West Muddy Creek Executive Summary

CWCB STAFF INSTREAM FLOW RECOMMENDATION
March 19-20, 2025

UPPER TERMINUS:	confluence Sheep Creek at UTM North: 4325599.99 UTM East: 286097.65
LOWER TERMINUS:	confluence Muddy Creek at UTM North: 4319399.06 UTM East: 295770.58
WATER DIVISION/DISTRICT:	4/40
COUNTY:	Gunnison
WATERSHED:	North Fork Gunnison
CWCB ID:	21/4/A-011
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	8.78 miles
FLOW RECOMMENDATION:	5.5 cfs (10/01 - 03/31) 12.9 cfs (04/01 - 07/15) 5.5 cfs (07/16 - 07/31) 2 cfs (08/01 - 09/30)

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 water rights (NLL). 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/2025-isf-recommendations.

RECOMMENDED ISF REACH

The BLM recommended that the CWCB appropriate an ISF water right on a reach of West Muddy Creek at the January 2020 ISF workshop. West Muddy Creek is located within Gunnison County and is approximately 17 miles northeast of Paonia (See Vicinity Map). The stream originates on the eastern slope of Chalk Mountain and flows southeast until it reaches the confluence with Muddy Creek above Paonia Reservoir. Muddy creek is a tributary to the North Fork Gunnison River, which is tributary to the Gunnison River.

The proposed ISF reach extends from the confluence with Sheep Creek downstream to the confluence with Muddy Creek for a total of 8.78 miles. Twelve percent of the land on the proposed reach is BLM, 30% is managed by the United States Forest Service and 58% is privately owned (See Land Ownership Map). BLM's management goals include maintaining and enhancing habitat that supports fish species and functional riparian and wetland systems. Establishing an ISF water rights will assist in meeting these BLM objectives.

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 West Muddy Creek was sent to the mailing list in November 2024, March 2024, January 2024, November 2023, March 2023, March 2022, and March 2020. Staff sent letters to identified landowners adjacent to West Muddy Creek based on information from the county assessor's website. Public notices about this recommendation were published in the Crested Butte News on January 5, 2024 and December 20, 2024 and the Delta County Independent on December 12, 2024.

Staff presented information about the ISF program and this recommendation to the Gunnison County Board of County Commissioners on November 10, 2020, September 13, 2022, October 24, 2023 and October 8, 2024. Staff spoke with Luke Reschke, District 40 Lead Water Commissioner, and Doug Christner, Disctrict 40 Water Commissioner to better understand the administration on West Muddy Creek and its tributaries. CWCB and CPW staff met with members

of the North Fork Gunnison Water Users Association and Raquel Flinker from the Colorado River District on November 28, 2023 about the East Muddy Creek and West Muddy Creek ISF recommendations. CWCB and CPW staff also met with members of the Ragged Mountain Water Users Association and Raquel Flinker to discuss the recommendations on April 13, 2024. These stakeholder meetings included a presentation on the ISF recommendations and included discussions and questions about the purpose of ISF protection, stock uses, water availablity, and other concerns.

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.

West Muddy Creek is a cool-water, moderate gradient stream. The upper four miles of the reach flow through a valley approximately 0.5 miles in width with some meadows and irrigated fields. The lower four miles flow through a narrow mountain valley approximately 0.25 miles in width. The stream cuts through alluvial deposits in some locations and is constrained by bedrock in locations where the stream comes close to valley walls. The upper four miles of the creek generally has medium sized substrate, ranging from silt to one-foot boulders, while the lower four miles of the creek generally have large-sized substrate, ranging from small cobbles to two-foot boulders. The stream has a good mix of pool and riffle habitat for supporting native fish species.

Fisheries surveys have revealed self-sustaining populations of bluehead suckers, speckled dace, and sculpin, all of which are native species (Table 1). Bluehead suckers appear on BLM's sensitive species list, and BLM is a signatory to a multi-party, multi-state conservation agreement for that species to prevent a listing of bluehead suckers under the Endangered Species Act. The stream also supports self-sustaining populations of brook trout, rainbow trout, and white suckers, all of which are introduced species. Northern leopard frogs, which also appear on BLM's sensitive species list, have been documented along the creek (Figure 1).

Table 1. List of species identified in West Muddy Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None
white-blue sucker hybrid	*Catostomus commersoni x discobolus*	None
bluehead sucker	*Catostomus discobolus*	State - Species of Greatest Conservation Need
sculpin	*Cottus bairdii*	None
speckled dace	*Rhinichthys osculus*	None
rainbow trout	*Oncorhynchus mykiss*	None
northern leopard frog	*Rana pipiens*	State - Species of Greatest Conservation Need State - Species of Special Concern

Figure 1. West Muddy Creek, northern leopard frog

The riparian community in this part of West Muddy Creek is mostly comprised of willow species, alder, narrowleaf cottonwood and spruce. In general, the riparian community is in good condition, provides substantial shading and cover for fish habitat, and provides stream stability during flood events.

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

BLM staff used the R2Cross method to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996; CWCB, 2022). Riffles are the stream habitat type that are most vulnerable to dry if streamflow ceases. The data collected consists of a streamflow measurement, a survey of channel geometry and features at a cross-section, and a survey of the longitudinal slope of the water surface.

The R2Cross model uses Ferguson's Variable-Power Equation (VPE) to estimate roughness and hydraulic conditions at different water stages at the measured cross-section (Ferguson 2007, 2001). This approach is based on calibrating the model as described in Ferguson (2021). The model is used to evaluate three hydraulic criteria: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff use the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on the flow that meets all three hydraulic criteria. The winter flow recommendation is based on the flow that meets two of the three hydraulic criteria.

The R2Cross method estimates the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree or withdraws the recommendation.

Data Collection and Analysis

BLM collected R2Cross data at five transects for this proposed ISF reach (Table 2 and Site Map). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the stream reach. The R2Cross model results in a winter flow of 5.5 cfs and a summer flow of 12.9 cfs. R2Cross field data and model results can be found in the appendix to this report.

Table 2. Summary of R2Cross transect measurements and results for West Muddy Creek.

Date, XS #	Top Width (feet)	Streamflow (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
06/01/2018, 1	33.50	4.73	3.28	10.08
06/01/2018, 2	33.49	5.82	4.41	12.34
05/11/2021, 1	47.04	33.34	7.43	19.16
08/06/2021, 1	30.13	4.57	3.39	13.65
08/06/2021, 2	36.16	4.57	8.75	9.30
			5.45	12.91

ISF Recommendation

The BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

5.5 cfs is recommended from October 1 to March 31. This flow rate meets two of the three hydraulic criteria in the cross-sections analyzed. This flow rate should maintain sufficiently cool temperatures in pools during the late fall and should prevent icing in pools during the winter.

12.9 cfs is recommended from April 1 to July 15 to meet three of three hydraulic criteria. This recommendation is for the snowmelt runoff period and is driven by the average velocity criteria.

5.5 cfs is recommended from July 16 to July 31; this flow rate is reduced due to water availability limitations. This rate provides the maximum amount of physical habitat possible to the fish community during this high growth period.

2.0 cfs is recommended from August 1 to September 30. This flow rate is severely water limited due to existing water use practices and meets just one of three hydraulic criteria. This flow

rate will protect the wetted perimeter or mean depth in most cross-sections and will work to maintain cooler temperatures in summer months.

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 drainage basin of the proposed ISF on West Muddy Creek is 97.9 square miles, with an average elevation of 8,751 feet and average annual precipitation of 24.9 inches. West Muddy Creek is a cold-water, moderate gradient snowmelt driven hydrologic system with influence from mid-season monsoonal periods. Run off initiates in early April and generally reaches peak flow conditions by early to mid-May. Streamflow conditions are generally lowest in August and September during late summer. Hydrology is altered by both irrigation practices and reservoir storage and releases.

Water Rights Assessment

There are 48 active water rights on West Muddy Creek and its tributaries. These include up to 120 cfs of direct flow ditch diversions, and 6,450 acre-feet of reservoir storage. There are also two ISF water rights within the basin, one on an upper reach of West Muddy Creek from the headwaters to the confluence with Cow Creek (case number 84CW0411) the other on Dyke Creek, a tributary to the upper reach of West Muddy Creek (case number 04CW0157). Within the extent of the recommended reach, there is one direct diversion water right, the Snooks Ditch No 2 (WDID 4001199), which has two appropriation dates for 0.75 cfs each, a 1910 and a 1961.

The Overland Reservoir (WDID 4003399) is located relatively high in the system on Cow Creek, a tributary to West Muddy Creek. The Overland Reservoir is decreed for 6,200 acre feet of the above-mentioned storage rights and stores water from Cow Creek which is exported for irrigation and stock uses outside of the West Muddy basin. Exported water from the Cow Creek basin is recorded in diversion records from the Overland Ditch "Cow Creek" (WDID 4000585). Between 2017 and 2023 diversion records show that between 84.3 (2018) and 4952.01 (2017) acre feet is exported typically from April to October. By late July or early August, the Overland Ditch on Cow Creek is no longer in priority and all natural streamflow from Cow Creek continues downstream to Paonia Reservoir via West Muddy Creek (personal communication, Water Commissioner Luke Reschke, 9/26/2023 and 1/03/2024).

The North Fork Gunnison River is often under administration with calls extending up both West and East Muddy Creek. The priority calling dates are typically in the late 1800s to early 1900's, but the exact priority can shift through the season. Typically, the call is on by late-July, but some calls have occurred as early as June. North Fork Water Conservancy District was decreed multiple points of exchange upstream of Paonia Reservoir in case number 05CW0236, with up to a volumetric limit of 2,000 acre feet. According to Water Commissioner Luke Reschke, in most years this exchange starts towards the end of July and the seasonal limit is reached by early to mid-September (personal communication, 9/26/2023 and 1/03/2024).

Data Collection and Analysis

Representative Gage Analysis

No current or long-term gages exist within the reach for the ISF recommendation on West Muddy Creek. There are three historic gages on West Muddy Creek above the confluence with Cow Creek that monitored stream conditions from the mid-1950's though the mid-1970's. Due to the extent of downstream uses on the main channel and tributaries CWCB staff installed a temporary gage at the lower terminus of the current recommended ISF reach on West Muddy Creek.

Gage Analysis

The CWCB installed a temporary gage (West Muddy gage) at the lower terminus of the reach, 500 feet above the confluence where West Muddy Creek and East Muddy Creek combine to create Muddy Creek. This gage included a Hobo MX2001 pressure transducer recorded at a 15-minute interval that was installed on May 19, 2021, and maintained through present. Gaged West Muddy streamflow data is analyzed through October 8, 2024 (period of record, POR: 5/19/2021 – 10/8/2024). There are periods when the gage was ice affected each winter and the pressure transducer failed for two weeks during the rising limb of 2022. Water year 2023 received the most precipitation during the gage record and this is reflected in the hydrographs

for each year. 2024 snowmelt peaked at the earliest date in late April and lowest streamflow at 125 cfs. By comparison, streamflow in 2023 reached over 400 cfs 10 days later than 2024 and maintained high flows longer than the other two water years.

Staff analyzed total streamflow from the Division of Water Resources Muddy Creek above Paonia Reservoir, CO gage (MUDAPRCO, DWR WDID: 4003152) during its POR from 1985 to present to contextualize gaged data on West Muddy gage. MUDAPRCO is located approximately 2,300 ft downstream from the confluence of East and West Muddy Creek. Annual streamflow yield during the previous 30-year record (1995-2024) show that the three years monitored represent a year that is slightly above median yield, a wet year, and a dry year for 2022 through 2024, respectively. Therefore, the three years monitored during the POR, represent variability in patterns of streamflow and timing.

Daily average West Muddy Creek gaged data was calculated as mean monthly streamflow (See Complete Hydrograph). All basin diversions are reflected in gage records at West Muddy and no further adjustments were made to assess the impact on water available for the ISF reach.

Site Visit Data

CWCB staff made 23 streamflow measurements on the proposed reach of West Muddy Creek in support of rating curve development for the West Muddy gage, as summarized in Table 3.

Table 3. Summary of streamflow measurements for West Muddy Creek.

Visit Date	Flow (cfs)	Collector
5/19/2021	33.00	CWCB
6/17/2021	0.35	CWCB
7/17/2021	0.00	CWCB
8/18/2021	0.62	CWCB
9/14/2021	0.54	CWCB
11/2/2021	2.63	CWCB
2/22/2022	0.50	CWCB
5/5/2022	125.00	CWCB and DWR
5/23/2022	58.00	CWCB
6/23/2022	8.36	CWCB
8/19/2022	3.03	CWCB
9/29/2022	0.93	CWCB
4/20/2023	163.00	CWCB and DWR
6/6/2023	250.00	CWCB
7/27/2023	5.19	CWCB
8/15/2023	0.98	CWCB
11/6/2023	4.48	CWCB
3/28/2024	5.29	CWCB
6/12/2024	11.00	CPW
6/25/2024	7.41	CWCB
8/12/2024	1.56	CWCB
9/12/2024	1.67	CWCB
10/8/2024	1.49	CWCB

Water Availability Summary

The hydrograph shows estimated mean-monthly at the temporary West Muddy gage along with the proposed ISF rate. The proposed ISF flow rate is below the mean-monthly streamflow. Staff has concluded that water is available for appropriation.

MATERIAL INJURY

If decreed, the proposed ISF on West Muddy 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

Citations

Colorado Water Conservation Board, 2022, R2Cross model- User's manual and technical guide. Retrieve from URL: https://r2cross.erams.com/

Colorado Water Conservation Board, 2024, R2Cross field manual. Retrieve from URL: https://dnrweblink.state.co.us/cwcbsearch/0/edoc/224685/R2Cross%20Field%20Manual%202024.pdf

Eurich, A., Kampf, S.K., Hammond, J.C., Ross, M., Willi, K., Vorster, A.G. and Pulver, B., 2021, Predicting mean annual and mean monthly streamflow in Colorado ungauged basins, River Research and Applications, 37(4), 569-578.

Ferguson, R.I., 2007. Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research 43. https://doi.org/10.1029/2006WR005422

Ferguson, R.I., 2021. Roughness calibration to improve flow predictions in coarse-bed streams. Water Res 57. https://doi.org/10.1029/2021WR029979

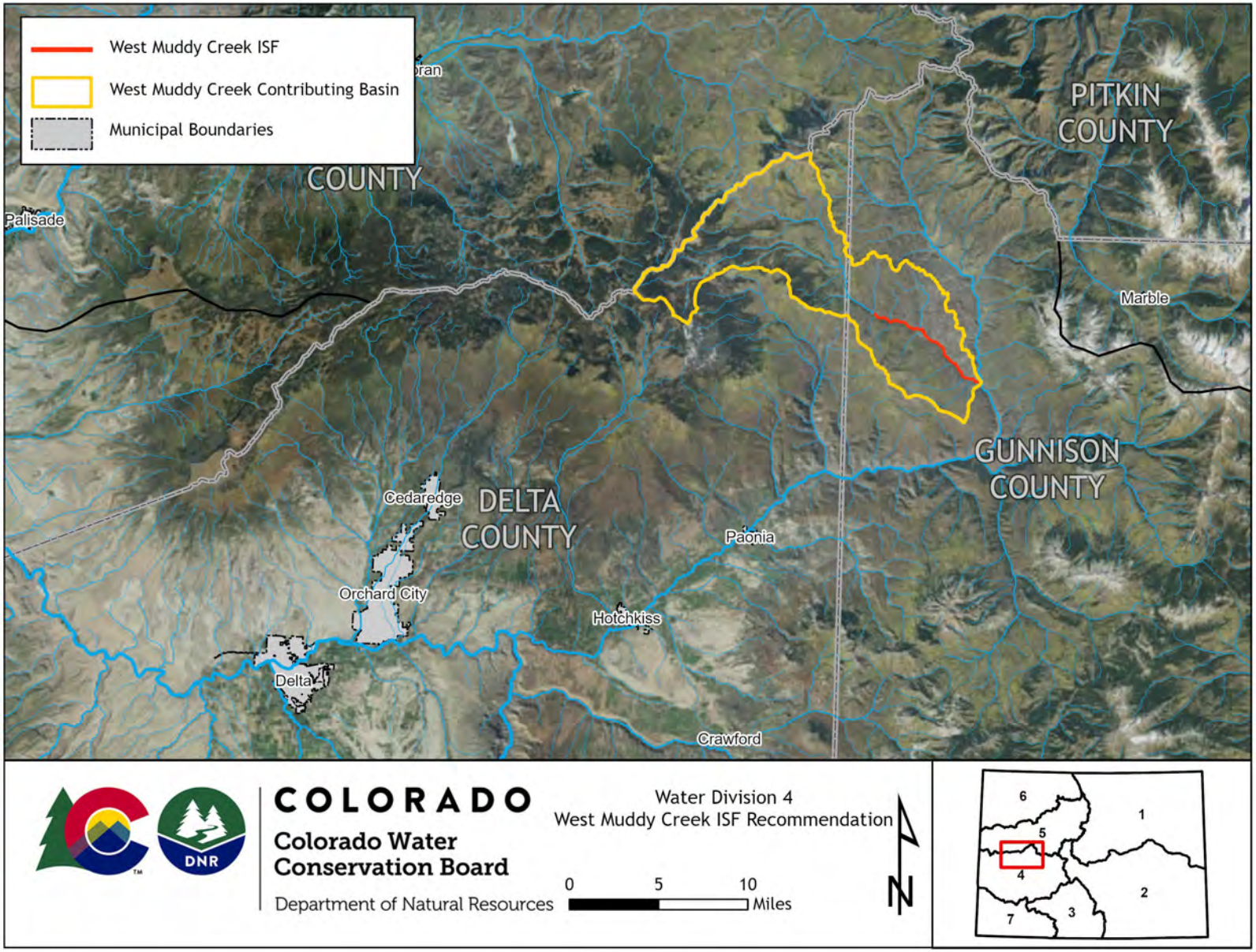
Nehring, B.R., 1979, Evaluation of instream flow methods and determination of water quantity needs for streams in the state of Colorado, Colorado Division of Wildlife.

Metadata Descriptions

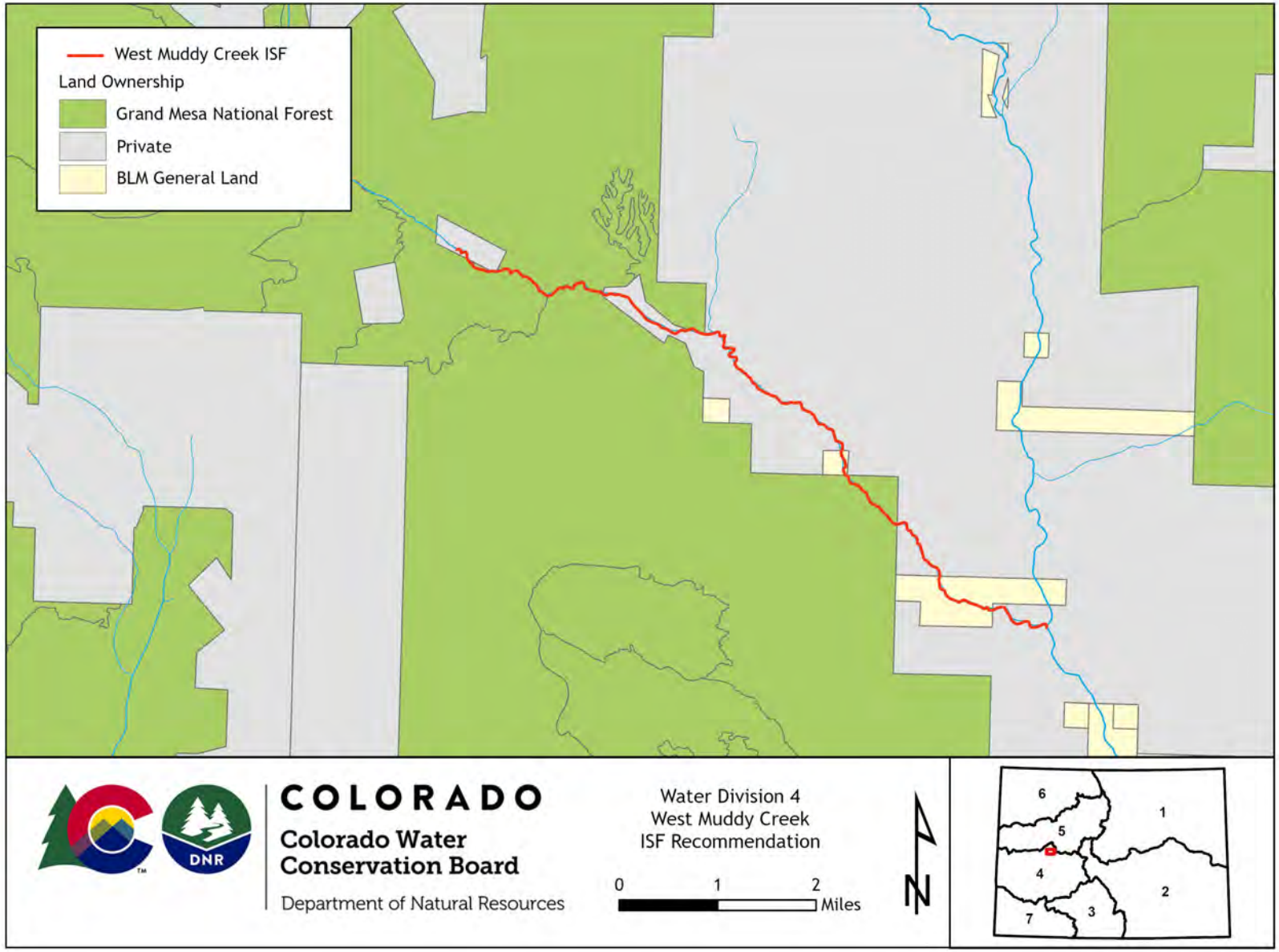
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

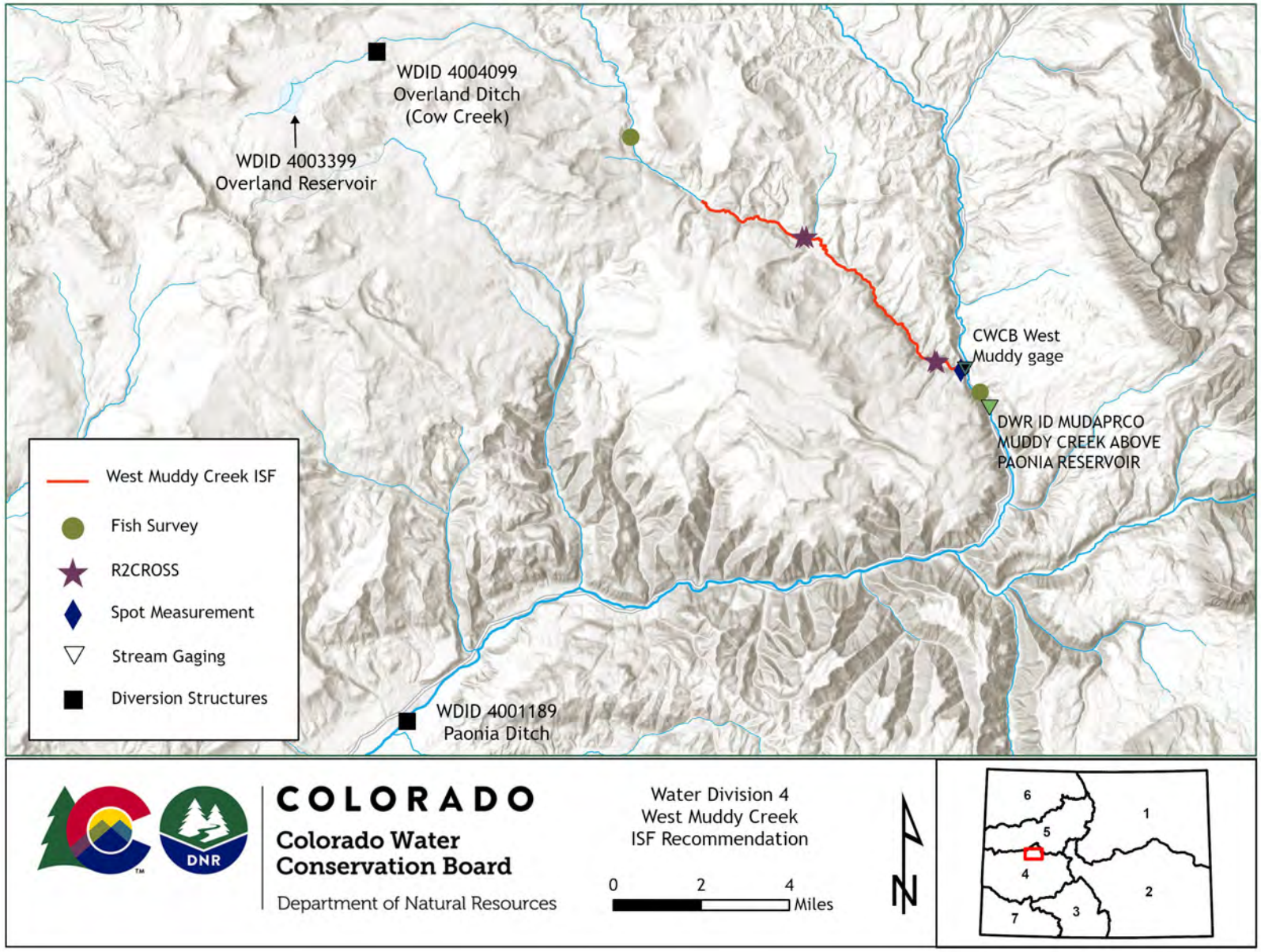
VICINITY MAP



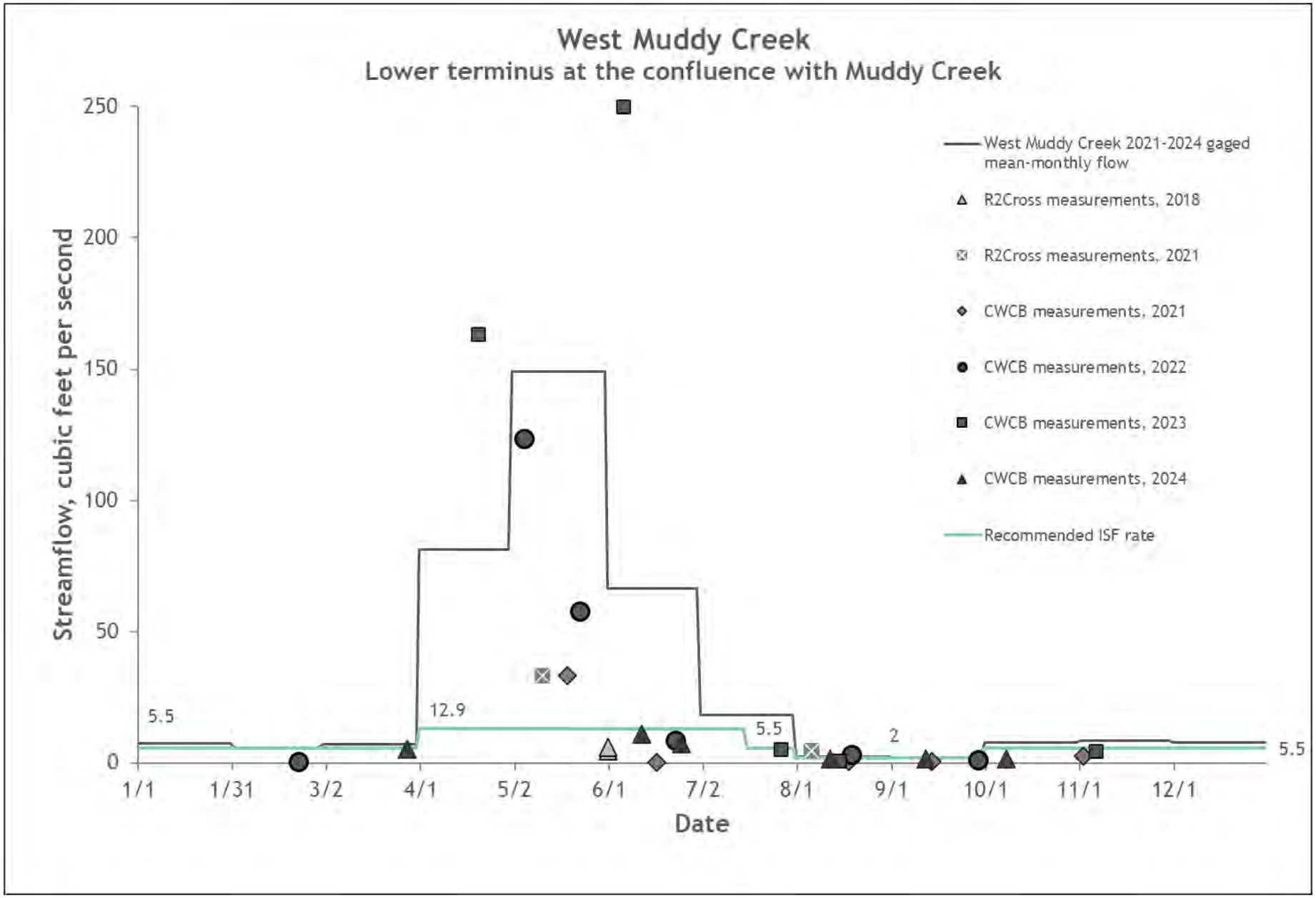
LAND OWNERSHIP MAP



SITE MAP


WDID 4004099
Overland Ditch
(Cow Creek)
WDID 4003399
Overland Reservoir
CWCB West
Muddy gage
DWR ID MUDAPRCO
MUDDY CREEK ABOVE
PAONIA RESERVOIR
West Muddy Creek ISF
Fish Survey
R2CROSS
Spot Measurement
Stream Gaging
Diversion Structures
WDID 4001189
Paonia Ditch
COLORADO
Colorado Water
Conservation Board
Department of Natural Resources
Water Division 4
West Muddy Creek
ISF Recommendation
0
2
4
Miles
N
6
1
5
4
2
7
3

COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH