area Weighted Suitability (AWS). Results for combined AWS for depth, velocity, and substrate are shown below for the two study sites:

⁴ Miller Ecological Consultants. January 26, 2024. Proposed Habitat Suitability Criteria for Flannemouth Sucker and Bluehead Sucker for use in Milk Creek Instream Flow Study



The hydraulic habitat modeling results for both sites were comparable with maximum AWS for occurring at a flow of 40 cfs for adult sucker species. For spawning habitat, the highest AWS occurs from 30 cfs to 40 cfs for both sites. For both general adult habitat and spawning habitat, AWS decreases rapidly below 40 cfs, indicating that additional increments of discharge provide significant habitat response benefits as flows approach 40 cfs. At flows greater than 40 cfs, additional increments of discharge provide smaller habitat benefits.

In addition to calculating AWS at various flow rates, a fish passage assessment was conducted using a depth criteria of 0.6 feet (7 inches). This was chosen based on professional judgment as this depth is approximately double the body depth of an adult Flannelmouth Sucker. This is

protective of Bluehead Sucker because Flannemouth Sucker is the larger of the two species. The SEFA fish passage connectivity evaluation showed that at a flow of 8.0 cfs, all cross-sections measured show a continuous pathway for fish passage that is at least 2 feet in width and at least 0.6 feet in depth at both study sites.

Instream Flow Recommendations

Using the approach and results summarized above, CPW and BLM developed the following instream flow recommendations. Based on the CWCB's water availability analysis, limited water was available for appropriation from August through the end of February, so biological flow recommendations were reduced.

40.0 cfs - April 1 through June 30

A flow rate of 40 cfs maximizes preferred habitat for adult Bluehead and Flannemouth Suckers across both sites. This flow rate also maximizes preferred spawning habitat for these species. Preserving this flow rate during the spring runoff period (including the rising and receding limb of the hydrograph) will support native fish by providing optimal depth, velocity, and substrate conditions to enable spawning migrations, as well as optimal overall habitat conditions for adult species. The snowmelt runoff peak can occur anytime between April and June on Milk Creek and is critically important in cueing native fish species to spawn, as well as providing geomorphic functions that support life cycle requirements of these fish. The higher flow rate supports sediment mobilization in the stream which supports habitat diversity and healthy spawning beds by flushing fines from interstices to support clean cobble and gravel substrate in the channel (the preferred spawning substrate for these species). Higher flows also support recruitment of woody debris and organic materials that can facilitate healthy stream function as well as a robust macroinvertebrate food base for fish. Protecting this flow rate over this extended spring runoff time period will provide a ramp during and after peak flows that helps with drift, dispersal, and incubation of eggs in the channel.

8.0 cfs - July 1 through July 31

The SEFA fish passage evaluation showed that 8 cfs will preserve a pathway for fish that is at least 2 feet wide and 0.6 feet deep across all modeled cross-sections at both study sites. The recommended flow rate of 8 cfs will maintain longitudinal connectivity of habitat and will enable large-bodied adult fish to move throughout Milk Creek to find suitable habitat or to emigrate into the Yampa River without being stranded. Additionally, this flow rate will support larvae development and emergence by maintaining wetted area in the channel and channel margins. This flow rate will support both fish passage for all life stages of native fish and habitat for larvae development and young-of-the-year fish to grow and mature in channel margins, creating refuge habitat for larvae, young-of-the-year, and juvenile fish.

4.5 cfs - August 1 through September 30

This recommended flow rate is based on limited water availability during the late irrigation season. Despite low flow conditions and limited mobility between habitat types, native species will use available habitat within Milk Creek during this period. These low baseflows allow Bluehead Sucker stocked by CPW to acclimate to wild conditions. The SEFA model AWS versus discharge relationship shows that additional increments of flow provide significant habitat response benefits at flow rates below 10 cfs. Preserving this flow rate is important because it enables rearing of juvenile and young-of-the-year fish. Growth during this late summer period is critical to their survival over the winter period. There is reduced occupancy by non-native species and less competition foraging in Milk Creek than in the mainstem Yampa River.

5.2 cfs - October 1 through December 31

This recommended flow rate is based on limited water availability during the baseflow period. Baseflow during the winter months is necessary to provide enough habitat variety to overwinter resident native fish. Additionally, the SEFA model AWS versus discharge relationship shows that additional increments of flow provide significant habitat response benefits at flow rates below 10 cfs.

7.8 cfs - January 1 through February 29

This recommended flow rate is based on slight water availability limitations during the baseflow period. This flow rate will provide conditions to enable longitudinal movement of resident fish to find more advantageous habitat.

18.0 cfs - March 1 through March 31

A flow rate of 18 cfs will provide enabling conditions during the beginning of the spawning period for native fish, a critical period for completing their life cycle. As low elevation snowmelt runoff begins in the early part of spring, it is important to preserve flows that begin to cue native fish and allow longitudinal movement between habitat types in order to reach suitable spawning areas.

Summary and Conclusions

CPW and BLM have developed an ISF proposal that is both reasonable and protective of the natural environment in Milk Creek that supports the native Three Species. CPW participates in the ISF Program and develops ISF recommendations to address CPW's legislative directives "... that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors ... and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" [§33-1-101 (1) C.R.S.], and "... that the natural, scenic, scientific, and outdoor recreation areas ... be protected, preserved, enhanced and managed for the use, benefit, and enjoyment of the people of this state and (its) visitors ... and that, to carry out such program

and policy, there shall be a continuous operation of acquisition, development, and management of ... lands, waters, and facilities." [§33-10-101 (1) C.R.S.].

Thank you for the opportunity to submit this important flow recommendation for the Board's consideration on lower Milk Creek. CPW staff will be available at the March Board meeting to answer any questions about the benefits this recommendation will provide for native species.

Sincerely,

A handwritten signature in black ink that reads "Kathryn Birch". The script is cursive and fluid.

Katie Birch
CPW Instream Flow Program Coordinator



Macroinvertebrate Sampling in October 2023



Large hemipteran observed by CPW staff in October 2023



CPW electroshocking survey in October 2023

Milk Creek Fish Community and Movement Summary

Tyler Swarr
Native Aquatic Species Biologist
Northwest Region



Jenn Logan
Native Aquatic Species Manager

Since 2009, fishery surveys have been conducted by Colorado Parks and Wildlife (CPW) regularly at Milk Creek in the reaches above the confluence with the Yampa River. Much of the work has been conducted just downstream of Highway 13 on privately owned land and Bureau of Land Management (BLM) property. Data is limited for the reaches below Thornburgh to the confluence of the Yampa River prior to 2009. Native suckers are present throughout Milk Creek and have been documented since at least 1963. However, interest in the creek for fisheries purposes early on was limited to trout and very little work was conducted in the lower reaches due to high temperatures and turbidity that preclude trout populations.

Milk Creek serves as a source of native fish for the Yampa River basin. The creek's unique characteristics including high turbidity, warmer temperatures, low base flows, and sporadic high flow events (Figure 1), generally favor native fish species and provide spawning areas, refuge and nursery habitat. Historically, the primary inhabitants of lower Milk Creek (Flannelmouth Sucker, Bluehead Sucker and Roundtail Chub collectively known as "Three Species") are native non-listed species (not listed as endangered or threatened).

Population estimates of individual species are difficult at Milk Creek due to poor conditions for electrofishing. The stream has very high conductivity which affects the capture efficiency and provides poor confidence intervals for population estimates. Additionally, when the majority of native fish occupy the creek in the spring and early summer, high flows make collecting accurate population estimates challenging. Fishery surveys on the reaches of Milk Creek downstream of Highway 13 have been limited to presence/absence surveys only.

Because of the difficulty in collecting accurate and reliable population estimates for fish at Milk Creek, we rely heavily on Passive Integrated Transponder (PIT) tag antennas and PIT-tagged fish to inform the use of the creek. We track the movement of fish in and out of the creek using submersible 3-foot and 5-foot diameter PIT tag antennas (Figure 2). The antenna arrays detect individual PIT tags as a tagged fish swims over or near the antenna. Because of the limited read range, we deploy antennas in the thalweg, or deepest portion of the creek, whenever possible because this is where fish are most likely to concentrate as they migrate upstream and downstream. We typically deploy six antennas annually throughout the lower 6.5 miles of Milk Creek, which covers BLM land ownership near the confluence with the Yampa River and private lands towards Colorado Highway 13 (Figure 3). The submersible antennas are powered by lithium batteries which last for approximately 21 days. We change

batteries as frequently as possible during antenna deployment to ensure continuous tag detections, however, occasionally an antenna battery may die one or two days before we are able to return and exchange the battery, so there are occasional gaps in our detection data.

Beginning in 2015, approximately 2,500 Bluehead Suckers are released annually in the lower 6 miles of Milk Creek as part of an effort to increase overall numbers of Bluehead Sucker in the Yampa River Basin. Milk Creek was identified as an augmentation site for native suckers due to few predators, low base flows that allow captive-reared fish to acclimate to wild conditions and a history of the species in the drainage. This was the first release of captive-reared Bluehead Sucker anywhere. The CPW Native Aquatic Species Restoration Facility in Alamosa, Colorado annually produces seven-inch long Bluehead Suckers for the Milk Creek augmentation project (Table 1). They also began to raise Flannelmouth Suckers in limited numbers in 2022 for the Milk Creek Project. Each spring, we PIT tag all of the fish that will be stocked into Milk Creek. The fish are then brought to Milk Creek by hatchery staff, typically in late April. Around the time of stocking, we see the number of unique tags detected daily in Milk Creek jump up substantially, as the fish begin to explore their new home (Figure 4). Other biologists and partner agencies also encounter stocked fish on the Yampa River, with many of the Milk Creek fish detected near Maybell, Colorado later in the year once they return to the Yampa River (Figure 5). Monitoring survival and movement of the stocked fish is conducted with a combination of surveys and submersible PIT tag antenna arrays.

Since 2009, surveys have captured 4 native fish species (Bluehead Sucker, Flannelmouth Sucker, Roundtail Chub, and Speckled Dace) and 13 non-native fish species in Milk Creek. All but 5 of the non-native fish species are small-bodied cyprinid (minnow) species. A few juvenile Smallmouth Bass and Green Sunfish have also been captured. No adult bass or sunfish have been encountered. All Smallmouth Bass captures occurred in the lower 2 miles and most likely emigrated from the Yampa River.

Species composition changes across seasons and is flow-dependent. Large adult suckers are most often found during high flows and spring runoff (Figure 6), likely seeking out spawning habitat. In late summer, during low flow periods, juvenile suckers and both native and non-native small-bodied minnows are frequent catches. During fall and winter, most native fish migrate from Milk Creek into the Yampa River where they overwinter. We also note that tagged fish move back into Milk Creek during monsoonal rains or discrete high-flow events in the creek, seemingly for refuge or to exploit newly available habitat (Figure 7). The data gathered since 2009 continues to provide valuable information in understanding the use and importance of tributaries by native fish in the Yampa River basin.

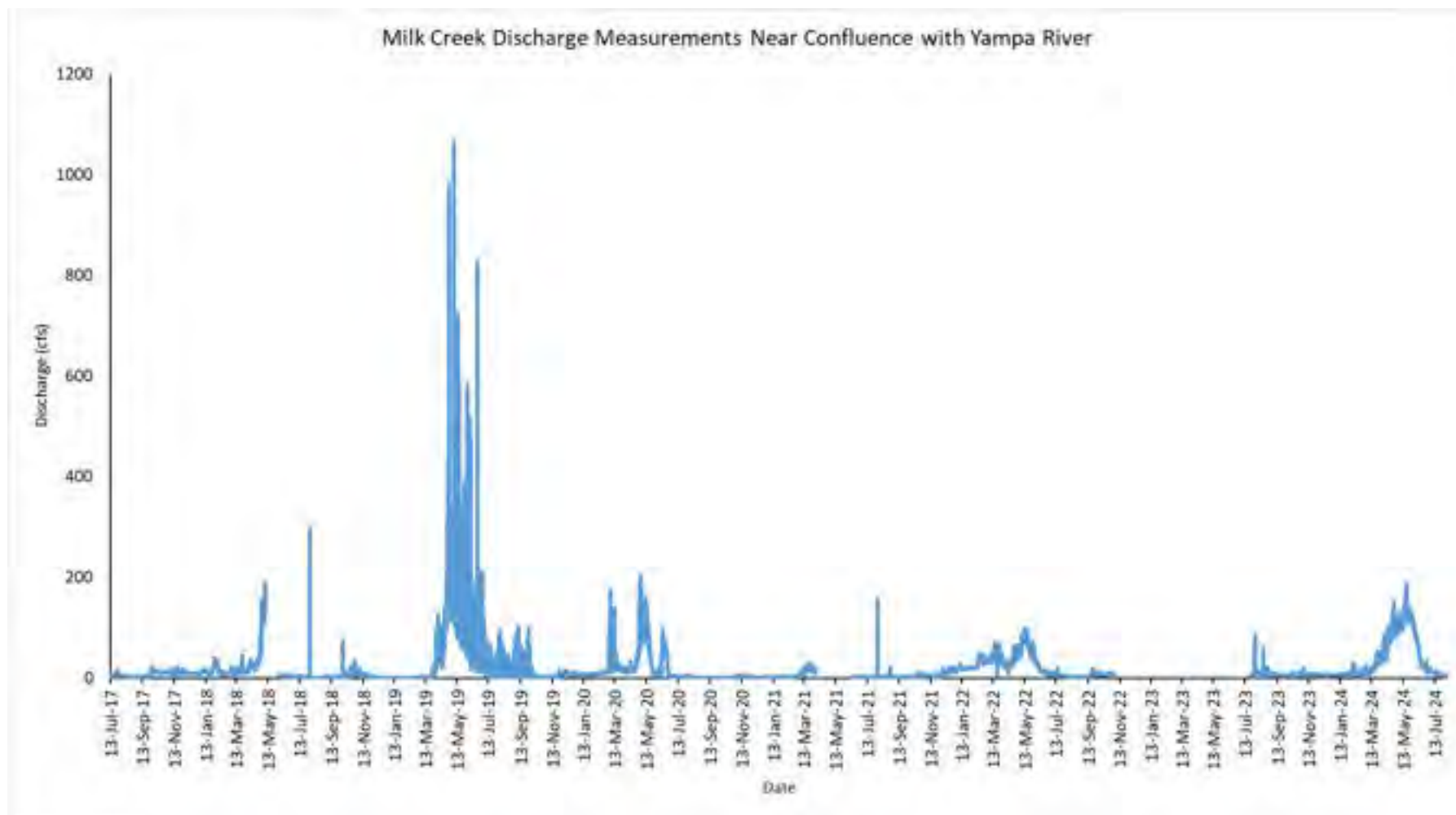


Figure 1. Stream discharge for Milk Creek near the confluence with the Yampa River from July 2017 through July 2024 (CWCB-gage records).



Figure 2. Photograph of a 3-foot diameter submersible PIT tag antenna. The circular tubing has a small copper wire inside of it which produces a low frequency electromagnetic field. When this field is disturbed by a PIT tag, the tag's unique alpha-numeric code is read and saved, along with the date and time of the detection by the datalogger on the antenna.



Figure 3. Map of Milk Creek showing the locations of PIT tag antennas with the relative number of tag detections by species from 2015 - summer 2024. Bluehead Sucker detections are in blue, while Flannemouth Sucker detections are in orange. Larger circles indicate a higher number of individual fish detected at that antenna. Fish typically are detected on the antennas in the lower four miles of Milk Creek where the stream is confined by canyon walls. Antennas are named by the river mile they are placed at upstream of the confluence with the Yampa River.

Table 1. Bluehead Sucker and Flannelmouth Sucker numbers stocked into Milk Creek by Colorado Parks and Wildlife's Native Aquatic Species Restoration Facility (NASRF). All fish are raised to approximately 7 inches in total length before stocking.

Year	Number of Fish Stocked	
	Bluehead Sucker	Flannelmouth Sucker
2015	2,807	0
2016	2,493	0
2017	1,924	0
2018	2,491	0
2019	2,240	0
2020	0	0
2021	2,440	0
2022	2,206	343
2023	2,472	0
2024	1,876	3,206

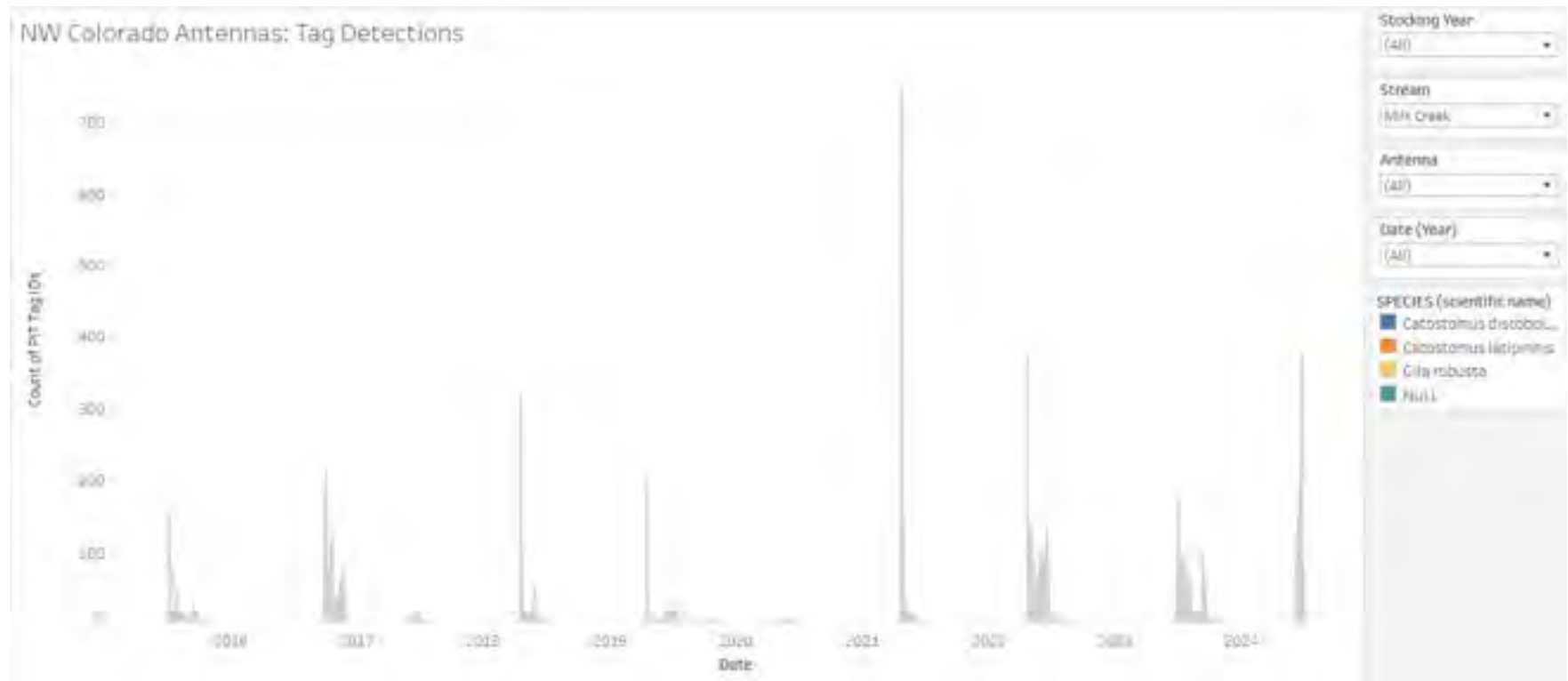


Figure 4. Graph showing the number of unique PIT tag numbers detected every day at Milk Creek from 2015 to 2024. The number of unique PIT tags detected per day is shown on the y-axis and the date is shown on the x-axis. The highest number of unique tags detected in one day occurred on April 21st 2021, which is one day following the 2021 Bluehead Sucker stocking event. Major spikes in detections typically occur immediately following the annual stocking event. No fish were stocked in 2020.

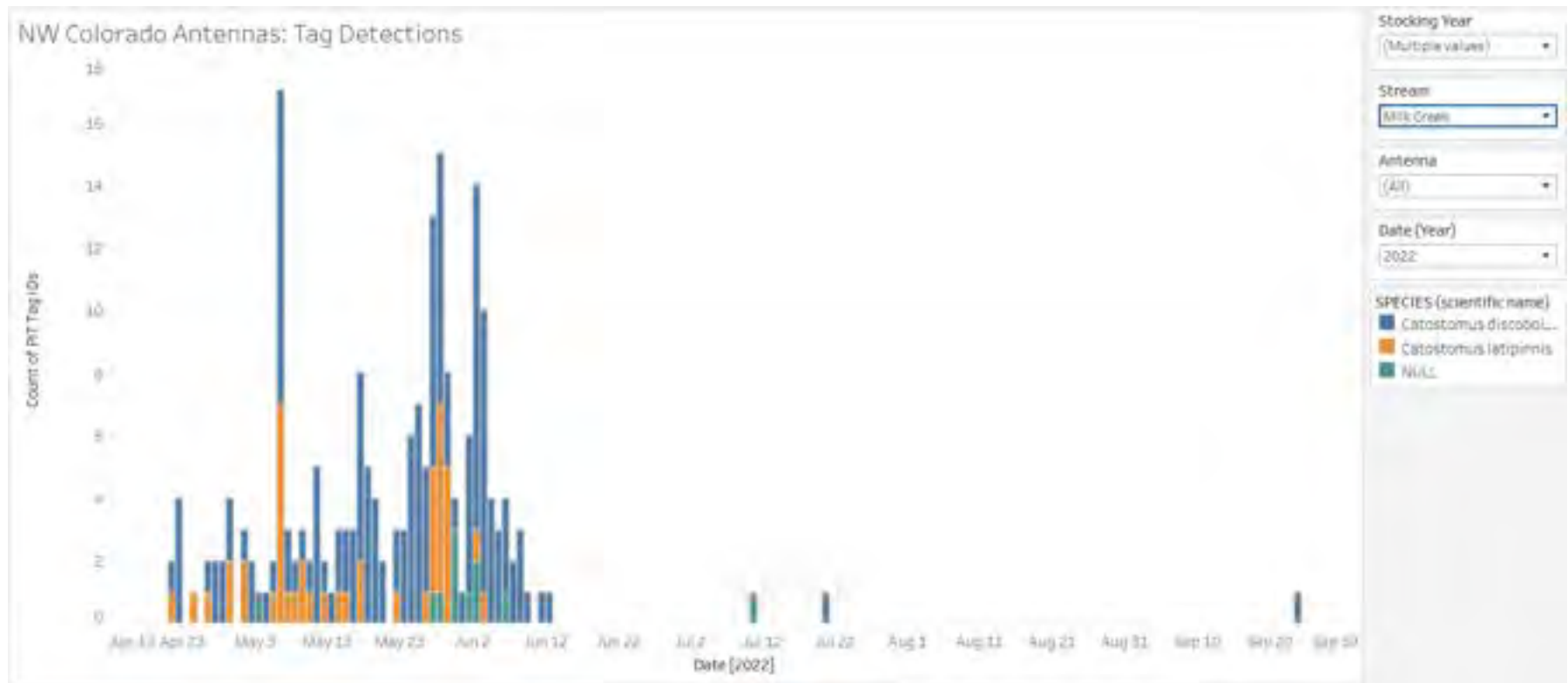


Figure 6. Unique PIT tag antenna detections from 2022 not including the fish stocked in 2022. This figure shows the timing of fish returning to Milk Creek during the rising limb of the hydrograph and gives the reader an approximation of the survivorship and site fidelity to Milk Creek of previously stocked fish. Adult fish leave Milk Creek after runoff and only occasionally return later in the year. NULL tags (teal) are fish that were detected but their identity has not yet been entered into the PIT tag database. These NULL tags are most likely wild fish that other biologists tagged somewhere in the basin. *Catostomus discobolus* (blue) are stocked Bluehead Sucker. *Catostomus latipinnis* (yellow) are stocked Flannemouth Sucker.

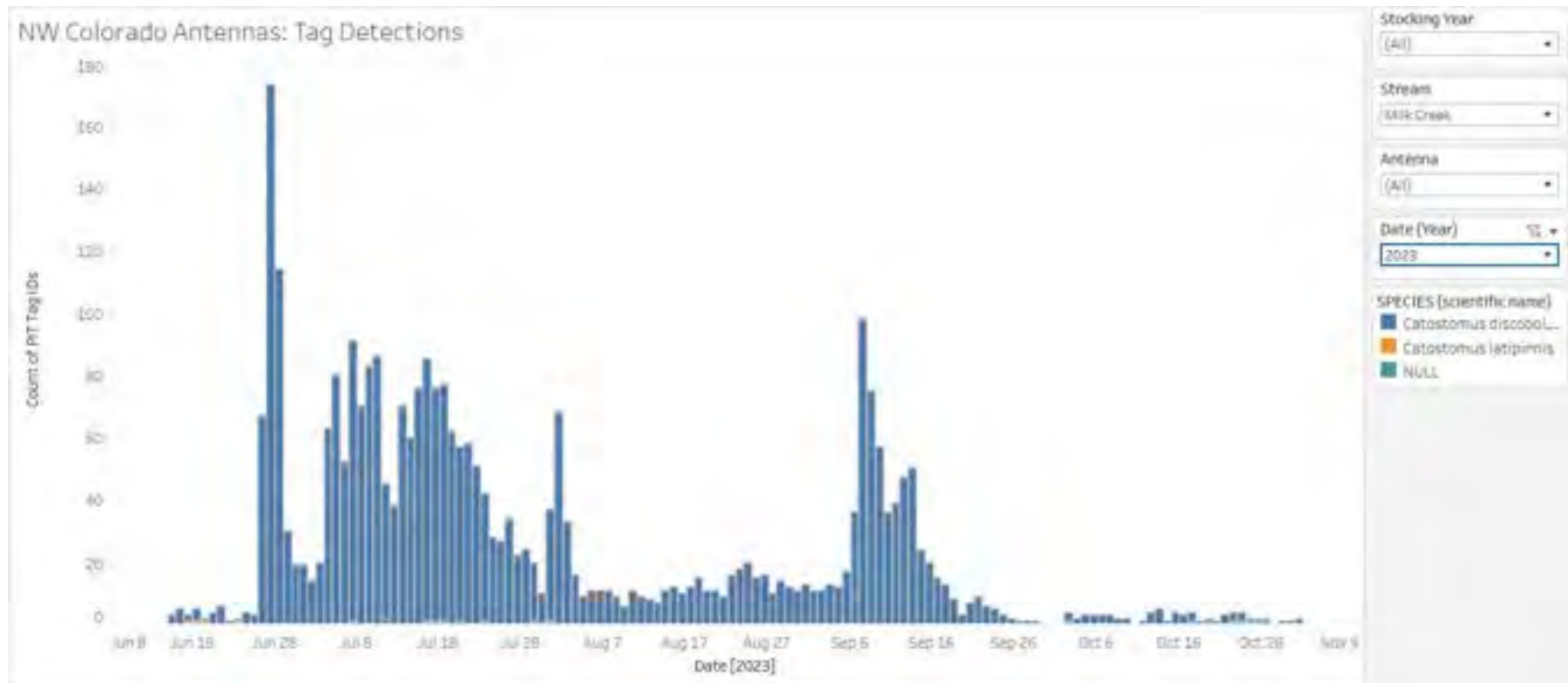


Figure 7. Annual tag detection histogram for Milk Creek showing the number of unique tags detected per day on the y-axis and the date on the x-axis for 2023 as an example of summer and fall detections. PIT tag antennas were deployed in June of 2023 and removed at the end of October once winter conditions became likely. Bluehead Suckers were stocked on June 26th 2023. A monsoon event occurred in September 2023, which triggered many of the fish to move back into Milk Creek during this high-flow event. Newly stocked juvenile fish remain in the creek throughout most of the year and leave Milk Creek for the mainstem Yampa River once baseflow conditions in Milk Creek set in around late September.

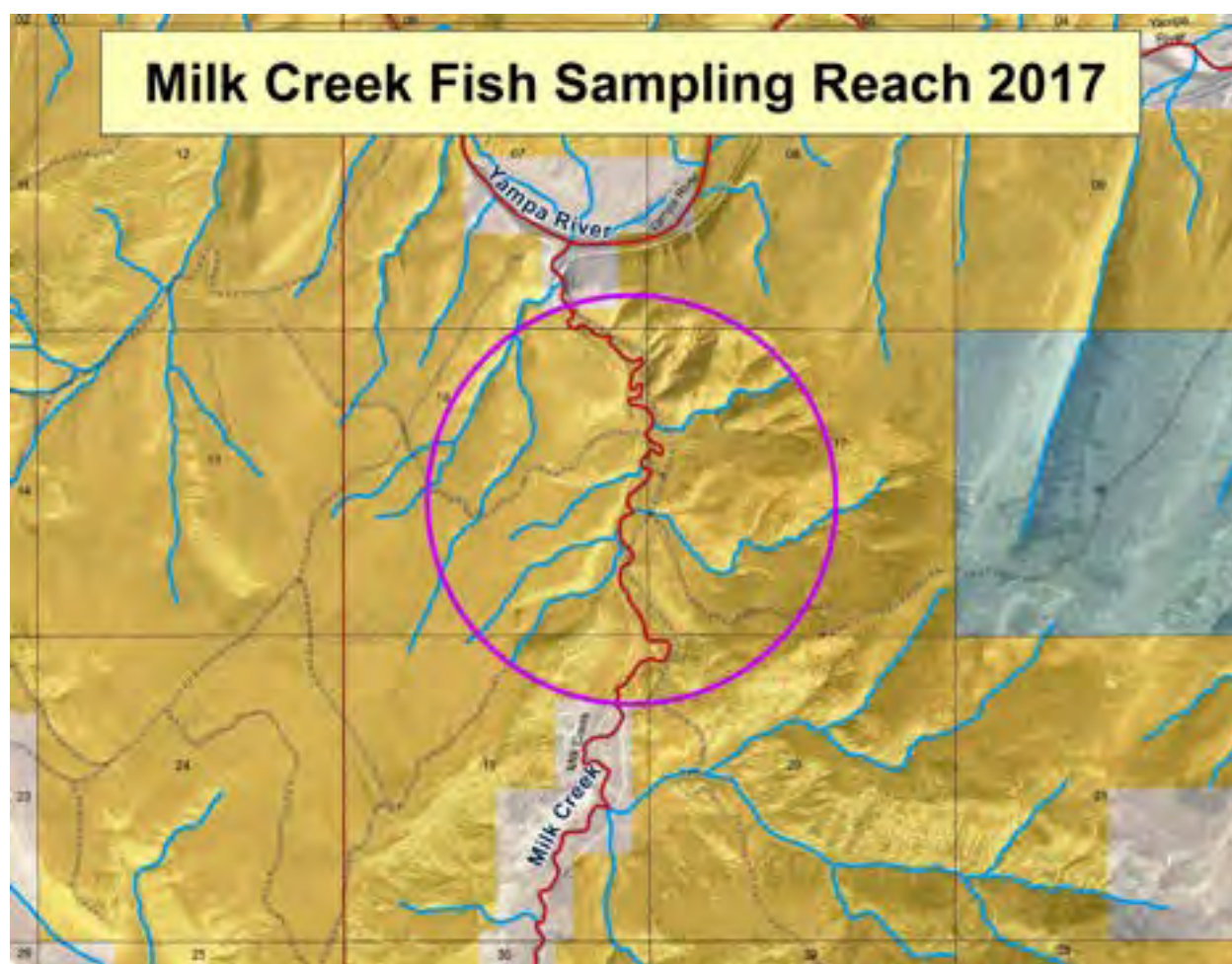
Little Snake Field Office

Stream Sampling September 2017

Milk Creek - Water Code #24961

Introduction:

Milk Creek, located southwest of Craig, Colorado on public lands managed by the Little Snake Field Office, was sampled on September 26, 2017. Sampling was conducted to monitor the status of previously stocked Bluehead Suckers prior to the stocking of a new batch of fish, document other native fish use, and to remove nonnative species. Colorado Parks & Wildlife and BLM biologist worked together using one seine and one backpack electrofisher to sample deep run and pool habitats. Species collected included target native Bluehead Suckers, Flannelmouth Suckers, Roundtail Chub, and Speckled Dace. Nonnative fish collected and removed included Creek Chubs, Sand Shiners, Red-Side Shiners, White Suckers, and Fathead Minnows. Personnel present were Tom Fresques, BLM, and Jenn Logan's Crew, Colorado Parks & Wildlife.





Milk Creek Bluehead Sucker



Milk Creek Flannelmouth Sucker



Milk Creek Roundtail Chub

Discussion:

Milk Creek contains a diverse fishery comprised of both native and nonnative species. The stocking of Passive Integrated Transponder (PIT) tagged Bluehead Suckers by CPW has been occurring for the past three years and another batch of fish were stocked after this sampling event. These stocking efforts are aimed at bolstering populations of this species in the Yampa River basin. Fish sampling was conducted to monitor these stocked fish and to remove nonnative/competitive species from the stream prior to another round of stocking to give the stocked fish a better chance of survival with less competition. In addition to active fish sampling, CPW has deployed 3 portable PIT tag readers in the stream that passively monitor fish as they pass within the detection distance of the reader. The recorders ping and the unique tag number and time and date are recorded. CPW manages this data.

A large number of nonnative creek chubs were removed from the stream as well as lesser numbers of white suckers, sand shiners, red-side shiners, and fathead minnows. Stocking and monitoring is planned to continue in Milk Creek over the next couple of years with longer-term monitoring to continue after stocking is ceased. Bluehead Suckers stocked into Milk Creek have been captured in the Yampa River both up and downstream of the Milk Creek confluence by other researchers sampling the river. This is encouraging and shows that these fish are surviving in the short-term and are utilizing preferred habitats in both Milk Creek and the Yampa River.

Recommendations:

- Continue to assist CPW with Bluehead Sucker stocking and monitoring efforts in Milk Creek
- Consider some habitat improvement projects in the BLM stream reaches in addition to tamarisk removal that has already been conducted
 - Assess livestock use of the stream and consider changes to provide for increased rest and habitat improvement along the stream and riparian corridor
 - Look at BLM Road 1596D that parallels the stream and potential drainage crossing improvements

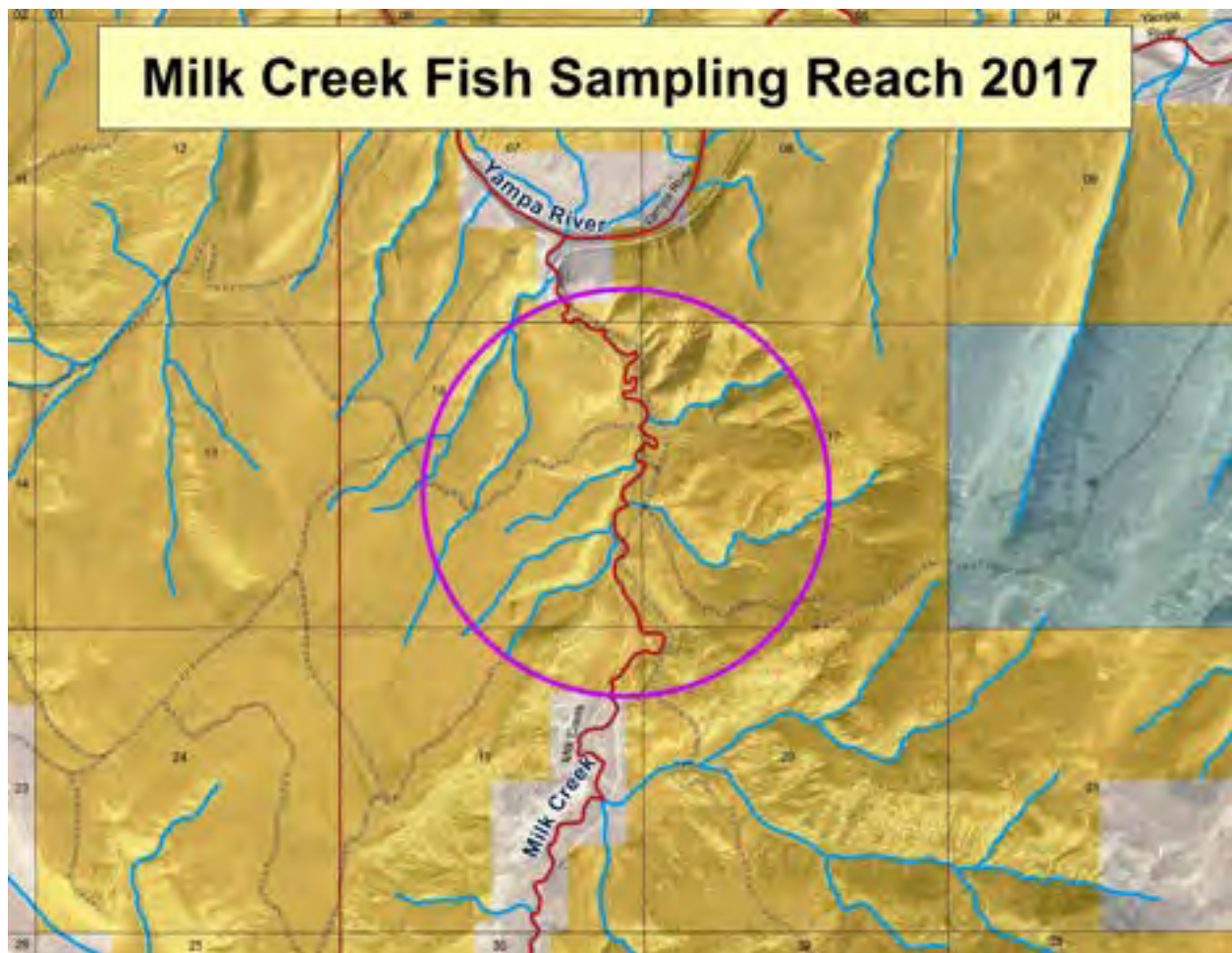
Little Snake Field Office

Stream Sampling September 2018

Milk Creek - Water Code #24961

Introduction:

Milk Creek located southwest of Craig, Colorado on public lands managed by the Little Snake Field Office, was sampled on July 18, 2018. Sampling was conducted to monitor the status of previously stocked Bluehead Suckers, document other native fish use, and to remove nonnative species. Colorado Parks & Wildlife and BLM biologist worked together using one seine and one backpack electrofisher to sample deep run and pool habitats. Species collected included target native Bluehead Suckers, Flannelmouth Suckers, Roundtail Chub, and Speckled Dace. Nonnative fish collected and removed included Creek Chubs, Sand Shiners, Red-Side Shiners, White Suckers, and Fathead Minnows. Personnel present were Tom Fresques, BLM, and Jenn Logan and her crew, Colorado Parks & Wildlife.





Milk Creek Bluehead Sucker



Milk Creek Flannelmouth Sucker



Milk Creek Roundtail Chub

Discussion:

Milk Creek contains a diverse fishery comprised of both native and nonnative species. The stocking of Passive Integrated Transponder (PIT) tagged Bluehead Suckers by CPW has been occurring for the past four years and another stocking occurred this year. These stocking efforts are aimed at bolstering populations of this species in the Yampa River basin. Fish sampling was conducted to monitor these stocked fish and to remove nonnative/competitive species from the stream to give the stocked fish a better chance of survival with less competition. In addition to active fish sampling, CPW and BLM have deployed 3 portable PIT tag readers in the stream that passively monitor fish as they pass within the detection distance of the reader. The recorders ping and the unique tag number and time and date are recorded. CPW manages this data.

A large number of nonnative creek chubs were removed from the stream as well as lesser numbers of white suckers, sand shiners, red-side shiners, and fathead minnows. Stocking and monitoring is planned to continue in Milk Creek over the next couple of years with longer-term monitoring to continue after stocking is ceased. Bluehead Suckers stocked into Milk Creek have been captured in the Yampa River both up and downstream of the Milk Creek confluence by other researchers sampling the river. This is encouraging and shows that these fish are surviving in the short-term and are utilizing preferred habitats in both Milk Creek and the Yampa River.

Recommendations:

- Continue to assist CPW with Bluehead Sucker stocking and monitoring efforts in Milk Creek
- Consider some habitat improvement projects in the BLM stream reaches in addition to tamarisk removal that has already been conducted
 - Assess livestock use of the stream and consider changes to provide for increased rest and habitat improvement along the stream and riparian corridor
 - Look at BLM Road 1596D that parallels the stream and potential drainage crossing improvements

Little Snake Field Office

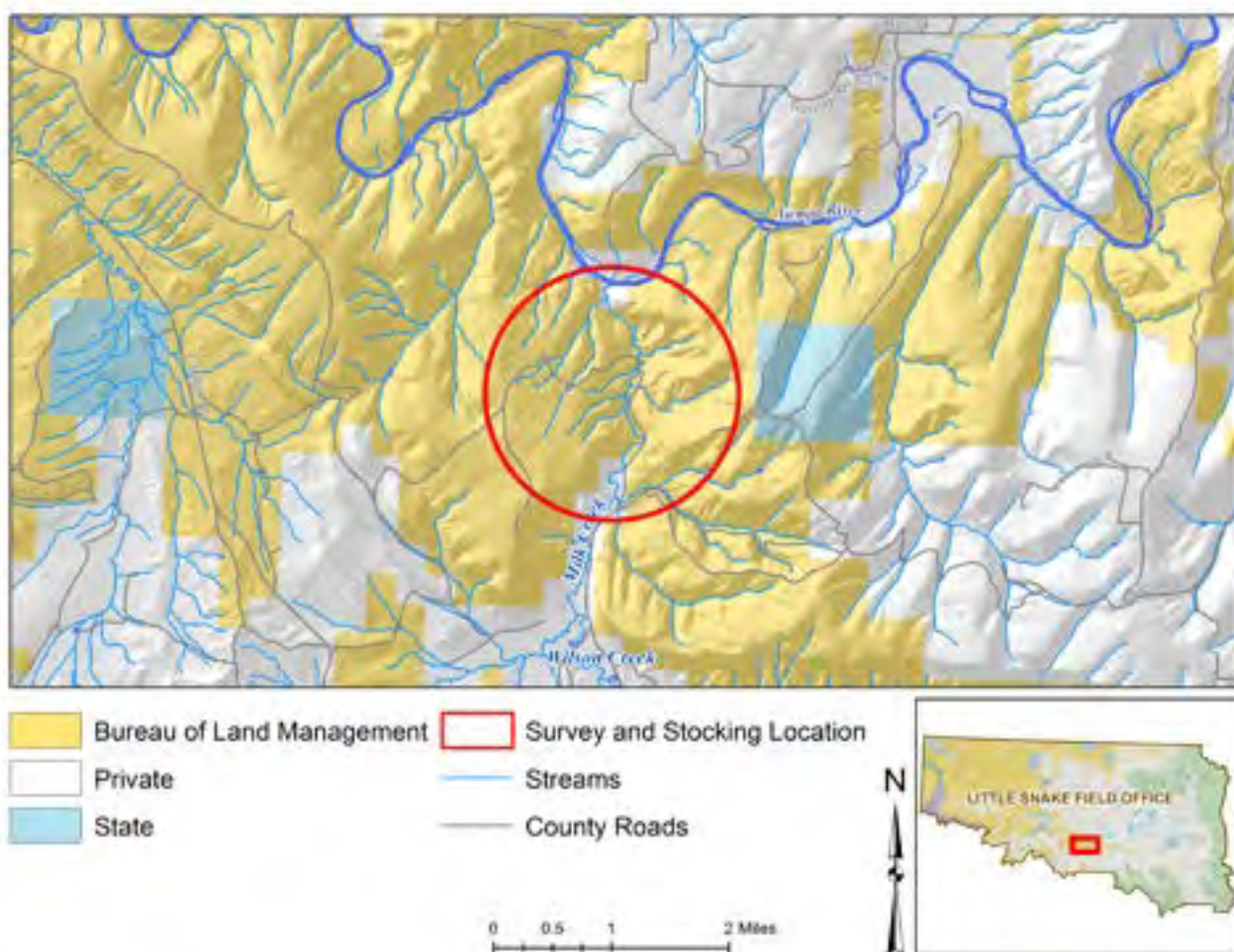
Stream Sampling June/October 2019

Milk Creek - Water Code #24961

Introduction:

Milk Creek located southwest of Craig, Colorado on public lands managed by the BLM's Little Snake Field Office, was sampled on June 27, 2019 and October 3, 2019. Sampling was conducted to monitor the status of previously stocked Bluehead Suckers, document other native fish use, and to remove competitive nonnative species. This has been a long-term cooperative effort between Colorado Parks & Wildlife and the BLM as PIT tagged Bluehead Suckers have been stocked into the stream for several years now.

Map of BLM Reach on Lower Milk Creek





Milk Creek Bluehead Sucker



Milk Creek Flannelmouth Sucker



Milk Creek Roundtail Chub

Methods:

Sampling is conducted via a combination of backpack electroshockers and backup netters when conducting nonnative removal and sucker hunting sampling, a bank rig shocking unit with 4 electrodes at the established population monitoring site, seining during sampling of larger pools, and on occasion via the use of passive hoop netting sets. Personnel present were Tom Fresques and Josh Ryan, BLM, and Jenn Logan and her Crew, Colorado Parks & Wildlife.

Results:

Species collected included target native Bluehead Suckers, Flannelmouth Suckers, Roundtail Chub, and Speckled Dace. Nonnative fish collected and removed included Creek Chubs, Sand Shiners, Red-Side Shiners, White Suckers, Plains Killifish, Brook Stickleback, and Fathead Minnows, and occasion small mouth bass.

Discussion:

Milk Creek contains a diverse fishery comprised of both native and nonnative species. The stocking of Passive Integrated Transponder (PIT) tagged Bluehead Suckers by CPW has been occurring for the past five years and another stocking occurred this past year. These stocking efforts are aimed at bolstering populations of this species in the Yampa River basin. Fish

sampling was conducted to monitor these stocked fish and to remove nonnative/competitive species from the stream to give the stocked fish a better chance of survival with less competition. In addition to active fish sampling, CPW and BLM have deployed 3 portable PIT tag readers in the stream that passively monitor tagged fish as they pass within the detection distance of the reader. The recorders ping and the unique tag number and time and date are recorded. CPW manages this data.

Many nonnative creek chubs were removed from the stream as well as lesser numbers of white suckers, sand shiners, red-side shiners, and fathead minnows. Stocking and monitoring will continue in Milk Creek over the next couple of years with longer-term monitoring to continue after stocking is ceased. Bluehead Suckers stocked into Milk Creek have been captured in the Yampa River both up and downstream of the Milk Creek confluence by other researchers sampling the river. This is encouraging and documents that these fish are surviving in the short-term and are utilizing preferred habitats in both Milk Creek and the Yampa River.

Recommendations:

- Continue to assist CPW with Bluehead Sucker stocking and monitoring efforts in Milk Creek
- Consider some habitat improvement projects in the BLM stream reaches in addition to tamarisk removal that has already been conducted
 - Assess livestock use of the stream and consider changes to provide for increased rest and habitat improvement along the stream and riparian corridor
 - Look at BLM Road 1596D that parallels the stream and potential drainage crossing improvements

Cross-Section Distances

	Left STA Bank	Right Bank	Cell distance Left	Cell distance Right	Average dist.	Average weight	Station distance	weighting factor	Reach distance
HP1							0	0.5	0
	8.8	80.8	4.4	40.4	44.8	22.4			
HP2							44.8	0.5	44.8
	70.9	81.8	35.5	40.9	76.4	38.2			
HP3							121.2	0.5	76.4
	152.5	168.4	76.3	84.2	160.5	80.2			
HP4							281.6	0.5	160.5
	171.1	182.0	85.6	91.0	176.6	88.3			
HP5							458.2	0.5	176.6
	53.1	88.2	26.6	44.1	70.7	35.3			
HP6							528.8	0.5	70.7
	31.2	48.0	15.6	24.0	39.6	19.8			
HP7							568.4	0.5	39.6
	63.0	78.1	31.5	31.1	70.6	31.3			
HP8							639.0	0.5	70.6

Level Loop

STA	BS	HI	FS	Elevation
BM	3.59	103.59		100.00
HP1			5.94	97.65
HP2			6.18	97.41
HP3			5.54	98.05
HP4			3.79	99.80
	6.82	106.62		
HP5			5.81	100.81
HP6			6.07	100.55
HP7			5.84	100.78
HP8			3.96	102.66
	4.05	106.71		
HP7			5.93	100.78
HP6			6.15	100.56
HP5			5.9	100.81
HP4			6.9	99.81
	3.51	103.32		
HP3			5.26	98.06
HP2			5.89	97.43
HP1			5.65	97.67
BM			3.31	100.01

Transect Data

Transect 1

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP1	4.62	102.29		97.67							
0.00			5.17	97.12			3				
23.00			5.95	96.34			3				
39.50			6.60	95.69			3				
45.50			5.83	96.46			6	3			
60.00			6.40	95.89			6	3			
62.00			7.45	94.84	0.00	0.00	6	3			LWSEL
63.00				94.58	0.25	0.14	6	3		0.01	
64.00				94.28	0.55	1.33	6	3		0.30	
65.00				94.13	0.70	2.89	6	3		1.32	
66.00				94.16	0.67	2.37	6	3		1.80	
67.00				94.33	0.50	1.77	6	3	instream	1.21	
68.00				94.33	0.50	0.79	6	3	instream	0.64	
69.00				94.44	0.39	0.03	6	3	instream	0.18	
70.00				94.55	0.28	0.13	6	3	instream	0.03	
71.00				94.55	0.28	-0.01	6	3	instream	0.02	
72.00				94.53	0.30	-0.01	6	3	instream	0.00	
73.00				94.56	0.27	0.76	6	3	instream	0.11	
74.00				94.50	0.33	0.35	6	3	instream	0.17	
75.00				94.60	0.23	-0.20	6	3	instream	0.02	
76.00				94.60	0.23	0.64	6	3	instream	0.05	
77.00				94.63	0.20	0.08	6	3	instream	0.08	
78.00			7.47	94.82	0.00	0.00	6	3	instream	0.00	RWSEL
87.30			7.27	95.02			6	3	instream		
89.4			5.06	97.23			3		Total Q	5.92	
103.00			5.06	97.23			3				

Transect 2

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP1	4.62	102.29		97.67							
0.00			5.03	97.26			3.00				
35.00			5.60	96.69			3.00				
50.00			6.40	95.89			3.00	instream			
59.80			7.15	95.14	0.00	0.00	3.00	instream			LWSEL
60.50				94.72	0.42	-0.01	3.00			0.00	
63.00				94.23	0.91	0.12	3.00			0.09	
64.50				93.85	1.29	0.36	3.00			0.39	
66.00				93.44	1.70	0.41	3.00	pool cover		0.86	
67.50				93.34	1.80	0.50	3.00	pool cover		1.20	
69.00				93.27	1.87	0.46	3.00	pool cover		1.31	
70.50				93.51	1.63	0.48	3.00	pool cover		1.22	
72.00				93.75	1.39	0.31	3.00			0.89	
73.50				94.10	1.04	0.05	3.00	instream		0.33	
75.00				94.48	0.66	-0.11	3.00	instream		-0.04	
76.70			7.15	95.14	0.00	0.00	3.00	instream		-0.03	RWSEL
81.10			3.25	99.04			3.00				
85.40			2.86	99.43			3.00				
									Total Q	6.23	

Crew: William J. Miller, Katie Birch, Sade Cromartie-Clemons, Laura Corona

Transect 3

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP3	4.61	102.69		98.08							
0.00			5.01	97.68							
17.00			5.58	97.11			3.00				
29.20			7.49	95.20	0.00	0.00	3.00	6.00	instream		LWSEL
30.50				94.90	0.30	0.38	3.00	6.00	instream	0.04	
32.00				94.70	0.50	0.49	3.00	6.00	instream	0.26	
33.50				94.60	0.60	0.48	3.00	6.00		0.40	
35.00				94.30	0.90	0.47	3.00	6.00		0.53	
36.50				94.40	0.80	0.44	3.00	6.00		0.58	
38.00				94.40	0.80	0.47	3.00	6.00		0.55	
39.50				94.30	0.90	0.54	3.00	6.00		0.64	
42.00				94.40	0.80	0.56	3.00	6.00		1.17	
43.50				94.40	0.80	0.65	3.00	6.00		0.72	
45.00				94.25	0.95	0.50	3.00	6.00		0.75	
46.50				94.25	0.95	0.26	3.00	6.00		0.54	
48.00				94.25	0.95	0.00	3.00	6.00	instream	0.19	
49.10			7.44	95.25	0.45	0.00	3.00		instream	0.00	RWSEL
53.50			4.81	97.88			3.00		instream		
57.90			1.01	101.68			3.00				
58.30			0.94	101.75			3.00		Total Q	6.36	

Crew: William J. Miller, Katie Birch, Sade Cromartie-Clemons, Laura Corona

Transect 4

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP4	4.22	104.04		99.82							
0.00			4.53	99.51			3				
1.70			4.68	99.36			3				
8.90			7.88	96.16	0.00	0.00	3	6	instream		LWSEL
10.00				95.81	0.35	0.54	6	7	instream	0.05	
11.50				95.66	0.50	1.28	6	7	instream	0.58	
13.00				95.51	0.65	0.67	6	7	instream	0.84	
14.50				95.76	0.40	2.18	6	7	instream	1.12	
16.00				95.76	0.40	0.00	6	7	instream	0.65	
17.50				95.76	0.40	1.53	6	7	instream	0.46	
19.00				95.76	0.40	0.25	6	7	instream	0.53	
20.50				95.86	0.30	0.82	6	7	instream	0.28	
24.00			7.89	96.15	0.00	0.00	6	3	instream	0.22	RWSEL
35.20			6.87	97.17			3	6			
43.70			7.25	96.79			3	6			
45.10			6.45	97.59			3		Total Q	4.73	
60.00			4.85	99.19			3				

Transect 5

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP5	4.82	105.65		100.83							
0.00			5.37	100.28			3.00				
11.00			6.65	99.00			3.00				
15.00			7.35	98.30			3.00		instream		
20.00			7.46	98.19			3.00				
24.00			7.45	98.20			3.00	7			
28.00			7.98	97.67	0.00	0.00	3.00	7			LWSEL
29.00				97.19	0.48	0.29	3.00			0.03	
30.50				96.87	0.80	0.26	3.00			0.26	
32.00				96.78	0.89	0.24	3.00			0.31	
33.50				96.53	1.14	0.54	3.00			0.59	
35.00				96.62	1.05	0.62	3.00			0.95	
36.50				96.73	0.94	0.72	3.00			1.00	
38.00				96.78	0.89	0.63	3.00			0.92	
39.50				96.75	0.92	0.70	3.00			0.90	
41.00				96.97	0.70	0.72	3.00			0.86	
43.00			8.01	97.64	0.00	0.00	3.00			0.25	RWSEL
47.00			6.68	98.97			8.00				
50.00			5.30	100.35			3.00		Total Q	6.09	
50.80			4.34	101.31			3.00				

Crew: William J. Miller, Katie Birch, Sade Cromartie-Clemons, Laura Corona

Transect 6

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP5	4.82	105.65		100.83							
0.00			5.36	100.29			3.00				
16.80			6.33	99.32			3.00				
23.30			7.99	97.66	0.00	0.00	3.00		instream		LWSEL
25.00				97.11	0.55	0.39	3.00			0.09	
26.50				97.03	0.63	0.82	3.00	8		0.54	
28.00				97.00	0.66	0.88	3.00	7		0.82	
29.50				97.06	0.60	0.00	3.00	7		0.41	
31.00				96.95	0.71	0.45	3.00	7	object	0.22	
32.50				96.88	0.78	1.87	3.00	7		1.29	
34.00				96.49	1.17	0.62	3.00	7		1.82	
35.50				96.56	1.10	0.32	3.00	7		0.80	
37.00				96.06	1.60	0.13	3.00	7	pool cover	0.46	
38.50				95.94	1.72	-0.04	3.00		pool cover	0.11	
40.00				96.28	1.38	-0.12	3.00			-0.19	
41.50				96.84	0.82	0.00	3.00			-0.10	
43.00				97.48	0.18	0.00	3.00			0.00	
48.50				97.52	0.14	0.00	3.00			0.00	
51.40			8.07	97.58	0.00	0.00	3.00			0.00	RWSEL
62.40			6.92	98.73			3.00				
66.40			1.97	103.68			3.00		Total Q	6.28	

Transect 7

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP5	4.82	105.65		100.83							
0.00			5.20	100.45			3				
7.00			5.60	100.05			3	7			
9.00			7.85	97.80	0.00	0.00	3	7			LWSEL
10.50				97.47	0.33	0.77	3	7	instream	0.10	
12.00				97.14	0.66	1.61	3	7		0.88	
13.50				97.03	0.77	1.54	3	7		1.69	
15.00				97.10	0.70	1.42	3	7		1.63	
16.50				97.00	0.80	0.93	3	7		1.32	
18.00				97.30	0.50	0.82	3	7		0.85	
19.50				97.34	0.46	0.52	3	7		0.48	
21.00				97.38	0.42	-0.05	3	7		0.15	
22.50				97.57	0.23	0.00	3	7		-0.01	
24.00				97.58	0.22	0.01	3	7		0.00	
24.80			7.89	97.76	0.00	0.00	3	7		0.00	RWSEL
35.00			7.20	98.45			3				
66.00			5.69	99.96			3		Total Q	7.10	
83.50			5.76	99.89			3				
88.00			4.17	101.48			3				

Crew: William J. Miller, Katie Birch, Sade Cromartie-Clemons, Laura Corona

Transect 8

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP8	4.69	107.37		102.68							
0.00			4.90	102.47			3				
4.00			4.99	102.38			3				
6.40			8.51	98.86			3				
8.50			9.32	98.05	0.00	0.00	3				LWSEL
10.00				97.50	0.55	0.37	3	7		0.08	
11.50				97.23	0.82	0.46	3	7		0.43	
13.00				97.05	1.00	0.56	3	7		0.69	
14.50				96.79	1.26	0.83	3	6		1.17	
16.00				96.87	1.18	0.91	3	6		1.58	
17.50				97.05	1.00	0.82	3	6		1.41	
19.00				97.20	0.85	0.33	3	6		0.80	
20.50				97.50	0.55	-0.09	3	6		0.13	
22.50			9.28	98.09	0.00	0.00	3	6		-0.02	RWSEL
26.00			8.38	98.99			3	6			
37.00			7.18	100.19			3	6	Total Q	6.26	
51.80			6.08	101.29			3				

Water Surface Elevation

XSEC	Left	Right	Average	Discharge	
1	94.84	94.82	94.830	5.92	
2	95.14	95.14	95.140	6.23	
3	95.20	95.25	95.225	6.36	
4	96.16	96.15	96.155	4.73	
5	97.67	97.64	97.655	6.09	
6	97.66	97.58	97.660	6.28	Used left bank WSEL
7	97.80	97.76	97.780	7.10	
8	98.05	98.09	98.070	6.26	
			6.12	Average Q	

Cross-section Distance

Left STA	Left Bank	Right Bank	Left	Right	Average dist.	Average weight	Station dist	weighting factor	Reach distance
HP1							0	0.5	0
	71.4	72.0	35.7	36.0	71.7	35.9			
HP2							71.7	0.5	71.7
	40.9	8.3	20.5	4.2	24.6	12.3			
HP3							96.3	0.5	24.6
	59.9	1.2	29.9	0.6	30.5	15.3			
HP4							126.8	0.5	30.5
	30.9	7.8	22.0	22.0	19.4	22.0			
HP5							146.2	0.5	19.4
	30.3	30.9	15.2	15.5	30.6	15.3			
HP6							176.8	0.5	30.6
	20.5	19.3	10.3	9.7	19.9	10.0			
HP7							196.7	0.5	19.9
	31.7	34.1	18.0	18.0	32.9	18.0			
HP8							229.6	0.5	32.9

Level Loop

STA	BS	HI	FS	Elevation
BM	4.94	104.94		100.00
HP1			5.43	99.51
HP2			5.34	99.60
HP3			5.09	99.85
HP4			5.26	99.68
HP5			4.82	100.12
HP6			4.98	99.96
HP7			3.48	101.46
HP8			3.14	101.80
	3.05	104.85		
HP7			3.4	101.45
HP6			4.89	99.96
HP5			4.72	100.13
HP4			5.17	99.68
HP3			5	99.85
HP2			5.25	99.60
HP1			5.35	99.50
BM			4.84	100.01

Transect Data

Transect 1

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP1	5.07	104.57		99.50							
0.00			5.50	99.07			3				
1.60			6.79	97.78			3		instream		
9.00			8.33	96.24			3		instream		
10.90			9.30	95.27	0.00	0.00	3		instream		LWSEL
12.00				94.77	0.50	1.05	3	6	instream	0.14	
13.50				94.59	0.68	1.36	3	6		1.06	
15.00				94.72	0.55	1.08	3	6		1.12	
16.50				94.82	0.45	0.59	3	6		0.62	
18.00				94.72	0.55	0.22	3	6		0.30	
19.50				94.87	0.40	0.52	3	6		0.26	
21.00				94.92	0.35	0.55	3	6		0.30	
22.50				94.97	0.30	0.27	3	6		0.20	
24.00				94.77	0.50	0.40	3	6		0.20	
25.50				94.67	0.60	0.80	3	6		0.50	
27.00				94.58	0.69	0.55	3	6		0.65	
28.50				94.59	0.68	0.52	3	6		0.55	
30.00				94.77	0.50	0.80	3	6		0.58	
32.00			9.28	95.29	0.00	0.00	3	6	instream	0.20	RWSEL
34.00			8.78	95.79			3		instream		
37.00			8.13	96.44			3				
38.00			7.55	97.02			3				
48.10			7.11	97.46					Total Q	6.71	

Transect 2

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP1	5.07	104.57		99.50							
53.90			6.68	97.89							
50.00			7.00	97.57			3.00	5.00			
47.00			7.57	97.00			3.00				
42.00			8.22	96.35			3.00				
38.60			8.95	95.62	0.00	0.00	3.00	5.00			RWSEL
37.00				95.30	0.32	0.00	3.00	6.00		0.00	
35.50				95.05	0.57	0.58	3.00	6.00		-0.19	
34.00				94.97	0.65	0.50	3.00	6.00		-0.49	
32.50				95.00	0.62	0.77	3.00	6.00		-0.61	
31.00				95.12	0.50	0.90	3.00	6.00		-0.70	
29.50				94.70	0.92	0.71	3.00	7.00	instream	-0.85	
28.00				94.88	0.74	0.48	3.00	7.00	instream	-0.74	
26.50				94.97	0.65	0.14	3.00	7.00	instream	-0.32	
25.00				94.86	0.76	0.41	3.00	7.00	instream	-0.29	
23.50				94.62	1.00	0.39	3.00	7.00	instream	-0.53	
22.00				94.97	0.65	0.30	3.00		instream	-0.43	
20.50			8.95	95.62	0.00	0.00	3.00			-0.07	LWSEL
18.00			8.12	96.45			3.00				
17.00			7.47	97.10			3.00				
2.50			6.36	98.21			3.00				
0.00			5.26	99.31					Total Q	-5.23	

Transect 3

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Subdom		Cover	Discharge	Comment
							Sub	Sub			
HP3	5.07	104.57		99.50							
0.00			4.92	99.65			3.00				
11.00			5.61	98.96			3.00		instream		
16.50			8.96	95.61	0.00	0.00	3.00		instream		LWSEL
18.00				94.83	0.78	-0.79	3.00		instream	-0.23	
19.50				94.00	1.61	-0.23	3.00		instream/pool	-0.92	
21.00				93.69	1.92	0.15	3.00		instream/pool	-0.11	
22.50				93.68	1.93	0.33	3.00		pool	0.70	
24.00				93.70	1.91	0.51	3.00		pool	1.22	
25.50				93.73	1.88	0.61	3.00		pool	1.59	
27.00				94.32	1.29	0.83	3.00			1.71	
28.50				94.58	1.03	0.60	3.00	7.00	instream	1.25	
30.00				94.72	0.89	0.68	3.00	7.00	instream	0.92	
31.50				94.93	0.68	0.74	3.00	7.00	instream	0.83	
33.00				94.80	0.81	0.27	3.00	7.00	instream	0.57	
34.50				94.91	0.70	0.00	3.00	7.00	instream	0.16	
38.40			8.94	95.63	0.00	0.00	3.00			0.00	RWSEL
40.00			8.52	96.05			3.00				
61.00			7.29	97.28			3.00				
68.80			6.45	98.12					Total Q	7.69	

Transect 4

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Subdom		Cover	Discharge	Comment
							Sub	Sub			
HP4	5.07	104.57		99.50							
63.30			6.47	98.10			3				
59.00			7.13	97.44			3				
35.80			8.90	95.67	0.00	0.00	3				RWSEL
34.00				95.00	0.67	0.00	3			0.00	
32.50				94.47	1.20	-0.63	3			0.44	
31.00				92.77	2.90	-0.30	3		pool	1.43	
29.50				93.27	2.40	-0.03	3		pool	0.65	
28.00				93.40	2.27	-0.18	3		pool	0.35	
26.50				93.17	2.50	0.50	3	7	pool/instream	-0.57	
25.00				93.37	2.30	1.29	3	7	pool/instream	-3.21	
23.50				93.73	1.94	0.43	3	7	pool/instream	-2.74	
22.00				95.31	0.36	0.05	3	7	instream	-0.42	
20.50			8.91	95.66	0.00	0.00	3		instream	-0.01	LWSEL
19.00			8.26	96.31			3		instream		
11.00			7.13	97.44			3		instream		
2.40			6.39	98.18			3				
1.6			5.83	98.74			3				
0			5.07	99.50			3				
									Total Q	-4.06	

Transect 5

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP5	6.15	106.27		100.12							
0.00			6.40	99.87			3.00				
4.00			9.16	97.11			3.00				
7.50			10.12	96.15	0.00	0.00	3.00		instream		LWSEL
9.00				95.95	0.20	2.06	6.00	7	instream	0.15	
10.50				95.75	0.40	2.65	6.00			1.06	
12.00				95.75	0.40	2.12	6.00			1.43	
13.50				95.90	0.25	3.53	6.00			1.38	
15.00				95.80	0.35	1.99	6.00	7		1.24	
16.50				95.85	0.30	1.98	6.00	7	instream	0.97	
18.00				95.85	0.30	0.00	6.00			0.44	
19.50				95.85	0.30	0.42	6.00			0.09	
21.00				95.95	0.20	0.02	6.00	7	instream	0.08	
22.50				95.95	0.20	1.07	6.00			0.16	
24.00				95.95	0.20	2.34	6.00			0.51	
26.50				95.95	0.20	0.17	6.00	7	instream	0.63	
28.80			10.01	96.26	0.00	0.00	6.00	7	instream/cobble	0.02	RWSEL
36.20			9.47	96.80			6.00	3	instream		
45.40			8.16	98.11			3.00		Total Q	8.18	

Transect 6

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP5	6.15	106.27		100.12							
44.30			8.16	98.11			3.00				
39.10			8.54	97.73			3.00		instream		
36.50			9.01	97.26			3.00		instream		
34.90			9.84	96.43	0.00	0.00	3.00		instream		RWSEL
33.00				95.53	0.90	1.04	6.00	7	instream	-0.45	
31.50				95.58	0.85	0.53	6.00	7	instream	-1.03	
30.00				95.63	0.80	0.45	6.00	7	instream	-0.60	
28.50				96.13	0.30	0.25	6.00	3		-0.29	
27.00				96.23	0.20	-0.04	6.00	3		-0.04	
25.50				95.88	0.55	0.00	6.00			0.01	
24.00				95.93	0.50	0.37	6.00			-0.15	
22.50				95.93	0.50	0.17	6.00			-0.20	
21.00				95.93	0.50	1.15	6.00			-0.50	
19.50				95.98	0.45	1.25	6.00			-0.86	
18.00				96.03	0.40	0.56	6.00	3	instream	-0.58	
16.50			9.82	96.45	0.00	0.00	3.00		instream	-0.08	LWSEL
3.40			8.68	97.59			3.00				
0.00			6.52	99.75			3.00				
Total Q										-4.75	

Transect 7

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom	Subdom	Cover	Discharge	Comment
							Sub	Sub			
HP5	6.15	106.27		100.12							
0.00			5.08	101.19			3				
3.00			6.74	99.53			3		instream		
24.50			9.79	96.48	0.00	0.00	3		instream		LWSEL
26.00				96.28	0.20	0.00	3	7	instream	0.00	
27.50				96.08	0.40	0.20	7	3		0.04	
29.00				95.98	0.50	1.49	7	3		0.57	
30.50				95.78	0.70	0.35	7	7/3		0.83	
32.00				95.68	0.80	0.87	7	7	instream	0.69	
33.50				94.88	1.60	0.82	7		instream/pool	1.52	
35.00				94.58	1.90	0.72	7		instream/pool	2.03	
36.50				94.58	1.90	0.34	5		instream/pool	1.51	
38.00				94.58	1.90	0.07	3	6	instream/pool	0.58	
39.50				94.88	1.60	0.00	3	6	pool	0.09	
41.00				95.38	1.10	0.00	3			0.00	
42.50				95.98	0.50	0.00	3			0.00	
43.30			9.85	96.42	0.00	0.00	3		instream	0.00	RWSEL
43.80			8.49	97.78			3				
52.80			7.55	98.72			3		Total Q	7.86	

Transect 8

STA	BS	HI	FS	Elevation	Depth	Velocity	Dom Sub	Subdom Sub	Cover	Discharge	Comment
HP8	6.15	106.27		100.12							
70.50			6.70	99.57			3				
60.70			7.31	98.96			3				
60.20			9.75	96.52	0.00	0.00	3		instream/overhead		RWSEL
58.50				95.42	1.10	0.52	6	3	instream	-0.24	
57.00				95.82	0.70	1.48	6	3		-1.35	
55.50				95.92	0.60	1.51	6			-1.46	
54.00				95.92	0.60	0.02	6	7	instream	-0.69	
52.50				96.12	0.40	0.00	6	7/3	instream	-0.01	
51.00				96.22	0.30	0.13	6	7/3	instream	-0.03	
49.50				96.22	0.30	0.40	6	7/3	instream	-0.12	
48.00				96.32	0.20	0.00	6	7/3	instream	-0.08	
46.50				96.32	0.20	-0.03	6	7/3	instream	0.00	
45.00				96.32	0.20	0.01	6	3		0.00	
43.30			9.62	96.65	0.00	0.00	6	3	instream	0.00	LWSEL
20.50			7.44	98.83			3		instream		
3.20			6.75	99.52			3				
0			4.73	101.54			3				
									Total Q	-3.96	

Water Surface Elevations

XSEC	Left	Right	Average	Discharge
1	95.27	95.29	95.280	6.71
2	95.62	95.62	95.620	-5.23
3	95.61	95.63	95.620	7.69
4	95.66	95.67	95.665	-4.06
5	96.15	96.26	96.205	8.18
6	96.45	96.43	96.450	-4.75
7	96.48	96.42	96.450	7.86
8	96.65	96.52	96.585	-3.96
				1.56
				Average Q

Headpin Check

STA	BS	HI	FS	Elevation	Previous Elevations	Difference
BM	2.46	102.46		100.00		
HP1			4.80	97.66	97.65	0.01
HP2			5.02	97.44	97.41	0.03
HP3			4.38	98.08	98.05	0.03
HP4			2.64	99.82	99.80	0.02
BM	5.32	105.32		100.00		
HP5			4.50	100.82	100.81	0.01
HP6			4.74	100.58	100.55	0.03
HP7			4.52	100.80	100.78	0.02
HP8			2.64	102.68	102.66	0.02

Water Surface Elevation Format 1

Average Q 127.6 cfs

STA	BS	HI	FS	Elevation	Average
HP1	4.80	102.46		97.66	
T1 LWSEL			6.76	95.70	
T1 RWSEL			6.76	95.70	95.70
HP2					
T2 LWSEL			6.20	96.26	
T2 RWSEL			6.20	96.26	96.26
HP3					
T3 LWSEL			6.00	96.46	
T3 RWSEL			6.00	96.46	96.46
HP4					
T4 LWSEL			5.22	97.24	
T4 RWSEL			5.22	97.24	97.24
HP5	4.50	105.32		100.82	
T5 LWSEL			6.47	98.85	
T5 RWSEL			6.47	98.85	98.85
HP6					
T6 LWSEL			6.46	98.86	
T6 RWSEL			6.46	98.86	98.86
HP7					
T7 LWSEL			6.36	98.96	
T7 RWSEL			6.36	98.96	98.96
HP8					
T8 LWSEL			5.81	99.51	
T8 RWSEL			5.81	99.51	99.51

Water Surface Elevation Format 2

XSEC	Left	Right	Average	Discharge
1	95.70	95.70	95.70	127.6
2	96.26	96.26	96.26	127.6
3	96.46	96.46	96.46	127.6
4	97.24	97.24	97.24	127.6
5	98.85	98.85	98.85	127.6
6	98.86	98.86	98.86	127.6
7	98.96	98.96	98.96	127.6
8	99.51	99.51	99.51	127.6

Headpin Check

STA	BS	HI	FS	Elevation	Previous Elevations	Difference
BM	4.52	104.52		100.00		
HP1			5.04	99.48	99.51	0.03
HP2			4.93	99.59	99.60	0.01
HP3			4.68	99.84	99.85	0.01
HP4			4.87	99.65	99.68	0.03
HP5			4.42	100.10	100.12	0.02
HP6			4.59	99.93	99.96	0.03
HP7			3.09	101.43	101.46	0.03
HP8			2.75	101.77	101.80	0.03

Water Level Elevation Format 1

Average Q 127.6 cfs

STA	BS	HI	FS	Elevation	Average
HP1	5.04	104.52		99.48	
T1 LWSEL			8.10	96.42	
T1 RWSEL			8.10	96.42	96.42
HP2					
T2 LWSEL			7.28	97.24	
T2 RWSEL			7.28	97.24	97.24
HP3					
T3 LWSEL			7.24	97.28	
T3 RWSEL			7.24	97.28	97.28
HP4					
T4 LWSEL			7.21	97.31	
T4 RWSEL			7.21	97.31	97.31
HP5					
T5 LWSEL			7.20	97.32	
T5 RWSEL			7.20	97.32	97.32
HP6					
T6 LWSEL			6.94	97.58	
T6 RWSEL			6.94	97.58	97.58
HP7					
T7 LWSEL			6.82	97.70	
T7 RWSEL			6.82	97.70	97.70
HP8					
T8 LWSEL			6.56	97.96	
T8 RWSEL			6.56	97.96	97.96

Water Level Elevation Format 2

XSEC	Left	Right	Average	Discharge
1	8.10	8.10	8.10	127.6
2	7.28	7.28	7.28	127.6
3	7.24	7.24	7.24	127.6
4	7.21	7.21	7.21	127.6
5	7.20	7.20	7.20	127.6
6	6.94	6.94	6.94	127.6
7	6.82	6.82	6.82	127.6
8	6.56	6.56	6.56	127.6

**Final
Milk Creek Instream Flow Study Report**

**Prepared for:
Colorado Water Conservation Board
Denver, Colorado**

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Introduction

Milk Creek is a tributary to the Yampa River downstream of the city of Craig, Colorado. Milk Creek is the largest tributary to the Yampa River between the confluence of the Williams Fork and Little Snake Rivers. Research and monitoring studies have shown that tributary streams in the upper Colorado and San Juan river basins provide important seasonal and year round habitat for native species, especially for native sucker species (Cathcart et al. 2015, Thompson and Hooley-Underwood 2019). Milk Creek provides spawning habitat for native Flannemouth Sucker (*Catostomus latipinnis*) and Bluehead Sucker (*Catostomus discobolus*). Colorado Parks and Wildlife (CPW) and the Bureau of Land Management (BLM) are developing an instream flow recommendation for the Colorado Water Conservation Board (CWCB) to protect the lower 4 miles of Milk Creek.

The purpose of this study is to quantify hydraulic habitat in lower Milk Creek for the adult and spawning life stages of the two native suckers. The objective of the study is to determine the appropriate instream flows to protect native sucker habitat. Freshwater Consulting was contracted to provide field and technical training to CPW, BLM and CWCB staff necessary to complete flow and habitat modeling using the System for Environmental Flow Analysis (SEFA). Freshwater Consulting summarized the study and findings in this report. CPW, BLM, and CWCB staff assisted in collecting field data and processing data in SEFA.

Study Area

The study area extends from the Yampa River confluence upstream approximately 4 miles. The Milk Creek study sites are located approximately 0.5 miles and 0.9 miles upstream from the confluence of Milk Creek and the Yampa River (Figure 1). The entire 4-mile study area was evaluated prior to the site selection. The two study locations were selected as representative of the habitat within the lower 4 miles of Milk Creek. The overall gradient in the lower 4 miles of Milk Creek is 0.0052 ft/ft. The gradient for Site 1 is 0.0050 ft/ft and the gradient for Site 2 is 0.0057ft/ft and are generally similar to the overall gradient for the entire 4-mile reach. Both sites include all habitat types present within the study area. Habitat features in the reach include riffle, run and pool habitat with stream substrates that range in size from fine silt to large cobble. Both sites have multiple repeats of these habitat types and are representative of the overall reach habitat characteristics.

Species of Interest

Milk Creek provides habitat for Flannemouth Sucker and Bluehead Sucker, which are endemic to the rivers in the Colorado River basin. BLM and CPW have signed a conservation agreement designed to protect and enhance habitat for these species. The agreement is titled “Range Wide Conservation Agreement and Strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*) and Flannemouth Sucker (*Catostomus latipinnis*) 2006”. This document is also known as the “Three Species Agreement”. A priority conservation action in

this agreement is the establishment of instream flow protection for streams known to provide habitat for the species.



Figure 1. Milk Creek Study Sites (Source: Google Earth).

Flannemouth Sucker were historically widely distributed through the Upper Colorado River Basin and use mainstem rivers and tributary streams during their life cycle. Flannemouth Sucker are a long-lived species with a maximum life span of about 30 years (Scoppettone 1988, Minckley 1991). Average size of mature adult Flannemouth Suckers is approximately 500 mm (19.7 inches) (McAda 1977). Flannemouth Sucker typically spawn between April and June in the upper Colorado River Basin (McAda 1977, Snyder and Muth 1990, Tyus and Karp 1990). Flannemouth Sucker may reach sexual maturity by age 4 but most reach maturity by age 5 or 6 (McAda and Wydoski 1985). McAda (1977) reported spawning at water temperatures from 6 to 12 C. Flannemouth Sucker eggs are demersal and adhere to the substrate. Eggs hatch in six to seven days (Carlson et al. 1979). Ripe Flannemouth Sucker were collected by McAda and Wydoski (1985) in areas with cobble substrate and an average velocity of 3.3 feet per second (fps). Newly hatched Flannemouth Sucker larvae drift with the river current as they absorb their yolk sac and become free swimming. The downstream drift of the larval life stage requires upstream movement of Flannemouth Suckers as they mature to maintain populations throughout the rivers and streams.

Bluehead Sucker were historically distributed throughout the Upper Colorado River Basin similar to the distribution of Flannemouth Sucker (Bezzarides and Bestgen 2002). Bluehead Sucker are a long-lived species with maximum ages reported at over 20 years (Scoppettone 1988, Minckley 1991). The majority of Bluehead Suckers are mature by the time they reach a total length of 380mm (15 inches) (McAda and Wydoski 1983). Spawning generally occurs in the spring and early summer from May through July (Holden 1973). Vanicek (1967) reported collecting ripe Bluehead Sucker in June and July in areas with large cobble.

Feeding habits differ between Flannemouth Sucker and Bluehead Sucker. Both species are omnivorous and feed on algae and invertebrates. Bluehead Sucker have a distinct cartilaginous ridge on their lower lip that is used to scrape food from hard surfaces. Flannemouth Sucker do not have the same feature and feed on softer substrates.

Methods

The CPW and the BLM originally planned to use the PHABSIM (Physical Habitat Simulation) software for the instream flow evaluation in Milk Creek. PHABSIM is a widely accepted method for quantifying the suitable versus unsuitable hydraulic habitat attributes of selected species and life stages as a function of discharge. PHABSIM has been widely used in North America to quantify instream flow requirements, and it has been utilized previously by the Colorado Water Conservation Board to quantify instream flow appropriations.

PHABSIM is one component of the Instream Flow Incremental Methodology (IFIM) (Bovee et al. 1998). IFIM was developed in the late 1970s and early 1980s by the US Fish and Wildlife Service Cooperative Instream Flow Group (IFG). IFIM was envisioned as a complete system for instream flow decision making with components for hydraulic habitat, water quality, including water temperature, habitat time series and hydrology time series. PHABSIM is limited to hydraulic habitat simulations with no additional components (Milhous 1999). The

comprehensive IFIM software was never completed due to change in direction of management objectives when the IFG became part of the US Geological Survey in early 2000s.

PHABSIM is now legacy software and no longer supported for current Windows operating systems. A newer and currently supported software for hydraulic habitat simulations is System for Environmental Flow Analysis (SEFA) (Payne and Jowett 2011; Jowett et al. 2023). SEFA includes all the hydraulic and habitat simulation functions of PHABSIM and includes additional capabilities to model sediment transport, bioenergetics, water temperature, dissolved oxygen, fish passage and hydrology and habitat time series (Payne and Jowett, 2011).

SEFA uses the same analytical approach to predicting hydraulic parameters as PHABSIM. SEFA uses log-log relationships fitted through survey flows with best fit to calibration measurements to develop the stage-discharge function for hydraulic simulations. Hydraulic habitat is calculated using the same univariate habitat suitability criteria for depth, velocity and substrate as PHABSIM combined with the predicted hydraulic parameters for a range of flows.

SEFA also has the capability to predict fish passage through a study site. The passage criteria can be specified in the analysis and the model calculates the amount of width available for fish passage through the site. SEFA also calculates maximum depth for each cross section and flow simulated. The fish passage analysis and maximum depth prediction provide the data needed for the determination of a minimum flow that provides longitudinal connectivity in the study site and the reach.

Field data collection

Field methods followed the general guidelines of IFIM and SEFA. Stream cross sections were placed in each habitat type at the study site with a metal headpin on the right bank above the high-water mark. The cross sections were placed perpendicular to stream flow with wooden stakes as working pins on both banks. Site elevations were surveyed using differential leveling and referenced to an arbitrary benchmark datum of 100.00 ft. Standard survey techniques were used to establish elevations of all headpins and bed profile elevations relative to the benchmark. Water depth and velocity were measured using a topset wading rod and digital flow meter. This initial data collection in SEFA is referred to as the survey flow. Additional water surface and discharge are measured at additional flows. These additional measurements are referred to as calibration measurements in SEFA.

Hydraulic Modeling

Data for model input and calibration was collected during three separate site visits (Table 1). The initial site visit included placement of cross sections, initial elevation survey, bed profile survey and depth and velocity measurements at all cross sections. The second and third site visits were completed to collect discharge and water surface elevations at two additional flows for model calibration.

Data from the site visits were entered into computer spreadsheets and imported into SEFA software for analysis. SEFA software processing included data entry, hydraulic model calibration, hydraulic model simulations, habitat suitability criteria entry, and hydraulic-habitat model simulations.

Table 1. Site description and measurement dates for Milk Creek instream flow study.

	Distance from confluence with Yampa River (miles)	Site Length (ft)	Number of Cross Sections	Flow 1 - measurement date and discharge	Flow 2 - measurement date and discharge	Flow 3 - measurement date and discharge
Site 1	0.47	639	8	Oct 22, 2023/ 6.26 cfs	April 12, 2024/44.5 cfs	May 29, 2024/127.6 cfs
Site 2	0.94	230	8	Oct 23, 2023/6.06 cfs	April 12, 2024/52.2 cfs	May 29, 2024/127.6 cfs

Data entry was quality checked for errors prior to model simulations. The SEFA software includes a “check” feature to determine that all necessary model data is correctly entered prior to model simulations. SEFA automatically runs all hydraulic simulations when the input file is loaded into the user interface. SEFA also automatically produces calibration details for each simulation. The hydraulic model can be calibrated if necessary to better match the stage-discharge predictions.

Habitat suitability criteria

The criteria for adult Flannemouth Sucker were updated in early 2024 from a combination of data from radio telemetry studies on the Colorado River near Grand Junction, existing data from a range of rivers and literature review of habitat and population studies (Miller 2024). Additional habitat criteria for Flannemouth Sucker were incorporated into the final suitability criteria as documented by Miller (2024). The habitat suitability criteria for Flannemouth Sucker also applies to Bluehead Sucker for this study. Bluehead Sucker feed by scaping on hard substrates and are known to feed in faster riffle habitat with cobble and boulders whereas Flannemouth Sucker feed on softer substrates in somewhat slower velocities so the habitat response shown for Flannemouth Sucker may approximate habitat response to flow for Bluehead Sucker but will not fully depict all areas suitable for Bluehead Sucker. The suitability indices used in the hydraulic-habitat modeling is a combination of the data from Flannemouth Sucker and Bluehead Sucker studies on the Colorado River and literature from the US Fish and Wildlife Service. The suitability indices are listed in Appendix A.

Flannemouth Sucker and Bluehead Sucker spawn in riffle habitat over gravel and cobble substrate. Spawning habitat use is generally restricted to shallower depths and higher velocity than the broader habitat types used by adults. The spawning habitat suitability criteria for both species were based on a combination of literature review and existing habitat suitability criteria from the US Fish and Wildlife Service. Suitable spawning substrate material was restricted to

gravel and cobble substrate types to accurately reflect the use of these sites during spawning (Appendix A).

Results

SEFA modeling steps were identical for Milk Creek Site 1 and Site 2. Hydraulic models were completed for flows from 5 cubic feet per second (cfs) to 300 cfs at each site for model calibration. Habitat suitability criteria were selected for the hydraulic-habitat simulations for each site after checking model calibration results. No hydraulic calibration was needed for either site. Hydraulic-habitat simulations were completed for flows from 5 cfs to 100 cfs at each site. A fish passage analysis was completed after the hydraulic-habitat simulations to evaluate longitudinal connectivity at base flows.

Hydraulic Model Results

The stage-discharge relationships for both sites were similar with the R-square for the rating curves ranging from 0.989 to 1.00 for Site 1 (Table 2) and ranging from 0.980 to 0.999 for Site 2 (Table 3). SEFA generates graphs of the rating curves for each cross section that also can be used to evaluate model calibration. The high R-square values result in very closing fitting predictions based on the measured flows at each site. Examples of the fit are shown for Site 1 (**Error! Reference source not found.**) and Site 2 (**Error! Reference source not found.**). No hydraulic model calibration was needed at either site prior to simulation of hydraulic-habitat.

Table 2. Site 1 ratings curves from SEFA model.

Cross Section	Selected rating type	Exponent	Constant	Stage of ZeroFlow	R ²
XSEC1	SZF rating	3.790	23.650	94.130	1.000
XSEC2	SZF rating	4.217	5.869	94.130	0.992
XSEC3	SZF rating	3.873	6.618	94.250	0.992
XSEC4	SZF rating	3.210	24.394	95.510	0.990
XSEC5	SZF rating	4.401	3.574	96.530	0.989
XSEC6	SZF rating	4.351	3.596	96.530	0.992
XSEC7	SZF rating	3.410	14.279	97.000	0.993
XSEC8	SZF rating	3.643	4.783	97.000	0.997

Table 3. Site 2 ratings curves from SEFA model.

Cross Section	Selected rating type	Exponent	Constant	Stage of Zero Flow	R ²
XSEC1	SZF rating	3.195	18.938	94.580	0.999
XSEC2	SZF rating	3.335	6.060	94.620	0.980
XSEC3	SZF rating	3.172	6.060	94.620	0.997
XSEC4	SZF rating	3.333	5.151	94.620	0.991
XSEC5	SZF rating	2.606	45.847	95.750	0.986
XSEC6	SZF rating	3.227	20.068	95.750	0.991
XSEC7	SZF rating	3.104	18.337	95.750	0.989
XSEC8	SZF rating	3.300	10.773	95.750	0.982

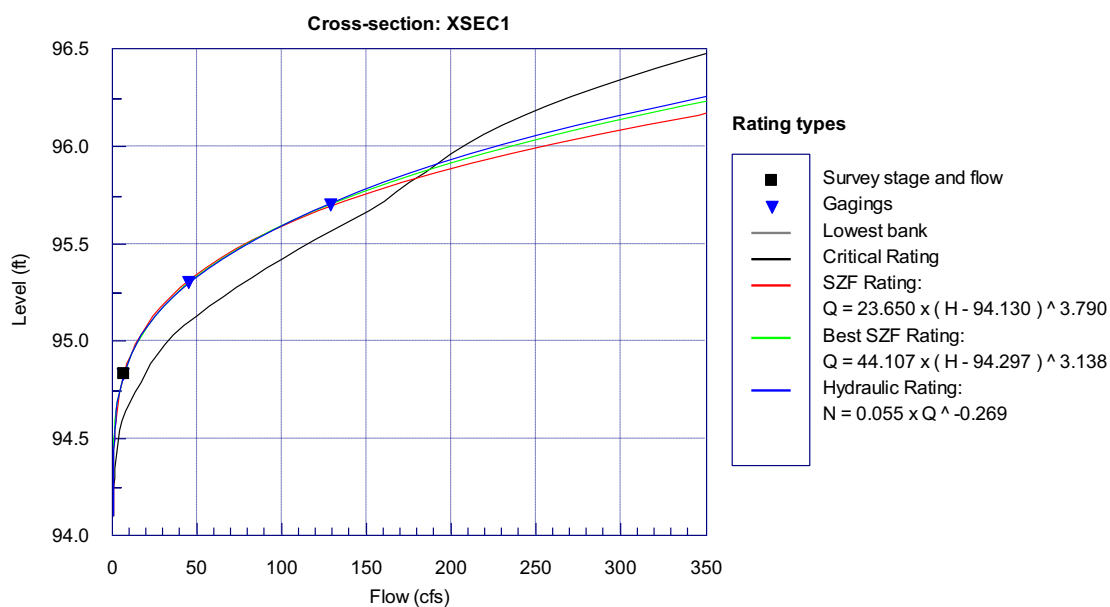


Figure 2. Site 1- example hydraulic calibration and predicted rating curve.

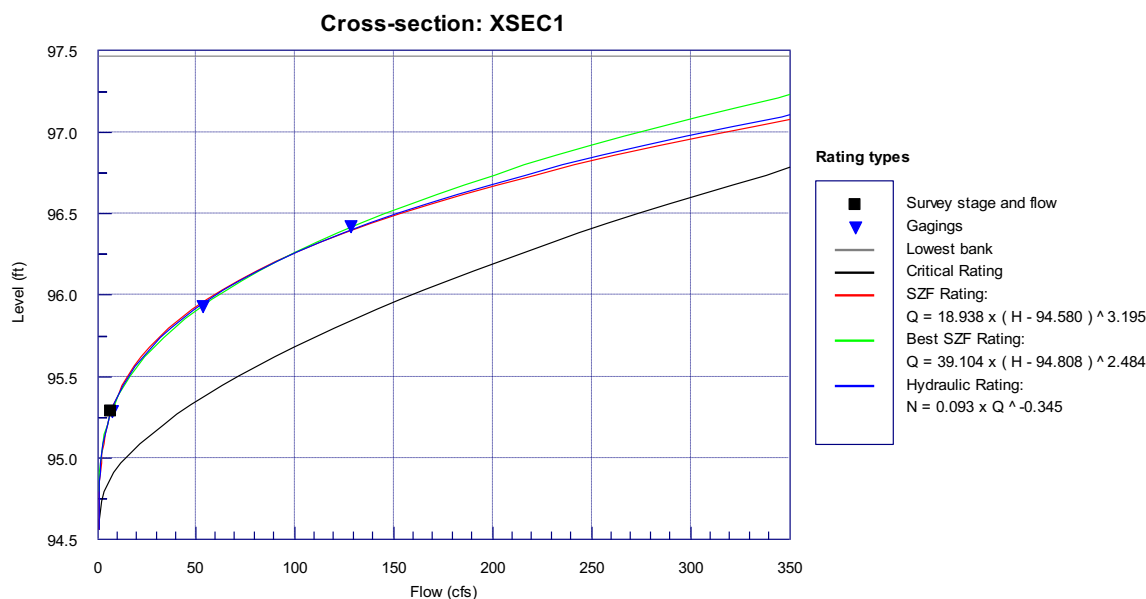


Figure 3. Site 2 - example hydraulic calibration and predicted rating curve.

Milk Creek Hydrology

The Milk Creek flow regime is typical of snowmelt – runoff hydrology in Colorado. No long-term streamflow gage data is available in the proposed instream reach. CWCB installed a temporary gage in 2017 in an effort to better understand the hydrology in the reach. Peak streamflows occur in May and June, base flows occur from August through February, March-April and July flows are the ascending and descending limb of the hydrograph, respectively (Figure 4). Stream flow in the study reach is affected by upstream diversions for irrigation and municipal/industrial uses. Peak flows can be over 400 cfs in high flow years. Mean peak flow from preliminary data is calculated at approximately 115 cfs **Error! Reference source not found..**

CWCB developed preliminary mean-monthly hydrology estimates based on the available gage data collected as of August 2024. These estimates include data from low flow years such as 2018 and 2020 as well as high flow years like 2019. The average monthly data show the snowmelt runoff period is from April through June. The lowest base flows occur in late summer into fall with mean monthly flows slightly lower than 5 cfs (Table 4).

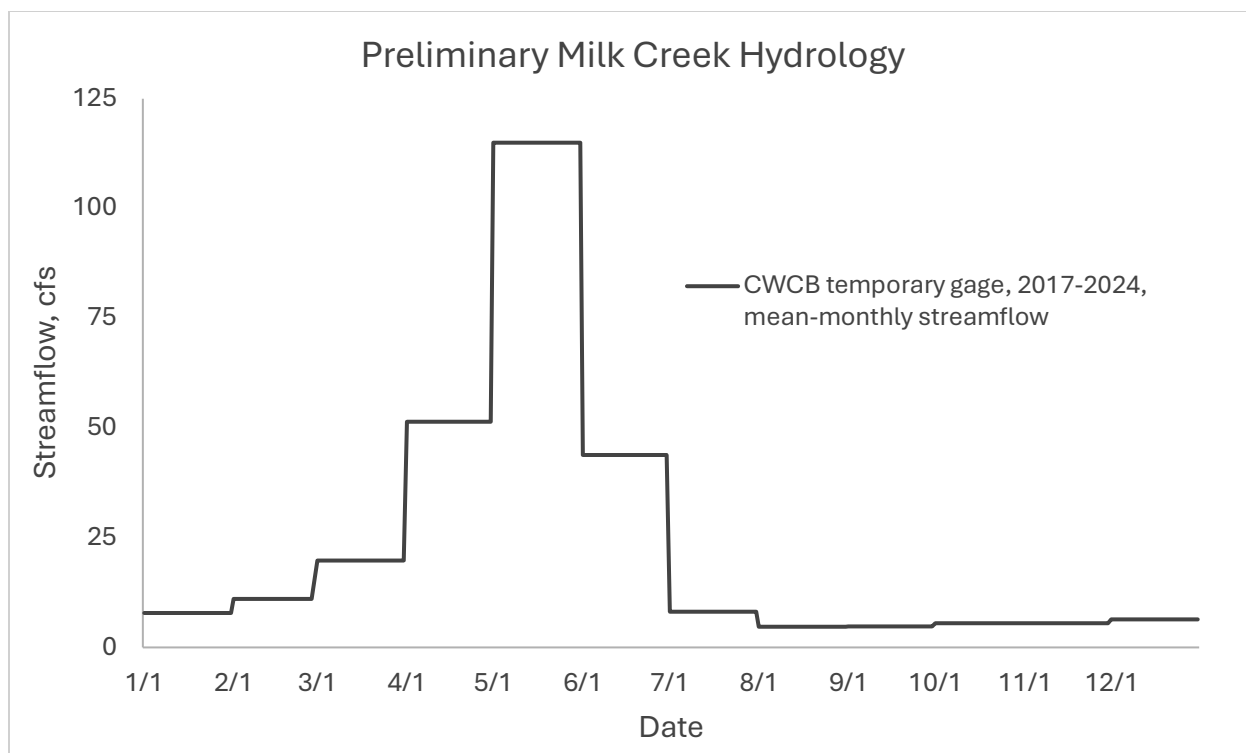


Figure 4. Milk Creek discharge from CWCB temporary gage, 2017 – 2024.

Table 4. Milk Creek mean monthly discharge for the period of record 2017 – 2024.

Month	Mean Monthly Value (cfs)
Jan	7.8
Feb	11.0
Mar	19.7
Apr	51.4
May	114.9
Jun	43.8
Jul	8.0
Aug	4.7
Sep	4.8
Oct	5.4
Nov	5.5
Dec	6.3

Habitat Model Results

SEFA produces a habitat index calculation of “Average Weighted Suitability” (AWS) to describe the hydraulic-habitat relationship to discharge. This calculation is similar to the PHABSIM habitat versus discharge function of “Weighted Usable Area”. The results of the hydraulic-habitat function are expressed as area (ft²) per linear distance (ft). The AWS is the Combined Suitability Index (CSI) for depth, velocity and substrate for each measurement point weighted by the area the point represents (Payne and Jowett 2011).

The maximum AWS for adult sucker habitat occurs at a flow of 40 cfs at both sites (Figure 5, Figure 6). The habitat index rapidly decreases for adult habitat as flow drop below 40 cfs. A flow of 10 cfs results in approximately 60% of the maximum habitat index. The habitat index has a less rapid decline for flows greater than 40 cfs. A flow of 100 cfs still has approximately 80% of the maximum habitat index.

The maximum AWS for spawning habitat occurs from 30 cfs to 40 cfs for both sites. There is very little difference between the spawning habitat index value at 30 cfs and 40 cfs (Figure 5, Figure 6). The shape of the AWS versus discharge function for spawning habitat is similar to the adult habitat discharge function with a steep decline in habitat as flows drop below 30 cfs. A flow of 10 cfs produces approximately 65% of the maximum potential habitat at Site 1 and approximately 58% of the maximum habitat potential at Site 2. The spawning habitat index at 100 cfs is slightly higher than 60% of the maximum habitat index at both sites.

The habitat time series shows the monthly change in average weighted suitability as a function of the average monthly flow. Adult and spawning habitat is highest at Site 1 and Site 2 during April through June when flows are greater than 40 cfs (Figure 7 ,Figure 8).

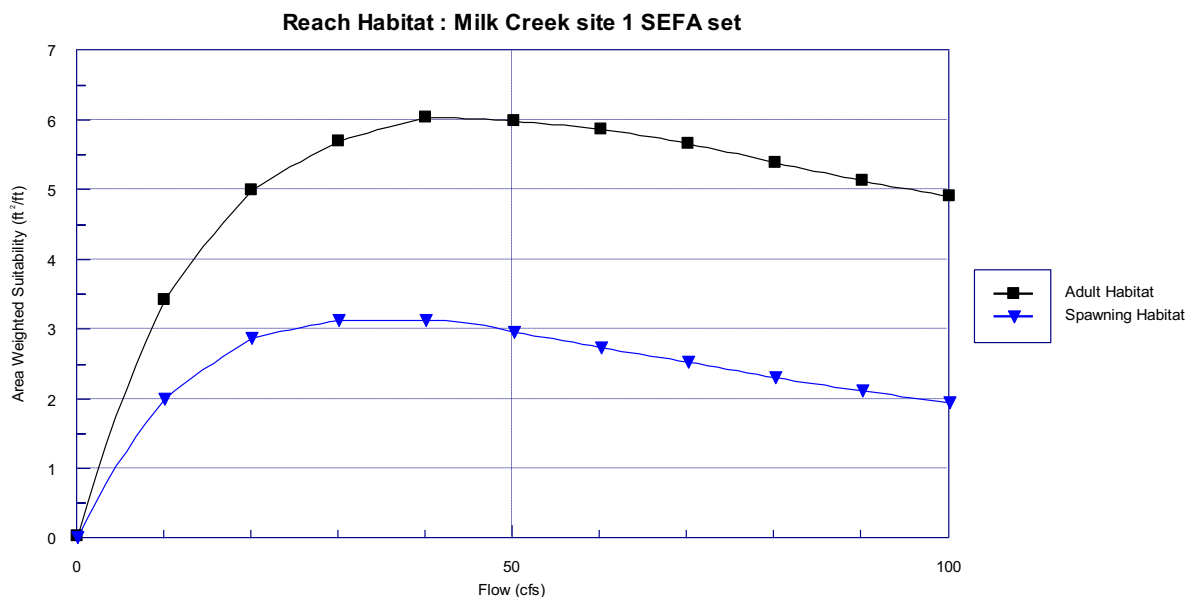


Figure 5. Milk Creek Site 1 predicted average weighted suitability as a function of discharge for adult and spawning Flannemouth and Bluehead Suckers.

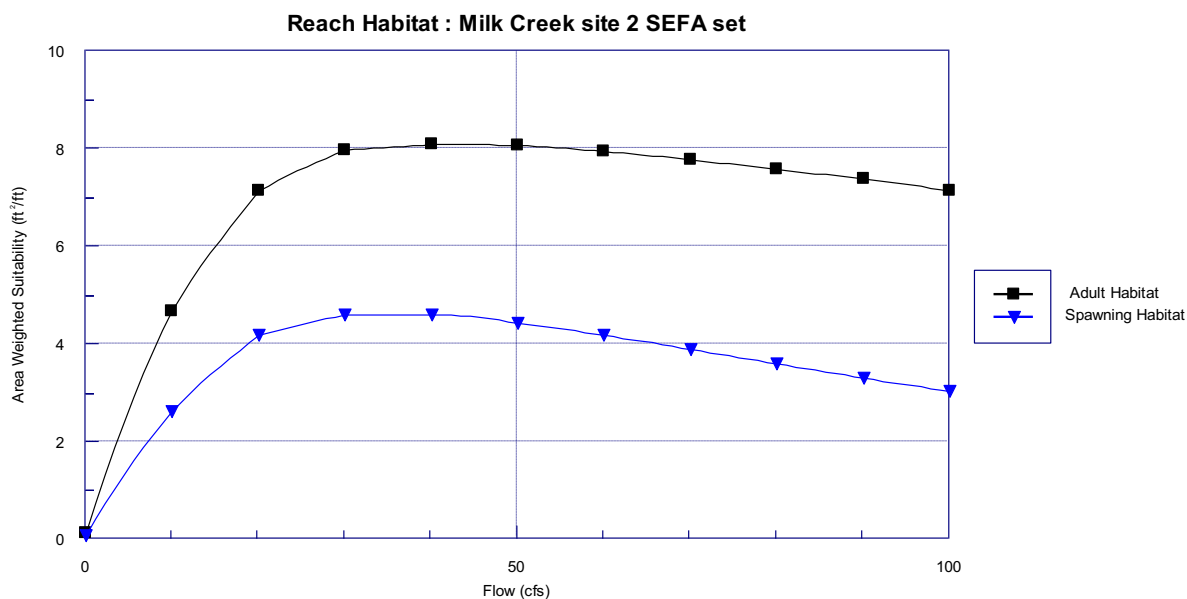


Figure 6. Milk Creek Site 2 predicted average weighted suitability as a function of discharge for adult and spawning Flannemouth and Bluehead Suckers.

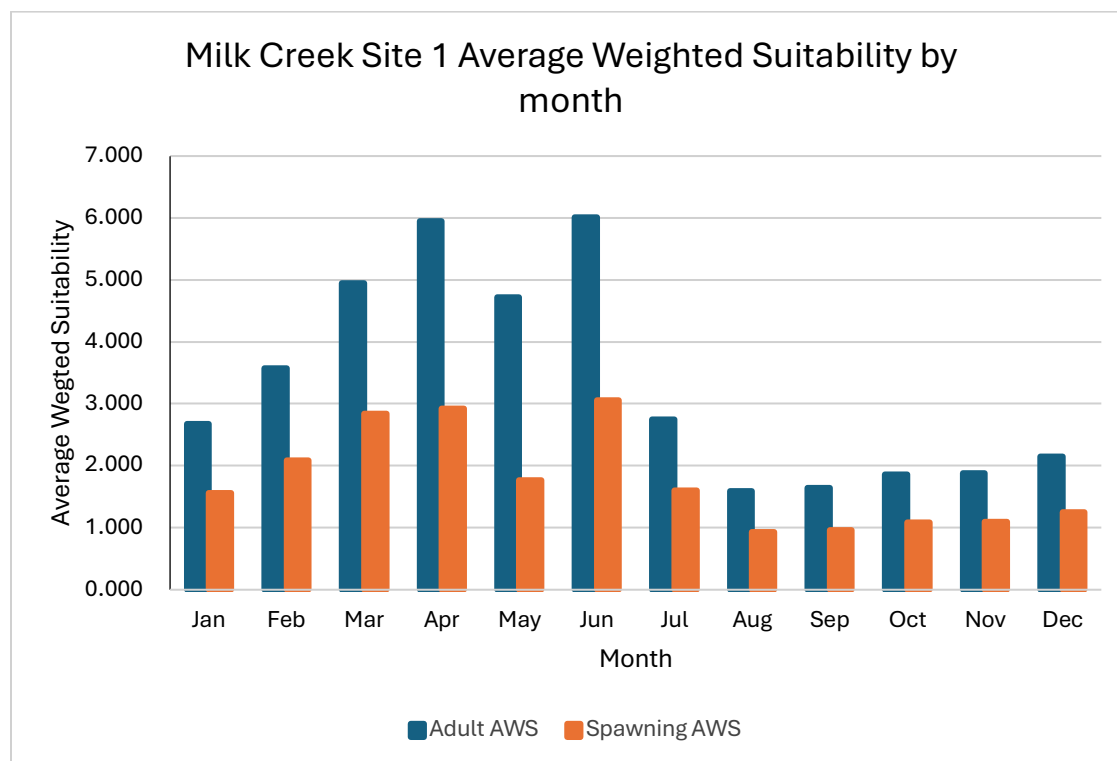


Figure 7. Milk Creek Site 1 average weighted suitability by month for adult and spawning Flannemouth and Bluehead Suckers.

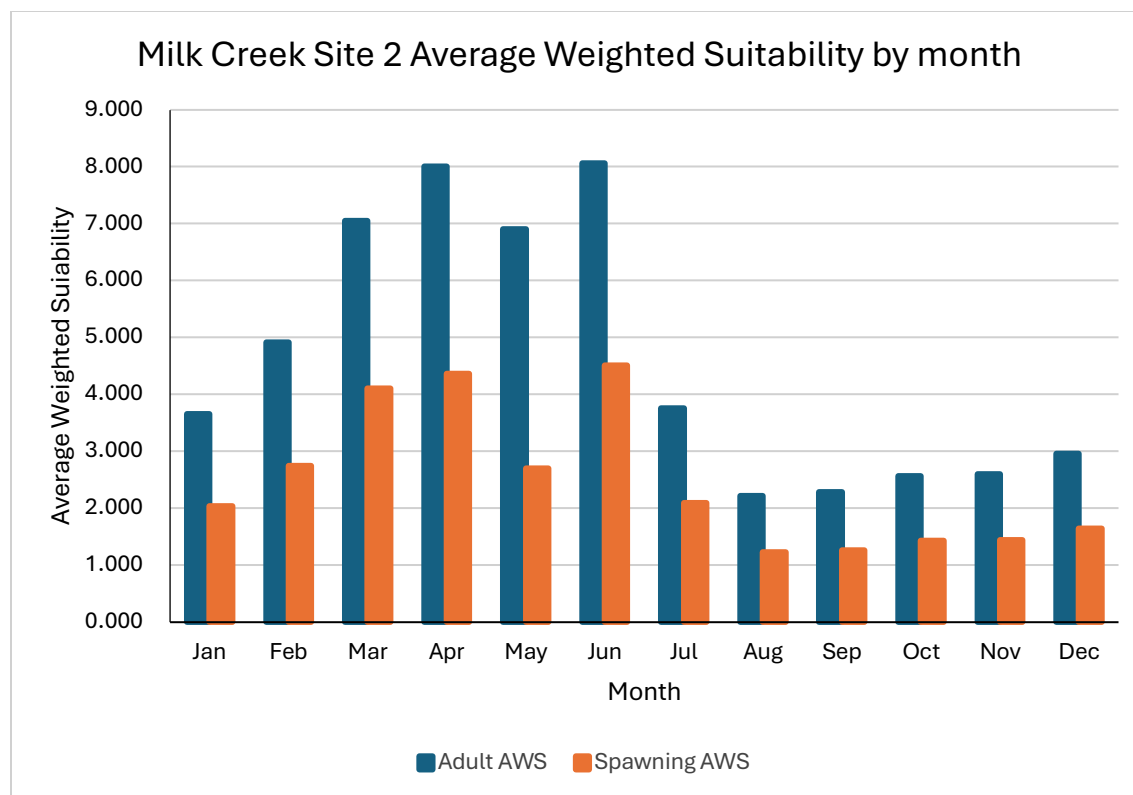


Figure 8. Milk Creek Site 2 average weighted suitability by month for adult and spawning Flannemouth and Bluehead Suckers.

Longitudinal connectivity is important in riverine systems to allow migration and localized movement required by fish and other aquatic biota (Annear et al. 2004). Analysis of fish passage is one means to assess connectivity and evaluate the flows needed to allow fish migration. Flannemouth Sucker and Bluehead Sucker migrate from larger rivers into smaller tributary streams for spawning. A passage criterion of 0.6 foot (7 inches) of depth was chosen based on professional judgement to evaluate fish passage for the native suckers. This depth is approximately double the body depth of adult Flannemouth Suckers (the larger of the two species), which should allow passage. The SEFA fish passage/connectivity analysis for Milk Creek showed a flow of 8 cfs there is a continuous pathway for fish passage through all cross sections that is at least 2 feet in width and at least 0.6 feet in depth at Milk Creek Site 1 (Figure 9) and Milk Creek Site 2 (Figure 10). The maximum depth analysis showed that a maximum depth of 0.6 feet in depth was present at some point in all cross sections at an average flow 4.6 cfs except for one of the seven shallowest cross sections. Fish movement across these shallow stream areas may be possible at flows as low as 4.6 cfs but movement may be slowed or temporarily impeded. Downstream movement may be less impeded for out migrating fish since the movement is in the same direction as the downstream velocity.

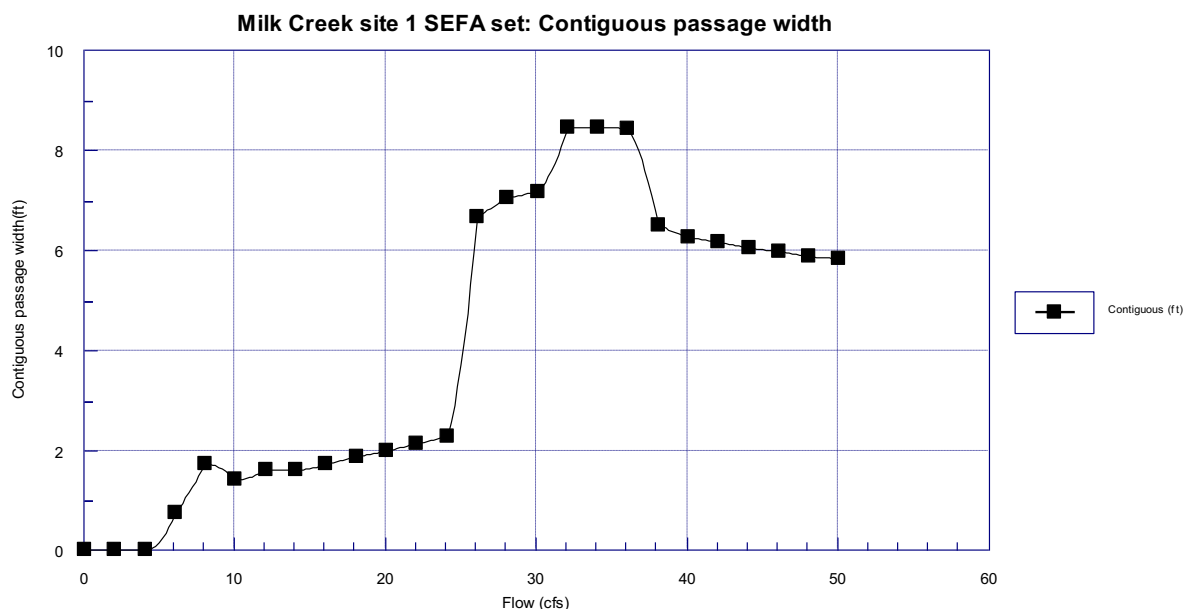


Figure 9. Milk Creek Site 1 predicted contiguous passage width as a function of discharge.

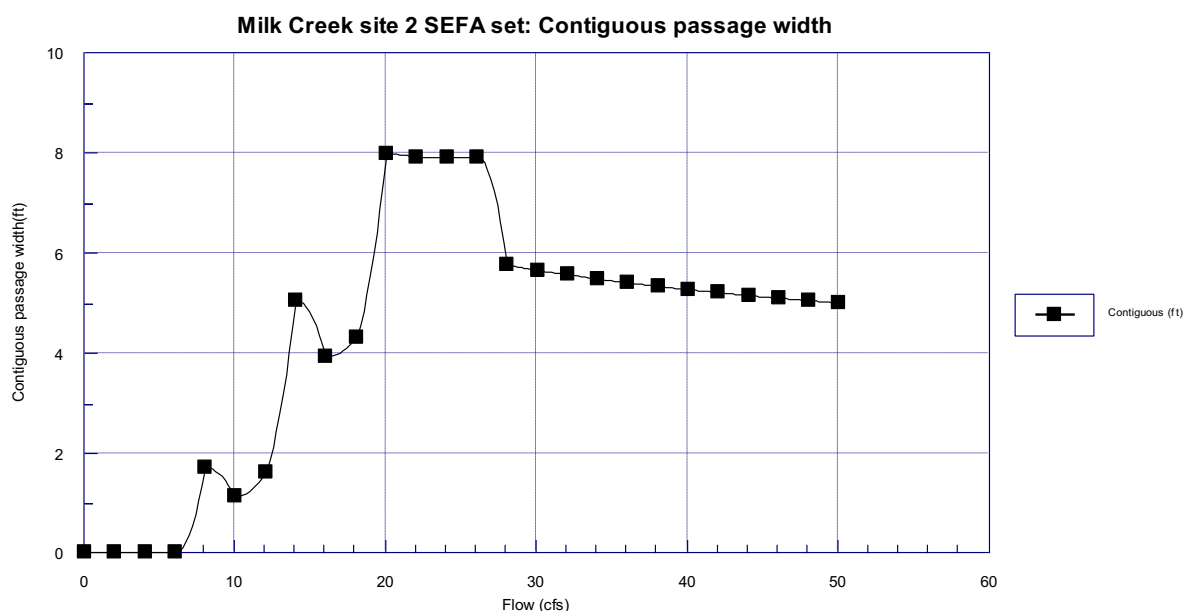


Figure 10. Milk Creek Site 2 predicted contiguous passage width as a function of discharge.

Discussion/Conclusion

The Milk Creek instream flow study used current state of the science methods to quantify fish habitat in the study reach. The study used field data from two representative study sites and SEFA software to quantify the relationship of habitat as a function of stream flow. The field

methods included multiple measurements of stream flow and water surface elevations for model calibration. The multiple measurements include flows for low base flow (less than 10 cfs), mid-range flows of 40-50 cfs and a moderately high flow of 126 cfs. The range of flow measurements provided data for a well calibrated hydraulic model.

The study sites and cross sections at both study sites included representation of all habitat types in the study reach. Each study site had eight cross sections which included replicate measurements of habitat types (riffle, pool, run) at each site. Each study site included habitat types for adult and spawning life stages of the two native suckers.

Stream flow of 30-40 cfs produces the maximum habitat for both adult and spawning life stages. Habitat availability declines at flow lower and higher than the maximum. Flannemouth Sucker and Bluehead Sucker spawn from spring to early summer, which coincides with the snowmelt-runoff peak flow in the stream. Protecting a minimum flow during snow melt runoff (April-June) of 40 cfs would provide unimpeded fish passage for fish migrating into Milk Creek and the most spawning habitat. The hydrology data demonstrate that a flow of 40 cfs is likely available in most years.

Adult Flannemouth Sucker and Bluehead Sucker migrate into tributary streams prior to the spawning period. Adequate streamflow is needed for longitudinal connectivity to allow migrating fish to move upstream. A minimum streamflow of 8 cfs is the flow at which fish passage through the study reach is possible. Flows lower than 8 cfs would likely make upstream migration difficult or unlikely. Passage increases as flow increase above 8 cfs.

Summer, fall and winter baseflows are needed to support resident native fish and the lower trophic levels that provide food resources for fish species. A base flow of 8 cfs provides the minimum flow at which passage is possible for resident and migratory fish, provides approximately 60% of the maximum habitat available for adult suckers, and provides approximately 60% of the maximum wetted perimeter at each site.

Appropriate flows for the ascending and descending limb of the hydrograph would allow more unimpeded movement for migration and for resident fish moving to spawning locations. A streamflow that is intermediate between the recommended base flow and peak flow would be more protective of the species than an abrupt change from baseflow to peak. An intermediate flow for the ascending and descending limb of the hydrograph based on water availability would be protective.

Summary of recommended instream flows for protection of native sucker in Milk Creek.

- Baseflow- August – March: 8 cfs
- Ascending and Descending limb – Based on water availability
- Peak flow- April-June: 40 cfs

Literature Cited

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Author's Biography

Dr. William J. Miller has over 44 years experience in fisheries, instream flow, and aquatic ecology studies. He has worked extensively throughout the western U.S. and is a recognized expert in the areas of instream flow, water temperature modeling and habitat assessments. Dr. Miller's experience includes research and evaluations for several threatened, endangered, and candidate aquatic species in the Colorado River, Platte River, Columbia River, and Missouri River basins. He has completed instream flow studies outside of the contiguous 48 states in Alaska and Puerto Rico. He has extensive experience in designing and conducting studies using the Instream Flow Incremental Methodology (IFIM), instream water temperature modeling and

developing and implementing ecological models for aquatic systems. Dr. Miller is a former member of the USFWS Instream Flow Group. He is co-author on the Stream Network Temperature Model, Instream Flow Information Paper 16. Dr. Miller has conducted seminars and training on instream flow techniques for federal, state, tribal and private entities.

Dr. Miller's experience includes designing and directing basinwide instream flow evaluations. He has completed instream flow evaluations for US Forest Service, US Fish and Wildlife Service, Bonneville Power Administration, U.S. Army Corps of Engineers, the U.S. Department of Justice and the Bureau of Land Management. Dr. Miller developed a GIS based methodology for determining flow/habitat relationships for aquatic species using 2 dimensional hydraulic modeling and habitat evaluations. Dr. Miller has presented his research at national conferences in the US and international conferences in Japan and New Zealand. Dr. Miller has testified as an instream flow expert in water court hearings in Colorado, Nebraska, California and Arizona.

Appendix A – Habitat Suitability Criteria

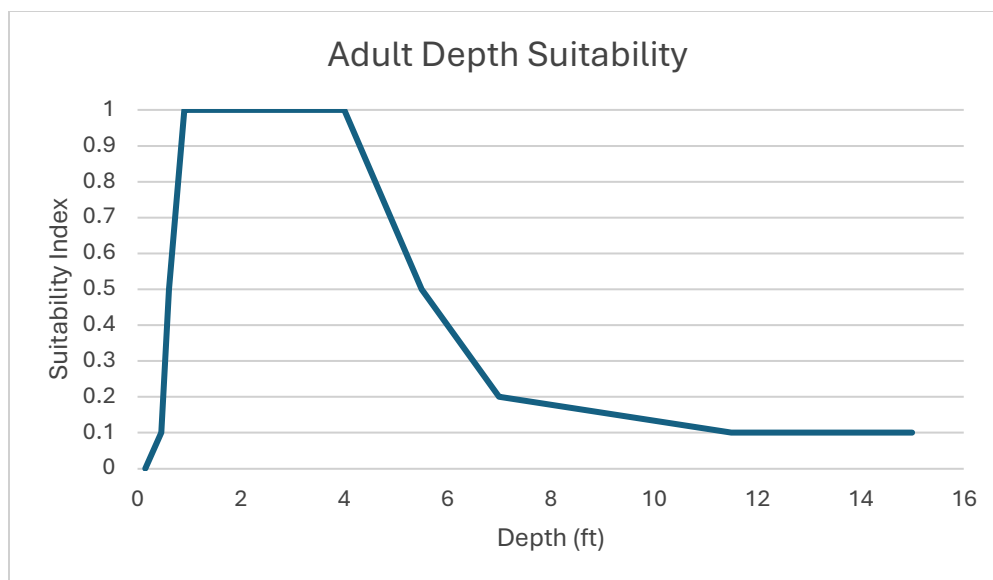


Figure A-1. Adult Depth Suitability Index for Flannelmouth Sucker and Bluehead Sucker. Data sources were values from Colorado River depth observation SI and USFWS published SI.

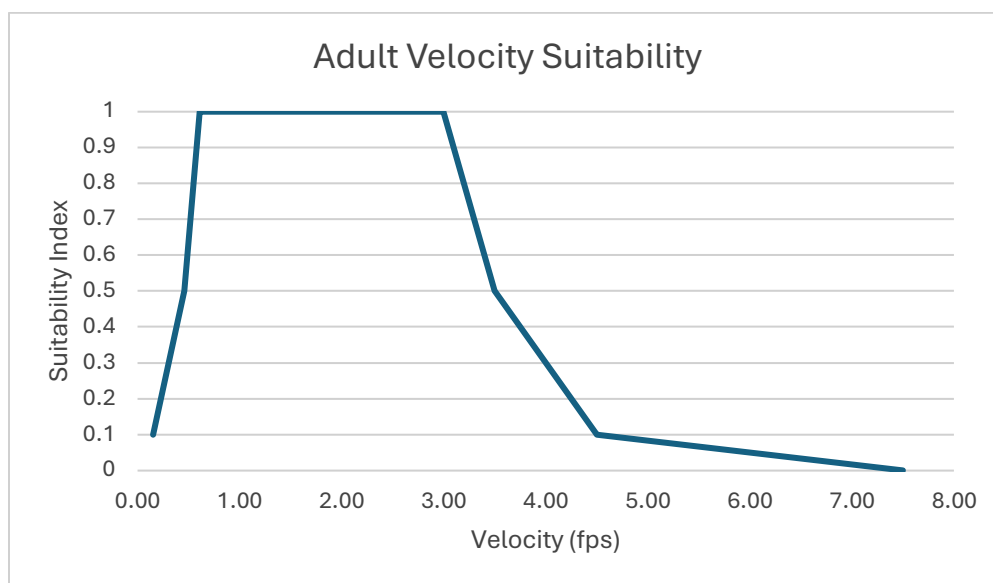


Figure A-2. Adult Velocity Suitability Index for Flannelmouth Sucker and Bluehead Sucker. Data sources were values from Colorado River velocity observation SI and USFWS published SI.

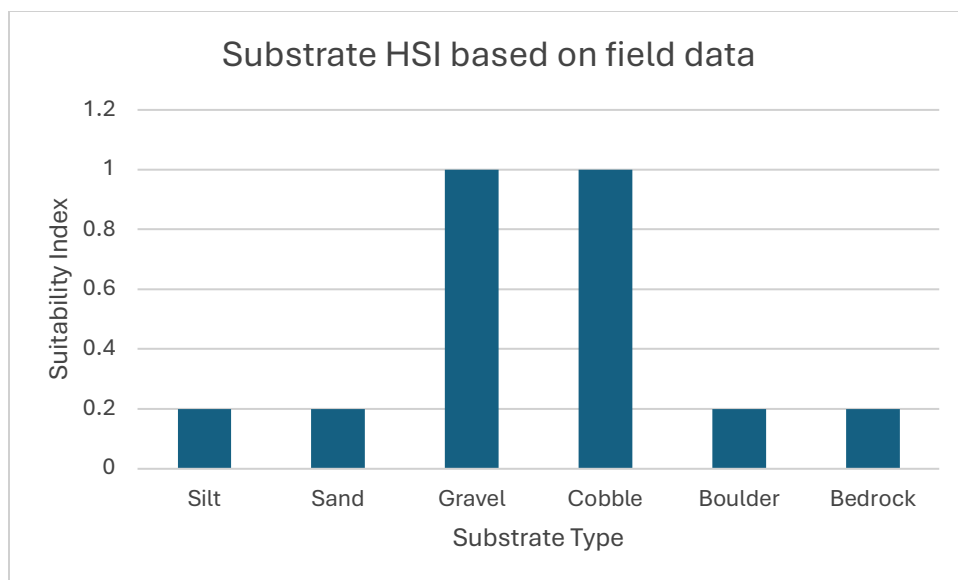


Figure A-3. Adult Flannemouth Sucker and Bluehead Sucker substrate suitability index based on field data collection.

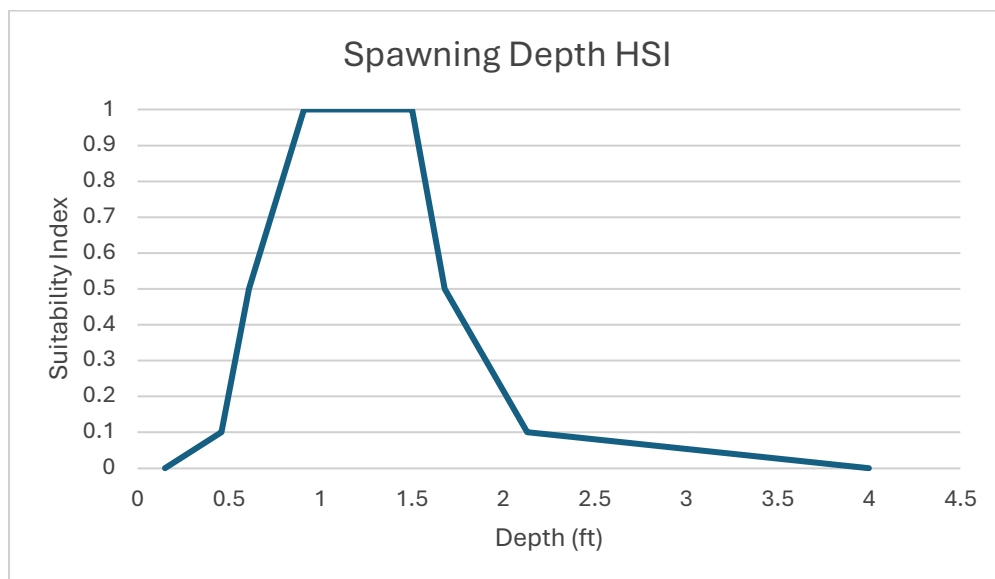


Figure A-4. Flannemouth Sucker and Bluehead Sucker spawning depth suitability index based on life history traits and adult habitat use.

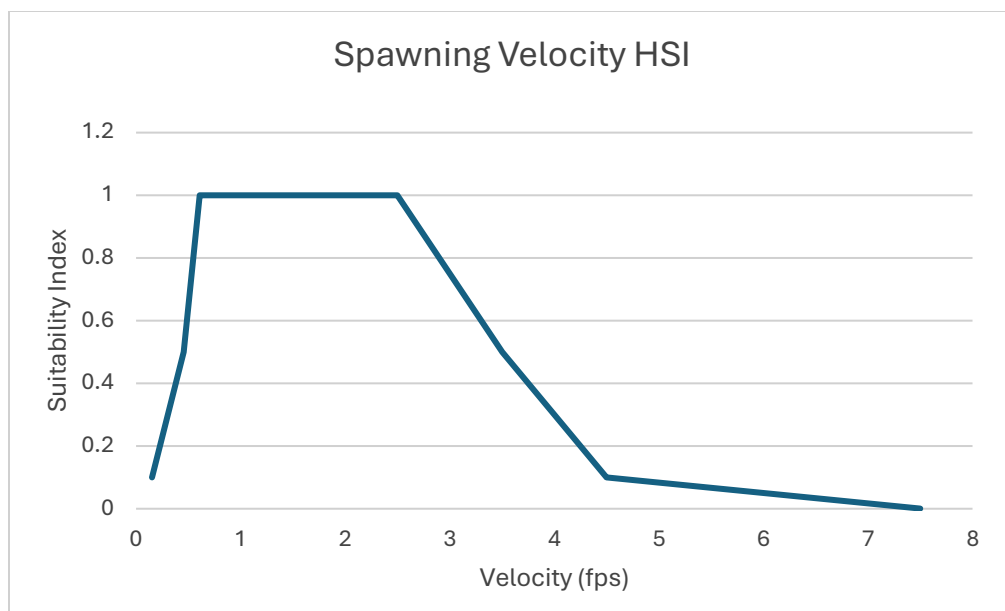


Figure A-5. Flannemouth Sucker and Bluehead Sucker spawning velocity suitability index based on life history traits and adult habitat use.

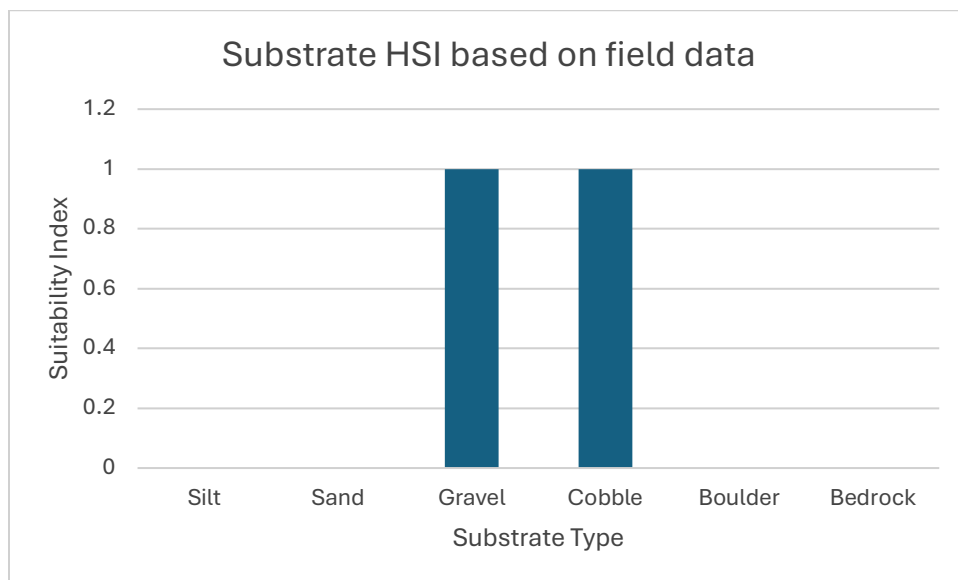


Figure A-6. Flannemouth Sucker and Bluehead Sucker spawning substrate suitability index based on life history traits and adult habitat use.

General Site Field Visit Data Report (Filters: Name begins with Milk Creek; Division = 6;)

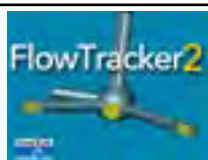
Type		Div	Name	CWCB Case Number	Segment ID	Visit Date	Location Description	Watershed Name
Stream		6	Milk Creek		18/6/A-002	7/13/2017	Milk Creek near confluence Yampa River	Lower Yampa
	Remarks	Date	Remark					
		13/07/17 09:00	Arrive BLM boundary near confluence					
		13/07/17 10:07	Reach characteristics: low gradient, rush covered bars, appropriate sinuosity, connection to flood plain, single channel					
	GPS Log	No GPS Log records for this visit.						

Stream	Photo Log	Photo Date	Camera	Media Type	Photo Video ID	Caption	Photo Comment
		13/07/17 09:37	Lumix DMC-TS2	Picture	10	Fresh beaver activity, instream	
		Link:					
		13/07/17 09:39	Lumix DMC-TS2	Picture	11	fresh beaver collection and in background, new instream work	
		Link:					
		13/07/17 10:07	Lumix DMC-TS2	Picture	12	Milk Creek looking downstream toward BLM/Private boundary	
		Link:					
		13/07/17 10:21	Lumix DMC-TS2	Picture	13	Milk Creek, low gradient section, cobble/boulder bed, cottonwoods, upland vegetation, high desert sage	
		Link:					
		13/07/17 10:59	Lumix DMC-TS2	Picture	14	Small fish observed at every place stopped along Milk Creek	
		Link:					
		13/07/17 13:29	Lumix DMC-TS2	Picture	15	Gage setup, looking downstream from right bank at control, natural boulders	
		Link:					
		13/07/17 13:29	Lumix DMC-TS2	Picture	16	Staff plate reading 1.50'	
		Link:					
		13/07/17 13:30	Lumix DMC-TS2	Picture	17	Same as 15, wide view of gage site	
		Link:					
		13/07/17 13:32	Lumix DMC-TS2	Picture	18	Taken downstream, center of channel, looking upstream at gage (taken below control at water level)	
		Link:					
		13/07/17 13:33	Lumix DMC-TS2	Picture	19	Taken downstream, center of channel, looking upstream at gage (taken below control at water level)	
		Link:					
		13/07/17 14:21	Lumix DMC-TS2	Picture	21	Crawfish, lots observed	
		Link:					
		13/07/17 14:23	Lumix DMC-TS2	Picture	20	Crawfish, lots observed	
		Link:					
		13/07/17 15:07	Lumix DMC-TS2	Picture	22	From BLM road looking at temp gage site	
		Link:					

Discharge Measurment Field Visit Data Report (Filters: Name begins with Milk Creek; Division = 6;)

Div	Name	CWCB Case Number	Segment ID	Meas. Date	UTM	Location	Flow Amount (cfs)	Meas #	Rating	Station ID
6	Milk Creek		18/6/A-002	07/13/2017	UTMx: 266158 UTMy: 4474679	Milk Creek near confluence Yampa River	3.92	1	G	MILCNCYR
6	Milk Creek		18/6/A-002	08/01/2017	UTMx: 266158 UTMy: 4474679	Milk Creek	4.66	2		
6	Milk Creek		18/6/A-002	08/14/2017	UTMx: 266158 UTMy: 4474679	Milk Creek	2.43	3		
6	Milk Creek		18/6/A-002	10/05/2017	UTMx: 266158 UTMy: 4474679	Milk Creek	14.13	4		
6	Milk Creek		18/6/A-002	11/27/2017	UTMx: 266158 UTMy: 4474679	Milk Creek	9.77	5		
6	Milk Creek		18/6/A-002	05/08/2018	UTMx: 266143 UTMy: 4474683	Milk Creek temporary gage, approx 1 mile upstream of confluence with Yampa River	170.01	6	Good(5%)	507
6	Milk Creek		18/6/A-002	06/04/2018	UTMx: 266317 UTMy: 4474205	Milk Creek near confl with Yampa River	6.63	7	Good(5%)	MILKCRD6
6	Milk Creek		18/6/A-002	08/15/2018	UTMx: 266342 UTMy: 4474174	Milk Creek 200ft upstream of gage	0.34	8	F	MILKCRD6
6	Milk Creek		18/6/A-002	09/13/2018	UTMx: 266342 UTMy: 4474174	Milk Creek temporary gage, approx 1 mile upstream of confluence with Yampa River	0.57	9	Good(5%)	MILKD6
6	Milk Creek		18/6/A-002	11/14/2018	UTMx: 266342 UTMy: 4474174	Milk Creek 400ft upstream of gage	3.83	10	F	MILKCRD6
6	Milk Creek		18/6/A-002	04/19/2019	UTMx: 266317 UTMy: 4474205	Milk Creek near confl with Yampa River - 80 feet downstream of road crossing (upstream of gage)	105.5	11		MILKCRD6
6	Milk Creek		18/6/A-002	05/07/2019	UTMx: 266317 UTMy: 4474205	Milk Creek near confl with Yampa River	263.26	12	Poor(>8%)	MILKCRD6
6	Milk Creek		18/6/A-002	07/12/2019	UTMx: 266317 UTMy: 4474205	Milk Creek near Yampa River - 375 feet upstream of gage (90 feet downstream of road crossing)	22.08	13	F	MILKCRD6
6	Milk Creek		18/6/A-002	07/30/2019	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	11.33	14	G	MILKCRD6
6	Milk Creek		18/6/A-002	10/08/2019	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	4.72	15		
6	Milk Creek		18/6/A-002	12/05/2019	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	13.1	16	G	MILKCRD6
6	Milk Creek		18/6/A-002	11/19/2020	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	6.31	17	G	MILKCRD6
6	Milk Creek		18/6/A-002	04/05/2021	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	17.13	18		MILKCRD6
6	Milk Creek		18/6/A-002	05/13/2021	UTMx: 266342 UTMy: 4474174	Milk Creek abv Yampa River confluence	17.47	19	G	
6	Milk Creek		18/6/A-002	06/16/2021	UTMx: 266342 UTMy: 4474174	Milk Creek abv Yampa River confluence	1.31	20	P	
6	Milk Creek		18/6/A-002	07/22/2021	UTMx: 266342 UTMy: 4474174	Milk Creek abv Yampa River confluence	1.24	21	P	

6	Milk Creek		18/6/A-002	08/19/2021	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	3.08	22	P	
6	Milk Creek		18/6/A-002	09/15/2021	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	1.15	23	F	
6	Milk Creek		18/6/A-002	11/01/2021	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	5.11	24		
6	Milk Creek		18/6/A-002	04/20/2022	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	38.46	25	g	
6	Milk Creek		18/6/A-002	05/24/2022	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	47.2	26		MILKCRD6
6	Milk Creek		18/6/A-002	08/18/2022	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	1.82	27	g	MILKCRD6
6	Milk Creek		18/6/A-002	11/01/2022	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	6.63	28	g	
6	Milk Creek		18/6/A-002	06/07/2023	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	146	30		MILKCRD6
6	Milk Creek		18/6/A-002	07/25/2023	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	5.73	31		MILKCRD6
6	Milk Creek		18/6/A-002	08/16/2023	UTMx: 266317 UTMy: 4474205	Milk Creek abv Yampa River confluence	8.24	32		MILKCRD6
6	Milk Creek		18/6/A-002	10/10/2023	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	4.84	33		MILKCRD6
6	Milk Creek		18/6/A-002	10/24/2023	UTMx: 266317 UTMy: 4474205	Milk Creek abd Yampa River confluence	5.72	34		MILKCRD6
6	Milk Creek		18/6/A-002	11/10/2023	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	4.99	35		MILKCRD6
6	Milk Creek		18/6/A-002	03/28/2024	UTMx: 266317 UTMy: 4474295	Milk creek abv Yampa River confluence	28.21	36		MILKCRD6
6	Milk Creek		18/6/A-002	04/12/2024	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	52.22	37		MILKCRD6
6	Milk Creek		18/6/A-002	05/29/2024	UTMx: 266317 UTMy: 4474295	Downstream SEFA site as part of SEFA water surface and Q measurement	127.6	38		MILKCRD6
6	Milk Creek		18/6/A-002	06/27/2024	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	13.13	39		MILKCRD6
6	Milk Creek		18/6/A-002	08/06/2024	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	4.37	40		MILKCRD6
6	Milk Creek		18/6/A-002	10/09/2024	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	2.27	41		MILKCRD6
6	Milk Creek		18/6/A-002	12/18/2024	UTMx: 266317 UTMy: 4474295	Milk Creek abv Yampa River confluence	5.34	42		MILKCRD6



Discharge Measurement Summary

Site name MILK CR NR CFL YAMPA
Site number
Operator(s) BRIAN EPSTEIN
File name MILCNCYR.001.FlowTracker2.ft
Comment

Start time	7/13/2017 2:29 PM	Sensor type	Unknown
End time	7/13/2017 2:50 PM	Handheld serial number	n/a
Start location latitude	-	Probe serial number	P2355
Start location longitude	-	Probe firmware	3.90
Calculations engine	FlowTracker2	Handheld software	n/a

# Stations	Avg interval (s)	Total discharge (ft³/s)
15	40	3.9242

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
14.300	7.5129	14.593

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
30	0.525	0.5223

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
84.124	0.760	0.7022

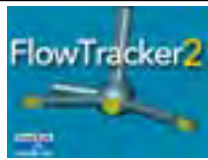
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.5%	3.2%
Velocity	0.4%	1.2%
Width	0.2%	0.2%
Method	2.3%	
# Stations	3.3%	
Overall	4.2%	3.6%

Discharge equation	Mid Section
Discharge uncertainty	ISO
Discharge reference	Measured

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

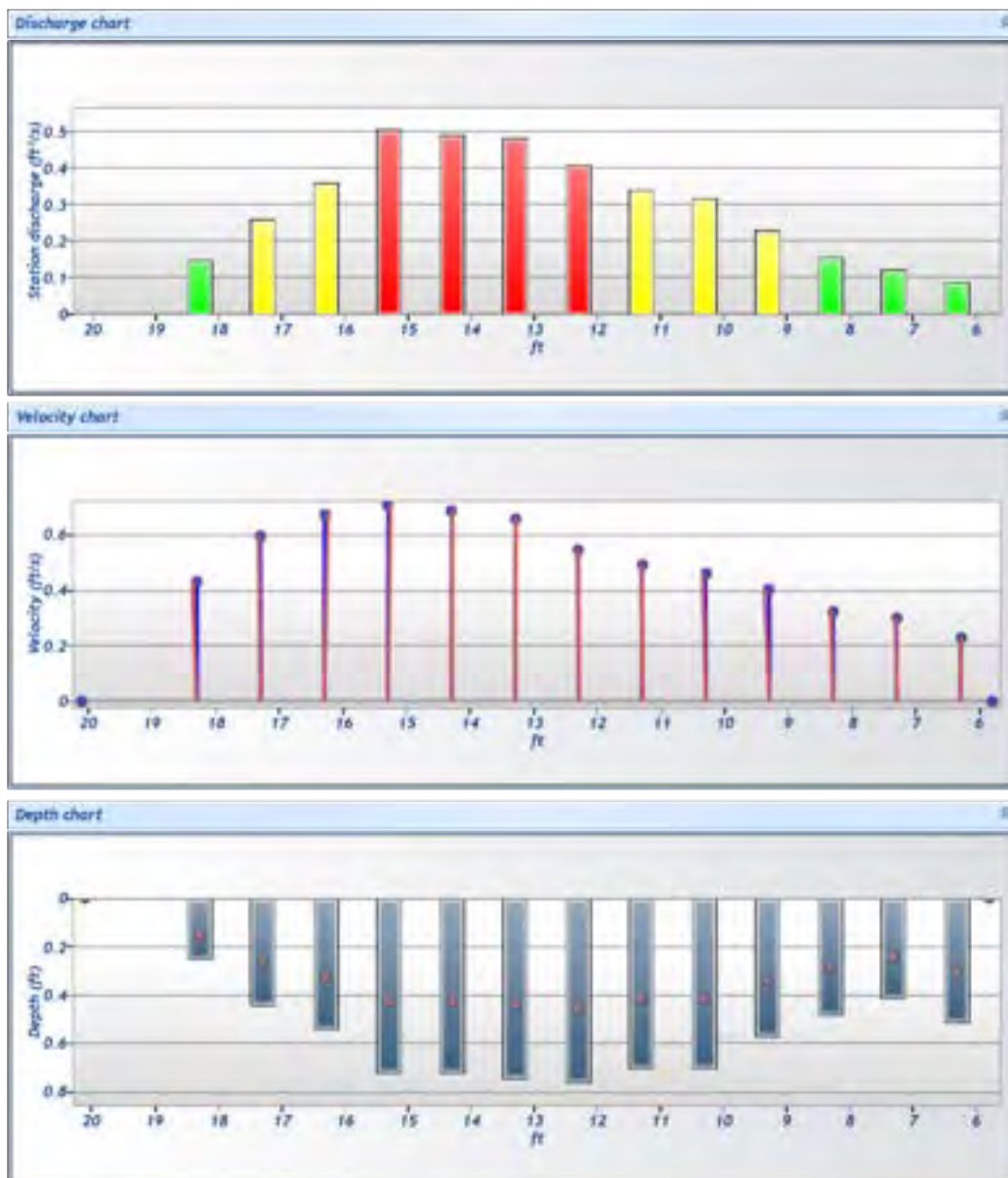


Discharge Measurement Summary

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Site number
Operator(s) BRIAN EPSTEIN
File name MILCNCYR.001.FlowTracker2.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	

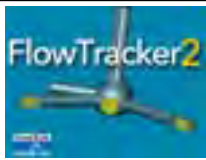




Discharge Measurement Summary

Site name MILK CR NR CFL YAMPA
Site number
Operator(s) BRIAN EPSTEIN
File name MILCNCYR.001.FlowTracker2.ft
Comment

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	MG
0	2:29 PM	5.300	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.2281	0.0000	0.0000	0.00
1	2:33 PM	6.300	0.6	0.510	0.6000	0.306	40	0.2281	1.0000	0.2281	0.3824	0.0872	2.22
2	2:34 PM	7.300	0.6	0.410	0.6000	0.246	40	0.2994	1.0000	0.2994	0.4101	0.1228	3.13
3	2:35 PM	8.300	0.6	0.480	0.6000	0.288	40	0.3245	1.0000	0.3245	0.4800	0.1558	3.97
4	2:37 PM	9.300	0.6	0.570	0.6000	0.342	40	0.4039	1.0000	0.4039	0.5699	0.2301	5.86
5	2:38 PM	10.300	0.6	0.700	0.6000	0.420	40	0.4565	1.0000	0.4565	0.7001	0.3196	8.14
6	2:39 PM	11.300	0.6	0.700	0.6000	0.420	40	0.4882	1.0000	0.4882	0.7001	0.3418	8.71
7	2:40 PM	12.300	0.6	0.760	0.6000	0.456	40	0.5429	1.0000	0.5429	0.7598	0.4125	10.51
8	2:42 PM	13.300	0.6	0.740	0.6000	0.444	40	0.6539	1.0000	0.6539	0.7402	0.4840	12.33
9	2:43 PM	14.300	0.6	0.720	0.6000	0.432	40	0.6832	1.0000	0.6832	0.7201	0.4920	12.54
10	2:44 PM	15.300	0.6	0.720	0.6000	0.432	40	0.7032	1.0000	0.7032	0.7201	0.5057	12.89
11	2:47 PM	16.300	0.6	0.540	0.6000	0.324	40	0.6696	1.0000	0.6696	0.5400	0.3616	9.21
12	2:48 PM	17.300	0.6	0.440	0.6000	0.264	40	0.5942	1.0000	0.5942	0.4400	0.2614	6.66
13	2:50 PM	18.300	0.6	0.250	0.6000	0.150	40	0.4274	1.0000	0.4274	0.3500	0.1496	3.81
14	2:50 PM	20.100	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.4274	0.0000	0.0000	0.00



Discharge Measurement Summary

Site name MILK CR NR CFL YAMPA
Site number
Operator(s) BRIAN EPSTEIN
File name MILCNCYR.001.FlowTracker2.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 4 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
7	2:40 PM	12.300	0.6	0.760	0.6000	0.456	High Str % Discharge
8	2:42 PM	13.300	0.6	0.740	0.6000	0.444	High Str % Discharge
9	2:43 PM	14.300	0.6	0.720	0.6000	0.432	High Str % Discharge
10	2:44 PM	15.300	0.6	0.720	0.6000	0.432	High Str % Discharge

[illegible]

Station Name: Milk Creek, T5N R62W Section 16, Jemp. gage						Spin tests		Meter Type: Marsh-McBirney		
Measurement information:						Pre	NA	Discharge =	2.43	ft ³ /s
Date: 8/14/2017						Post	NA	Area =	7.66	ft ²
						Average Velocity = 0.32 ft/s				
						Maximum Observed Depth = 1.10 ft				
XS Location: above gage										
Observers: E. Schmitt, R. Smith										
Dist. From initial point (ft)	Width (ft)	Depth (feet)	Revolutions	Seconds	Revs/sec	V=0.6 depth ft/s	Area, ft ²	Discharge, ft ³ /s	% Q	comment
5.0		0.00				0.00	0.000	0.000	0%	LEW
5.0	0.750	0.10				0.00	0.075	0.000	0%	
6.5	0.500	0.25				0.00	0.125	0.000	0%	
7.0	0.500	0.35				0.00	0.175	0.000	0%	
7.5	0.500	0.55				0.00	0.275	0.000	0%	
8.0	0.500	0.55				0.03	0.275	0.008	0%	
8.5	0.500	0.75				0.15	0.375	0.036	2%	
9.0	0.400	0.85				0.28	0.340	0.088	4%	
9.5	0.300	0.85				0.30	0.255	0.099	4%	
9.6	0.300	0.95				0.44	0.285	0.125	5%	
9.9	0.300	0.90				0.50	0.270	0.135	6%	
10.2	0.300	0.75				0.53	0.225	0.119	5%	
10.5	0.300	0.75				0.54	0.225	0.122	5%	
10.8	0.300	0.90				0.42	0.270	0.113	5%	
11.1	0.300	0.90				0.48	0.240	0.115	5%	
11.4	0.300	0.95				0.50	0.255	0.143	6%	
11.7	0.300	1.00				0.40	0.300	0.120	5%	
12.0	0.300	1.00				0.36	0.300	0.108	4%	
12.3	0.300	1.00				0.42	0.300	0.126	5%	
12.6	0.300	1.10				0.45	0.330	0.149	6%	
12.9	0.300	1.10				0.49	0.330	0.162	7%	
13.2	0.300	1.05				0.45	0.315	0.142	6%	
13.5	0.300	1.00				0.38	0.300	0.114	5%	
13.8	0.300	0.70				0.38	0.210	0.080	3%	
14.1	0.300	0.75				0.33	0.225	0.074	3%	
14.4	0.300	0.75				0.27	0.225	0.061	2%	
14.7	0.300	0.60				0.25	0.180	0.045	2%	
15.0	0.400	0.55				0.22	0.220	0.048	2%	
15.5	0.500	0.50				0.28	0.250	0.070	3%	
16.0	0.500	0.50				0.04	0.250	0.010	0%	
16.5	0.500	0.45				0.00	0.225	0.000	0%	
17.0	0.800	0.25				0.00	0.200	0.000	0%	
18.1	-8.500	0.00				0.00	0.000	0.000	0%	REW
	-9.050									
Total							7.655	2.43		

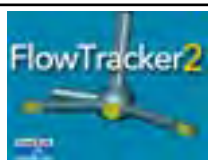
Station Name: Milk Creek, T5N R92W Section 18, temp. gage					Spin tests		Meter Type: Pygmy			
<u>Measurement information:</u>					Pre: 47		Discharge = 14.1 3 ft³/s			
Date: 10/5/2017					Pos: 54		Area = 7 ft²			
							Average Velocity = 0.71 ft/s			
							Maximum Observed Depth = 1.30 ft			
XS 100' below gage										
Observers: E. Scherff										
Dist. From initial point (ft)	Width (ft)	Depth (feet)	Revolutions	Seconds	Revs/sec	V-0.6 depth ft/s	Area, ft²	Discharge, ft³/s	% Q	comment
1.60		0.00			#DIV/0!	0.00	0.000	0.000	0%	LEW
2.00	0.450	0.20	0	34.8	0.0	0.00	0.090	0.000	0%	
2.50	0.500	0.32	3	35.6	0.1	0.11	0.160	0.018	0%	
3.00	0.400	0.45	12	31.7	0.4	0.40	0.180	0.072	1%	
3.30	0.300	0.45	17	30.2	0.6	0.58	0.135	0.078	1%	
3.60	0.300	0.50	25	30.6	0.8	0.83	0.150	0.124	1%	
3.90	0.300	0.53	30	30.5	1.0	0.99	0.159	0.157	1%	
4.20	0.300	0.57	30	30.4	1.0	0.99	0.171	0.170	1%	
4.50	0.300	0.62	29	30.7	0.9	0.95	0.186	0.177	1%	
4.80	0.250	0.70	32	30.3	1.1	1.06	0.175	0.185	1%	
5.00	0.225	0.72	32	30.0	1.1	1.07	0.162	0.173	1%	
5.25	0.250	0.73	34	30.5	1.1	1.12	0.183	0.204	1%	
5.50	0.250	0.75	34	30.4	1.1	1.12	0.188	0.210	1%	
5.75	0.250	0.80	34	30.7	1.1	1.11	0.200	0.222	2%	
6.00	0.250	0.80	33	30.0	1.1	1.10	0.200	0.220	2%	
6.25	0.250	0.80	34	30.0	1.1	1.13	0.200	0.227	2%	
6.50	0.250	0.83	33	30.3	1.1	1.09	0.208	0.226	2%	
6.75	0.250	0.90	32	30.0	1.1	1.07	0.225	0.241	2%	
7.00	0.250	0.95	32	30.3	1.1	1.06	0.238	0.251	2%	
7.25	0.250	0.95	32	30.6	1.0	1.05	0.238	0.249	2%	
7.50	0.250	1.00	32	30.7	1.0	1.05	0.250	0.261	2%	
7.75	0.250	1.00	32	30.3	1.1	1.06	0.250	0.265	2%	
8.00	0.250	1.07	30	30.5	1.0	0.99	0.268	0.264	2%	
8.25	0.250	1.10	30	30.0	1.0	1.00	0.275	0.276	2%	

8.50	0.250	1.12	29	30.4	1.0	0.96	0.280	0.269	2%
8.75	0.250	1.14	30	30.2	1.0	1.00	0.285	0.284	2%
9.00	0.250	1.20	31	30.6	1.0	1.02	0.300	0.305	2%
9.25	0.250	1.23	31	30.0	1.0	1.04	0.308	0.319	2%
9.50	0.250	1.25	29	30.7	0.9	0.95	0.313	0.297	2%
9.75	0.250	1.23	29	30.0	1.0	0.97	0.308	0.299	2%
10.00	0.250	1.20	28	30.0	0.9	0.94	0.300	0.282	2%
10.25	0.250	1.20	27	30.3	0.9	0.90	0.300	0.270	2%
10.50	0.250	1.20	27	30.8	0.9	0.88	0.300	0.265	2%
10.75	0.250	1.20	28	30.0	0.9	0.94	0.300	0.282	2%
11.00	0.250	1.20	27	30.6	0.9	0.89	0.300	0.267	2%
11.25	0.250	1.20	26	30.3	0.9	0.87	0.300	0.260	2%
11.50	0.250	1.25	26	30.7	0.8	0.86	0.313	0.267	2%
11.75	0.250	1.25	26	30.0	0.9	0.87	0.313	0.273	2%
12.00	0.250	1.25	24	30.0	0.8	0.81	0.313	0.253	2%
12.25	0.250	1.28	25	30.0	0.8	0.84	0.320	0.270	2%
12.50	0.250	1.30	25	30.3	0.8	0.83	0.325	0.271	2%
12.75	0.250	1.30	25	30.4	0.8	0.83	0.325	0.270	2%
13.00	0.250	1.30	24	30.7	0.8	0.79	0.325	0.258	2%
13.25	0.250	1.30	23	30.8	0.7	0.76	0.325	0.246	2%
13.50	0.250	1.30	23	30.0	0.8	0.78	0.325	0.253	2%
13.75	0.250	1.23	23	30.3	0.8	0.77	0.308	0.237	2%
14.00	0.275	1.20	23	30.5	0.8	0.77	0.330	0.253	2%
14.30	0.300	1.20	22	31.1	0.7	0.72	0.360	0.259	2%
14.60	0.300	1.16	22	30.0	0.7	0.75	0.348	0.259	2%
14.90	0.300	1.20	21	31.0	0.7	0.69	0.360	0.249	2%
15.20	0.300	1.20	21	30.7	0.7	0.70	0.360	0.251	2%
15.50	0.300	1.15	19	30.7	0.6	0.63	0.345	0.219	2%
15.80	0.300	1.12	18	30.5	0.6	0.61	0.336	0.204	1%
16.10	0.300	1.12	17	30.0	0.6	0.58	0.336	0.196	1%
16.40	0.300	1.15	17	30.0	0.6	0.58	0.345	0.201	1%
16.70	0.300	1.15	17	31.3	0.5	0.56	0.345	0.193	1%
17.00	0.400	1.14	16	30.0	0.5	0.55	0.456	0.251	2%
17.50	0.500	1.10	13	30.0	0.4	0.45	0.550	0.250	2%

18.00	0.500	1.10	13	30.5	0.4	0.45	0.55 0	0.246	2%
18.50	0.500	1.10	10	30.2	0.3	0.35	0.55 0	0.195	1%
19.00	0.500	1.10	10	33.0	0.3	0.33	0.55 0	0.180	1%
19.50	0.500	1.20	9	31.2	0.3	0.31	0.60 0	0.188	1%
20.00	0.500	1.30	7	30.0	0.2	0.26	0.65 0	0.169	1%
20.50	0.500	1.25	5	36.9	0.1	0.16	0.62 5	0.103	1%
21.00	0.750	1.10	0	30.0	0.0	0.00	0.82 5	0.000	0%
22.00	1.000	0.80	0	30.0	0.0	0.00	0.80 0	0.000	0%
23.00	1.050	0.65	0	30.0	0.0	0.00	0.68 3	0.000	0%
24.10	-11.500	0.00			#DIV/0 !	0.00	0.00 0	0.000	0%
	-12.050				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
	0.000				#DIV/0 !	0.00	0.00 0	0.000	0%
				Total:			21.5 74	14.13	100 %

REW

Station Name: Milk Creek, TSN R32V Section 18, lamp, gage					Son tests		Meter Type: Pygmy			
Measurement information:					Pre: 52		Discharge = 9.77 ft ³ /s			
Date: 11/27/2017					Post: 57		Area = 10.84 ft ²			
					Average Velocity = 0.80 ft/s					
					Maximum Observed Depth = 1.35 ft					
XS Location: 20 m above gage										
Observers: E. Scherff										
Dist. From	Width (ft)	Depth	Revolutions	Seconds	Revs/sec	%	Area, ft ²	Discharge, ft ³ /s	% Q	comment
Initial point (ft)		(feet)								
4.00		0.00	0		#DN/0!	0.00	0.000	0.000	0%	LEW
5.40		0.05	9	30.9	0.3	0.32	0.129	0.040	0%	
6.00		0.50	11	31.2	0.4	0.36	0.165	0.062	1%	
6.80		0.50	13	30.1	0.4	0.45	0.185	0.084	1%	
7.00		0.50	16	30.8	0.5	0.54	0.250	0.134	1%	
7.50		0.50	16	31.7	0.5	0.52	0.220	0.115	1%	
8.00		0.50	21	30.0	0.7	0.71	0.275	0.196	2%	
8.50		0.50	19	31.0	0.6	0.63	0.300	0.189	2%	
9.00		0.50	18	31.4	0.6	0.59	0.450	0.285	3%	
9.50		0.50	23	30.5	0.8	0.77	0.500	0.363	4%	
10.00		0.450	26	30.7	0.8	0.86	0.518	0.443	5%	
10.40		0.400	32	30.2	1.1	1.06	0.440	0.467	5%	
10.80		0.400	36	30.3	1.2	1.19	0.480	0.570	6%	
11.20		0.400	40	30.1	1.3	1.32	0.540	0.715	7%	
11.60		0.400	53	30.0	1.1	1.10	0.540	0.595	6%	
12.00		0.400	38	30.8	1.2	1.24	0.420	0.522	5%	
12.40		0.400	37	30.1	1.2	1.23	0.440	0.540	6%	
12.80		0.400	34	30.8	1.1	1.11	0.480	0.531	5%	
13.20		0.400	32	30.8	1.0	1.04	0.480	0.500	5%	
13.60		0.400	35	30.8	1.1	1.14	0.460	0.526	5%	
14.00		0.400	34	30.1	1.1	1.13	0.440	0.497	5%	
14.40		0.400	31	30.3	1.0	1.03	0.440	0.452	5%	
14.80		0.400	28	30.8	0.9	0.92	0.400	0.368	4%	
15.20		0.400	22	30.9	0.7	0.73	0.400	0.293	3%	
15.60		0.400	30	30.0	1.0	1.00	0.390	0.381	3%	
16.00		0.450	23	30.0	0.8	0.78	0.428	0.322	3%	
16.50		0.500	17	33.3	0.5	0.53	0.300	0.159	2%	
17.00		0.500	25	30.6	0.8	0.83	0.200	0.165	2%	
17.50		0.500	15	30.2	0.5	0.52	0.225	0.118	1%	
18.00		0.500	16	30.1	0.5	0.56	0.075	0.041	0%	
18.50		0.500	17	31.5	0.5	0.56	0.200	0.111	1%	
19.00		0.450	12	30.6	0.4	0.41	0.180	0.075	1%	
19.40	#REF!	0.30	0		#DN/0!	0.00	0.000	0.000	0%	REW
			Total		#DN/0!		10.838	9.77	100%	



Discharge Measurement Summary

Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Start time	5/8/2018 11:43 AM	Sensor type	Top Setting
End time	5/8/2018 12:30 PM	Handheld serial number	FT2H1747037
Start location latitude	-	Probe serial number	FT2P1747048
Start location longitude	-	Probe firmware	1.23
Calculations engine	FlowTracker2	Handheld software	1.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
19	40	170.0106

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
26.700	51.6000	28.135

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
61	1.933	3.2948

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
54.087	2.700	5.0201

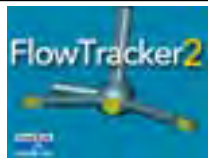
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.1%	1.8%
Velocity	0.3%	2.2%
Width	0.1%	0.1%
Method	1.0%	
# Stations	2.6%	
Overall	3.0%	3.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

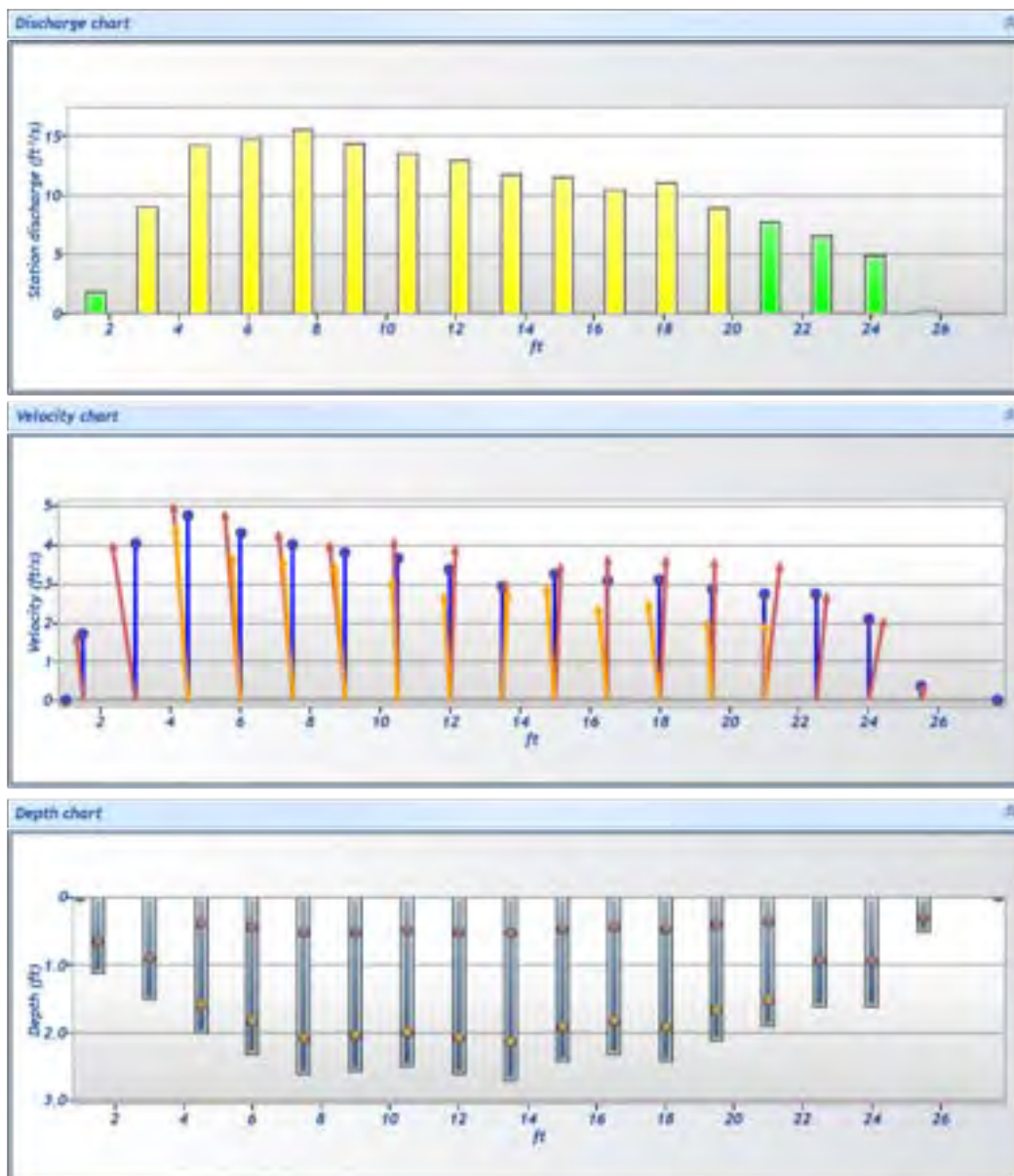


Discharge Measurement Summary

Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Station Warning Settings

Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	





Discharge Measurement Summary

Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Sta	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrects (ft)	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
0	11:43 AM	1.000	None	0.000	0.0000	0.000	0	0.0000	1.0000	1.6789	0.0000	0.0000	0.00	✓
1	11:51 AM	1.500	0.6	1.100	0.6000	0.660	80	1.6789	1.0000	1.6789	1.1000	1.8468	1.09	✓
2	11:52 AM	3.000	0.6	1.500	0.6000	0.900	80	4.0259	1.0000	4.0259	2.2500	9.0582	5.33	✓
3	11:54 AM	4.500	0.2/0.8	2.000	0.2000	0.400	80	5.0701	1.0000	4.7469	1.0000	14.2407	8.38	✓
3	11:54 AM	4.500	0.2/0.8	2.000	0.8000	1.600	80	4.4737	1.0000	4.7469	1.0000	14.2407	8.38	✓
4	11:57 AM	6.000	0.2/0.8	2.300	0.2000	0.460	80	4.8267	1.0000	4.2739	3.4500	14.7450	8.67	✓
4	11:57 AM	6.000	0.2/0.8	2.300	0.8000	1.840	80	3.7211	1.0000	4.2739	1.4500	14.7450	8.67	✓
5	11:59 AM	7.500	0.2/0.8	2.600	0.2000	0.520	80	4.3110	1.0000	3.9830	3.9000	15.5336	9.14	✓
5	11:59 AM	7.500	0.2/0.8	2.600	0.8000	2.080	80	3.6049	1.0000	3.9830	3.9000	15.5336	9.14	✓
6	12:02 PM	9.000	0.2/0.8	2.550	0.2000	0.510	80	3.0493	1.0000	3.7641	3.8250	14.3875	8.47	✓
6	12:02 PM	9.000	0.2/0.8	2.550	0.8000	2.040	80	3.4790	1.0000	3.7641	3.8250	14.3875	8.47	✓
7	12:05 PM	10.500	0.2/0.8	2.500	0.2000	0.500	80	4.1307	1.0000	3.6158	3.7500	13.5591	7.98	✓
7	12:05 PM	10.500	0.2/0.8	2.500	0.8000	2.000	80	3.1013	1.0000	3.6158	3.7500	13.5591	7.98	✓
8	12:07 PM	12.000	0.2/0.8	2.600	0.2000	0.520	80	3.9368	1.0000	3.3268	3.0000	12.9744	7.63	✓
8	12:07 PM	12.000	0.2/0.8	2.600	0.8000	2.080	80	2.7167	1.0000	3.3268	3.0000	12.9744	7.63	✓
9	12:10 PM	13.500	0.2/0.8	2.700	0.2000	0.540	80	3.0415	1.0000	2.9066	4.0500	11.7715	6.92	✓
9	12:10 PM	13.500	0.2/0.8	2.700	0.8000	2.160	80	2.7716	1.0000	2.9066	4.0500	11.7715	6.92	✓
10	12:12 PM	15.000	0.2/0.8	2.400	0.2000	0.480	80	3.4075	1.0000	3.2200	3.6000	11.5919	6.80	✓
10	12:12 PM	15.000	0.2/0.8	2.400	0.8000	1.920	80	2.9524	1.0000	3.2200	3.6000	11.5919	6.80	✓
11	12:14 PM	16.500	0.2/0.8	2.300	0.2000	0.460	80	3.0866	1.0000	3.0489	3.4500	10.5187	6.19	✓
11	12:14 PM	16.500	0.2/0.8	2.300	0.8000	1.840	80	2.4113	1.0000	3.0489	3.4500	10.5187	6.19	✓
12	12:17 PM	18.000	0.2/0.8	2.400	0.2000	0.480	80	2.6471	1.0000	3.0925	3.6000	11.1373	6.55	✓
12	12:17 PM	18.000	0.2/0.8	2.400	0.8000	1.920	80	2.5381	1.0000	3.0925	3.6000	11.1373	6.55	✓
13	12:19 PM	19.500	0.2/0.8	2.100	0.2000	0.420	80	3.6137	1.0000	2.8306	3.1500	8.9352	5.26	✓
13	12:19 PM	19.500	0.2/0.8	2.100	0.8000	1.680	80	2.0904	1.0000	2.8306	3.1500	8.9352	5.26	✓
14	12:22 PM	21.000	0.2/0.8	1.900	0.2000	0.380	80	3.5211	1.0000	2.7479	2.8500	7.8315	4.61	✓
14	12:22 PM	21.000	0.2/0.8	1.900	0.8000	1.520	80	1.9747	1.0000	2.7479	2.8500	7.8315	4.61	✓
15	12:24 PM	22.500	0.6	1.600	0.6000	0.960	80	2.7297	1.0000	2.7297	2.4000	6.5513	3.85	✓
15	12:26 PM	24.000	0.6	1.600	0.6000	0.960	80	2.0798	1.0000	2.0798	2.4000	4.9814	2.94	✓
17	12:28 PM	25.500	0.6	0.300	0.6000	0.300	80	0.3571	1.0000	0.3571	0.3250	0.3304	0.19	✓
18	12:30 PM	27.000	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.3571	0.0000	0.0000	0.00	✓



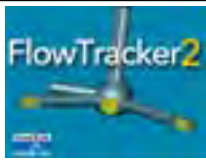
Discharge Measurement Summary

Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

ST#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	11:51 AM	1.500	0.6	1.100	0.6000	0.660	Water Depth = QC_Standard Error > QC
2	11:52 AM	3.000	0.6	1.500	0.6000	0.900	Standard Error > QC
3	11:54 AM	4.500	0.2/0.8	2.000	0.2000	0.400	Standard Error > QC
3	11:54 AM	4.500	0.2/0.8	2.000	0.8000	1.600	Standard Error > QC
4	11:57 AM	6.000	0.2/0.8	2.300	0.2000	0.460	Standard Error > QC
4	11:57 AM	6.000	0.2/0.8	2.300	0.8000	1.840	Standard Error > QC
5	11:59 AM	7.500	0.2/0.8	2.600	0.2000	0.520	Standard Error > QC
5	11:59 AM	7.500	0.2/0.8	2.600	0.8000	2.080	Standard Error > QC
6	12:02 PM	9.000	0.2/0.8	2.550	0.2000	0.510	Standard Error > QC
6	12:02 PM	9.000	0.2/0.8	2.550	0.8000	2.040	Standard Error > QC
7	12:05 PM	10.500	0.2/0.8	2.500	0.2000	0.500	Standard Error > QC
7	12:05 PM	10.500	0.2/0.8	2.500	0.8000	2.000	Standard Error > QC
8	12:07 PM	12.000	0.2/0.8	2.600	0.2000	0.520	Standard Error > QC
8	12:07 PM	12.000	0.2/0.8	2.600	0.8000	2.080	Standard Error > QC
9	12:10 PM	13.500	0.2/0.8	2.700	0.2000	0.540	Standard Error > QC
9	12:10 PM	13.500	0.2/0.8	2.700	0.8000	2.160	Standard Error > QC
10	12:12 PM	15.000	0.2/0.8	2.400	0.2000	0.480	Standard Error > QC
10	12:12 PM	15.000	0.2/0.8	2.400	0.8000	1.920	Standard Error > QC
11	12:14 PM	16.500	0.2/0.8	2.300	0.2000	0.460	Standard Error > QC
11	12:14 PM	16.500	0.2/0.8	2.300	0.8000	1.840	Standard Error > QC
12	12:17 PM	18.000	0.2/0.8	2.400	0.2000	0.480	Standard Error > QC
12	12:17 PM	18.000	0.2/0.8	2.400	0.8000	1.920	Standard Error > QC
13	12:19 PM	19.500	0.2/0.8	2.100	0.2000	0.420	Standard Error > QC
13	12:19 PM	19.500	0.2/0.8	2.100	0.8000	1.680	Standard Error > QC
14	12:22 PM	21.000	0.2/0.8	1.900	0.2000	0.380	Standard Error > QC
14	12:22 PM	21.000	0.2/0.8	1.900	0.8000	1.520	Standard Error > QC
15	12:24 PM	22.500	0.6	1.600	0.6000	0.960	Standard Error > QC
16	12:26 PM	24.000	0.6	1.600	0.6000	0.960	Standard Error > QC

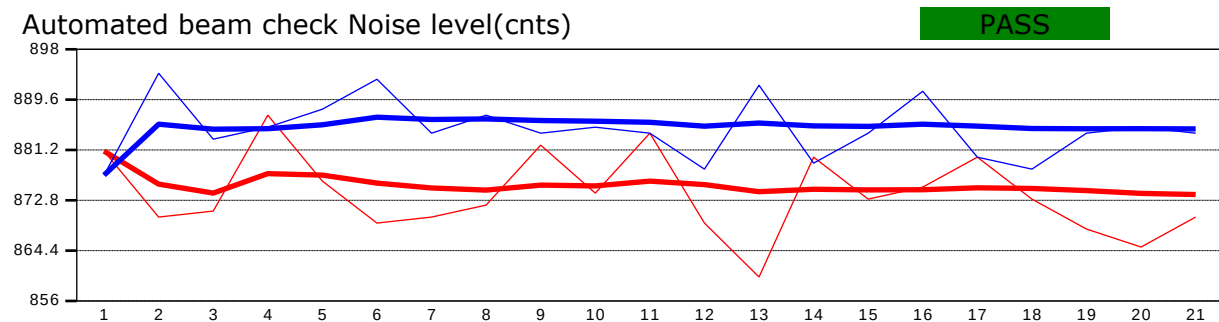
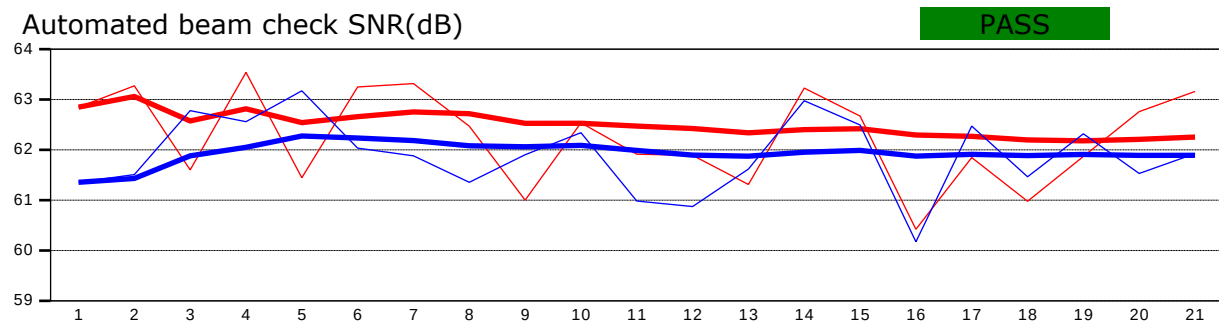


Discharge Measurement Summary

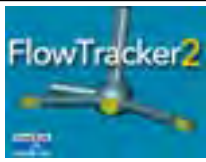
Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 5/8/2018 11:40:46 AM



Automated beam check Quality control warnings
No quality control warnings



Discharge Measurement Summary

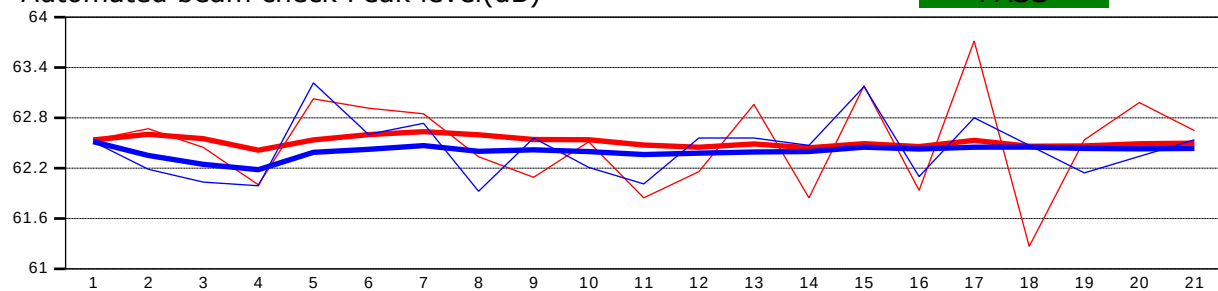
Site name Milk Creek - D6
Site number 0508
Operator(s) Jack Landers
File name 20180508_Milk Creek - D6.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 5/8/2018 11:40:46 AM

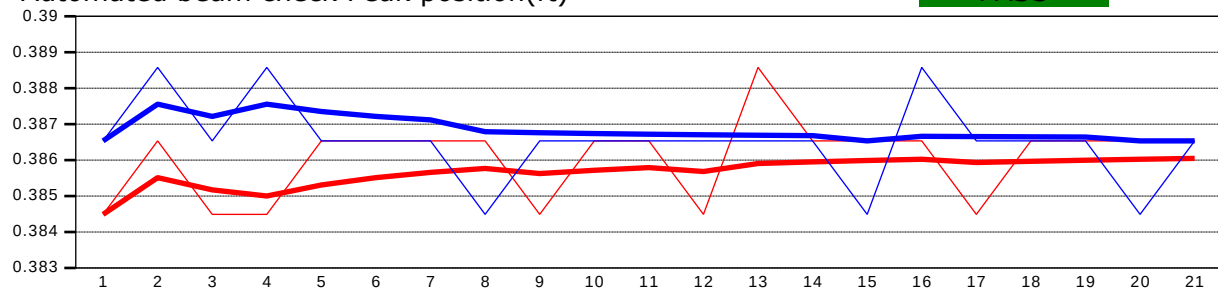
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings

Discharge Measurement Summary

Date Generated: Fri Nov 30 2018

File Information

File Name MILKCRD6.001.WAD
Start Date and Time 2018/06/04 17:55:19

Site Details

Site Name MILK CR GAGE 2
Operator(s) JACK LANDERS

System Information

Sensor Type FlowTracker
Serial # P2355
CPU Firmware Version 3.9
Software Ver 2.30
Mounting Correction 0.0%

Units (English Units)

Distance ft
Velocity ft/s
Area ft²
Discharge cfs

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.4%	2.3%
Velocity	0.9%	6.1%
Width	0.1%	0.1%
Method	2.0%	-
# Stations	2.1%	-
Overall	3.2%	6.6%

Summary

Averaging Int. 40 # Stations 24
Start Edge LEW Total Width 15.700
Mean SNR 30.2 dB Total Area 11.060
Mean Temp 77.88 °F Mean Depth 0.704
Disch. Equation Mid-Section Mean Velocity 0.5991
Total Discharge 6.6259

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	17:55	1.30	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
<i>1</i>	<i>17:56</i>	<i>1.50</i>	<i>0.6</i>	<i>0.900</i>	<i>0.6</i>	<i>0.360</i>	<i>-0.0016</i>	<i>1.00</i>	<i>-0.0016</i>	<i>0.405</i>	<i>-0.0007</i>	<i>0.0</i>
2	17:57	2.20	0.6	0.900	0.6	0.360	0.9219	1.00	0.9219	0.630	0.5809	8.8
3	17:58	2.90	0.6	0.750	0.6	0.300	1.1099	1.00	1.1099	0.525	0.5828	8.8
<i>4</i>	<i>17:59</i>	<i>3.60</i>	<i>0.6</i>	<i>0.850</i>	<i>0.6</i>	<i>0.340</i>	<i>0.8868</i>	<i>1.00</i>	<i>0.8868</i>	<i>0.595</i>	<i>0.5278</i>	<i>8.0</i>
5	18:00	4.30	0.6	0.800	0.6	0.320	0.8389	1.00	0.8389	0.560	0.4698	7.1
<i>6</i>	<i>18:01</i>	<i>5.00</i>	<i>0.6</i>	<i>0.700</i>	<i>0.6</i>	<i>0.280</i>	<i>0.4416</i>	<i>1.00</i>	<i>0.4416</i>	<i>0.490</i>	<i>0.2165</i>	<i>3.3</i>
7	18:02	5.70	0.6	0.900	0.6	0.360	0.9436	1.00	0.9436	0.630	0.5945	9.0
8	18:03	6.40	0.6	1.000	0.6	0.400	0.8862	1.00	0.8862	0.700	0.6204	9.4
9	18:04	7.10	0.6	0.900	0.6	0.360	0.9324	1.00	0.9324	0.630	0.5875	8.9
<i>10</i>	<i>18:05</i>	<i>7.80</i>	<i>0.6</i>	<i>0.800</i>	<i>0.6</i>	<i>0.320</i>	<i>0.6883</i>	<i>1.00</i>	<i>0.6883</i>	<i>0.560</i>	<i>0.3855</i>	<i>5.8</i>
11	18:06	8.50	0.6	1.000	0.6	0.400	0.4705	1.00	0.4705	0.700	0.3294	5.0
12	18:07	9.20	0.6	0.950	0.6	0.380	0.8091	1.00	0.8091	0.665	0.5382	8.1
13	18:08	9.90	0.6	0.850	0.6	0.340	0.6732	1.00	0.6732	0.595	0.4007	6.0
14	18:09	10.60	0.6	0.600	0.6	0.240	0.7021	1.00	0.7021	0.420	0.2950	4.5
<i>15</i>	<i>18:10</i>	<i>11.30</i>	<i>0.6</i>	<i>0.600</i>	<i>0.6</i>	<i>0.240</i>	<i>0.1821</i>	<i>1.00</i>	<i>0.1821</i>	<i>0.420</i>	<i>0.0765</i>	<i>1.2</i>
16	18:11	12.00	0.6	0.700	0.6	0.280	0.0912	1.00	0.0912	0.490	0.0447	0.7
17	18:12	12.70	0.6	0.700	0.6	0.280	0.3107	1.00	0.3107	0.490	0.1523	2.3
18	18:14	13.40	0.6	0.500	0.6	0.200	0.2753	1.00	0.2753	0.350	0.0964	1.5
19	18:14	14.10	0.6	0.500	0.6	0.200	0.1512	1.00	0.1512	0.350	0.0529	0.8
20	18:15	14.80	0.6	0.500	0.6	0.200	0.1450	1.00	0.1450	0.350	0.0508	0.8
21	18:16	15.50	0.6	0.450	0.6	0.180	0.0823	1.00	0.0823	0.315	0.0260	0.4
22	18:17	16.20	0.6	0.250	0.6	0.100	-0.0098	1.00	-0.0098	0.187	-0.0018	0.0
23	18:17	17.00	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

Discharge Measurement Summary

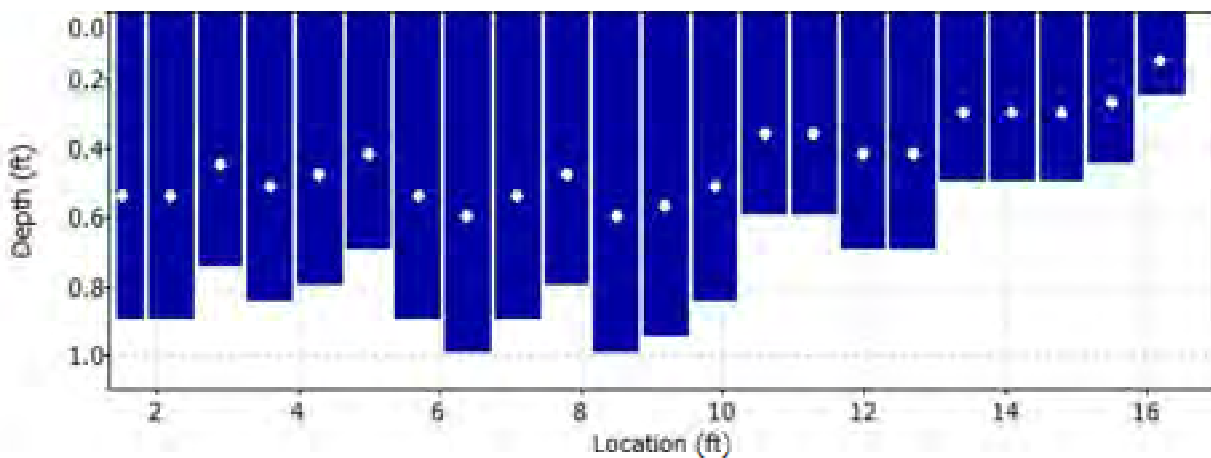
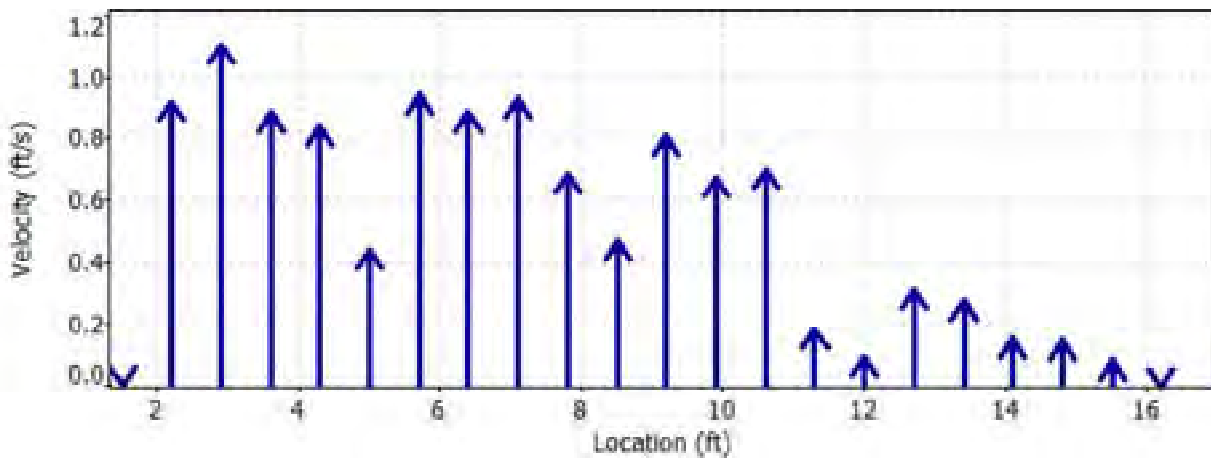
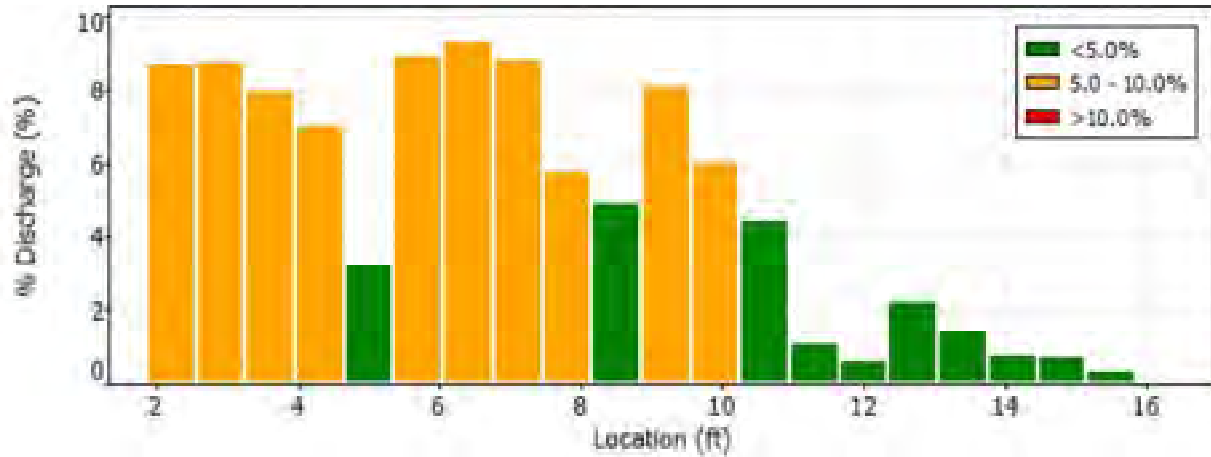
Date Generated: Fri Nov 30 2018

File Information

File Name MILKCRD6.001.WAD
Start Date and Time 2018/06/04 17:55:19

Site Details

Site Name MILK CR GAGE 2
Operator(s) JACK LANDERS



Discharge Measurement Summary

Date Generated: Fri Nov 30 2018

File Information

File Name MILKCRD6.001.WAD
Start Date and Time 2018/06/04 17:55:19

Site Details

Site Name MILK CR GAGE 2
Operator(s) JACK LANDERS

Quality Control

St	Loc	%Dep	Message
1	1.50	0.6	SNR (44.5) is different from typical SNR (30.2)
		0.6	High SNR variation during measurement: 6.9,14.2
4	3.60	0.6	High angle: -21
6	5.00	0.6	High standard error: 0.046
10	7.80	0.6	High standard error: 0.036
15	11.30	0.6	High angle: -32

Discharge Measurement Summary

Date Generated: Fri Nov 30 2018

File Information

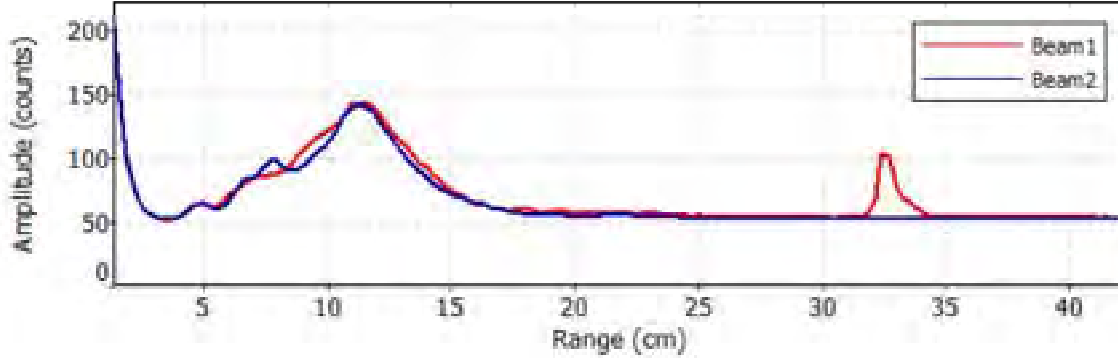
File Name MILKCRD6.001.WAD
Start Date and Time 2018/06/04 17:55:19

Site Details

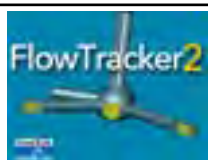
Site Name MILK CR GAGE 2
Operator(s) JACK LANDERS

Automatic Quality Control Test (BeamCheck)

Mon Jun 4 17:53:37 MDT 2018



- ✓ Noise level check - Pass
- ✓ SNR check - Pass
- ✓ Peak location check - Pass
- ✓ Peak shape check - Pass



Discharge Measurement Summary

Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Start time	9/13/2018 8:35 AM	Sensor type	Top Setting
End time	9/13/2018 8:59 AM	Handheld serial number	FT2H1747037
Start location latitude	40.385	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.23
Calculations engine	FlowTracker2	Handheld software	1.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
22	40	0.5674

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
9.700	4.0400	10.174

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
35	0.416	0.1404

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
53.871	0.800	0.2316

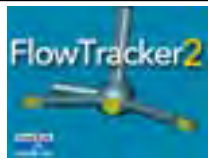
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	5.1%
Velocity	0.7%	7.6%
Width	0.1%	0.1%
Method	1.9%	
# Stations	2.3%	
Overall	3.2%	9.2%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
 Quality control warnings



Discharge Measurement Summary

Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Station Warning Settings

Station discharge OK Station discharge < 5.00%
Station discharge caution 5.00% >= Station discharge < 10.00%
Station discharge warning Station discharge >= 10.00%

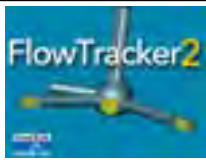




Discharge Measurement Summary

Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Seq	Time	Location (ft)	Method	Depth (ft)	%Depth	Missed Depth (ft)	Samples	Velocity (ft/s)	Correct on	Mean Velocity (ft/s)	Area (ft²)	Flow (ft³/s)	Q2	
0	8:25 AM	5.101	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.0000	0.0000	0.00	✓	
1	8:25 AM	6.600	0.6	0.200	0.6000	0.120	80	0.0001	1.0000	0.0001	0.1500	0.0000	0.00	✓
2	8:27 AM	7.000	0.6	0.200	0.6000	0.120	80	0.2316	1.0000	0.2316	0.0800	0.0185	1.37	✓
3	8:28 AM	7.400	0.6	0.250	0.6000	0.150	80	0.2232	1.0000	0.2232	0.1600	0.0223	1.93	✓
4	8:29 AM	7.800	0.6	0.300	0.6000	0.180	80	0.1779	1.0000	0.1779	0.1200	0.0213	1.76	✓
5	8:41 AM	8.200	0.6	0.500	0.6000	0.300	80	0.1801	1.0000	0.1801	0.2000	0.0360	5.55	✓
6	8:42 AM	8.600	0.6	0.450	0.6000	0.270	80	0.2248	1.0000	0.2248	0.1800	0.0405	7.13	✓
7	8:43 AM	9.000	0.6	0.500	0.6000	0.300	80	0.1617	1.0000	0.1617	0.2000	0.0323	5.70	✓
8	8:44 AM	9.400	0.6	0.450	0.6000	0.270	80	0.1726	1.0000	0.1726	0.1800	0.0311	5.48	✓
9	8:45 AM	9.800	0.6	0.390	0.6000	0.260	80	0.1361	1.0000	0.1361	0.1200	0.0163	2.88	✓
10	8:46 AM	10.200	0.6	0.300	0.6000	0.180	80	0.1663	1.0000	0.1663	0.1200	0.0200	3.52	✓
11	8:47 AM	10.600	0.6	0.500	0.6000	0.300	80	0.0351	1.0000	0.0351	0.2000	0.0070	1.24	✓
12	8:48 AM	11.000	0.6	0.600	0.6000	0.360	80	0.1724	1.0000	0.1724	0.2400	0.0414	7.29	✓
13	8:50 AM	11.400	0.6	0.750	0.6000	0.420	80	0.2295	1.0000	0.2295	0.2800	0.0643	11.23	✓
14	8:51 AM	11.800	0.6	0.650	0.6000	0.390	80	0.2272	1.0000	0.2272	0.2600	0.0591	10.41	✓
15	8:52 AM	12.200	0.6	0.550	0.6000	0.330	80	0.1572	1.0000	0.1572	0.2200	0.0346	6.10	✓
16	8:53 AM	12.600	0.6	0.800	0.6000	0.480	80	0.0999	1.0000	0.0999	0.1200	0.0320	5.64	✓
17	8:54 AM	13.000	0.6	0.750	0.6000	0.420	80	0.0881	1.0000	0.0881	0.2800	0.0247	4.25	✓
18	8:55 AM	13.400	0.6	0.650	0.6000	0.390	80	0.1189	1.0000	0.1189	0.2600	0.0309	5.45	✓
19	8:56 AM	13.800	0.6	0.600	0.6000	0.360	80	0.1102	1.0000	0.1102	0.2400	0.0265	4.66	✓
20	8:57 AM	14.200	0.6	0.500	0.6000	0.300	80	0.0346	1.0000	0.0346	0.2500	0.0087	1.52	✓
21	8:58 AM	14.600	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.0346	0.0000	0.0000	0.00	✓



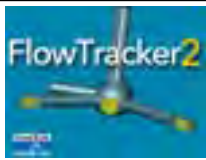
Discharge Measurement Summary

Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

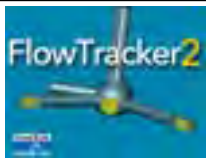
Quality control warnings							
Sta	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	6:35 AM	6.600	0.6	0.260	0.6000	0.120	Large SNR Variation SNR Threshold Violation
3	6:38 AM	7.400	0.6	0.250	0.6000	0.150	Min Spacing > QC
13	6:50 AM	11.400	0.6	0.700	0.6000	0.420	High Site % Discharge
14	6:51 AM	11.800	0.6	0.650	0.6000	0.390	High Site % Discharge



Discharge Measurement Summary

Site name	Milk Creek - D6
Site number	913
Operator(s)	Jack Landers
File name	Milk Creek - D6_20180913-090039.ft
Comment	Temp gage

Supplemental data summary					
Gauge height time	Gauge height (ft)	Rated discharge (ft ³ /s)	Temperature (°F)	Salinity (PSS-78)	Gauge height comments
9/13/2018 8:35 AM	1.580				



Discharge Measurement Summary

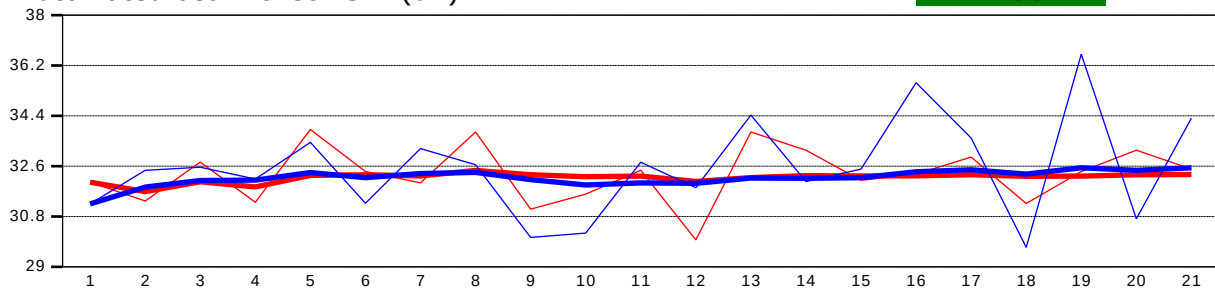
Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 9/13/2018 8:34:28 AM

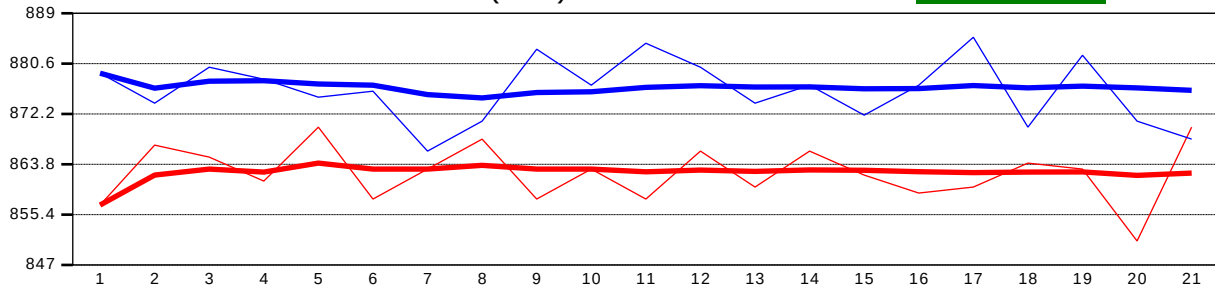
Automated beam check SNR(dB)

PASS



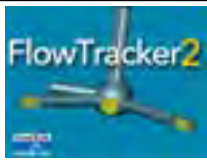
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

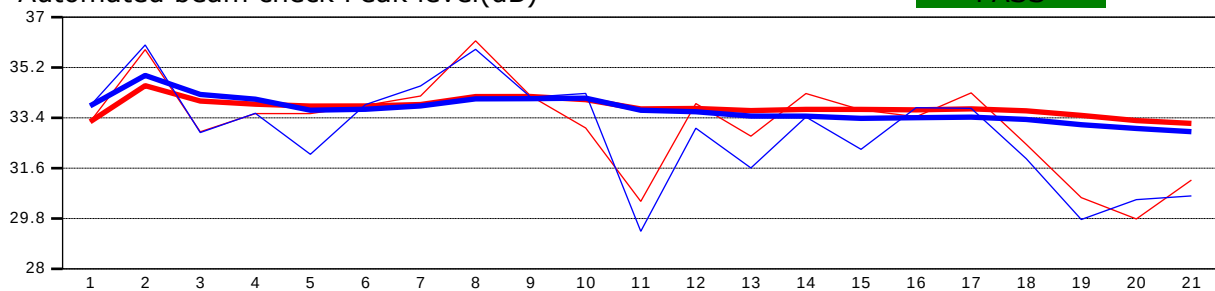
Site name Milk Creek - D6
Site number 913
Operator(s) Jack Landers
File name Milk Creek - D6_20180913-090039.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 9/13/2018 8:34:28 AM

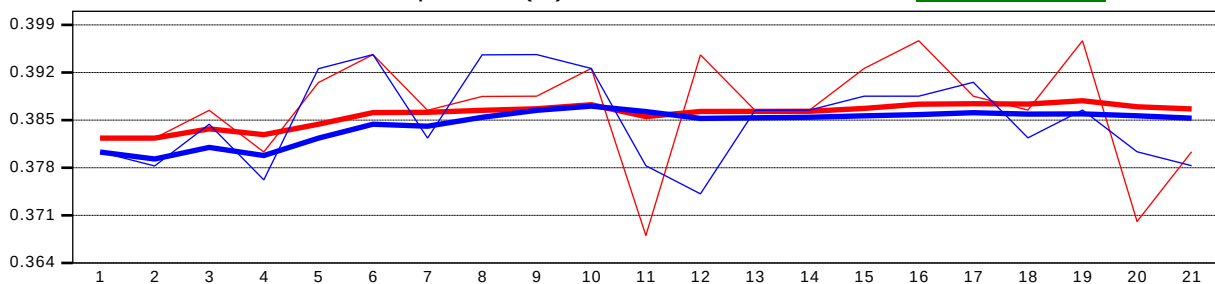
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings

Profile Name: MILK_CRK	Operator Name: EJS	16:05:56 11.14.2018	Stage Reference: 1.70 ft
Model: FH950	s/n: 181981004086	Boot: v1.00	Application: v1.02
Sensor Type: Velocity and Depth	s/n: 182000338654	Boot: v1.00	Application: v1.02
Filter: FPA Parameter: 20 s	Pre-filter: On Rank: 5	EMI: 60Hz.	0.6 point method

This line is reading from staff gage at beginning of measurement. It was the same at end of measurement. Effectively cleared ice from around staff gage prior to Q msmt. Q msmt taken about 400' US of staff gage, and about 100' DS of road crossing. Cleared all ice from msmt XS prior to Q msmt.

Station Entry: Non-fixed	Flow Calculation: Mid-section	Start Edge: Left edge water	# of Stations: 37
Stream Width: 15.40 ft	Total Discharge: 3.83 ft ³ /s	Total Area: 10.84 ft ²	Mean Depth: 0.70 ft

Time	Station	Location (ft)	Depth (ft)	Average Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)
15:31:08	1	1.7	0	0	0	0
15:32:52	2	2.1	0.27	0.02	0.11	0
15:33:52	3	2.5	0.42	0.24	0.19	0.04
15:35:00	4	3	0.7	0.22	0.31	0.07
15:35:55	5	3.4	0.75	0.2	0.3	0.06
15:36:47	6	3.8	0.8	0.34	0.32	0.11
15:37:35	7	4.2	0.9	0.37	0.36	0.13
15:38:42	8	4.6	0.94	0.31	0.37	0.12
15:39:37	9	5	1.06	0.45	0.42	0.19
15:40:27	10	5.4	1.2	0.5	0.48	0.24
15:41:18	11	5.8	1.25	0.49	0.5	0.25
15:42:24	12	6.2	1.22	0.31	0.49	0.15
15:43:20	13	6.6	1.15	0.12	0.46	0.06
15:44:35	14	7	1	0.14	0.4	0.06
15:45:21	15	7.4	0.83	0.26	0.33	0.09
15:46:16	16	7.8	0.85	0.52	0.34	0.18
15:47:26	17	8.2	0.73	0.63	0.29	0.18
15:48:26	18	8.6	0.96	0.6	0.38	0.23
15:49:13	19	9	0.95	0.58	0.38	0.22
15:50:00	20	9.4	0.9	0.51	0.36	0.18
15:51:18	21	9.8	0.85	0.52	0.34	0.18
15:52:26	22	10.2	0.85	0.57	0.34	0.19
15:53:16	23	10.6	0.63	0.63	0.25	0.16
15:54:15	24	11	0.6	0.52	0.24	0.12
15:55:11	25	11.4	0.68	0.48	0.27	0.13
15:56:06	26	11.8	0.57	0.36	0.23	0.08
15:56:57	27	12.2	0.63	0.17	0.25	0.04
15:57:58	28	12.6	0.56	-0.02	0.22	0
15:58:57	29	13	0.56	0.02	0.25	0
15:59:45	30	13.5	0.57	0.06	0.28	0.01
16:00:27	31	14	0.49	0.11	0.24	0.03
16:01:13	32	14.5	0.53	0.25	0.26	0.07
16:02:01	33	15	0.42	0.21	0.21	0.04
16:02:47	34	15.5	0.45	0.32	0.22	0.07
16:03:43	35	16	0.42	0.35	0.21	0.07
16:04:43	36	16.5	0.35	0.28	0.19	0.05
16:05:19	37	17.1	0	0	0	0

Discharge Measurement Summary

Date Measured: Tuesday, May 7, 2019

Site Information			Measurement Information	
Site Name	Milk Creek gage		Party	Jack Landers
Station Number	002		Boat/Motor	HydroboardII
Location	500ft upstream of gage, just above road ford		Meas. Number	002

System Information		System Setup		Units	
System Type	RS-S5	Transducer Depth (ft)	0.20	Distance	ft
Serial Number	2562	Screening Distance (ft)	0.00	Velocity	ft/s
Firmware Version	4.10	Salinity (ppt)	0.0	Area	ft2
Software Version	4.1	Magnetic Declination (deg)	11.0	Discharge	cfs
				Temperature	degF

Discharge Calculation Settings				Discharge Results	
Track Reference	GPS-GGA	Left Method	Sloped Bank	Width (ft)	36.883
Depth Reference	Vertical Beam	Right Method	Sloped Bank	Area (ft2)	55.049
Coordinate System	ENU	Top Fit Type	Power Fit	Mean Speed (ft/s)	4.785
		Bottom Fit Type	Power Fit	Total Q (cfs)	263.261
		Start Gauge Height (ft)	0.00	Maximum Measured	4.068
		End Gauge Height (ft)	0.00	Depth	
				Maximum Measured	9.045
				Speed	

Measurement Results																	
Tr	Time			Distance				Mean Vel		Discharge							%
#	Time	Duration	Temp.	Track	DMG	Width	Area	Boat	Water	Left	Right	Top	Middle	Bottom	Total	MBTotal	Measured
4 R	12:19:51 PM	0:02:18	50.9	38.84	26.74	38.744	58.058	0.281	4.629	0.00	18.46	76.11	103.14	71.05	268.748	--	38.4
5 L	12:23:27 PM	0:02:37	50.8	51.65	25.45	37.454	54.663	0.329	4.554	0.00	25.95	66.21	105.64	51.15	248.960	--	42.4
6 R	12:27:15 PM	0:02:27	50.8	35.19	25.25	37.248	55.593	0.239	4.627	0.00	26.77	70.41	100.35	59.71	257.243	--	39.0
7 L	12:30:16 PM	0:02:25	50.7	45.71	24.95	36.947	54.309	0.315	5.097	0.00	26.18	73.98	115.76	60.88	276.808	--	41.8
8 R	12:33:43 PM	0:02:06	50.8	35.65	23.23	35.233	53.254	0.283	4.891	6.97	26.61	71.01	101.02	54.86	260.478	--	38.8
9 L	12:36:13 PM	0:02:14	50.7	43.94	23.67	35.672	54.416	0.328	4.913	7.15	22.13	70.89	111.14	56.01	267.331	--	41.6
		Mean	50.8	41.83	24.88	36.883	55.049	0.296	4.785	2.35	24.35	71.44	106.18	58.94	263.261	0.000	40.3
		Std Dev	0.1	5.88	1.16	1.163	1.509	0.032	0.195	3.33	3.07	3.09	5.58	6.28	8.932	0.000	1.6
		COV	0.0	0.141	0.047	0.032	0.027	0.107	0.041	1.414	0.126	0.043	0.053	0.107	0.034	0.000	0.041

Exposure Time: 0:14:07

Tr4=20190507121950.riv; Tr5=20190507122326.riv; Tr6=20190507122714.riv; Tr7=20190507123015.riv; Tr8=20190507123342.riv; Tr9=20190507123611.riv;

Comments	
Tr4=20190507121950.riv - ; Tr5=20190507122326.riv - ; Tr6=20190507122714.riv - ; Tr7=20190507123015.riv - ; Tr8=20190507123342.riv - ; Tr9=20190507123611.riv - ;	

Compass Calibration	
Passed Calibration	
Error from calibration: 0.11 deg	
Mean Magnitude: 9318.54	
Pitch: -25/35	
Roll: -20/40	

System Test	
System Test: PASS	

Parameters and settings marked with a * are not constant for all files.

Report generated using SonTek RiverSurveyor Live v4.1



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	730
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20190730-161929.ft
Comment	Temp gage

Start time	7/30/2019 3:50 PM	Sensor type	Top Setting
End time	7/30/2019 4:18 PM	Handheld serial number	FT2H1747037
Start location latitude	40.386	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.23
Calculations engine	FlowTracker2	Handheld software	1.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
25	40	11.3268

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
16.700	14.5330	17.226

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
40	0.870	0.7794

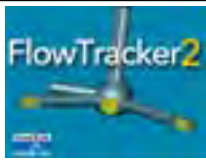
Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
74.470	1.300	1.0537

Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.4%
Velocity	0.4%	1.7%
Width	0.1%	0.1%
Method	1.9%	
# Stations	2.0%	
Overall	3.0%	3.1%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview
No changes were made to this file
Quality control warnings

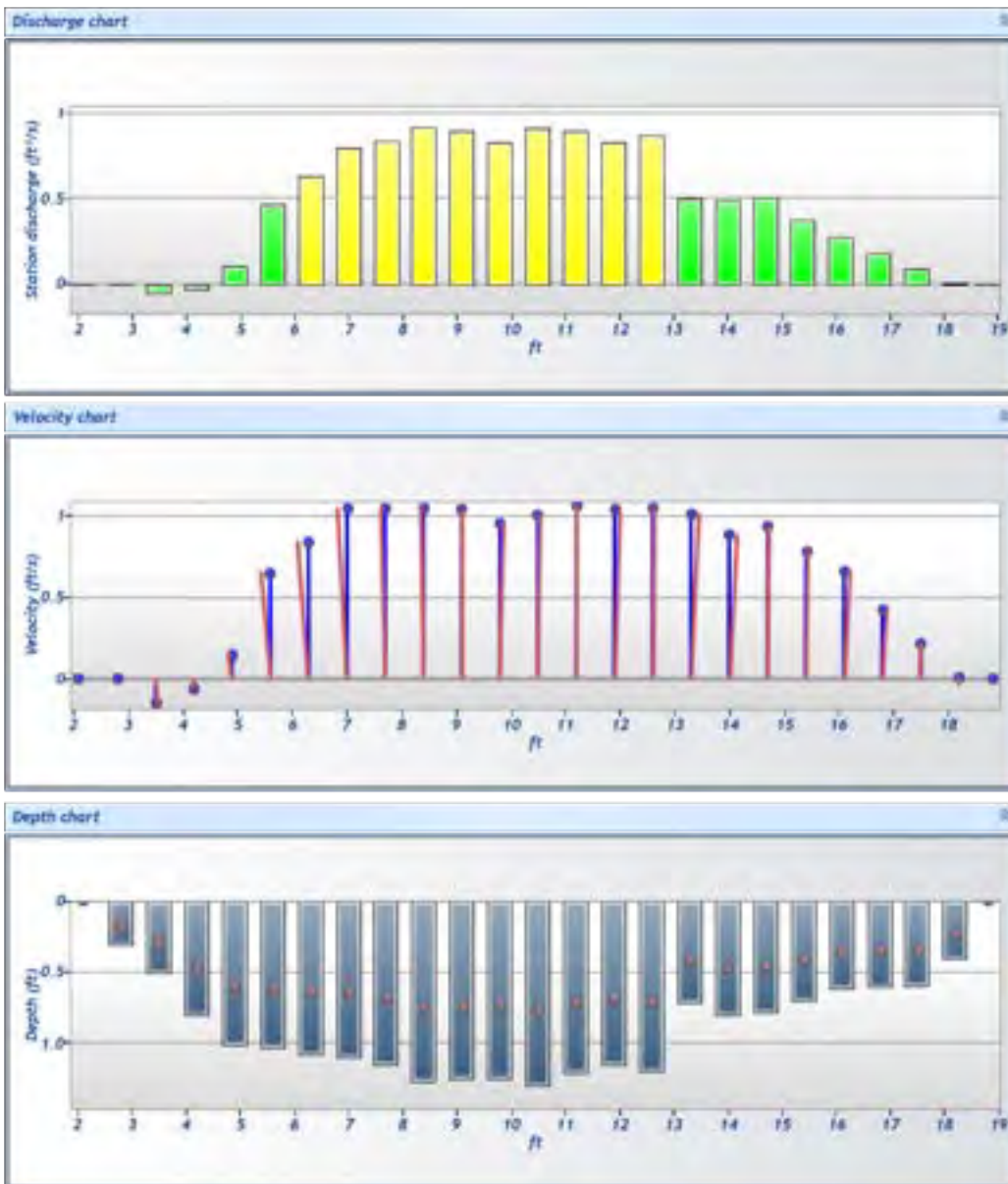


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 730
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20190730-161929.ft
Comment Temp gage

Station Warning Settings

Station discharge OK Station discharge < 5.00%
Station discharge caution 5.00% >= Station discharge < 10.00%
Station discharge warning Station discharge >= 10.00%

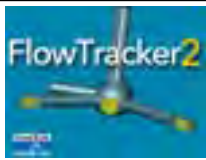




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 730
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20190730-161929.ft
Comment Temp gage

Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Strokes	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	MG	
0	3:50 PM	2.100	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.0000	0.0000	0.0000	0.00	✓
1	3:50 PM	2.800	0.6	0.300	0.6000	0.180	80	0.0004	1.0000	0.0004	0.2100	0.0001	0.00	✓
2	3:52 PM	3.500	0.6	0.500	0.6000	0.300	80	0.1452	1.0000	0.1452	0.2500	0.0500	0.45	✓
3	3:53 PM	4.200	0.6	0.800	0.6000	0.480	80	0.0540	1.0000	0.0540	0.5600	0.0300	0.32	✓
4	3:54 PM	4.900	0.6	1.010	0.6000	0.606	80	0.1510	1.0000	0.1510	0.7070	0.1067	0.94	✓
5	3:56 PM	5.600	0.6	1.030	0.6000	0.618	80	0.6478	1.0000	0.6478	0.7210	0.4671	4.12	✓
6	3:57 PM	6.300	0.6	1.080	0.6000	0.648	80	0.8362	1.0000	0.8362	0.7560	0.6322	5.58	✓
7	3:58 PM	7.000	0.6	1.100	0.6000	0.660	80	1.0384	1.0000	1.0384	0.7700	0.7996	7.06	✓
8	3:59 PM	7.700	0.6	1.150	0.6000	0.690	80	1.0404	1.0000	1.0404	0.8050	0.8375	7.39	✓
9	4:02 PM	8.400	0.6	1.270	0.6000	0.762	80	1.0364	1.0000	1.0364	0.8890	0.9213	8.13	✓
10	4:03 PM	9.100	0.6	1.250	0.6000	0.750	80	1.0268	1.0000	1.0268	0.8750	0.8984	7.93	✓
11	4:04 PM	9.800	0.6	1.250	0.6000	0.750	80	0.9464	1.0000	0.9464	0.8750	0.8281	7.31	✓
12	4:05 PM	10.500	0.6	1.300	0.6000	0.780	80	0.9991	1.0000	0.9991	0.9100	0.9092	8.03	✓
13	4:06 PM	11.200	0.6	1.210	0.6000	0.726	80	1.0537	1.0000	1.0537	0.8470	0.8925	7.88	✓
14	4:07 PM	11.900	0.6	1.150	0.6000	0.690	80	1.0270	1.0000	1.0270	0.8050	0.8268	7.30	✓
15	4:08 PM	12.600	0.6	1.200	0.6000	0.720	80	1.0351	1.0000	1.0351	0.8400	0.8664	7.68	✓
16	4:09 PM	13.300	0.6	0.710	0.6000	0.426	80	1.0040	1.0000	1.0040	0.4070	0.4090	4.41	✓
17	4:11 PM	14.000	0.6	0.800	0.6000	0.480	80	0.8739	1.0000	0.8739	0.5600	0.4894	4.32	✓
18	4:11 PM	14.700	0.6	0.780	0.6000	0.468	80	0.9245	1.0000	0.9245	0.5460	0.5048	4.46	✓
19	4:13 PM	15.400	0.6	0.700	0.6000	0.420	80	0.7718	1.0000	0.7718	0.4900	0.3782	3.34	✓
20	4:14 PM	16.100	0.6	0.610	0.6000	0.366	80	0.6561	1.0000	0.6561	0.4270	0.2801	2.47	✓
21	4:15 PM	16.800	0.6	0.680	0.6000	0.408	80	0.4207	1.0000	0.4207	0.4200	0.1767	1.56	✓
22	4:16 PM	17.500	0.6	0.580	0.6000	0.348	80	0.2125	1.0000	0.2125	0.4130	0.0878	0.77	✓
23	4:17 PM	18.200	0.6	0.400	0.6000	0.240	80	0.0120	1.0000	0.0120	0.2600	0.0031	0.03	✓
24	4:18 PM	18.900	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.0120	0.0000	0.0000	0.00	✓



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	730
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20190730-161929.ft
Comment	Temp gage

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	3:50 PM	2.800	0.6	0.300	0.6000	0.180	Boundary Interference
2	3:52 PM	3.500	0.6	0.500	0.6000	0.300	Velocity Angle > QC
4	3:54 PM	4.900	0.6	1.010	0.6000	0.606	Boundary Interference, Velocity Angle > QC



Discharge Measurement Summary

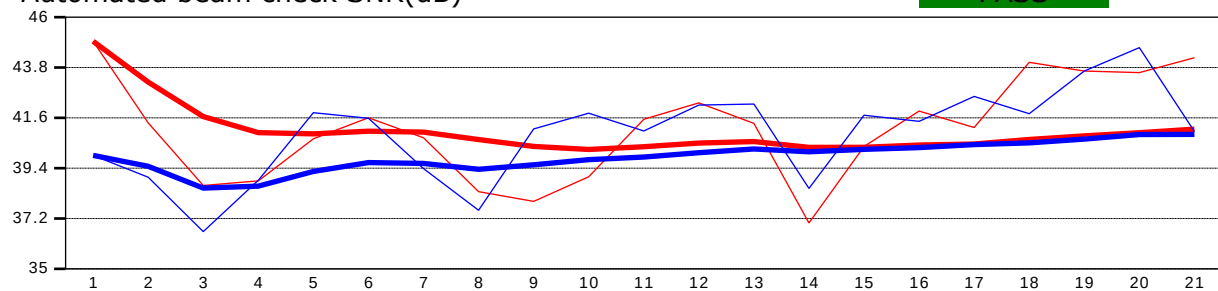
Site name Milk Creek near confl with Yampa River
Site number 730
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20190730-161929.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 7/30/2019 3:49:49 PM

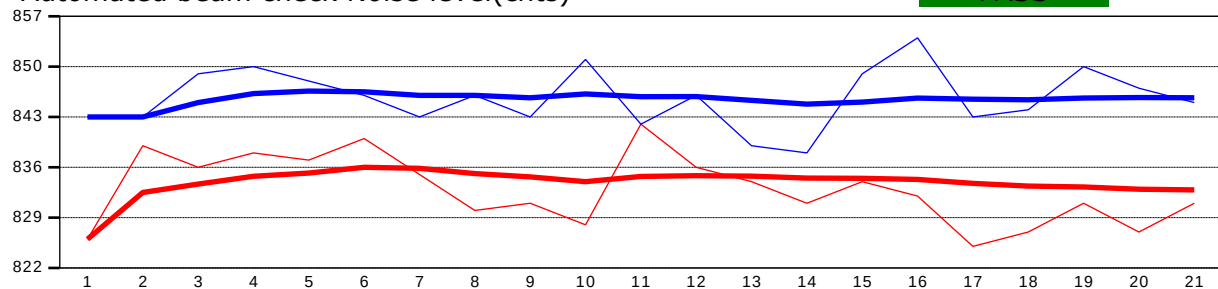
Automated beam check SNR(dB)

PASS



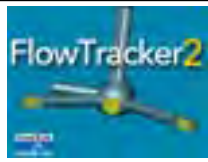
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

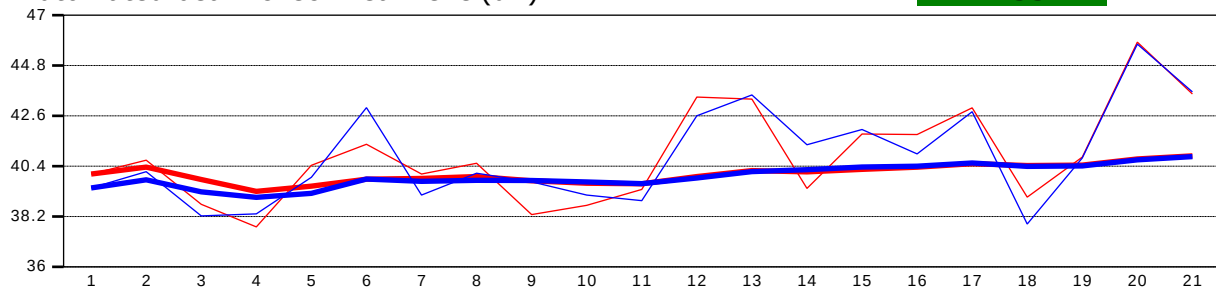
Site name Milk Creek near confl with Yampa River
Site number 730
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20190730-161929.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 7/30/2019 3:49:49 PM

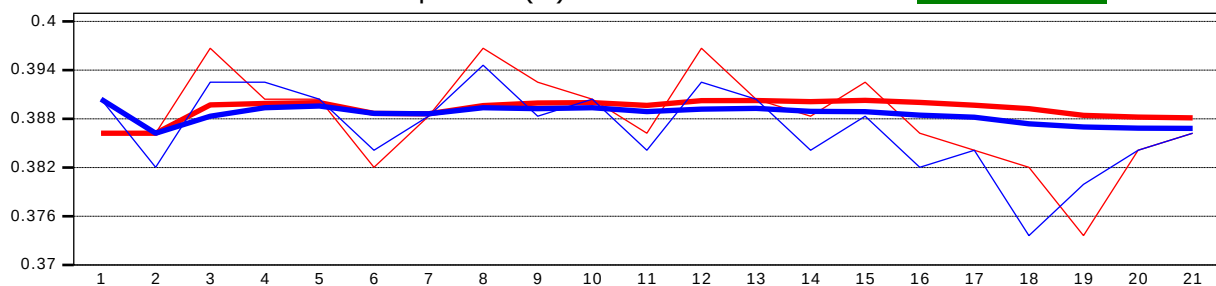
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	9
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20191205-112254.ft
Comment	Temp gage

Start time	12/5/2019 10:51 AM	Sensor type	Top Setting
End time	12/5/2019 11:20 AM	Handheld serial number	FT2H1747037
Start location latitude	40.386	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.23
Calculations engine	FlowTracker2	Handheld software	1.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
28	40	13.0950

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
16.700	15.8655	17.378

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
44	0.950	0.8254

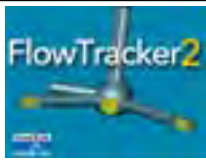
Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
31.958	1.420	1.4563

Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.2%
Velocity	0.5%	1.3%
Width	0.1%	0.1%
Method	1.8%	
# Stations	1.8%	
Overall	2.8%	2.7%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

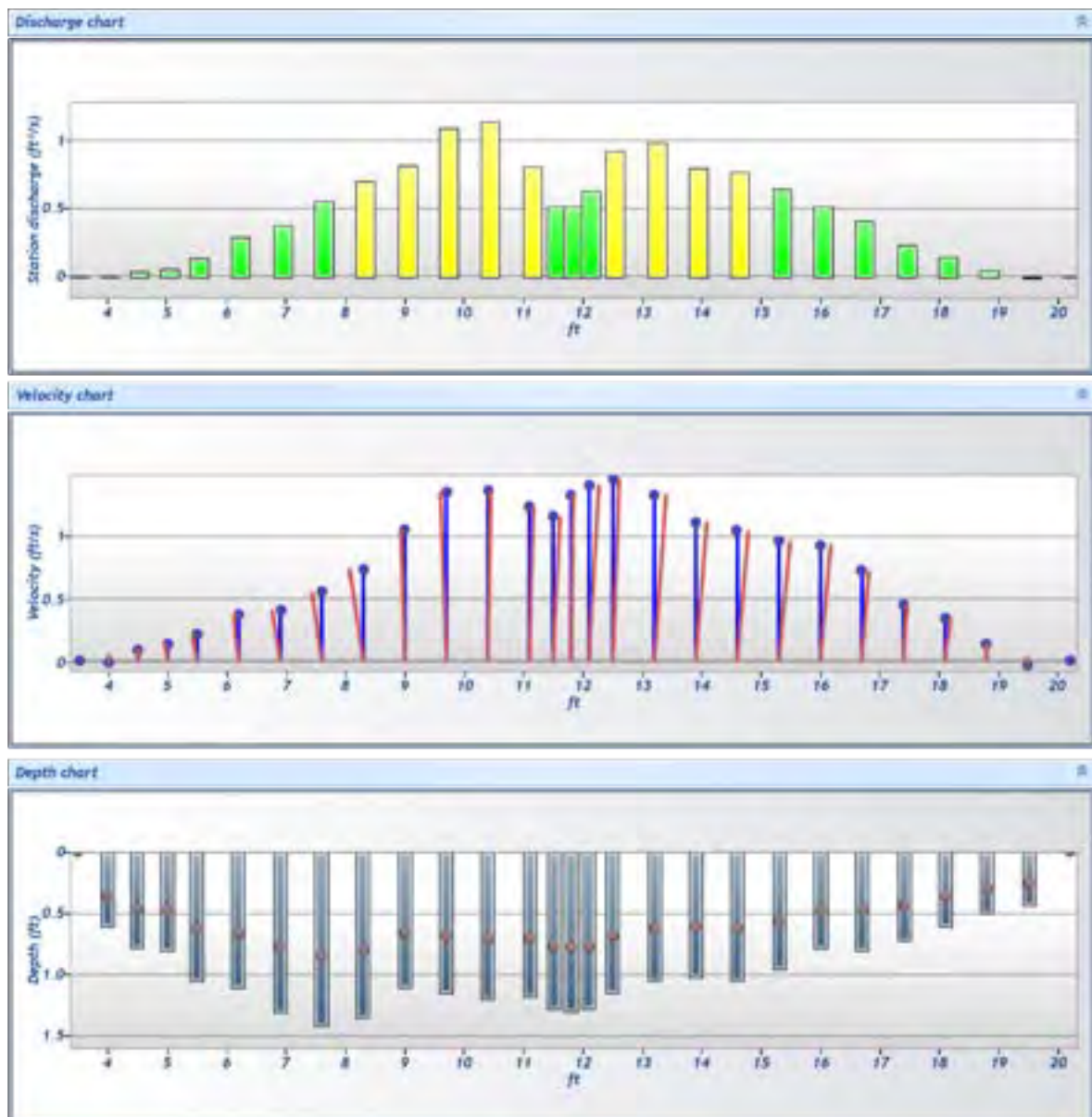
Summary overview
No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 9
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20191205-112254.ft
Comment Temp gage

Station Warning Settings		
Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	

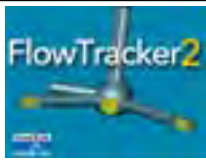




Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	9
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20191205-112254.ft
Comment	Temp gage

Measurement Results													
Sta#	Time	Location (ft)	Width (ft)	Depth (ft)	Velocity (ft/s)	Measured Depth (ft)	samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft²)	Flow (ft³/s)	WQI
0	10:51 AM 3.500	None	0.000	0.000	0.000	0	0	0.0000	1.0000	0.0000	0.0000	0.000	-
1	10:52 AM 4.000	0.6	0.600	0.600	0.360	80	80	0.0000	1.0000	0.0000	0.2000	0.000	-
2	10:53 AM 4.500	0.6	0.600	0.600	0.480	80	80	0.0044	1.0000	0.0044	0.2000	0.000	-
3	10:54 AM 5.000	0.6	0.600	0.600	0.480	80	80	0.1406	1.0000	0.1406	0.4000	0.0567	-
4	10:55 AM 5.500	0.6	0.600	0.600	0.600	80	80	0.2137	1.0000	0.2137	0.6000	0.1246	-
5	10:56 AM 6.200	0.6	0.600	0.600	0.600	80	80	0.3751	1.0000	0.3751	0.7200	0.2808	-
6	10:58 AM 6.900	0.6	0.600	0.600	0.780	80	80	0.4087	1.0000	0.4087	0.9170	0.3748	-
7	10:59 AM 7.600	0.6	0.600	0.600	0.852	80	80	0.5041	1.0000	0.5041	0.9940	0.5008	-
8	11:00 AM 8.300	0.6	0.600	0.600	0.810	80	80	0.7385	1.0000	0.7385	0.9450	0.6978	-
9	11:01 AM 9.000	0.6	0.600	0.600	0.861	80	80	0.8570	1.0000	0.8570	0.7200	0.6199	-
10	11:02 AM 9.700	0.6	0.600	0.600	0.690	80	80	1.2550	1.0000	1.2550	0.6050	1.0000	-
11	11:03 AM 10.400	0.6	0.600	0.600	0.770	80	80	1.3589	1.0000	1.3589	0.8400	1.1415	-
12	11:04 AM 11.100	0.6	0.600	0.600	0.708	80	80	1.2983	1.0000	1.2983	0.6400	0.8043	-
13	11:19 AM 11.500	0.6	0.600	0.600	0.768	80	80	1.1601	1.0000	1.1601	0.4480	0.5197	-
14	11:05 AM 11.800	0.6	0.600	0.600	0.790	80	80	1.3323	1.0000	1.3323	0.3900	0.5196	-
15	11:20 AM 12.100	0.6	0.600	0.600	0.768	80	80	1.4058	1.0000	1.4058	0.4480	0.6298	-
16	11:06 AM 12.500	0.6	0.600	0.600	0.690	80	80	1.4563	1.0000	1.4563	0.6325	0.9211	-
17	11:07 AM 13.200	0.6	0.600	0.600	0.870	80	80	1.3172	1.0000	1.3172	0.7350	0.9828	-
18	11:08 AM 13.900	0.6	0.600	0.600	0.612	80	80	1.1122	1.0000	1.1122	0.7140	0.7941	-
19	11:10 AM 14.600	0.6	0.600	0.600	0.570	80	80	1.0444	1.0000	1.0444	0.7350	0.7676	-
20	11:11 AM 15.300	0.6	0.600	0.600	0.570	80	80	0.9590	1.0000	0.9590	0.6650	0.6377	-
21	11:12 AM 16.000	0.6	0.600	0.600	0.424	80	80	0.9324	1.0000	0.9324	0.5030	0.5158	-
22	11:13 AM 16.700	0.6	0.600	0.600	0.480	80	80	0.7222	1.0000	0.7222	0.5600	0.4044	-
23	11:14 AM 17.400	0.6	0.600	0.600	0.432	80	80	0.4545	1.0000	0.4545	0.5040	0.2290	-
24	11:15 AM 18.100	0.6	0.600	0.600	0.360	80	80	0.3417	1.0000	0.3417	0.4200	0.1433	-
25	11:16 AM 18.800	0.6	0.600	0.600	0.300	80	80	0.1410	1.0000	0.1410	0.3500	0.0494	-
26	11:17 AM 19.500	0.6	0.600	0.600	0.258	80	80	0.0288	1.0000	0.0288	0.3010	0.0087	-
27	11:18 AM 20.200	None	0.000	0.000	0.000	0	0	0.0000	1.0000	0.0000	0.0000	0.000	-

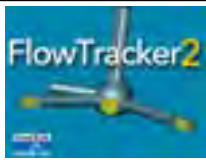


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	9
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20191205-112254.ft
Comment	Temp gage

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings						
Sta	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)
1	10:52 AM	4.000	0.6	0.600	0.6000	0.560
3	10:54 AM	5.000	0.6	0.600	0.6000	0.480
14	11:05 AM	11.800	0.6	1.300	0.6000	0.780



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	9
Operator(s)	Jack Landers
File name	Milk Creek near confl with Yampa River_20191205-112254.ft
Comment	Temp gage

Supplemental data summary					
Gauge height time	Gauge height (ft)	Rated discharge (ft ³ /s)	Temperature (°F)	Salinity (PSS-78)	Gauge height comments
12/5/2019 10:51 AM	2.805				



Discharge Measurement Summary

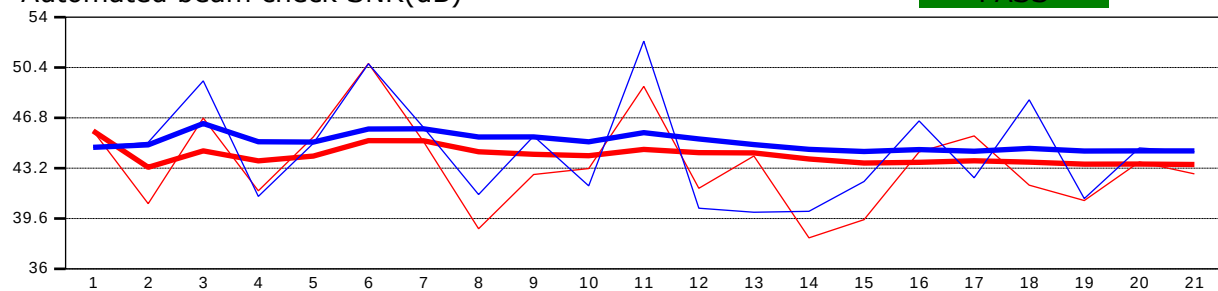
Site name Milk Creek near confl with Yampa River
Site number 9
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20191205-112254.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 12/5/2019 10:50:41 AM

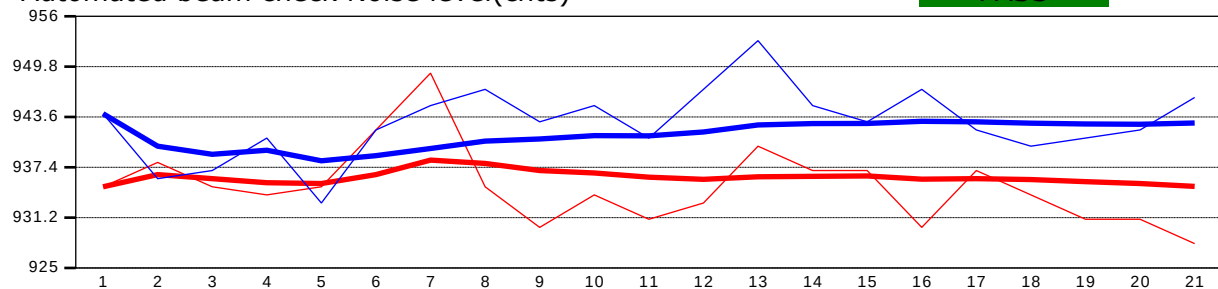
Automated beam check SNR(dB)

PASS



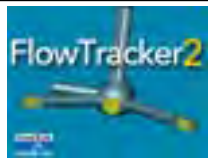
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

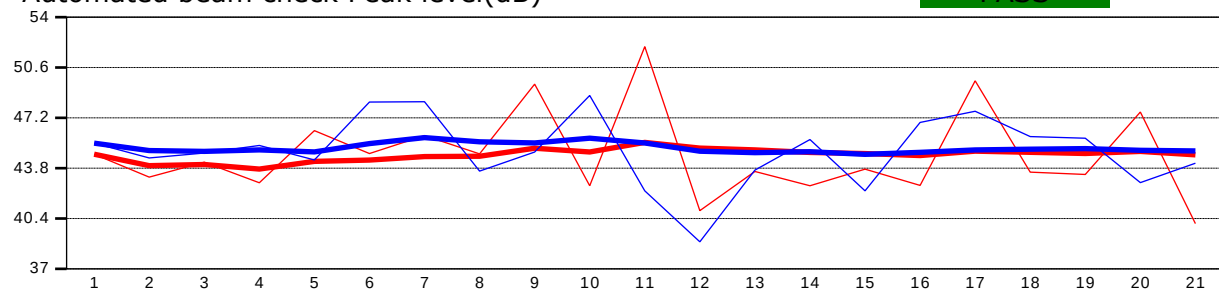
Site name Milk Creek near confl with Yampa River
Site number 9
Operator(s) Jack Landers
File name Milk Creek near confl with Yampa River_20191205-112254.ft
Comment Temp gage

Beam 1	
Beam 2	

Automated beam check Start time 12/5/2019 10:50:41 AM

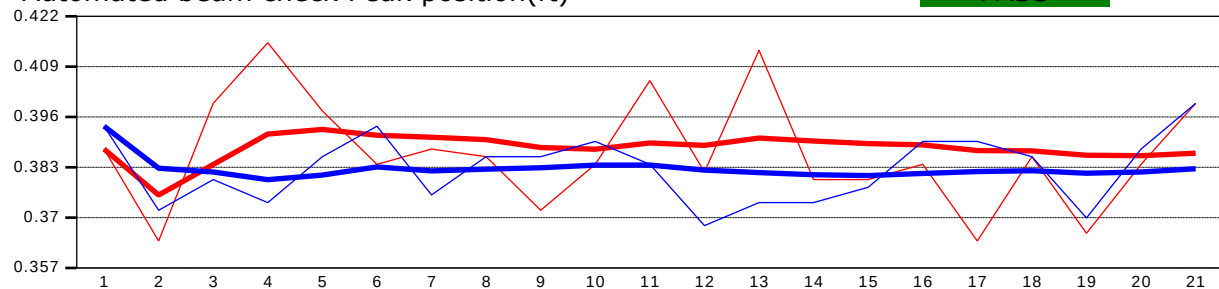
Automated beam check Peak level(dB)

PASS



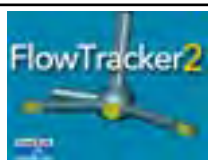
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	11192020
Operator(s)	Laura FS
File name	Milk Creek near confl with Yampa River_20201119-153313.ft
Comment	

Start time	11/19/2020 2:59 PM	Sensor type	Top Setting
End time	11/19/2020 3:29 PM	Handheld serial number	FT2H1747037
Start location latitude	40.386	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
19	40	6.3095

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
11.500	8.0945	11.856

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
38	0.704	0.7795

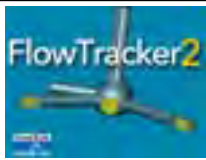
Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
44.870	1.000	1.0524

Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	3.2%
Velocity	0.4%	2.4%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.5%	
Overall	3.3%	4.1%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

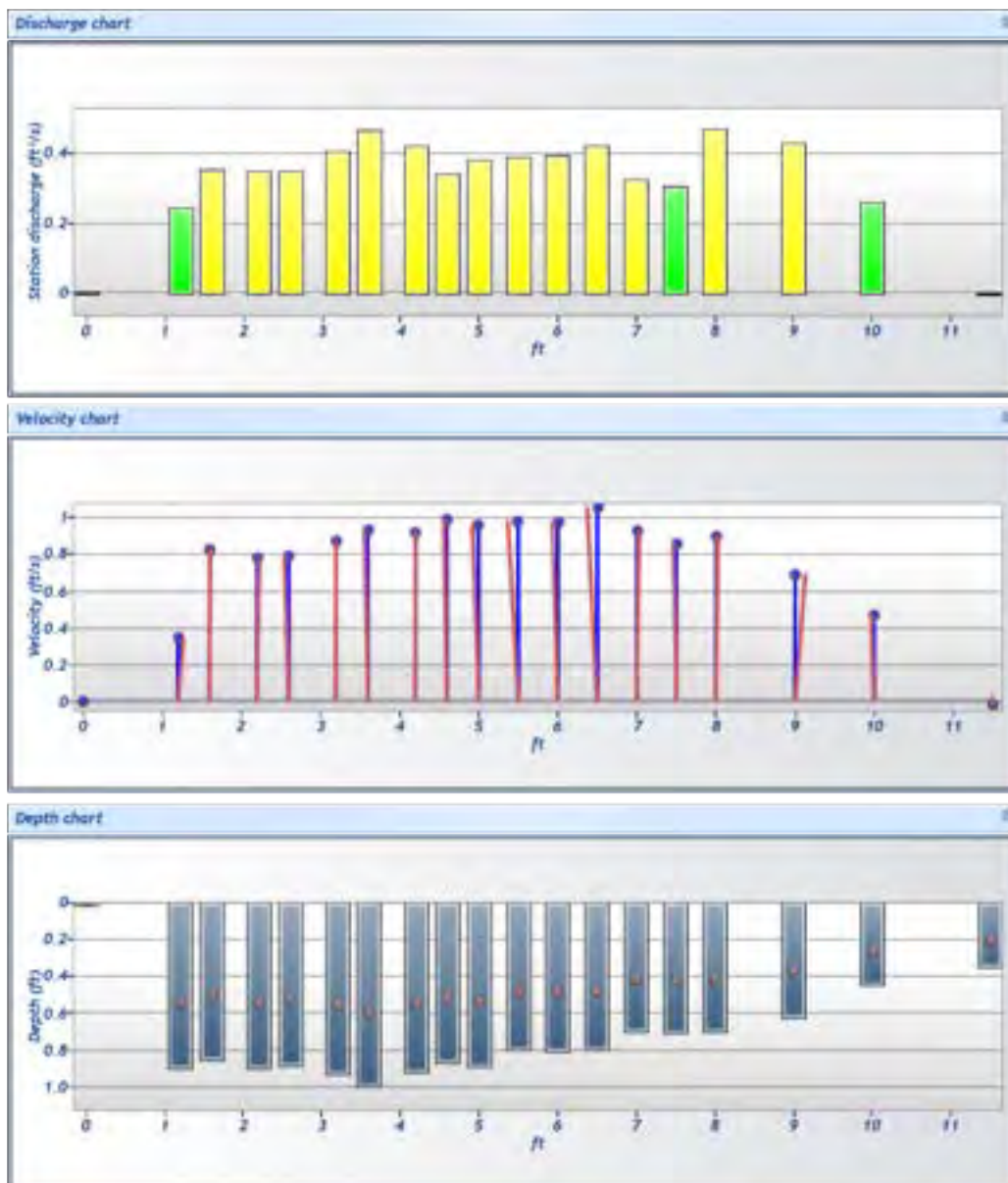
Summary overview
No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 11192020
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20201119-153313.ft
Comment

Station Warning Settings	
Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%

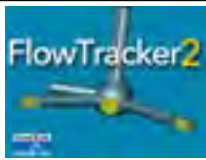




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 11192020
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20201119-153313.ft
Comment

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Stations	Velocity (ft/s)	Corrected	Avg Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
0	2:50 PM	0.000	Waver	0.010	0.0000	0.000	0	0.0000	1.0000	0.3417	0.0060	0.0021	0.03
1	2:50 PM	1.200	0.6	0.900	0.6000	0.540	80	0.3417	1.0000	0.3417	0.7200	0.2460	3.90
2	3:02 PM	1.600	0.6	0.850	0.6000	0.510	80	0.8291	1.0000	0.8291	0.4250	0.3524	5.58
3	3:04 PM	2.200	0.6	0.900	0.6000	0.540	80	0.7771	1.0000	0.7771	0.4500	0.3497	5.54
4	3:05 PM	2.600	0.6	0.880	0.6000	0.528	80	0.7897	1.0000	0.7897	0.4400	0.3475	5.51
5	3:07 PM	3.200	0.6	0.930	0.6000	0.558	80	0.8706	1.0000	0.8706	0.4650	0.4048	6.42
6	3:08 PM	3.600	0.6	1.000	0.6000	0.600	80	0.9340	1.0000	0.9340	0.5000	0.4670	7.40
7	3:09 PM	4.200	0.6	0.920	0.6000	0.552	80	0.9180	1.0000	0.9180	0.4600	0.4223	6.69
8	3:27 PM	4.600	0.6	0.870	0.6000	0.522	80	0.9840	1.0000	0.9840	0.3480	0.3424	5.43
9	3:10 PM	5.000	0.6	0.890	0.6000	0.534	80	0.9575	1.0000	0.9575	0.4000	0.3835	6.08
10	3:24 PM	5.500	0.6	0.800	0.6000	0.480	80	0.9782	1.0000	0.9782	0.4000	0.3913	6.20
11	3:11 PM	6.000	0.6	0.810	0.6000	0.486	80	0.9732	1.0000	0.9732	0.4050	0.3941	6.25
12	3:29 PM	6.500	0.6	0.890	0.6000	0.480	80	1.0524	1.0000	1.0524	0.4000	0.4210	6.67
13	3:13 PM	7.000	0.6	0.700	0.6000	0.420	80	0.9247	1.0000	0.9247	0.3500	0.3237	5.13
14	3:23 PM	7.500	0.6	0.710	0.6000	0.426	80	0.8573	1.0000	0.8573	0.3550	0.3043	4.82
15	3:15 PM	8.000	0.6	0.700	0.6000	0.420	80	0.8977	1.0000	0.8977	0.5250	0.4713	7.47
16	3:17 PM	9.000	0.6	0.620	0.6000	0.372	80	0.6907	1.0000	0.6907	0.6200	0.4283	6.79
17	3:19 PM	10.000	0.6	0.450	0.6000	0.270	80	0.4665	1.0000	0.4665	0.5625	0.2624	4.16
18	3:21 PM	11.500	0.6	0.350	0.6000	0.210	80	0.0170	1.0000	0.0170	0.2625	0.0044	0.07



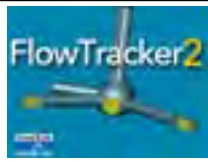
Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 11192020
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20201119-153313.ft
Comment

Quality Control Settings

Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
18	3:21 PM	11.500	0.6	0.350	0.6000	0.210	SNR Threshold Violation



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 11192020
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20201119-153313.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/19/2020 2:58:50 PM

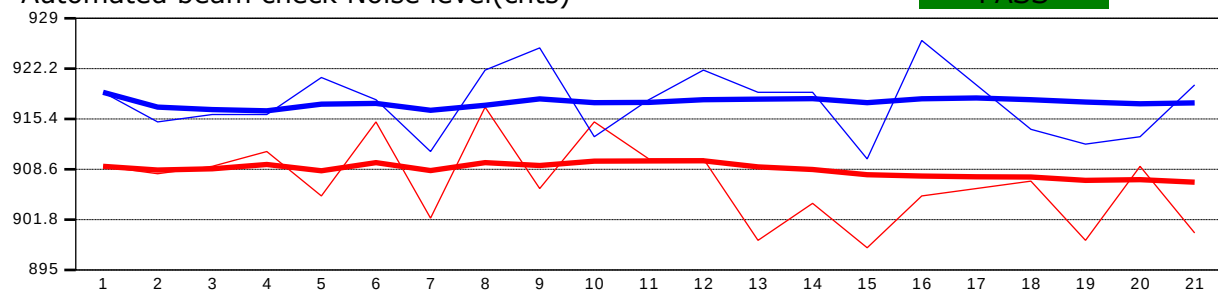
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

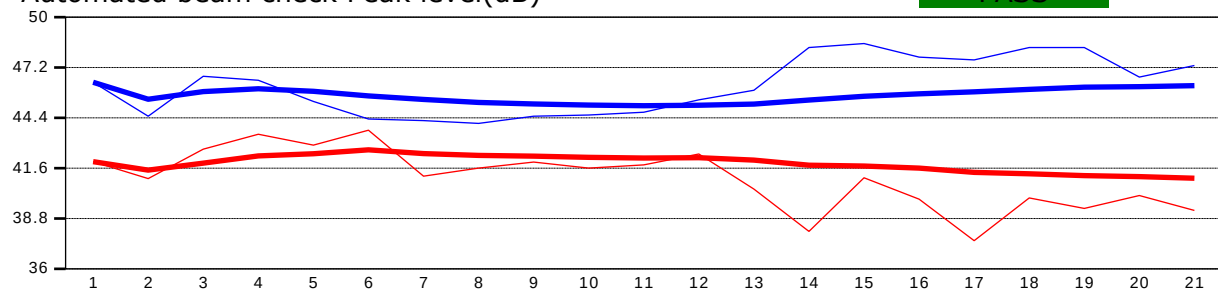
Site name Milk Creek near confl with Yampa River
Site number 11192020
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20201119-153313.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/19/2020 2:58:50 PM

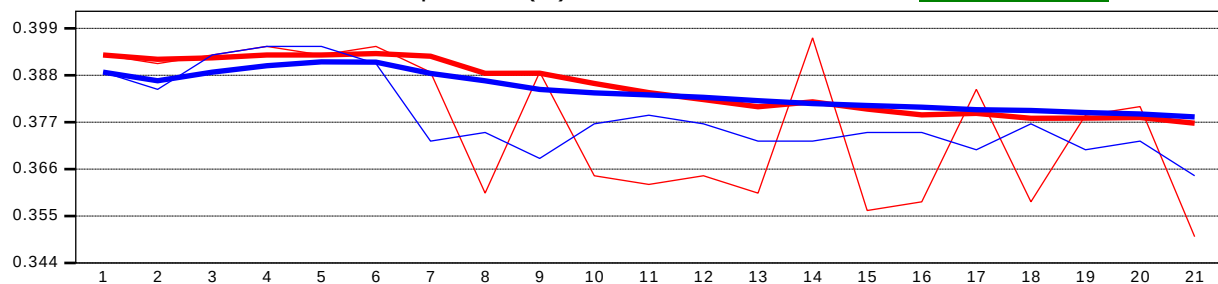
Automated beam check Peak level(dB)

PASS



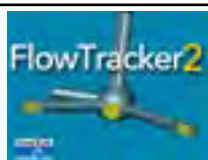
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

Start time	4/5/2021 11:07 PM	Sensor type	Top Setting
End time	4/5/2021 11:24 PM	Handheld serial number	FT2H2104006
Start location latitude	40.386	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
16	40	17.1301

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
15.500	12.9975	15.751

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
44	0.839	1.3180

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
62.861	1.200	1.5876

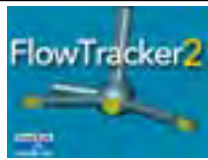
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	2.8%
Velocity	0.4%	2.2%
Width	0.1%	0.1%
Method	2.1%	
# Stations	3.1%	
Overall	3.9%	3.7%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file



Discharge Measurement Summary

Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

Station Warning Settings

Station discharge OK

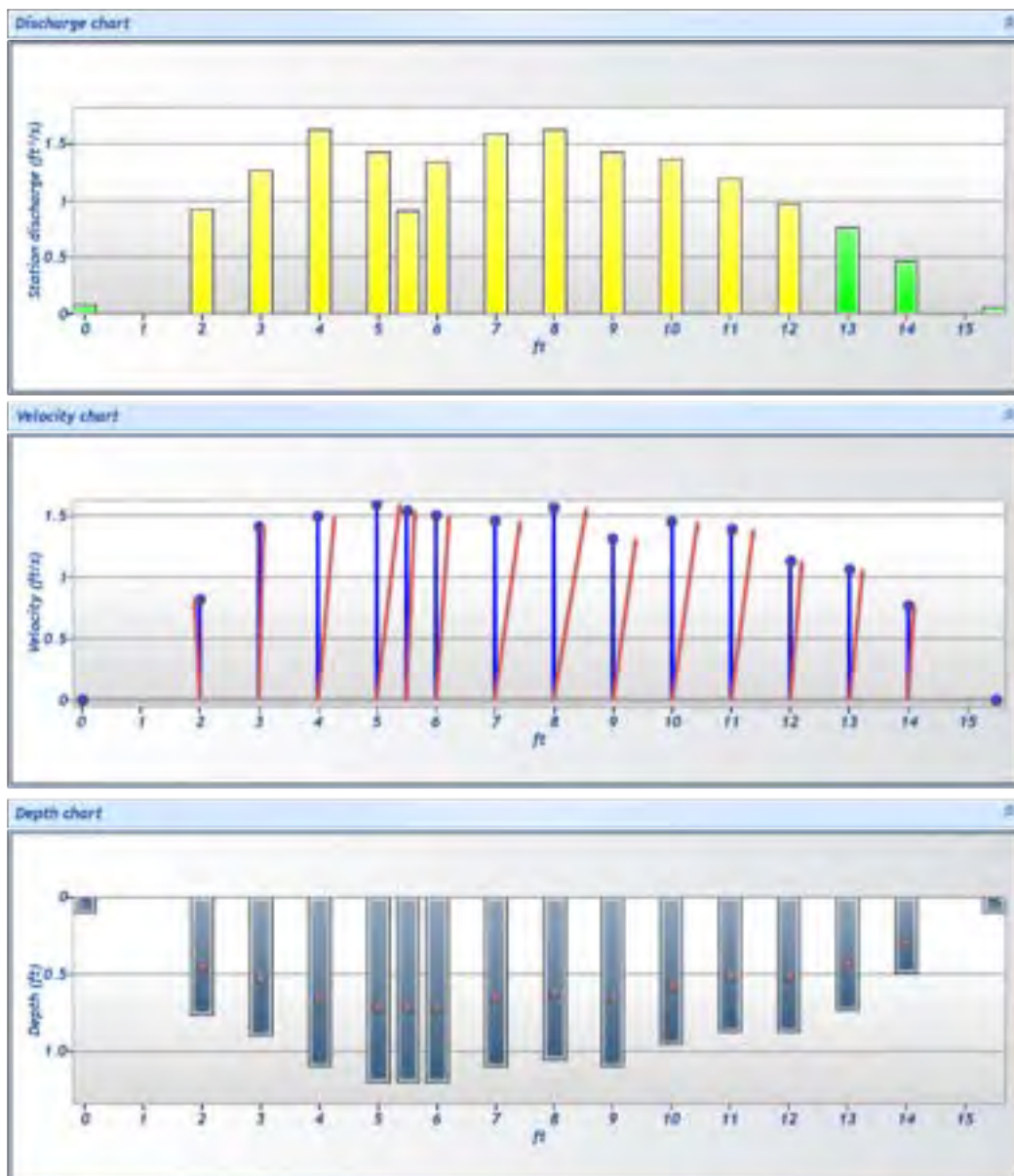
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

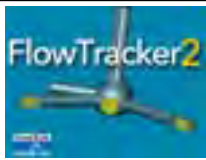




Discharge Measurement Summary

Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
15	11:24 PM	0.000	None	0.100	0.0000	0.000	0	0.0000	1.0000	0.8143	0.1000	0.0814	0.48	✓
14	11:21 PM	2.000	0.6	0.760	0.0000	0.456	80	0.8143	1.0000	0.8143	1.1400	0.9283	5.42	✓
13	11:20 PM	3.000	0.6	0.900	0.0000	0.540	80	1.4097	1.0000	1.4097	0.9000	1.2687	7.41	✓
12	11:19 PM	4.000	0.6	1.100	0.0000	0.660	80	1.4844	1.0000	1.4844	1.1000	1.6329	9.53	✓
11	11:18 PM	5.000	0.6	1.200	0.0000	0.720	80	1.5876	1.0000	1.5876	0.9000	1.4289	8.34	✓
10	11:22 PM	5.500	0.6	1.200	0.0000	0.720	80	1.5327	1.0000	1.5327	0.6000	0.9196	5.37	✓
9	11:16 PM	6.000	0.6	1.200	0.0000	0.720	80	1.4977	1.0000	1.4977	0.9000	1.3470	7.87	✓
8	11:15 PM	7.000	0.6	1.100	0.0000	0.660	80	1.4549	1.0000	1.4549	1.1000	1.6004	9.34	✓
7	11:14 PM	8.000	0.6	1.050	0.0000	0.630	80	1.5550	1.0000	1.5550	1.0500	1.6327	9.50	✓
6	11:13 PM	9.000	0.6	1.100	0.0000	0.660	80	1.3078	1.0000	1.3078	1.1000	1.4389	8.40	✓
5	11:12 PM	10.000	0.6	0.950	0.0000	0.570	80	1.4435	1.0000	1.4435	0.9500	1.3713	8.01	✓
4	11:11 PM	11.000	0.6	0.870	0.0000	0.522	80	1.3819	1.0000	1.3819	0.8700	1.2023	7.02	✓
3	11:10 PM	12.000	0.6	0.870	0.0000	0.522	80	1.1256	1.0000	1.1256	0.8700	0.9793	5.72	✓
2	11:08 PM	13.000	0.6	0.730	0.0000	0.438	80	1.0547	1.0000	1.0547	0.7300	0.7699	4.49	✓
1	11:07 PM	14.000	0.6	0.490	0.0000	0.294	80	0.7678	1.0000	0.7678	0.6125	0.4703	2.70	✓
0	11:07 PM	15.000	None	0.100	0.0000	0.000	0	0.0000	1.0000	0.7678	0.0750	0.0576	0.34	✓



Discharge Measurement Summary

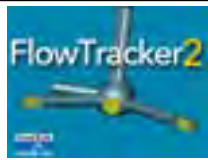
Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

Quality Control Settings

Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
No quality control warnings							



Discharge Measurement Summary

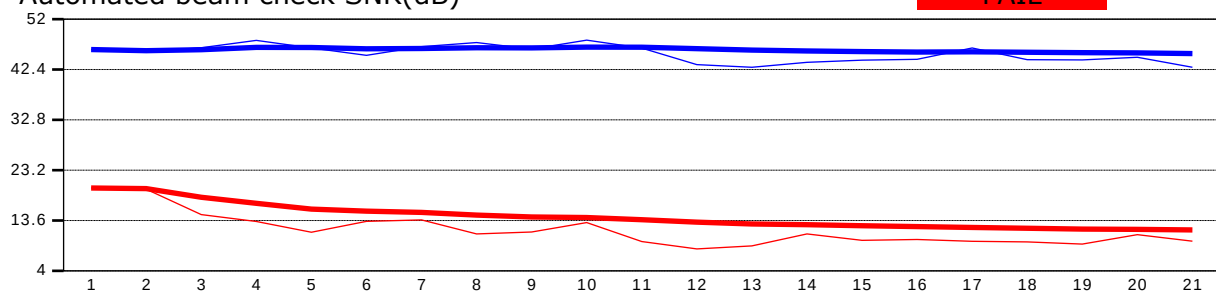
Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/5/2021 11:06:08 PM

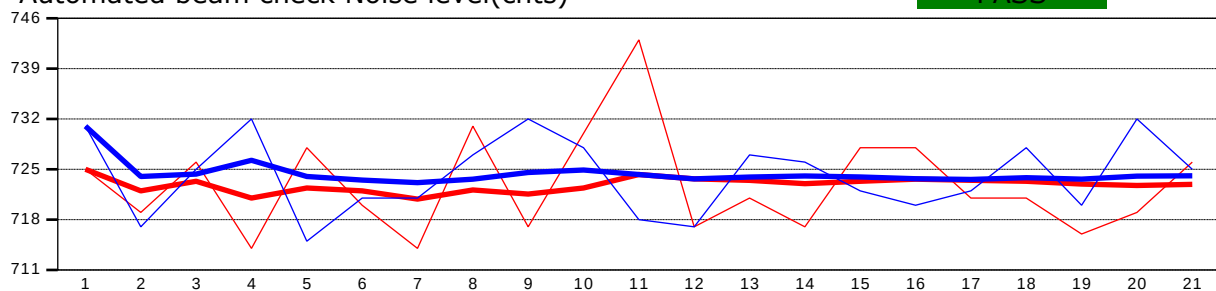
Automated beam check SNR(dB)

FAIL



Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

Beam SNRs Not Similar



Discharge Measurement Summary

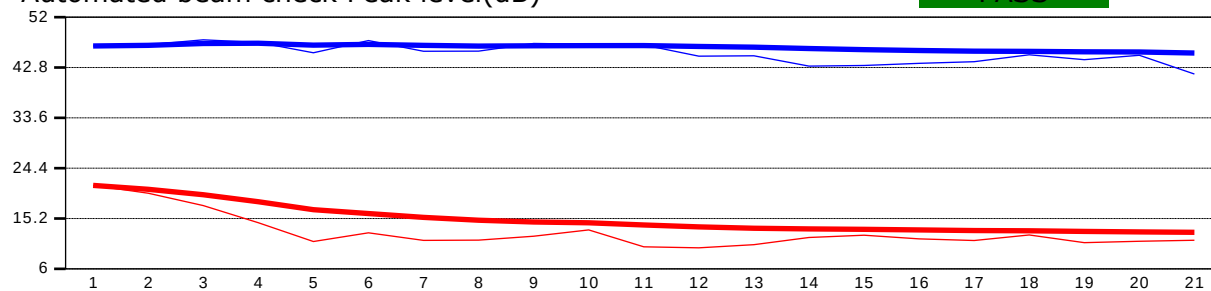
Site name Milk
Site number 4521
Operator(s) Lfs
File name Milk_20210405-232744.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/5/2021 11:06:08 PM

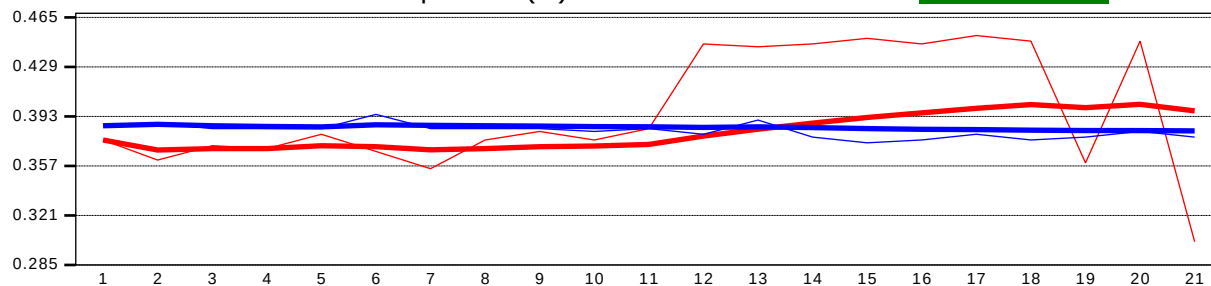
Automated beam check Peak level(dB)

PASS



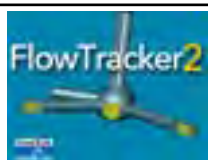
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

Beam SNRs Not Similar



Discharge Measurement Summary

Site name	Milkcr
Site number	5132021
Operator(s)	Lfs
File name	Milkcr_20210513-104154.ft
Comment	

Start time	5/13/2021 10:12 AM	Sensor type	Top Setting
End time	5/13/2021 10:33 AM	Handheld serial number	FT2H2104006
Start location latitude	40.386	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
17	40	17.4674

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
14.900	15.3905	15.587

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
42	1.033	1.1349

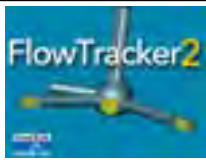
Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
50.724	1.650	1.7471

Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.4%
Velocity	0.6%	4.0%
Width	0.1%	0.1%
Method	2.0%	
# Stations	3.0%	
Overall	3.8%	4.8%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

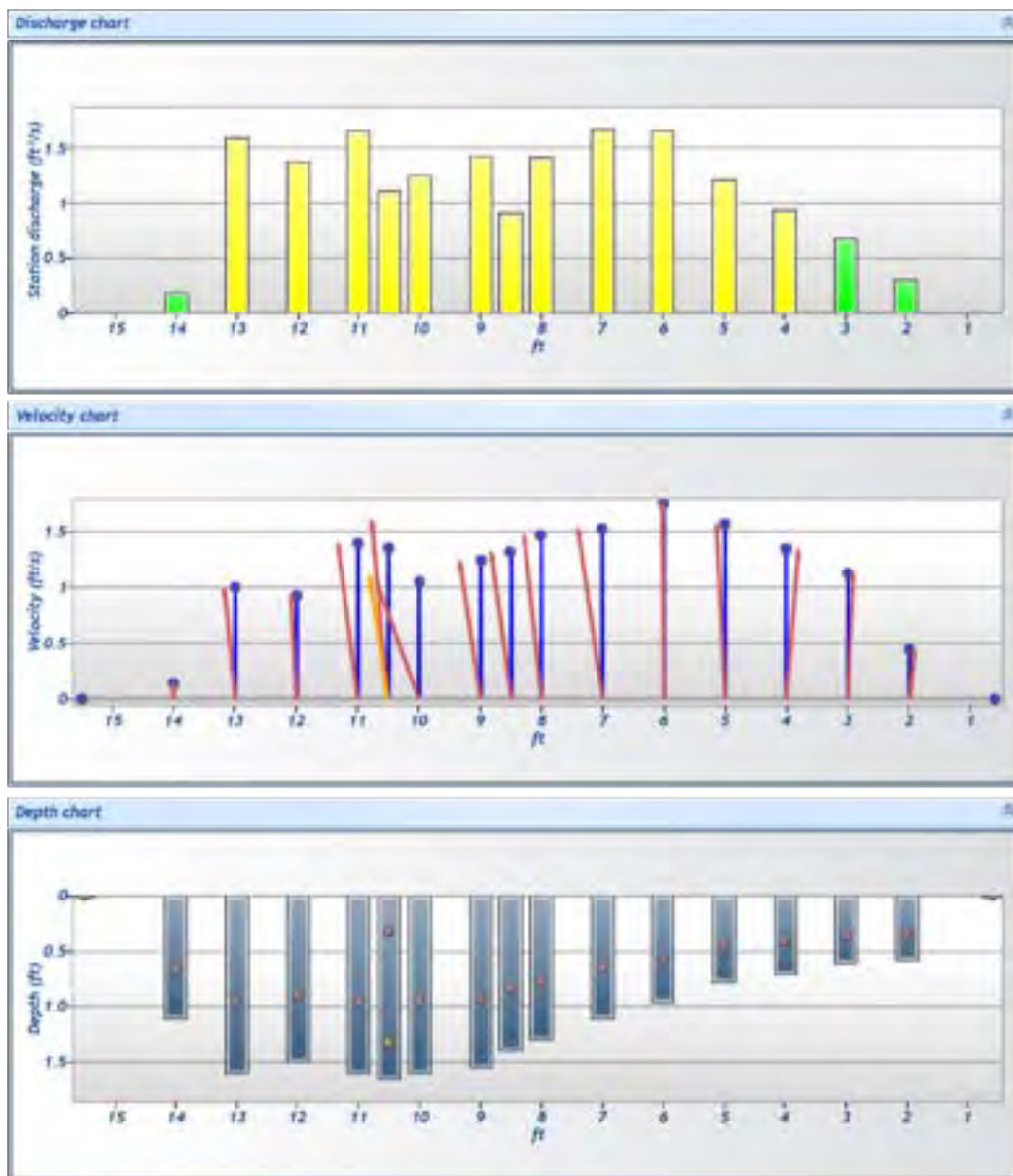
Summary overview
No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 5132021
Operator(s) Lfs
File name Milkcr_20210513-104154.ft
Comment

Station Warning Settings	
Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%

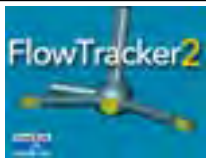




Discharge Measurement Summary

Site name Milkcr
Site number 5132021
Operator(s) Lfs
File name Milkcr_20210513-104154.ft
Comment

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
0	10:12 AM	0.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.4360	0.0070	0.0031	0.02	✓
1	10:12 AM	2.000	0.6	0.580	0.6000	0.348	80	0.4360	1.0000	0.4360	0.6960	0.3035	1.74	✓
2	10:13 AM	3.000	0.6	0.600	0.6000	0.360	80	1.1326	1.0000	1.1326	0.9600	0.6795	3.89	✓
3	10:14 AM	4.000	0.6	0.700	0.6000	0.420	80	1.3346	1.0000	1.3346	0.7000	0.9342	5.35	✓
4	10:16 AM	5.000	0.6	0.780	0.6000	0.468	80	1.5662	1.0000	1.5662	0.7800	1.2216	6.99	✓
5	10:17 AM	6.000	0.6	0.950	0.6000	0.570	80	1.7471	1.0000	1.7471	0.9500	1.6597	9.50	✓
6	10:18 AM	7.000	0.6	1.100	0.6000	0.660	80	1.5205	1.0000	1.5205	1.1000	1.6725	9.58	✓
7	10:19 AM	8.000	0.6	1.300	0.6000	0.780	80	1.4660	1.0000	1.4660	0.9750	1.4293	8.18	✓
8	10:33 AM	8.500	0.6	1.400	0.6000	0.840	80	1.3143	1.0000	1.3143	0.7000	0.9280	5.27	✓
9	10:20 AM	9.000	0.6	1.550	0.6000	0.930	80	1.2355	1.0000	1.2355	1.1625	1.4383	8.22	✓
10	10:22 AM	10.000	0.6	1.600	0.6000	0.960	80	1.0463	1.0000	1.0463	1.2000	1.2555	7.19	✓
11	10:30 AM	10.500	0.7/0.8	1.650	0.7000	0.330	80	1.5980	1.0000	1.3483	0.8250	1.1123	6.37	✓
11	10:30 AM	10.500	0.7/0.8	1.650	0.8000	1.370	80	1.0985	1.0000	1.3483	0.8250	1.1123	6.37	✓
12	10:24 AM	11.000	0.6	1.600	0.6000	0.960	80	1.3852	1.0000	1.3852	1.2000	1.6622	9.52	✓
13	10:25 AM	12.000	0.6	1.500	0.6000	0.900	80	0.9271	1.0000	0.9271	1.5000	1.3907	7.46	✓
14	10:26 AM	13.000	0.6	1.600	0.6000	0.960	80	0.9983	1.0000	0.9983	1.6000	1.5973	9.14	✓
15	10:28 AM	14.000	0.6	1.110	0.6000	0.666	80	0.1358	1.0000	0.1358	1.3875	0.1885	1.08	✓
16	10:29 AM	15.500	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.1358	0.0075	0.0010	0.01	✓



Discharge Measurement Summary

Site name Milkcr
Site number 5132021
Operator(s) Lfs
File name Milkcr_20210513-104154.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
10	10:22 AM	10.000	0.6	1.600	0.6000	0.960	Velocity Angle > QC
13	10:25 AM	12.000	0.6	1.500	0.6000	0.900	Standard Error > QC
15	10:28 AM	14.000	0.6	1.110	0.6000	0.666	Boundary Interference
16	10:29 AM	15.500	None	0.010	0.0000	0.000	Water Depth > QC



Discharge Measurement Summary

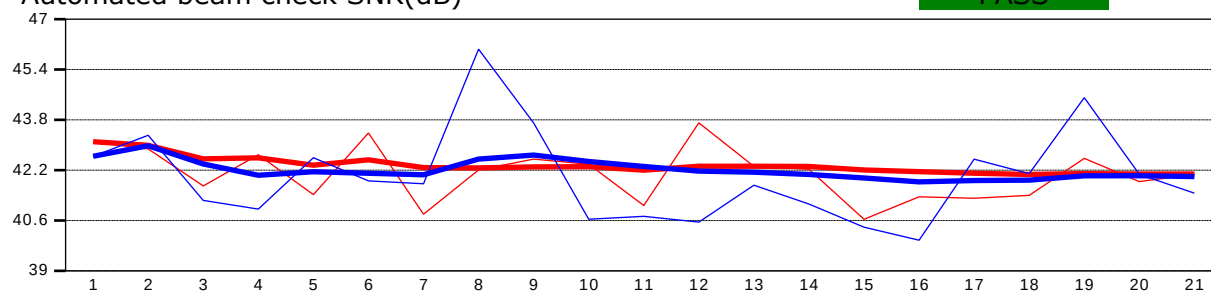
Site name Milkcr
Site number 5132021
Operator(s) Lfs
File name Milkcr_20210513-104154.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/13/2021 10:11:33 AM

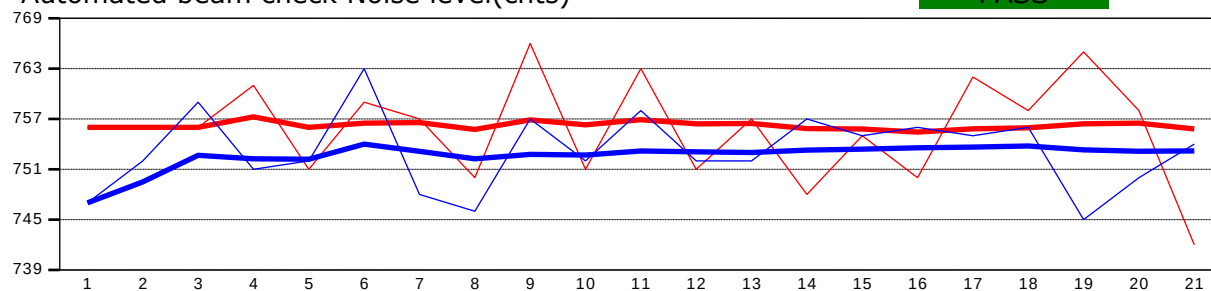
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

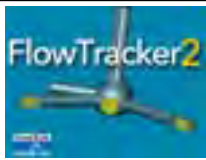
PASS



Automated beam check Quality control warnings

No quality control warnings

5/14/2021 10:56:54 AM



Discharge Measurement Summary

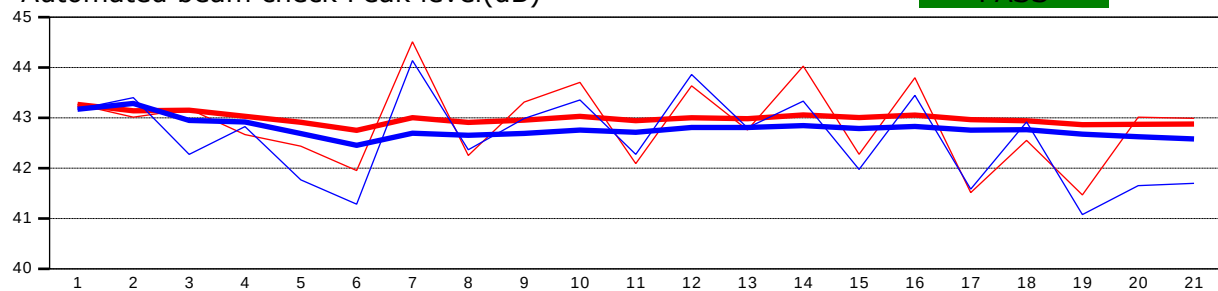
Site name Milkcr
Site number 5132021
Operator(s) Lfs
File name Milkcr_20210513-104154.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/13/2021 10:11:33 AM

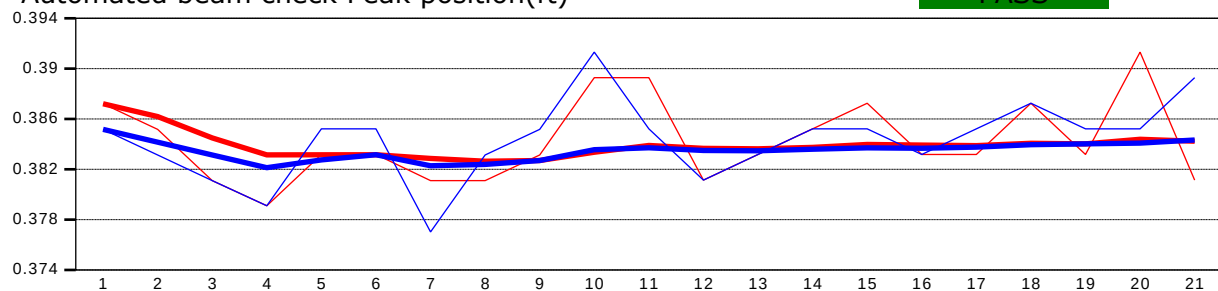
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

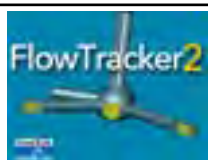
PASS



Automated beam check Quality control warnings

No quality control warnings

5/14/2021 10:56:54 AM



Discharge Measurement Summary

Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Start time	6/16/2021 10:11 AM	Sensor type	Top Setting
End time	6/16/2021 10:34 AM	Handheld serial number	FT2H2104006
Start location latitude	40.385	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
18	40	1.3060

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
9.350	5.8920	9.656

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
30	0.630	0.2217

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
66.841	0.970	0.4965

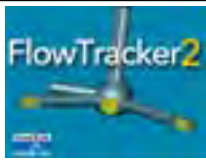
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	3.6%
Velocity	1.0%	12.8%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.8%	
Overall	3.8%	13.4%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Station Warning Settings

Station discharge OK

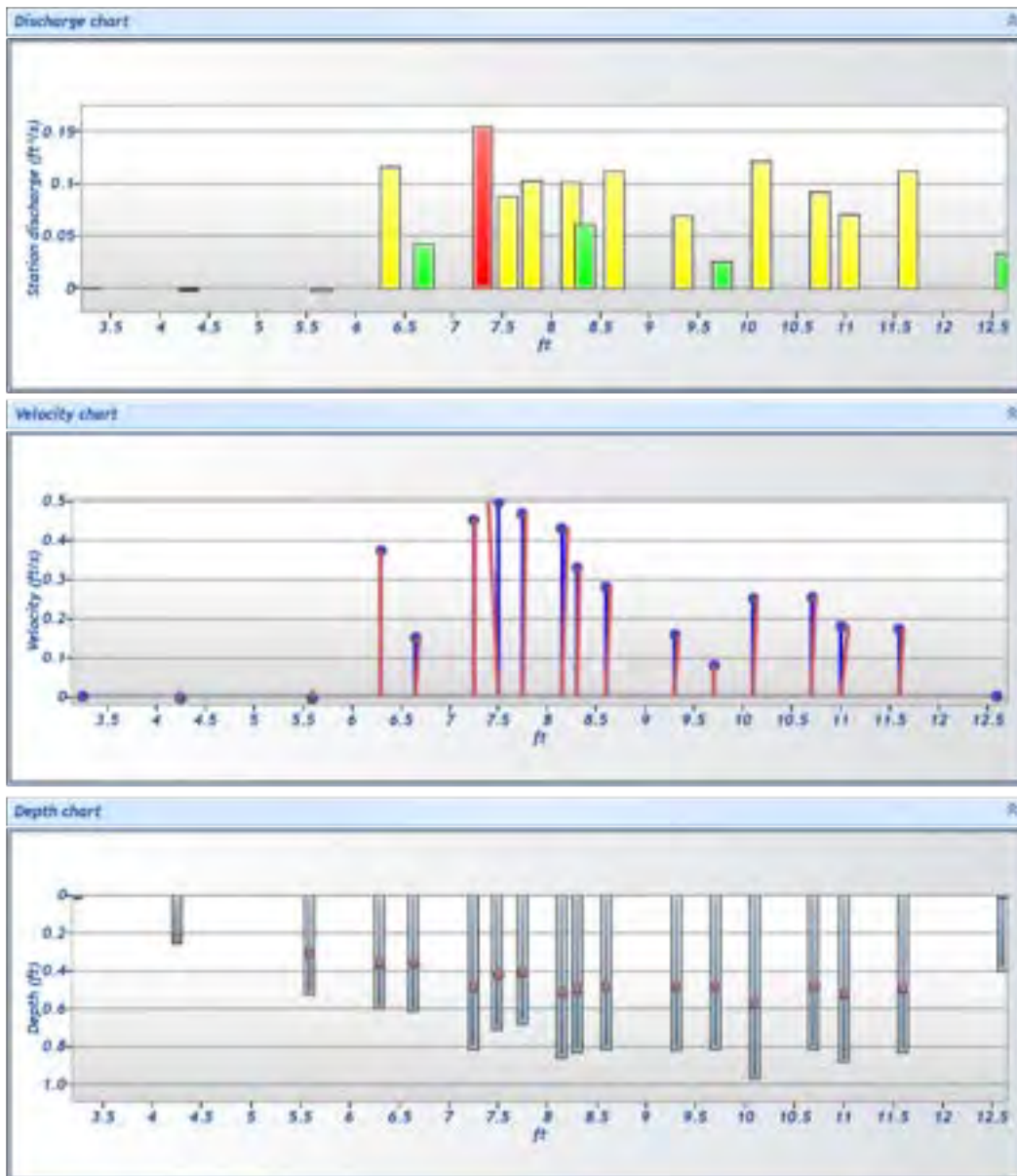
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

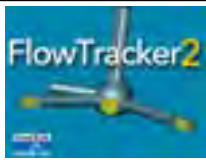




Discharge Measurement Summary

Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Site	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
0	10:11 AM	3.250	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0055	0.0050	0.0000	0.00
1	10:11 AM	4.250	0.6	0.250	0.0000	0.236	80	0.0055	1.0000	0.0055	0.2938	0.0016	0.12
2	10:13 AM	5.600	0.6	0.520	0.0000	0.312	80	-0.0044	1.0000	-0.0044	0.5330	-0.0024	-0.18
3	10:14 AM	6.300	0.6	0.600	0.0000	0.360	80	0.3710	1.0000	0.3710	0.3150	0.1169	8.95
4	10:33 AM	6.650	0.6	0.610	0.0000	0.366	80	0.1493	1.0000	0.1493	0.2898	0.0433	3.31
5	10:16 AM	7.250	0.6	0.810	0.0000	0.486	80	0.4520	1.0000	0.4520	0.3442	0.1556	11.91
6	10:31 AM	7.500	0.6	0.710	0.0000	0.426	80	0.4965	1.0000	0.4965	0.1775	0.0881	6.75
7	10:30 AM	7.750	0.6	0.680	0.0000	0.408	80	0.4685	1.0000	0.4685	0.2210	0.1035	7.93
8	10:17 AM	8.150	0.6	0.860	0.0000	0.516	80	0.4309	1.0000	0.4309	0.2365	0.1019	7.80
9	10:34 AM	8.300	0.6	0.830	0.0000	0.498	80	0.3275	1.0000	0.3275	0.1868	0.0612	4.68
10	10:18 AM	8.600	0.6	0.810	0.0000	0.486	80	0.2774	1.0000	0.2774	0.4050	0.1123	8.60
11	10:19 AM	9.300	0.6	0.820	0.0000	0.492	80	0.1551	1.0000	0.1551	0.4510	0.0700	5.36
12	10:22 AM	9.700	0.6	0.810	0.0000	0.486	80	0.0766	1.0000	0.0766	0.3240	0.0248	1.90
13	10:23 AM	10.100	0.6	0.970	0.0000	0.582	80	0.2513	1.0000	0.2513	0.4850	0.1219	9.33
14	10:24 AM	10.700	0.6	0.810	0.0000	0.486	80	0.2546	1.0000	0.2546	0.3645	0.0928	7.11
15	10:28 AM	11.000	0.6	0.880	0.0000	0.528	80	0.1797	1.0000	0.1797	0.3960	0.0712	5.45
16	10:26 AM	11.600	0.6	0.830	0.0000	0.498	80	0.1697	1.0000	0.1697	0.6040	0.1127	8.63
17	10:27 AM	12.600	None	0.400	0.0000	0.000	0	0.0000	1.0000	0.1097	0.2000	0.0329	2.60



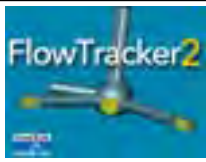
Discharge Measurement Summary

Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	10:11 AM	4.250	0.6	0.250	0.6000	0.236	Boundary Interference: SNR Threshold Variation
2	10:13 AM	5.600	0.6	0.520	0.6000	0.312	Boundary Interference: SNR Threshold Variation
5	10:16 AM	7.250	0.6	0.810	0.6000	0.486	High Stn % Discharge
7	10:30 AM	7.750	0.6	0.680	0.6000	0.408	Stn Spacing > QC
10	10:18 AM	8.600	0.6	0.810	0.6000	0.486	Stn Spacing > QC
15	10:28 AM	11.000	0.6	0.880	0.6000	0.528	Velocity Angle > QC



Discharge Measurement Summary

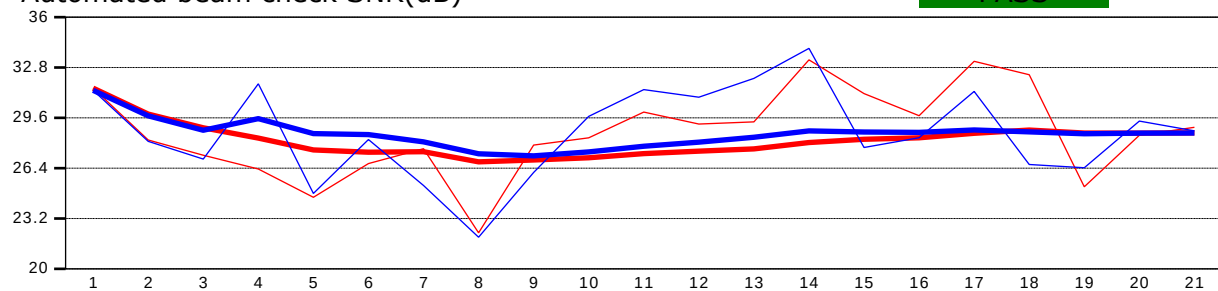
Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 6/16/2021 10:10:56 AM

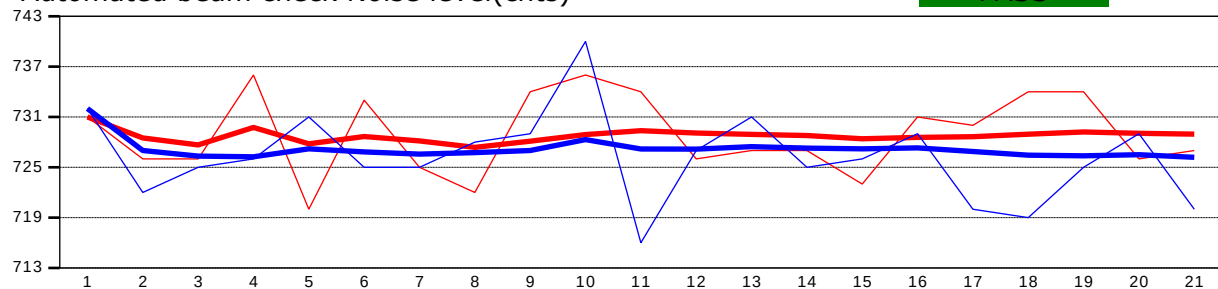
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

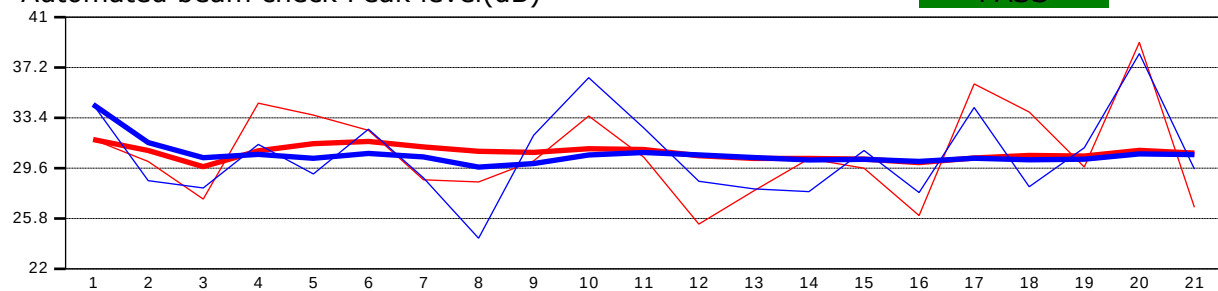
Site name Milkcr
Site number 6162021A
Operator(s) Lfs
File name Milkcr_20210616-103653.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 6/16/2021 10:10:56 AM

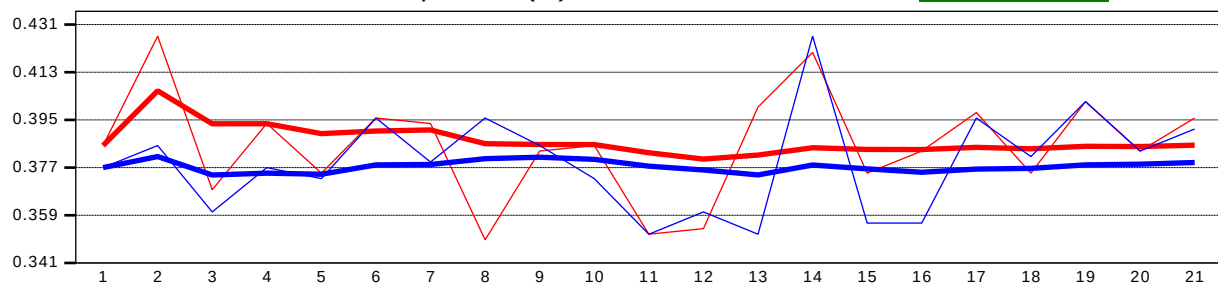
Automated beam check Peak level(dB)

PASS



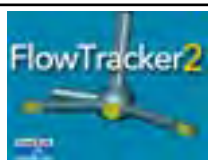
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

Start time	7/22/2021 2:32 PM	Sensor type	Top Setting
End time	7/22/2021 2:57 PM	Handheld serial number	FT2H2104006
Start location latitude	40.385	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
18	40	1.2435

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
17.900	4.7970	17.970

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
37	0.268	0.2592

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
80.809	0.440	0.5620

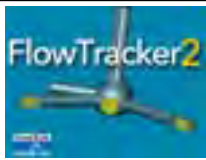
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	11.8%
Velocity	0.7%	9.2%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.8%	
Overall	3.7%	15.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

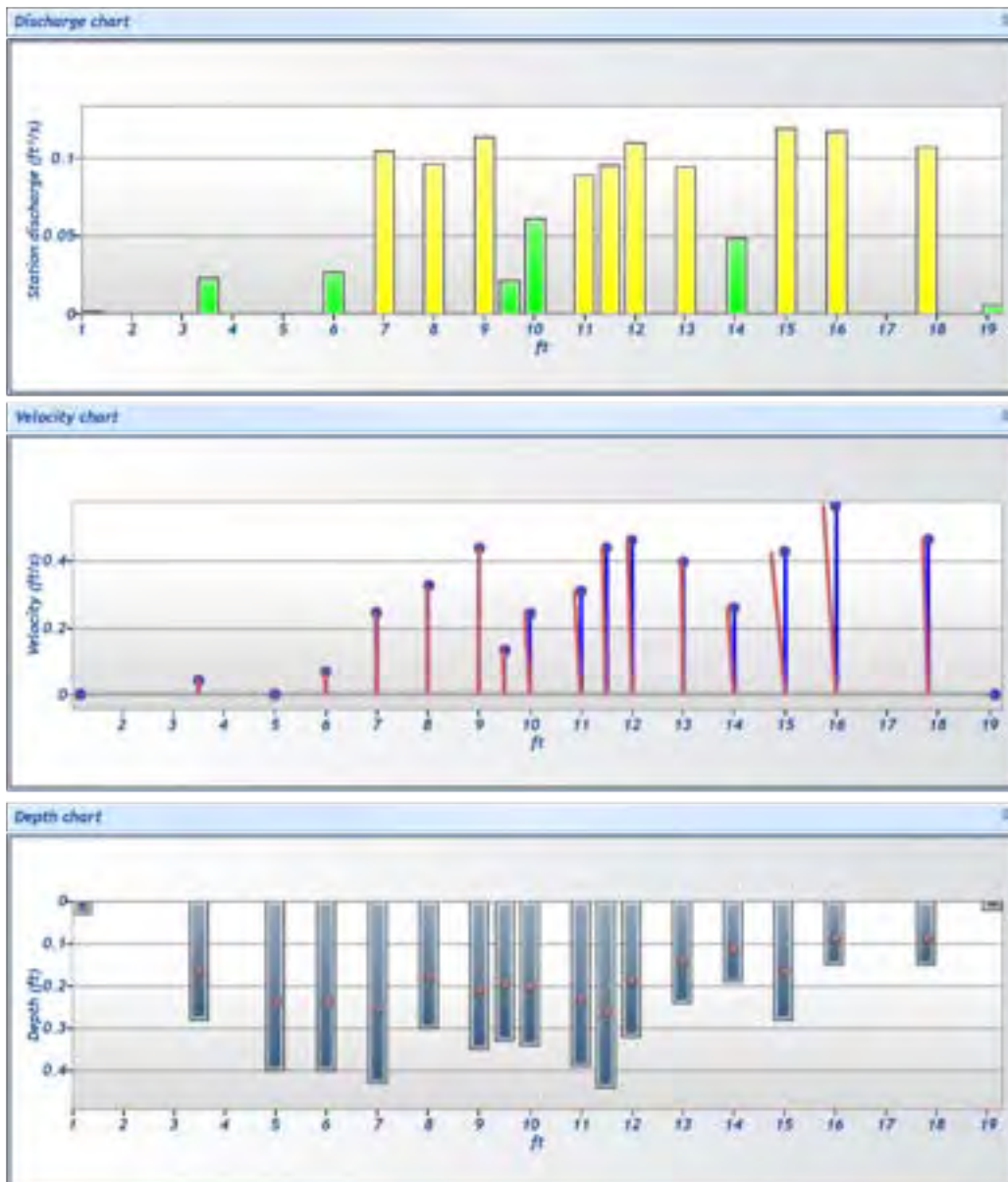


Discharge Measurement Summary

Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

Station Warning Settings

Station discharge OK Station discharge < 5.00%
Station discharge caution 5.00% >= Station discharge < 10.00%
Station discharge warning Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Stations	Velocity (ft/s)	Corrected	Ablon Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
17	2:54 PM	1.200	None	0.130	0.0000	0.000	0	0.0000	1.0000	0.0443	0.0345	0.0015	0.12	✓
16	2:53 PM	1.500	0.6	0.280	0.6000	0.168	80	0.0443	1.0000	0.0443	0.5320	0.0235	1.89	✓
15	2:52 PM	5.000	0.6	0.400	0.6000	0.240	80	0.0614	1.0000	0.0619	0.5000	0.0009	0.08	✓
14	2:50 PM	6.000	0.6	0.400	0.6000	0.240	80	0.0681	1.0000	0.0681	0.4000	0.0272	2.19	✓
13	2:49 PM	7.000	0.6	0.430	0.6000	0.258	80	0.2439	1.0000	0.2439	0.4300	0.1049	8.43	✓
12	2:48 PM	8.000	0.6	0.300	0.6000	0.180	80	0.3227	1.0000	0.3227	0.3000	0.0968	7.78	✓
11	2:47 PM	9.000	0.6	0.350	0.6000	0.210	80	0.4356	1.0000	0.4356	0.2625	0.1143	9.20	✓
10	2:55 PM	9.500	0.6	0.330	0.6000	0.198	80	0.1309	1.0000	0.1309	0.1650	0.0216	1.74	✓
9	2:45 PM	10.000	0.6	0.340	0.6000	0.204	80	0.2417	1.0000	0.2417	0.2550	0.0616	4.96	✓
8	2:44 PM	11.000	0.6	0.390	0.6000	0.234	80	0.3065	1.0000	0.3065	0.2925	0.0896	7.21	✓
7	2:57 PM	11.500	0.6	0.440	0.6000	0.264	80	0.4376	1.0000	0.4376	0.2200	0.0963	7.74	✓
6	2:43 PM	12.000	0.6	0.370	0.6000	0.192	80	0.4588	1.0000	0.4588	0.2400	0.1101	8.86	✓
5	2:42 PM	13.000	0.6	0.240	0.6000	0.144	80	0.3964	1.0000	0.3964	0.2400	0.0951	7.65	✓
4	2:40 PM	14.000	0.6	0.190	0.6000	0.114	80	0.2570	1.0000	0.2570	0.1900	0.0488	3.93	✓
3	2:39 PM	15.000	0.6	0.280	0.6000	0.168	80	0.4256	1.0000	0.4256	0.2800	0.1192	9.58	✓
2	2:34 PM	16.000	0.6	0.150	0.6000	0.090	80	0.5620	1.0000	0.5620	0.2100	0.1180	9.49	✓
1	2:33 PM	17.800	0.6	0.150	0.6000	0.090	80	0.4634	1.0000	0.4634	0.2325	0.1077	8.66	✓
0	2:32 PM	14.100	None	0.020	0.0000	0.000	0	0.0000	1.0000	0.4614	0.0130	0.0060	0.48	✓



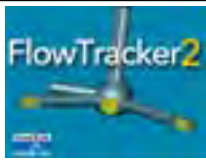
Discharge Measurement Summary

Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
16	2:53 PM	3.500	0.6	0.280	0.6000	0.168	Boundary Interference
15	2:52 PM	5.000	0.6	0.400	0.6000	0.240	SNR Threshold Violation
10	2:55 PM	9.500	0.6	0.330	0.6000	0.198	Boundary Interference
9	2:45 PM	10.000	0.6	0.340	0.6000	0.204	Velocity Angle > QC
8	2:44 PM	11.000	0.6	0.390	0.6000	0.234	Velocity Angle > QC
4	2:40 PM	14.000	0.6	0.190	0.6000	0.114	Velocity Angle > QC
3	2:39 PM	15.000	0.6	0.280	0.6000	0.168	Velocity Angle > QC
2	2:34 PM	16.000	0.6	0.150	0.6000	0.090	Velocity Angle > QC



Discharge Measurement Summary

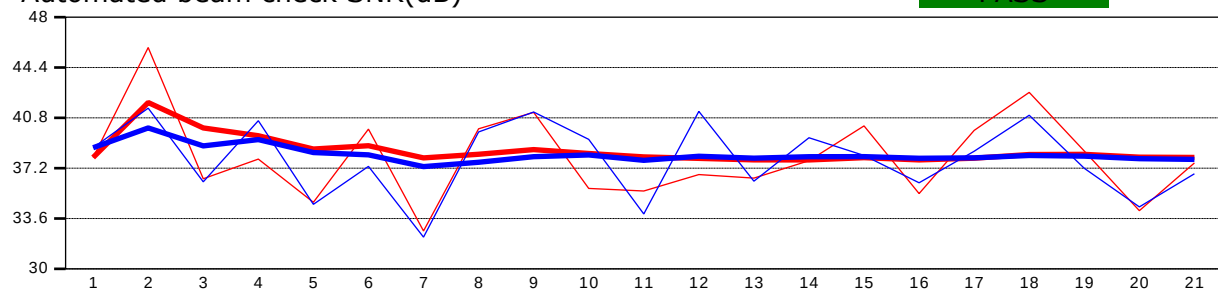
Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 7/22/2021 2:32:04 PM

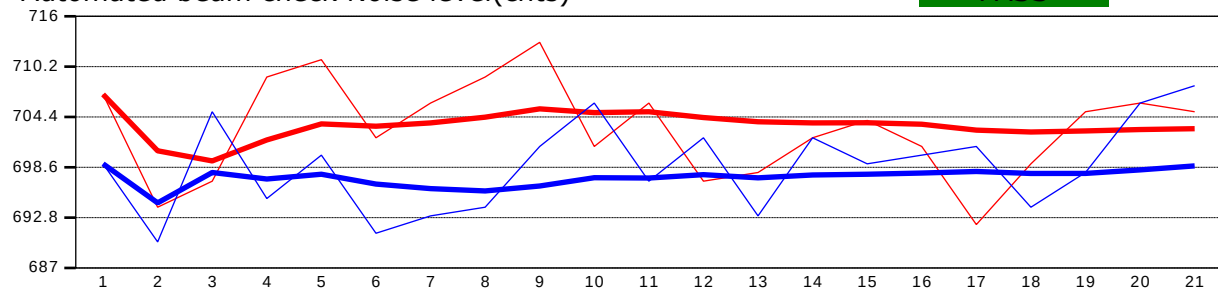
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

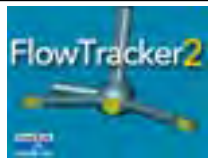
PASS



Automated beam check Quality control warnings

No quality control warnings

7/23/2021 10:43:22 AM



Discharge Measurement Summary

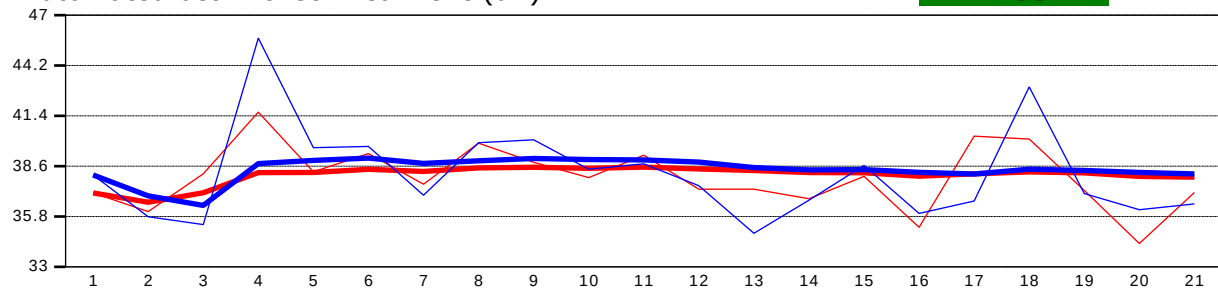
Site name Milkcr
Site number 72221
Operator(s) Lfs
File name Milkcr_20210722-150015.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 7/22/2021 2:32:04 PM

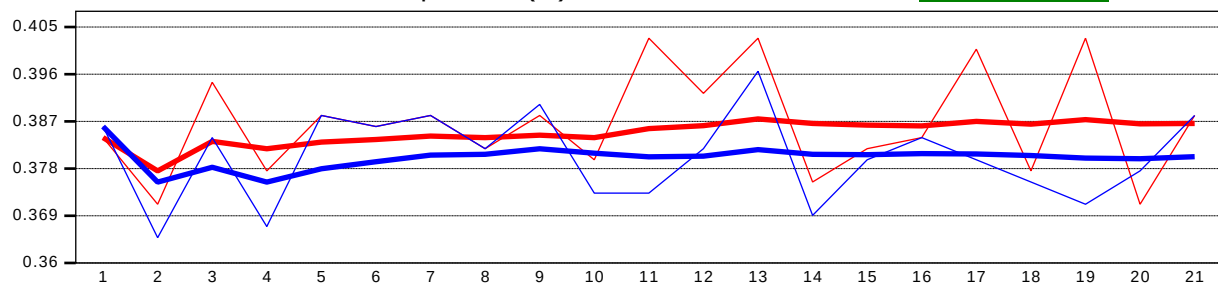
Automated beam check Peak level(dB)

PASS



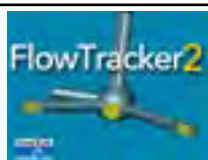
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Start time	9/15/2021 11:53 AM	Sensor type	Top Setting
End time	9/15/2021 12:30 PM	Handheld serial number	FT2H2104006
Start location latitude	40.386	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
25	40	1.1454

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
10.400	2.4900	10.525

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
41	0.239	0.4600

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
67.706	0.370	1.3758

Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	9.3%
Velocity	0.7%	8.7%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.0%	
Overall	3.0%	12.8%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Station Warning Settings

Station discharge OK

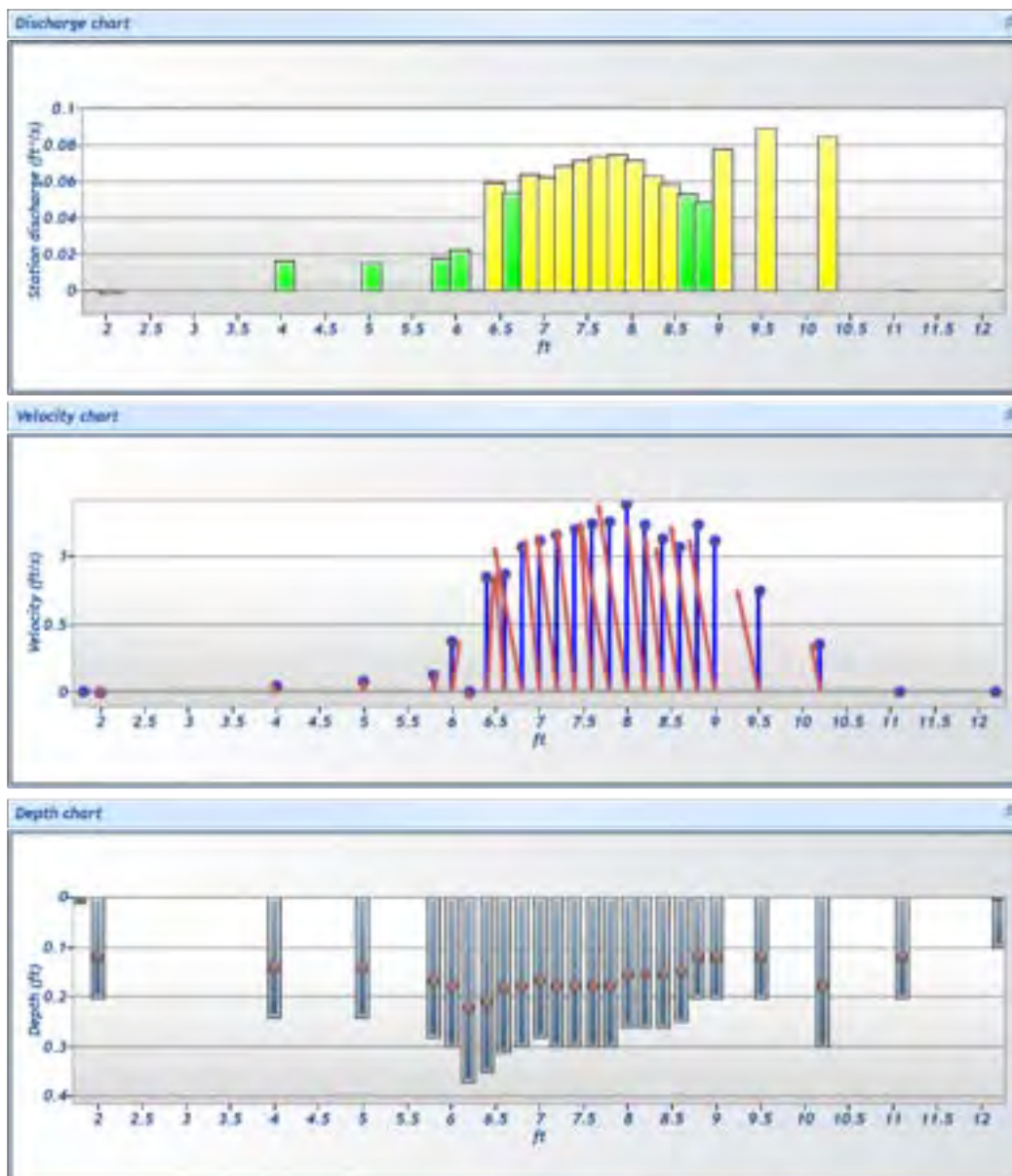
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

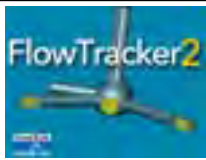




Discharge Measurement Summary

Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Sta	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
24	12:30 PM	1.800	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0057	0.0010	0.0000	0.00	✓
23	12:29 PM	2.000	0.6	0.200	0.6000	0.120	80	0.0057	1.0000	0.0057	0.2200	0.0012	0.11	✓
22	12:27 PM	4.000	0.6	0.240	0.6000	0.144	80	0.0447	1.0000	0.0447	0.3600	0.0161	1.40	✓
21	12:26 PM	5.000	0.6	0.240	0.6000	0.144	80	0.0723	1.0000	0.0723	0.2160	0.0156	1.36	✓
20	12:24 PM	5.800	0.6	0.280	0.6000	0.168	80	0.1288	1.0000	0.1288	0.1400	0.0180	1.57	✓
19	12:23 PM	6.000	0.6	0.300	0.6000	0.180	80	0.3690	1.0000	0.3690	0.0600	0.0221	1.93	✓
18	12:22 PM	6.200	0.6	0.370	0.6000	0.222	80	0.0947	1.0000	0.0947	0.0740	0.0033	0.03	✓
17	12:21 PM	6.400	0.6	0.350	0.6000	0.210	80	0.8439	1.0000	0.8439	0.0700	0.0591	5.16	✓
16	12:20 PM	6.600	0.6	0.310	0.6000	0.186	80	0.8700	1.0000	0.8700	0.0620	0.0539	4.71	✓
15	12:19 PM	6.800	0.6	0.300	0.6000	0.180	80	1.0602	1.0000	1.0602	0.0600	0.0636	5.55	✓
14	12:18 PM	7.000	0.6	0.280	0.6000	0.168	80	1.1130	1.0000	1.1130	0.0560	0.0623	5.44	✓
13	12:16 PM	7.200	0.6	0.300	0.6000	0.180	80	1.1482	1.0000	1.1482	0.0600	0.0689	6.01	✓
12	12:15 PM	7.400	0.6	0.300	0.6000	0.180	80	1.1895	1.0000	1.1895	0.0600	0.0714	6.23	✓
11	12:13 PM	7.600	0.6	0.300	0.6000	0.180	80	1.2302	1.0000	1.2302	0.0600	0.0738	6.44	✓
10	12:12 PM	7.800	0.6	0.300	0.6000	0.180	80	1.2419	1.0000	1.2419	0.0600	0.0745	6.51	✓
9	12:11 PM	8.000	0.6	0.260	0.6000	0.156	80	1.3758	1.0000	1.3758	0.0520	0.0715	6.25	✓
8	12:10 PM	8.200	0.6	0.260	0.6000	0.156	80	1.2199	1.0000	1.2199	0.0520	0.0634	5.54	✓
7	12:09 PM	8.400	0.6	0.260	0.6000	0.156	80	1.1206	1.0000	1.1206	0.0520	0.0583	5.09	✓
6	12:08 PM	8.600	0.6	0.250	0.6000	0.150	80	1.0566	1.0000	1.0566	0.0500	0.0528	4.61	✓
5	12:06 PM	8.800	0.6	0.200	0.6000	0.120	80	1.2200	1.0000	1.2200	0.0400	0.0488	4.26	✓
4	12:05 PM	9.000	0.6	0.200	0.6000	0.120	80	1.1142	1.0000	1.1142	0.0700	0.0780	6.81	✓
3	12:04 PM	9.500	0.6	0.200	0.6000	0.120	80	0.7464	1.0000	0.7464	0.1200	0.0896	7.82	✓
2	11:55 AM	10.200	0.6	0.300	0.6000	0.180	80	0.3527	1.0000	0.3527	0.2400	0.0847	7.39	✓
1	11:53 AM	11.100	0.6	0.200	0.6000	0.120	80	0.0008	1.0000	0.0008	0.2000	0.0002	0.01	✓
0	11:53 AM	12.200	None	0.100	0.0000	0.000	0	0.0000	1.0000	0.0000	0.0550	0.0000	0.00	✓



Discharge Measurement Summary

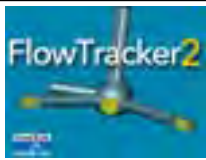
Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
18	12:22 PM	6.200	0.6	0.370	0.6000	0.222	Boundary Interference; High % Spikes
3	12:04 PM	9.500	0.6	0.200	0.6000	0.120	Standard Error > QC



Discharge Measurement Summary

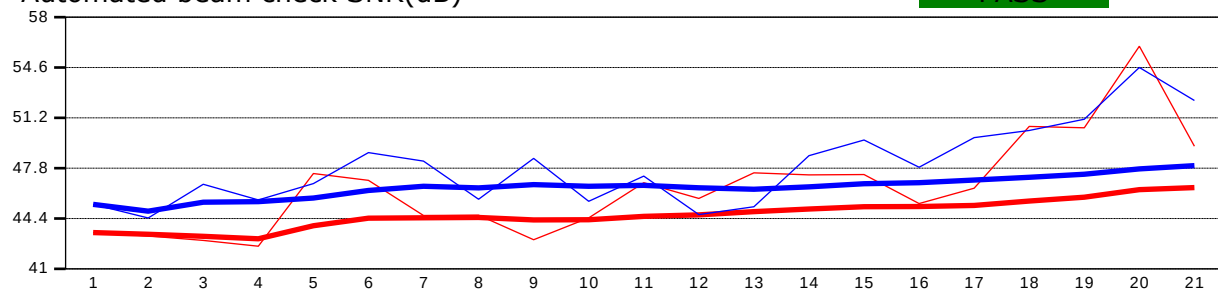
Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 9/15/2021 11:52:48 AM

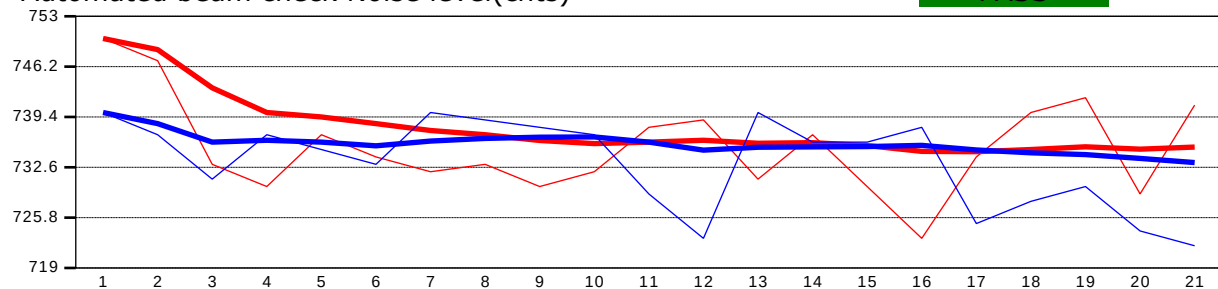
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

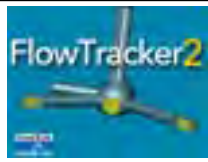
PASS



Automated beam check Quality control warnings

No quality control warnings

9/16/2021 11:28:04 AM



Discharge Measurement Summary

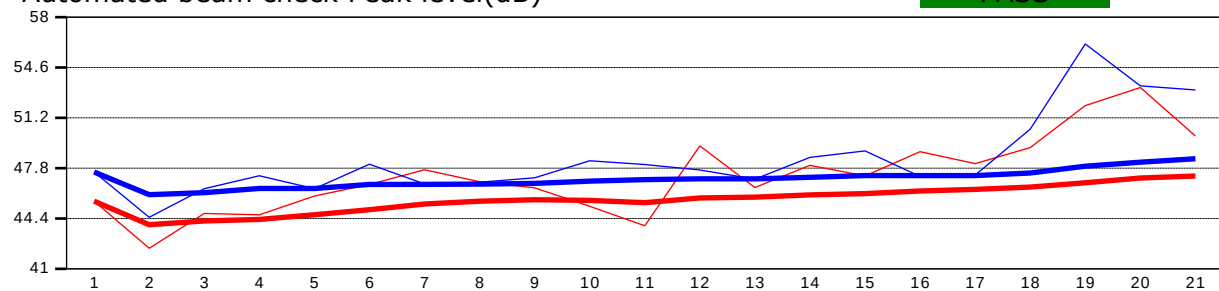
Site name Milkcr
Site number 91520211152
Operator(s) Lfs
File name Milkcr_20210915-123515.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 9/15/2021 11:52:48 AM

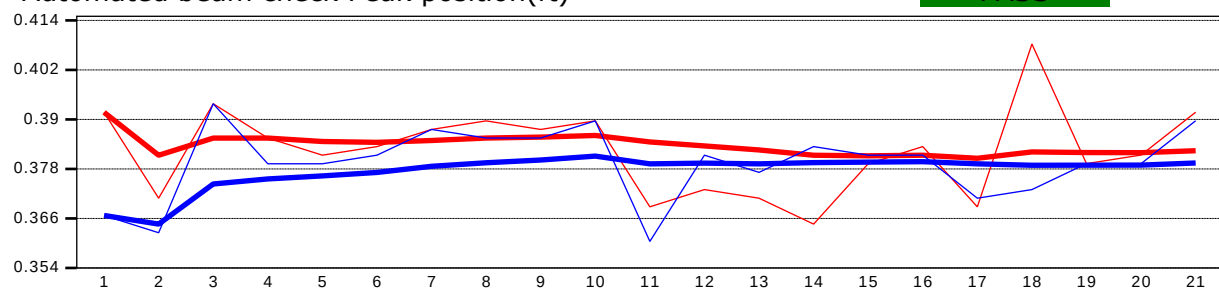
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

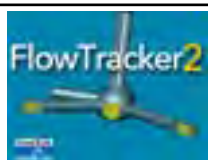
PASS



Automated beam check Quality control warnings

No quality control warnings

9/16/2021 11:28:04 AM



Discharge Measurement Summary

Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

Start time	11/1/2021 4:07 PM	Sensor type	Top Setting
End time	11/1/2021 4:25 PM	Handheld serial number	FT2H2104006
Start location latitude	40.386	Probe serial number	FT2P2103011
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6.4

# Stations	Avg interval (s)	Total discharge (ft³/s)
19	40	5.1137

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
10.000	6.6475	10.120

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
42	0.665	0.7693

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
49.387	1.080	1.3263

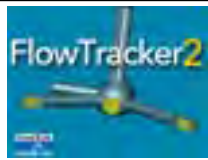
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	4.4%
Velocity	0.5%	3.8%
Width	0.1%	0.1%
Method	2.0%	
# Stations	2.6%	
Overall	3.5%	5.9%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
 Quality control warnings



Discharge Measurement Summary

Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

Station Warning Settings

Station discharge OK

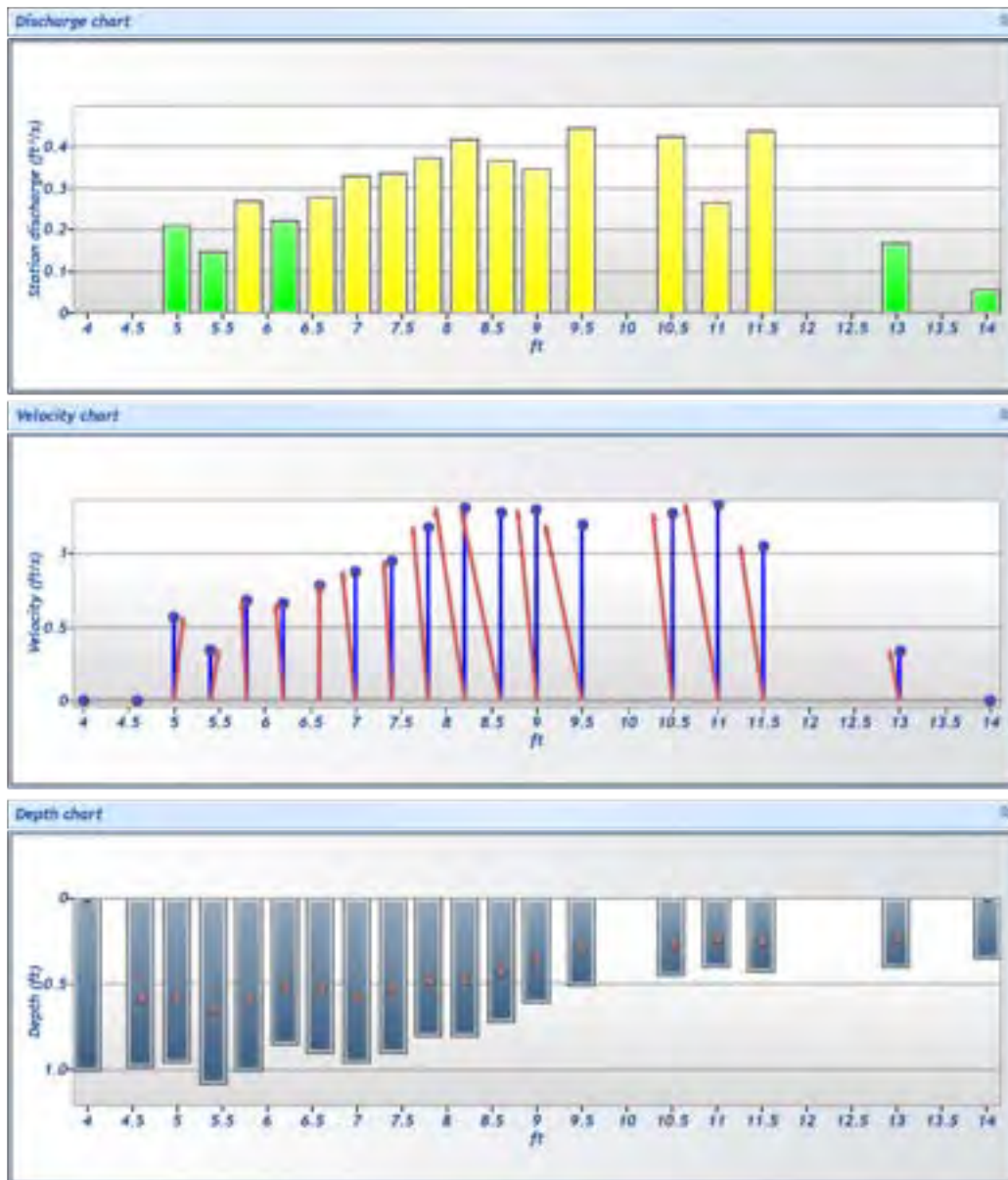
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

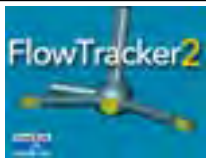




Discharge Measurement Summary

Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Strokes	Velocity (ft/s)	Corrected	Area Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q	
0	4:07 PM	4.000	None	1.000	0.0000	0.000	0	0.0000	1.0000	0.0004	0.3000	0.0001	0.00	✓
1	4:07 PM	4.600	0.6	0.980	0.6000	0.588	80	0.0004	1.0000	0.0004	0.4900	0.0002	0.00	✓
2	4:08 PM	5.000	0.6	0.950	0.6000	0.570	80	0.5613	1.0000	0.5613	0.3800	0.2130	4.17	✓
3	4:10 PM	5.400	0.6	1.000	0.6000	0.648	80	0.3404	1.0000	0.3404	0.4320	0.1471	2.88	✓
4	4:11 PM	5.800	0.6	1.000	0.6000	0.600	80	0.6744	1.0000	0.6744	0.4000	0.2698	5.28	✓
5	4:12 PM	6.200	0.6	0.850	0.6000	0.510	80	0.6545	1.0000	0.6545	0.3400	0.2225	4.35	✓
6	4:13 PM	6.600	0.6	0.900	0.6000	0.540	80	0.7770	1.0000	0.7770	0.3000	0.2397	5.47	✓
7	4:14 PM	7.000	0.6	0.950	0.6000	0.570	80	0.8728	1.0000	0.8728	0.3800	0.3317	6.49	✓
8	4:15 PM	7.400	0.6	0.900	0.6000	0.540	80	0.9428	1.0000	0.9428	0.3600	0.3394	6.64	✓
9	4:16 PM	7.800	0.6	0.800	0.6000	0.480	80	1.1725	1.0000	1.1725	0.3200	0.3752	7.34	✓
10	4:17 PM	8.200	0.6	0.800	0.6000	0.480	80	1.3041	1.0000	1.3041	0.3200	0.4173	8.16	✓
11	4:18 PM	8.600	0.6	0.770	0.6000	0.432	80	1.2740	1.0000	1.2740	0.2880	0.3664	7.18	✓
12	4:19 PM	9.000	0.6	0.600	0.6000	0.360	80	1.2872	1.0000	1.2872	0.2700	0.3475	6.80	✓
13	4:20 PM	9.500	0.6	0.500	0.6000	0.300	80	1.1858	1.0000	1.1858	0.1750	0.4447	8.70	✓
14	4:22 PM	10.500	0.6	0.450	0.6000	0.270	80	1.2630	1.0000	1.2630	0.3375	0.4263	8.34	✓
15	4:25 PM	11.000	0.6	0.400	0.6000	0.240	80	1.3263	1.0000	1.3263	0.2000	0.2653	5.19	✓
16	4:23 PM	11.500	0.6	0.420	0.6000	0.252	80	1.0468	1.0000	1.0468	0.4200	0.4397	8.60	✓
17	4:24 PM	11.000	0.6	0.400	0.6000	0.240	80	0.3364	1.0000	0.3364	0.5000	0.1682	3.29	✓
18	4:25 PM	14.000	None	0.350	0.0000	0.000	0	0.0000	1.0000	0.3364	0.1750	0.0589	1.15	✓



Discharge Measurement Summary

Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

Quality Control Settings

Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	4:07 PM	4.600	0.6	0.980	0.6000	0.588	Beam SNRs Not Similar



Discharge Measurement Summary

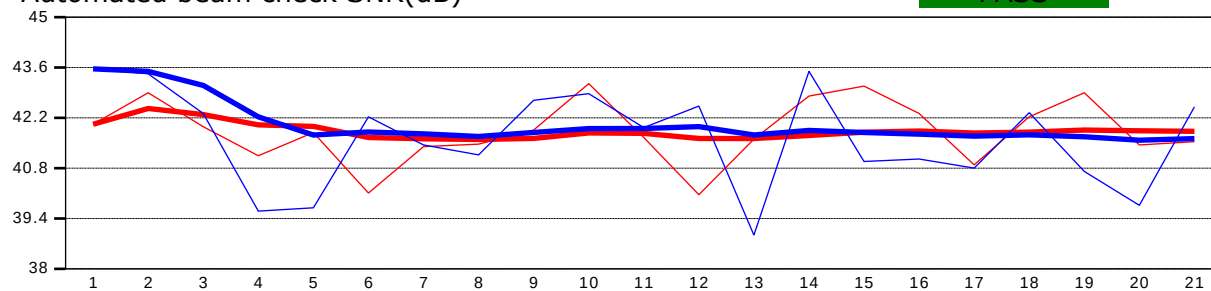
Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/1/2021 4:06:43 PM

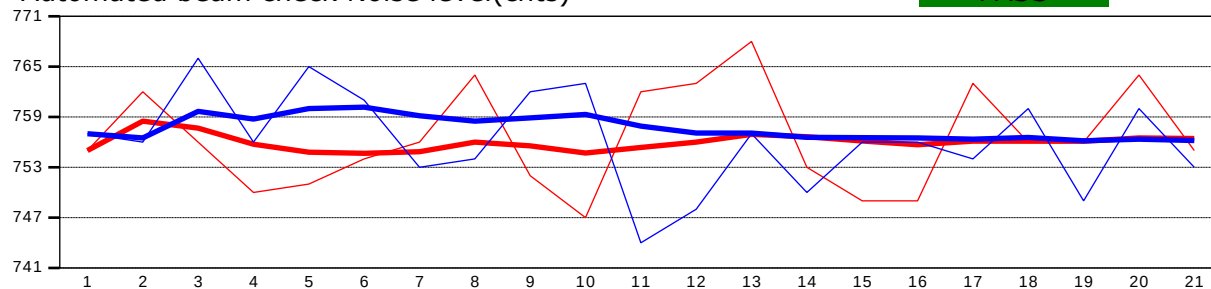
Automated beam check SNR(dB)

PASS



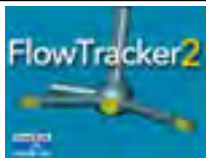
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

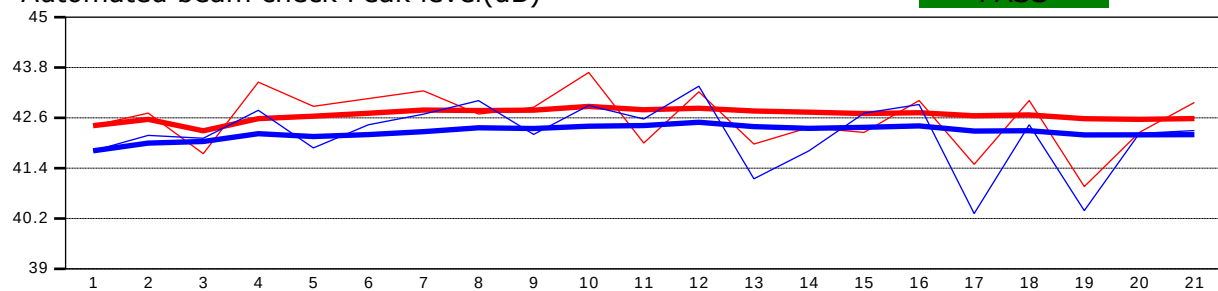
Site name Milkcr
Site number 11012021
Operator(s) Lfs
File name Milkcr_20211101-163101.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/1/2021 4:06:43 PM

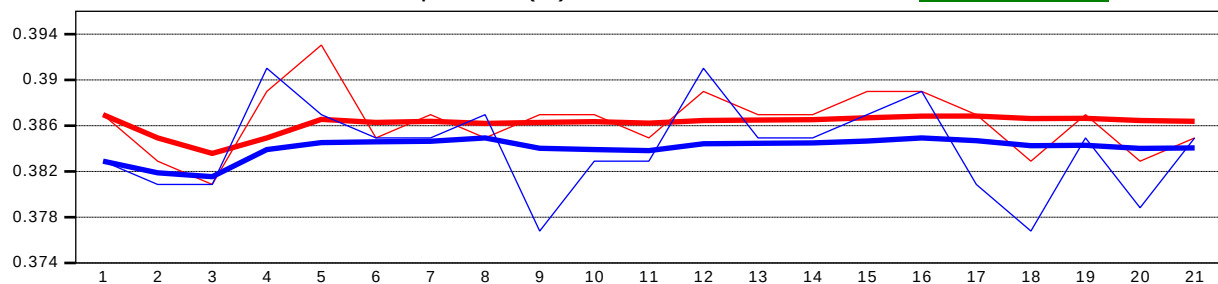
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Start time	4/20/2022 11:58 AM	Sensor type	Top Setting
End time	4/20/2022 12:32 PM	Handheld serial number	FT2H1747037
Start location latitude	40.385	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
23	40	38.4597

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
18.100	21.5785	19.329

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
60	1.192	1.7823

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
52.523	1.900	2.7162

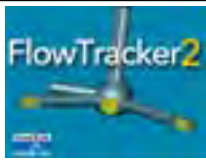
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.1%	2.6%
Velocity	0.6%	4.0%
Width	0.1%	0.1%
Method	1.5%	
# Stations	2.2%	
Overall	2.9%	4.9%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

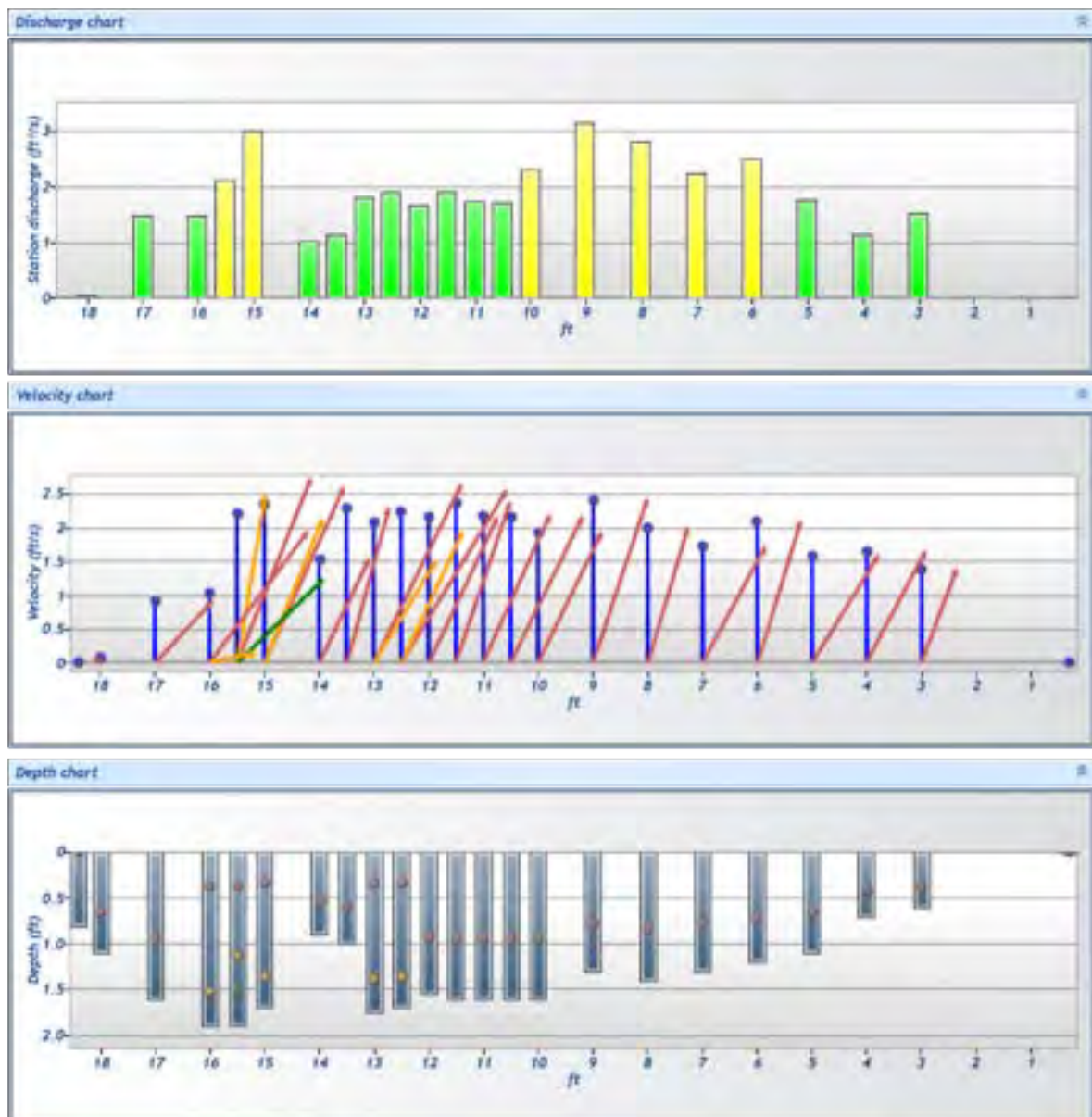


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Measurement results													
Sta	Time	Location (ft)	Method	Depth (ft)	Backsight	Measured (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	WQ
22	12:31 PM	0.800	None	0.010	0.0000	0.000	0	0.0000	1.0000	1.3764	0.0135	0.0186	0.05 ✓
21	12:29 PM	1.000	0.6	0.600	0.0000	0.360	80	1.3764	1.0000	1.3764	1.1100	1.5278	3.97 ✓
20	12:28 PM	4.000	0.6	0.700	0.0000	0.420	80	1.6471	1.0000	1.6471	0.7500	1.1530	7.00 ✓
19	12:27 PM	5.000	0.6	1.100	0.0000	0.660	80	1.5908	1.0000	1.5908	1.1000	1.3499	4.55 ✓
18	12:25 PM	6.000	0.6	1.200	0.0000	0.720	80	2.0875	1.0000	2.0875	1.2000	2.5051	6.51 ✓
17	12:24 PM	7.000	0.6	1.300	0.0000	0.780	80	1.7182	1.0000	1.7182	1.3000	2.2317	5.81 ✓
16	12:23 PM	8.000	0.6	1.400	0.0000	0.840	80	2.0018	1.0000	2.0018	1.4000	2.8025	7.29 ✓
15	12:22 PM	9.000	0.6	1.300	0.0000	0.780	80	2.4120	1.0000	2.4120	1.3000	3.1356	8.15 ✓
14	12:21 PM	10.000	0.6	1.600	0.0000	0.960	80	1.9258	1.0000	1.9258	1.2000	2.3110	6.01 ✓
13	12:20 PM	10.500	0.6	1.600	0.0000	0.960	80	2.1553	1.0000	2.1553	0.8000	1.7242	4.48 ✓
12	12:19 PM	11.000	0.6	1.600	0.0000	0.960	80	2.1764	1.0000	2.1764	0.8000	1.7411	4.53 ✓
11	12:17 PM	11.500	0.6	1.600	0.0000	0.960	80	2.3675	1.0000	2.3675	0.8000	1.8940	4.92 ✓
10	12:16 PM	12.000	0.6	1.500	0.0000	0.930	80	2.1413	1.0000	2.1413	0.7750	1.6610	4.39 ✓
9	12:13 PM	12.500	0.2/0.8	1.700	0.2500	0.340	80	2.5490	1.0000	2.2373	0.8500	1.9017	4.94 ✓
9	12:13 PM	12.500	0.2/0.8	1.700	0.8000	1.200	80	1.9250	1.0000	2.2373	0.8500	1.9017	4.94 ✓
8	12:11 PM	13.000	0.2/0.8	1.750	0.2500	0.350	80	2.6730	1.0000	2.0668	0.8750	1.8084	4.70 ✓
8	12:11 PM	13.000	0.2/0.8	1.750	0.8000	1.400	80	1.5000	1.0000	2.0668	0.8750	1.8084	4.70 ✓
7	12:09 PM	13.500	0.6	1.000	0.0000	0.600	80	2.2899	1.0000	2.2899	0.5000	1.1450	2.68 ✓
6	12:08 PM	14.000	0.6	0.900	0.0000	0.540	80	1.5114	1.0000	1.5114	0.6250	1.0317	2.60 ✓
5	12:05 PM	15.000	0.2/0.8	1.700	0.2500	0.350	80	2.5830	1.0000	2.3483	1.2750	2.9941	7.29 ✓
5	12:05 PM	15.100	0.2/0.8	1.700	0.8000	1.360	80	2.1137	1.0000	2.3483	1.2750	2.9941	7.29 ✓
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.2000	0.380	80	2.7162	1.0000	2.2185	0.9500	2.1075	5.48 ✓
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.6000	1.180	80	2.4627	1.0000	2.2185	0.9500	2.1075	5.48 ✓
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.8000	1.520	80	1.2323	1.0000	2.2185	0.9500	2.1075	5.48 ✓
3	12:01 PM	16.000	0.2/0.8	1.900	0.2000	0.380	80	1.9154	1.0000	1.9154	1.4250	1.4791	1.85 ✓
3	12:01 PM	16.000	0.2/0.8	1.900	0.8000	1.520	80	0.1400	1.0000	1.9154	1.4250	1.4791	1.85 ✓
2	12:01 PM	17.500	0.6	1.600	0.0000	0.960	80	0.9151	1.0000	0.9151	1.6000	1.4641	1.81 ✓
1	11:59 AM	18.000	0.6	1.100	0.0000	0.660	80	0.6738	1.0000	0.6738	0.7700	0.0569	0.15 ✓
0	11:58 AM	18.400	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.6738	0.1600	0.0118	0.03 ✓

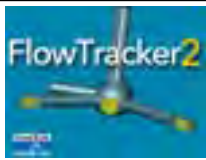


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

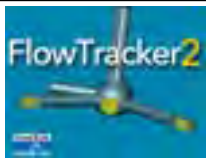
Quality control warnings							
Sta	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
21	12:29 PM	3.600	0.6	0.600	0.6000	0.360	Standard Error > QC, Velocity Angle > QC
20	12:28 PM	4.000	0.6	0.700	0.6000	0.420	Standard Error > QC, Velocity Angle > QC
19	12:27 PM	5.200	0.6	1.100	0.6000	0.660	Standard Error > QC, Velocity Angle > QC
18	12:25 PM	6.500	0.6	1.300	0.6000	0.780	Standard Error > QC, Velocity Angle > QC
17	12:24 PM	7.600	0.6	1.300	0.6000	0.780	Standard Error > QC, Velocity Angle > QC
16	12:23 PM	8.000	0.6	1.400	0.6000	0.840	Standard Error > QC, Velocity Angle > QC
15	12:22 PM	9.000	0.6	1.300	0.6000	0.780	Standard Error > QC, Velocity Angle > QC
14	12:21 PM	10.000	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
13	12:20 PM	10.500	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
12	12:19 PM	11.000	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
11	12:17 PM	11.500	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
10	12:16 PM	12.000	0.6	1.550	0.6000	0.930	Standard Error > QC, Velocity Angle > QC
9	12:13 PM	12.500	0.2/0.8	1.700	0.2000	0.340	Standard Error > QC, Velocity Angle > QC
9	12:13 PM	12.500	0.2/0.8	1.700	0.8000	1.360	Standard Error > QC, Velocity Angle > QC
8	12:11 PM	13.000	0.2/0.8	1.750	0.2000	0.350	Standard Error > QC, Velocity Angle > QC
8	12:11 PM	13.000	0.2/0.8	1.750	0.8000	1.400	Standard Error > QC, Velocity Angle > QC
7	12:09 PM	13.500	0.6	1.000	0.6000	0.600	Standard Error > QC
6	12:08 PM	14.000	0.6	0.900	0.6000	0.540	Standard Error > QC, Velocity Angle > QC
5	12:05 PM	15.000	0.2/0.8	1.700	0.2000	0.340	Standard Error > QC, Velocity Angle > QC
5	12:05 PM	15.000	0.2/0.8	1.700	0.8000	1.360	Standard Error > QC, Velocity Angle > QC
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.2000	0.380	Standard Error > QC, Velocity Angle > QC
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.6000	1.140	Standard Error > QC, Velocity Angle > QC
4	12:32 PM	15.500	0.2/0.6/0.8	1.900	0.8000	1.520	Standard Error > QC, Velocity Angle > QC
3	12:01 PM	16.000	0.2/0.8	1.900	0.2000	0.380	Standard Error > QC, Velocity Angle > QC
3	12:01 PM	16.000	0.2/0.8	1.900	0.8000	1.520	Standard Error > QC, Velocity Angle > QC
2	12:00 PM	17.000	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
1	11:59 AM	18.000	0.6	1.100	0.6000	0.660	Flow: Still Not Stable, Velocity Angle > QC



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	42020A
Operator(s)	Laura FS
File name	Milk Creek near confl with Yampa River_20220420-123723.ft
Comment	

Supplemental data summary					
Gauge height time	Gauge height (ft)	Rated discharge (ft ³ /s)	Temperature (°F)	Salinity (PSS-78)	Gauge height comments
4/26/2022 11:58 AM	3.505				Ruler:



Discharge Measurement Summary

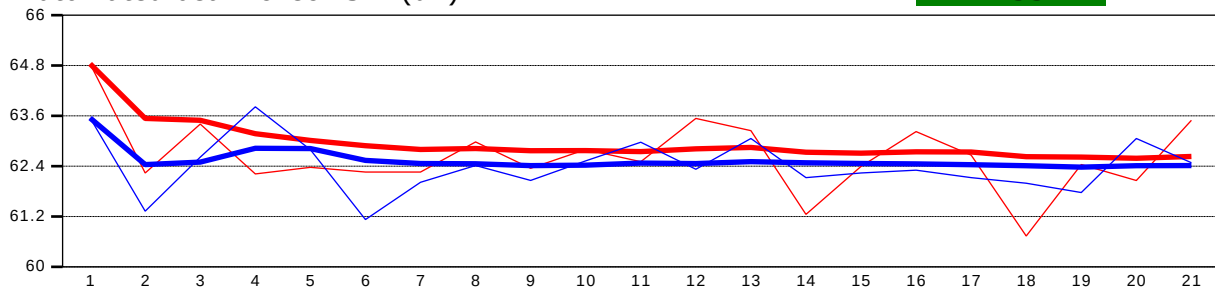
Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/20/2022 11:57:35 AM

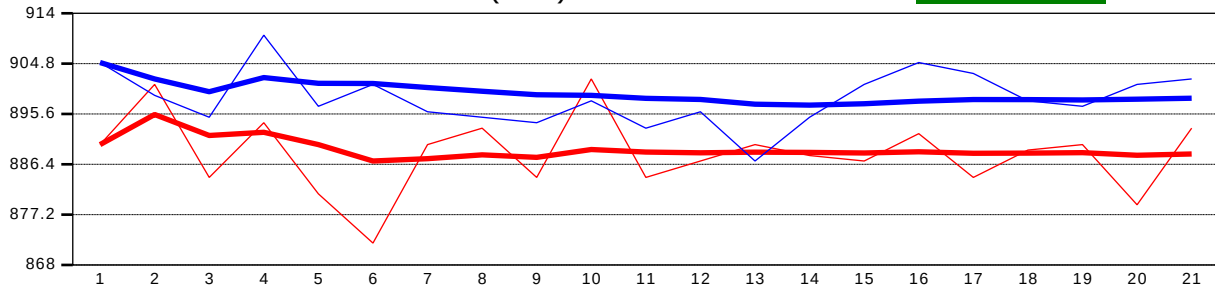
Automated beam check SNR(dB)

PASS



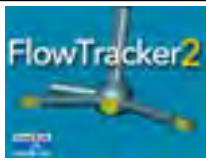
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

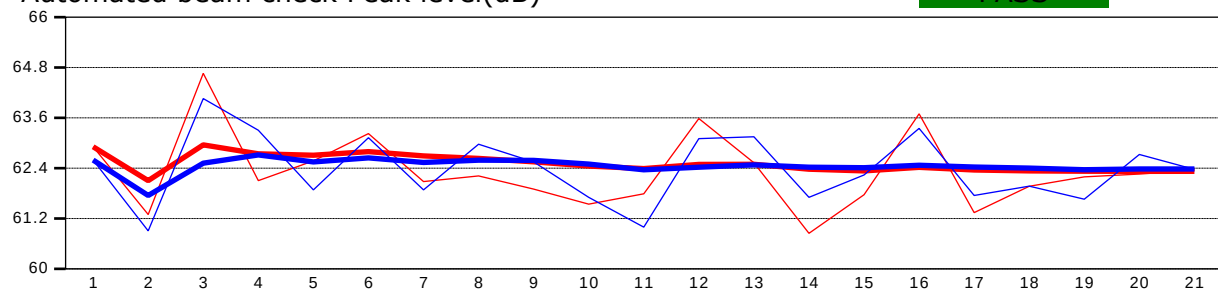
Site name Milk Creek near confl with Yampa River
Site number 42020A
Operator(s) Laura FS
File name Milk Creek near confl with Yampa River_20220420-123723.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/20/2022 11:57:35 AM

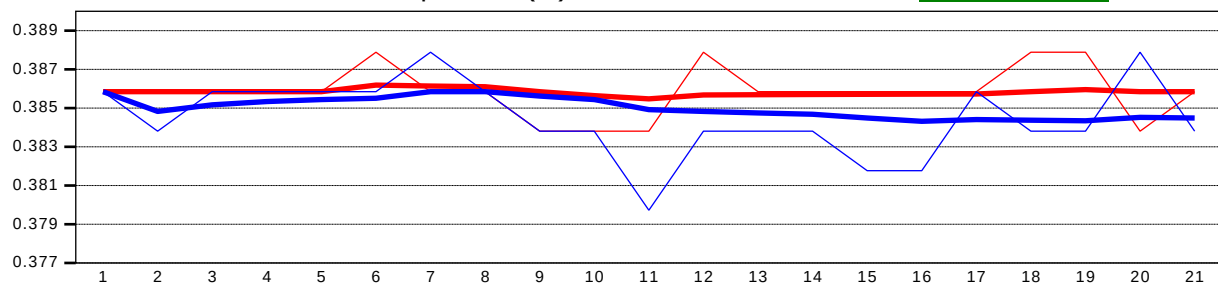
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 052420A
Operator(s) Kb
File name Milk Creek near confl with Yampa River_20220524-114355.ft
Comment

Start time	5/24/2022 11:08 AM	Sensor type	Top Setting
End time	5/24/2022 11:40 AM	Handheld serial number	FT2H1747037
Start location latitude	40.385	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
20	40	47.2024

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
17.900	22.3375	18.952

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
52	1.248	2.1131

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
51.557	1.800	4.3139

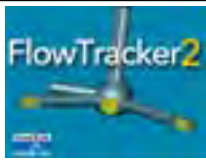
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.1%	2.2%
Velocity	0.7%	3.4%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.5%	
Overall	3.3%	4.2%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

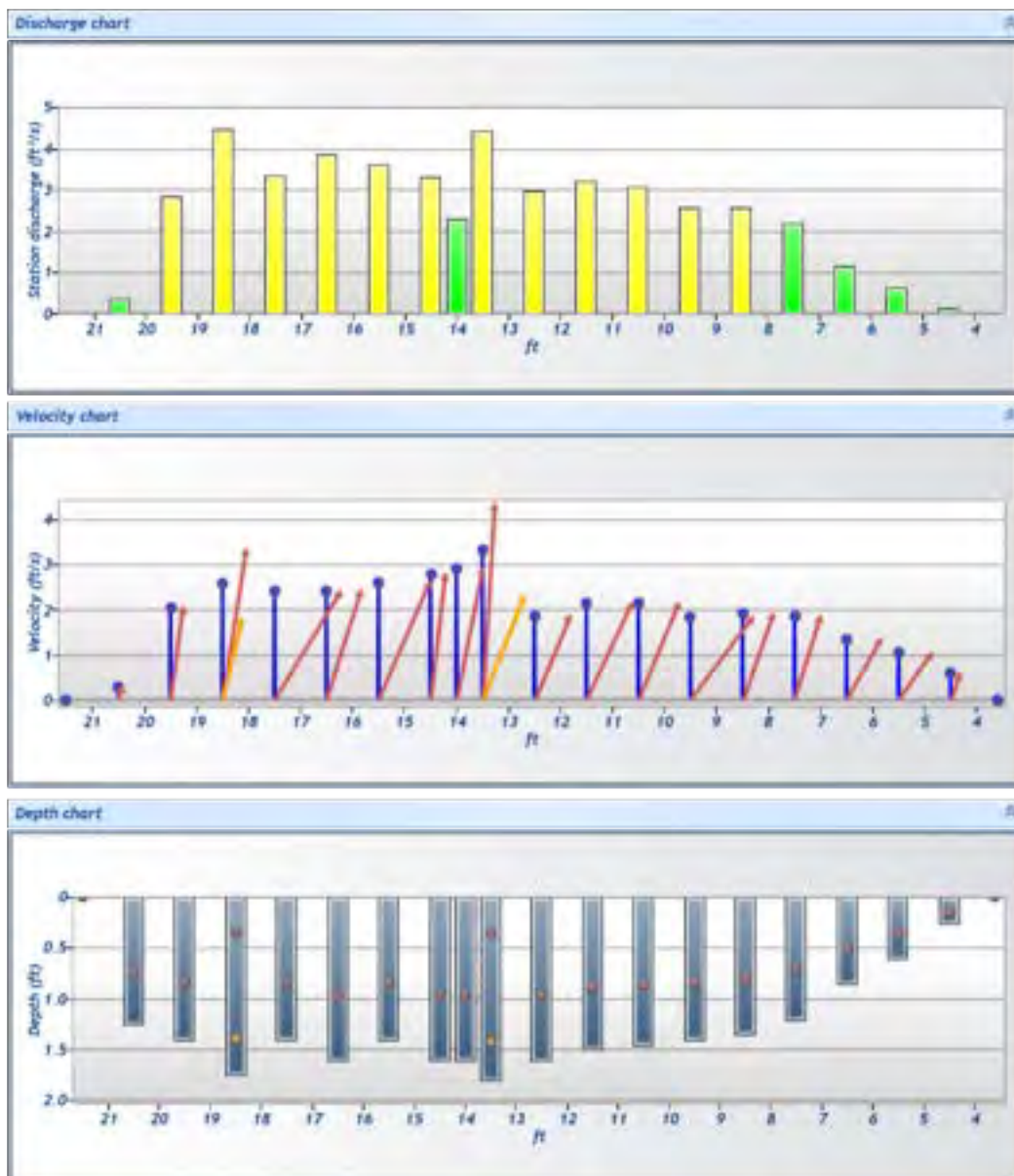


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 052420A
Operator(s) Kb
File name Milk Creek near confl with Yampa River_20220524-114355.ft
Comment

Station Warning Settings

Station discharge OK Station discharge < 5.00%
Station discharge caution 5.00% >= Station discharge < 10.00%
Station discharge warning Station discharge >= 10.00%





Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	052420A
Operator(s)	Kb
File name	Milk Creek near confl with Yampa River_20220524-114355.ft
Comment	

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft²)	Flow (ft³/s)	%Q
0	11:08 AM	3.600	None	0.000	0.0000	0.000	0	0.0000		0.5881	0.0000	0.0000	0.00
1	11:08 AM	4.500	0.6	0.250	0.6000	0.150	80	0.5881	1.0000	0.5881	0.2375	0.1397	0.30
2	11:10 AM	5.500	0.6	0.600	0.6000	0.360	80	1.0448	1.0000	1.0448	0.6000	0.6299	1.33
3	11:12 AM	6.500	0.6	0.850	0.6000	0.510	80	1.3449	1.0000	1.3449	0.8500	1.1402	2.42
4	11:14 AM	7.500	0.6	1.200	0.6000	0.720	80	1.8439	1.0000	1.8439	1.2000	2.2127	4.69
5	11:15 AM	8.500	0.6	1.350	0.6000	0.810	80	1.9121	1.0000	1.9121	1.3500	2.5814	5.47
6	11:17 AM	9.500	0.6	1.400	0.6000	0.840	80	1.8325	1.0000	1.8325	1.4000	2.5654	5.43
7	11:18 AM	10.500	0.6	1.450	0.6000	0.870	80	2.1293	1.0000	2.1293	1.4500	3.0876	6.54
8	11:19 AM	11.500	0.6	1.500	0.6000	0.900	80	2.1408	1.0000	2.1408	1.5000	3.2112	6.80
9	11:21 AM	12.500	0.6	1.600	0.6000	0.960	80	1.8665	1.0000	1.8665	1.6000	2.9864	6.33
10	11:24 AM	13.500	0.7/0.8	1.800	0.2000	0.360	80	4.3139	1.0000	3.2973	1.3500	4.4514	9.43
10	11:24 AM	13.500	0.7/0.8	1.800	0.8000	1.440	80	2.2808	1.0000	3.2973	1.3500	4.4514	9.43
11	11:40 AM	14.000	0.6	1.600	0.6000	0.960	80	2.8946	1.0000	2.8946	0.8000	2.3157	4.91
12	11:27 AM	14.500	0.6	1.600	0.6000	0.960	80	2.7808	1.0000	2.7808	1.2000	3.3370	7.07
13	11:28 AM	15.500	0.6	1.400	0.6000	0.840	80	2.5971	1.0000	2.5971	1.4000	3.6360	7.70
14	11:30 AM	16.500	0.6	1.600	0.6000	0.960	80	2.4139	1.0000	2.4139	1.6000	3.8622	8.18
15	11:31 AM	17.500	0.6	1.400	0.6000	0.840	80	2.4014	1.0000	2.4014	1.4000	3.3620	7.12
16	11:32 AM	18.500	0.7/0.8	1.750	0.2000	0.350	80	3.3305	1.0000	2.5518	1.7500	4.4657	9.46
16	11:32 AM	18.500	0.7/0.8	1.750	0.8000	1.400	80	1.7732	1.0000	2.5518	1.7500	4.4657	9.46
17	11:35 AM	19.500	0.6	1.400	0.6000	0.840	80	2.0437	1.0000	2.0437	1.4000	2.8612	6.06
18	11:36 AM	20.500	0.6	1.250	0.6000	0.750	80	0.2855	1.0000	0.2855	1.2500	0.3560	0.76
19	11:39 AM	21.500	None	0.000	0.0000	0.000	0	0.0000		0.2855	0.0000	0.0000	0.00



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 052420A
Operator(s) Kb
File name Milk Creek near confl with Yampa River_20220524-114355.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
2	11:10 AM	5.500	0.6	0.600	0.6000	0.360	Standard Error > QC, Velocity Angle > QC
3	11:12 AM	6.500	0.6	0.650	0.6000	0.510	Velocity Angle > QC
4	11:14 AM	7.500	0.6	1.200	0.6000	0.720	Standard Error > QC
5	11:15 AM	8.500	0.6	1.350	0.6000	0.810	Standard Error > QC
6	11:17 AM	9.500	0.6	1.400	0.6000	0.840	Standard Error > QC, Velocity Angle > QC
7	11:18 AM	10.500	0.6	1.450	0.6000	0.870	Standard Error > QC
8	11:19 AM	11.500	0.6	1.500	0.6000	0.900	Standard Error > QC, Velocity Angle > QC
9	11:21 AM	12.500	0.6	1.600	0.6000	0.960	Standard Error > QC, Velocity Angle > QC
10	11:24 AM	13.500	0.2/0.8	1.800	0.2000	0.360	Standard Error > QC
10	11:24 AM	13.500	0.2/0.8	1.800	0.8000	1.440	Standard Error > QC
11	11:40 AM	14.000	0.6	1.600	0.6000	0.960	Standard Error > QC
12	11:27 AM	14.500	0.6	1.600	0.6000	0.960	Standard Error > QC
13	11:28 AM	15.500	0.6	1.400	0.6000	0.840	Standard Error > QC, Velocity Angle > QC
14	11:30 AM	16.500	0.6	1.600	0.6000	0.960	Standard Error > QC
15	11:31 AM	17.500	0.6	1.400	0.6000	0.840	Standard Error > QC, Velocity Angle > QC
16	11:32 AM	18.500	0.2/0.8	1.750	0.2000	0.350	Standard Error > QC
16	11:32 AM	18.500	0.2/0.8	1.750	0.8000	1.400	Standard Error > QC
17	11:35 AM	19.500	0.6	1.400	0.6000	0.840	Standard Error > QC
19	11:39 AM	21.500	None	0.000	0.0000	0.000	Water Depth > QC

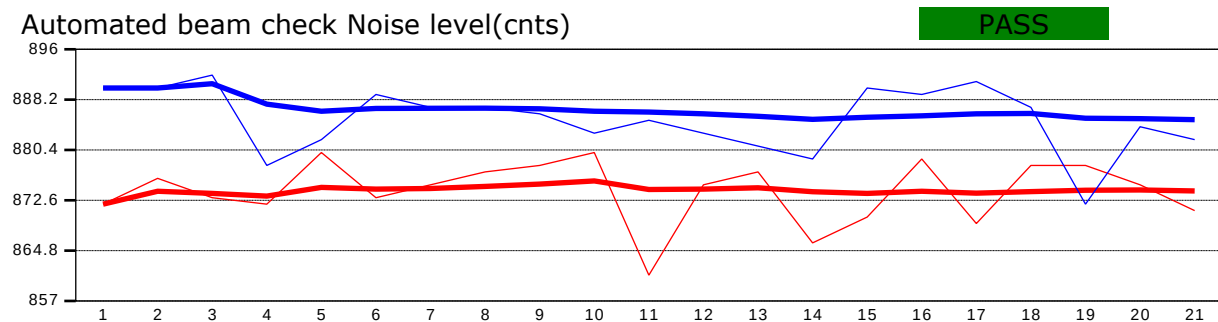
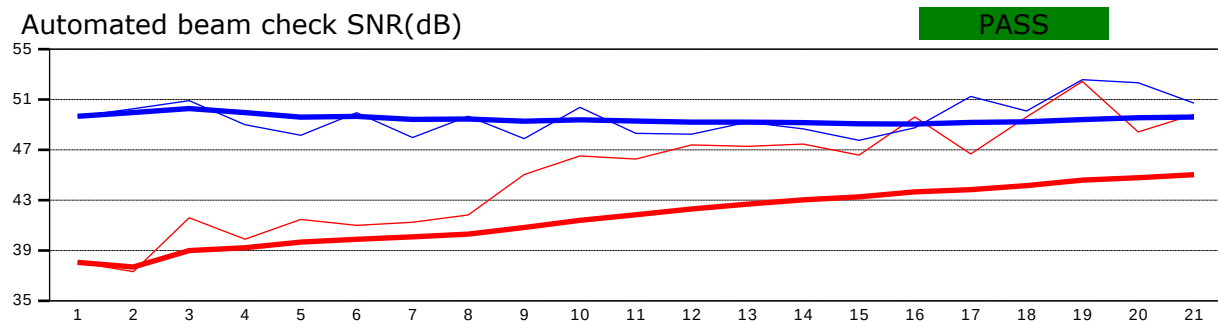


Discharge Measurement Summary

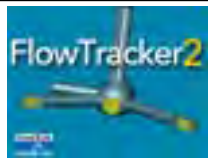
Site name Milk Creek near confl with Yampa River
Site number 052420A
Operator(s) Kb
File name Milk Creek near confl with Yampa River_20220524-114355.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/24/2022 11:07:38 AM



Automated beam check Quality control warnings
No quality control warnings



Discharge Measurement Summary

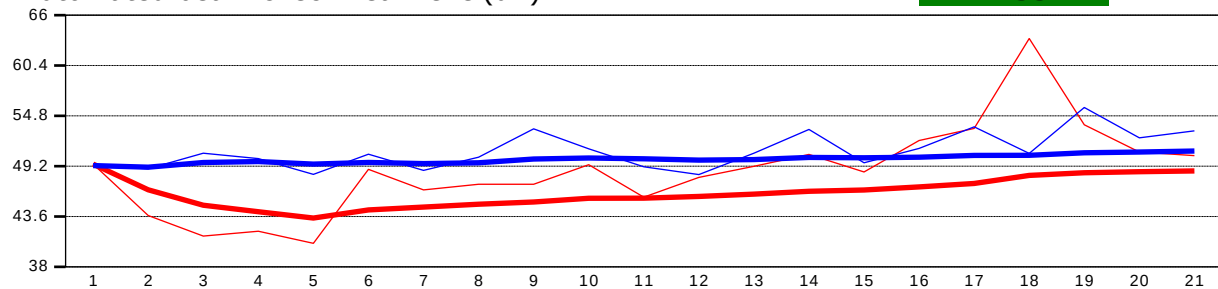
Site name Milk Creek near confl with Yampa River
Site number 052420A
Operator(s) Kb
File name Milk Creek near confl with Yampa River_20220524-114355.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/24/2022 11:07:38 AM

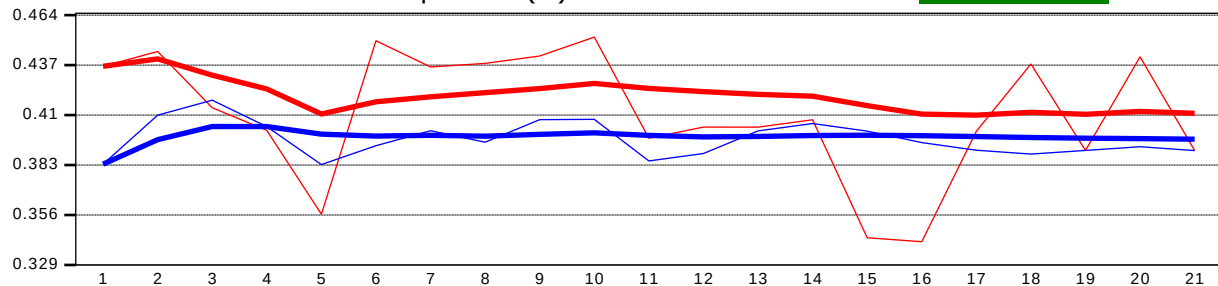
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Start time	8/18/2022 3:06 PM	Sensor type	Top Setting
End time	8/18/2022 3:37 PM	Handheld serial number	FT2H1747037
Start location latitude	40.386	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
26	40	1.8151

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
11.400	7.6870	12.098

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
41	0.674	0.2361

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
79.210	1.200	0.5212

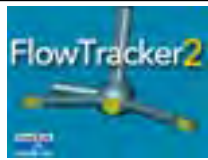
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.5%
Velocity	0.7%	3.0%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.0%	
Overall	2.9%	4.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file

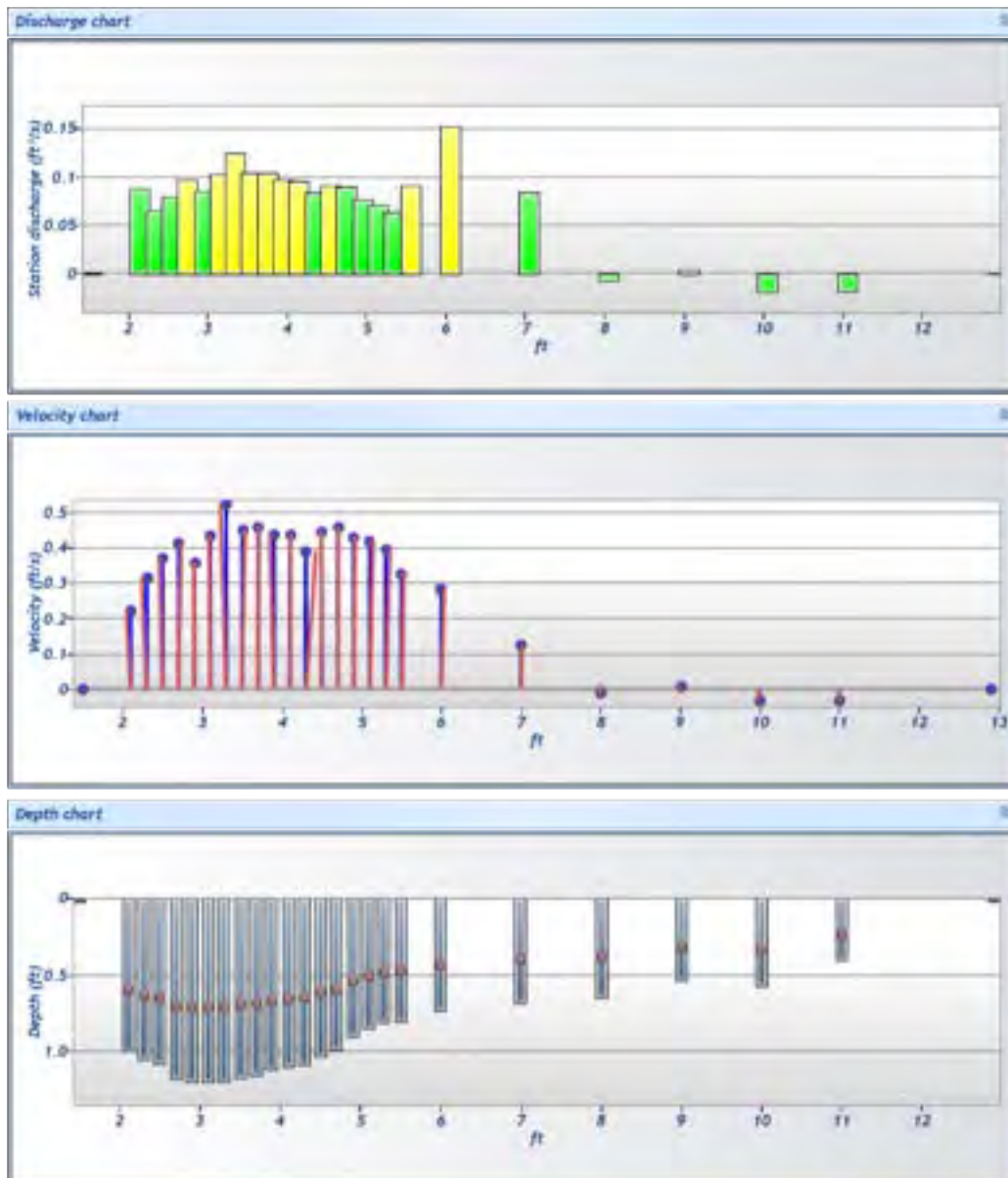


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	

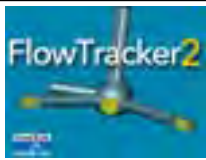




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Strokes	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	MG	
25	3:32 PM	1.500	None	0.050	0.0000	0.000	0	0.0000	1.0000	0.2217	0.0060	0.0013	0.07	✓
24	3:36 PM	2.100	0.6	1.000	0.6000	0.600	80	0.2217	1.0000	0.2217	0.4000	0.0887	4.89	✓
23	3:35 PM	2.300	0.6	1.050	0.6000	0.630	80	0.3134	1.0000	0.3134	0.3100	0.0658	3.63	✓
22	3:33 PM	2.500	0.6	1.080	0.6000	0.648	80	0.3677	1.0000	0.3677	0.2160	0.0794	4.28	✓
21	3:32 PM	2.700	0.6	1.100	0.6000	0.708	80	0.4110	1.0000	0.4110	0.2360	0.0970	5.34	✓
20	3:31 PM	2.900	0.6	1.200	0.6000	0.720	80	0.3557	1.0000	0.3557	0.2400	0.0854	4.70	✓
19	3:30 PM	3.100	0.6	1.200	0.6000	0.720	80	0.4322	1.0000	0.4322	0.2400	0.1017	5.72	✓
18	3:29 PM	3.300	0.6	1.200	0.6000	0.720	80	0.5212	1.0000	0.5212	0.2400	0.1251	6.89	✓
17	3:27 PM	3.500	0.6	1.170	0.6000	0.702	80	0.4466	1.0000	0.4466	0.2340	0.1046	5.76	✓
16	3:26 PM	3.700	0.6	1.150	0.6000	0.690	80	0.4565	1.0000	0.4565	0.2300	0.1050	5.78	✓
15	3:25 PM	3.900	0.6	1.170	0.6000	0.672	80	0.4370	1.0000	0.4370	0.2240	0.0979	5.39	✓
14	3:24 PM	4.100	0.6	1.100	0.6000	0.660	80	0.4345	1.0000	0.4345	0.2200	0.0956	5.27	✓
13	3:23 PM	4.300	0.6	1.080	0.6000	0.654	80	0.3873	1.0000	0.3873	0.2160	0.0844	4.65	✓
12	3:22 PM	4.500	0.6	1.030	0.6000	0.618	80	0.4421	1.0000	0.4421	0.2060	0.0911	5.02	✓
11	3:21 PM	4.700	0.6	0.990	0.6000	0.594	80	0.4549	1.0000	0.4549	0.1980	0.0901	4.96	✓
10	3:19 PM	4.900	0.6	0.900	0.6000	0.540	80	0.4265	1.0000	0.4265	0.1800	0.0768	4.23	✓
9	3:18 PM	5.100	0.6	0.850	0.6000	0.510	80	0.4172	1.0000	0.4172	0.1700	0.0709	3.91	✓
8	3:17 PM	5.300	0.6	0.810	0.6000	0.486	80	0.3934	1.0000	0.3934	0.1620	0.0617	3.51	✓
7	3:16 PM	5.500	0.6	0.800	0.6000	0.480	80	0.3260	1.0000	0.3260	0.2800	0.0913	5.03	✓
6	3:14 PM	6.000	0.6	0.730	0.6000	0.438	80	0.2794	1.0000	0.2794	0.5475	0.1530	8.43	✓
5	3:13 PM	7.000	0.6	0.680	0.6000	0.408	80	0.1232	1.0000	0.1232	0.6800	0.0838	4.62	✓
4	3:11 PM	8.000	0.6	0.650	0.6000	0.390	80	-0.0105	1.0000	-0.0105	0.6500	-0.0008	-0.38	✓
3	3:10 PM	9.000	0.6	0.540	0.6000	0.324	80	0.0071	1.0000	0.0071	0.5400	0.0038	0.21	✓
2	3:08 PM	10.000	0.6	0.570	0.6000	0.342	80	0.0326	1.0000	0.0326	0.5700	-0.0186	-1.02	✓
1	3:07 PM	11.000	0.6	0.400	0.6000	0.240	80	0.0303	1.0000	0.0303	0.5800	-0.0175	-0.97	✓
0	3:06 PM	12.900	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0000	0.0095	0.0001	-0.02	✓



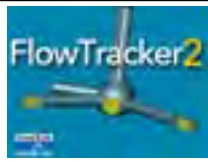
Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Quality Control Settings

Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings						
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)
No quality control warnings						



Discharge Measurement Summary

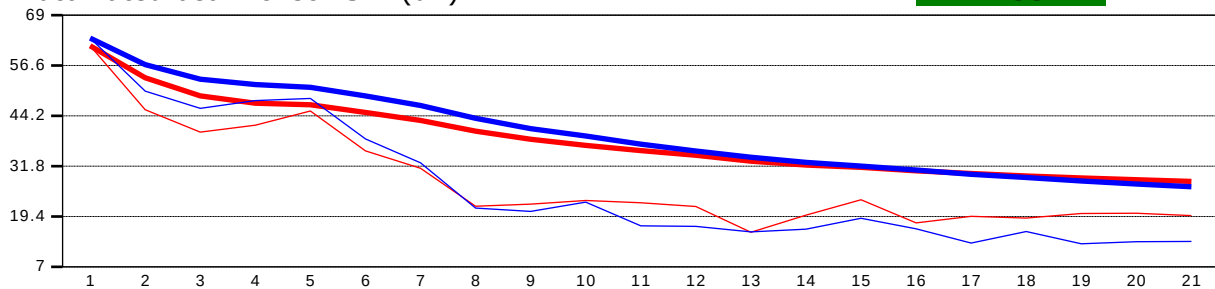
Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/18/2022 3:06:36 PM

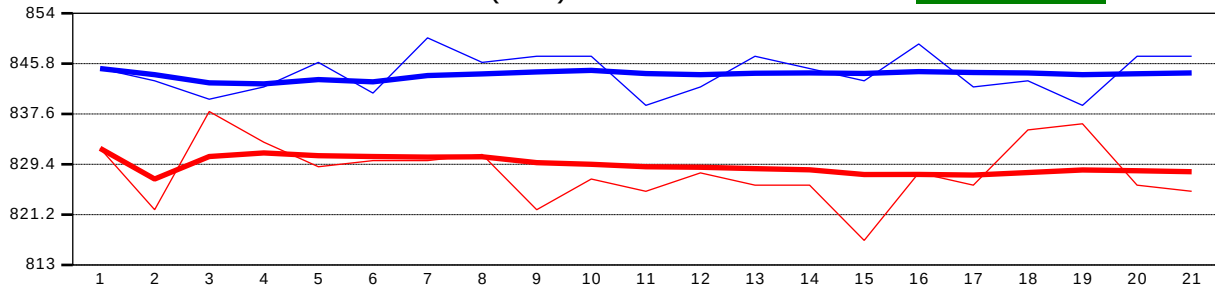
Automated beam check SNR(dB)

PASS



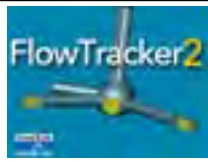
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

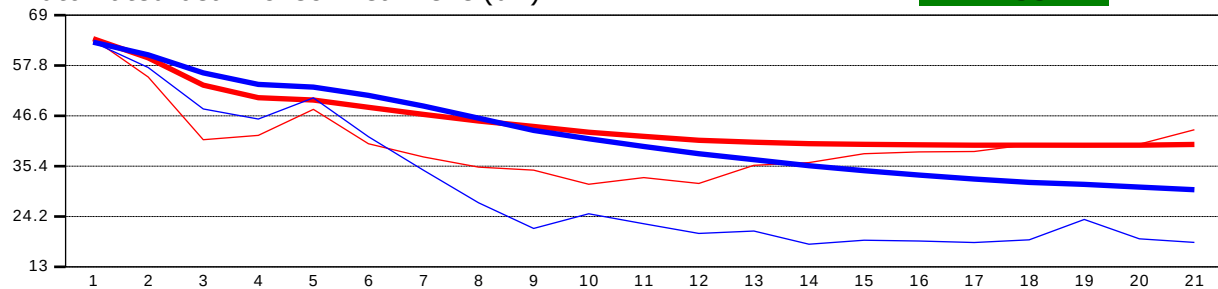
Site name Milk Creek near confl with Yampa River
Site number 08182022
Operator(s) LFS
File name Milk Creek near confl with Yampa River_20220818-154658.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/18/2022 3:06:36 PM

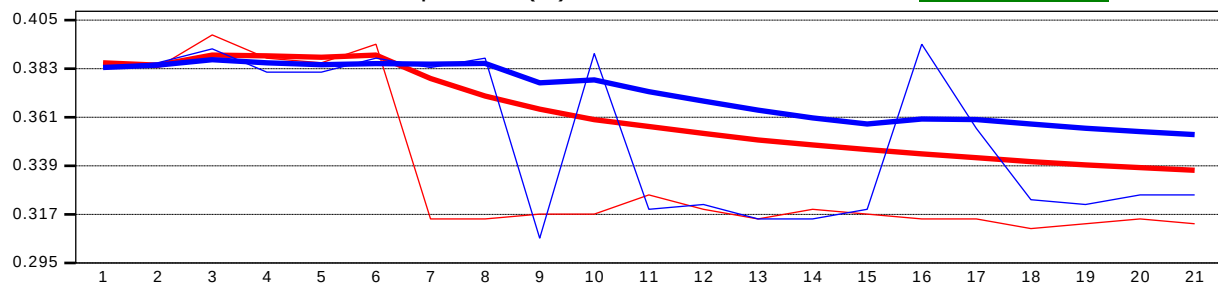
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRCO
Operator(s)	JAJ
File name	Milk Creek near confl with Yampa River_20221101-160336.ft
Comment	

Start time	11/1/2022 3:26 PM	Sensor type	Top Setting
End time	11/1/2022 3:58 PM	Handheld serial number	FT2H1747037
Start location latitude	40.385	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
27	40	6.6299

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
13.200	7.5440	13.589

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
50	0.572	0.8788

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
47.314	0.800	1.1815

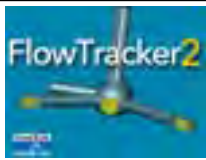
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	3.3%
Velocity	0.4%	1.4%
Width	0.1%	0.1%
Method	1.6%	
# Stations	1.9%	
Overall	2.7%	3.7%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

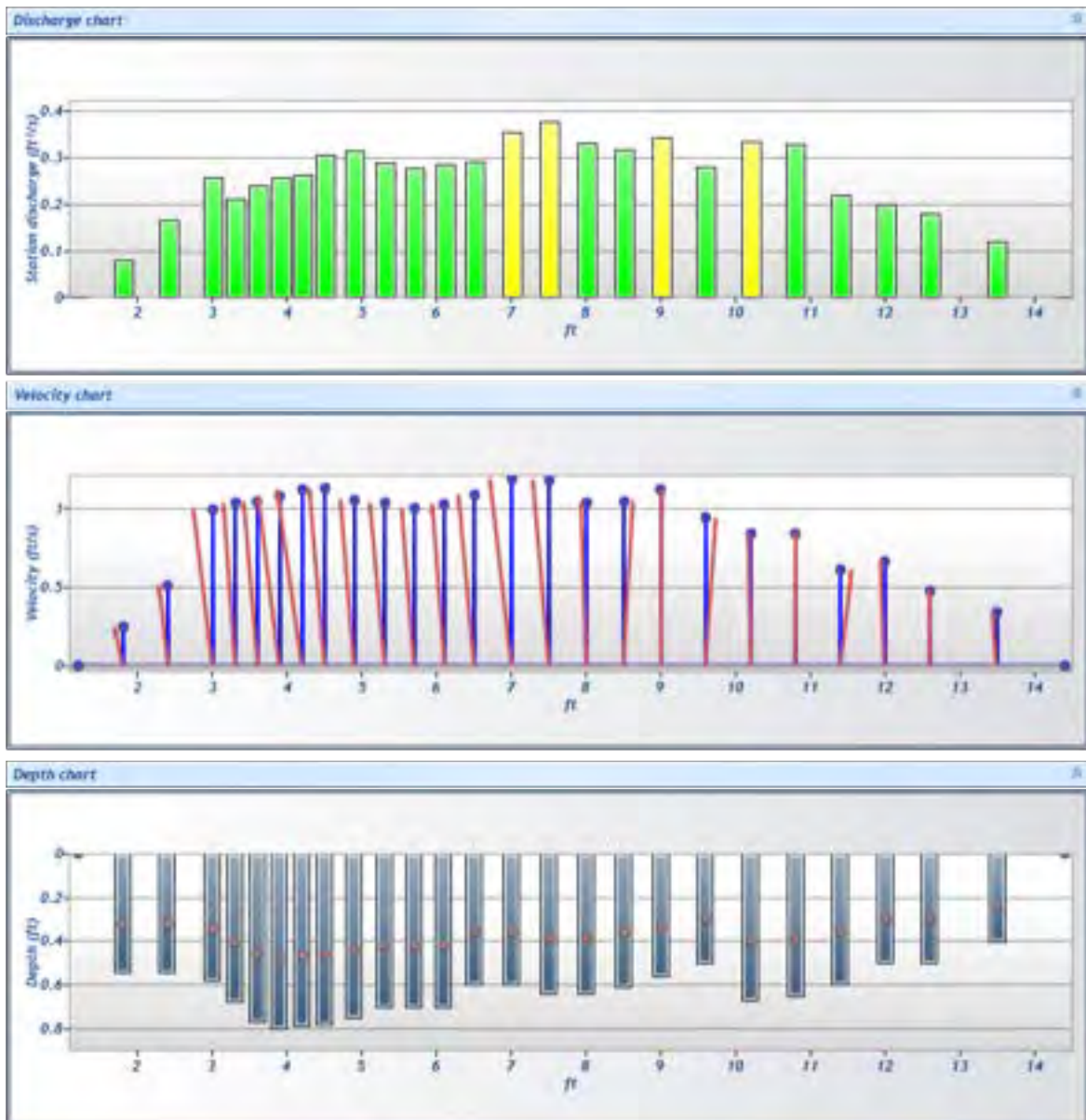


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Station Warning Settings

Station discharge OK Station discharge < 5.00%
Station discharge caution 5.00% >= Station discharge < 10.00%
Station discharge warning Station discharge >= 10.00%

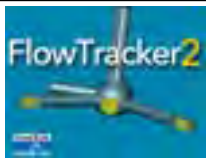




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Stn#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Sample	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	log
0	3:26 PM	1.200	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.2496	0.0000	0.0000	0.00
1	3:26 PM	1.800	0.5	0.540	0.5000	0.324	80	0.2496	1.0000	0.2496	0.3240	0.0809	0.81
2	3:28 PM	2.400	0.5	0.540	0.5000	0.324	80	0.5091	1.0000	0.5091	0.3240	0.1650	1.65
3	3:30 PM	3.000	0.5	0.580	0.5000	0.348	80	0.9899	1.0000	0.9899	0.2610	0.2584	2.58
4	3:31 PM	3.300	0.5	0.680	0.5000	0.488	80	1.0325	1.0000	1.0325	0.2040	0.2106	2.11
5	3:32 PM	3.600	0.5	0.770	0.6000	0.462	90	1.0407	1.0000	1.0407	0.2310	0.2404	2.40
6	3:33 PM	3.900	0.5	0.800	0.6000	0.480	80	1.0720	1.0000	1.0720	0.2400	0.2573	2.57
7	3:35 PM	4.200	0.5	0.790	0.6000	0.474	80	1.1146	1.0000	1.1146	0.2370	0.2642	2.64
8	3:36 PM	4.500	0.5	0.790	0.6000	0.488	80	1.1229	1.0000	1.1229	0.2730	0.3066	3.07
9	3:37 PM	4.900	0.5	0.750	0.5000	0.450	80	1.0511	1.0000	1.0511	0.3000	0.3153	3.15
10	3:38 PM	5.300	0.5	0.700	0.6000	0.420	80	1.0290	1.0000	1.0290	0.2800	0.2883	2.88
11	3:39 PM	5.700	0.5	0.700	0.6000	0.420	80	0.9953	1.0000	0.9953	0.2800	0.2786	2.79
12	3:40 PM	6.100	0.5	0.700	0.6000	0.420	80	1.0215	1.0000	1.0215	0.2800	0.2880	2.86
13	3:41 PM	6.500	0.5	0.600	0.5000	0.360	80	1.0042	1.0000	1.0042	0.3700	0.2927	2.93
14	3:42 PM	7.000	0.5	0.600	0.6000	0.360	80	1.1815	1.0000	1.1815	0.3000	0.3544	3.54
15	3:44 PM	7.500	0.5	0.640	0.6000	0.384	80	1.1775	1.0000	1.1775	0.3200	0.3788	3.77
16	3:45 PM	8.000	0.5	0.640	0.6000	0.384	80	1.0355	1.0000	1.0355	0.3200	0.3314	3.31
17	3:46 PM	8.500	0.5	0.610	0.6000	0.366	80	1.0408	1.0000	1.0408	0.3560	0.3174	3.17
18	3:48 PM	9.000	0.5	0.580	0.6000	0.336	80	1.1148	1.0000	1.1148	0.3580	0.3933	3.93
19	3:49 PM	9.600	0.5	0.500	0.6000	0.300	80	0.9356	1.0000	0.9356	0.3000	0.2867	2.81
20	3:50 PM	10.200	0.5	0.678	0.6000	0.402	80	0.8337	1.0000	0.8337	0.4020	0.3351	3.35
21	3:51 PM	10.800	0.5	0.650	0.6000	0.390	80	0.8407	1.0000	0.8407	0.3900	0.3270	3.28
22	3:53 PM	11.400	0.5	0.600	0.6000	0.360	80	0.8898	1.0000	0.8898	0.3600	0.3194	3.19
23	3:54 PM	12.000	0.5	0.500	0.6000	0.300	80	0.8635	1.0000	0.8635	0.3000	0.1991	1.99
24	3:55 PM	12.600	0.5	0.500	0.6000	0.300	80	0.4778	1.0000	0.4778	0.3750	0.1792	1.79
25	3:56 PM	13.500	0.5	0.400	0.6000	0.240	80	0.3357	1.0000	0.3357	0.3600	0.1209	1.21
26	3:58 PM	14.400	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.3357	0.0000	0.0000	0.00



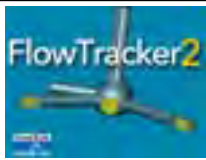
Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

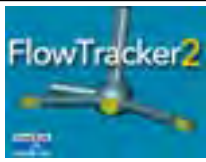
Quality control warnings						
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)
1	3:26 PM	1.800	0.6	0.540	0.6000	0.324
2	3:28 PM	2.400	0.6	0.540	0.6000	0.324
10	3:45 PM	8.000	0.6	0.540	0.6000	0.384
Warnings						
Velocity Angle > QC						
SNR Threshold Variation						
SNR Threshold Variation						



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Supplemental data summary					
Gauge height time	Gauge height (ft)	Rated discharge (ft ³ /s)	Temperature (°F)	Salinity (PSS-78)	Gauge height comments
11/1/2022 3:26 PM	1.038	10.0000			



Discharge Measurement Summary

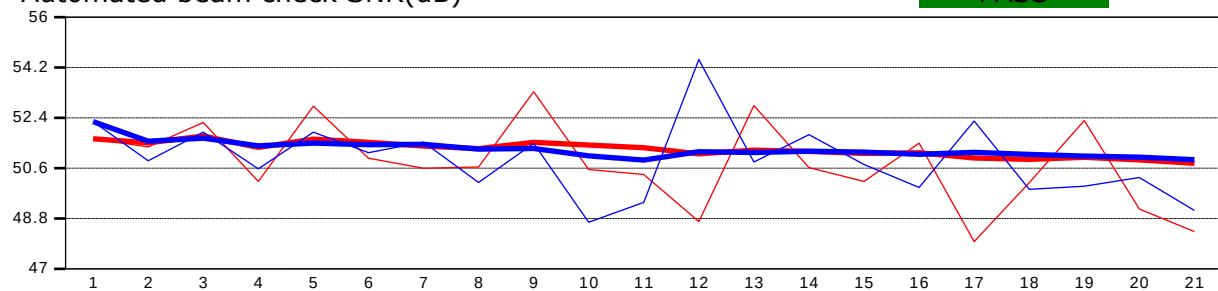
Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/1/2022 3:25:35 PM

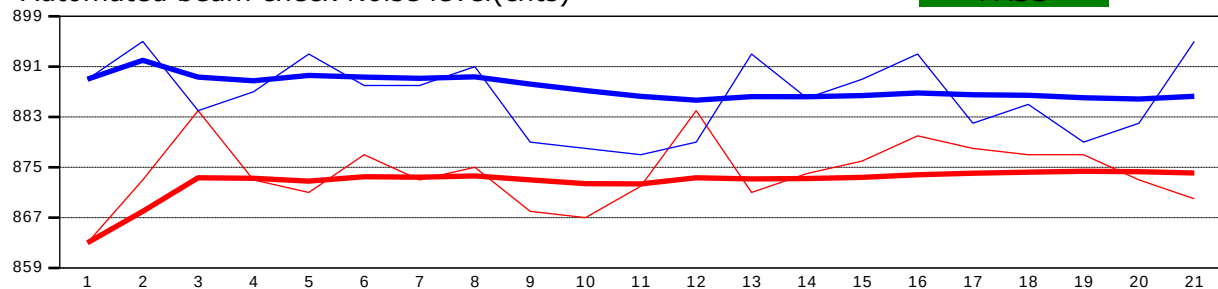
Automated beam check SNR(dB)

PASS



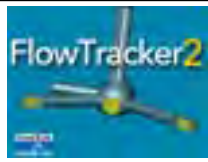
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings

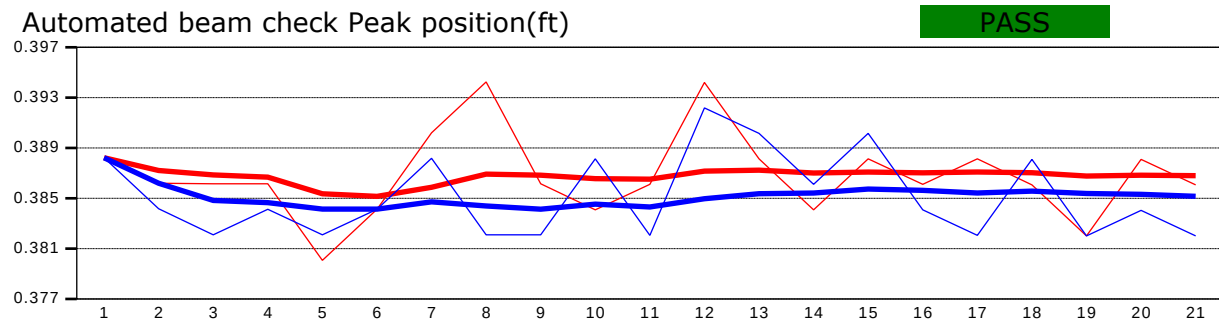
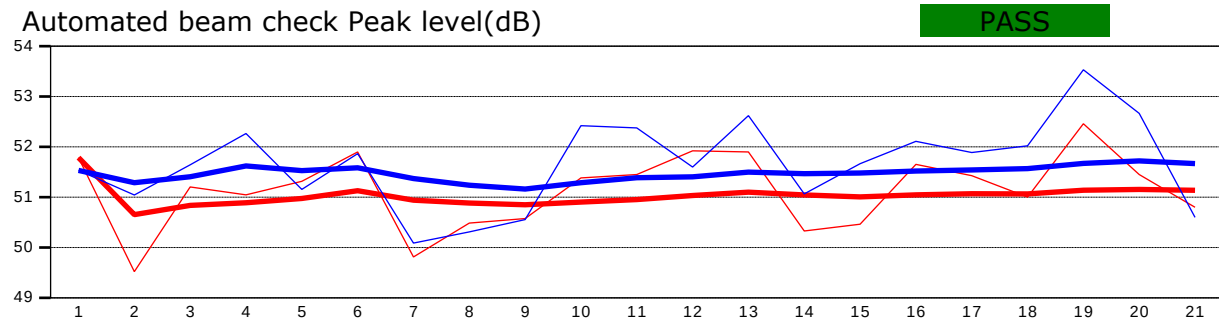


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRCO
Operator(s) JAJ
File name Milk Creek near confl with Yampa River_20221101-160336.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/1/2022 3:25:35 PM



Automated beam check Quality control warnings
No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	07252023
Operator(s)	Lfs
File name	Milk Creek near confl with Yampa River_20230725-173144.ft
Comment	

Start time	7/25/2023 5:12 PM	Sensor type	Top Setting
End time	7/25/2023 5:27 PM	Handheld serial number	FT2H1747037
Start location latitude	40.386	Probe serial number	FT2P1747048
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
23	40	5.7289

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
11.700	6.1455	11.999

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
42	0.525	0.9322

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
81.468	0.870	2.2171

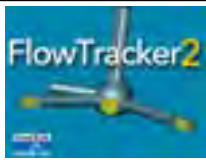
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	4.4%
Velocity	1.3%	5.1%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.2%	
Overall	3.3%	6.8%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number 07252023
Operator(s) Lfs
File name Milk Creek near confl with Yampa River_20230725-173144.ft
Comment

Station Warning Settings

Station discharge OK

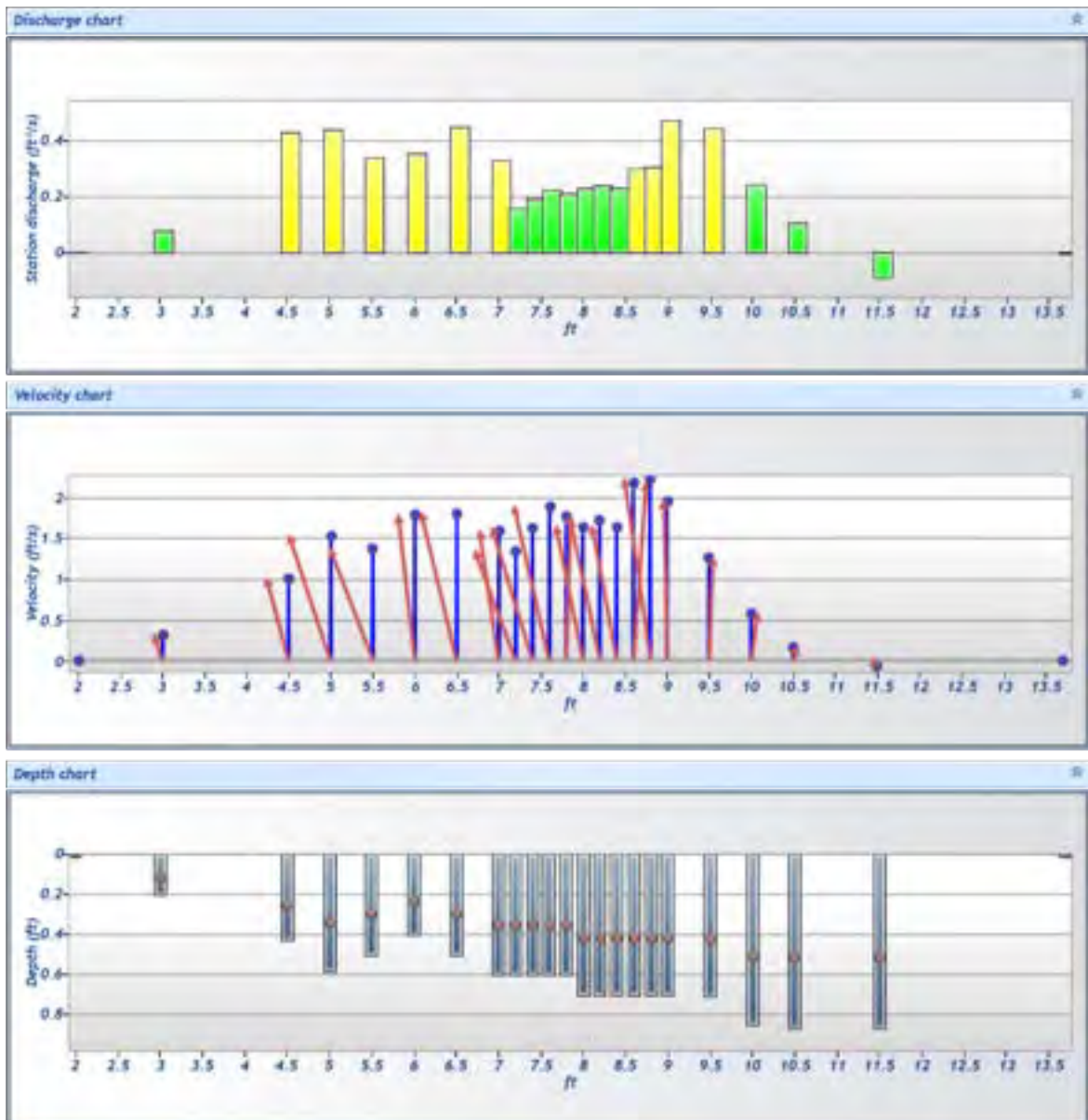
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%





Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	07252023
Operator(s)	Lfs
File name	Milk Creek near confl with Yampa River_20230725-173144.ft
Comment	

Measurement results													
Stk	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
22	5:27 PM 2.000		None	0.000	0.0000	0.000	0	0.0000	1.0000	0.3193	0.0050	0.0016	0.03
21	5:27 PM 1.000		0.6	0.200	0.6000	0.120	49	0.3193	1.0000	0.3193	0.2500	0.0798	1.39
20	5:26 PM 0.500		0.6	0.430	0.6000	0.258	35	1.0000	1.0000	1.0000	0.4300	0.4304	7.51
19	5:25 PM 0.000		0.6	0.580	0.6000	0.348	12	1.5288	1.0000	1.5288	0.2900	0.4434	7.74
18	5:24 PM 0.500		0.6	0.500	0.6000	0.300	25	1.3682	1.0000	1.3682	0.2500	0.3421	5.97
17	5:24 PM 0.000		0.6	0.400	0.6000	0.240	16	1.7763	1.0000	1.7763	0.2000	0.3553	6.20
16	5:23 PM 0.500		0.6	0.500	0.6000	0.300	30	1.8033	1.0000	1.8033	0.2500	0.4508	7.87
15	5:22 PM 0.000		0.6	0.600	0.6000	0.360	15	1.5833	1.0000	1.5833	0.2100	0.3325	5.80
14	5:22 PM 0.200		0.6	0.600	0.6000	0.360	16	1.3415	1.0000	1.3415	0.1200	0.1610	2.81
13	5:21 PM 0.400		0.6	0.600	0.6000	0.360	17	1.6222	1.0000	1.6222	0.1200	0.1947	3.40
12	5:20 PM 0.600		0.6	0.600	0.6000	0.360	24	1.8860	1.0000	1.8860	0.1200	0.2263	3.95
11	5:20 PM 0.800		0.6	0.600	0.6000	0.360	19	1.7627	1.0000	1.7627	0.1200	0.2115	3.69
10	5:19 PM 0.000		0.6	0.700	0.6000	0.420	29	1.6373	1.0000	1.6373	0.1400	0.2292	4.00
9	5:18 PM 0.200		0.6	0.700	0.6000	0.420	32	1.7194	1.0000	1.7194	0.1400	0.2407	4.20
8	5:18 PM 0.400		0.6	0.700	0.6000	0.420	20	1.6391	1.0000	1.6391	0.1400	0.2295	4.01
7	5:17 PM 0.600		0.6	0.700	0.6000	0.420	25	2.1729	1.0000	2.1729	0.1400	0.3042	5.31
6	5:16 PM 0.800		0.6	0.700	0.6000	0.420	17	2.2371	1.0000	2.2371	0.1400	0.3109	5.42
5	5:15 PM 0.000		0.6	0.700	0.6000	0.420	23	1.9466	1.0000	1.9466	0.2450	0.4769	8.32
4	5:15 PM 0.500		0.6	0.710	0.6000	0.426	26	1.2540	1.0000	1.2540	0.2550	0.4454	7.80
3	5:14 PM 0.000		0.6	0.850	0.6000	0.510	28	0.5787	1.0000	0.5787	0.4250	0.2459	4.29
2	5:13 PM 0.500		0.6	0.820	0.6000	0.522	29	0.1620	1.0000	0.1620	0.6525	0.1057	1.85
1	5:12 PM 1.500		0.6	0.820	0.6000	0.522	23	-0.0630	1.0000	-0.0630	1.7520	-0.0877	-1.52
0	5:12 PM 13.700		None	0.000	0.0000	0.000	0	0.0000	1.0000	-0.0630	0.0110	-0.0007	-0.01

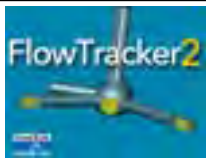


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	07252023
Operator(s)	Lfs
File name	Milk Creek near confl with Yampa River_20230725-173144.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

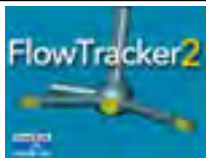
Quality control warnings						
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)
20	5:26 PM	4.500	0.0	0.430	0.6000	0.258
19	5:25 PM	5.000	0.0	0.580	0.6000	0.348
18	5:24 PM	5.500	0.0	0.500	0.6000	0.300
17	5:24 PM	6.000	0.0	0.400	0.6000	0.240
16	5:23 PM	6.500	0.0	0.500	0.6000	0.300
15	5:22 PM	7.000	0.0	0.600	0.6000	0.360
14	5:22 PM	7.200	0.0	0.600	0.6000	0.360
13	5:21 PM	7.400	0.0	0.600	0.6000	0.360
12	5:20 PM	7.600	0.0	0.600	0.6000	0.360
11	5:20 PM	7.800	0.0	0.600	0.6000	0.360
10	5:19 PM	8.000	0.0	0.700	0.6000	0.420
9	5:18 PM	8.200	0.0	0.700	0.6000	0.420
8	5:18 PM	8.400	0.0	0.700	0.6000	0.420
7	5:17 PM	8.600	0.0	0.700	0.6000	0.420
6	5:16 PM	8.800	0.0	0.700	0.6000	0.420
5	5:15 PM	9.000	0.0	0.700	0.6000	0.420
4	5:15 PM	9.500	0.0	0.710	0.6000	0.426
0	5:12 PM	11.700	None	0.010	0.0000	0.000



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	07252023
Operator(s)	Lfs
File name	Milk Creek near confl with Yampa River_20230725-173144.ft
Comment	

Supplemental data summary					
Gauge height time	Gauge height (ft)	Rated discharge (ft ³ /s)	Temperature (°F)	Salinity (PSS-78)	Gauge height comments
7/25/2023 5:00 PM	0.970				
7/25/2023 5:24 PM	0.970				



Discharge Measurement Summary

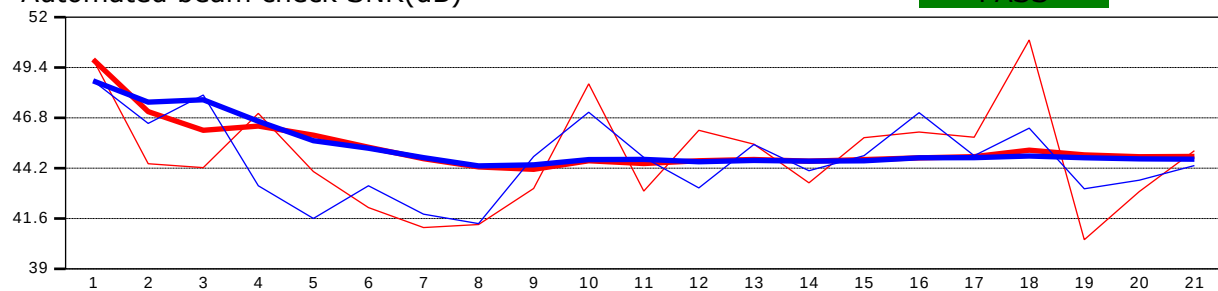
Site name Milk Creek near confl with Yampa River
Site number 07252023
Operator(s) Lfs
File name Milk Creek near confl with Yampa River_20230725-173144.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 7/25/2023 5:11:35 PM

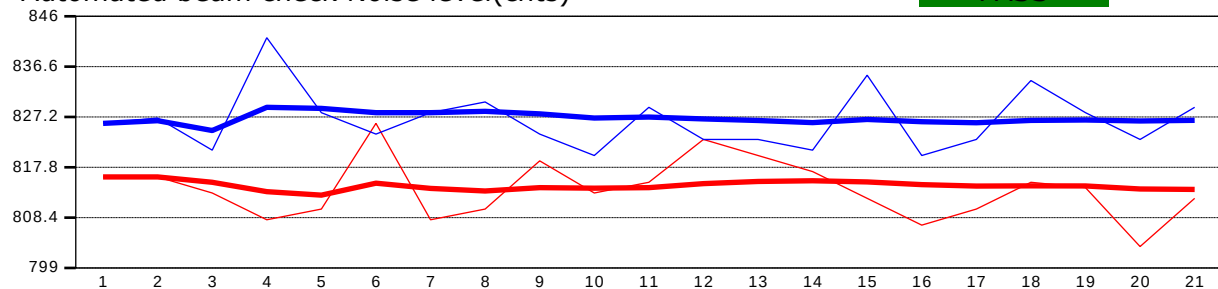
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

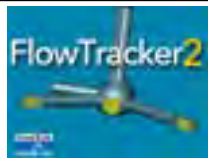
PASS



Automated beam check Quality control warnings

No quality control warnings

7/26/2023 8:08:32 PM



Discharge Measurement Summary

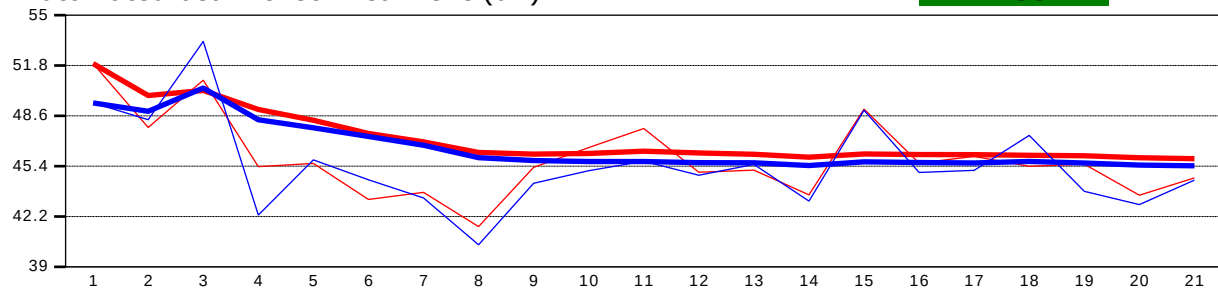
Site name Milk Creek near confl with Yampa River
Site number 07252023
Operator(s) Lfs
File name Milk Creek near confl with Yampa River_20230725-173144.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 7/25/2023 5:11:35 PM

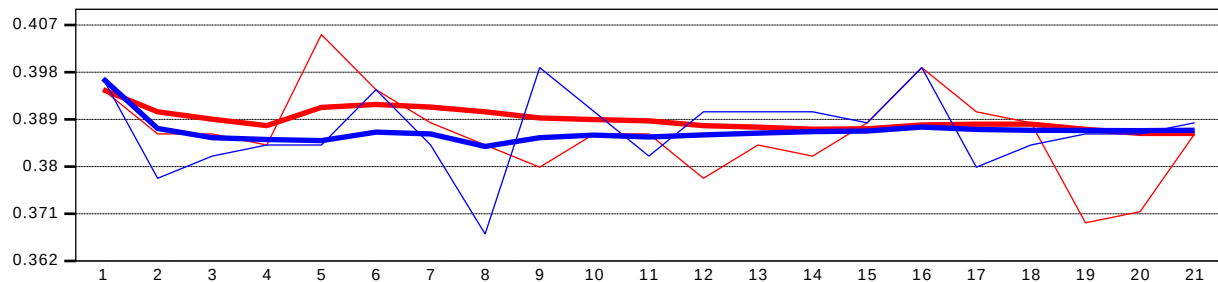
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings

7/26/2023 8:08:32 PM



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20230816-123519.ft
Comment	

Start time	8/16/2023 12:12 PM	Sensor type	Top Setting
End time	8/16/2023 12:29 PM	Handheld serial number	FT2H2322005
Start location latitude	40.386	Probe serial number	FT2P2317010
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
20	40	8.2418

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
16.500	14.0805	17.089

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
45	0.853	0.5853

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
69.412	1.250	1.3242

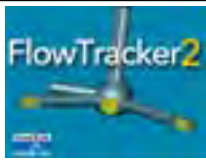
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.6%
Velocity	1.4%	5.9%
Width	0.1%	0.1%
Method	2.0%	
# Stations	2.5%	
Overall	3.6%	6.5%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20230816-123519.ft
Comment

Station Warning Settings

Station discharge OK

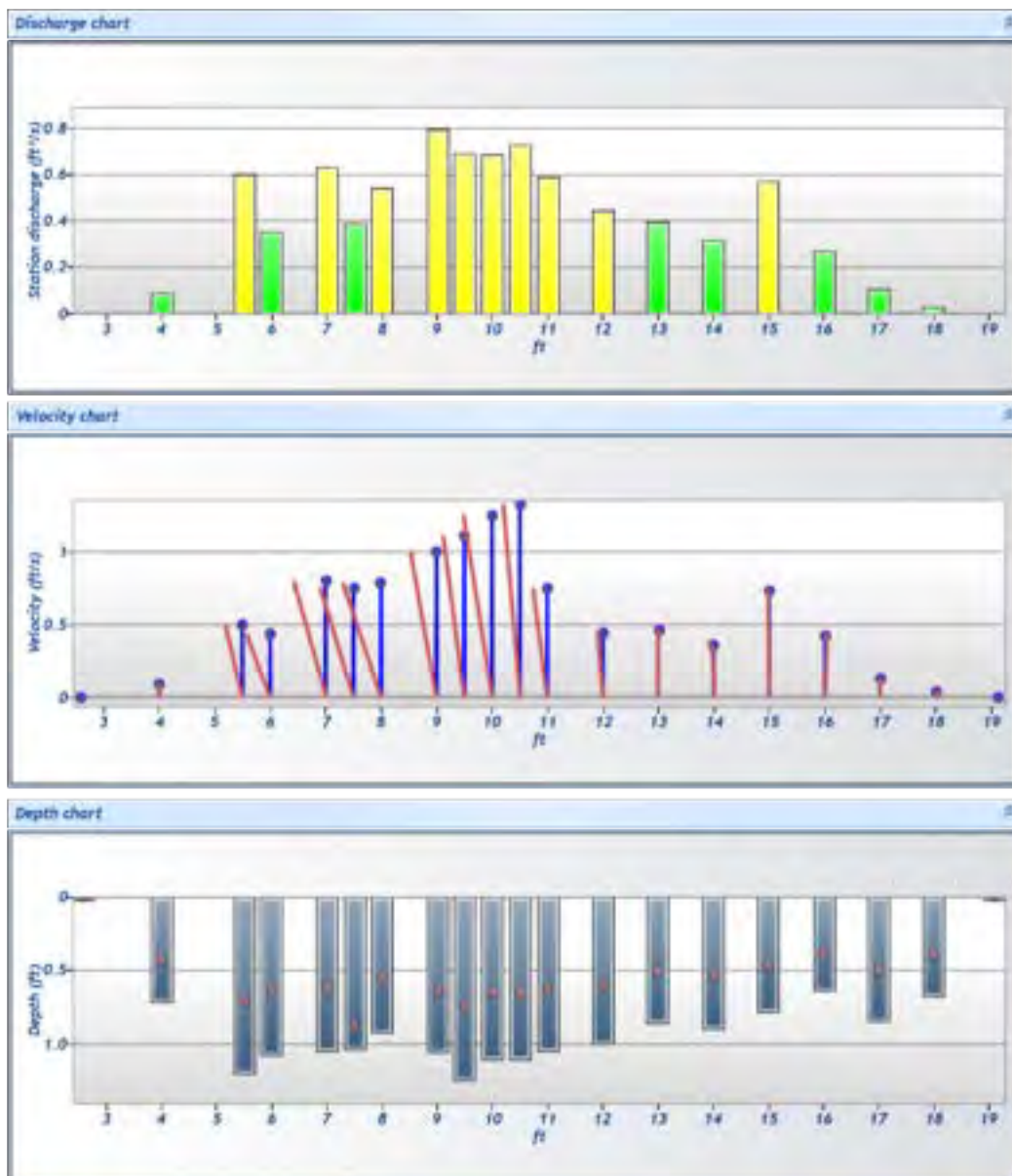
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20230816-123519.ft
Comment

Measurement results													
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
19	12:25 PM	2.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0883	0.0070	0.0006	0.01
18	12:24 PM	4.000	0.6	0.710	0.0000	0.426	26	0.0883	1.0000	0.0883	1.0295	0.0909	1.10
17	12:23 PM	5.500	0.6	1.200	0.0000	0.720	21	0.5034	1.0000	0.5034	1.2000	0.6040	7.33
16	12:25 PM	6.000	0.6	1.080	0.0000	0.648	35	0.4364	1.0000	0.4364	0.8100	0.3535	4.29
15	12:22 PM	7.000	0.6	1.050	0.0000	0.630	34	0.8027	1.0000	0.8027	0.7875	0.6321	7.67
14	12:27 PM	7.500	0.6	1.040	0.0000	0.880	27	0.7513	1.0000	0.7513	0.5200	0.3947	4.75
13	12:21 PM	8.000	0.6	0.920	0.0000	0.552	20	0.7850	1.0000	0.7850	0.6000	0.5416	6.57
12	12:20 PM	9.000	0.6	1.060	0.0000	0.636	19	0.9967	1.0000	0.9967	0.7500	0.7524	9.61
11	12:28 PM	9.500	0.6	1.250	0.0000	0.750	20	1.1076	1.0000	1.1076	0.6250	0.6823	8.40
10	12:19 PM	10.000	0.6	1.100	0.0000	0.660	19	1.2494	1.0000	1.2494	0.5500	0.6871	8.34
9	12:29 PM	10.500	0.6	1.100	0.0000	0.660	24	1.3242	1.0000	1.3242	0.5500	0.7283	8.84
8	12:19 PM	11.000	0.6	1.050	0.0000	0.630	23	0.7477	1.0000	0.7477	0.7875	0.5888	7.14
7	12:18 PM	12.000	0.6	1.000	0.0000	0.600	28	0.4444	1.0000	0.4444	1.0000	0.4444	5.39
6	12:17 PM	13.000	0.6	0.860	0.0000	0.516	17	0.4586	1.0000	0.4586	0.8600	0.3944	4.79
5	12:17 PM	14.000	0.6	0.890	0.0000	0.534	33	0.3612	1.0000	0.3612	0.8900	0.3214	3.90
4	12:16 PM	15.000	0.6	0.780	0.0000	0.468	21	0.7293	1.0000	0.7293	0.7800	0.5689	6.90
3	12:15 PM	16.000	0.6	0.640	0.0000	0.384	19	0.4276	1.0000	0.4276	0.6400	0.2730	3.32
2	12:14 PM	17.000	0.6	0.850	0.0000	0.510	47	0.1267	1.0000	0.1267	0.8500	0.1077	1.31
1	12:13 PM	18.000	0.6	0.670	0.0000	0.402	22	0.0393	1.0000	0.0393	0.7035	0.0277	0.34
0	12:12 PM	10.100	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0393	0.0055	0.0002	0.00

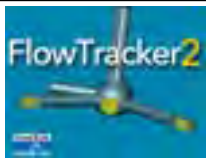


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20230816-123519.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
18	12:24 PM	4.000	0.6	0.710	0.6000	0.426	Boundary Interference
17	12:23 PM	5.500	0.6	1.200	0.6000	0.720	Velocity Angle > QC
16	12:25 PM	6.000	0.6	1.080	0.6000	0.648	Velocity Angle > QC
15	12:22 PM	7.000	0.6	1.050	0.6000	0.630	Standard Error > QC, Velocity Angle > QC
14	12:27 PM	7.500	0.6	1.040	0.6000	0.680	High % Spikes, Velocity Angle > QC
13	12:21 PM	8.000	0.6	0.920	0.6000	0.552	Standard Error > QC, Velocity Angle > QC
12	12:20 PM	9.000	0.6	1.060	0.6000	0.636	Standard Error > QC, Velocity Angle > QC
11	12:28 PM	9.500	0.6	1.250	0.6000	0.750	Standard Error > QC
10	12:19 PM	10.000	0.6	1.100	0.6000	0.660	Standard Error > QC, Velocity Angle > QC
9	12:29 PM	10.500	0.6	1.100	0.6000	0.660	Standard Error > QC
8	12:19 PM	11.000	0.6	1.050	0.6000	0.630	Standard Error > QC
7	12:18 PM	12.000	0.6	1.000	0.6000	0.600	Standard Error > QC
6	12:17 PM	13.000	0.6	0.860	0.6000	0.516	High % Spikes
4	12:16 PM	15.000	0.6	0.780	0.6000	0.468	Standard Error > QC
3	12:15 PM	16.000	0.6	0.640	0.6000	0.384	Standard Error > QC
0	12:12 PM	19.100	None	0.010	0.0000	0.000	Water Depth > QC



Discharge Measurement Summary

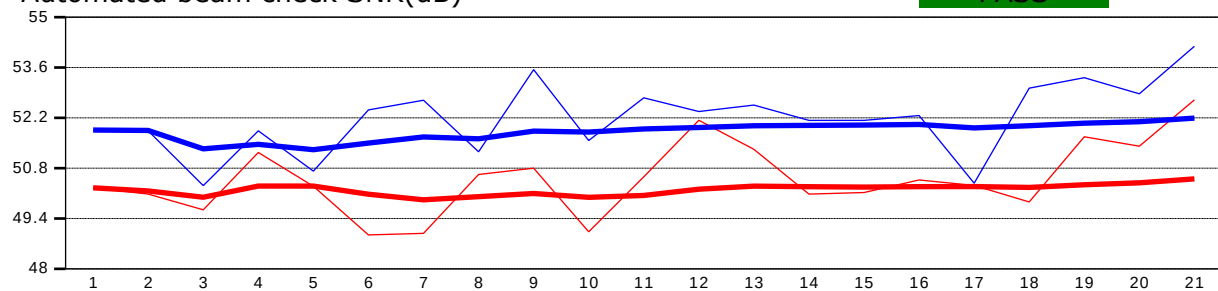
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20230816-123519.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/16/2023 12:12:38 PM

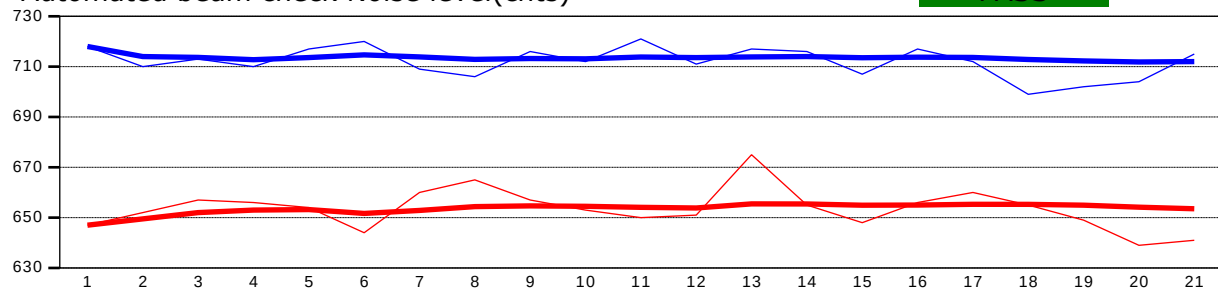
Automated beam check SNR(dB)

PASS



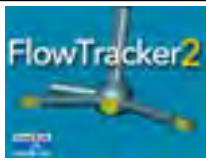
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

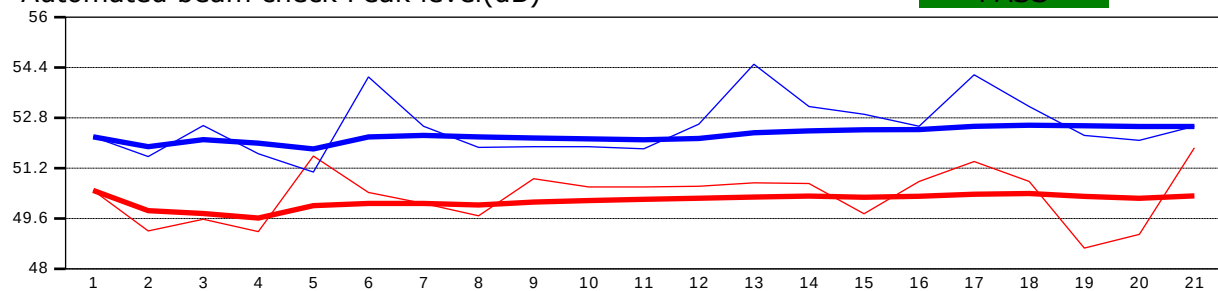
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20230816-123519.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/16/2023 12:12:38 PM

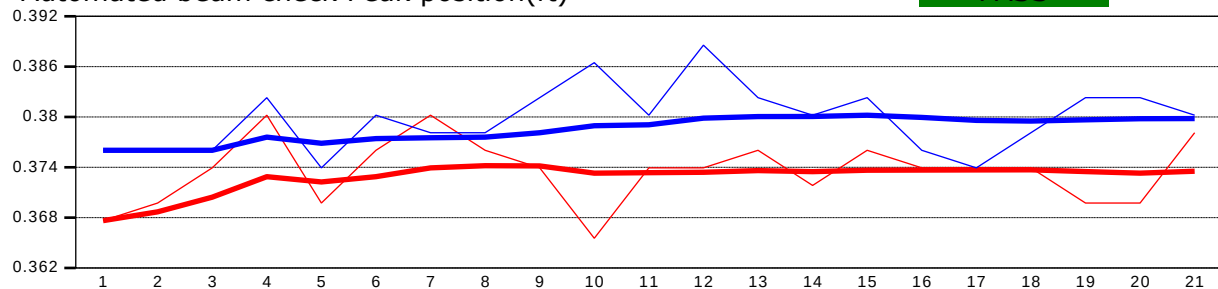
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231010-125958.ft
Comment

Start time	10/10/2023 12:02 PM	Sensor type	Top Setting
End time	10/10/2023 12:57 PM	Handheld serial number	FT2H2322005
Start location latitude	40.386	Probe serial number	FT2P2317010
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
23	40	4.8387

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
15.350	11.3920	16.063

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
34	0.742	0.4247

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
52.484	1.320	1.2317

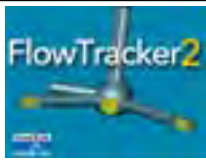
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	3.2%
Velocity	0.8%	6.0%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.2%	
Overall	3.1%	6.9%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

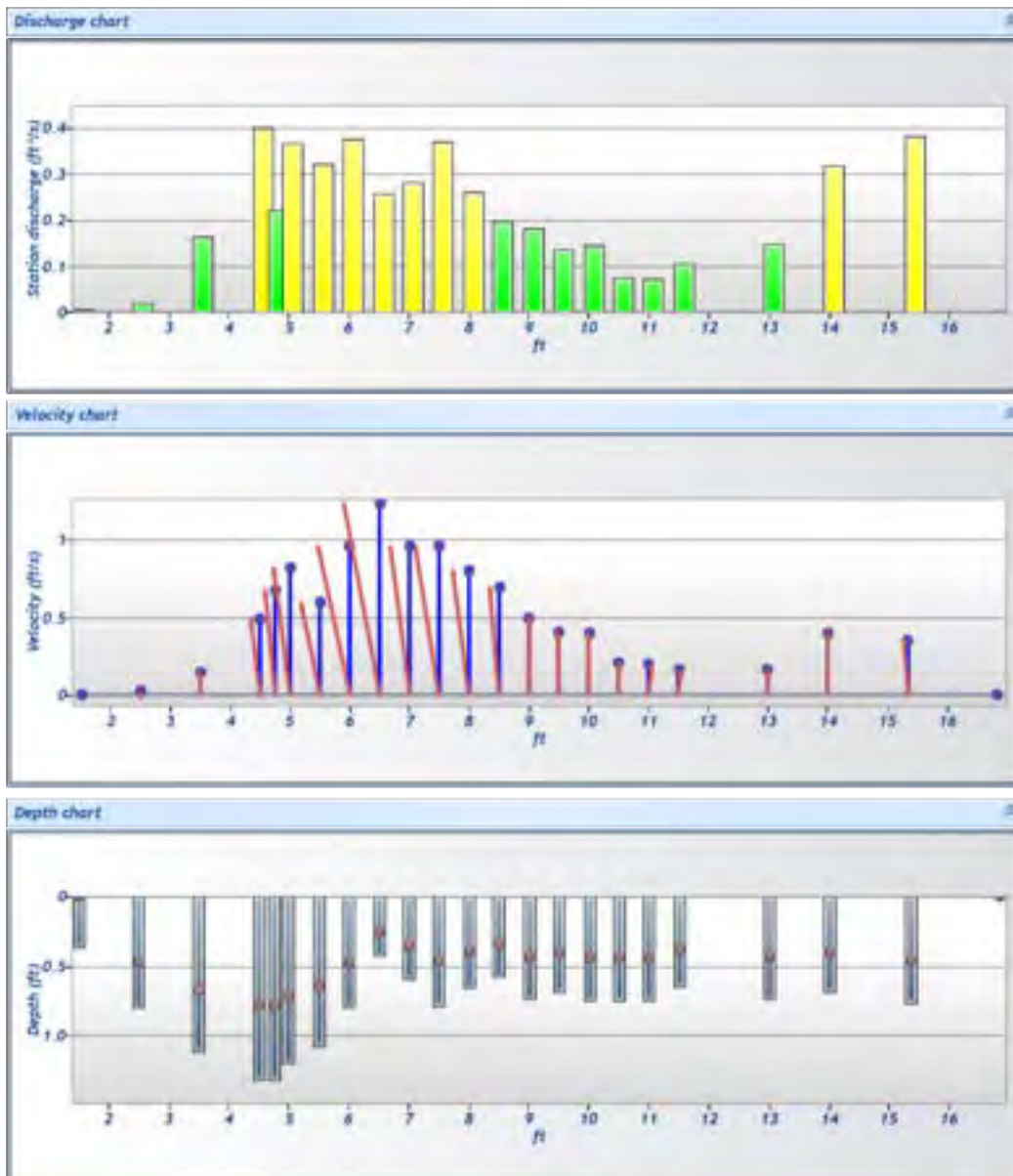


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231010-125958.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%	
Station discharge caution	5.00% >= Station discharge < 10.00%	
Station discharge warning	Station discharge >= 10.00%	

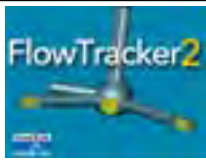




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231010-125958.ft
Comment

Measurement results													
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correct (ft)	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
22	12:50 PM	1.500	None	0.360	0.0000	0.000	0	0.0000	1.0000	0.0264	0.1800	0.0047	0.10
21	12:47 PM	2.500	0.6	0.790	0.0000	0.474	80	0.0264	1.0000	0.0264	0.7500	0.0208	0.43
20	12:45 PM	3.500	0.6	1.120	0.0000	0.672	80	0.1481	1.0000	0.1481	1.1200	0.1659	3.43
19	12:41 PM	4.500	0.6	1.120	0.0000	0.792	80	0.4864	1.0000	0.4864	0.8250	0.4013	8.29
18	12:57 PM	4.750	0.6	1.120	0.0000	0.792	80	0.6770	1.0000	0.6770	0.3300	0.2234	4.62
17	12:53 PM	5.000	0.6	1.200	0.0000	0.720	80	0.8206	1.0000	0.8206	0.4500	0.3693	7.63
16	12:39 PM	5.500	0.6	1.080	0.0000	0.648	80	0.5971	1.0000	0.5971	0.5400	0.3224	6.66
15	12:37 PM	6.000	0.6	0.790	0.0000	0.474	80	0.9584	1.0000	0.9584	0.3950	0.3780	7.82
14	12:35 PM	6.500	0.6	0.420	0.0000	0.252	80	1.2317	1.0000	1.2317	0.2100	0.2586	5.35
13	12:31 PM	7.000	0.6	0.590	0.0000	0.354	80	0.9555	1.0000	0.9555	0.2800	0.2819	5.83
12	12:28 PM	7.500	0.6	0.780	0.0000	0.468	80	0.9538	1.0000	0.9538	0.3900	0.3720	7.64
11	12:26 PM	8.000	0.6	0.650	0.0000	0.390	80	0.8039	1.0000	0.8039	0.3250	0.2613	5.40
10	12:24 PM	8.500	0.6	0.570	0.0000	0.342	80	0.6930	1.0000	0.6930	0.2850	0.1975	4.08
9	12:21 PM	9.000	0.6	0.730	0.0000	0.438	80	0.5009	1.0000	0.5009	0.3650	0.1828	3.78
8	12:19 PM	9.500	0.6	0.680	0.0000	0.408	80	0.4037	1.0000	0.4037	0.3400	0.1372	2.84
7	12:15 PM	10.000	0.6	0.740	0.0000	0.444	80	0.3947	1.0000	0.3947	0.3700	0.1461	3.02
6	12:14 PM	10.500	0.6	0.740	0.0000	0.444	80	0.2086	1.0000	0.2086	0.3700	0.0772	1.60
5	12:12 PM	11.000	0.6	0.740	0.0000	0.444	80	0.1984	1.0000	0.1984	0.3700	0.0734	1.52
4	12:10 PM	11.500	0.6	0.640	0.0000	0.384	80	0.1669	1.0000	0.1669	0.6400	0.1068	2.21
3	12:07 PM	13.000	0.6	0.730	0.0000	0.438	80	0.1643	1.0000	0.1643	0.9125	0.1500	3.10
2	12:06 PM	14.000	0.6	0.680	0.0000	0.408	80	0.4016	1.0000	0.4016	0.7990	0.3208	6.63
1	12:03 PM	15.350	0.6	0.760	0.0000	0.456	80	0.2546	1.0000	0.2546	1.0800	0.2841	5.94
0	12:02 PM	16.850	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.3546	0.0075	0.0027	0.05

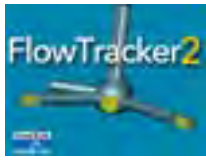


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20231010-125958.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
21	12:47 PM	2.500	0.6	0.790	0.6000	0.474	Boundary Interference
17	12:53 PM	5.000	0.6	1.200	0.6000	0.720	Sn Spacing > QC
16	12:39 PM	5.500	0.6	1.080	0.6000	0.648	Velocity Angle > QC
15	12:37 PM	6.000	0.6	0.790	0.6000	0.474	Velocity Angle > QC
14	12:35 PM	6.500	0.6	0.470	0.6000	0.252	Velocity Angle > QC
12	12:28 PM	7.500	0.6	0.780	0.6000	0.468	Velocity Angle > QC
0	12:02 PM	16.850	None	0.010	0.0000	0.000	Water Depth < QC



Discharge Measurement Summary

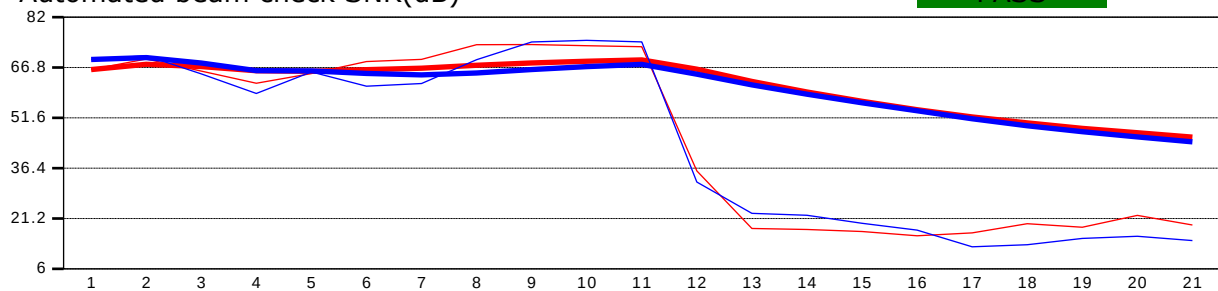
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231010-125958.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 10/10/2023 12:01:30 PM

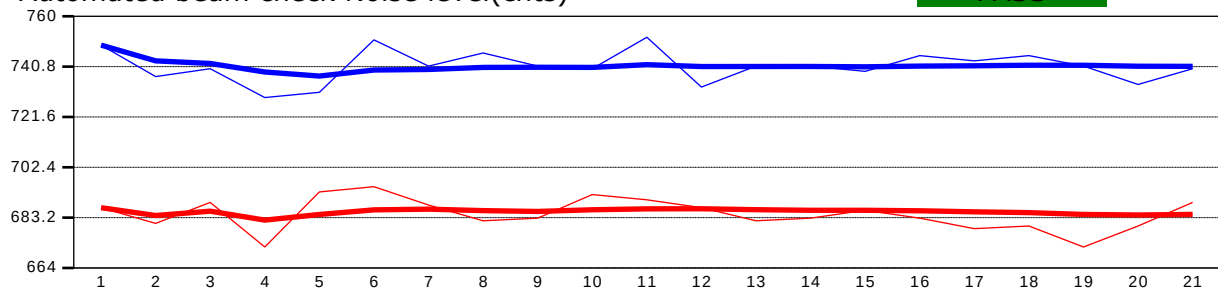
Automated beam check SNR(dB)

PASS



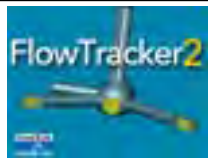
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

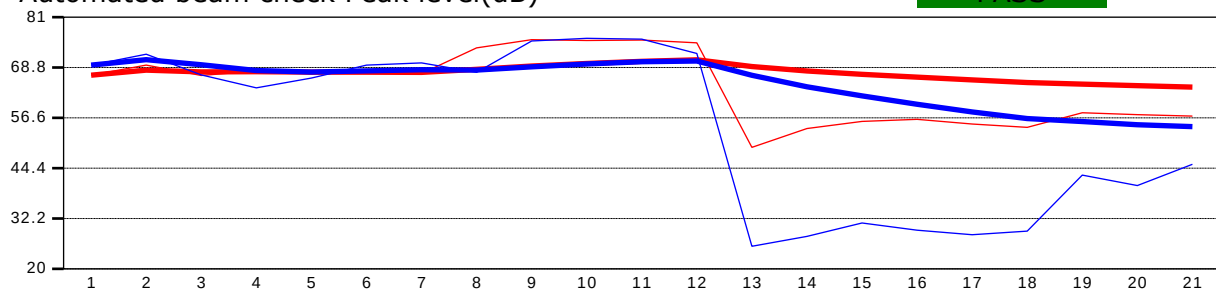
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231010-125958.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 10/10/2023 12:01:30 PM

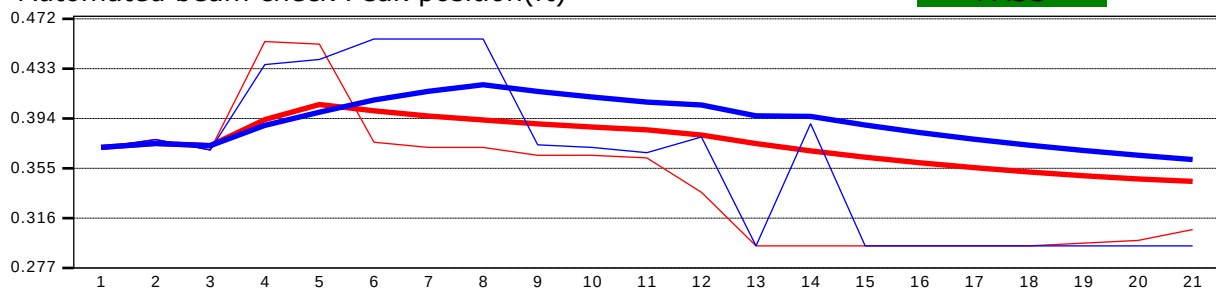
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20231024-101655.ft
Comment	Site1

Start time	10/24/2023 9:47 AM	Sensor type	Top Setting
End time	10/24/2023 10:16 AM	Handheld serial number	FT2H2322005
Start location latitude	40.386	Probe serial number	FT2P2317010
Start location longitude	-107.739	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
17	40	5.7230

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
15.800	5.7590	15.925

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
31	0.364	0.9938

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
44.486	0.700	2.3653

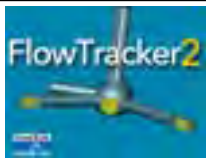
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.7%	7.3%
Velocity	1.7%	9.4%
Width	0.2%	0.2%
Method	3.4%	
# Stations	3.0%	
Overall	4.9%	11.9%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

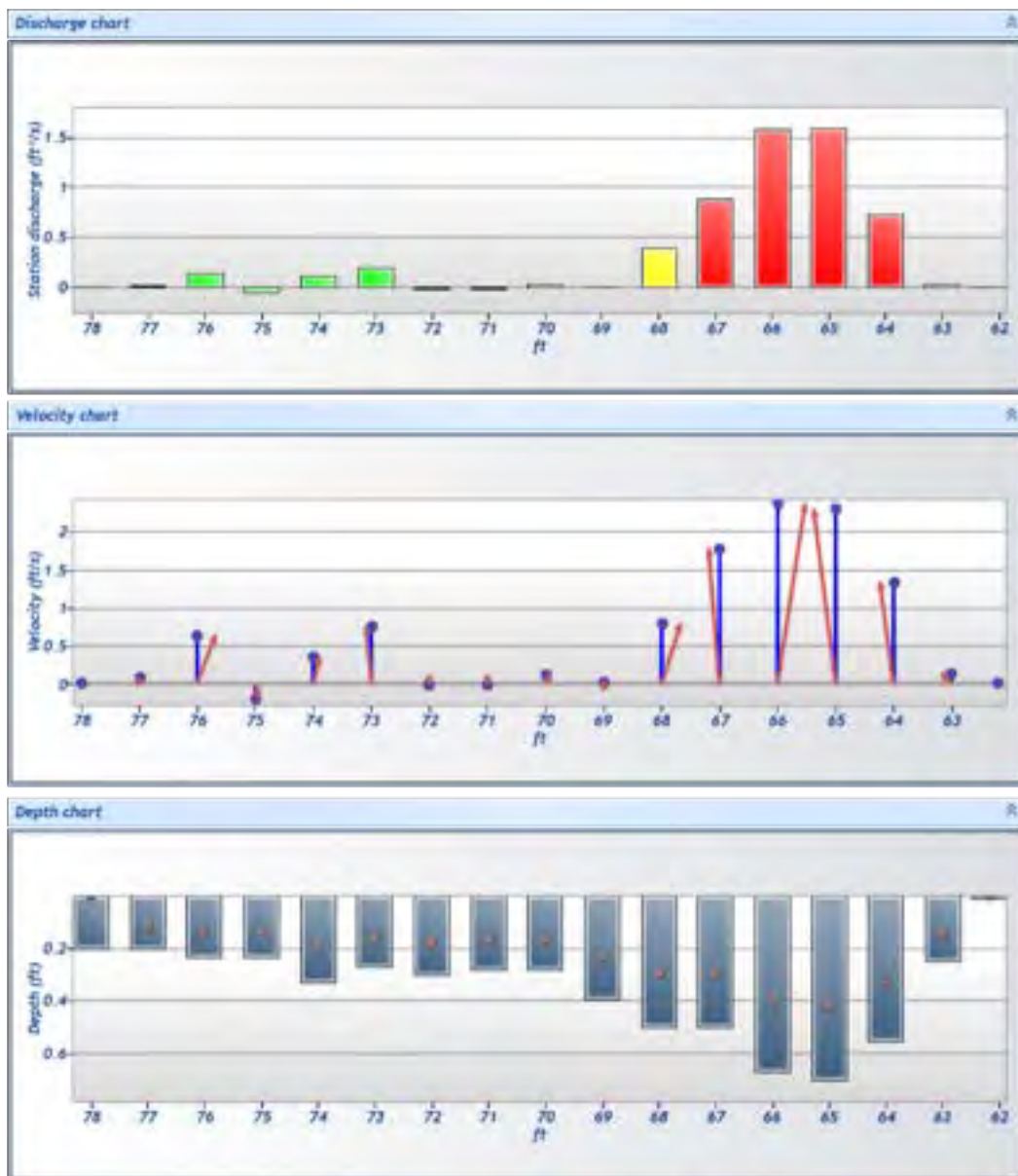
No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20231024-101655.ft
Comment	Site1

Station Warning Settings	
Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%





Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20231024-101655.ft
Comment	Site1

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
0	9:47 AM	62.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.1418	0.0040	0.0006	0.01
1	9:47 AM	63.000	0.6	0.250	0.6000	0.150	29	0.1418	1.0000	0.1418	0.2250	0.0319	0.16
2	9:50 AM	64.000	0.6	0.550	0.6000	0.300	41	1.3335	1.0000	1.3335	0.5500	0.7334	12.82
3	9:52 AM	65.000	0.6	0.700	0.6000	0.420	31	2.2891	1.0000	2.2891	0.7000	1.6024	28.00
4	9:53 AM	66.000	0.6	0.670	0.6000	0.402	63	2.3653	1.0000	2.3653	0.6700	1.5847	27.69
5	9:55 AM	67.000	0.6	0.500	0.6000	0.300	35	1.7719	1.0000	1.7719	0.5000	0.8859	15.48
6	9:57 AM	68.000	0.6	0.500	0.6000	0.300	45	0.7892	1.0000	0.7892	0.5000	0.3946	6.89
7	9:59 AM	69.000	0.6	0.390	0.6000	0.234	27	0.0248	1.0000	0.0248	0.3900	0.0097	0.17
8	10:00 AM	70.000	0.6	0.280	0.6000	0.168	40	0.1258	1.0000	0.1258	0.2800	0.0352	0.62
9	10:01 AM	71.000	0.6	0.280	0.6000	0.168	21	0.0069	1.0000	0.0069	0.2800	0.0019	0.03
10	10:01 AM	72.000	0.6	0.300	0.6000	0.180	23	0.0058	1.0000	0.0058	0.3000	0.0017	0.03
11	10:06 AM	71.000	0.6	0.270	0.6000	0.162	26	0.7642	1.0000	0.7642	0.2700	0.2063	3.64
12	10:08 AM	74.000	0.6	0.330	0.6000	0.198	34	0.3521	1.0000	0.3521	0.3300	0.1162	2.03
13	10:09 AM	75.000	0.6	0.230	0.6000	0.138	61	-0.1988	1.0000	-0.1988	0.2300	-0.0457	-0.80
14	10:11 AM	76.000	0.6	0.230	0.6000	0.138	22	0.6381	1.0000	0.6381	0.2300	0.1468	2.56
15	10:13 AM	77.000	0.6	0.200	0.6000	0.120	44	0.0825	1.0000	0.0825	0.2000	0.0165	0.29
16	10:16 AM	78.000	None	0.200	0.0000	0.000	0	0.0000	1.0000	0.0825	0.1000	0.0083	0.14

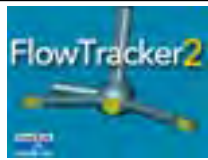


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20231024-101655.ft
Comment	Site1

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	9:47 AM	63.000	0.6	0.250	0.6000	0.150	Standard Error > QC, Velocity Angle > QC
2	9:50 AM	64.000	0.6	0.550	0.6000	0.330	Standard Error > QC, High Stn % Discharge
3	9:52 AM	65.000	0.6	0.700	0.6000	0.420	Standard Error > QC, High Stn % Discharge
4	9:53 AM	66.000	0.6	0.670	0.6000	0.407	Standard Error > QC, High Stn % Discharge
5	9:55 AM	67.000	0.6	0.500	0.6000	0.300	Standard Error > QC, High Stn % Discharge
6	9:57 AM	68.000	0.6	0.500	0.6000	0.300	Standard Error > QC, Velocity Angle > QC
7	9:59 AM	69.000	0.6	0.390	0.6000	0.234	Boundary Interference, High % Spikes
8	10:00 AM	70.000	0.6	0.280	0.6000	0.168	Boundary Interference, Velocity Angle > QC
10	10:03 AM	72.000	0.6	0.300	0.6000	0.180	Boundary Interference, Beam SNRs Not Similar, SNR Threshold Violation
11	10:06 AM	73.000	0.6	0.270	0.6000	0.162	Standard Error > QC
12	10:08 AM	74.000	0.6	0.330	0.6000	0.198	Boundary Interference, Standard Error > QC
13	10:09 AM	75.000	0.6	0.230	0.6000	0.138	Boundary Interference, Velocity Angle > QC
14	10:11 AM	76.000	0.6	0.230	0.6000	0.138	Velocity Angle > QC
15	10:13 AM	77.000	0.6	0.200	0.6000	0.120	Boundary Interference



Discharge Measurement Summary

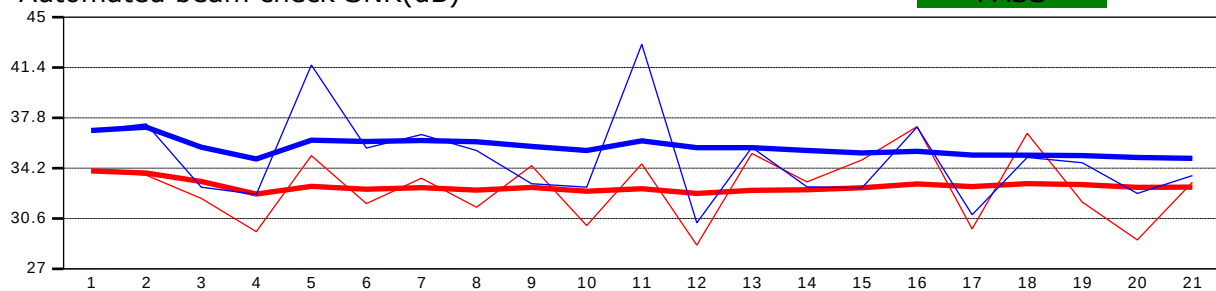
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231024-101655.ft
Comment Site1

Beam 1	
Beam 2	

Automated beam check Start time 10/24/2023 9:47:03 AM

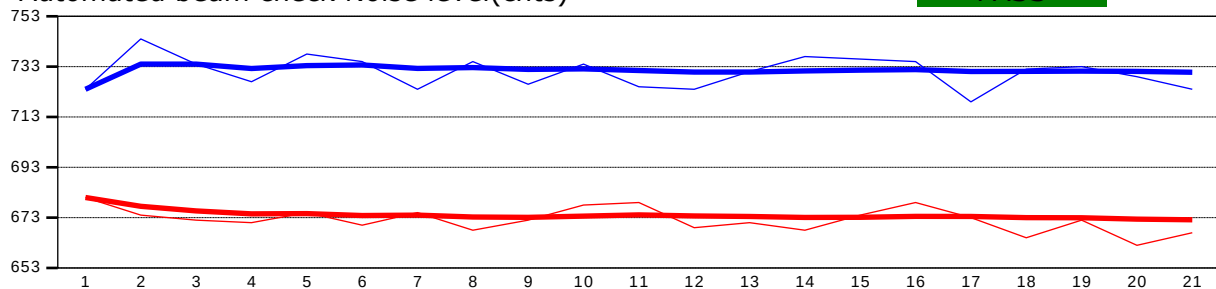
Automated beam check SNR(dB)

PASS



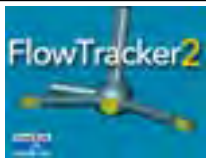
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

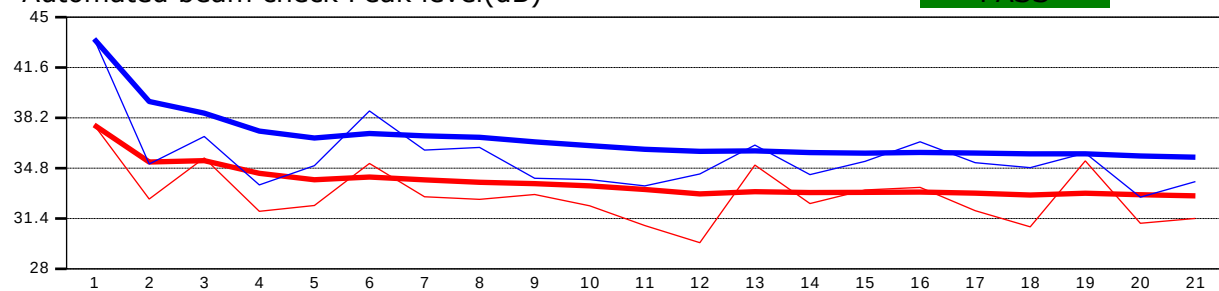
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20231024-101655.ft
Comment Site1

Beam 1	
Beam 2	

Automated beam check Start time 10/24/2023 9:47:03 AM

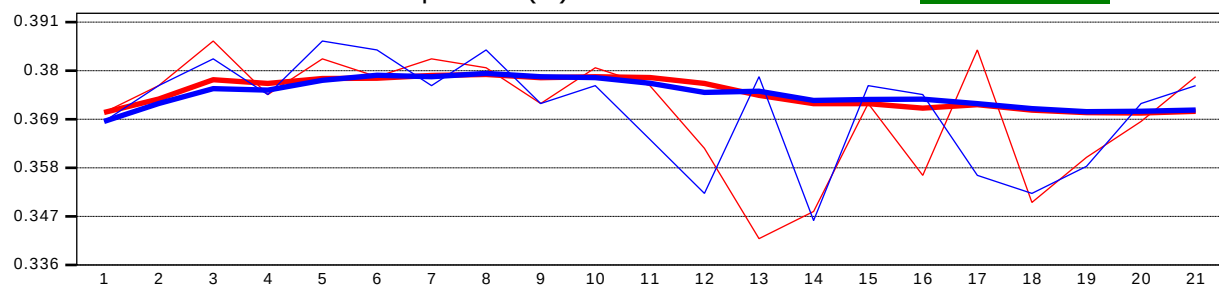
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Start time	11/10/2023 9:04 AM	Sensor type	Top Setting
End time	11/10/2023 9:48 AM	Handheld serial number	FT2H2322005
Start location latitude	40.386	Probe serial number	FT2P2317010
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
23	40	4.9942

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
11.900	9.6575	12.363

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
38	0.812	0.5171

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
32.520	1.120	1.5247

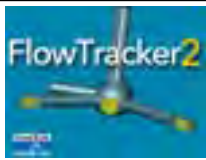
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.4%	3.4%
Velocity	1.3%	15.1%
Width	0.1%	0.1%
Method	2.1%	
# Stations	2.2%	
Overall	3.5%	15.5%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Station Warning Settings

Station discharge OK

Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%





Discharge Measurement Summary

Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	WQ
22	9:48 AM	19.200	None	0.510	0.0000	0.000	0	0.0000	1.0000	0.3931	0.2440	0.0959	1.92 ✓
21	9:46 AM	20.000	0.6	0.740	0.6000	0.444	57	0.3931	1.0000	0.3931	0.4810	0.1891	3.79 ✓
20	9:44 AM	20.500	0.6	0.840	0.6000	0.504	80	0.6093	1.0000	0.6093	0.4200	0.2559	5.12 ✓
19	9:42 AM	21.000	0.6	0.790	0.6000	0.474	80	0.9137	1.0000	0.9137	0.3850	0.3609	7.23 ✓
18	9:41 AM	21.500	0.6	0.800	0.6000	0.480	80	0.7492	1.0000	0.7492	0.4000	0.2997	6.80 ✓
17	9:39 AM	22.000	0.6	0.770	0.6000	0.462	49	0.8659	1.0000	0.8659	0.3850	0.3334	6.68 ✓
16	9:38 AM	22.500	0.6	0.820	0.6000	0.492	52	1.0521	1.0000	1.0521	0.4100	0.4314	8.64 ✓
15	9:33 AM	23.000	0.6	0.800	0.6000	0.480	57	1.2881	1.0000	1.2881	0.4000	0.5152	10.32 ✓
14	9:31 AM	23.500	0.6	0.790	0.6000	0.474	58	1.5247	1.0000	1.5247	0.3950	0.6023	12.06 ✓
13	9:28 AM	24.000	0.6	0.780	0.6000	0.468	46	0.6899	1.0000	0.6899	0.3900	0.2690	5.39 ✓
12	9:27 AM	24.500	0.6	0.680	0.6000	0.408	57	1.1207	1.0000	1.1207	0.3400	0.4490	8.99 ✓
11	9:24 AM	25.000	0.6	0.670	0.6000	0.402	51	-0.0047	1.0000	-0.0047	0.3350	-0.0016	-0.03 ✓
10	9:23 AM	25.500	0.6	0.730	0.6000	0.438	49	0.6293	1.0000	0.6293	0.3650	0.2297	4.60 ✓
9	9:21 AM	26.000	0.6	0.850	0.6000	0.510	54	0.1747	1.0000	0.1747	0.4250	0.0743	1.49 ✓
8	9:19 AM	26.500	0.6	0.790	0.6000	0.474	54	0.0052	1.0000	0.0052	0.3950	0.0020	0.04 ✓
7	9:18 AM	27.000	0.6	0.920	0.6000	0.552	54	0.0048	1.0000	0.0048	0.4600	0.0022	0.04 ✓
6	9:16 AM	27.500	0.6	1.100	0.6000	0.660	47	0.4888	1.0000	0.4888	0.5500	0.2688	5.38 ✓
5	9:14 AM	28.000	0.6	1.120	0.6000	0.672	50	0.6610	1.0000	0.6610	0.5600	0.3702	7.41 ✓
4	9:12 AM	28.500	0.6	1.030	0.6000	0.618	54	0.2118	1.0000	0.2118	0.5150	0.1091	2.18 ✓
3	9:11 AM	29.000	0.6	1.090	0.6000	0.630	46	0.2626	1.0000	0.2626	0.5250	0.1379	2.76 ✓
2	9:08 AM	29.500	0.6	1.020	0.6000	0.612	59	0.0005	1.0000	0.0005	0.5100	0.0003	0.01 ✓
1	9:05 AM	30.000	0.6	0.940	0.6000	0.564	59	-0.0007	1.0000	-0.0007	0.7520	-0.0005	-0.01 ✓
0	9:04 AM	31.100	None	0.010	0.0000	0.000	0	0.0000	1.0000	-0.0007	0.0055	0.0000	0.00 ✓



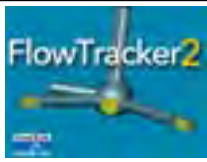
Discharge Measurement Summary

Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
21	9:46 AM	20.000	0.6	0.740	0.6000	0.444	Standard Error > QC, Velocity Angle > QC
20	9:44 AM	20.500	0.6	0.840	0.6000	0.504	Velocity Angle > QC
19	9:42 AM	21.000	0.6	0.790	0.6000	0.474	Velocity Angle > QC
18	9:41 AM	21.500	0.6	0.800	0.6000	0.480	Velocity Angle > QC
17	9:39 AM	22.000	0.6	0.770	0.6000	0.462	Velocity Angle > QC
16	9:38 AM	22.500	0.6	0.820	0.6000	0.492	Velocity Angle > QC
15	9:33 AM	23.000	0.6	0.800	0.6000	0.480	Standard Error > QC, High Stn % Discharge
14	9:31 AM	23.500	0.6	0.790	0.6000	0.474	Standard Error > QC, High Stn % Discharge
13	9:28 AM	24.000	0.6	0.780	0.6000	0.508	Large SNR Variation, Standard Error > QC, Velocity Angle > QC
12	9:27 AM	24.500	0.6	0.680	0.6000	0.408	Standard Error > QC
11	9:24 AM	25.000	0.6	0.670	0.6000	0.402	Large SNR Variation
10	9:23 AM	25.500	0.6	0.730	0.6000	0.438	Boundary Interference, Standard Error > QC
9	9:21 AM	26.000	0.6	0.850	0.6000	0.510	Boundary Interference, Large SNR Variation, SNR Threshold Variation, Standard Error > QC
8	9:19 AM	26.500	0.6	0.790	0.6000	0.474	Boundary Interference, Large SNR Variation
7	9:18 AM	27.000	0.6	0.920	0.6000	0.552	Large SNR Variation
6	9:16 AM	27.500	0.6	1.100	0.6000	0.660	Standard Error > QC
5	9:14 AM	28.000	0.6	1.120	0.6000	0.672	Standard Error > QC
4	9:12 AM	28.500	0.6	1.030	0.6000	0.618	Large SNR Variation, Velocity Angle > QC
3	9:11 AM	29.000	0.6	1.050	0.6000	0.630	Large SNR Variation
2	9:08 AM	29.500	0.6	1.020	0.6000	0.612	Boundary Interference, Beam SNRs Not Similar, High % Spikes
1	9:05 AM	30.000	0.6	0.940	0.6000	0.564	High % Spikes
0	9:04 AM	31.100	None	0.010	0.0000	0.000	Stn Spacing > QC, Water Depth > QC



Discharge Measurement Summary

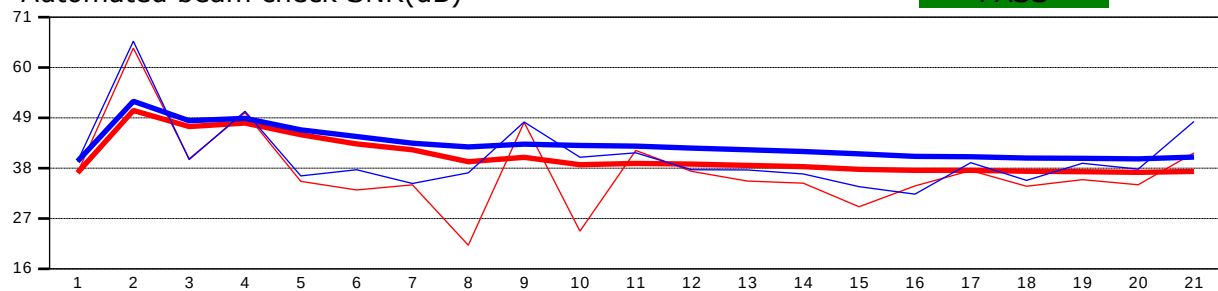
Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/10/2023 9:04:04 AM

Automated beam check SNR(dB)

PASS



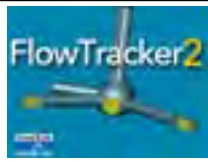
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

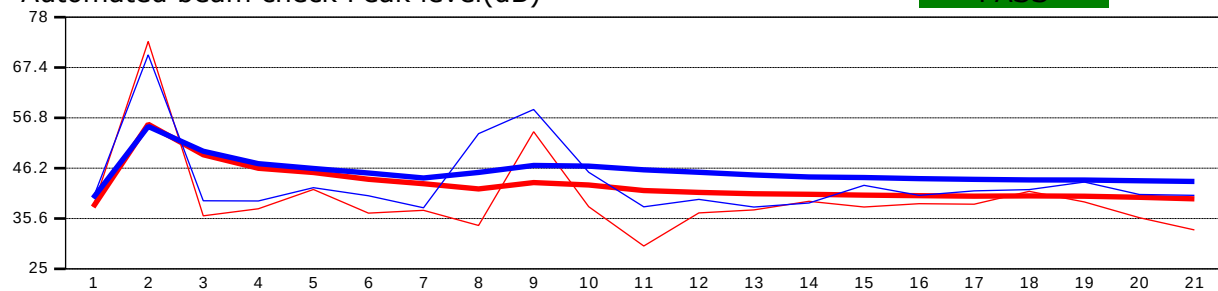
Site name MilkCreek
Site number 11102023
Operator(s) SC
File name MilkCreek_20231110-095143.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 11/10/2023 9:04:04 AM

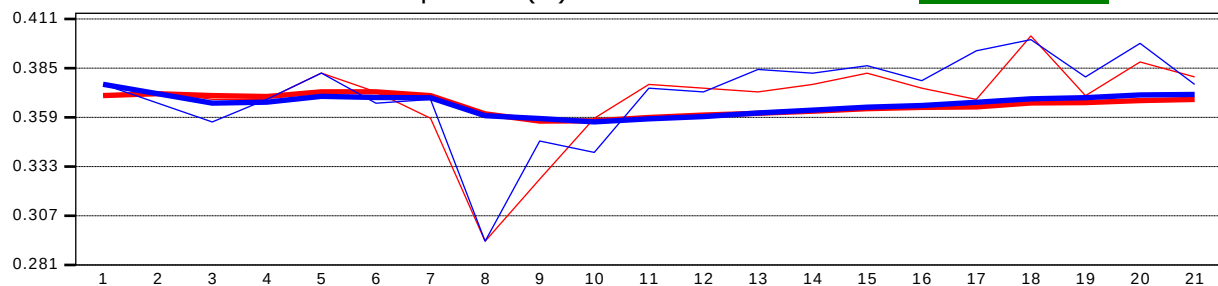
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20240328-102256.ft
Comment	

Start time	3/28/2024 9:58 AM	Sensor type	Top Setting
End time	3/28/2024 10:21 AM	Handheld serial number	FT2H2322005
Start location latitude	40.386	Probe serial number	FT2P2317010
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
19	40	28.2123

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
17.100	19.4625	18.893

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
53	1.138	1.4496

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
40.022	2.000	2.3301

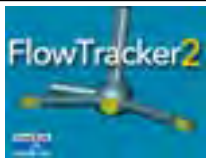
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	3.0%
Velocity	1.1%	7.8%
Width	0.1%	0.1%
Method	1.6%	
# Stations	2.6%	
Overall	3.4%	8.4%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20240328-102256.ft
Comment

Station Warning Settings

Station discharge OK

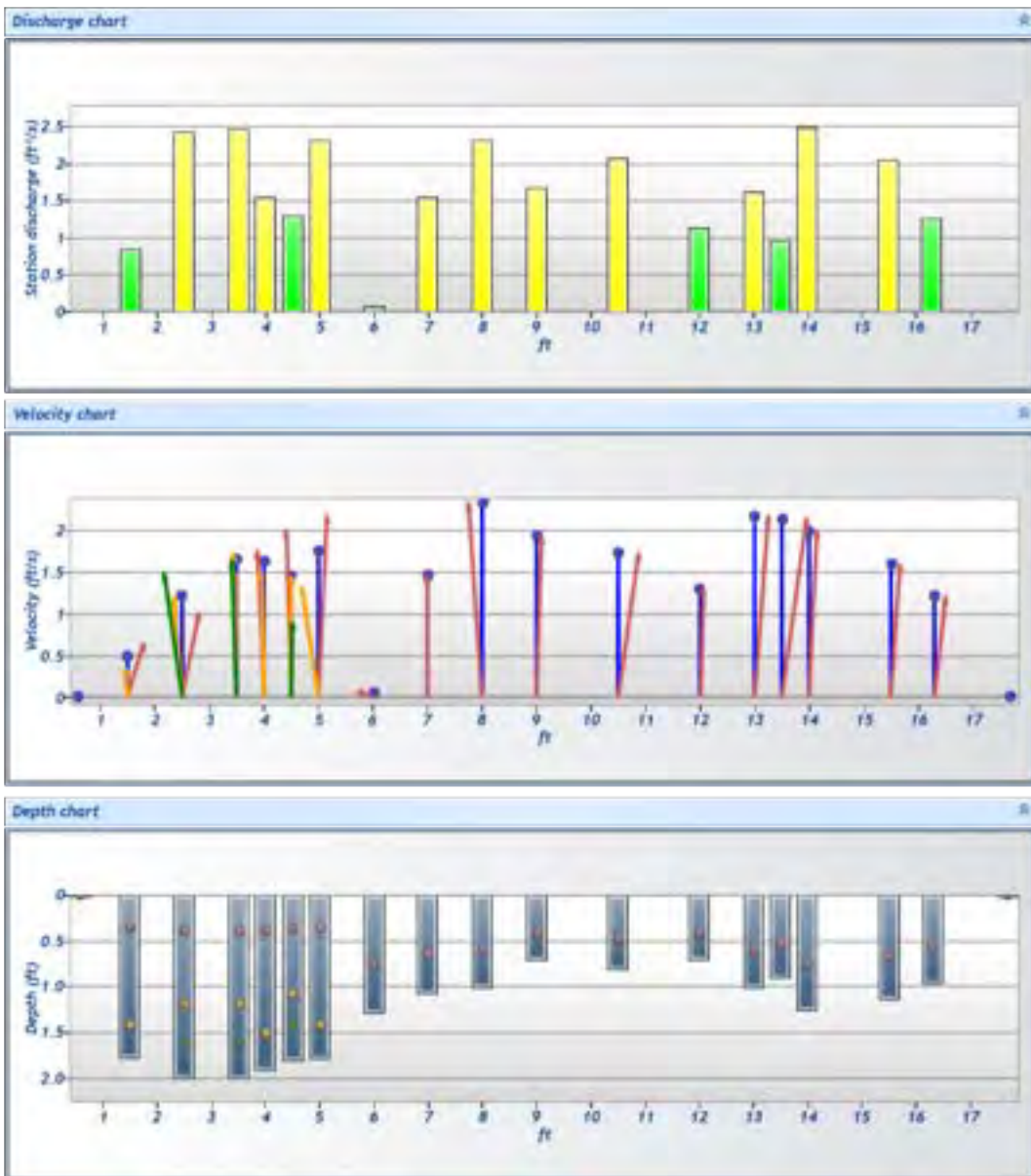
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

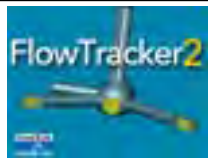




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20240328-102256.ft
Comment

Measurement results													
Sta	Time	Location (ft)	Method	Depth (ft)	W/Depth	Measured Depth (ft)	Sampler	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	Q ₂
18	10:17 AM	0.600	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.5010	0.0045	0.0023	0.01 ✓
17	10:17 AM	1.500	0.2/0.8	1.770	0.2000	0.254	23	0.6474	1.0000	0.5010	1.6815	0.8424	2.99 <
17	10:17 AM	1.500	0.2/0.8	1.770	0.8000	1.416	28	0.3546	1.0000	0.5010	1.6815	0.8424	2.99 <
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.2000	0.480	48	1.0079	1.0000	1.2213	2.0000	2.4426	8.66 >
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.6000	1.700	73	1.1936	1.0000	1.2213	2.0000	2.4426	8.66 >
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.8000	1.600	31	1.4901	1.0000	1.2213	2.0000	2.4426	8.66 >
15	10:10 AM	3.500	0.2/0.6/0.8	2.000	0.2000	0.490	22	1.4528	1.0000	1.6448	1.5000	2.4672	8.75 >
15	10:10 AM	3.500	0.2/0.6/0.8	2.000	0.6000	1.390	16	1.7252	1.0000	1.6448	1.5000	2.4672	8.75 >
15	10:10 AM	3.500	0.2/0.6/0.8	2.000	0.8000	1.600	32	1.6458	1.0000	1.6448	1.5000	2.4672	8.75 >
14	10:09 AM	4.000	0.2/0.8	1.960	0.2000	0.380	26	1.7580	1.0000	1.6279	0.9500	1.5465	5.48 ✓
14	10:09 AM	4.000	0.2/0.8	1.960	0.8000	1.520	28	1.4978	1.0000	1.6279	0.9500	1.5465	5.48 >
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.2000	0.380	23	2.0012	1.0000	1.4482	0.9000	1.3034	4.62 >
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.6000	1.080	23	1.4438	1.0000	1.4482	0.9000	1.3034	4.62 >
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.8000	1.440	24	0.9020	1.0000	1.4482	0.9000	1.3034	4.62 >
12	10:08 AM	5.000	0.2/0.8	1.780	0.2000	0.356	17	2.1763	1.0000	1.7447	1.3350	2.3292	8.26 >
12	10:08 AM	5.000	0.2/0.8	1.780	0.8000	1.424	25	1.3131	1.0000	1.7447	1.3350	2.3292	8.26 >
11	10:07 AM	6.000	0.6	1.780	0.6000	0.768	27	0.0652	1.0000	0.0652	1.2800	0.0835	0.30 <
10	10:06 AM	7.000	0.6	1.060	0.6000	0.636	20	1.4618	1.0000	1.4638	1.0600	1.5516	5.50 >
9	10:05 AM	8.000	0.6	1.050	0.6000	0.600	26	2.3301	1.0000	2.3301	1.0000	2.3301	8.26 <
8	10:05 AM	9.000	0.6	0.700	0.6000	0.420	19	1.0278	1.0000	1.0278	0.8750	1.6868	5.96 >
7	10:04 AM	10.500	0.6	0.800	0.6000	0.480	34	1.7302	1.0000	1.7302	1.2000	2.0762	7.36 <
6	10:03 AM	12.000	0.6	0.700	0.6000	0.420	45	1.2957	1.0000	1.2957	0.8750	1.1317	4.02 <
5	10:02 AM	13.000	0.6	1.000	0.6000	0.600	25	2.1746	1.0000	2.1746	0.7500	1.6310	5.78 <
4	10:21 AM	13.500	0.6	0.900	0.6000	0.540	21	2.1370	1.0000	2.1370	0.4500	0.9610	3.41 <
3	10:01 AM	14.000	0.6	1.250	0.6000	0.750	24	1.9600	1.0000	1.9600	1.2500	2.4675	8.83 <
2	10:00 AM	15.500	0.6	1.130	0.6000	0.670	27	1.5903	1.0000	1.5903	1.2995	2.0665	7.32 >
1	9:59 AM	16.300	0.6	0.950	0.6000	0.570	26	1.2074	1.0000	1.2074	1.0450	1.2617	4.47 >
0	9:58 AM	17.700	None	0.010	0.0000	0.000	0	0.0000	1.0000	1.2074	0.0070	0.0035	0.00 <

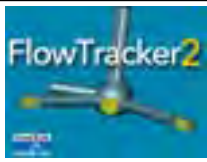


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	LFSC
File name	Milk Creek near confl with Yampa River_20240328-102256.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings						
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)
17	10:17 AM	1.500	0.2/0.8	1.770	0.2000	0.354
17	10:17 AM	1.500	0.2/0.8	1.770	0.8000	1.416
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.2000	0.400
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.6000	1.200
16	10:11 AM	2.500	0.2/0.6/0.8	2.000	0.8000	1.600
15	10:19 AM	3.500	0.2/0.6/0.8	2.000	0.2000	0.400
15	10:19 AM	3.500	0.2/0.6/0.8	2.000	0.6000	1.200
15	10:19 AM	3.500	0.2/0.6/0.8	2.000	0.8000	1.600
14	10:09 AM	4.000	0.2/0.8	1.900	0.2000	0.380
14	10:09 AM	4.000	0.2/0.8	1.900	0.8000	1.520
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.2000	0.360
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.6000	1.080
13	10:14 AM	4.500	0.2/0.6/0.8	1.800	0.8000	1.440
12	10:08 AM	5.000	0.2/0.8	1.780	0.2000	0.356
12	10:08 AM	5.000	0.2/0.8	1.780	0.8000	1.424
11	10:07 AM	6.000	0.6	1.280	0.6000	0.768
10	10:06 AM	7.000	0.6	1.060	0.6000	0.636
9	10:05 AM	8.000	0.6	1.000	0.6000	0.600
8	10:05 AM	9.000	0.6	0.790	0.6000	0.474
7	10:04 AM	10.500	0.6	0.800	0.6000	0.480
6	10:03 AM	12.000	0.6	0.790	0.6000	0.474
5	10:02 AM	13.000	0.6	1.000	0.6000	0.600
4	10:21 AM	13.500	0.6	0.900	0.6000	0.540
3	10:01 AM	14.000	0.6	1.250	0.6000	0.750
1	9:59 AM	16.300	0.6	0.950	0.6000	0.570
0	9:58 AM	17.700	None	0.010	0.0000	0.000



Discharge Measurement Summary

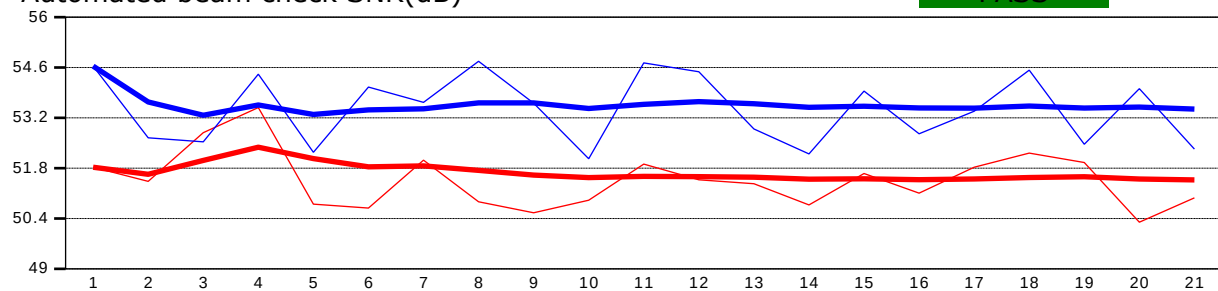
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20240328-102256.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 3/28/2024 9:58:14 AM

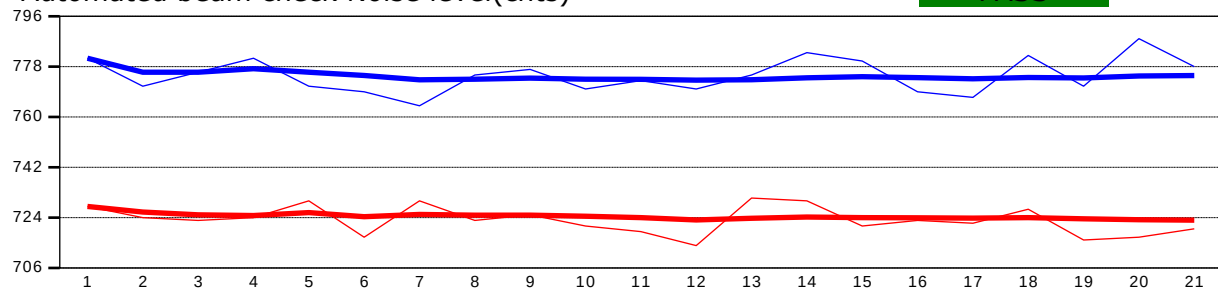
Automated beam check SNR(dB)

PASS



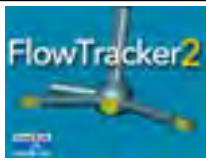
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

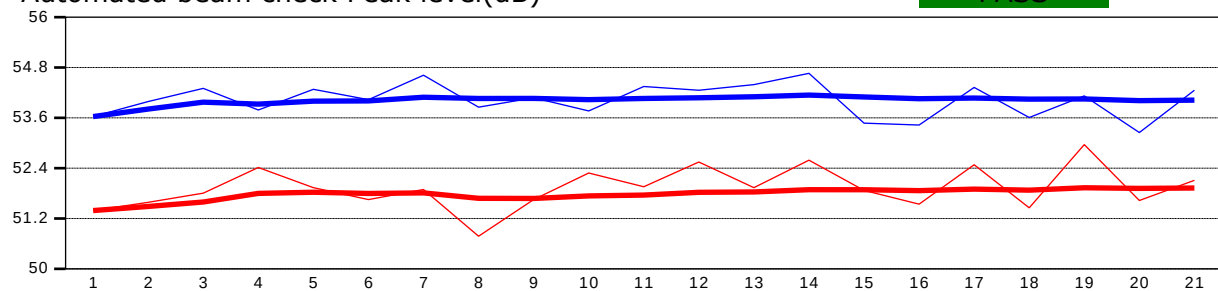
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) LFSC
File name Milk Creek near confl with Yampa River_20240328-102256.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 3/28/2024 9:58:14 AM

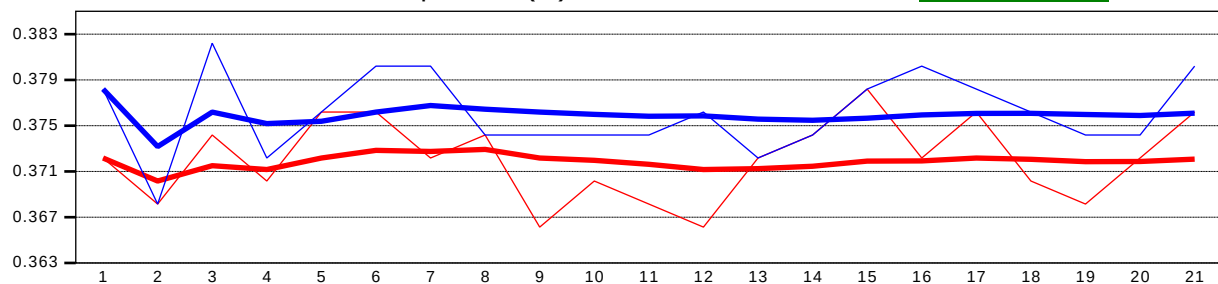
Automated beam check Peak level(dB)

PASS



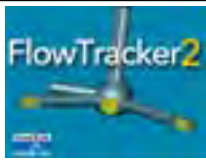
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk2
Site number	041224
Operator(s)	Kb
File name	Milk2_20240412-115515.ft
Comment	

Start time	4/12/2024 11:23 AM	Sensor type	Top Setting
End time	4/12/2024 11:54 AM	Handheld serial number	FT2H2322005
Start location latitude	40.391	Probe serial number	FT2P2317010
Start location longitude	-107.754	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft ³ /s)
24	40	44.4524

Total width (ft)	Total area (ft ²)	Wetted Perimeter (ft)
23.700	19.8375	24.404

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
56	0.837	2.2408

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
48.763	1.400	3.8188

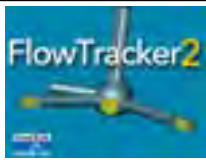
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	3.6%
Velocity	0.8%	7.3%
Width	0.1%	0.1%
Method	1.9%	
# Stations	2.1%	
Overall	3.1%	8.2%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-115515.ft
Comment

Station Warning Settings

Station discharge OK

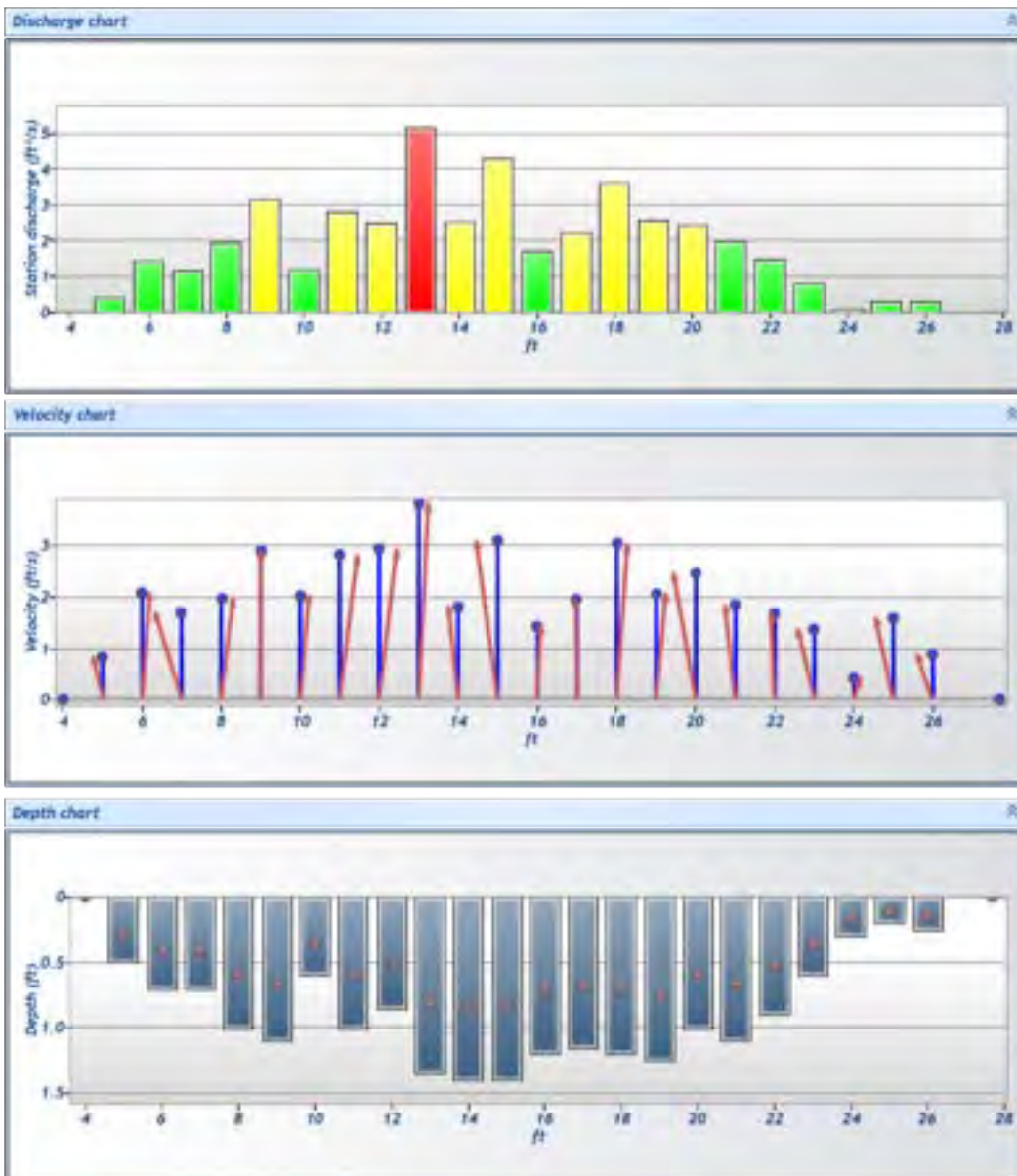
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-115515.ft
Comment

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
0	11:23 AM	4.000	None	0.000	0.0000	0.000	0	0.0000	0.5000	0.4140	0.0000	0.0000	0.00
1	11:23 AM	5.000	0.6	0.500	0.6000	0.300	80	0.8279	1.0000	0.8279	0.5000	0.4140	0.93
2	11:25 AM	6.000	0.6	0.700	0.6000	0.420	80	2.0808	1.0000	2.0808	0.7000	1.4585	1.28
3	11:26 AM	7.000	0.6	0.700	0.6000	0.420	80	1.6904	1.0000	1.6904	0.7000	1.1833	2.66
4	11:27 AM	8.000	0.6	1.000	0.6000	0.600	80	1.9696	1.0000	1.9696	1.0000	1.9696	4.41
5	11:29 AM	9.000	0.6	1.100	0.6000	0.660	80	2.8909	1.0000	2.8909	1.1000	3.1880	7.15
6	11:30 AM	10.000	0.6	0.600	0.6000	0.360	80	2.0248	1.0000	2.0248	0.6000	1.2149	2.73
7	11:32 AM	11.000	0.6	1.000	0.6000	0.600	80	2.8181	1.0000	2.8181	1.0000	2.8181	6.34
8	11:33 AM	12.000	0.6	0.850	0.6000	0.510	80	2.9304	1.0000	2.9304	0.8500	2.4908	5.60
9	11:35 AM	13.000	0.6	1.350	0.6000	0.810	80	3.8188	1.0000	3.8188	1.3500	5.1553	11.60
10	11:37 AM	14.000	0.6	1.400	0.6000	0.840	80	1.8188	1.0000	1.8188	1.4000	2.5464	5.73
11	11:38 AM	15.000	0.6	1.400	0.6000	0.840	80	3.0867	1.0000	3.0867	1.4000	4.3213	9.72
12	11:40 AM	16.000	0.6	1.200	0.6000	0.720	80	1.4334	1.0000	1.4334	1.2000	1.7201	3.87
13	11:41 AM	17.000	0.6	1.150	0.6000	0.690	80	1.9451	1.0000	1.9451	1.1500	2.2368	5.03
14	11:43 AM	18.000	0.6	1.200	0.6000	0.720	80	3.0257	1.0000	3.0257	1.2000	3.6389	8.17
15	11:44 AM	19.000	0.6	1.250	0.6000	0.750	80	2.0636	1.0000	2.0636	1.2500	2.5795	5.80
16	11:45 AM	20.000	0.6	1.000	0.6000	0.600	80	2.4636	1.0000	2.4636	1.0000	2.4636	5.54
17	11:46 AM	21.000	0.6	1.100	0.6000	0.660	80	1.8302	1.0000	1.8302	1.1000	2.0132	4.53
18	11:48 AM	22.000	0.6	0.900	0.6000	0.540	80	1.6604	1.0000	1.6604	0.9000	1.4943	3.36
19	11:49 AM	23.000	0.6	0.600	0.6000	0.360	80	1.3728	1.0000	1.3728	0.6000	0.8237	1.85
20	11:50 AM	24.000	0.6	0.300	0.6000	0.180	80	0.4226	1.0000	0.4226	0.3000	0.1268	0.29
21	11:52 AM	25.000	0.6	0.200	0.6000	0.120	44	1.5815	1.0000	1.5815	0.2000	0.3163	0.71
22	11:53 AM	26.000	0.6	0.250	0.6000	0.150	80	0.8799	1.0000	0.8799	0.3375	0.2970	0.67
23	11:54 AM	27.700	None	0.000	0.0000	0.000	0	0.0000		0.8799	0.0000	0.0000	0.00

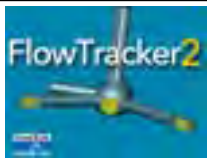


Discharge Measurement Summary

Site name	Milk2
Site number	041224
Operator(s)	Kb
File name	Milk2_20240412-115515.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	11:23 AM	5.000	0.6	0.500	0.6000	0.300	Boundary Interference, Down SNRs Not Similar, SNR Threshold Violation, Standard Error > QC
2	11:25 AM	6.000	0.6	0.700	0.6000	0.420	Standard Error > QC
3	11:26 AM	7.000	0.6	0.700	0.6000	0.420	Velocity Angle > QC, Rod Angle > QC
4	11:27 AM	8.000	0.6	1.000	0.6000	0.600	Standard Error > QC
5	11:29 AM	9.000	0.6	1.100	0.6000	0.660	Standard Error > QC
6	11:30 AM	10.000	0.6	0.600	0.6000	0.360	Standard Error > QC
7	11:32 AM	11.000	0.6	1.000	0.6000	0.600	Standard Error > QC
8	11:33 AM	12.000	0.6	0.850	0.6000	0.510	Standard Error > QC
9	11:35 AM	13.000	0.6	1.350	0.6000	0.810	Standard Error > QC, Rod Angle > QC, High Str % Discharge
10	11:37 AM	14.000	0.6	1.400	0.6000	0.840	Standard Error > QC
11	11:38 AM	15.000	0.6	1.400	0.6000	0.840	Standard Error > QC
12	11:40 AM	16.000	0.6	1.200	0.6000	0.720	Standard Error > QC
13	11:41 AM	17.000	0.6	1.150	0.6000	0.690	Standard Error > QC, Rod Angle > QC
14	11:43 AM	18.000	0.6	1.200	0.6000	0.720	Standard Error > QC
15	11:44 AM	19.000	0.6	1.250	0.6000	0.750	Standard Error > QC
16	11:45 AM	20.000	0.6	1.000	0.6000	0.600	Standard Error > QC
17	11:46 AM	21.000	0.6	1.100	0.6000	0.660	Standard Error > QC
18	11:48 AM	22.000	0.6	0.900	0.6000	0.540	Standard Error > QC
20	11:50 AM	24.000	0.6	0.300	0.6000	0.180	Large SNR Variation, Standard Error > QC, Velocity Angle > QC, Rod Angle > QC
21	11:52 AM	25.000	0.6	0.200	0.6000	0.120	Standard Error > QC, Rod Angle > QC
22	11:53 AM	26.000	0.6	0.250	0.6000	0.150	Velocity Angle > QC, Rod Angle > QC



Discharge Measurement Summary

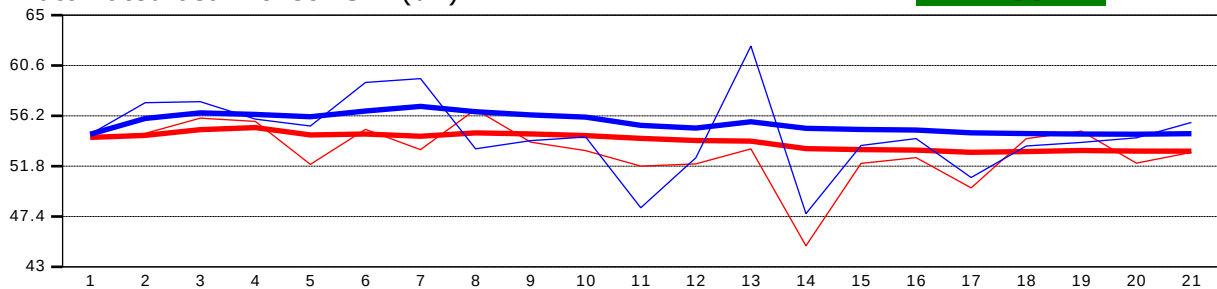
Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-115515.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/12/2024 11:21:56 AM

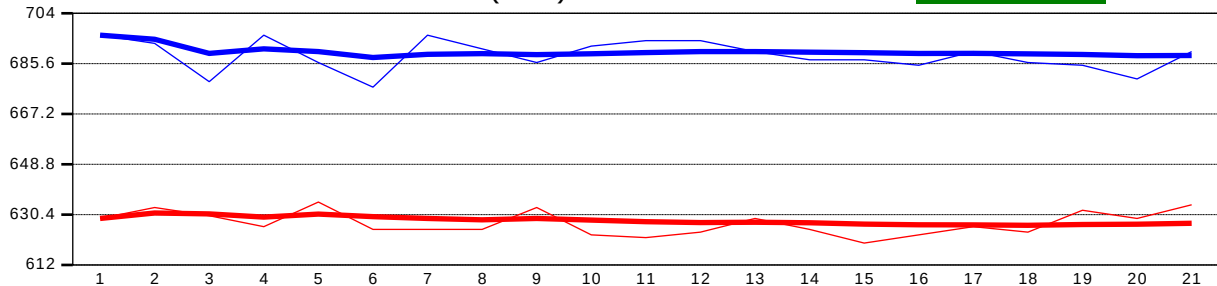
Automated beam check SNR(dB)

PASS



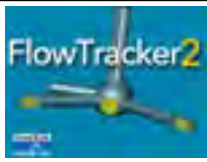
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

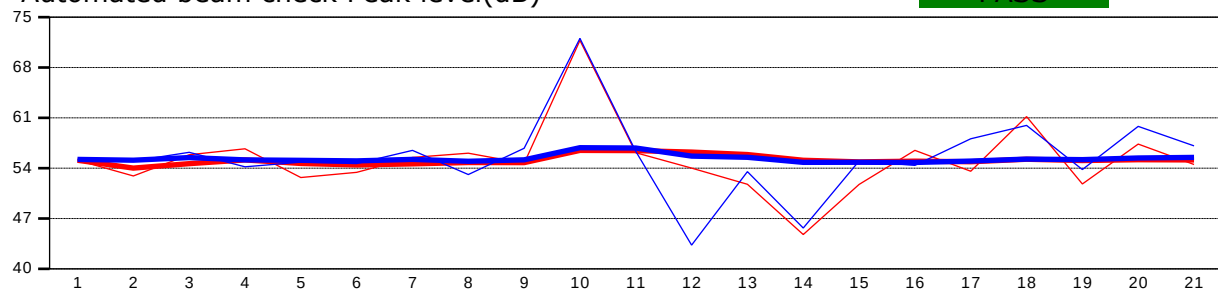
Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-115515.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 4/12/2024 11:21:56 AM

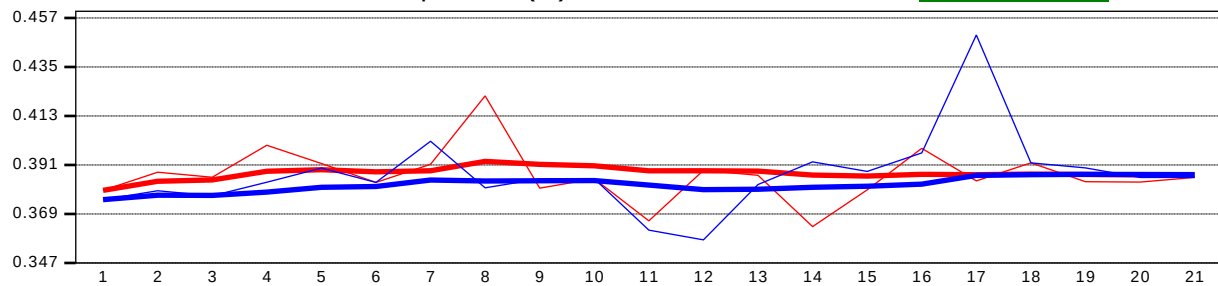
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

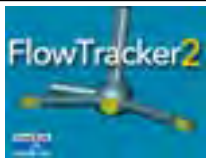
PASS



Automated beam check Quality control warnings

No quality control warnings

5/4/2024 11:30:17 AM



Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-141627.ft
Comment

Start time	4/12/2024 1:41 PM	Sensor type	Top Setting
End time	4/12/2024 2:15 PM	Handheld serial number	FT2H2322005
Start location latitude	40.393	Probe serial number	FT2P2317010
Start location longitude	-107.749	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft ³ /s)
23	40	52.2239

Total width (ft)	Total area (ft ²)	Wetted Perimeter (ft)
21.400	26.0000	22.509

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
58	1.215	2.0086

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
54.665	1.800	3.6598

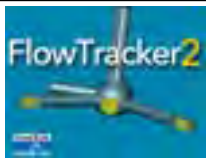
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	1.8%
Velocity	0.6%	3.1%
Width	0.1%	0.1%
Method	1.5%	
# Stations	2.2%	
Overall	2.9%	3.7%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

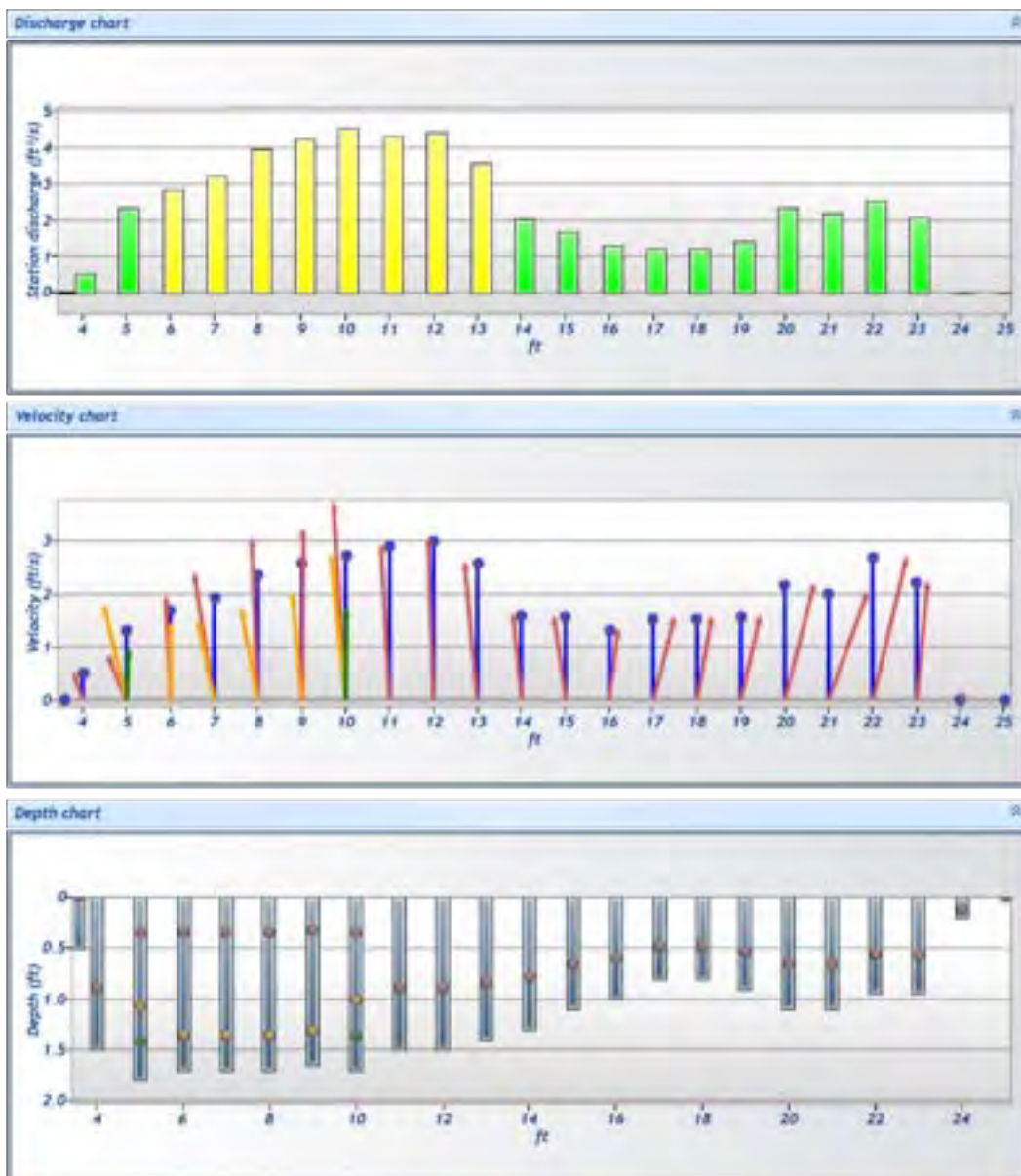


Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-141627.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-141627.ft
Comment

Measurement results													
Sta	Time	Location (ft)	Method	Depth (ft)	W-Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	log ₁₀
0	1:41 PM	3.000	None	0.300	0.0000	0.000	0	0.0000	0.0000	0.2479	0.1000	0.0248	0.03
1	1:42 PM	4.000	0.6	1.500	0.0000	0.900	80	0.4058	1.0000	0.4058	1.0500	0.5206	1.00
2	1:44 PM	5.000	0.2/0.5/0.8	1.800	0.2000	0.380	80	0.8142	1.0000	1.3047	1.8000	2.3485	4.50
2	1:44 PM	5.000	0.2/0.5/0.8	1.800	0.6000	1.080	80	1.7419	1.0000	1.3047	1.8000	2.3485	4.50
2	1:44 PM	5.000	0.2/0.5/0.8	1.800	0.8000	1.440	80	0.9707	1.0000	1.3047	1.8000	2.3485	4.50
3	1:48 PM	6.000	0.2/0.8	1.700	0.2000	0.340	80	1.0170	1.0000	1.6723	1.7000	2.8430	5.44
3	1:48 PM	6.000	0.2/0.8	1.700	0.8000	1.360	80	1.4276	1.0000	1.6723	1.7000	2.8430	5.44
4	1:50 PM	7.000	0.2/0.8	1.700	0.2000	0.340	80	2.3507	1.0000	1.9023	1.7000	3.2339	6.19
4	1:50 PM	7.000	0.2/0.8	1.700	0.8000	1.360	80	1.4539	1.0000	1.9023	1.7000	3.2339	6.19
5	1:53 PM	8.000	0.2/0.8	1.700	0.2000	0.340	80	2.9881	1.0000	2.3355	1.7000	3.9704	7.60
5	1:53 PM	8.000	0.2/0.8	1.700	0.8000	1.360	80	1.6829	1.0000	2.3355	1.7000	3.9704	7.60
6	1:55 PM	9.000	0.2/0.8	1.650	0.2000	0.330	80	3.1704	1.0000	2.5714	1.6500	4.7429	8.12
6	1:55 PM	9.000	0.2/0.8	1.650	0.8000	1.320	80	1.9724	1.0000	2.5714	1.6500	4.7429	8.12
7	1:57 PM	10.000	0.2/0.5/0.8	1.700	0.2000	0.340	62	3.6508	1.0000	2.6903	1.7000	4.5736	8.76
7	1:57 PM	10.000	0.2/0.5/0.8	1.700	0.6000	1.020	62	2.7070	1.0000	2.6903	1.7000	4.5736	8.76
7	1:57 PM	10.000	0.2/0.5/0.8	1.700	0.8000	1.360	60	1.6875	1.0000	2.6903	1.7000	4.5736	8.76
8	2:00 PM	11.000	0.6	1.500	0.0000	0.900	62	2.8810	1.0000	2.8810	1.5000	4.3215	8.27
9	2:01 PM	12.000	0.6	1.500	0.6000	0.900	63	2.9724	1.0000	2.9724	1.5000	4.4586	8.54
10	2:02 PM	13.000	0.6	1.400	0.6000	0.840	69	2.5658	1.0000	2.5658	1.4000	3.5922	6.88
11	2:03 PM	14.000	0.6	1.300	0.6000	0.780	62	1.5840	1.0000	1.5840	1.3000	2.0562	3.94
12	2:04 PM	15.000	0.6	1.100	0.6000	0.660	62	1.5404	1.0000	1.5404	1.1000	1.6944	3.24
13	2:05 PM	16.000	0.6	1.000	0.6000	0.600	62	1.3117	1.0000	1.3117	1.0000	1.3117	2.51
14	2:06 PM	17.000	0.6	0.800	0.6000	0.480	64	1.5229	1.0000	1.5229	0.8000	1.2184	2.33
15	2:08 PM	18.000	0.6	0.800	0.6000	0.480	62	1.5315	1.0000	1.5315	0.8000	1.2252	2.35
16	2:08 PM	19.000	0.6	0.900	0.6000	0.540	62	1.5608	1.0000	1.5608	0.9000	1.4047	2.69
17	2:10 PM	20.000	0.6	1.100	0.6000	0.660	62	2.1523	1.0000	2.1523	1.1000	2.3676	4.53
18	2:11 PM	21.000	0.6	1.100	0.6000	0.660	63	1.9992	1.0000	1.9992	1.1000	2.1991	4.21
19	2:12 PM	22.000	0.6	0.950	0.6000	0.570	63	2.6622	1.0000	2.6622	0.9500	2.5701	4.84
20	2:13 PM	23.000	0.6	0.950	0.6000	0.570	62	2.1949	1.0000	2.1949	0.9500	2.0852	3.99
21	2:14 PM	24.000	0.6	0.200	0.6000	0.120	62	-0.0015	1.0000	0.0015	0.2000	-0.0003	0.00
22	2:15 PM	25.000	None	0.000	0.0000	0.000	0	0.0000		0.0015	0.0000	0.0000	0.00



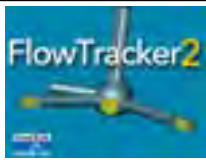
Discharge Measurement Summary

Site name Milk2
Site number 041224
Operator(s) Kb
File name Milk2_20240412-141627.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	1:42 PM	4.000	0.6	1.500	0.6000	0.900	Standard Error > QC, Velocity Angle > QC
2	1:44 PM	5.000	0.2/0.6/0.8	1.800	0.2000	0.360	Standard Error > QC, Velocity Angle > QC, Rod Angle > QC
2	1:44 PM	5.000	0.2/0.6/0.8	1.800	0.6000	1.080	Standard Error > QC, Velocity Angle > QC, Rod Angle > QC
2	1:44 PM	5.000	0.2/0.6/0.8	1.800	0.8000	1.440	Standard Error > QC, Velocity Angle > QC, Rod Angle > QC
3	1:48 PM	6.000	0.2/0.8	1.700	0.2000	0.340	Standard Error > QC
3	1:48 PM	6.000	0.2/0.8	1.700	0.8000	1.360	Standard Error > QC
4	1:50 PM	7.000	0.2/0.8	1.700	0.2000	0.340	Standard Error > QC
4	1:50 PM	7.000	0.2/0.8	1.700	0.8000	1.360	Standard Error > QC
5	1:53 PM	8.000	0.2/0.8	1.700	0.2000	0.340	Standard Error > QC, High % Spikes
5	1:53 PM	8.000	0.2/0.8	1.700	0.8000	1.360	Standard Error > QC, High % Spikes
6	1:55 PM	9.000	0.2/0.8	1.650	0.2000	0.330	Standard Error > QC, High % Spikes, Rod Angle > QC
6	1:55 PM	9.000	0.2/0.8	1.650	0.8000	1.320	Standard Error > QC, High % Spikes, Rod Angle > QC
7	1:57 PM	10.000	0.2/0.6/0.8	1.700	0.2000	0.340	Standard Error > QC, High % Spikes, Rod Angle > QC
7	1:57 PM	10.000	0.2/0.6/0.8	1.700	0.6000	1.020	Standard Error > QC, High % Spikes, Rod Angle > QC
7	1:57 PM	10.000	0.2/0.6/0.8	1.700	0.8000	1.360	Standard Error > QC, High % Spikes, Rod Angle > QC
8	2:00 PM	11.000	0.6	1.500	0.6000	0.900	Standard Error > QC
9	2:01 PM	12.000	0.6	1.500	0.6000	0.900	Standard Error > QC
10	2:02 PM	13.000	0.6	1.400	0.6000	0.840	Standard Error > QC
11	2:03 PM	14.000	0.6	1.300	0.6000	0.780	Standard Error > QC
12	2:04 PM	15.000	0.6	1.100	0.6000	0.660	Standard Error > QC
13	2:05 PM	16.000	0.6	1.000	0.6000	0.600	Standard Error > QC
14	2:06 PM	17.000	0.6	0.800	0.6000	0.480	Standard Error > QC
15	2:08 PM	18.000	0.6	0.800	0.6000	0.480	Standard Error > QC
16	2:08 PM	19.000	0.6	0.900	0.6000	0.540	Standard Error > QC
17	2:10 PM	20.000	0.6	1.100	0.6000	0.660	Standard Error > QC
18	2:11 PM	21.000	0.6	1.100	0.6000	0.660	Standard Error > QC, Velocity Angle > QC
19	2:12 PM	22.000	0.6	0.950	0.6000	0.570	Standard Error > QC, Rod Angle > QC
20	2:13 PM	23.000	0.6	0.950	0.6000	0.570	Standard Error > QC, Rod Angle > QC
21	2:14 PM	24.000	0.6	0.200	0.6000	0.120	Boundary Interference, SNR Threshold Violation, Rod Angle > QC



Discharge Measurement Summary

Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Start time	5/29/2024 11:12 AM	Sensor type	Top Setting
End time	5/29/2024 12:25 PM	Handheld serial number	FT2H1723034
Start location latitude	40.391	Probe serial number	FT2P2319002
Start location longitude	-107.756	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.6

# Stations	Avg interval (s)	Total discharge (ft³/s)
28	40	127.6030

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
28.800	47.2000	29.825

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
56	1.639	2.7035

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
57.710	2.950	4.5120

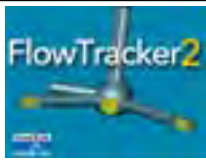
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.1%	1.1%
Velocity	0.4%	2.6%
Width	0.1%	0.1%
Method	1.0%	
# Stations	1.8%	
Overall	2.3%	3.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Station Warning Settings

Station discharge OK

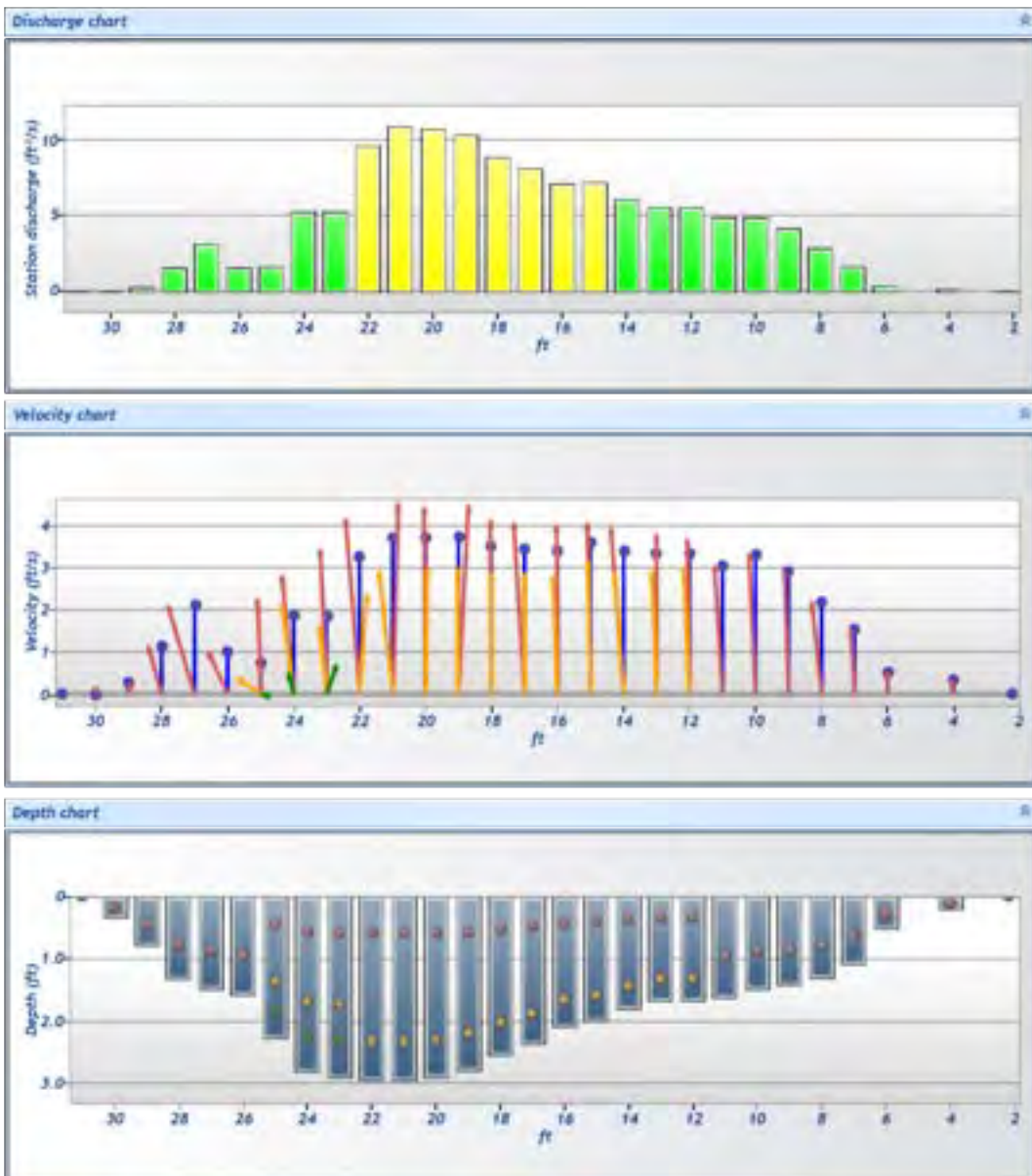
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

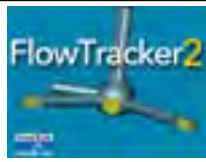




Discharge Measurement Summary

Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Measurement results													
Sta	Time	Location (ft)	Method	Depth (ft)	Velocity	Measured Depth (ft)	Sampler	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	Q ₁₀₀
27	12:25 PM	2.200	None	0.000	0.0000	0.000	0	0.0000		0.3497	0.0000	0.0000	0.00
26	12:24 PM	4.000	0.6	0.200	0.6000	0.120	80	0.3497	1.0000	0.3497	0.3800	0.1329	0.10
25	12:22 PM	6.000	0.6	0.500	0.6000	0.300	80	0.5107	1.0000	0.5107	0.7500	0.3830	0.30
24	12:21 PM	7.000	0.6	1.020	0.6000	0.642	80	1.5299	1.0000	1.5299	1.0700	1.6370	1.20
23	12:19 PM	8.000	0.6	1.300	0.6000	0.780	80	2.1753	1.0000	2.1753	1.3000	2.8278	2.22
22	12:18 PM	9.000	0.6	1.420	0.6000	0.852	80	2.9146	1.0000	2.9146	1.4200	4.1387	3.24
21	12:17 PM	10.000	0.6	1.470	0.6000	0.882	80	3.3047	1.0000	3.3047	1.4700	4.8579	3.81
20	12:15 PM	11.000	0.6	1.610	0.6000	0.966	80	3.0266	1.0000	3.0266	1.6100	4.8729	3.82
19	12:13 PM	12.000	0.2/0.8	1.670	0.8000	0.334	80	3.6650	1.0000	3.3173	1.6700	5.5400	4.34
19	12:13 PM	12.000	0.2/0.8	1.670	0.8000	1.236	80	2.9697	1.0000	3.3173	1.6700	5.5400	4.34
18	12:10 PM	13.000	0.2/0.8	1.670	0.7000	0.734	80	3.7789	1.0000	3.3399	1.6700	5.5776	4.37
18	12:10 PM	13.000	0.2/0.8	1.670	0.8000	1.236	80	2.9038	1.0000	3.3399	1.6700	5.5776	4.37
17	12:03 PM	14.000	0.2/0.8	1.800	0.7000	0.360	80	3.9358	1.0000	3.3917	1.8000	6.1050	4.78
17	12:03 PM	14.000	0.2/0.8	1.800	0.8000	1.440	80	2.8476	1.0000	3.3917	1.8000	6.1050	4.78
16	12:00 PM	15.000	0.2/0.8	2.000	0.7000	0.460	80	4.0484	1.0000	3.5902	2.0000	7.1894	5.63
16	12:00 PM	15.000	0.2/0.8	2.000	0.8000	1.600	80	3.1320	1.0000	3.5902	2.0000	7.1894	5.63
15	11:57 AM	16.000	0.2/0.8	2.190	0.7000	0.420	80	4.0008	1.0000	3.3874	2.1000	7.1125	5.57
15	11:57 AM	16.000	0.2/0.8	2.190	0.8000	1.680	80	2.7739	1.0000	3.3874	2.1000	7.1125	5.57
14	11:55 AM	17.000	0.2/0.8	2.370	0.7000	0.474	80	4.0341	1.0000	3.4390	2.3700	8.1505	6.39
14	11:55 AM	17.000	0.2/0.8	2.370	0.8000	1.896	80	2.8440	1.0000	3.4390	2.3700	8.1505	6.39
13	11:51 AM	18.000	0.2/0.8	2.550	0.7000	0.510	80	4.1083	1.0000	3.4782	2.5500	8.8603	6.95
13	11:51 AM	18.000	0.2/0.8	2.550	0.8000	2.040	80	2.8481	1.0000	3.4782	2.5500	8.8603	6.95
12	11:48 AM	19.000	0.2/0.8	2.780	0.7000	0.536	80	4.4670	1.0000	3.7171	2.7800	10.3335	8.10
12	11:48 AM	19.000	0.2/0.8	2.780	0.8000	2.234	80	2.9072	1.0000	3.7171	2.7800	10.3335	8.10
11	11:45 AM	20.000	0.2/0.8	2.900	0.7000	0.580	80	4.4130	1.0000	3.6870	2.9000	10.6923	8.38
11	11:45 AM	20.000	0.2/0.8	2.900	0.8000	2.320	80	2.9601	1.0000	3.6870	2.9000	10.6923	8.38
10	11:41 AM	21.000	0.2/0.8	2.950	0.7000	0.590	80	4.5120	1.0000	3.7070	2.9500	10.9382	8.57
10	11:41 AM	21.000	0.2/0.8	2.950	0.8000	2.360	80	2.9036	1.0000	3.7070	2.9500	10.9382	8.57
9	11:38 AM	22.000	0.2/0.8	2.950	0.7000	0.590	80	4.1418	1.0000	3.2603	2.9500	9.6180	7.54
9	11:38 AM	22.000	0.2/0.8	2.950	0.8000	2.360	80	2.3759	1.0000	3.2603	2.9500	9.6180	7.54
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.7000	0.580	80	3.4180	1.0000	1.8261	2.9000	5.2572	4.15
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.8000	1.740	80	1.5981	1.0000	1.8261	2.9000	5.2572	4.15
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.8000	2.320	80	0.6904	1.0000	1.8261	2.9000	5.2572	4.15
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.7000	0.564	80	2.7991	1.0000	1.8730	2.8200	5.2817	4.14
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.8000	1.692	80	2.0945	1.0000	1.8730	2.8200	5.2817	4.14
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.8000	2.256	80	0.5017	1.0000	1.8730	2.8200	5.2817	4.14
6	11:22 AM	25.000	0.2/0.6/0.8	2.280	0.7000	0.456	80	2.2495	1.0000	0.7308	2.2800	1.6662	1.31
6	11:22 AM	25.000	0.2/0.6/0.8	2.280	0.8000	1.368	80	0.3733	1.0000	0.7308	2.2800	1.6662	1.31
6	11:22 AM	25.000	0.2/0.6/0.8	2.280	0.8000	1.824	80	-0.0731	1.0000	0.7308	2.2800	1.6662	1.31
5	11:19 AM	26.000	0.6	1.570	0.6000	0.942	80	1.0148	1.0000	1.0148	1.5700	1.5922	1.25
4	11:18 AM	27.000	0.6	1.470	0.6000	0.882	80	2.0948	1.0000	2.0948	1.4700	3.0794	2.41
3	11:16 AM	28.000	0.6	1.330	0.6000	0.798	80	1.1312	1.0000	1.1312	1.3300	1.5045	1.18
2	11:15 AM	29.000	0.6	0.770	0.6000	0.462	80	0.2787	1.0000	0.2787	0.7700	0.2140	0.17
1	11:13 AM	30.000	0.6	0.320	0.6000	0.192	80	-0.0034	1.0000	-0.0034	0.3200	0.0011	0.00
0	11:12 AM	31.000	None	0.000	0.0000	0.000	0	0.0000		-0.0034	0.0000	0.0000	0.00



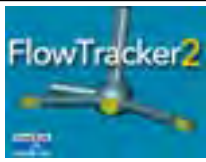
Discharge Measurement Summary

Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings							
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
24	12:21 PM	7.000	0.6	1.070	0.6000	0.642	Standard Error > QC
23	12:19 PM	8.000	0.6	1.300	0.6000	0.780	Standard Error > QC
22	12:18 PM	9.000	0.6	1.420	0.6000	0.852	Standard Error > QC
21	12:17 PM	10.000	0.6	1.470	0.6000	0.882	Standard Error > QC
20	12:15 PM	11.000	0.6	1.610	0.6000	0.966	Standard Error > QC
19	12:13 PM	12.000	0.2/0.8	1.670	0.2000	0.334	Standard Error > QC
19	12:13 PM	12.000	0.2/0.8	1.670	0.8000	1.336	Standard Error > QC
18	12:10 PM	13.000	0.2/0.8	1.670	0.2000	0.334	Standard Error > QC
18	12:10 PM	13.000	0.2/0.8	1.670	0.8000	1.336	Standard Error > QC
17	12:03 PM	14.000	0.2/0.8	1.800	0.2000	0.360	Standard Error > QC
17	12:03 PM	14.000	0.2/0.8	1.800	0.8000	1.440	Standard Error > QC
16	12:00 PM	15.000	0.2/0.8	2.000	0.2000	0.400	Standard Error > QC
16	12:00 PM	15.000	0.2/0.8	2.000	0.8000	1.600	Standard Error > QC
15	11:57 AM	16.000	0.2/0.8	2.100	0.2000	0.420	Standard Error > QC
15	11:57 AM	16.000	0.2/0.8	2.100	0.8000	1.680	Standard Error > QC
14	11:55 AM	17.000	0.2/0.8	2.370	0.2000	0.474	Standard Error > QC
14	11:55 AM	17.000	0.2/0.8	2.370	0.8000	1.896	Standard Error > QC
13	11:51 AM	18.000	0.2/0.8	2.550	0.2000	0.510	Standard Error > QC
13	11:51 AM	18.000	0.2/0.8	2.550	0.8000	2.040	Standard Error > QC
12	11:48 AM	19.000	0.2/0.8	2.780	0.2000	0.556	Standard Error > QC
12	11:48 AM	19.000	0.2/0.8	2.780	0.8000	2.224	Standard Error > QC
11	11:45 AM	20.000	0.2/0.8	2.900	0.2000	0.580	Standard Error > QC
11	11:45 AM	20.000	0.2/0.8	2.900	0.8000	2.320	Standard Error > QC
10	11:41 AM	21.000	0.2/0.8	2.950	0.2000	0.590	Standard Error > QC
10	11:41 AM	21.000	0.2/0.8	2.950	0.8000	2.360	Standard Error > QC
9	11:38 AM	22.000	0.2/0.8	2.950	0.2000	0.590	Standard Error > QC
9	11:38 AM	22.000	0.2/0.8	2.950	0.8000	2.360	Standard Error > QC
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.2000	0.580	Standard Error > QC, Velocity Angle > QC
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.6000	1.740	Standard Error > QC, Velocity Angle > QC
8	11:33 AM	23.000	0.2/0.6/0.8	2.900	0.8000	2.320	Standard Error > QC, Velocity Angle > QC
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.2000	0.564	Standard Error > QC
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.6000	1.692	Standard Error > QC
7	11:27 AM	24.000	0.2/0.6/0.8	2.820	0.8000	2.256	Standard Error > QC
6	11:22 AM	25.000	0.2/0.6/0.8	2.780	0.2000	0.456	Standard Error > QC, Velocity Angle > QC
6	11:22 AM	25.000	0.2/0.6/0.8	2.780	0.6000	1.368	Standard Error > QC, Velocity Angle > QC
6	11:22 AM	25.000	0.2/0.6/0.8	2.780	0.8000	1.824	Standard Error > QC, Velocity Angle > QC
5	11:19 AM	26.000	0.6	1.570	0.6000	0.942	Standard Error > QC, Velocity Angle > QC
4	11:18 AM	27.000	0.6	1.470	0.6000	0.882	Standard Error > QC, Velocity Angle > QC
3	11:16 AM	28.000	0.6	1.330	0.6000	0.798	Standard Error > QC
1	11:13 AM	30.000	0.6	0.320	0.6000	0.192	Boundary Interference, Down Shifts Not Similar, SNR Threshold Violation



Discharge Measurement Summary

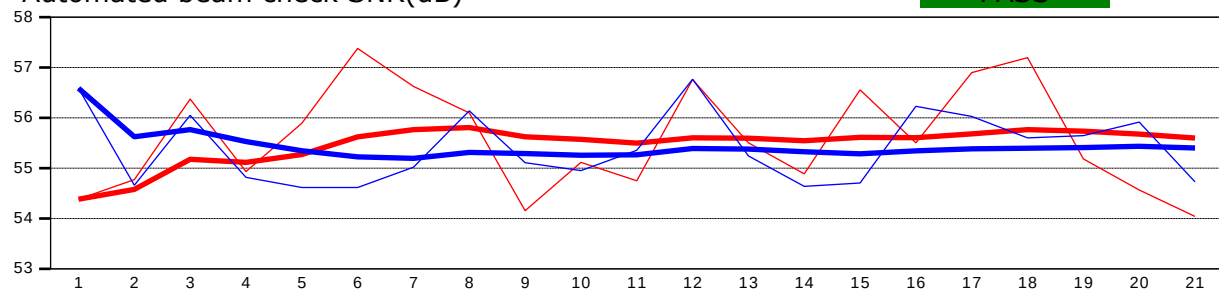
Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/29/2024 11:12:24 AM

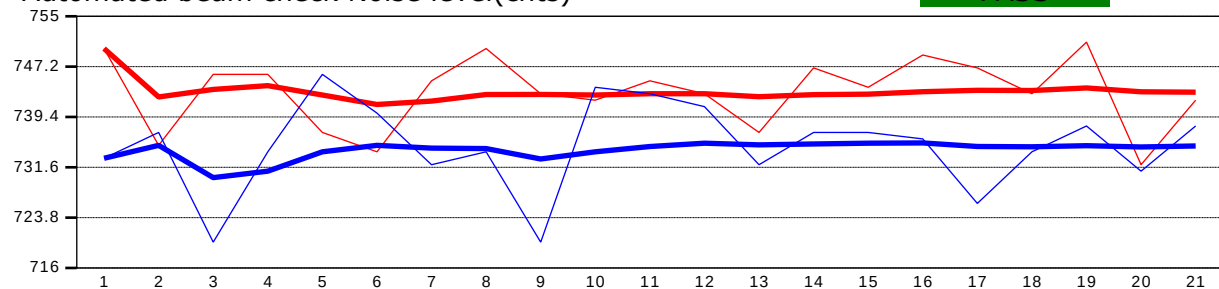
Automated beam check SNR(dB)

PASS



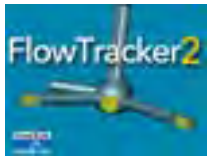
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

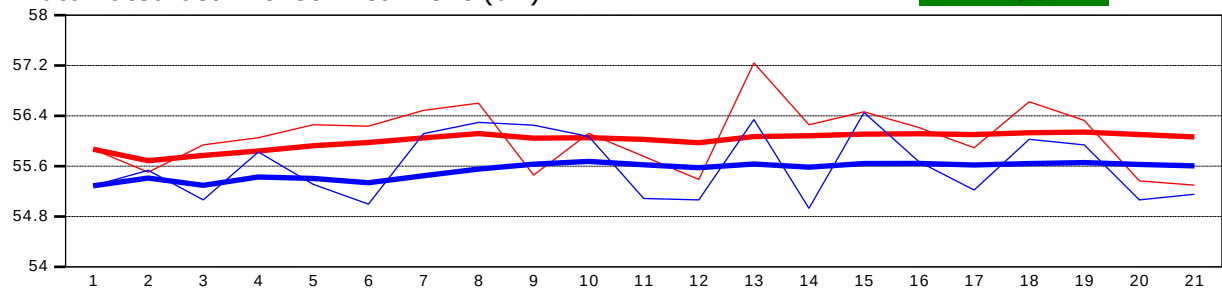
Site name Milk creek
Site number
Operator(s) JMO
File name 20240529_Milk creek.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 5/29/2024 11:12:24 AM

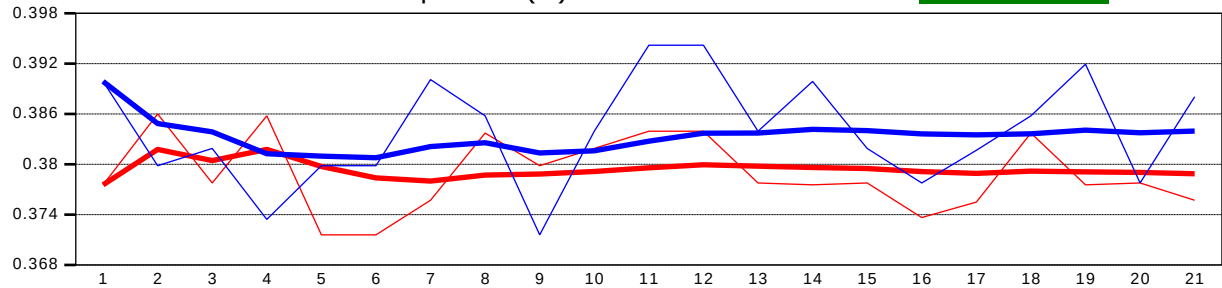
Automated beam check Peak level(dB)

PASS



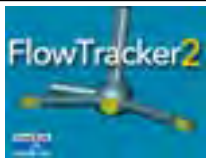
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20240627-151147_Milk Creek near confl with Yampa River.ft
Comment	

Start time	6/27/2024 2:43 PM	Sensor type	Top Setting
End time	6/27/2024 3:06 PM	Handheld serial number	FT2H2322006
Start location latitude	-	Probe serial number	FT2P2319001
Start location longitude	-	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
34	40	13.1319

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
21.100	13.7110	22.497

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
48	0.650	0.9578

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
74.474	1.200	2.0119

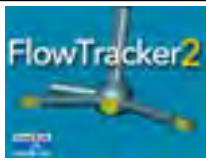
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	4.0%
Velocity	1.6%	9.1%
Width	0.1%	0.1%
Method	1.5%	
# Stations	1.5%	
Overall	2.9%	10.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240627-151147_Milk Creek near confl with Yampa River.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240627-151147_Milk Creek near confl with Yampa River.ft
Comment

Measurement results													
Stn	Time	Location (ft)	Method	Depth (ft)	WDepth	Measured Depth (ft)	Stations	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	MQ ²
33	3:06 PM	2.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.2464	0.0025	0.0018	0.01
32	3:06 PM	3.500	0.6	0.360	0.6000	0.216	20	0.2464	1.0000	0.2464	0.4500	0.1109	0.89
31	3:05 PM	4.500	0.6	0.500	0.6000	0.336	12	0.0326	1.0000	0.0326	0.5600	0.0182	0.14
30	3:04 PM	5.500	0.6	0.800	0.6000	0.480	15	1.1770	1.0000	1.1770	0.6000	0.7062	5.28
29	3:04 PM	6.000	0.6	0.800	0.6000	0.480	12	2.0119	1.0000	2.0119	0.4000	0.8048	6.13
28	3:03 PM	6.500	0.6	0.700	0.6000	0.420	15	1.4000	1.0000	1.4000	0.3500	0.5215	3.97
27	3:03 PM	7.000	0.6	0.600	0.6000	0.360	17	1.4033	1.0000	1.4033	0.3000	0.4210	3.21
26	3:02 PM	7.500	0.6	0.670	0.6000	0.402	19	1.5982	1.0000	1.5982	0.3350	0.5354	4.08
25	3:01 PM	8.000	0.6	0.670	0.6000	0.402	18	1.7074	1.0000	1.7074	0.3350	0.5720	4.36
24	3:01 PM	8.500	0.6	0.400	0.6000	0.240	19	1.8216	1.0000	1.8216	0.2000	0.3643	2.77
23	3:00 PM	9.000	0.6	0.450	0.6000	0.270	30	1.4128	1.0000	1.4128	0.2250	0.3179	2.42
22	2:59 PM	9.500	0.6	1.170	0.6000	0.702	18	0.4258	1.0000	0.4258	0.5850	0.2491	1.90
21	2:58 PM	10.000	0.6	1.200	0.6000	0.720	18	0.7108	1.0000	0.7108	0.6000	0.4265	3.25
20	2:58 PM	10.500	0.6	1.150	0.6000	0.690	19	0.5875	1.0000	0.5875	0.5250	0.3328	2.57
19	2:57 PM	11.000	0.6	1.080	0.6000	0.648	15	0.7240	1.0000	0.7240	0.5400	0.3909	2.98
18	2:57 PM	11.500	0.6	0.840	0.6000	0.504	15	0.7229	1.0000	0.7229	0.4200	0.3036	2.31
17	2:56 PM	12.000	0.6	0.770	0.6000	0.462	26	1.0160	1.0000	1.0160	0.3850	0.3912	2.98
16	2:55 PM	12.500	0.6	1.000	0.6000	0.600	29	0.8542	1.0000	0.8542	0.5000	0.4271	3.25
15	2:55 PM	13.000	0.6	0.700	0.6000	0.420	15	1.5381	1.0000	1.5381	0.3500	0.5384	4.10
14	2:54 PM	13.500	0.6	0.700	0.6000	0.420	29	1.3676	1.0000	1.3676	0.3500	0.4787	3.64
13	2:53 PM	14.000	0.6	0.800	0.6000	0.480	20	1.1376	1.0000	1.1376	0.4000	0.4550	3.47
12	2:53 PM	14.500	0.6	0.500	0.6000	0.300	17	0.8730	1.0000	0.8730	0.2500	0.2185	1.66
11	2:52 PM	15.000	0.6	0.430	0.6000	0.258	20	0.7472	1.0000	0.7472	0.2150	0.1607	1.22
10	2:51 PM	15.500	0.6	1.000	0.6000	0.600	28	0.6611	1.0000	0.6611	0.5000	0.3305	2.52
9	2:50 PM	16.000	0.6	0.800	0.6000	0.480	40	0.9670	1.0000	0.9670	0.4000	0.3868	2.95
8	2:49 PM	16.500	0.6	0.800	0.6000	0.480	15	1.6861	1.0000	1.6861	0.4000	0.6744	5.14
7	2:49 PM	17.000	0.6	0.750	0.6000	0.450	15	1.5636	1.0000	1.5636	0.3750	0.5864	4.47
6	2:48 PM	17.500	0.6	0.700	0.6000	0.420	22	0.6438	1.0000	0.6438	0.3500	0.2253	1.72
5	2:47 PM	18.000	0.6	0.450	0.6000	0.270	19	1.9550	1.0000	1.9550	0.2250	0.4399	3.35
4	2:46 PM	18.500	0.6	0.750	0.6000	0.450	22	0.1810	1.0000	0.1810	0.3750	0.0679	0.52
3	2:45 PM	19.000	0.6	0.830	0.6000	0.498	28	1.4700	1.0000	1.4700	0.6225	0.9154	6.97
2	2:44 PM	20.000	0.6	0.730	0.6000	0.438	23	0.7983	1.0000	0.7983	0.7300	0.5835	4.44
1	2:44 PM	21.000	0.6	0.510	0.6000	0.306	24	0.5396	1.0000	0.5396	0.7900	0.4266	3.25
0	2:43 PM	23.100	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.5296	0.0100	0.0057	0.04



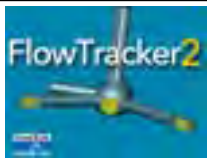
Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240627-151147_Milk Creek near confl with Yampa River.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
32	3:06 PM	3.500	0.6	0.360	0.6000	0.216	Standard Error > QC; Velocity Angle > QC
31	3:05 PM	4.500	0.6	0.560	0.6000	0.336	Standard Error > QC
30	3:04 PM	5.500	0.6	0.800	0.6000	0.480	Standard Error > QC
29	3:04 PM	6.000	0.6	0.800	0.6000	0.480	Standard Error > QC
28	3:03 PM	6.500	0.6	0.700	0.6000	0.420	Standard Error > QC
27	3:03 PM	7.000	0.6	0.600	0.6000	0.360	Standard Error > QC
26	3:02 PM	7.500	0.6	0.670	0.6000	0.402	Standard Error > QC
25	3:01 PM	8.000	0.6	0.670	0.6000	0.402	Standard Error > QC
24	3:01 PM	8.500	0.6	0.400	0.6000	0.240	Standard Error > QC
23	3:00 PM	9.000	0.6	0.450	0.6000	0.270	Standard Error > QC
22	2:59 PM	9.500	0.6	1.170	0.6000	0.702	Standard Error > QC; Velocity Angle > QC
21	2:58 PM	10.000	0.6	1.200	0.6000	0.720	Standard Error > QC; Velocity Angle > QC
20	2:58 PM	10.500	0.6	1.150	0.6000	0.690	Standard Error > QC; High % Spikes; Velocity Angle > QC
19	2:57 PM	11.000	0.6	1.080	0.6000	0.648	Standard Error > QC
18	2:57 PM	11.500	0.6	0.840	0.6000	0.504	Standard Error > QC
17	2:56 PM	12.000	0.6	0.770	0.6000	0.462	Standard Error > QC
16	2:55 PM	12.500	0.6	1.000	0.6000	0.600	Standard Error > QC; Velocity Angle > QC
15	2:55 PM	13.000	0.6	0.700	0.6000	0.420	Standard Error > QC
14	2:54 PM	13.500	0.6	0.700	0.6000	0.420	Standard Error > QC
13	2:53 PM	14.000	0.6	0.800	0.6000	0.480	Standard Error > QC
12	2:53 PM	14.500	0.6	0.500	0.6000	0.300	Standard Error > QC
11	2:52 PM	15.000	0.6	0.430	0.6000	0.258	Standard Error > QC
10	2:51 PM	15.500	0.6	1.000	0.6000	0.600	Standard Error > QC
9	2:50 PM	16.000	0.6	0.800	0.6000	0.480	Standard Error > QC
8	2:49 PM	16.500	0.6	0.800	0.6000	0.480	Standard Error > QC
7	2:49 PM	17.000	0.6	0.750	0.6000	0.450	Standard Error > QC
6	2:48 PM	17.500	0.6	0.700	0.6000	0.420	Standard Error > QC
5	2:47 PM	18.000	0.6	0.450	0.6000	0.270	Standard Error > QC
4	2:46 PM	18.500	0.6	0.750	0.6000	0.450	Standard Error > QC; Velocity Angle > QC
3	2:45 PM	19.000	0.6	0.830	0.6000	0.498	Standard Error > QC
2	2:44 PM	20.000	0.6	0.730	0.6000	0.438	Standard Error > QC
1	2:44 PM	21.000	0.6	0.510	0.6000	0.306	Velocity Angle > QC
0	2:43 PM	23.100	None	0.010	0.0000	0.000	Str Spacing > QC



Discharge Measurement Summary

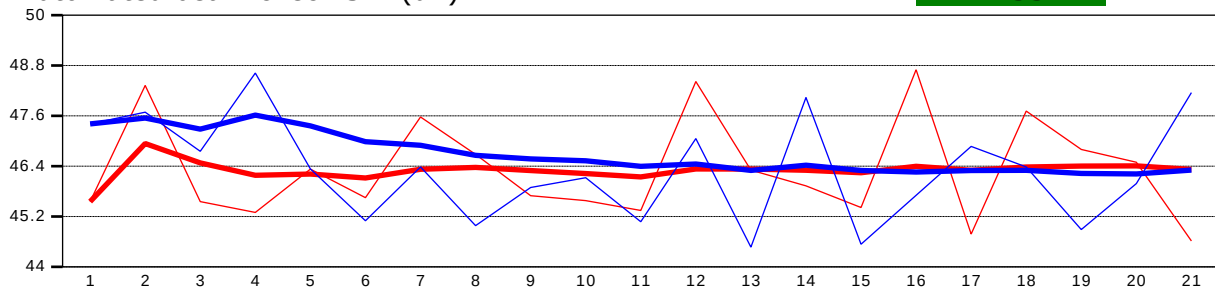
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240627-151147_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 6/27/2024 2:42:58 PM

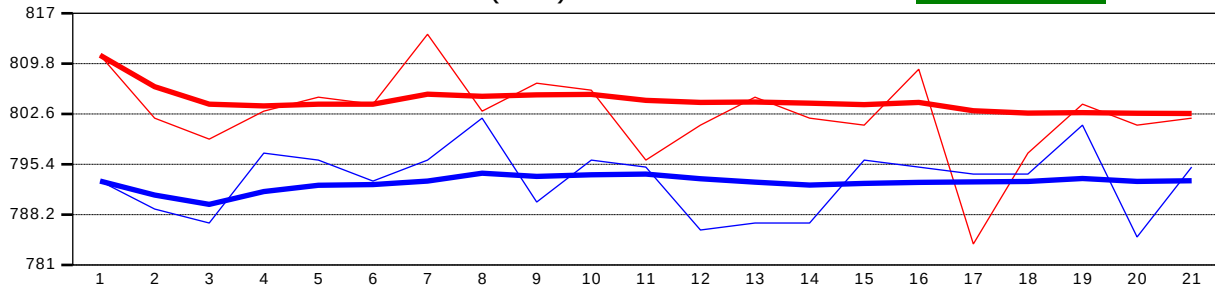
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

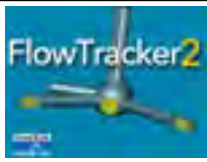
PASS



Automated beam check Quality control warnings

No quality control warnings

6/28/2024 7:34:57 AM



Discharge Measurement Summary

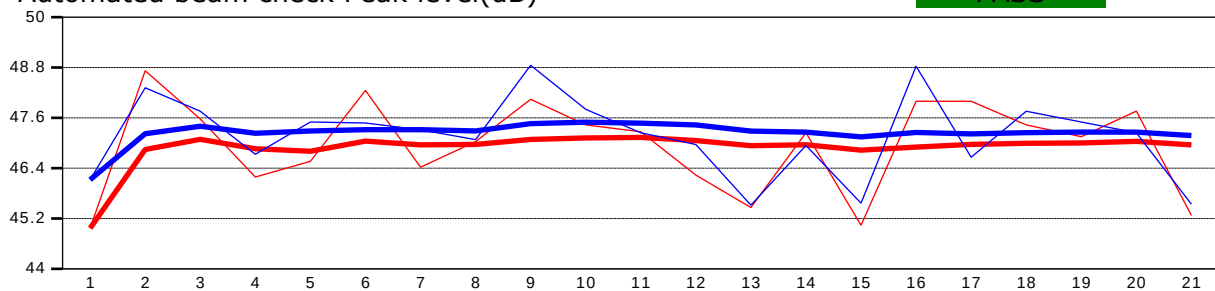
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240627-151147_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 6/27/2024 2:42:58 PM

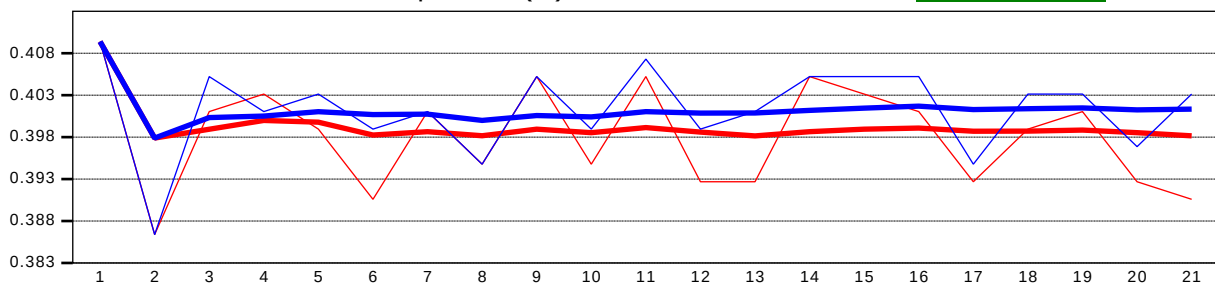
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20240806-101132_Milk Creek near confl with Yampa River.ft
Comment	

Start time	8/6/2024 9:36 AM	Sensor type	Top Setting
End time	8/6/2024 10:02 AM	Handheld serial number	FT2H2322006
Start location latitude	40.386	Probe serial number	FT2P2319001
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
23	40	4.3749

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
14.300	11.3795	14.880

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
42	0.796	0.3845

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
68.581	1.050	0.8262

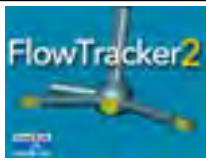
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	3.1%
Velocity	1.1%	7.0%
Width	0.1%	0.1%
Method	2.0%	
# Stations	2.1%	
Overall	3.3%	7.8%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240806-101132_Milk Creek near confl with Yampa River.ft
Comment

Station Warning Settings

Station discharge OK

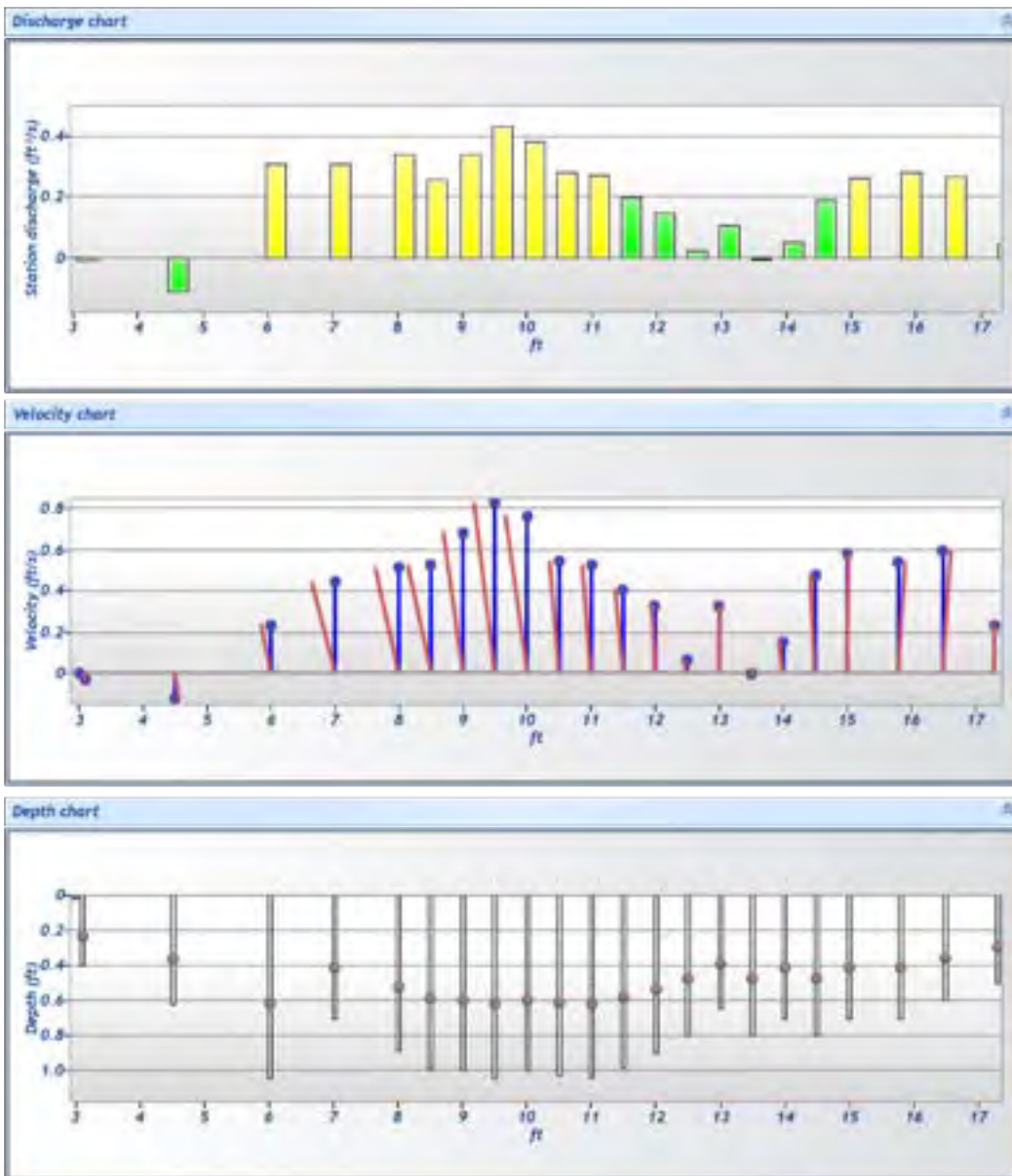
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%

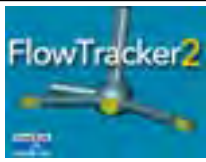




Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20240806-101132_Milk Creek near confl with Yampa River.ft
Comment	

Measurement results													
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
0	9:36 AM	3.000	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0339	0.0005	0.0000	0.00
1	9:36 AM	3.100	0.6	0.400	0.6000	0.240	18	0.0339	1.0000	0.0339	0.3000	-0.0102	0.23
2	9:37 AM	4.500	0.6	0.670	0.6000	0.372	13	0.1216	1.0000	0.1216	0.8990	-0.1088	-2.49
3	9:38 AM	6.000	0.6	1.050	0.6000	0.630	50	0.2348	1.0000	0.2348	1.3125	0.3062	7.04
4	9:45 AM	7.000	0.6	0.700	0.6000	0.420	24	0.4407	1.0000	0.4407	0.7000	0.3085	7.05
5	9:46 AM	8.000	0.6	0.890	0.6000	0.534	27	0.5112	1.0000	0.5112	0.6675	0.3413	7.80
6	9:47 AM	8.500	0.6	0.990	0.6000	0.594	62	0.5240	1.0000	0.5240	0.4950	0.2594	5.93
7	9:48 AM	9.000	0.6	1.000	0.6000	0.600	66	0.6821	1.0000	0.6821	0.5000	0.3411	7.80
8	9:49 AM	9.500	0.6	1.050	0.6000	0.630	40	0.8262	1.0000	0.8262	0.5250	0.4338	9.91
9	9:50 AM	10.000	0.6	1.000	0.6000	0.600	14	0.7622	1.0000	0.7622	0.5000	0.3811	8.71
10	9:51 AM	10.500	0.6	1.030	0.6000	0.618	80	0.5417	1.0000	0.5417	0.5150	0.2790	6.38
11	9:53 AM	11.000	0.6	1.040	0.6000	0.624	46	0.5209	1.0000	0.5209	0.5200	0.2708	6.19
12	9:53 AM	11.500	0.6	0.980	0.6000	0.588	42	0.4002	1.0000	0.4002	0.4900	0.1961	4.68
13	9:54 AM	12.000	0.6	0.990	0.6000	0.590	36	0.3278	1.0000	0.3278	0.4500	0.1475	3.37
14	9:55 AM	12.500	0.6	0.890	0.6000	0.490	16	0.0614	1.0000	0.0614	0.4000	0.0245	0.56
15	9:56 AM	13.000	0.6	0.650	0.6000	0.390	32	0.3257	1.0000	0.3257	0.3250	0.1058	2.42
16	9:57 AM	13.500	0.6	0.800	0.6000	0.480	16	0.0076	1.0000	0.0076	0.4000	0.0030	0.07
17	9:57 AM	14.000	0.6	0.790	0.6000	0.420	44	0.1480	1.0000	0.1480	0.3500	0.0518	1.18
18	9:58 AM	14.500	0.6	0.800	0.6000	0.480	36	0.4771	1.0000	0.4771	0.4000	0.1909	4.36
19	9:59 AM	15.000	0.6	0.790	0.6000	0.420	54	0.5762	1.0000	0.5762	0.4550	0.2622	5.99
20	10:01 AM	15.800	0.6	0.790	0.6000	0.420	44	0.5363	1.0000	0.5363	0.5250	0.2815	6.44
21	10:01 AM	16.500	0.6	0.600	0.6000	0.360	30	0.5941	1.0000	0.5941	0.4500	0.2674	6.11
22	10:02 AM	17.300	0.6	0.590	0.6000	0.300	22	0.2308	1.0000	0.2308	0.2000	0.0462	1.06

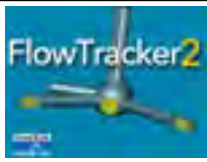


Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20240806-101132_Milk Creek near confl with Yampa River.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
2	9:37 AM	4.500	0.6	0.620	0.6000	0.372	Boundary [Influence], Velocity Angle > QC
3	9:38 AM	6.000	0.6	1.050	0.6000	0.630	Velocity Angle > QC
4	9:45 AM	7.000	0.6	0.700	0.6000	0.420	Velocity Angle > QC
5	9:46 AM	8.000	0.6	0.890	0.6000	0.534	Velocity Angle > QC
6	9:47 AM	8.500	0.6	0.990	0.6000	0.594	Velocity Angle > QC
7	9:48 AM	9.000	0.6	1.000	0.6000	0.600	Velocity Angle > QC
8	9:49 AM	9.500	0.6	1.050	0.6000	0.630	Velocity Angle > QC
9	9:50 AM	10.000	0.6	1.000	0.6000	0.600	Velocity Angle > QC
17	9:57 AM	14.000	0.6	0.700	0.6000	0.420	Velocity Angle > QC



Discharge Measurement Summary

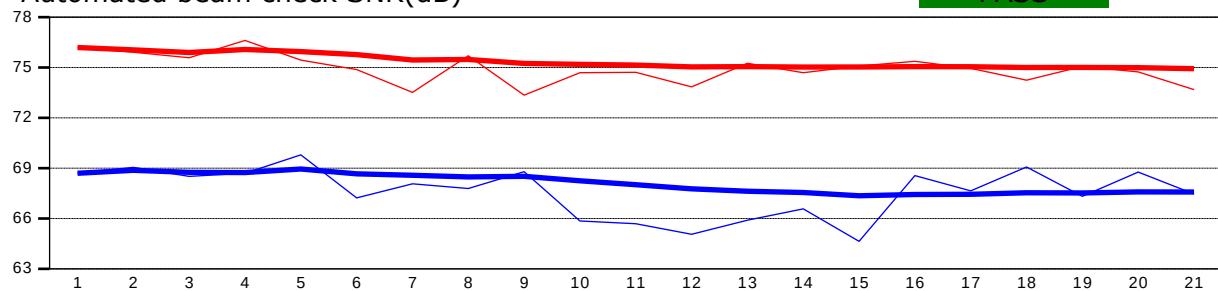
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240806-101132_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/6/2024 9:35:59 AM

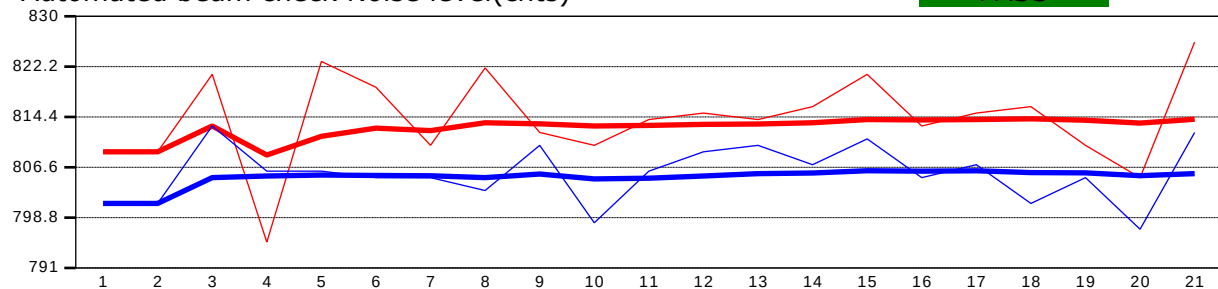
Automated beam check SNR(dB)

PASS



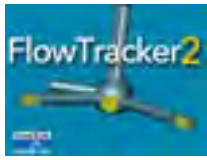
Automated beam check Noise level(cnts)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

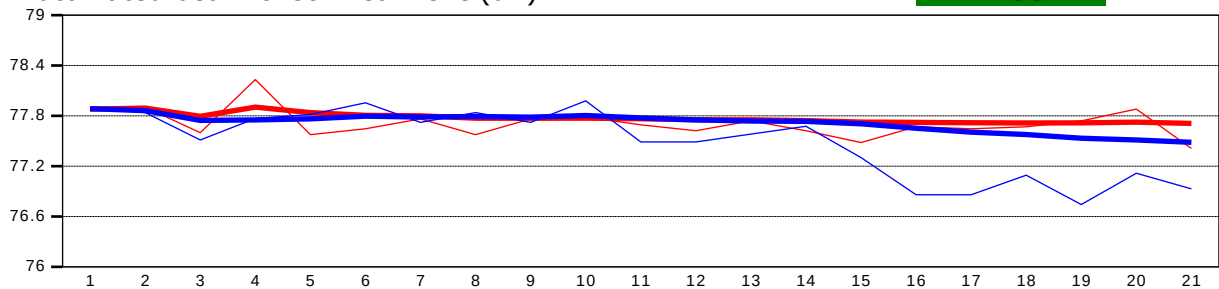
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20240806-101132_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 8/6/2024 9:35:59 AM

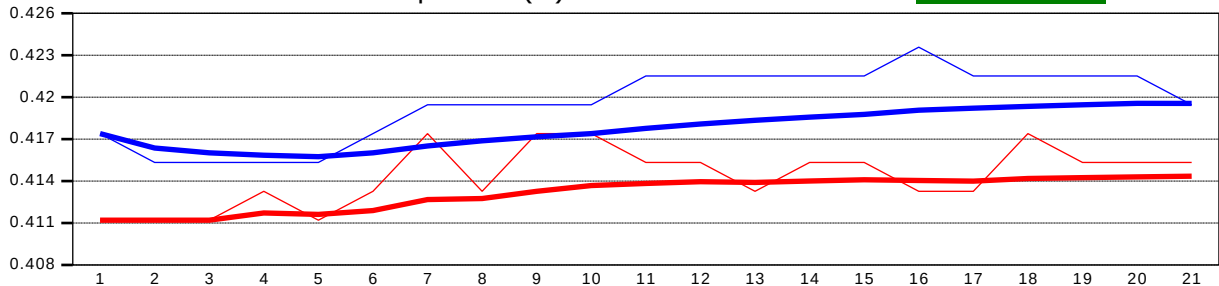
Automated beam check Peak level(dB)

PASS



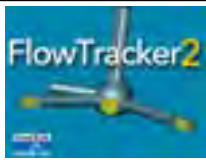
Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20241009-140159_Milk Creek near confl with Yampa River.ft
Comment	

Start time	10/9/2024 1:26 PM	Sensor type	Top Setting
End time	10/9/2024 1:51 PM	Handheld serial number	FT2H2322006
Start location latitude	40.386	Probe serial number	FT2P2319001
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
31	40	2.2650

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
14.400	8.2980	15.031

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
36	0.576	0.2730

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
61.079	0.840	0.5303

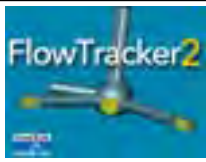
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	3.3%
Velocity	0.9%	3.7%
Width	0.1%	0.1%
Method	1.5%	
# Stations	1.7%	
Overall	2.7%	5.0%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings



Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241009-140159_Milk Creek near confl with Yampa River.ft
Comment

Station Warning Settings

Station discharge OK

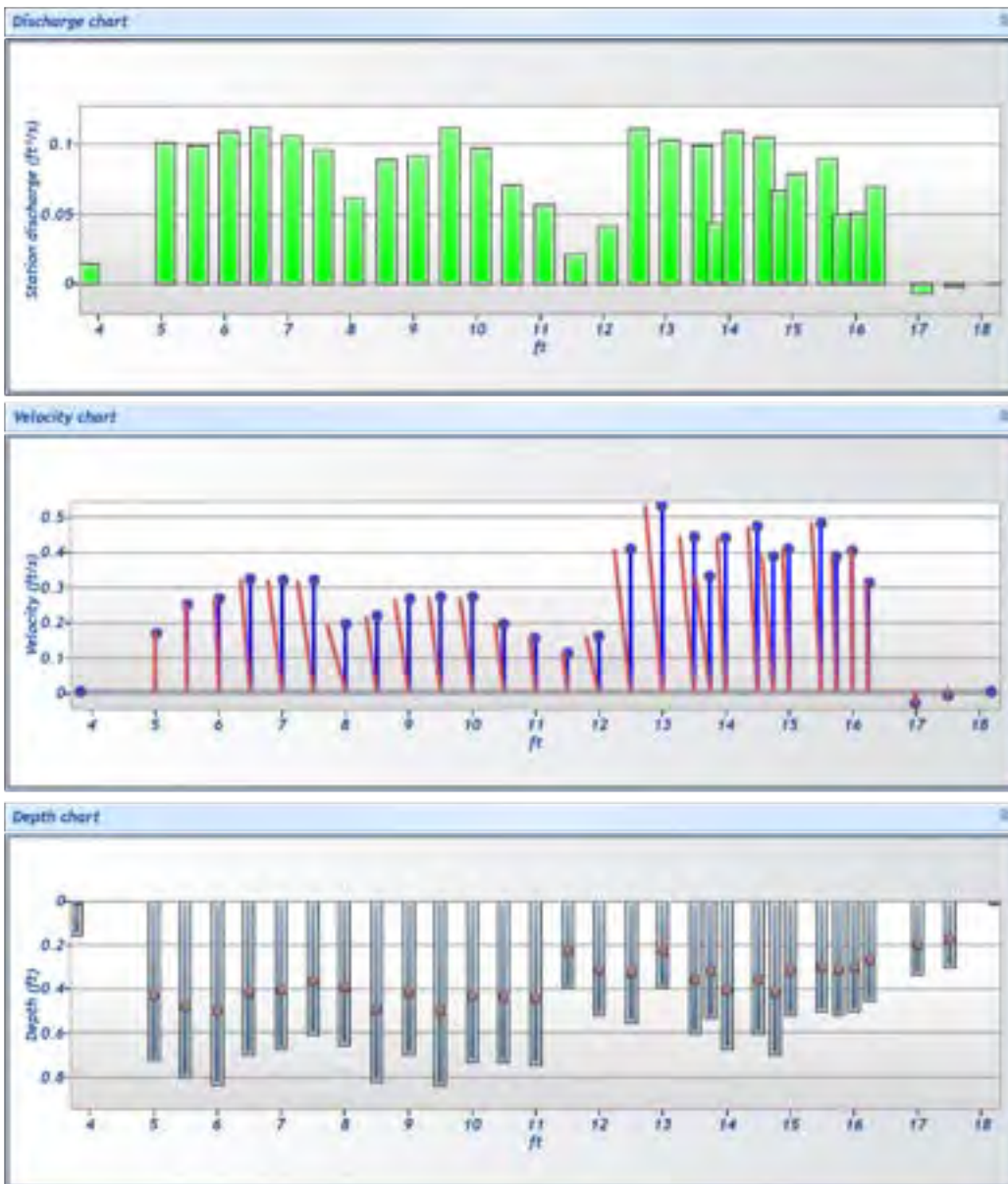
Station discharge < 5.00%

Station discharge caution

5.00% >= Station discharge < 10.00%

Station discharge warning

Station discharge >= 10.00%





Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241009-140159_Milk Creek near confl with Yampa River.ft
Comment

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	WDepth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correcti on	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	WQ
30	1:43 PM	3.800	None	0.150	0.0000	0.000	0	0.0000	1.0000	0.1659	0.0900	0.0149	0.00 ✓
29	1:42 PM	5.000	0.6	0.720	0.6000	0.432	28	0.1659	1.0000	0.1659	0.6120	0.1015	4.48 ✓
28	1:43 PM	5.500	0.6	0.800	0.6000	0.480	17	0.2487	1.0000	0.2487	0.4000	0.0995	4.39 ✓
27	1:41 PM	6.000	0.6	0.830	0.6000	0.498	29	0.2655	1.0000	0.2655	0.4150	0.1102	4.86 ✓
26	1:44 PM	6.500	0.6	0.700	0.6000	0.420	37	0.3212	1.0000	0.3212	0.3500	0.1124	4.96 ✓
25	1:40 PM	7.000	0.6	0.670	0.6000	0.402	33	0.3198	1.0000	0.3198	0.3350	0.1071	4.73 ✓
24	1:45 PM	7.500	0.6	0.610	0.6000	0.366	39	0.3180	1.0000	0.3180	0.3050	0.0970	4.78 ✓
23	1:39 PM	8.000	0.6	0.650	0.6000	0.390	31	0.1925	1.0000	0.1925	0.3250	0.0626	2.76 ✓
22	1:46 PM	8.500	0.6	0.820	0.6000	0.492	29	0.2179	1.0000	0.2179	0.4100	0.0893	3.94 ✓
21	1:38 PM	9.000	0.6	0.700	0.6000	0.420	35	0.2656	1.0000	0.2656	0.3500	0.0930	4.10 ✓
20	1:38 PM	9.500	0.6	0.840	0.6000	0.504	26	0.2694	1.0000	0.2694	0.4200	0.1131	5.00 ✓
19	1:37 PM	10.000	0.6	0.730	0.6000	0.438	26	0.2689	1.0000	0.2689	0.3650	0.0982	4.33 ✓
18	1:36 PM	10.500	0.6	0.730	0.6000	0.438	47	0.1950	1.0000	0.1950	0.3650	0.0715	3.16 ✓
17	1:36 PM	11.000	0.6	0.740	0.6000	0.444	34	0.1555	1.0000	0.1555	0.3200	0.0575	2.54 ✓
16	1:35 PM	11.500	0.6	0.390	0.6000	0.234	20	0.1097	1.0000	0.1097	0.1950	0.0214	0.94 ✓
15	1:34 PM	12.000	0.6	0.520	0.6000	0.312	20	0.1595	1.0000	0.1595	0.2600	0.0415	1.83 ✓
14	1:34 PM	12.500	0.6	0.550	0.6000	0.330	41	0.4060	1.0000	0.4060	0.2750	0.1117	4.93 ✓
13	1:33 PM	13.000	0.6	0.390	0.6000	0.234	27	0.5303	1.0000	0.5303	0.1050	0.1034	4.57 ✓
12	1:32 PM	13.500	0.6	0.600	0.6000	0.360	41	0.4428	1.0000	0.4428	0.2250	0.0996	4.40 ✓
11	1:47 PM	13.750	0.6	0.530	0.6000	0.318	32	0.3318	1.0000	0.3318	0.1325	0.0440	1.94 ✓
10	1:31 PM	14.000	0.6	0.670	0.6000	0.402	31	0.4374	1.0000	0.4374	0.2513	0.1090	4.85 ✓
9	1:30 PM	14.500	0.6	0.600	0.6000	0.360	31	0.4702	1.0000	0.4702	0.2250	0.1058	4.67 ✓
8	1:49 PM	14.750	0.6	0.700	0.6000	0.420	25	0.3859	1.0000	0.3859	0.1750	0.0675	2.98 ✓
7	1:30 PM	15.000	0.6	0.520	0.6000	0.312	28	0.4077	1.0000	0.4077	0.1950	0.0795	3.51 ✓
6	1:29 PM	15.500	0.6	0.500	0.6000	0.300	24	0.4811	1.0000	0.4811	0.1875	0.0902	3.98 ✓
5	1:50 PM	15.750	0.6	0.520	0.6000	0.312	48	0.3873	1.0000	0.3873	0.1300	0.0503	2.22 ✓
4	1:28 PM	16.000	0.6	0.500	0.6000	0.300	27	0.4048	1.0000	0.4048	0.1250	0.0506	2.23 ✓
3	1:51 PM	16.250	0.6	0.450	0.6000	0.270	34	0.3120	1.0000	0.3120	0.2250	0.0702	3.10 ✓
2	1:28 PM	17.000	0.6	0.330	0.6000	0.198	16	-0.0311	1.0000	-0.0311	0.3900	-0.0064	-0.26 ✓
1	1:27 PM	17.500	0.6	0.300	0.6000	0.180	35	0.0111	1.0000	0.0111	0.1800	-0.0020	-0.09 ✓
0	1:26 PM	18.200	None	0.010	0.0000	0.000	0	0.0000	1.0000	0.0111	0.0035	0.0000	0.00 ✓



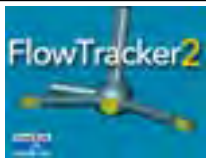
Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241009-140159_Milk Creek near confl with Yampa River.ft
Comment

Quality Control Settings

Maximum depth change 50.00%
Maximum spacing change 100.00%
SNR threshold 10 dB
Standard error threshold 0.0328 ft/s
Spike threshold 10.00%
Maximum velocity angle 20.0 deg
Maximum tilt angle 5.0 deg

Quality control warnings							
Sta#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
27	1:41 PM	6.000	0.6	0.830	0.6000	0.498	Strs Spacing > QC
26	1:44 PM	6.500	0.6	0.700	0.6000	0.420	Velocity Angle > QC
25	1:40 PM	7.000	0.6	0.670	0.6000	0.402	Velocity Angle > QC
24	1:45 PM	7.500	0.6	0.610	0.6000	0.366	Velocity Angle > QC
23	1:39 PM	8.000	0.6	0.650	0.6000	0.390	Velocity Angle > QC
22	1:46 PM	8.500	0.6	0.820	0.6000	0.492	Velocity Angle > QC
21	1:38 PM	9.000	0.6	0.700	0.6000	0.420	Velocity Angle > QC
20	1:38 PM	9.500	0.6	0.840	0.6000	0.504	Velocity Angle > QC
19	1:37 PM	10.000	0.6	0.730	0.6000	0.438	Velocity Angle > QC
18	1:36 PM	10.500	0.6	0.730	0.6000	0.438	Velocity Angle > QC
17	1:36 PM	11.000	0.6	0.740	0.6000	0.444	Velocity Angle > QC
16	1:35 PM	11.500	0.6	0.390	0.6000	0.234	Velocity Angle > QC
15	1:34 PM	12.000	0.6	0.520	0.6000	0.312	Velocity Angle > QC
14	1:34 PM	12.500	0.6	0.550	0.6000	0.330	Standard Error > QC, Velocity Angle > QC
13	1:33 PM	13.000	0.6	0.390	0.6000	0.234	Standard Error > QC, Velocity Angle > QC
12	1:32 PM	13.500	0.6	0.600	0.6000	0.360	Velocity Angle > QC
11	1:47 PM	13.750	0.6	0.530	0.6000	0.318	Velocity Angle > QC
8	1:49 PM	14.750	0.6	0.700	0.6000	0.420	High % Spikes, Velocity Angle > QC
7	1:28 PM	17.000	0.6	0.330	0.6000	0.198	Large SNR Variation, SNR Threshold Variation
1	1:27 PM	17.500	0.6	0.300	0.6000	0.180	SNR Threshold Variation



Discharge Measurement Summary

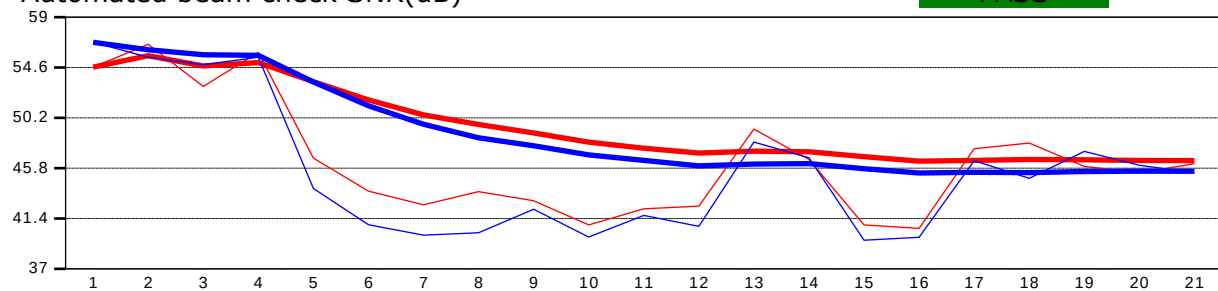
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241009-140159_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 10/9/2024 1:26:23 PM

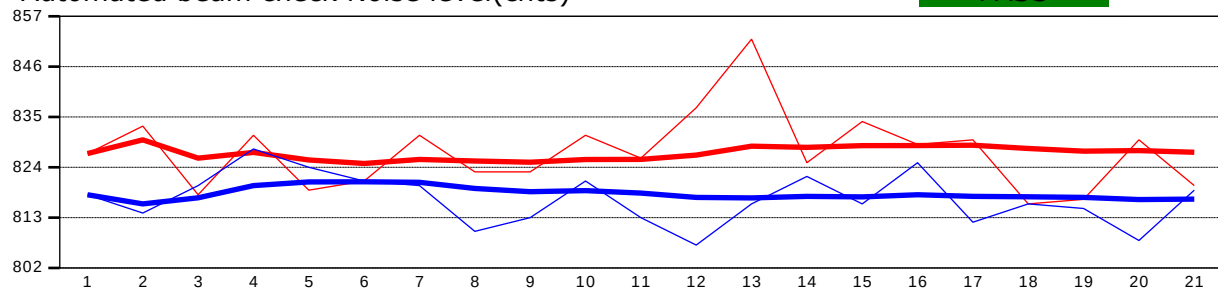
Automated beam check SNR(dB)

PASS



Automated beam check Noise level(cnts)

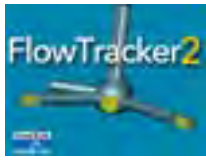
PASS



Automated beam check Quality control warnings

No quality control warnings

10/15/2024 2:57:26 PM



Discharge Measurement Summary

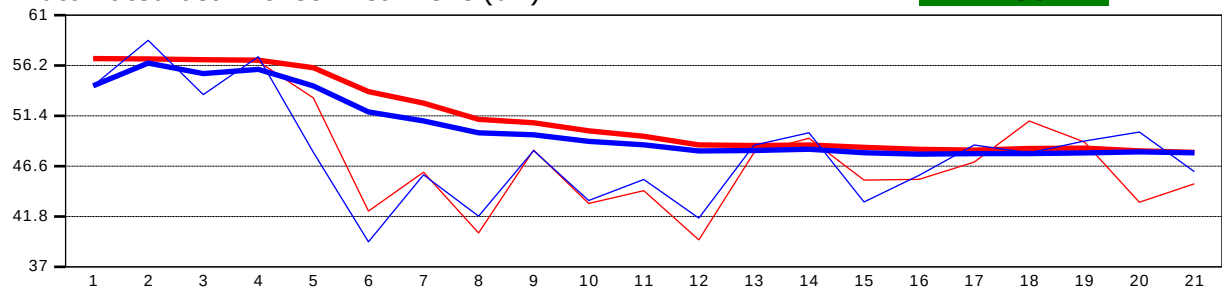
Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241009-140159_Milk Creek near confl with Yampa River.ft
Comment

Beam 1	
Beam 2	

Automated beam check Start time 10/9/2024 1:26:23 PM

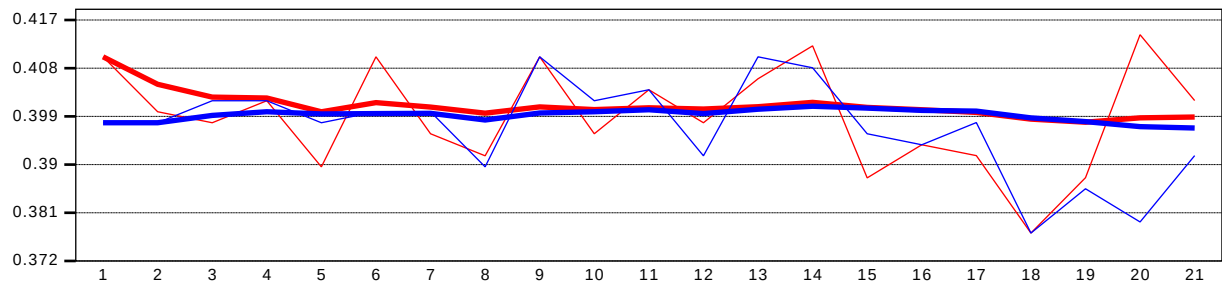
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings

10/15/2024 2:57:26 PM



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20241218-111352_Milk Creek near confl with Yampa River.ft
Comment	

Start time	12/18/2024 10:36 AM	Sensor type	Top Setting
End time	12/18/2024 11:11 AM	Handheld serial number	FT2H2322006
Start location latitude	40.386	Probe serial number	FT2P2319001
Start location longitude	-107.753	Probe firmware	1.30
Calculations engine	FlowTracker2	Handheld software	1.7

# Stations	Avg interval (s)	Total discharge (ft³/s)
28	40	5.3414

Total width (ft)	Total area (ft²)	Wetted Perimeter (ft)
8.700	5.4450	9.387

Mean SNR (dB)	Mean depth (ft)	Mean velocity (ft/s)
35	0.626	0.9810

Mean temp (°F)	Max depth (ft)	Max velocity (ft/s)
32.155	0.980	1.9424

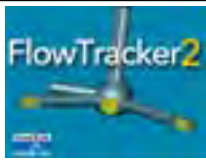
Discharge Uncertainty		
Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.3%	2.9%
Velocity	0.6%	2.2%
Width	0.1%	0.1%
Method	1.6%	
# Stations	1.8%	
Overall	2.7%	3.8%

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Data Collection Settings	
Salinity	0.000 PSS-78
Temperature	-
Sound speed	-
Mounting correction	0.000 %

Summary overview

No changes were made to this file
Quality control warnings

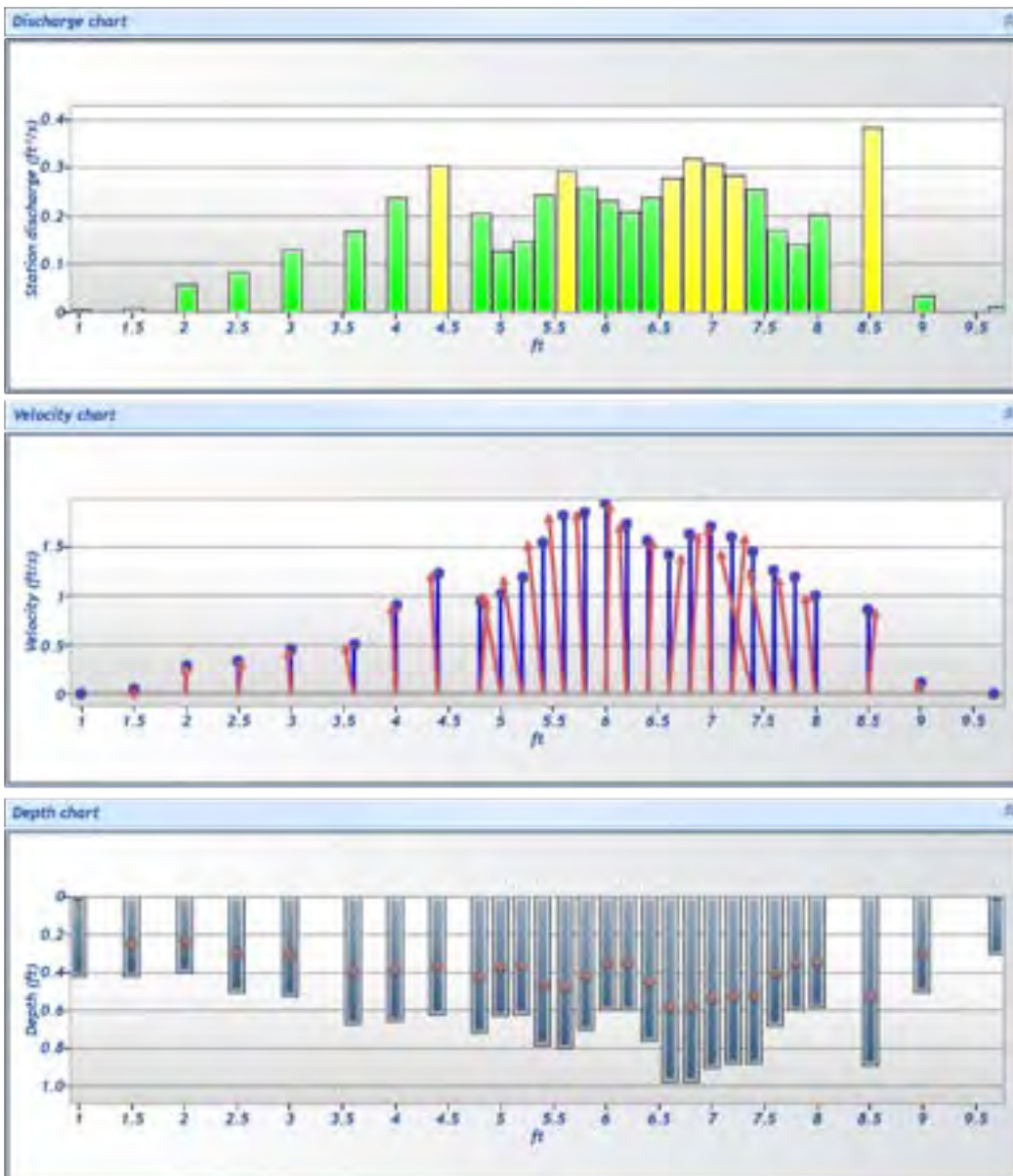


Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241218-111352_Milk Creek near confl with Yampa River.ft
Comment

Station Warning Settings

Station discharge OK	Station discharge < 5.00%
Station discharge caution	5.00% >= Station discharge < 10.00%
Station discharge warning	Station discharge >= 10.00%

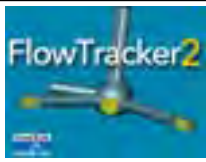




Discharge Measurement Summary

Site name Milk Creek near confl with Yampa River
Site number MILKCRD6
Operator(s) Lfsc
File name 20241218-111352_Milk Creek near confl with Yampa River.ft
Comment

Measurement results													
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Corrected (ft)	Mean Velocity (ft/s)	Area (ft ²)	Flow (ft ³ /s)	%Q
27	11:11 AM	1.000	None	0.420	0.0000	0.000	0	0.0000	1.0000	0.0432	0.1050	0.0045	0.08
26	11:10 AM	1.500	0.6	0.420	0.6000	0.252	89	0.0432	1.0000	0.0432	0.2300	0.0091	0.17
25	11:09 AM	2.000	0.6	0.400	0.6000	0.240	80	0.2885	1.0000	0.2885	0.2000	0.0577	1.08
24	11:07 AM	2.500	0.6	0.500	0.6000	0.300	80	0.3406	1.0000	0.3406	0.2500	0.0852	1.59
23	11:05 AM	3.000	0.6	0.520	0.6000	0.312	80	0.4567	1.0000	0.4567	0.2800	0.1286	2.45
22	11:04 AM	3.600	0.6	0.670	0.6000	0.402	80	0.5616	1.0000	0.5616	0.3350	0.1680	3.15
21	11:02 AM	4.000	0.6	0.660	0.6000	0.396	80	0.9037	1.0000	0.9037	0.2640	0.2386	4.47
20	11:01 AM	4.400	0.6	0.620	0.6000	0.372	80	1.2286	1.0000	1.2286	0.2480	0.3047	5.70
19	10:59 AM	4.800	0.6	0.720	0.6000	0.432	80	0.9462	1.0000	0.9462	0.2160	0.2044	3.83
18	10:58 AM	5.000	0.6	0.630	0.6000	0.378	80	1.0212	1.0000	1.0212	0.1280	0.1287	2.41
17	10:57 AM	5.200	0.6	0.620	0.6000	0.372	80	1.1931	1.0000	1.1931	0.1240	0.1479	2.77
16	10:55 AM	5.400	0.6	0.780	0.6000	0.468	80	1.5516	1.0000	1.5516	0.1560	0.2421	4.53
15	10:54 AM	5.600	0.6	0.800	0.6000	0.480	80	1.8242	1.0000	1.8242	0.1600	0.2919	5.46
14	10:53 AM	5.800	0.6	0.700	0.6000	0.420	80	1.8510	1.0000	1.8510	0.1400	0.2591	4.85
13	10:51 AM	6.000	0.6	0.600	0.6000	0.360	80	1.9424	1.0000	1.9424	0.1200	0.2331	4.36
12	10:50 AM	6.200	0.6	0.600	0.6000	0.360	80	1.7303	1.0000	1.7303	0.1200	0.2076	3.89
11	10:49 AM	6.400	0.6	0.750	0.6000	0.450	80	1.5644	1.0000	1.5644	0.1520	0.2378	4.45
10	10:48 AM	6.600	0.6	0.980	0.6000	0.588	80	1.4145	1.0000	1.4145	0.1960	0.2772	5.19
9	10:46 AM	6.800	0.6	0.980	0.6000	0.588	80	1.6296	1.0000	1.6296	0.1960	0.3194	5.98
8	10:45 AM	7.000	0.6	0.900	0.6000	0.540	80	1.6994	1.0000	1.6994	0.1800	0.3079	5.73
7	10:44 AM	7.200	0.6	0.880	0.6000	0.528	80	1.6102	1.0000	1.6102	0.1760	0.2834	5.31
6	10:43 AM	7.400	0.6	0.880	0.6000	0.528	80	1.4518	1.0000	1.4518	0.1760	0.2555	4.78
5	10:42 AM	7.600	0.6	0.680	0.6000	0.408	80	1.2666	1.0000	1.2666	0.1360	0.1723	3.23
4	10:40 AM	7.800	0.6	0.600	0.6000	0.360	80	1.1907	1.0000	1.1907	0.1200	0.1429	2.67
3	10:39 AM	8.000	0.6	0.580	0.6000	0.348	80	1.0918	1.0000	1.0918	0.2030	0.2034	3.81
2	10:38 AM	8.500	0.6	0.890	0.6000	0.534	80	0.8582	1.0000	0.8582	0.4450	0.3819	7.15
1	10:36 AM	9.000	0.6	0.500	0.6000	0.300	80	0.1200	1.0000	0.1200	0.3000	0.0360	0.67
0	10:36 AM	9.700	None	0.300	0.0000	0.000	0	0.0000	1.0000	0.1200	0.1050	0.0126	0.24



Discharge Measurement Summary

Site name	Milk Creek near confl with Yampa River
Site number	MILKCRD6
Operator(s)	Lfsc
File name	20241218-111352_Milk Creek near confl with Yampa River.ft
Comment	

Quality Control Settings	
Maximum depth change	50.00%
Maximum spacing change	100.00%
SNR threshold	10 dB
Standard error threshold	0.0328 ft/s
Spike threshold	10.00%
Maximum velocity angle	20.0 deg
Maximum tilt angle	5.0 deg

Quality control warnings							
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
21	11:02 AM	4.000	0.6	0.660	0.6000	0.396	Standard Error > QC
16	10:55 AM	5.400	0.6	0.780	0.6000	0.468	Standard Error > QC
14	10:53 AM	5.800	0.6	0.700	0.6000	0.420	Standard Error > QC
13	10:51 AM	6.000	0.6	0.600	0.6000	0.360	Standard Error > QC
10	10:48 AM	6.600	0.6	0.980	0.6000	0.588	Standard Error > QC
9	10:46 AM	6.800	0.6	0.980	0.6000	0.588	Standard Error > QC
8	10:45 AM	7.000	0.6	0.900	0.6000	0.540	Standard Error > QC
7	10:44 AM	7.200	0.6	0.880	0.6000	0.528	Standard Error > QC
6	10:43 AM	7.400	0.6	0.880	0.6000	0.528	Standard Error > QC
5	10:42 AM	7.600	0.6	0.680	0.6000	0.408	Standard Error > QC
4	10:40 AM	7.800	0.6	0.600	0.6000	0.360	Standard Error > QC
3	10:39 AM	8.000	0.6	0.580	0.6000	0.348	Standard Error > QC
1	10:36 AM	9.000	0.6	0.500	0.6000	0.300	SNR Threshold Violation



1313 Sherman Street, Room 718
Denver, CO 80203

Milk Creek Temporary Streamgage

Location: 13N 266317 4474205

Installation Date: July 13, 2017

Equipment: Onset HOBO MX2001 water level logger, staff gage, and trail camera.

Description: The streamgage consists of a datalogger and a pressure transducer protected in a 2 inch width PVC pipe, secured to the bank with fence post. The pressure transducer measured water level and temperature on a 15 minute intervals in a pool formed by boulders at the top of a riffle. A co-located staff gage and reference marks were used to calibrate the water level measured by the pressure transducer. A trail camera was used to document conditions at the gage site, such as ice.





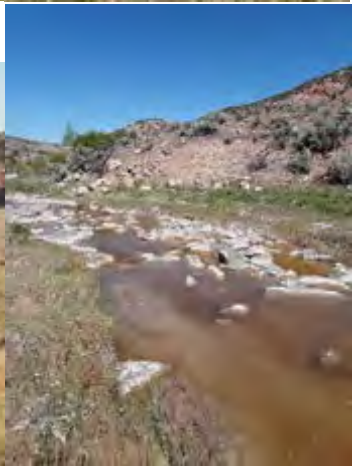




























10 Y 3 01-13-2023 10:08:10



10 Y 3 01-01-2023 02:00:20



10 Y 3 03-14-2023 07:23:40



10 Y 3 01-13-2023 11:00:33



10 Y 3 04-10-2023 12:11:57



10 Y 3 12-21-2023 07:00:40







**Proposed Habitat Suitability Criteria for Flannemouth Sucker and Bluehead
Sucker for use in Milk Creek Instream Flow Study**

Submitted to:

**Colorado Water Conservation Board
Denver, Colorado**

Submitted By:

**William J. Miller, PhD
Miller Ecological Consultants, Inc.
2404 Thoroughbred Ln.
Bozeman, Montana**

January 26, 2024

Introduction

This report describes the process used to select and recommend the habitat suitability criteria for the species of interest in the Milk Creek Instream Flow study. The species of interest for this study are Flannemouth Sucker (*Catostomas latipinnis*) and Bluehead Sucker (*Catostomas discobolus*). One dimensional hydraulic models such as Physical Habitat Simulation System (PHABSIM) and System for Environmental Flow Analysis (SEFA) use univariate habitat suitability criteria in the computer modeling. These habitat suitability criteria are expressed as a suitability index value (SI) for each physical flow component of water depth, water velocity, and channel index (substrate or cover). The terms habitat suitability criteria, suitability curves, or suitability indices are used interchangeably with the same meaning. The suitability criteria in this report were developed using available field data, literature review and professional judgement following guidelines in Bovee (1986).

Habitat Suitability Curves

Species habitat suitability criteria are required for the one-dimensional habitat analysis. Habitat suitability criteria that accurately reflect the habitat requirements of the species of interest are essential to conducting meaningful and defensible habitat analyses. The curves proposed for this study fit that criterion. The preferred approach is to collect new data to develop site-specific criteria for each species and life stage of interest (Bovee 1986), however, this is not always practical due to site specific and logistic factors. Habitat suitability indices for use in instream flow studies require point location data for water depths, velocities, substrates, and cover types used by each life stage of the target species. The collection of new site-specific or stream specific data is not always feasible due to lack of species presence and time constraints of the study. An alternative approach which follows IFIM guidelines is the use existing curves, data from other studies and literature to develop suitability criteria for species of interest. This study used the alternative approach.

The majority of the existing habitat suitability criteria for use in instream flow studies are for game species. There are limited existing habitat suitability criteria for the two non-game native species of interest for this study, Flannemouth Sucker and Bluehead Sucker. There is one habitat suitability curve set for Flannemouth Sucker in the older “FISHFIL” data from USFWS PHABSIM archives. The FISHFIL suitability curve library was a compilation of multiple species and life stages developed in the late 1970s and early 1980s by the USFWS. The source of the data used for the curve set is not stated and based on the data range in the graphs of the Flannemouth Sucker SI curve set it appears to be from a smaller stream.

Habitat specific data for adult Flannemouth Sucker and adult Bluehead Sucker were collected during studies on the Colorado River in the early 2000s (Beyers et al. 2001, Rees and Miller 2001). The study sites for those two investigations were on the Colorado River near Grand Junction, Colorado where habitat features including depths and velocities exceed those in Milk Creek. A summary of depth and velocity use data for

native species, including Flannemouth Sucker and Bluehead Sucker was completed in 2023 (Lewis and Kanno 2023). The summary synthesized the findings from multiple publications and reports for studies on range of streams and rivers and provided the range and mean depth and velocities from those studies, however, no individual data sets were included. Miller et al. (1995) collected data from the La Plata River on habitat characteristics for depth by habitat with concurrent fish captures. Bower et al. (2008) collected fish capture data by habitat, which included water depths of the habitats. Underwood et al. (2014) tested swimming capabilities of Bluehead Suckers and Flannemouth Suckers at a range of velocities. Stewart and Anderson (2009) completed fish population estimates in conjunction with two-dimensional hydraulic modeling to predict biomass based on stream hydraulic parameters of depth and velocity. All of the above reports and data sets were reviewed and synthesized into the habitat suitability criteria proposed for the Milk Creek instream flow study.

Depth Habitat Use Criteria

Depth habitat use is similar for the larger summary data set and the site specific data as shown in the graph comparing Lewis and Kanno (2023) summary and the site specific Colorado River data (Figure 1). Additional studies by Stewart and Anderson (2009) and Yao and Chen (2018) also report habitat use for adult Flannemouth Sucker.

Flannemouth Sucker and Bluehead Sucker general show use of similar water depths. Maximum water depths were reported approximately 6 feet deep and deeper. Byers et al. (2001) reported use of depths greater than 10 feet. Minimum water depths were reported as approximately 0.5 feet. Mean water depths ranged from approximately 2.5 to 3.5 feet deep. One distinct difference is the minimum depth and mean depth reported for Bluehead Sucker in the Colorado River data set. These differences are likely due to the very low number of observations (11) for Bluehead Sucker compared to the higher number of observations (134) for Flannemouth Sucker. Histogram of depth data shows that the Bluehead Sucker data is nested within the Flannemouth Sucker data set, which indicates the use of similar depths for these species (Figure 2).

Physical characteristics of La Plata River habitats were measures during July, 1994 concurrent with fish captures. The data were collected for use in the native fish study for the Animas-La Plata EIS (Miller et al. 1995). Reaches 2-4 are located from the Colorado-New Mexico state line upstream to Cherry Creek, approximately 15 miles. Average depths for riffles and glides range from 0.6 feet to approximately 1.2 feet (Table 1). Average pool depths range from 1.4 feet to 1.9 feet. Maximum pool depths were approximately 4.5 feet. The fish collections show that majority of the captures for Bluehead and Flannemouth suckers were in riffles and glides followed by pools (Table 2).

Depth SI was constructed from the Colorado River data using the non-parametric tolerance method as outlined in Bovee (1986). The SI values range from 0.0 (unusable) to 1.0 (highest used). The SI is a two tailed index with the peak values occurring between 3 feet and 4 feet deep (Figure 3). The FISHFIL SI for adult Flannemouth

Sucker shows a minimum usable depth of approximately 0.5 feet and peak SI values for depths that range from approximately 1 foot to 1.3 feet deep (Figure 4). The La Plata River data reported by Miller et al. (1995) confirms the use of this range of depth values for the FISHFIL curve

These two individual depth SI curves include use for both shallow and deeper stream conditions. The data from Lewis and Kanno (2023) includes data for depths over a wide range of stream conditions from large rivers to smaller streams. Data for pool depths by Bower et al. (2008) included depths of 6 feet concurrent with captures of native suckers. Depth data from Beyers et al. (2001) show habitat use at depths greater than 10 feet. Stewart and Anderson (2009) report depths greater than 6 feet as usable habitat. It seems appropriate that a Suitability Index should include the full range of observed conditions. As such the recommended SI for depth is a combined function that uses the SI values from the USFWS criteria for the shallower depths and the Colorado River site specific criteria for the deeper conditions (Figure 5) as supported by the additional field data from Bower et al (2008) and Miller et al. (1995).

Velocity Habitat Use Criteria

Flannemouth Sucker and Bluehead Sucker have more variability in velocity use than depth use (Figure 6). Lewis and Kanno (2023) report the velocity use from a minimum of near 0.4 fps to a maximum of just over 3.0 fps. Underwood et al. (2014) reported maximum sustained swimming speeds for Bluehead Sucker and Flannemouth Sucker adults near 3.5 feet per second. Colorado River velocity observations for these two species ranged from -0.1 fps to 4.5 fps. Stewart and Anderson (2009) reported use of velocities between 0.3 fps and 5.8 fps. Peak habitat use was reported between 1.5 fps and 4.5 fps. Average velocity use was less variable when comparing the summarized data of Lewis and Kanno with the site-specific data from the Colorado River. Again, the largest difference was the site specific Bluehead Sucker data from the Colorado River and likely due to the small observation data set.

The site-specific velocity data for Flannemouth Sucker and Bluehead Sucker shows that habitat use for Bluehead Sucker is nested within the Flannemouth Sucker data (Figure 7). Since the data for Bluehead Sucker are within the bounds of the Flannemouth sucker data, it seems reasonable to combine the data sets. Further, it also is reasonable to construct the velocity suitability index from the entire data set and apply the resulting SI to both species.

The velocity suitability index for the site-specific Colorado River data has a minimum SI value at 0.0 fps. The peak SI values occur between 2.0 fps and 2.5 fps (Figure 8). The FISHFIL velocity SI values are shifted to slower velocities than the Colorado River data (Figure 9). This shift is likely due to collection of the data from smaller streams rather than large rivers, however, there is no documentation to confirm this hypothesis.

The use of the broader range for velocity conditions is shown in the data summary from Lewis and Kanno (2023) and the site-specific Colorado River data. To use the full range

of velocity conditions a combined SI curve was constructed by merging the two SI curves from the USFWS and the Colorado River (Figure 10).

Channel Index Habitat Use Criteria

The channel index criteria can represent either stream substrate or cover. In this application the channel index represents substrate. There is less data for stream substrate use than available for depth and velocity. Lewis and Kanno (2023) did not summarize stream substrate use in a quantitative format. They did include statements in the report narrative that suggests most used substrate is “rocky” with some mention of other substrate types. This implies that anything from clean gravel to cobble is used by these two species. The most used substrate for the Colorado River data set was cobble with fewer observations in other substrate types (Figure 11). The USFWS channel index criteria shows all substrate as suitable (Figure 12). Bottcher (2009) reports gravel and small cobble as the most used substrate with lower use of other substrate types (Figure 13). The recommended substrate index is to have maximum index value for gravel and cobble with lower suitability of other substrate types (Figure 14).

Recommended Adult Suitability Indices

There are limited number of studies that document habitat use for either Flannemouth Sucker or Bluehead Sucker. There is more quantitative data for Flannemouth Sucker but it is limited to the adult life stage and from a large river. The data that is available for Bluehead Sucker falls within the boundaries of the habitat use by Flannemouth Sucker. It seems reasonable to combine the data sets and use a single Suitability Index Criteria for both species. Based on the data and reports available, the SI curves recommended for the Milk Creek Instream Flow study are the combined SI curve for depth (Figure 5), the combined SI curve for velocity (Figure 10), and the field data observations SI for substrate (Figure 14). The data points for these SI curves are listed in Table 1.

Spawning Suitability Indices

There are no studies that directly measured habitat use during spawning for either species. Several studies report the use of smaller tributaries in the Colorado River Basin during spawning (Hooley-Underwood et al. 2019; Cathcart et al. 2015). Life history studies of these two species report spawning in riffle habitat over clean gravel or cobble substrate during the ascending limb and peak runoff, generally in late March through May. The use of this type of habitat is confirmed by population abundance sampling (Ryden 2005).

The recommended spawning SI curves are modifications to the adult SI curves based on literature review and knowledge of habitat use during spawning. Depth SI curve is a modification to the adult depth criteria that has peak suitability between 1 foot and 1.5 foot of water depth (Figure 15). This depth range provides adequate depth for fish movement in riffle habitat during spawning activities.

The velocity SI curve for spawning also is a modification of the adult velocity curve. The peak SI values are in the velocity range of 1 fps to 2.5 fps (Figure 16). These values are typical of velocities found in riffle habitat during moderate flows associated with the seasonality of spawning.

Flannemouth sucker and Bluehead Suckers are broadcast spawners. The demersal eggs sink to the stream bottom and into the clean stream substrate for incubation and emergence. This life history trait requires a clean substrate with adequate interstitial space to allow the eggs fall into the substrate (Rees et al. 2005; Ptacek et al. 2005). The proposed spawning substrate SI curve reflects this requirement by limiting the suitable substrate to gravel and cobble (Figure 17).

The recommended spawning SI curve values are listed in tabular form for use in the instream flow study (Table 4).

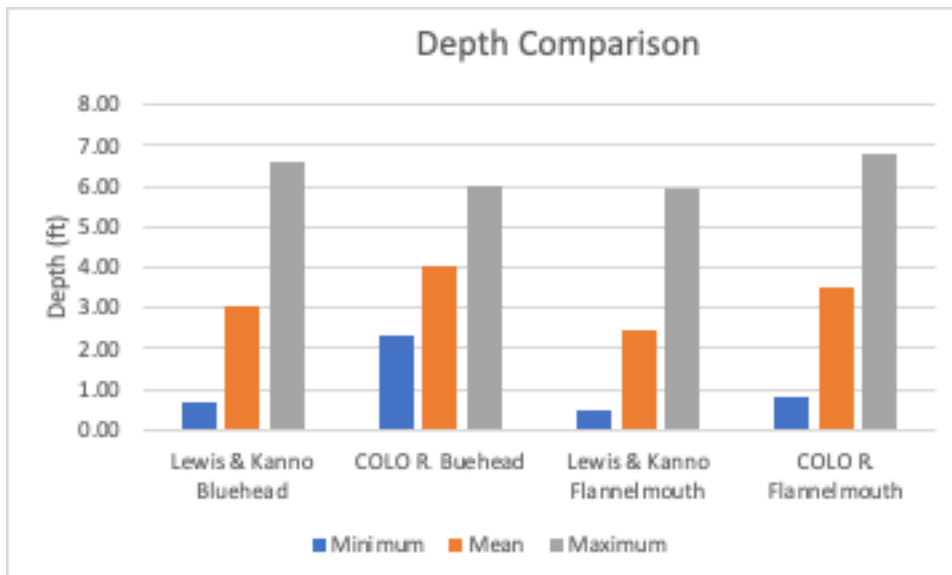


Figure 1. Comparison of depths used by Flannemouth Sucker and Bluehead Sucker.

Table 1. Habitat measurements for La Plata River, July 1994

LA PLATA - REACH 2					summer 94				
#									
POOL	RIFFLE	GLIDE	REACH TOTAL	POOL	RIFFLE	GLIDE	REACH TOTAL		
TOTAL LENGTH OF HABITAT (ft.)	754.0	1227.0	1277.0	3258.0	TOTAL AREA OF HABITAT (sq. ft.)	14196.0	23427.0	19725.0	57348.0
AVERAGE WIDTH OF HABITAT (ft.)	20.6	18.9	15.6	18.4	% OF TOTAL NUM. OF HABITATS	30.8	33.3	35.9	100.0
AVERAGE RESIDUAL DEPTH (ft.)	2.4	0.0	0.0	2.4	HABITAT TYPE	24.8	40.9	34.4	100.0
AVERAGE DEPTH (ft.)	1.9	0.6	1.0	1.9	AS A % OF TOTAL AREA				

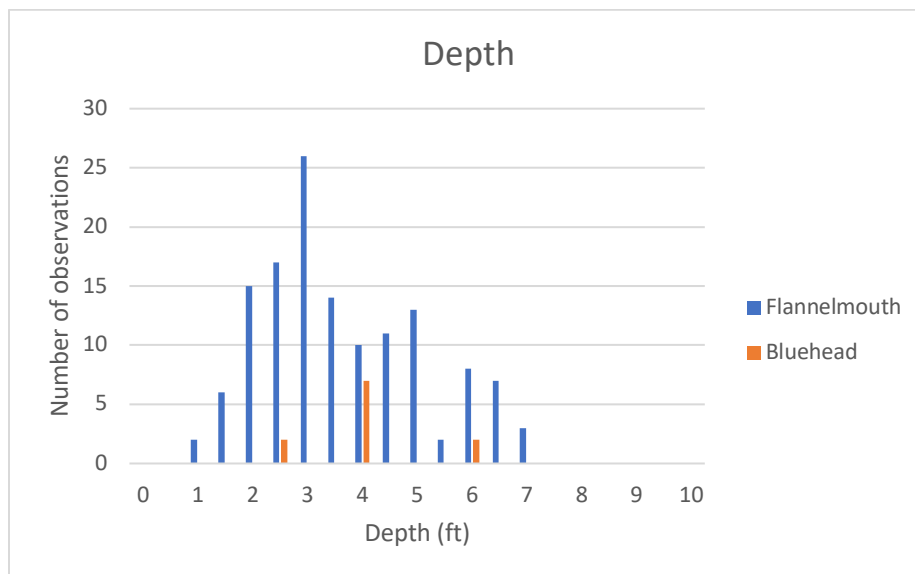
LA PLATA - REACH 3					summer 94				
#									
POOL	RIFFLE	GLIDE	REACH TOTAL	POOL	RIFFLE	GLIDE	REACH TOTAL		
TOTAL LENGTH OF HABITAT (ft.)	2663.00	2522.00	2643.00	7828.00	TOTAL AREA OF HABITAT (sq. ft.)	38912.0	36519.0	34041.0	109472.0
AVERAGE WIDTH OF HABITAT (ft.)	14.12	14.04	13.21	13.79	% OF TOTAL NUM. OF HABITATS	37.6	36.7	25.7	100.0
AVERAGE RESIDUAL DEPTH (ft.)	3.30	0.00	0.00	3.30	HABITAT TYPE	35.5	33.4	31.1	100.0
AVERAGE DEPTH (ft.)	1.88	0.57	1.17	1.88	AS A % OF TOTAL AREA				

LA PLATA - REACH 4					summer 94				
##									
POOL	RIFFLE	GLIDE	REACH TOTAL	POOL	RIFFLE	GLIDE	REACH TOTAL		
TOTAL LENGTH OF HABITAT (ft.)	245.00	524.00	485.00	1254.00	TOTAL AREA OF HABITAT (sq. ft.)	4421.0	9349.0	7526.0	21296.0
AVERAGE WIDTH OF HABITAT (ft.)	17.75	17.00	14.80	16.52	% OF TOTAL NUM. OF HABITATS	28.6	35.7	35.7	100.0
AVERAGE RESIDUAL DEPTH (ft.)	1.80	0.00	0.00	1.80	HABITAT TYPE	20.8	43.9	35.3	100.0
AVERAGE DEPTH (ft.)	1.40	0.78	1.06	1.40	AS A % OF TOTAL AREA				

Table 2. Fish capture by habitat type, La Plata River July 1994.

Number of fish captured	Habitat type				
Species	Glide	Glide/Riffle	Pool	Riffle	Grand Total
Bluehead Sucker	686	0	568	219	1473
Flannemouth Sucker	1685	4	1443	226	3358
Mottled Sculpin	28	0	12	8	48
Roundtail Chub	26	1	114	0	141
Speckled Dace	3869	62	1902	5873	11706
Grand Total	6294	67	4039	6326	16726

Percent capture by habitat	Habitat type				
Species	Glide	Glide/Riffle	Pool	Riffle	Grand Total
Bluehead Sucker	46.6	0.0	38.6	14.9	100.0
Flannemouth Sucker	50.2	0.1	43.0	6.7	100.0
Mottled Sculpin	58.3	0.0	25.0	16.7	100.0
Roundtail Chub	18.4	0.7	80.9	0.0	100.0
Speckled Dace	33.1	0.5	16.2	50.2	100.0
Grand Total	37.6	0.4	24.1	37.8	100.0

**Figure 2. Colorado River depth data for Flannemouth Sucker and Bluehead Sucker. Source: Beyers et al. 2001 and Rees and Miller 2001.**

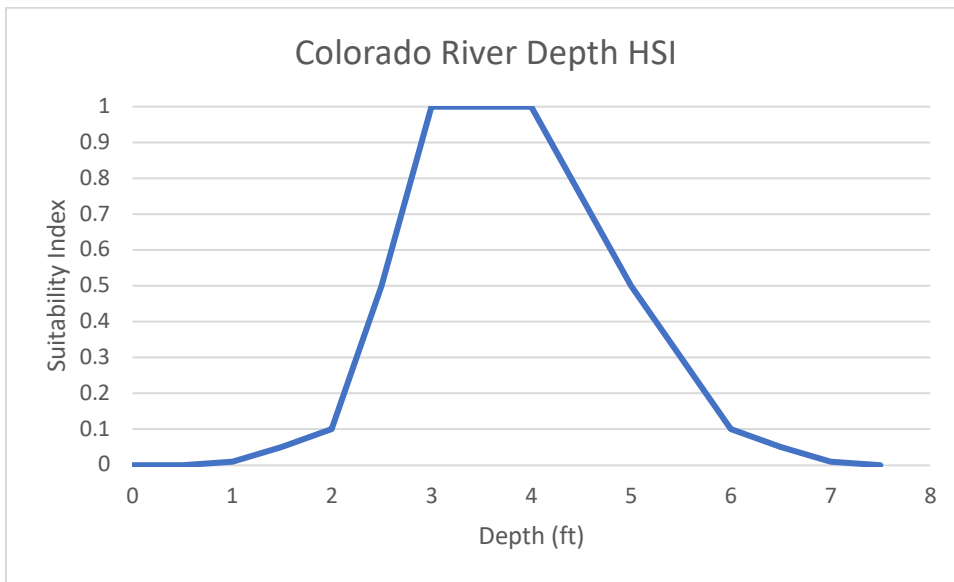


Figure 3. Depth Suitability Index for combined data set from Flannemouth Sucker and Bluehead Sucker depth observations.

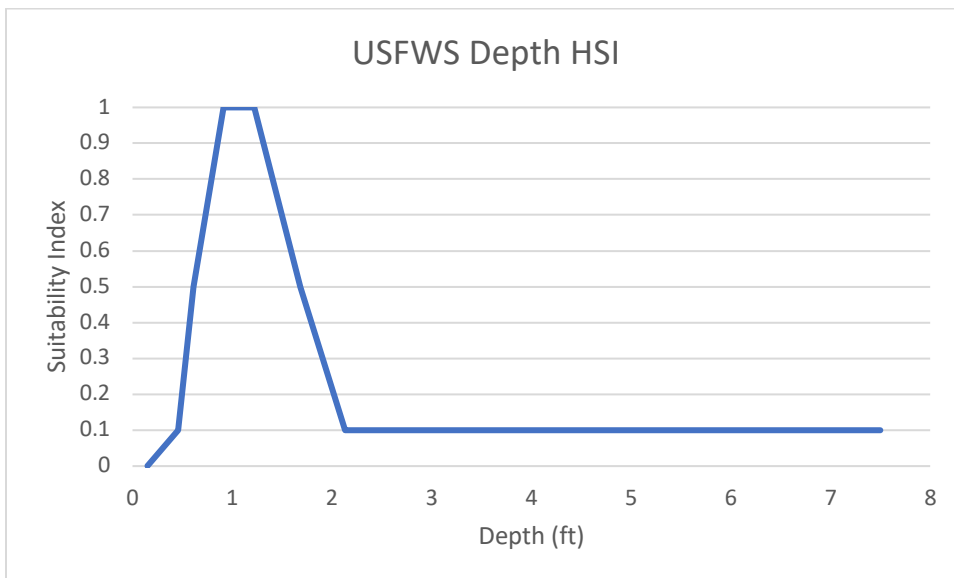


Figure 4. Depth Suitability Index for adult Flannemouth Sucker from USFWS "FISHFIL".

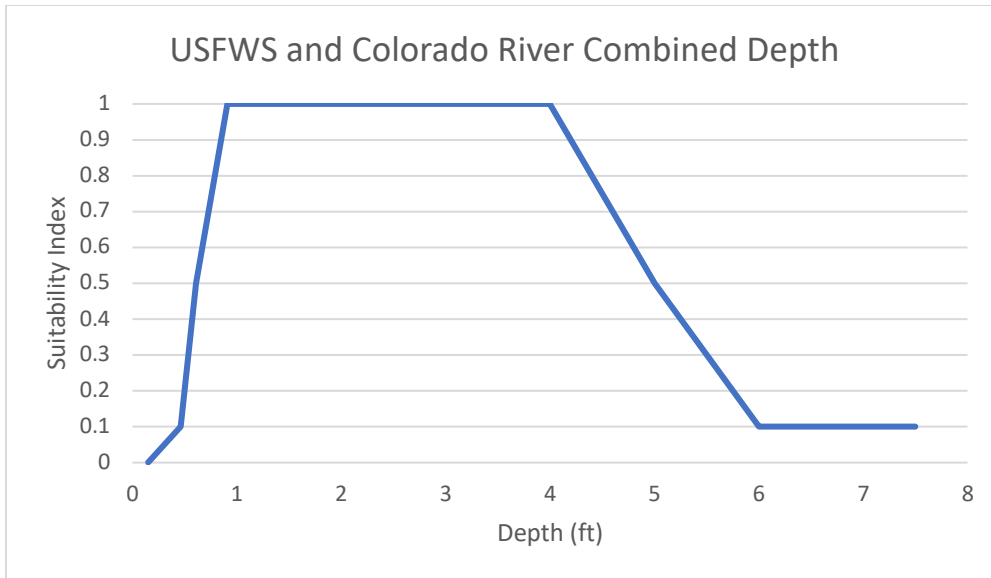


Figure 5. Depth Suitability Index for combined values from Colorado River depth SI and USFWS FISHFIL SI.

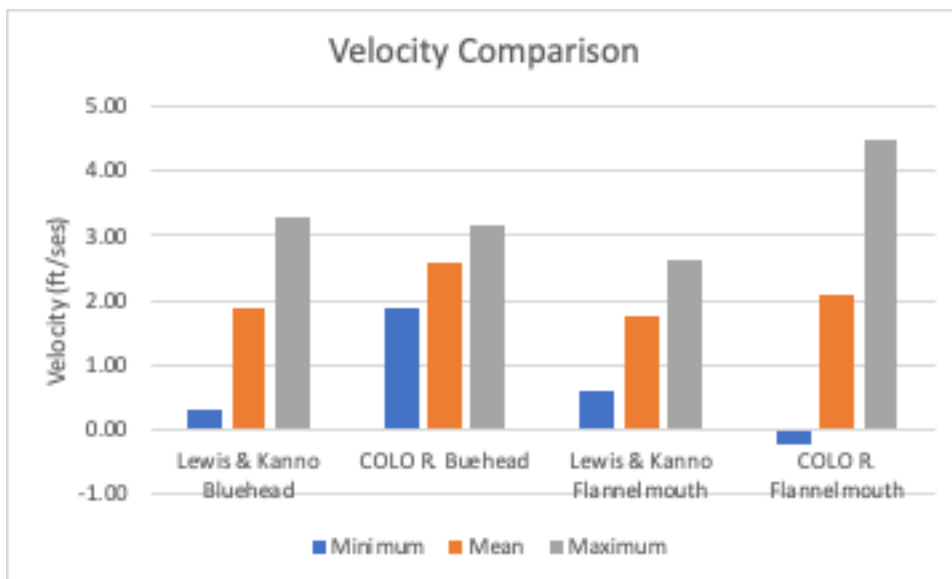


Figure 6. Comparison of velocities used by Flannelmouth Sucker and Bluehead Sucker.

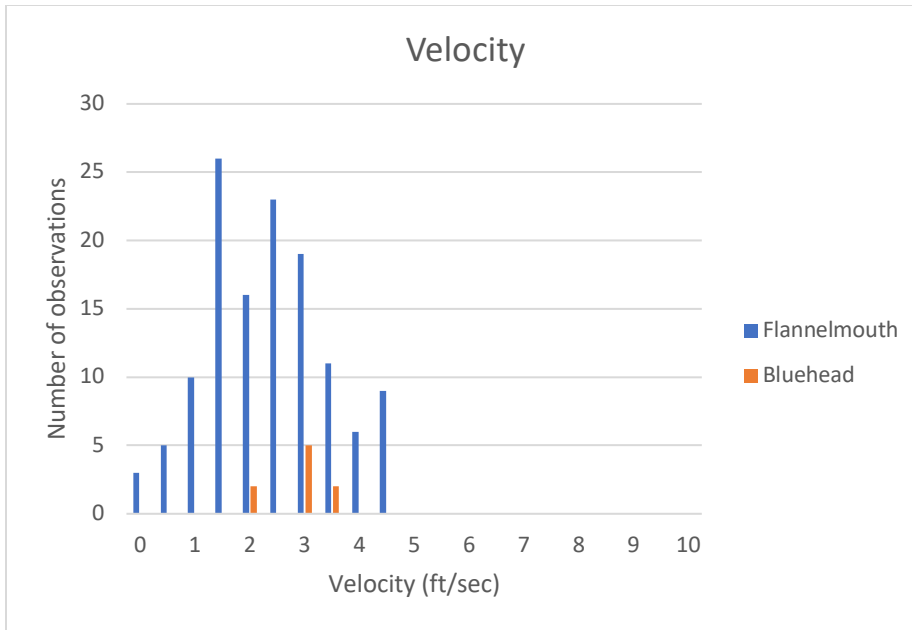


Figure 7. Colorado River velocity data for Flannemouth Sucker and Bluehead Sucker. Source: Beyers et al. 2001 and Rees and Miller 2001.

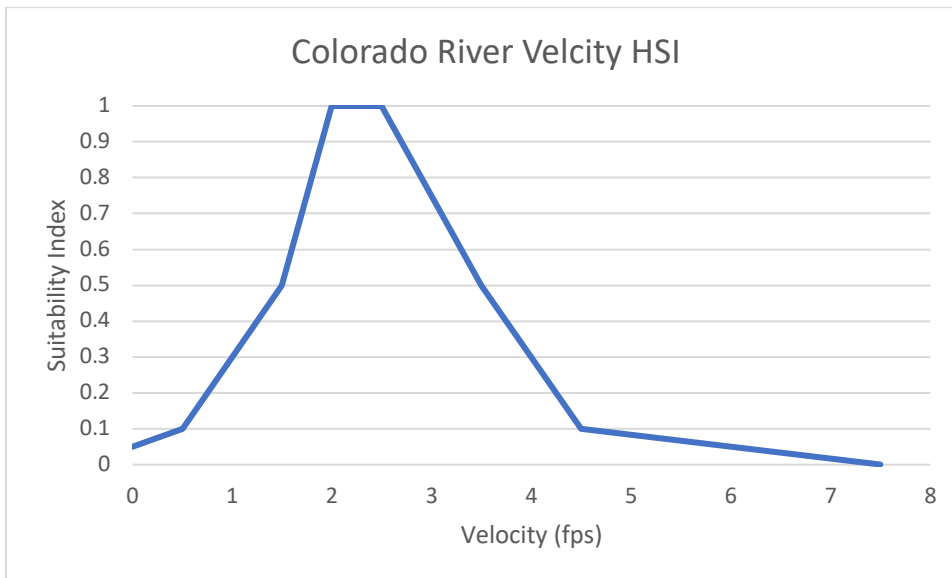


Figure 8. Suitability Index for combined data set from Flannemouth Sucker and Bluehead Sucker velocity observations.

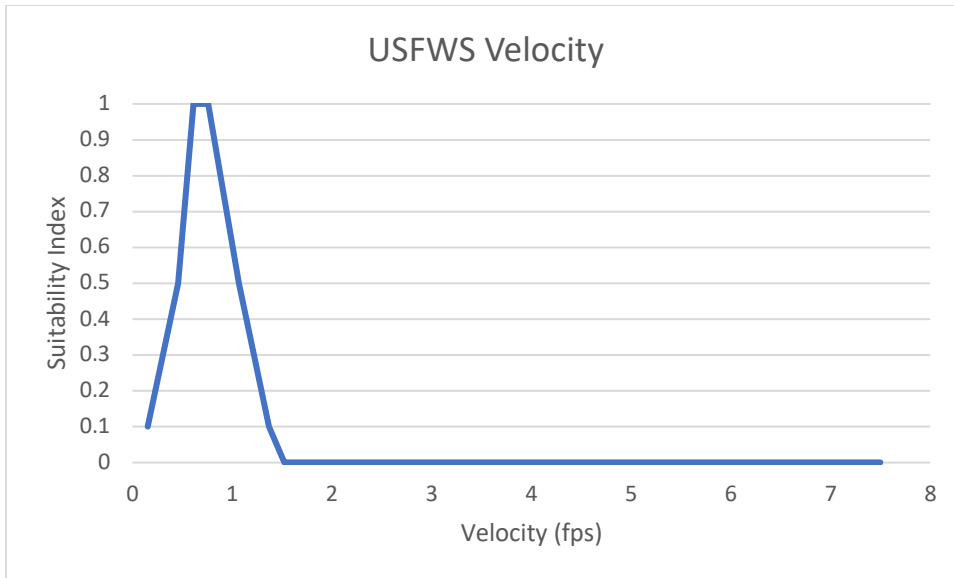


Figure 9. Velocity Suitability Index for adult Flannemouth Sucker from USFWS “FISHFIL”.

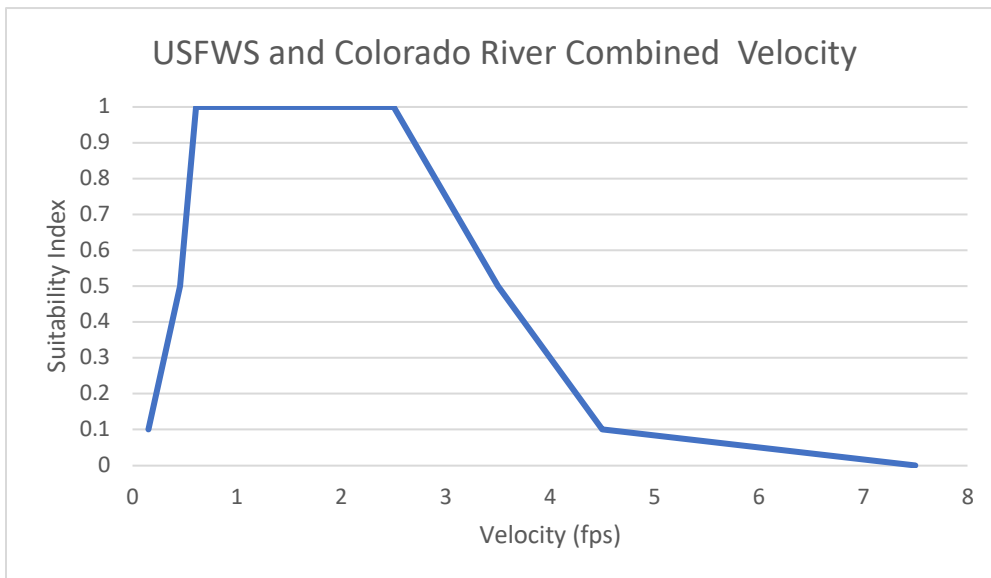


Figure 10. Velocity Suitability Index for combined values from Colorado River depth SI and USFWS FISHFIL SI.

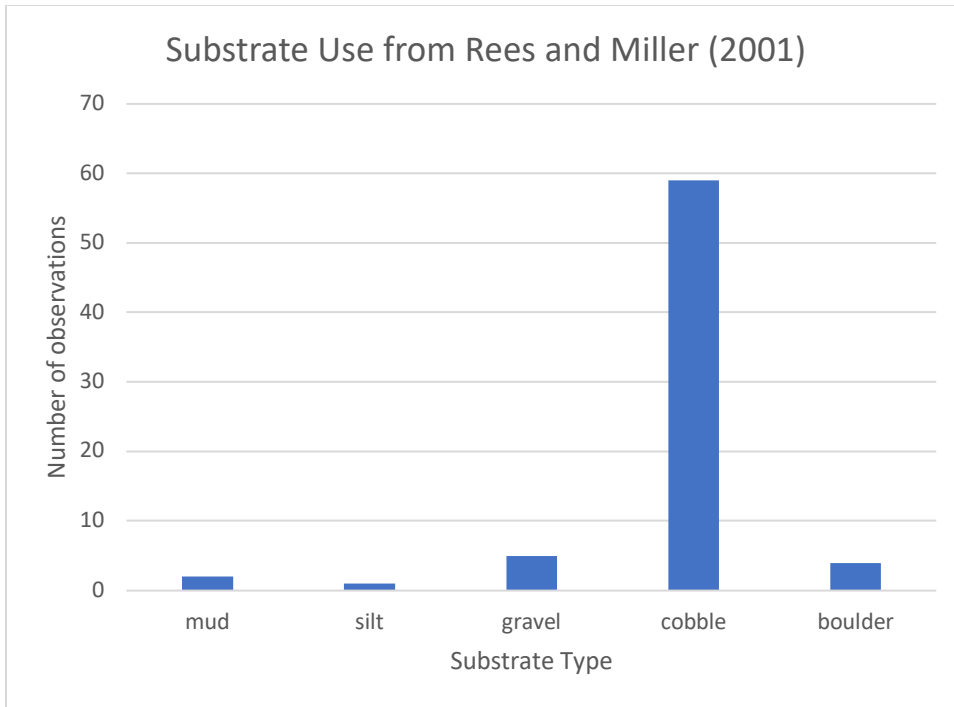


Figure 11. Substrate use observations from Colorado River; Source: Rees and Miller 2001.

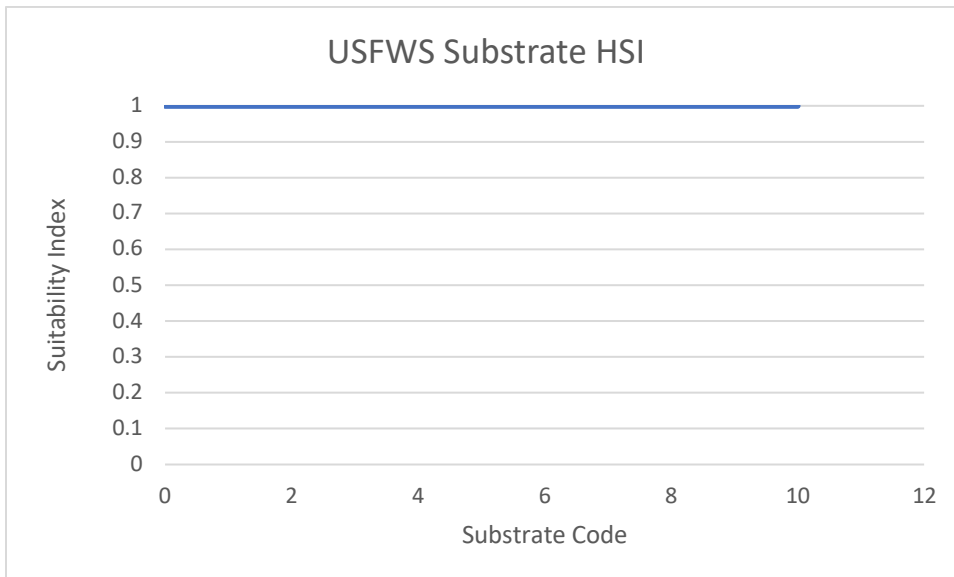


Figure 12. USFWS substrate suitability index from “FISHFIL” curve set.

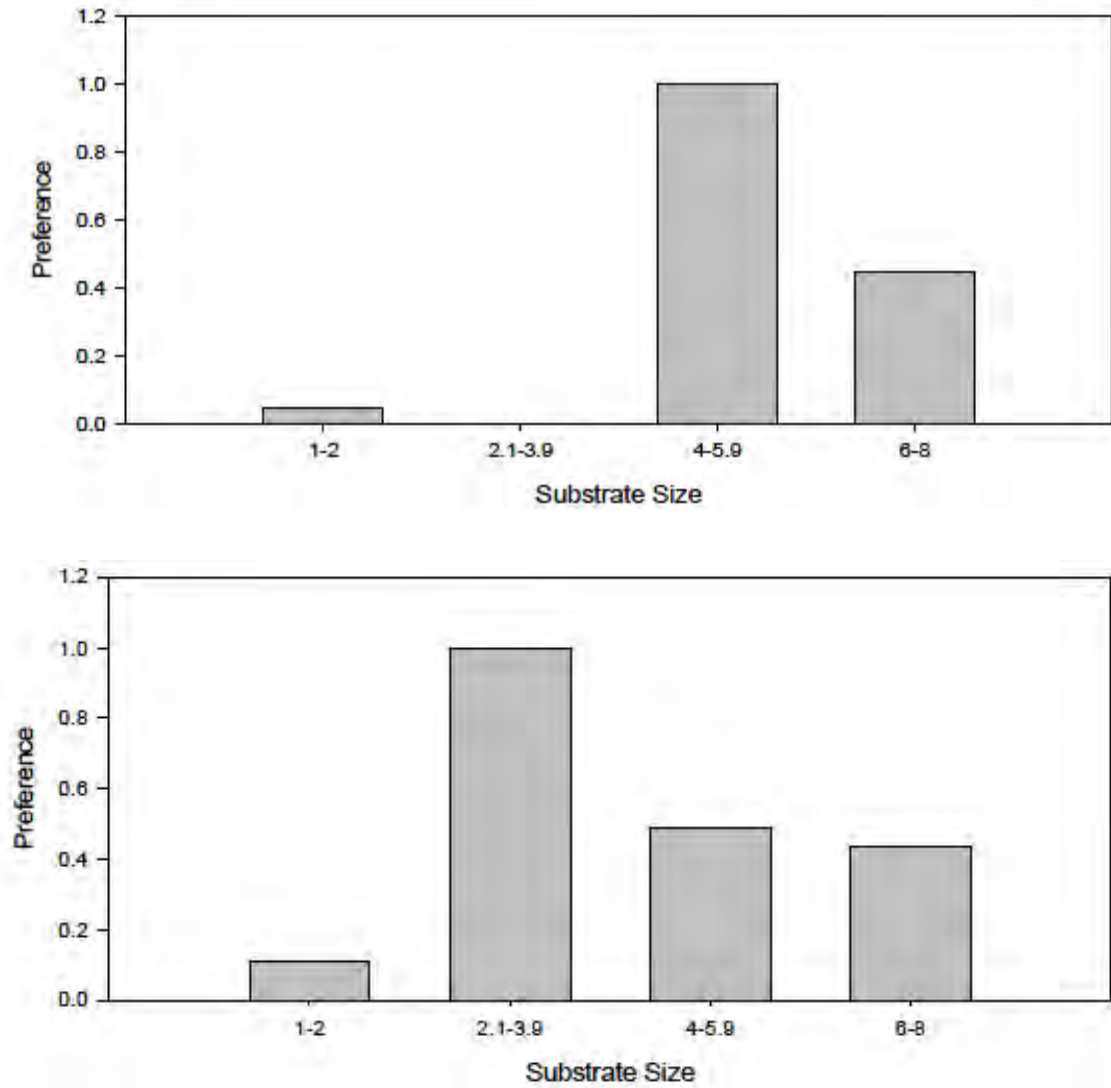


Figure 13. Substrate use for Bluehead Sucker (top) and Flannelmouth Sucker (bottom); Source: Bottcher (2009).

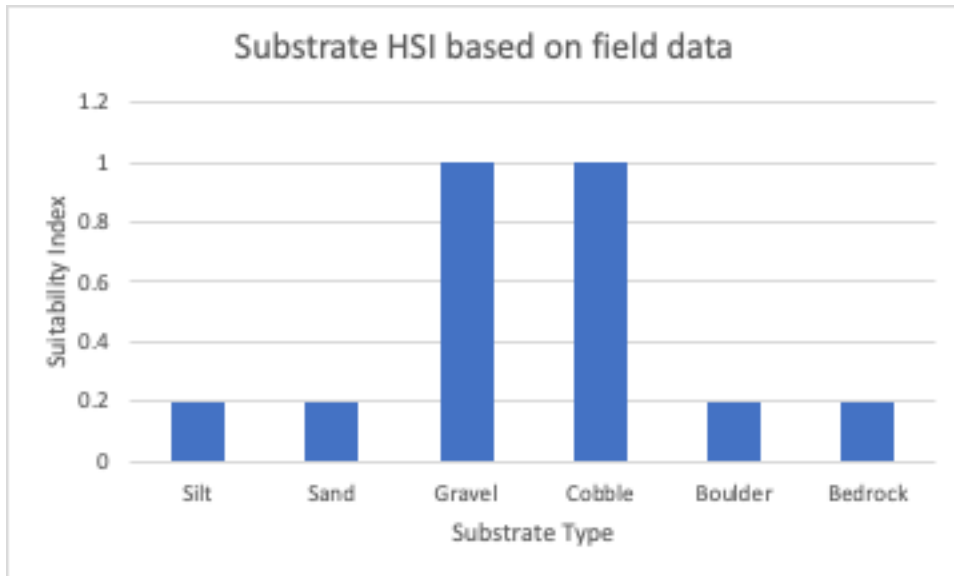


Figure 14. Proposed substrate suitability index based on field data collection.

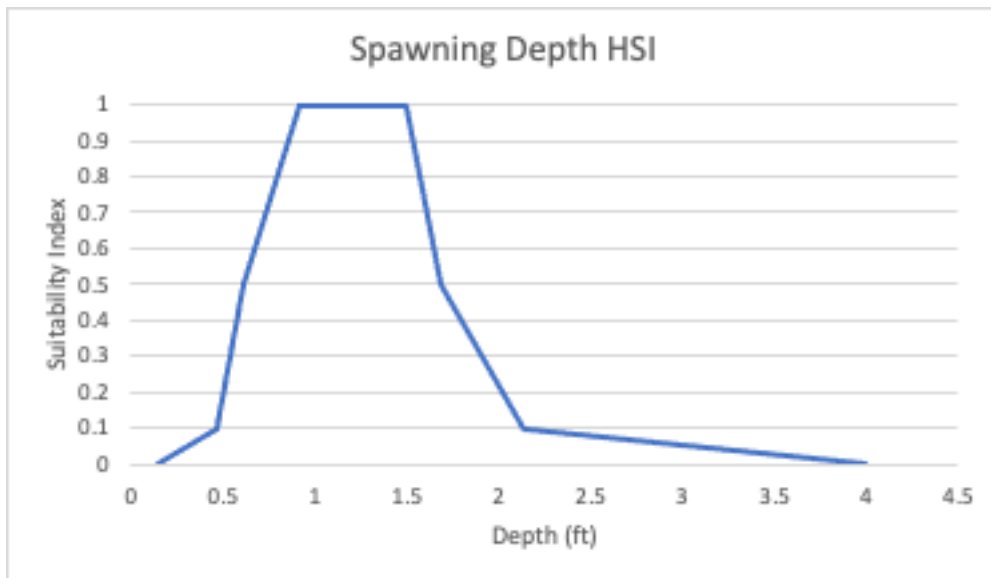


Figure 15. Proposed spawning depth suitability index based on life history traits and adult habitat use.

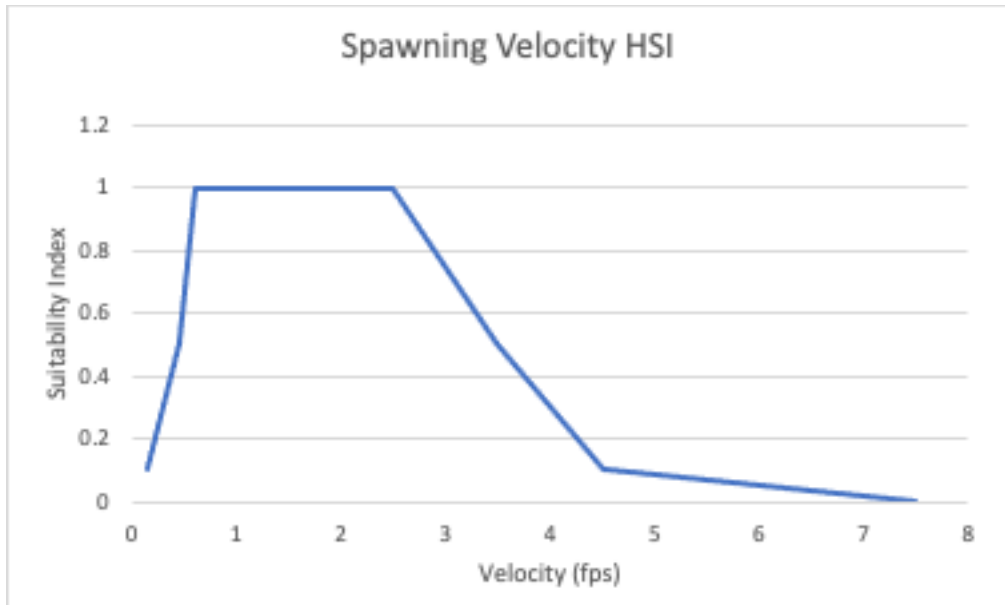


Figure 16. Proposed spawning velocity suitability index based on life history traits and adult habitat use.

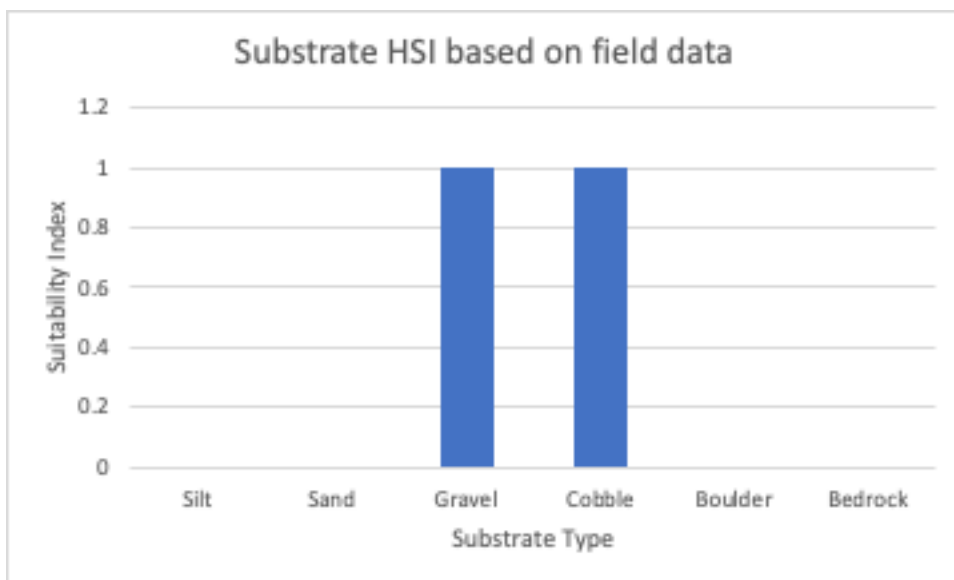


Figure 17. Proposed spawning substrate suitability index based on life history traits and adult habitat use.

Table 3. Recommended SI criteria for adult Flannemouth Sucker and adult Bluehead Sucker in Milk Creek Instream Flow study.

Depth (ft)	SI value	Velocity (fps)	SI value	Channel Index	SI value
0.15	0	0	0.1	Silt	0.2
0.46	0.1	0.1524	0.1	Sand	0.2
0.61	0.5	0.4572	0.5	Gravel	1
0.91	1	0.6096	1	Cobble	1
3	1	2.5	1	Boulder	0.2
3.5	1	3.5	0.5	Bedrock	0.2
4	1	4.5	0.1		
5	0.5	7.5	0		
6	0.1				
6.5	0.1				
7	0.1				
15	0.1				

Table 4. Recommended SI criteria for spawning Flannemouth Sucker and spawning Bluehead Sucker in Milk Creek Instream Flow study.

Depth (ft)	SI value	Velocity (fps)	SI value	Channel Index	SI value
0.15	0.00	0.15	0.10	Silt	0.00
0.46	0.10	0.46	0.50	Sand	0.00
0.61	0.50	0.61	1.00	Gravel	1.00
0.91	1.00	2.50	1.00	Cobble	1.00
1.50	1.00	3.50	0.50	Boulder	0.00
1.68	0.50	4.50	0.10	Bedrock	0.00
2.13	0.10	7.50	0.00		
4.00	0.00				

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United States Department of the Interior
BUREAU OF LAND MANAGEMENT



Colorado State Office
Denver Federal Center, Building 40
Lakewood, Colorado 80225
www.blm.gov/colorado

In Reply Refer To:
CO-932 (7250)

Mr. Rob Viehl
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Mr. Viehl:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its instream flow recommendation for lower Milk Creek, located in Water Division 6. Milk Creek is tributary to the Yampa River approximately 12 miles southwest of Craig, Colorado. This recommendation covers the stream reach beginning at the confluence with Wilson Creek and extends downstream to the confluence with the Yampa River, a distance of 4.1 miles. Of this reach, BLM manages 2.49 miles, while 1.62 miles are in private ownership.

The importance of this stream reach for native fishes has led to cooperation between the BLM and Colorado Parks and Wildlife (CPW) to document use by native species, implement fish stocking programs, and complete cooperative studies to determine the flow rates needed to support the natural environment. Milk Creek is known to provide habitat for Flannemouth Sucker, Bluehead Sucker, and Roundtail Chub, large-bodied native fishes endemic to rivers and streams of western Colorado. BLM and CPW are signatories to a multi-state, multi-agency conservation agreement designed to protect and enhance habitat for these species, with the objective of preventing the need to list any of these species under the Endangered Species Act. This agreement is entitled "Range-Wide Conservation Agreement and Strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannemouth Sucker (*Catostomus latipinnis*).” The agreement was signed in 2006 and is also known as the “Three Species Agreement.” The intention of the agreement is to increase populations and distribution of the identified species, thereby assisting in their long-term persistence.

The success of the Three Species Agreement could potentially curtail the need for federal listing of these species under the Endangered Species Act (ESA). Establishment of instream flow protection for streams known to provide habitat for the species is identified as a priority conservation action under the Three Species Agreement. Appropriation of an instream flow water right is a crucial component of protecting habitat for these species that occur on BLM-managed lands.

The BLM believes that instream flow protection for native fishes residing in Milk Creek can be achieved while allowing water to be developed and used for current and future needs, including

industrial and agricultural uses. BLM is willing to meet with water users and stakeholders within the watershed to discuss any concerns they may have about the impact of the proposed appropriation on future water uses and development. BLM is also willing to provide all supporting data to interested parties for their review. An attachment to this letter provides specific information that supports BLM's instream flow recommendation, including biological characteristics of Milk Creek, habitat modeling, water availability for instream flow protection, and recommended flow protection rates.

BLM requests the Colorado Water Conservation Board (CWCB) proceed with its appropriation process at the regularly scheduled board meeting in March 2025, given that outreach to stakeholders in the watershed have not revealed any significant reasons for a delay. If you have any questions regarding this formal recommendation, please contact Roy Smith at 303-239-3940.

Sincerely,

JOEL
HUMPHRIES



Digitally signed by
JOEL HUMPHRIES
Date: 2025.02.27
09:45:02 -07'00'

for

Alan Bittner
Deputy State Director
Resources

Enclosure:
BLM Milk Creek Instream Flow Recommendation

cc:
Kymm Gresset, Little Snake Field Office
Eric Scherff, Little Snake Field Office
Bob Swithers, Northwest District

BLM Instream Flow Recommendation for Milk Creek

February 2025



BLM Instream Flow Recommendation for Milk Creek

Section 1 - Biological Summary

Physical Habitat

This portion of Milk Creek is a low to moderate gradient stream in a canyon approximately 0.5 miles in width. In some locations, there is sufficient width in the canyon bottom for the stream to meander over time. In other locations, stream movement is confined by bedrock. The creek stream has a stable channel but has a highly variable substrate size, ranging from gravels to 2-foot diameter boulders. The stream has a good mix of riffle, run, and pool habitat to support native fish populations. Water quality, water temperatures, and food sources are also suitable for native species.

Native Fishery

Fishery surveys indicate that the lowest 4.1 miles of Milk Creek provides habitat for native species, including Flannemouth Sucker (*Catostomus latipinnis*), Bluehead Suckers (*Catostomus discobolus*), Roundtail Chub (*Gila robusta*), and Speckled Dace (*Rhinichthys osculus*). Flannemouth Sucker, Bluehead Sucker, and Roundtail Chub (the “Three Species”) are considered sensitive species by the BLM. Criteria that apply to BLM sensitive species include the following: 1) species under status review by the U.S. Fish and Wildlife Service; or 2) species with numbers declining so rapidly that federal listing may become necessary; or 3) species with typically small and widely dispersed populations; or 4) species inhabiting ecological refugia or other specialized or unique habits. The Three Species meet the first two of the criteria listed above, qualifying them as BLM “sensitive species.”¹

All three species are listed in the Colorado State Wildlife Action Plan (2012) as Tier 1 Species of Greatest Conservation Need, or “species which are truly of highest conservation priority in the state.” The Three Species are exhibiting a downward trend and collectively occupy less than half of their historic native range in the Colorado River Basin overall.²

Milk Creek provides important spawning habitat for adult populations of the Three Species that reside in the Yampa River. Very few significant perennial tributaries enter the Yampa River at the low elevations that are required for native fish spawning habitat, so Milk Creek provides important habitat for restoring native fish populations in the Yampa River watershed. Tributary habitats provide unique refugia for juvenile native fish where threats of predation and hybridization with non-native species may be substantially lower than those in the mainstem Yampa River.

Recognizing the importance of the Milk Creek habitat, BLM and CPW have taken the following actions:

¹ www.blm.gov/programs/wildlife/threatened-and-endangered/blm-special-status-species

² Bezzerides, N. and K. Bestgen. 2002 Status review of Roundtail Chub, Flannemouth Sucker, and Bluehead Sucker in the Colorado River Basin. Larval Fish Laboratory, Colorado State University, Fort Collins.

- CPW has stocked 20,632 Bluehead Suckers and 3,549 Flannemouth Suckers in the creek since 2015. The objective of the stocking effort is to augment populations in the Yampa River that have been reduced by predation by non-native fishes. The stocked fish were adults fitted with Passive Integrated Transponder (PIT) tags prior to release that are large enough to avoid predation by small mouth bass.
- Since Bluehead Sucker stocking was initiated, BLM and CPW have utilized PIT tag arrays to monitor their use of and affinity to Milk Creek.
- BLM and CPW have removed nonnative competitive species during all fish survey efforts.

Nonnative Fishery

Non-native fish species that utilize Milk Creek include Black Bullhead (*Ameiurus melas*), Brook Stickleback (*Culaea inconstans*), Brown Trout (*Salmo trutta*), Common Carp (*Cyprinus carpio*), Creek Chub (*Semotilus atromaculatus*), Fathead Minnow (*Pimephales promelas*), Green Sunfish (*Lepomis cyanellus*), Iowa Darter (*Etheostoma exile*), Northern Plains Killifish (*Fundulus kansae*), Red Shiner (*Cyprinella lutrensis*), Sand Shiner (*Miniellus stramineus*), Smallmouth Bass (*Micropterus dolomieu*), White Sucker (*Catostomus commersonii*), White x Bluehead Sucker Hybrid, and White x Flannemouth Sucker Hybrid.

Macroinvertebrates

Aquatic macroinvertebrates are an important component of aquatic food webs and serve as an important food source for fish. In October 2023, CPW staff collected macroinvertebrate samples using CPW's River Watch kick-net sampling procedure. Two samples were collected at different locations within the ISF reach and analyzed using a 500-count sub-sample. Taxa identified from the two samples were odonata, ephemeroptera, plecoptera, tricoptera, decapoda, coleopteran, diptera, and amphipoda. Of primary interest are the EPT taxa – ephemeroptera (mayflies), plecoptera (stoneflies), and tricoptera (caddisflies) – all of which were observed at both sampling locations. The presence and abundance of EPT taxa reflect the health of aquatic systems.

Riparian Community

The creek supports a riparian community comprised primarily of willows, sedges, cottonwoods, and rushes. The riparian community has been impacted by historical grazing practices but is now on an upward trend in lower portions of the reach and is static farther upstream. This reach also hosts mature cottonwood trees, and substantial cottonwood regeneration has been observed.

BLM Instream Flow Recommendation for Milk Creek

Section 2 - Flow Quantification Methodology and Results

System for Environmental Flow Analysis (SEFA)

In 2023, CPW, BLM, and CWCB embarked on a collaborative effort to collect cross section, flow, and substrate data to identify flow rates needed to support the adult and spawning life stages of the Three Species. The three agencies employed the System for Environmental Flow Analysis (SEFA), which is used to simulate the relationship between streamflow and physical habitat available to various life stages of fish species. The SEFA model is part of Instream Flow Incremental Methodology (IFIM), and it is used across the U.S. to identify specific flow rates needed to maintain fish habitat. The three agencies elected to utilize SEFA because it supports the development of instream flow recommendations that are specific to the habitat needs of Flannemouth Suckers and Bluehead Suckers. Even though SEFA requires extensive data collection over time, CPW and BLM believed the investment was warranted because of the importance of habitat in lower Milk Creek for sensitive fish species.

CPW and the BLM originally planned to use the PHABSIM (Physical Habitat Simulation) software for the instream flow evaluation in Milk Creek. PHABSIM is a widely accepted method for quantifying the suitable versus unsuitable hydraulic habitat attributes of selected species and life stages as a function of discharge. PHABSIM has been widely used in North America to quantify instream flow requirements, and it has been utilized previously by CWCB to quantify instream flow appropriations.

PHABSIM is now legacy software and is no longer supported for current Windows operating systems. SEFA includes all the hydraulic and habitat simulation functions of PHABSIM and includes additional capabilities to model sediment transport, bioenergetics, water temperature, dissolved oxygen, fish passage and hydrology and habitat time series. SEFA also has the capability to predict fish passage through a study site. The passage criteria can be specified in the analysis and the model calculates the amount of width available for fish passage through the site. SEFA also calculates maximum depth for each cross section and at various flow rates. The fish passage analysis and maximum depth prediction provide the data needed for the determination of a minimum flow that provides longitudinal connectivity in the study site and the reach.

CWCB contracted with Freshwater Consulting, LLC to provide guidance in selecting field sites, data collection techniques, and developing habitat suitability indices. Freshwater Consulting also ran the SEFA model and provided a report summarizing model results.³

Study Area

The study area extended from the Yampa River confluence to approximately four miles upstream. The Milk Creek study sites are located approximately 0.5 miles (Site 1) and 0.9 miles (Site 2) upstream from the confluence of Milk Creek and the Yampa River. The entire four-mile study area was evaluated prior to the site selection. The two study locations were selected as

³ All study data that supports this section of the CPW and BLM instream flow recommendation can be found in Miller, William J., PhD, *Final Milk Creek Instream Flow Study Report*, September 30, 2024.

representative of the habitat within the lower four miles of Milk Creek. Both sites include all habitat types present within the study area, which include riffle, run and pool habitat with stream substrates that range in size from fine silt to large cobble. Both sites have multiple sequences of these habitat types and are representative of the overall reach habitat characteristics.

Field Data Collection and Model Input

Stream cross sections were established in each habitat type at each study site with a metal headpin on the right bank above the high-water mark. The cross sections were placed perpendicular to stream flow with wooden stakes as working pins on both banks. Eight cross sections were monumented at each study site. Standard survey techniques were used to establish elevations of all headpins and bed profile elevations relative to a benchmark. Water depth and velocity were measured using a topset wading rod and digital flow meter.

During 2023 and spring 2024, additional water surface data was collected at both sites, with flow rates of 6.26 cfs, 44.5 cfs, and 127.6 cfs at Site 1 and at 6.06 cfs, 52.2 cfs, and 127.6 cfs at Site 2. These additional measurements are referred to as calibration measurements in SEFA, and they allow the model to more accurately predict habitat availability at various flow rates.

Data from the site visits were entered into computer spreadsheets and imported into SEFA software for analysis. SEFA software processing included data entry, hydraulic model calibration, hydraulic model simulations, habitat suitability criteria entry, and hydraulic-habitat model simulations.

Habitat Suitability Criteria and Area Weighted Suitability

Habitat suitability criteria describe a habitat's ability to support a particular life stage of a fish species. It is expressed in a numerical format that specifies the stream depths, velocities, and substrate types that a species will use. These criteria are applied to the stream hydraulic characteristics documented at various flow rates to calculate the amount of usable habitat for each species and life stage.

For this study, the habitat suitability criteria for adult Flannemouth Sucker were updated in early 2024. The update drew from a combination of data from radio telemetry studies on the Colorado River near Grand Junction, existing data from a range of rivers, and literature review of habitat and population studies. Limited data is available specific to Bluehead Sucker habitat preferences, so the habitat suitability criteria for Flannemouth Sucker were also used for Bluehead Sucker in this study. Bluehead Sucker feed by scaping on hard substrates and are known to feed in faster riffle habitat with cobble and boulders whereas Flannemouth Sucker feed on softer substrates in somewhat slower velocities. Accordingly, the habitat response shown for Flannemouth Sucker approximate habitat response to flow for Bluehead Sucker but will not fully depict all areas suitable for Bluehead Sucker. The suitability indices used in the hydraulic-habitat modeling are a combination of the data from Flannemouth Sucker and Bluehead Sucker studies on the Colorado River and literature from the U.S. Fish and Wildlife Service.

Flannelmouth Sucker and Bluehead Sucker spawn in riffle habitat over gravel and cobble substrate. Spawning habitat use is generally restricted to shallower depths and higher velocity than the broader habitat types used by adults. The spawning habitat suitability criteria for both species were based on a combination of literature review and existing habitat suitability criteria from the U.S. Fish and Wildlife Service. Suitable spawning substrate material was restricted to gravel and cobble substrate types in the model to accurately reflect the use of these sites during spawning.

In SEFA, the amount of habitat calculated to be available at various flow rates is referred to as “Area Weighted Suitability” (AWS). The results of the hydraulic-habitat function are expressed as area (ft²) per linear distance (ft). The AWS is the Combined Suitability Index (CSI) for depth, velocity and substrate for each measurement point weighted by the area the point represents.

Fish Passage

Longitudinal connectivity is important in riverine systems to allow migration and localized movement required by fish and other aquatic biota. Flannelmouth Sucker and Bluehead Sucker migrate from larger rivers into smaller tributary streams such as Milk Creek for spawning, and habitat connectivity is critical for that life stage. Analysis of fish passage is one means to assess connectivity and evaluate the flows needed to allow fish migration.

SEFA has the capability to predict fish passage through a study site. The passage criteria can be specified in the analysis and the model calculates the amount of width available for fish passage through the site. SEFA also calculates maximum depth for each cross section and simulated flow. The fish passage analysis and maximum depth prediction provide the data needed for the determination of a minimum flow that provides longitudinal connectivity within the study site and through the reach.

SEFA Modeling Results

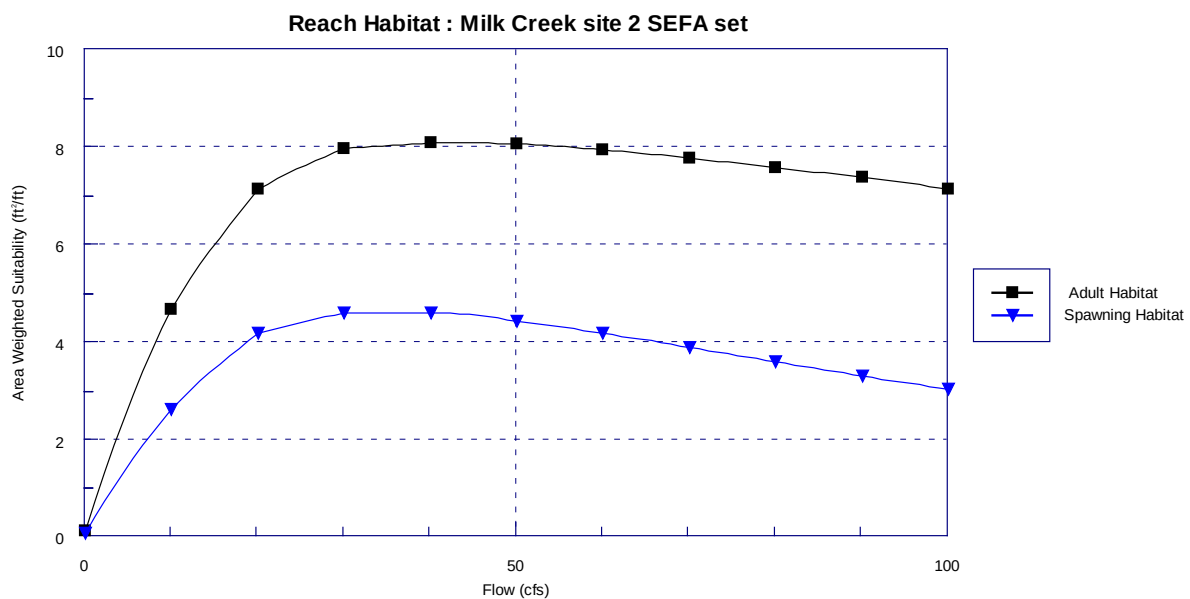
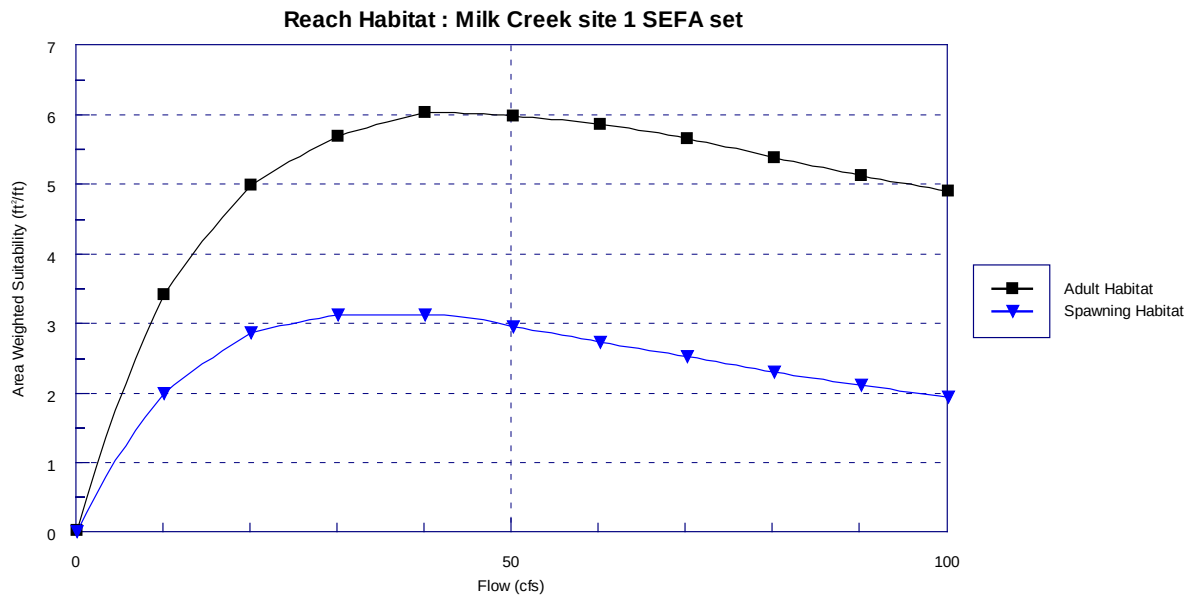
Modeling to identify hydraulic characteristics for each site was completed for flows ranging from 5.0 to 300.0 cfs. Because data were collected at a range of flow rates from base flows to snowmelt runoff flows, the R-square for the rating curves at each site was close to 1.0. Accordingly, no model calibration was required to derive accurate estimates of hydraulic characteristics. Hydraulic-habitat simulations were completed for flows from 5 cfs to 100 cfs at each site. A fish passage analysis was completed after the hydraulic-habitat simulations to evaluate longitudinal connectivity at base flows.

The modeling revealed that maximum AWS for adult sucker habitat occurs at a flow of 40 cfs at both sites. AWS rapidly decreases for adult habitat as flow drops below 40 cfs. A flow of 10 cfs results in approximately 60% of the maximum habitat index. The habitat index has a less rapid decline when flows exceed 40 cfs. A flow of 100 cfs still has approximately 80% of the maximum habitat index.

The maximum AWS for spawning habitat occurs from 30 cfs to 40 cfs for both sites. There is very little difference between the spawning habitat index value at 30 cfs and 40 cfs. The shape of

the AWS versus discharge function for spawning habitat is similar to the adult habitat discharge function with a steep decline in habitat as flows drop below 30 cfs. A flow of 10 cfs produces approximately 65% of the maximum potential habitat at Site 1 and approximately 58% of the maximum habitat potential at Site 2. The spawning habitat index at 100 cfs is slightly higher than 60% of the maximum habitat index at both sites.

The figures below show AWS as a function of discharge for adult and spawning Flannelmouth Suckers and Bluehead Suckers.



In addition to calculating AWS at various flow rates, a fish passage criterion of 0.6 foot (7 inches) of depth was chosen based on professional judgement to evaluate fish passage for the native suckers. This depth is approximately double the body depth of adult Flannelmouth Suckers (the larger of the two species), which should allow passage. The SEFA fish passage/connectivity analysis for Milk Creek showed that at a flow of 8.0 cfs, there is a continuous pathway for fish passage through all cross sections that is at least 2 feet in width and at least 0.6 feet in depth at Milk Creek Site 1 and Milk Creek Site 2.

BLM Instream Flow Recommendation for Milk Creek

Part 3 – Recommended Flow Rates and Rationale

Development of Flow Recommendations

The recommended flow values were determined using the best professional judgment of CPW and BLM biologists and hydrologists, and they are designed to protect a reasonable amount of habitat for native fishes. The initial biological flow recommendations produced by the SEFA modeling were adjusted to reflect water availability. The recommendations consider the needs of various species and their life stages, and habitat usage at various time of the year. In addition, the recommended flow rates consider the vital function that Milk Creek plays in providing spawning habitat for native fishes in the Yampa River. The recommended flow rates are as follows:

40.0 cfs – April 1 through June 30

A flow rate of 40 cfs maximizes preferred habitat across both SEFA sites. It appears that 40 cfs is available at least 50% of the time between April 1 and June 30, so no water availability adjustment was required during this time period. Snowmelt runoff generally occurs from mid-April to mid-June, and it has multiple benefits for native species. First, snowmelt runoff flows clear riffles of sediment and often re-set bed sediments to provide optimal aeration for deposited eggs. Second, snowmelt runoff flows are critical for maintaining habitat diversity within the stream channel, which supports all life stages of native fish. Especially important for emerging fry are side-channel and backwater sites that become refugia for young fish following snowmelt runoff flows. Third, peak flows are critical for redistributing sediments, creating new instream and near-stream habitat. Spawning for Bluehead Suckers and Flannelmouth Suckers may occur during pre-peak or post-peak periods. Fry emergence and dispersal shortly thereafter (7-10 days) is aided by continuing high flows and subsequent drift to side-channel, backwater, channel margins, and other low velocity sites. A flow rate of 40 cfs will provide optimal habitat availability beginning on the rising limb of the hydrograph and through the receding limb. This will support adequate depth and velocity for adult and spawning native fish. This flow rate will also provide a ramp during and after peak flows that helps with the lifecycle requirements of native fish (specifically incubation of eggs and dispersal of emerged larvae in channel margins).

8.0 cfs - July 1 through July 31

After June, flows decrease rapidly because of declining natural water availability and strong irrigation demand upstream. The descending limb of the hydrograph occurs at the warmest time of the year when the species are most active, and when the species are attempting to put on weight to survive limited food availability during winter. This recommended flow rate is based on maintaining longitudinal connectivity of habitat during this critical time of the year, when fingerlings, fry, emerged larvae, and developing eggs are moving from nursery areas in Milk Creek to the habitat in the Yampa River.

The SEFA model showed that a flow of 8.0 cfs will provide a continuous pathway for fish passage through all cross sections that are at least 2 feet in width and at least 0.6 feet in depth at

Milk Creek Site 1 and Milk Creek Site 2. This recommended flow rate is based on maintaining longitudinal connectivity of habitat during the transitional period between snowmelt runoff conditions and baseflow conditions.

4.5 cfs - August 1 through September 30

5.2 cfs - October 1 through December 31

7.8 cfs – January 1 through February 29

The three recommended flow rates above are based on limited water availability during the base flow period. Fish surveys have revealed that some native species use Milk Creek during this period, even though the mobility of fish between habitat types is limited. CPW and BLM believe that protecting these flow rates are critical for maintaining habitat for resident native fishes, and that limited flows during this period also reduce habitat occupancy by predatory non-native fishes. Adequate baseflow conditions are critical for survival of native fish for several reasons. Native suckers, particularly Bluehead Suckers, are primarily foraging fish that feed on algae and detritus within the stream channel, and incidental to consumption of vegetation by these fish is the consumption of a number of high-protein macroinvertebrates that also feed on or inhabit riverine plants. This primary and secondary production within the channel is highly dependent on riffles that have both good aeration and available sunlight. Growth during summer baseflow months is critical to provide fish the resilience needed to survive the winter, when forage is scarce. Baseflow during winter months is necessary to provide enough habitat variety to overwinter both young-of-year, and juvenile, fish, and to provide enough mobility so that fish can escape predation or find more advantageous habitats as seasonal conditions evolve.

18.0 cfs – March 1 through March 31

As low elevation snowmelt runoff begins, it is important to protect flows that allow the populations to move between habitat types. Protection of higher flows associated with the beginning of snowmelt runoff is warranted during this period because it is the beginning of the portion of the year when native fishes complete critical parts of their life cycles, including the commencement of spawning activities in early spring. Both Flannelmouth Sucker and Bluehead Sucker have been documented to start spawning in streams in western Colorado during March.

Low elevation streams in western Colorado often surge in response to melt of low elevation snowpack, spring storms, and early ripening of the snowpack in higher terrain. Water also begins warming in response to longer days and warmer air temperatures. Along with an increasing photoperiod, these hydrologic cues signal native fish to navigate toward likely spawning sites. Flannelmouth Suckers and Bluehead Suckers have been known to travel long distances toward habitual spawning areas. Increased flows during this period also mobilize fine sediments that may have settled during localized late-summer or fall monsoon storms, improving conditions in cobbles for spawning.

Summary

This recommendation recognizes that the Three Species evolved within the Colorado Plateau, a region that is hydrologically diverse and variable. Optimal conditions for spawning, growth, and

survival were typically unpredictable. Adaptations of these fishes to accommodate this variability include their relatively large body sizes and longevity, as well as their egg-dispersal mechanisms, which favored high volume and low investment in terms of energy required to nurture and care for emerging fry. In essence, these adaptations reflect the hydrologic landscape from which they evolved. Any instream flow water right should maintain, on a minimum basis, the seasonal variations in conditions required for these native fish to persist in Milk Creek.

TO: Western Resource Advocates
FROM: John Woodling, Ph.D. Woodling Aquatics
DATE: 2/20/2025
RE: **An analysis of the relationship of Miller (2024a) Milk Creek proposed instream flows to habitat requirements of native fishes.**

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Executive Summary

The US Bureau of Land Management (BLM) and Colorado Parks and Wildlife (CPW) co-recommended an instream flow for Milk Creek to the Colorado Water Conservation Board (CWCB) to protect native fish species. Milk Creek is tributary to the Yampa River in Water Division 6. The recommendation was based in-part on the *Final Milk Creek Instream Study Report* by Miller (2024a) that was prepared for the CWCB. The following is an analysis of the Miller (2024a) report regarding instream flow recommendations for the claimed reach.

I support Miller's (2024a) proposed instream flows as discussed in detail in the following sections:

- 40 cfs for April 1 through June 30
- 8 cfs, or lower, depending on what flow is available for August through February

I differ from the Miller's proposal in that I recommend:

- a higher instream flow (20 cfs) from that proposed by the Miller for the month of March
- an instream flow (8 cfs) for the month of July. Miller (2024a) did not include a specific flow proposal for July.

Figure 1. A smaller Bluehead Sucker, late summer, breeding colors, Roan Creek.



The proposed Milk Creek instream reach (claimed reach) extends upstream from the confluence with the Yampa River to the point where Wilson Creek enters the stream, a distance of about 4.1 miles. Three native fish species, the Bluehead Sucker (*Catostomus discobolus*), the Flannelmouth Sucker (*Catostomus latipinnis*) and the Roundtail Chub (*Gila robusta*) are native

to the Yampa River basin. Multiple state, federal and other entities have implemented programs designed to halt the decline in range and numbers of these fishes. This small group of fish species is collectively referred to as the Three Species by the various management agencies involved in native fish protection in the upper Colorado River basin, which includes the Yampa River basin. Another native species is also found in this stream reach, the Speckled Dace (*Rhinichthys osculus*).

As a fish biologist for 59 years, I was asked by Western Resource Advocates to provide an analysis of the Miller (2024a) report prepared for the CWCB regarding instream flow recommendations for the claimed reach. Adopting an instream flow in the claimed reach is particularly important in that four different subsets of the Three Species are found in the reach. The four subsets are,

1. Resident individuals of the Three Species that inhabit the claimed reach on a year-round basis,
2. Migratory individuals of the Three Species whose home range includes the claimed reach of Milk Creek and the mainstem Yampa River on a seasonal basis. These individuals move into Milk Creek to spawn in the spring and then return to the mainstem Yampa River for the remainder of the year,
3. The Bluehead Sucker that are stocked by CPW into the claimed reach of Milk Creek. The objective of stocking Bluehead Suckers into Milk Creek is to increase the number of Bluehead Suckers in the mainstem Yampa River. CPW stocks two- and three-year old Bluehead Suckers. These older, and relatively larger (five-inch), individuals may avoid predation from the larger non-native piscivorous species that inhabit the mainstem Yampa River by remaining in the claimed reach. These stocked Bluehead Sucker are expected to move out into the Yampa River, mature and return to Milk Creek in a subsequent spawning season,
4. The larvae and age-0 fingerlings of the first three groups that may be found in the claimed reach spring, summer and fall. Longitudinal connectivity must be maintained from the claimed reach to the mainstem Yampa River to allow developing eggs, emerged larvae, fry and fingerlings to migrate to the mainstem Yampa River from nursery areas in the claimed reach.

I believe the analysis and data generated by Miller (2024a) are excellent and were done in a professional manner. Miller (2024a) utilized the System for Environmental Flow Analysis (SEFA) to calculate instream flows for Milk Creek. SEFA is a technically sound method. SEFA allows for additional analyses in comparison to the PHABSIM model used by BLM in prior instream analysis studies. SEFA has the ability to determine longitudinal connectivity in the claimed stream reach as well as the amount of suitable habitat for the Three Species (Miller 2024a). The suitability criteria used by Miller (2024a) in the modeling were updated for the analysis (Miller 2024b). These updates accurately described the relationship of Bluehead suckers and Flannelmouth Sucker to depth and water velocity.

Miller (2024a) adhered to the spirit and word of the instream flow program and proposed flows that minimally protect aquatic resources in Milk Creek. Miller (2024a) recognized that Milk Creek flows in late summer decrease to levels that do not protect the largest, adult members of

the Three Species. Miller (2024a) suggests approving instream flows that result in Milk Creek providing critical spawning habitat for the Bluehead Sucker and Flannelmouth Sucker in the spring and early summer, and lower flows in the rest of the year. These lower flows allow longitudinal connectivity with the Yampa River, and/or flows that protect fry and fingerlings of the Three Species in the claimed reach.

Many tributary streams in the Gunnison River, Dolores River and the mainstem Colorado River portions of the Colorado Plateau are dry or have much reduced flows from late summer to spring, much like Milk Creek. Spring snowmelt in the surrounding mountains creates a seasonal flow regime in these tributaries. Bluehead Sucker and Flannelmouth Sucker, and other big river fish species migrate from main channels of larger rivers, such as Yampa River, to the few tributaries that provides this seasonal spawning habitat. Protecting the spawning flows in spring and early summer in Milk Creek serves a strategic purpose in protecting the Three Species in the entire Yampa River basin.

Milk Creek appears to have surface water flows between pools on a 12-month basis (Roy Smith, BLM, personal communication), and does not go dry in the fall and winter like many streams in the arid portions of western Colorado. The year-round flows in Milk Creek provide habitat for smaller life stages of the Three Species, even at very low flows. Pools, runs and backwaters in Milk Creek provide adequate habitat for fry and fingerling Bluehead Suckers and Flannelmouth Suckers in fall and winter. The fry and fingerling Bluehead Sucker and Flannelmouth Sucker remaining in the claimed reach during low flow are protected from predatory species found in the mainstem Yampa River. Thus, protecting Milk Creek low flows in fall and winter is important to protecting the Three Species in the entire Yampa River basin, not just Milk Creek. The Miller (2024a) proposal protects the majority of the spawning period for the Flannelmouth Sucker and the Bluehead Sucker and provides for longitudinal connectivity to the Yampa River from August through March.

As noted in the first paragraphs of this report, Miller (2024a) suggested two different seasonal instream flows for the claimed reach of Milk Creek based on season: 40 cfs from April through June and 8 cfs from August through March.

Specific flow recommendations for the month of July were not provided by Miller (2024a). Miller (2024a) did point out that

“Appropriate flows for the ascending and descending limb of the hydrograph would allow more unimpeded movement for migration and for resident fish moving to spawning locations. A streamflow that is intermediate between the recommended base flow and peak flow would be more protective of the species than an abrupt change from baseflow to peak. An intermediate flow for the ascending and descending limb of the hydrograph based on water availability would be protective.”

On the basis of my review and analysis. I offer the following recommendations.

Recommendation Regarding the Flow Proposal of 40 cfs from April through June

I recommend the flow of 40 cfs from April 1 through June 30 be approved by the Colorado Water Conservation Board for the claimed reach. The flow of 40 cfs would provide adequate habitat during most of the spawning season (but not all of the spawning season) for Three Species that inhabit the claimed reach of Milk Creek as well as members of the Three Species that migrate from the Yampa River into Milk Creek each spring to spawn. Flannemouth Sucker spawning season begins in March, not in April. These flows would also provide suitable habitat for Bluehead Suckers stocked by the CPW.

The Bluehead Sucker uses riffle habitats more than the other two members of the Three Species. Water depth in general is deeper in runs and pools than in riffles in a given stream reach. Maintaining a suitable water depth in riffles for Bluehead Suckers would provide protection for not only Bluehead Suckers but also the Flannemouth Sucker and Roundtail Chub (Anderson and Stewart 2007). The CWCB has agreed in prior instream flow hearings that a water level that reasonably protects Bluehead Suckers in riffles would provide suitable habitat for the Flannemouth Sucker and the Roundtail Chub.

The Speckled Dace would also be protected at a flow of 40 cfs. The Speckled Dace is still widely distributed in the species' native range on the western slope, but the species has disappeared from some waters on the western slope. Protection of the species is warranted.

Recommendation Regarding the Flow Proposal of 8 cfs from August through March

The flow of 8 cfs from August 1 through March 31 proposed by Miller (2024a) provides water depths and habitat that are minimally protective for,

1. larvae and fry of the Three Species that hatch and grow to fingerling size in the claimed reach,
2. five-inch long Bluehead Suckers stocked by CPW,
3. the Speckled Dace,
4. and perhaps smaller adults of the Three Species that may be resident in the claimed reach

The flow of 8 cfs from August 1 through March 31 (Miller 2024a) importantly provides longitudinal connectivity with the mainstem Yampa River that will allow large adult Bluehead Sucker and Flannemouth Sucker to move back and forth from the main channel. Such movement allows Milk Creek to serve as a spawning habitat and fry habitat for the Three Species.

The flow of 8 cfs from August 1 through March 31 (Miller 2024a) does not provide suitable habitat for,

1. any large adults of the Three Species that are resident to the claimed reach,
2. large, spawning adults of the Three Species in a pre-spawn condition that may migrate from the mainstem Yampa River into Milk Creek at any time from August through March.

The proposed flow of 8 cfs from August 1 through March 31 (Miller 2024a) would provide a level of protection for the five-inch long Bluehead Suckers CPW stocks in Milk Creek. These stocked fish are much smaller than adults of the species. These smaller fish may find appropriate habitat in Milk Creek at a flow of 8 cfs for a period of time. These stocked fish could feed and grow in Milk Creek at a flow of 8 cfs and at the same time avoid predation by the large bodied piscivorous species that inhabit the mainstem Yampa River. The CPW stocking program is designed to use Milk Creek as a source of young Bluehead Suckers to bolster the species' population in the mainstem of the Yampa River and not just the claimed reach.

A flow of 8 cfs maintains minimal longitudinal connectivity from the claimed reach to the mainstem Yampa River. A continuous pathway at least two feet wide is present through all the cross sections at a flow of 8 cfs (Miller 2024a). Adults, fry and fingerlings of the Three Species would not be stranded and die in the claimed reach in the late summer months, an outcome common in many streams on the arid west slope of Colorado. In contrast, fry and fingerlings of the Three Species stranded in Cottonwood Creek in the Gunnison River basin die as the water disappears each year (Hooley Underwood 2019). With the 8 cfs flow proposed by Miller (2024a), Milk Creek can serve as a source of young Bluehead Suckers and Flannemouth Suckers to the mainstem Yampa River population for the Three Species.

I recommend that the proposed flow of 8 cfs be approved for the time period of August 1 through February 28, but that a higher flow be approved for the month of March (see following section). Miller (2024a) indicated that “a maximum depth of 0.6 feet was present at some point in all cross sections at an average flow 4.6 cfs except for one of shallowest cross sections,” and that movement across these shallows” may be possible for adult Bluehead Sucker and Flannemouth Sucker. I do not believe that large, adult members of the Three Species would be able to adequately transit the claimed reach at such low flows. However, surface flows less 4.6 feet would allow immature life stages to move throughout the claimed reach to find appropriate habitat, or to migrate to the mainstem Yampa River. Protecting the young fry and fingerlings of the Bluehead Sucker and Flannemouth Sucker in Milk Creek at flows less than 8 cfs could be a management option for all entities interested in the Three Species program. A flow of 8 cfs provides minimum longitudinal connectivity for larger adults. If, however, flows of 4.6 cfs are all that is available, those flows will provide protection of younger life stages.

Recommendation Regarding the Flow Proposal of 8 cfs in March

I recommend a March instream flow of 20 cfs for Flannemouth Sucker and Bluehead Sucker. Multiple studies have shown that these two sucker species may spawn in March. For example, Mature Flannemouth and Bluehead Sucker entered Cottonwood Creek in mid-March of 2017 (Hooley Underwood et al. 2019). Flannemouth Sucker spawned in March in Paria Creek and Bright Angel Creek, tributaries of the mainstem Colorado River in Arizona (Weiss et al.1998). Flannemouth Suckers and Bluehead Suckers spawned from the middle of March through early July in San Juan River (Barkalow et al. 2016). I have collected large, mature, pre-spawn, tuberculated, adult Flannemouth Sucker in Salt Wash, a tributary of the mainstem Colorado River in Mesa County in March. Approved instream flows for Milk Creek in March are needed to protect spawning Bluehead Sucker and Flannemouth Sucker in March as well as April through June.

The average March flow in Milk Creek is 19.7 cfs, much more than the 8 cfs proposal in Miller (2024a). Bluehead Sucker and Flannelmouth Sucker will likely move into Milk Creek in March and may need appropriate spawning habitat as well as deeper water in pools to provide cover for the mature pre-spawn adults. Such habitat is available at a flow of 20 cfs (Miller 2024a, Figure 5 and Figure 6).

Recommendation Regarding a Flow Proposal for the Month of July

Miller (2024a) did not propose a specific flow rate for the month of July, but does indicate that “intermediate flows” would be “more protective.” July flows are critical. Post-spawn adults may be in the claimed reach at this time and would require longitudinal connectivity to the mainstem Yampa River channel. Developing eggs may be drifting downstream as well as recently hatched larvae or developing fry. These life stages must be protected in July.

The average July flow is 8 cfs in the claimed reach (Miller 2024a). At a minimum, a July instream flow of 8 cfs should be approved for the claimed reach. This flow would provide longitudinal connectivity to the mainstem channel for adults as well as habitat for developing eggs, drifting larvae and fry. An instream flow of 8 cfs for July would also provide a level of protection for the five-inch long Bluehead Suckers CPW stocks into Milk Creek as well as Speckled Dace.

1.0 Introduction

Miller (2024a) proposed instream flow rates to protect native fish species in the claimed reach of Milk Creek, tributary to the Yampa River, in CWCW Water Division 6. Milk Creek is a comparatively small tributary to the mainstem Yampa River that drains about 223 square miles in northwestern Colorado. The stream enters the Yampa River about 12 miles southwest of Craig, Colorado. The claimed reach extends upstream from the Yampa confluence to the point where Wilson Creek enters the stream, a distance of about 4.1 miles. The BLM owns 2.49 miles of the claimed reach while 1.62 miles are privately owned. Water depths in Milk Creek vary seasonally and the Miller (2024a) instream flow proposals mirror that seasonal variation.

Three of the native fish species that inhabit the claimed reach are the Bluehead Sucker (*Catostomus discobolus*), the Flannelmouth Sucker (*Catostomus latipinnis*) and the Roundtail Chub (*Gila robusta*). This group of fish species is collectively referred to as the Three Species. The Three Species are the object of interstate efforts designed to halt the decline in range and numbers of the fish. Another native species is also found in this stream reach, the Speckled Dace (*Rhinichthys osculus*).

I was asked by Western Resource Advocates to provide an analysis of the Miller report (2024a) and the instream flow proposals for the claimed reach. I have worked with the Three Species and Speckled Dace since 1974 when I first sampled the Colorado River, the San Miguel River and the Dolores River, working as a researcher for the Colorado Water Quality Control Division.

I periodically sampled and studied the Three Species from 1978 through 2003 as a biologist with CPW. I authored a book about fish species not normally targeted by anglers titled “Colorado’s Little Fish” that was published in 1985. This book described more than 40 fish species, including life history information, range description, habitat, etc. Descriptions of the Three Species and the Speckled Dace were part of that book. I am currently working with CPW biologists writing a book titled “Fishes of Colorado,” and am also an editor of the publication. I am a co-author of the chapters on Flannelmouth Sucker, Roundtail Chub and Speckled Dace.

The following sections address the status of the Three Species native fish assemblage on the western slope of Colorado, and the status of the Three Species in Milk Creek Basin. Also included are sections on the importance of longitudinal connectivity to the Flannelmouth Sucker and Bluehead Sucker, and the Miller (2024a) proposed instream flow rates. Each of these topics is addressed in the following sections.

2.0 Overview and Status of Native Fish Species

2.1 Native Fish Assemblage on the Western Slope of Colorado

Only 13 fish species are thought to be native to waters on the western slope in Colorado, including the Yampa River basin. The number of native fish species that inhabit west slope waters is very low compared to other major river basins in the Continental United States. Five of these species are currently federally and/or state listed as threatened or endangered, including the Razorback Sucker (*Xyrauchen texanus*), the Colorado Pikeminnow (*Ptychocheilus lucius*), the Humpback Chub (*Gila cypha*), the Bonytail Chub (*Gila elegans*), and lineages of the native Cutthroat Trout (*Oncorhynchus clarkii*). The Mountain Sucker (*Catostomus platyrhynchus*) is also listed as a species of concern by the State of Colorado. The BLM considers the Flannelmouth Sucker (*Catostomus latipinnis*), Bluehead Sucker (*Catostomus discobolus*) and Roundtail Chub (*Gila robusta*) to be “sensitive” species. The Flannelmouth Sucker, the Bluehead Sucker and the Roundtail Chub are often treated as a single management unit. This species assemblage is referred to as the Three Species (See section 2.2 for a description of the Three Species).

In total, nine of the 13 native fish species (69%) on the western slope of Colorado have declined in numbers and distribution to the point that some form of designation has been applied to the taxa or is warranted. The decline in the fish assemblage on the west slope of Colorado can be compared to a similar nationwide phenomenon. When examined in 2000, A total of 37% of the native fish species in the United States had declined in abundance and distribution to the point that the species had some form of official designation as imperiled (Master et al. 2000). In general, the native fish assemblage of Colorado’s western slope has experienced twice as much of a decline as the rest of the United States. Such declines in fish throughout Colorado have resulted in the design and implementation of a variety of recovery endeavors to protect these species. At least five of these declining species are endemic to the Colorado River basin.

2.2 The Three Species

The Three Species are the focus of a multi-state and federal effort. Protection and enhancement of existing populations of the Three Species is a component of many state and federal fish management programs. All three taxa appear to be restricted to less than 50% of the species' historic range in the Upper Colorado River Basin (Bezzarides and Bestgen 2002). The Upper Colorado River Basin is that portion of the Colorado Basin located upstream of Glen Canyon Dam, an expanse that includes the San Juan River basin, the Green River basin and all of the Colorado River basin upstream of the Green River/Colorado River confluence. The Yampa River is tributary to the Green River. The objective of the state and federal efforts is to avoid federal listing of any of the Three Species. Reproducing populations of the Bluehead Sucker, Flannemouth Sucker and Roundtail Chub inhabit the lower reaches of the several Colorado Rivers including the Yampa River basin. Milk Creek is a tributary to the mainstem Yampa River that supports the Three Species and Speckled Dace.

Any further decline in distribution and abundance of the Three Species is significant. Most western slope rivers in Colorado still support reproducing populations of the Three Species, although the Flannemouth Sucker and Bluehead Sucker have disappeared from the Gunnison River upstream of Blue Mesa Reservoir (Woodling 1985). The relatively robust Colorado Three Species populations are somewhat of an anomaly compared to the status of the populations throughout the entire native range of this species group. The distribution of the Three Species is also different for the individual fish species. Flannemouth Sucker are still found in most of the species' historical range in Wyoming and Colorado but the species has disappeared or become less abundant throughout the remainder of the species range: California, Utah, Arizona and Nevada (Rees et al. 2005). Thus, a decrease in abundance or distribution of the Three Species in Colorado has more influence on the status of the taxa than in other states where most populations have disappeared. The failure to protect Colorado populations could lead to the listing of one or more of the Three Species on the national level, an occurrence that could have relatively more implications in Colorado where the taxa are still present.

The Three Species and the four federally listed species are normally associated with larger rivers in the minds of most people who have an interest in this species group. In fact, the Three Species also inhabit smaller rivers and streams on the west slope of Colorado. Flannemouth Suckers have been collected in all sized stream reaches from the mainstem Colorado River in Mesa County, which is the largest river in western Colorado, to small streams such as Yellowjacket Creek in the southwestern corner of Colorado (John Woodling, personal observation). Yellowjacket Creek was about 8 feet wide where the Flannemouth Suckers were collected, with pools about 1.5 feet deep. Bluehead Suckers have been found in the mainstem Colorado River at the Utah/Colorado border and in smaller waters at an elevation of 8,500 feet (CPW database). These higher elevation waters support not only Bluehead Suckers but in some cases trout. Roundtail Chub are also found in a wide range of waters from the mainstem Colorado River to much smaller streams such as Yellowjacket Creek and McElmo Creek in the San Juan River (Dan Cammack, CPW, personal communication), and small irrigation return waters in Mesa County (John Woodling, personal observation).

The Three Species not only inhabit various sized streams and rivers, but individuals of the Three Species may be highly mobile. The mobility of individual members of the Three Species means

that these fish often have a rather large home range and these fish may move hundreds of miles in the course of a year. Protecting these mobile species requires providing adequate habitat and connectivity over a large geographic area and in more than one stream or river. Mainstem and tributary reaches are all important.

Flannemouth Suckers, like the more widely known Colorado Pikeminnow, are very mobile. One Flannemouth Sucker tagged in the Green River in 2011 was found in the Dolores River in 2014 and 2016, meaning that this fish moved about 260 miles from the point of initial tagging (Zack. Hooley-Underwood CPW, personal communication), while others moved up to 143 miles over time in other waters (Bezzarides and Bestgen 2002).

Individual Roundtail Chub, like Flannemouth Sucker, can be very mobile. An adult tagged in the Yampa River near Craig, Colorado moved downstream to the Green River in Utah, then downstream to the confluence of the Colorado River and the Green River, and finally upstream in the Colorado River to Grand Junction, Colorado, a distance of more than 200 miles.

The Bluehead Sucker does not appear to move as much as Flannemouth Sucker or Roundtail Chub (Beyers et al. 2001). One Bluehead Sucker in the San Juan River moved 38 miles in 435 days (Carman 2007). In fact, Bluehead Suckers stocked by CPW in Milk Creek have moved out of the stream and into the Yampa River downstream to Lily Park (Jenn Logan, CPW, personal communication). Others moved upstream in the Yampa River, but for shorter distances than those that moved downstream.

The Three species spawn in the spring, the time of maximum flows in streams and rivers on Colorado's western slope. The high-water levels are created by snow melting at higher elevations in the mountains and/or spring rains at lower elevations. The Three Species are known to spawn in the large mainstem rivers on the western slope of Colorado. However, each of the Three Species are also known to migrate into smaller tributaries from larger rivers to spawn, for example,

1. Flannemouth in the Grand Canyon move from the mainstem Colorado into Bright Angel Creek and the Paria River (Weiss et al. 1998).
2. Bluehead Sucker, Flannemouth Suckers and Roundtail Chub move into Cottonwood Creek, an intermittent tributary of Roubideau Creek in the Gunnison River basin (Hooley-Underwood et al. 2019),
3. Bluehead Sucker and Flannemouth Sucker move into Coal Creek from the White River (Fraser et al. 2017),
4. Flannemouth Sucker move into McElmo Creek from the San Juan River (Cathcart et al. 2015),
5. Milk Creek was identified by BLM (2009) as a tributary where native fish species spawn.

Large Flannemouth Sucker have been observed spawning in Parachute Creek in the month of June (John Woodling, personal observation). The large size of these fish indicated that these fish had migrated upstream from the mainstem Colorado River to spawn. Large Flannemouth Sucker, many with breeding tubercles, were collected in Salt Wash, a tributary to the mainstem Colorado River in Mesa County Colorado, in March. These fish were presumed to be migrants from the Colorado River (John Woodling, personal observation).

The Three Species appear to display spawning site fidelity with many fish returning to the same tributary year after year to reproduce. Seventy one percent of the Flannemouth Suckers and 61% of Bluehead Suckers tagged in 2016 in Cottonwood Creek returned in 2017 (Hooley Underwood 2019). Return rates for Roundtail Chub were lower. From 18% to 42% of Roundtail Chub returned (Hooley-Underwood et al. 2019). Protecting these declining species in small tributaries during spawning season results in protecting and enhancing the species numbers in the large downstream rivers.

Spawning is cued by increasing temperature. Suckers moved into Coal Creek from the White River beginning in mid-May of 2012 and 2013 to spawn (Fraser et al. 2017). Fraser et al. (2017) determined that the majority of sucker spawning movements occurred when water temperatures in White River exceeded 11–14°C and those in Coal Creek were 2.5–4°C warmer, while flows varied between years. Water levels however can also influence when the Three Species move into a tributary to spawn. The Three Species enter Cottonwood Creek when water levels increase to a level that the adults can access the stream (Zack Hooley Underwood CPW personal communication).

The Three Species have a rather extended spawning season that can begin in early spring. Flannemouth and Bluehead Sucker entered Cottonwood Creek in mid-March of 2017 while Roundtail Chub were not encountered until the middle of April (Zack Hooley Underwood et al. 2019). Flannemouth Sucker also spawned in March in Paria Creek and Bright Angel Creek, tributaries of the mainstem Colorado River in Arizona (Weiss et al. 1998). Flannemouth Suckers and Bluehead Suckers spawned from the middle of March through early July in San Juan River (Clark Barkalow et al. 2016). Migrating adult Flannemouth Suckers were collected in Escalante Creek in mid-March (Roy Smith BLM, personal observation). These multiple observations more than demonstrate that Bluehead Suckers and Flannemouth Suckers can initiate spawning activities in March. Reasonable protection for the Three Species includes actions designed to provide adequate habitat through the entire spawning season. Such actions include providing reasonable instream flows that allow migrating adults to enter tributaries in the month of March.

2.3 Speckled Dace

The Speckled Dace (*Rhinichthys osculus*) ranges from British Columbia south through California east to Wyoming and down through the Rocky Mountains to Sonora Mexico. This small fish evidently can disperse rapidly and is the only fish species found in all major river basins in the western United States. The species is native to waters on the western slope of the Continental Divide in Colorado.

Various populations of Speckled Dace have been designated as distinct subspecies throughout the native range of this dace species. Some of these subspecies have been listed as federally endangered including the Kendall Springs (*Rhinichthys osculus thermalis*) in Wyoming and the Ash Meadows (*R. osculus nevadensis*) in Nevada, while the Foscett Dace (*R. osculus* spp.) is a federally listed fish in Oregon. No populations in Colorado have been designated as distinct subspecies, nor have any listing actions been proposed. Fishery biologists, including Minckley (1985), have described the Speckled Dace as a "complex" which may actually be several species.

The dace populations on the western slope may be shown to be a distinct subspecies in the future. Thus, protecting Speckled Dace populations in Colorado is a worthwhile proposal.

The Speckled Dace is one of the very few native fish species in Colorado that has not seriously declined in distribution, although some Colorado populations have disappeared. The Longnose Dace, *Rhinichthys cataractae*, is native to the eastern slope of Colorado. However, Longnose Dace replaced Speckled Dace in some waters on Colorado's western slope. For example, the Longnose Dace has replaced the Speckled Dace throughout most of the Gunnison River basin upstream of Blue Mesa Reservoir and in the mainstem Colorado River in the stream reach just downstream of Windy Gap Reservoir. Thus, protection of this native species is warranted.

The Speckled Dace inhabits multiple microhabitats in streams, including riffles. The depth and velocity in riffle areas can be compared to the habitat requirements of Speckled Dace to determine what flows are needed in streams to provide reasonable protection for this species.

2.4 Milk Creek and the Three Species

Milk Creek is a small tributary to the Yampa River. The creek enters the Yampa River about 12 miles southwest of Craig, Colorado. Milk Creek is one of the few permanently flowing tributaries of the Yampa River. The stream in the claimed reach includes fast, shallow riffles and larger deeper pools (BLM 2009).

Four native species, the Flannelmouth Sucker, Bluehead Sucker, Roundtail Chub and Speckled Dace inhabit Milk Creek (BLM 2009, 2017, 2019). These populations are considered to be naturally reproducing. BLM (2009) reported the collection of "Small suckers," which were probably the result of the natural spawning of Flannelmouth Sucker or Bluehead Sucker in Milk Creek. A Roundtail Chub about three inches in length was pictured in BLM (2009, 2017, 2019) reports. This was likely a young of the year fish that may well have been spawned in the claimed reach.

Milk Creek is one of the few permanently flowing streams that enters the mainstem Yampa River in the relatively arid canyonland environment from Hayden, Colorado to the Utah/Colorado border. As such, the Three Species population in this small stream may be more important than in other large river systems where permanently flowing tributaries are more abundant. As previously described, small tributaries are important spawning sites for the Three Species. Large numbers of the Three Species seasonally move into small tributaries to spawn and then return to larger rivers such as the Yampa River. Milk Creek was identified by BLM (2009) as "important" tributary where native fish species spawn.

BLM fish sampling has not reported the presence of large numbers of large piscivorous species in Milk Creek, only the occasional Smallmouth Bass has been collected (BLM 2009, 2017). In contrast, many large piscivorous fish (including Northern Pike and Smallmouth Bass) are abundant in the mainstem Yampa River and are known to prey on other fish in the mainstem river, including the Three Species. The numbers of native fish species in the mainstem Yampa River have been reduced over the last decades.

The absence of large bodied predatory fish species in Milk Creek is an indication that Milk Creek may provide the Three Species with a refuge from predation by these species. BLM has, however, found Creek Chub, a smaller bodied predatory fish, in Milk Creek (BLM 2017). Creek Chub are omnivorous consuming anything, including small fish such as fry and young fingerlings of the Three Species.

BLM and CPW utilize the relatively predator free claimed reach of Milk Creek as part of a program to protect and enhance Bluehead Sucker populations in the mainstem Yampa River. CPW rears Bluehead Sucker for two and three years at a state hatchery. The resulting five-inch-long fish have been stocked into Milk Creek since 2015 and 2016 (BLM 2015, 2016). These fish are all tagged and are individually identified when recaptured. The five-inch fish are too large to be preyed upon by Creek Chub. Stocking Bluehead Sucker appears to have been successful. Tagged Bluehead Sucker have been reported in Yampa River upstream and downstream of Milk Creek (BLM 2019). The Bluehead Sucker collected in the mainstem Yampa River may well display site fidelity and return to Milk Creek to spawn like the Three Species in Cottonwood Creek (Hooley Underwood et al. 2019). Protecting the stocked five-inch Bluehead Suckers in Milk Creek improves population numbers in the mainstem Yampa River.

Adopting an instream flow for Milk Creek is one important component of maintaining and enhancing the Three Species in the Yampa River basin. Approval of the proposed instream flow would provide not only reasonable levels of spawning habitat but also longitudinal connectivity between Milk Creek and the mainstem Yampa River. Connectivity allows adults, juveniles and fingerlings to migrate in and out of Milk Creek to the Yampa River in relation to changes in season and flow. Maintaining longitudinal connectivity is considered to be a vital component in the conservation of Flannemouth and Bluehead Suckers (Cathcart et al. 2015).

3.0 Flow Proposals for Milk Creek, and Depth and Velocity Requirements of the Three Species

3.1 Proposed Instream Flow Rates

Miller (2024a) used the System for Environmental Flow Analysis (SEFA) software, to calculate instream flows for Milk Creek. SEFA is a technically sound method that allows for additional analyses in comparison to the PHABSIM model used in prior instream analysis studies. SEFA can be utilized to determine the extent of stream width available for fish passage through a site. The amount of stream width for passage and maximum depth predictions determine the minimum flow that provides longitudinal connectivity in the claimed stream reach (Miller 2024a). The suitability criteria used by Miller (2024a) in the modeling were updated for the analysis (Miller 2024b). These updates accurately described the relationship of Bluehead suckers and Flannemouth Sucker to depth and water velocity. Connecting the water depth and water velocity needed for adult suckers and adult spawners was critical to producing flow recommendations that protect the Three Species to a reasonable degree.

The goal of the instream flow rates proposed is to protect the Three Species and the natural environment in the claimed reach of Milk Creek to a reasonable degree. The instream flows

proposed by Miller (2024a) are required by statute to be the minimum flow that would protect to a reasonable level, not an optimum level.

Miller's (2024a) flow recommendations for Milk Creek are as follows:

1. A flow of 40 cfs from April through June,
2. A flow of 8 cfs from August through March.

Specific flow recommendations for the month of July were not provided by Miller (2024a). Miller (2024a) did point out that

“Appropriate flows for the ascending and descending limb of the hydrograph would allow more unimpeded movement for migration and for resident fish moving to spawning locations. A streamflow that is intermediate between the recommended base flow and peak flow would be more protective of the species than an abrupt change from baseflow to peak. An intermediate flow for the ascending and descending limb of the hydrograph based on water availability would be protective.”

Water in excess of the Miller (2024a) proposal appears to be present in the claimed reach during the spring snowmelt period, April 1 through July 30. Milk Creek has bank full water levels most years during the spring snowmelt period. These bank full flows are in excess of the proposed 40 cfs instream flow rate to protect native fishes. The existing spring snowmelt flow regime provides adequate depths and velocity to support the Three Species and Speckled Dace in the claimed reach of Milk Creek.

The habitat requirements of the Three Species and the Speckled Dace can be compared to the water depths and velocities provided by the Miller (2024a) flow proposals to determine the level of protection that would be provided at the proposed flows.

3.2 Three Species Depth and Velocity Requirements

The Miller (2024a) flow proposal for Milk Creek is intriguing because four different subsets of the Three Species in Milk Creek may be protected, including

1. Resident individuals of the Three Species that inhabit the claimed reach on a year-round basis,
2. Migratory individuals of the Three Species whose home range includes the claimed reach of Milk Creek and the mainstem Yampa River on a seasonal basis. These individuals move into Milk Creek in the spring to spawn and then return to the mainstem Yampa River for the remainder of the year,
3. The Bluehead Sucker that are stocked by the CPW into the claimed reach of Milk Creek. The objective of stocking Bluehead Suckers into Milk Creek is to increase the number of Bluehead Suckers in the mainstem Yampa River. CPW stocks two- and three-year old Bluehead Suckers. These older, and relatively larger (five-inch), individuals may avoid predation from the larger non-native piscivorous species that inhabit the mainstem Yampa River by remaining in the claimed reach. These stocked Bluehead Sucker may

well move out into the Yampa River to mature and then return to Milk Creek in a subsequent spawning season,

4. The larvae and age-0 fingerlings of all the first three groups that may be found in the claimed reach each spring, summer and fall. Longitudinal connectivity must be maintained from the claimed reach to the mainstem Yampa River to allow fingerlings to migrate to the mainstem Yampa River from nursery areas in lower Milk Creek.

Milk Creek is different in that an instream flow will protect adults of the Three Species that migrate into Milk Creek from the mainstem Yampa River, not just those that are year-round residents of the stream. These adults are large fish moving into a small stream. Most instream flow recommendations have been based on a principle that large fish live in large waters and smaller fish live in smaller waters. In the case of Milk Creek, larger fish are predominately present during part of the year in a small stream and these fish require adequate habitat to successfully spawn.

Water depth and water velocity are two habitat variables that can determine if a fish species can colonize or spawn in a stream reach. Water depth and water velocity are also two variables that Miller (2024a) emphasized in development of his flow proposals.

CPW fishery biologists have long recognized that depth and velocity are important factors when sampling for the Three Species. Adults of the Three Species will be most abundant when water is deepest in the habitat used by each species; deep runs (Miller [2024b] uses the term “glides” for runs) and pools for Flannemouth Sucker, riffles or runs for Bluehead Sucker and pools, in general, for the Roundtail Chub. Flannemouth Suckers are often encountered in deep runs when water is from waist to chest deep while Bluehead Suckers are often collected in slightly faster waters that may be a little shallower. The Roundtail Chub seems to use deeper water in the day and shallower water in the nighttime hours. Roundtail Chub are associated with diverse habitat where water is relatively deep, and structure is more prevalent, including areas of undercut banks, large rocks on the substrate or stream bank and in some stream reaches overhanging shrubs and trees.

Published data are similar to the qualitative observations of CPW biologists. The optimum depth for Flannemouth Suckers in Colorado waters appears to be a depth between 1.3 feet to 6.6 feet (Anderson and Stewart, 2003, page 56, Figure 8). Flannemouth Suckers in Wyoming selected waters from 1.6 feet to 3.3 feet in depth (Sweet 2007). The optimum depth for Bluehead Suckers in Colorado waters appears to be a depth between 1.6 feet and 5 feet (Anderson and Stewart, 2003, page 55, Figure 7). Bluehead Suckers in Wyoming selected waters from 1.6 feet to 3.3 feet in depth (Sweet 2007). Miller (2024b) calculated that a depth of 0.91 feet to 4.0 feet are the recommended suitability index for Flannemouth Sucker and Bluehead Sucker in the claimed reach, values similar to the published literature noted in the first portion of this paragraph. Specific information regarding Roundtail Chub and water depth is lacking. However, adults and juveniles are usually taken in comparatively deep water with low water velocity (Rees et al. 2005) and in stream reaches with a complex combination of pool and riffle habitat and cover (Bezzarides and Bestgen 2002).

The Bluehead Sucker uses riffle habitats more than the other two members of the Three Species. Water depth in general is deeper in runs and pools than in riffles in a given stream reach. Maintaining a reasonable water depth in riffles for Bluehead Suckers would provide protection for not only Bluehead Suckers but also the Flannemouth Sucker and Roundtail Chub (Stewart and Anderson 2007). The CWCB has agreed in prior hearings that a water level that provides Bluehead Suckers with adequate habitat in riffles would provide adequate habitat for the Flannemouth Sucker and the Roundtail Chub.

An average water depth of 1.0 foot and a flow velocity of 1.3 feet/second provides “marginally suitable” habitat for Bluehead Suckers (Anderson and Stewart 2003). The term “marginally suitable” is a quote from Anderson and Stewart (2003) and is interpreted and used throughout this report as the low end of a range of values that provides “reasonable” protection as used in the instream flow program. Thus, the Miller (2024a) instream flow rates proposed for Milk Creek can be compared to the marginally acceptable water depths and velocities for Bluehead Sucker to determine if the flow recommendation is appropriate to provide the fishery to an adequate habitat.

Lower water depths will not necessarily eliminate the Three Species from Milk Creek. However, at low flows the adult members of the Three Species that are present may well be smaller fish, a situation observed in other Colorado stream reaches. Flannemouth Suckers, for example, were found in Yellow Jacket Creek in the southwest corner of Colorado. The runs were about 1.5 feet deep and the largest Flannemouth Suckers were less than 14 inches in length. Yellow Jacket Creek water depth was at the low end of the “optimum” depth as noted by Anderson and Stewart (2003) for Flannemouth Sucker but a lack of deeper runs and pools resulted in comparatively smaller adult Flannemouth Sucker. Flows in the Dolores River upstream of the San Miguel River confluence are even lower and Flannemouth Suckers only reached a maximum length of eight to ten inches (R. Anderson, CPW retired, personal communication). In contrast, Flannemouth Suckers can be 25-inches in length in streams and rivers with runs and pools in excess of 3.3 feet deep. A decrease in size may well lead to a reduced fecundity in the population as a whole. Water depths may become so low that the fish populations become extirpated. The resident population of the Three Species could likewise be impacted if the current flows are reduced for a period of years.

The water depth in riffles is especially important. Water too shallow in riffles may restrict movement of large adult fish in a stream reach. Adequate depths are needed to provide longitudinal connectivity along a stream reach so that fish can move freely through pool, runs and riffles. In Milk Creek, longitudinal connectivity is needed to allow Bluehead Sucker and Flannemouth Sucker to move through the claimed reach but also to access the Yampa River at the lower terminus of the claimed reach. Mature adult Bluehead Sucker and Flannemouth Sucker can move through riffles at a water depth of 0.6 feet (Zach Hooley-Underwood, CPW personal communication). Thus, these two species would be able to move into and through the claimed reach at a flow of 8 cfs in the months of August through March. This represents a minimum flow since only a portion of riffles in the claimed reach (slightly less than two feet in any stream profile: Miller 2024a) have water depths greater than or equal to 0.6 feet.

Water depth is correlated with water velocity. Water velocity and water depth in riffles, runs and pools increase as the flow volume increases during spring snow melt time periods, or during summer thunderstorms. Both Flannemouth Suckers and Bluehead Suckers may select different areas within the stream as flow levels change. For example, Flannemouth Sucker may well be in deep water runs at water velocities of 3 feet/second to 4 feet/second but move to areas with slower currents, including pools, when water velocities exceed 4 feet/second at higher stream flows. Miller (2024b) calculated that water velocities from 0.6 feet per second to 2.5 feet/second are the recommended suitability index velocities for Flannemouth Sucker and Bluehead Sucker in the claimed reach. Bluehead Suckers may move to deep water runs and Flannemouth Sucker may move to pool areas with slower current. Movement of Bluehead Sucker and Flannemouth Sucker within rivers like the claimed reach of Milk Creek is a seasonal pattern depending on fluctuations in flow rates that influence both water depth and water velocity and sensitive stages of the fish species' natural history. Water depth and water velocity needs of the Three Species were used by Miller (2024a, 2024b) to create proposed instream flow recommendations for the claimed reach

3.3 Speckled Dace Depth and Velocity Requirements

Protection for the Speckled Dace must also be considered when analyzing the proposed instream flow rates. The Speckled Dace is a small bodied native fish that is not known to migrate long distances. Protection of Speckled Dace involves providing adequate habitat within the stream reach in question. Habitat needs regarding depths and velocities for this species have been determined.

Speckled Dace occupy a wide range of water depths from 2 inches (Moyle and Baltz 1985) to 5.1 feet (Batty 2010), but prefer shallow, low velocity habitats. In a similar manner, Speckled Dace inhabit a wide range of water velocities ranging from 0.3 feet/second (Baltz et al. 1982) to 3.5 feet/second (Batty 2010). This dace species prefers water velocities of 0.95 feet/second to 1.4 feet/second (Moyle and Baltz 1985).

Spawning requirements are also quite broad. Winkowski and Kendall (2018) determined this small minnow prefers a spawning depth of about 2 feet. In extreme contrast, Speckled Dace were observed spawning in a small New Mexico stream in two inches of water over a clean gravel substrate one to two inches in diameter (Mueller 1984). This species has an extended spawning period throughout the spring and summer, where peak activity occurs when water temperatures reach 65°F (18.3°C) (Sigler and Sigler 1996).

The Miller (2024a) instream flow rates proposed for Milk Creek result in a water depth in portions of riffles of at least 0.6 feet. A depth of 0.6 feet (7.2 inches) is closer to the two-inch depth reported by Mueller (1984) to be acceptable for spawning compared to the 2 feet depth postulated by Winkowski and Kendall (2018). Speckled Dace spawn in riffles with a cobble substrate. So, riffle depths of 0.6 feet would be appropriate for Speckled Dace spawning and can be considered to be minimal depths for purposes of establishing instream flows for the species. Adults are usually found in pools, slow runs, eddies and along shorelines, not riffles. Water depth in pools and runs would be greater than 0.6 feet if, water depth in portions of Milk Creek

riffles was 0.6 feet. Thus, a flow of 8 cfs results in appropriate habitat for the native Speckled Dace in Milk Creek.

4.0 Comparison of Milk Creek Instream Flow Rates Proposed to Habitat Needs of the Three Species and Speckled Dace

4.1 Background

The instream flow rates proposed by Miller (2024a) provide different water depths and velocities based on season for the claimed reach of Milk Creek. The behavioral patterns of the Three Species vary from season to season and with changing flows. Fish behave differently in breeding season compared to the remainder of the year. A separate analysis for each seasonal flows recommended is presented in the following sections for that reason.

An instream flow should provide a “reasonable” level of protection for the Three Species resident to the claimed reach. However, the term “reasonable” is not defined by the CWC. There is no specific flow value that represents the minimum instream flow that provides reasonable protection. The flow in a stream or river fluctuates to some degree over the course of each day. Assessing flow recommendations is thus an action that considers a range of flow values. Some flow rates would be on the low side of what is reasonable and some would be on the high side of what is reasonable. This type of assessment includes an aspect of best professional judgement.

As with many Colorado streams, Milk Creek is at base flows through the late summer, fall and winter months, and elevated flows in spring and early summer. Higher spring and early summer flows protect and support reproduction of the Bluehead Sucker and Flannelmouth Sucker. Fertilized eggs, developing larvae and fry would be protected in late summer, fall and winter months, when flows are lower. These recommended flows would protect Bluehead Sucker and Flannelmouth to a reasonable degree. The flow requests are explained in the following sections: 4.2 through 4.5.

4.2 Spring Flows April – June (40 cfs)

Spring flows through the claimed reach of Milk Creek are critical. Spring and early summer are the spawning season for the Three Species and Speckled Dace. These species spawn in riffles and relatively shallow runs, with a cobble, rubble substrate. Any adults of the Three Species that are resident to the lower section of Milk Creek spawn in the claimed reach, as do adults that migrate to Milk Creek from the mainstem Yampa River, as well as adult Bluehead Suckers that were stocked by CPW. Adequate flow is needed in the spring when water temperatures increase in Milk Creek and initiate spawning activities in the Three Species. The CPW plans to enhance Bluehead Sucker populations in the mainstem Yampa River are part of the reason for requesting an instream flow for Milk Creek and demonstrate the importance of maintaining reasonable protection of these fish in Milk Creek.

Bluehead Suckers and Flannemouth Suckers are broadcast spawners. A single male, or a group of males, move with a gravid female into an appropriate microhabitat (usually a cobble bottomed riffle) to spawn. Usually more than one male swims closely alongside the female. The female releases eggs while the attending males release sperm. A cloud of sperm can be observed drifting downstream from the spawning aggregate. The fertilized eggs then drift downstream, settling to the stream bed to begin embryonic development. The more water in the river at that time the more the eggs disperse, settling into a wider range of microhabitats, perhaps enhancing survival of eggs.

Miller (2024a) analyzed the habitat in the claimed reach of Milk Creek for the spring spawning period from April through June using the System for Environmental Flow Analysis (SEFA), discussed above. Miller (2024a) examined water velocity, depth and substrate type by data collected in different seasons, including the spring and early summer spawning period. Water depth and velocity from multiple cross sections on two stream reaches were included in the analysis. The term applied to the model output is “Average Weighted Suitability” (AWS). AWS is to create the instream flows for the claimed reach (Miller 2024a). This is a combined index for velocity, depth and substrate. AWS is measured as the number of square feet per foot of stream. Adult Bluehead Suckers and Flannemouth Suckers need both holding habitat and spawning habitat in the claimed reach. Figure 5 from Miller (2024a) is included immediately below to demonstrate both the change at different flows and the differences between adult habitat and spawning requirements.

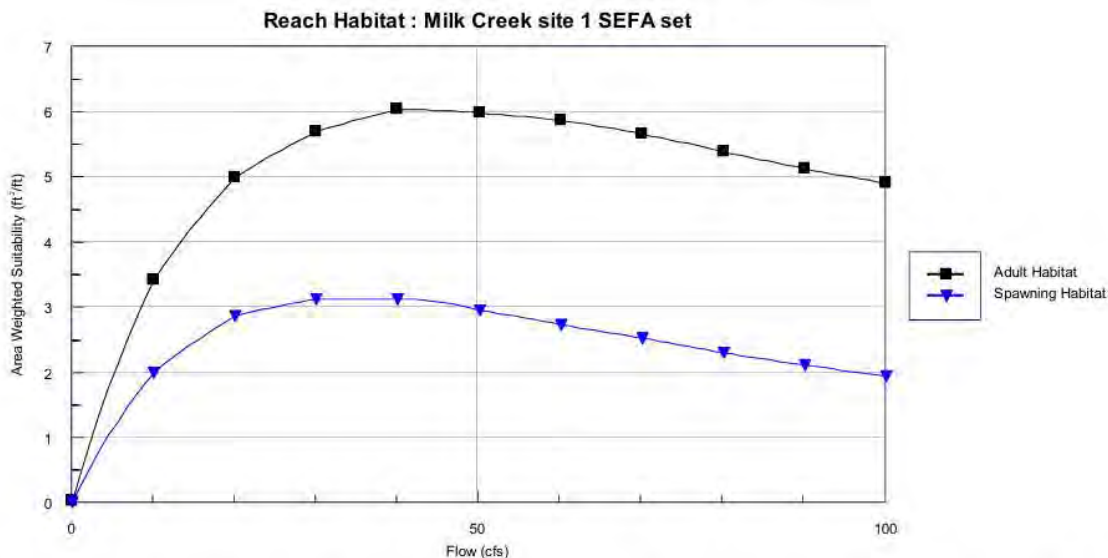


Figure 5. Milk Creek Site 1 predicted average weighted suitability as a function of discharge for adult and spawning Flannemouth and Bluehead Suckers.

The interaction of these variables is such that the highest AWS index value occurs at a flow of 40 cfs in Milk Creek (Miller 2024a, Figure 5 and Figure 6). The amount of suitable habitat decreases at both lower and higher flows. The amount of appropriate habitat for spawning is lower than the amount of appropriate habitat suitable for adults at all flows. However, the goal of the proposed instream flow regime in Milk Creek is not to just protect large adult suckers, but to protect spawning fish. Protection of spawning adults becomes more important in Milk Creek

where the production of young enhances the population in the mainstem Yampa River as well as Milk Creek. Protection of the young of the Three Species can be assisted by providing appropriate flows through as much of spawning season as possible. Miller (2024) noted that,

“protecting a minimum flow during snow melt runoff (April June) of 40 cfs would provide unimpeded fish passage for fish migrating into Milk Creek and the most spawning habitat.”

Monthly modeled flow data demonstrated that the amount of spawning habitat increases in the spring (April) as snowmelt starts in the surrounding mountains, peaks at a flow of 40 cfs, and then decreases at higher flows. Spawning success would appear to vary across years through wet years and drought years. One way to assure reproductive success for these two sucker species would be to protect a 40 cfs flow through the claimed reach, because the protection of spawning habitat is important for the fishery of the entire Yampa River basin.

Many aspects of a river’s ecology are related to maximum spring river flows. Sediments move when flows reach certain levels. Successful fish reproduction is connected to elevated flows. The stream channel is altered based on elevated river levels. The 40 cfs flow recommendation is much less than the peak water levels that often occur in Milk Creek during the spring snowmelt period. Adoption by the CWCB of the Miller (2024a) proposal of 40 cfs is appropriate. The flow of 40 cfs proposed by Miller (2024a) would provide reasonable protection for the Three Species during the spring and early summer spawning period.

4.3 Base Flows August – March (8 cfs)

The base flow period for Colorado streams such as Milk Creek is the time period following the spring snowmelt, extending to the following spring. These August through March flows are critical in the claimed reach. Larvae and fingerlings originating from the spawning of the Three Species may well be present annually during much of the time period of August through March. Bluehead Suckers stocked by CPW may well be present, and there are some Bluehead Sucker and Flannelmouth Sucker that are resident to the claimed reach.

Miller (2024a) recommended an instream flow of 8 cfs for the time period of August through March. A flow of 8 cfs maintains longitudinal connectivity from the claimed reach to the mainstem Yampa River. A continuous pathway at least two feet wide is present through all the cross sections at a flow of 8 cfs (Miller 2024a). Adults, fry and fingerlings of the Three Species would not be stranded and die in the claimed reach in the late summer months, an outcome common in many streams on the arid west slope of Colorado. Fry and fingerlings of the Three Species stranded in Cottonwood Creek in the Gunnison River basin die as the water disappears each year (Hooley Underwood 2019). With the 8 cfs proposed flow, Milk Creek can serve as a source of young Bluehead Suckers and Flannelmouth Suckers to the mainstem Yampa River population for the Three Species.

Available flow data indicate that a flow of 8 cfs is not always present in the claimed reach between August and April (Miller 2024a, Table 4). Instead, monthly flows may be as low as 4.7 cfs. Miller (2024a) addressed this, noting,

“The maximum depth analysis showed that a maximum depth of 0.6 feet in depth was present at some point in all cross sections at an average flow 4.6 cfs except for one of the seven shallowest cross sections. Fish movement across these shallow stream areas may be possible at flows as low as 4.6 cfs but movement may be slowed or temporarily impeded. Downstream movement may be less impeded for out migrating fish since the movement is in the same direction as the downstream velocity.”

Indeed, Miller (2024a, Figure 8 and 9) shows little longitudinal connectivity at flows less than 6 cfs. I would not think that a depth of 0.6 feet “at some point in all cross sections at an average flow 4.6 cfs” would provide long term protection and transit for large, or small, adult Bluehead Suckers or Flannemouth Suckers. Such shallow depths would provide scant shelter from predators such as Great Blue Herons, racoons and coyotes. However, relatively small, adult Bluehead Suckers can be found in small streams like Milk Creek, including sections of Roan Creek, Naturita Creek, and Mack Wash (John Woodling personal observation), where the depth of riffles can be less than 0.6 feet.

Flows that do not provide adequate habitat for larger Bluehead Suckers and Flannemouth Suckers may provide adequate habitat for younger fish. Fry and fingerlings resulting from these two species spawning in the claimed reach may well overwinter in Milk Creek. The parents of these larvae and fingerlings could be either migratory adults of the Three Species that spend most of the year in the mainstem Yampa River, year-round residents, or even adult Bluehead Suckers stocked by CPW that matured and returned to spawn. These young fish inhabit areas of the stream with shallower depths (along the shoreline) and lower water velocities (Tyus and Haines 1991; Childs et al. 1998). The presence of continual stream flow during the August to March time period will provide holding habitat and shelter for these small fish that are so vulnerable to predation.

The 5-inch Bluehead Sucker stocked by CPW may well find a reasonable amount of habitat in pools and runs at flows less than 8 cfs. These stocked fish could feed, grow to a larger size, and be protected from the large-bodied predatory species that inhabit the mainstem Yampa River. Protection for younger stocked Bluehead Sucker in the claimed reach during base flow periods would help and enhance the Bluehead Sucker population in the mainstem of the Yampa River, once the stocked fish grow and migrate out into the mainstem river. Protection of Bluehead Suckers would by definition, provide a benefit for the CPW program to enhance the numbers of this sucker species in the mainstem Yampa River.

I recommend that the proposed flow of 8 cfs be approved for the time period of August through February, but that a higher flow be approved for the month of March (see following section). A flow less than 8 cfs may not provide minimum protection for larger adults. If, however, only mean monthly flows from 4.6 cfs to 8 cfs are available in some months, protection of younger life stages should not be ignored.

4.4 July Flow

Miller (2024) did not suggest a specific flow rate for the month of July. Instead, he noted,

“Appropriate flows for the ascending and descending limb of the hydrograph would allow more unimpeded movement for migration and for resident fish moving to spawning locations. A streamflow that is intermediate between the recommended base flow and peak flow would be more protective of the species than an abrupt change from baseflow to peak. An intermediate flow for the ascending and descending limb of the hydrograph based on water availability would be protective.”

The average July flow is 8 cfs in the claimed reach (Miller 2024a). This July flow of 8 cfs would provide longitudinal connectivity to the mainstem channel for adult Bluehead Suckers and Flannemouth Suckers. Miller (2024a) noted that,

“A passage criterion of 0.6 foot (7 inches) of depth was chosen based on professional judgement to evaluate fish passage for the native suckers. This depth is approximately double the body depth of adult Flannemouth Suckers (the larger of the two species), which should allow passage. The SEFA fish passage/connectivity analysis for Milk Creek showed a flow of 8 cfs there is a continuous pathway for fish passage through all cross sections that is at least 2 feet in width and at least 0.6 feet in depth at Milk Creek Site 1 (Figure 9) and Milk Creek Site 2 (Figure 10).”

This connectivity may be especially important in July. Adults that migrated upstream from the mainstem Yampa River upstream into Milk Creek to spawn earlier in the spring will move downstream to the mainstem Yampa River, often as stream flows subside on the descending arm of the hydrograph. Adults resident to the claimed reach can likewise move if appropriate. During this time period developing eggs, larvae and fry that did not settle to the substrate, may still be drifting downstream. An instream flow of 8 cfs for July would also provide a level of protection for the five-inch long Bluehead Suckers CPW stocks into Milk Creek as well as Speckled Dace.

A July instream flow of 8 cfs for the claimed reach would be appropriate. This would help provide a continual flow in the claimed reach on a year-round basis, assuring that the Three Species and Speckled Dace would be a viable, vigorous assemblage in Milk Creek surviving over an extended number of decades.

4.5 March Flow

Miller (2024a) recommended a flow of 8 cfs for the month of March which does not address Bluehead Sucker and Flannemouth Sucker spawning in March (Barkalow et al. 2016). As described above in section 2.2, Flannemouth Sucker and Bluehead Sucker spawning in March is well documented.

A flow of 8 cfs is not appropriate for March. Appropriate instream flows for Milk Creek in March are needed to protect spawning Bluehead Sucker and Flannemouth Sucker in March as

well as April through June. While adult sucker migrating into Milk Creek in March may not actually spawn at that time, adult habitat is needed to protect and shelter these fish.

A mean flow of 19.7 cfs exists in March in Milk Creek (Miller 2024a, Table 4 page 9). The AWS present in March is more than is present in the month of May (Miller 2024a, Figure 7 and Figure 8). Accordingly, I recommend a flow of 20 cfs be adopted for the month of March to provide reasonable protection for the Three Species during the annual spawning period.

4.6 Speckled Dace

The two seasonal instream flows proposed by Miller (2024a) for Milk Creek generally fall within the range of depths and velocities that support Speckled Dace populations. The Speckled Dace seems to be a generalist in regard to water depth and velocity, at least in comparison to the depths and velocities proposed by Miller (2024a). The Speckled Dace appears to be reasonably protected by instream flows proposed by Miller (2024a).

5.0 Summary and Recommendation

Adopting an instream flow in the claimed reach is particularly important in that four different subsets of the Three Species are found in the claimed reach. The four subsets are,

1. Resident individuals of the Three Species that inhabit the claimed reach on a year-round basis,
2. Migratory individuals of the Three Species whose home range includes the claimed reach of Milk Creek and the mainstem Yampa River on a seasonal basis. These individuals move into Milk Creek in the spring to spawn and then return to the mainstem Yampa River for the remainder of the year,
3. The Bluehead Sucker that are stocked by the CPW into the claimed reach of Milk Creek. The objective of stocking Bluehead Suckers into Milk Creek is to increase the number of Bluehead Suckers in the mainstem Yampa River. CPW stocks two- and three-year old Bluehead Suckers. These older, and relatively larger (five-inch), individuals may avoid predation from the larger non-native piscivorous species that inhabit the mainstem Yampa River by remaining in the claimed reach. These stocked Bluehead Sucker may well move out into the Yampa River to mature and then return to Milk Creek in a subsequent spawning season,
4. The larvae and age-0 fingerlings of the first three groups that may be found in the claimed reach spring, summer and fall. Longitudinal connectivity must be maintained from the claimed reach to the mainstem Yampa River to allow fingerlings to migrate to the mainstem Yampa River from nursery areas in the claimed reach.

Establishing an appropriate instream flow for Milk Creek would also provide protection for the Speckled Dace.

No set of numeric values exists that indicates precisely when a habitat variable (such as depth or velocity) becomes unsuitable for colonization by a fish species or when that variable may reduce growth or numbers. Milk Creek is a much smaller stream than the Yampa River. Members of the Three Species that are year-round residents in Milk Creek may be smaller than the adults that

migrate upstream from the Yampa River to the claimed reach to spawn in the spring and early summer to spawn. The larger, migratory fish coming from the larger Yampa River would select deeper waters than the resident fish of the same species. Determining appropriate flows for all species includes addressing a range of values for a number of parameters and some level of professional judgement.

I believe the analysis and data generated by Miller (2024a) in this matter are excellent and were done in a professional manner. Miller (2024a) has suggested two different seasonal instream flows for the claimed reach of Milk Creek based on season. These two recommendations are,

1. 40 cfs (April through June),
2. 8 cfs (August through March).

5.1 Recommendation Regarding the Flow Proposal of 40 cfs from April through July

I recommend the flow of 40 cfs from April through June be approved by the Colorado Water Conservation Board. The flow of 40 cfs would provide reasonable protection during most of the spawning season for the native fish (the Three Species and the Speckled Dace) that inhabit the claimed reach of Milk Creek as well as members of the Three Species that migrate from the Yampa River to spawn in the spring. Flannemouth Sucker spawning season begins in March, not in April. These flows would also provide reasonable protection for the Bluehead Suckers stocked by the CPW into Milk Creek.

The Bluehead Sucker is often found in shallower water than either the Flannemouth Sucker or the Roundtail Chub. In addition, the Bluehead Sucker is often found in riffles. The CWCB has agreed in the past that the adults of the Three Species are assumed to be protected to a reasonable degree when the Bluehead Sucker is provided with appropriate habitat to a reasonable degree.

The Speckled Cub would also be reasonably protected at a flow of 40 cfs. The Speckled Dace is still widely distributed in the species' native range on the western slope, but the species has disappeared from some waters on the western slope. Protection of the species is warranted.

5.2 Recommendation Regarding the Flow Proposal of 8 cfs from August through March

I recommend a flow of 8 cfs from August through February. The proposed flow of 8 cfs from August through February provides reasonable water depths and habitat for,

1. the Speckled Dace,
2. larvae and fry of the Three Species that hatch and grow to fingerling size in the claimed reach,
3. The five-inch long Bluehead Suckers CPW stocks into Milk Creek. These Bluehead Suckers stocked by CPW are much smaller than adults of the species. These smaller fish may find appropriate habitat in Milk Creek at a flow of 8 cfs for an extended period of

time. These stocked fish could feed and grow in Milk Creek at a flow of 8 cfs and at the same time be protected from predation by the large bodied piscivorous species that inhabit the mainstem Yampa River

4. Smaller adults that may use Milk Creek in the claimed reach throughout the entire year and do not migrate to the mainstem Yampa River in low flow months.

The flow of 8 cfs also provides longitudinal connectivity for the Three Species to move throughout the claimed reach and to migrate downstream to the Yampa River. Maintaining connectivity assures that the fry and fingerlings of the Three Species would not be stranded in Milk Creek in the late summer months, an action which could mean the death of these fry and fingerlings. Milk Creek can serve as a source of recruits to the mainstem Yampa River population for the Three Species. The CPW stocking program is designed to use Milk Creek as a source of young Bluehead Suckers to bolster the species' population in the mainstem of the Yampa River and not just the claimed reach.

Available flow data indicate that a flow of 8 cfs is not always present in the claimed reach between August and April (Miller 2024a, Table 4). Instead, monthly flows may be as low as 4.7 cfs. A flow less than 8 cfs does not provide minimum protection for larger adults moving into and out of the claimed reach to the Yampa River. If, however, only mean monthly flows from 4.6 cfs to 8 cfs are available in some months from August through February, protection of younger life stages should not be ignored. A minimum flow equal to the mean flows found in the months.

5.3 Recommendation Regarding March

Miller (2024a) recommended a flow of 8 cfs for the month of March which does not protect Bluehead Sucker and Flannelmouth Sucker spawning in March. A flow of 8 cfs is not appropriate for March as discussed above in section 5.2. Appropriate instream flows for Milk Creek in March are needed to protect spawning Bluehead Sucker and Flannelmouth Sucker in March as well as April through June. While adult sucker migrating into Milk Creek in March may not actually spawn at that time, adult habitat is needed to protect and shelter these fish.

A mean flow of 19.7 cfs exists in March in Milk Creek. Accordingly, a flow of 20 cfs should be adopted for the month of March to provide reasonable protection for the Three Species during the annual spawning period.

5.4 Recommendation Regarding July

Miller (2024a) did not suggest a flow for the month of July. No reason was given by Miller (2024a) for not proposing a July flow. The average July flow is 8 cfs in the claimed reach (Miller 2024a) which would provide longitudinal connectivity to the mainstem channel for adult Bluehead Suckers and Flannelmouth Suckers. I recommend an instream flow rate of 8 cfs for the month of July.

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CURRICULUM VITAE

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EDUCATION

Ph.D., Biology Major, University of Colorado, Boulder, Colorado, 1993.

Title of Doctoral Dissertation: "Factors Effecting Toxicity of Metals To Brown Trout, An In Situ study of the Arkansas River"

M.S., Biology Major, Chemistry Minor, University of Louisville, Louisville, Kentucky, 1971.

Masters Thesis: "Biological, Chemical, and Physical Characteristics of Brashears Creek, Spencer and Shelby Counties"

B.S., Biology Major, Mathematics Minor, Southern Colorado State College, Pueblo, Colorado, 1968.

PROFESSIONAL EXPERIENCE

- Jan 2007 - 2014 **College Instructor**
Colorado Mesa University, Grand Junction, Colorado. Scientific Writing, Aquatic Entomology, Fish Biology and Senior thesis (Undergraduate courses)
- Jan. 2004 - Present **Consultant, Woodling Aquatics, LLC.**
Clients include Colorado Trout Unlimited, Colorado State Land Board, Colorado Division of Hazardous Materials and Waste Management, West Slope Water Network, Sierra Club, Western Resource Advocates, Eagle River Watershed Council, City of Boise, Idaho and Eagle Mine Limited. Prepare technical assessments of environmental issues in aquatic systems. Represent organizations at Colorado Water Quality Control rulemaking hearings and testify as expert witness in US District Court.
- Jan. 1994 - 2005. **University Instructor**
University of Denver, Community College, Environmental Policy Management
Instructor, Wetland Ecology, General Ecology, Aquatic Toxicology, Research Writing, Endangered Species and Introduction to Water Quality (Graduate level classes) and capstone student advisor.
- Jan 1998 - 2010 **Research Associate**
University of Colorado Boulder, Colorado. Awarded US EPA grant in 2003 to study impacts of estrogenic compounds on Colorado fish populations.
- Jan. 1997 - 2003 **University Instructor**
University of Colorado, EPO Biology. Stream Biology.
- July 2002 - Retired
May 2003 **Cost Center Supervisor**
Colorado Division of Wildlife (DOW), Denver Colorado
- Principal duty was to manage and supervise water unit of the habitat section, including water quality and Water Quantity aspects of agency goals and objectives.
 - Develop budget and work objectives used by DOW to respond to water resource issues.
 - Supervised and directed water unit employees to achieve program goals
- Designed and developed web-based model to analyze fishery and habitat data for DOW use.
- Participated in state and federal Superfund and CERCLA by development and writing of and/or review of remedial investigation documents, feasibility studies and remedial action plans; negotiate for the state in settlement actions, testify in water quality related hearings and court cases.
- July 1987 - June 2002. **Program Specialist**
Colorado Division of Wildlife (DOW), Denver Colorado
- Principal duty was to represent the DOW in all matters pertaining to water quality issues.
 - Developed policy and programs used by DOW to respond to water quality issues.

- Designed and performed laboratory and field research studies of rivers throughout Colorado to define and quantify impacts of pollutants to aquatic ecosystems. Projects included efforts to create biological stream standard proposals for Colorado's eastern plains warm water streams and rivers and mountain trout streams. Potential biological stream standards were developed using results from genetic analysis of trout and aquatic macroinvertebrates, fish community structure modeling and stress hormone response studies on a variety of fish species. Ancillary studies included a multi-year monitoring program of the Eagle River, Arkansas River and Clear Creek to assess efficacy of remediation programs and systematic studies of the fish genera *Phoxinus* and *Cottus* in Colorado.
- Wrote and submitted successful grant applications to receive funding from US EPA, Colorado Department of Public Health and private enterprise for field and laboratory studies.
- Participated in state and federal Superfund and CERCLA by review and/or development of remedial investigation documents, feasibility studies and remedial action plans; negotiated for the state in settlement actions involving fish kills and CERCLA actions.
- Created DOW position in rulemaking hearings for the Colorado Water Quality Control Commission (WQCC) through which stream standards and use classifications are adopted.
- Member Colorado 319 Nonpoint Pollution Task Force.
- Appointed by WQCC to rewrite Colorado Stream Standards for nitrogen compounds.
- Testified as expert witness in court proceedings and rulemaking hearing of the WQCC.

April 1984 -
July 1987

Coldwater Program Specialist, DOW

- Developed, implemented and monitored statewide DOW coldwater fishery program.
- Developed annual budgets for DOW-fish hatcheries, aquatics section and aquatic research—\$6 million/year.
- Developed statewide DOW fish program budget, including hatcheries.
- Assisted DOW fish hatcheries in increasing production and efficiency.
- Co-authored report that resulted in the reorganization of the DOW fish hatchery system.
- Provided WQCC with technical information regarding water quality issues such as mine drainage.

July 1979 -
April 1984

Warmwater Program Specialist, DOW

- Developed, implemented and monitored statewide DOW warmwater fishery program.
- Prepared DOW response to legislative queries regarding annual budget.
- Worked with fish hatcheries to increase production and efficiency.
- Provided WQCC and Colorado Wildlife Commission with technical information regarding water quality issues such as nutrient enrichment and acid rain.

Sept. 1978 -
July 1979

Project Manager

Camp, Dresser and McKee, Denver, Colorado.

- Prepared bids, planned and directed interdisciplinary studies. Wrote final reports for these studies.
- Represented power companies, coal mining and other underground mining corporations.

Sept. 1973 -
Sept. 1978

Research Biologist

Colorado Water Quality Control Division, Denver, Colorado

- Planned and performed stream and river basin studies concerning impacts of mining, milling, agricultural, domestic and industrial effluents on water quality.
- Monitored and analyzed biological, chemical and physical components of aquatic ecosystems to determine impacts from effluents on these systems.
- Performed *in situ* assays to determine toxicity of pollutants to resident fish populations.
- Served as expert witness at public hearings and adjudicatory hearings.
- Served as member of subcommittee to develop Colorado water quality standards and use classifications.

Jan. 1971-
May 1971

College Instructor

- Taught Human Anatomy and Physiology, University of Southern Colorado.

Sept. 1971-
June, 1972

High School Teacher

Cathedral High School, Denver, Colorado.

- Taught high school biology and coached football and wrestling.

July 1968-
Dec, 1970

Research Assistant

University of Louisville, Louisville, Kentucky

- Implemented a pre-impoundment study of the Salt River in central Kentucky. Collected and analyzed water quality samples, collected and identified aquatic macroinvertebrate and fish samples.

- Collected and analyzed samples measuring the movement of radioactive nucleotides through a spring-fed system, Doe Run in Kentucky.

Sept. 1966-
Dec. 1967.

Laboratory Assistant

Southern Colorado State College, Pueblo, Colorado.

- Taught laboratory sections in zoology, botany, plant physiology and ecology

PUBLIC SERVICE

Colorado 319 Nonpoint Pollution Council. Voting member 1989-2001.

Cherry Creek Basin Authority. Voting member 2001-2005, 2015 - present. Appointed by Governor of Colorado.

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