Stream: Colorado River

Executive Summary

Water Division: 5
Water District: 100
CDOW#: 21262, 19637
CWCB ID: 10/5/A-001, 10//A-002, 10/5/A-003

Segment: Confluence with Blue River to Confluence with Piney River

Upper Terminus: CONFLUENCE WITH BLUE RIVER
(Latitude 40° 02' 33.25"N) (Longitude 106° 23' 53.24"W)

Lower Terminus: CONFLUENCE WITH PINEY RIVER
(Latitude 39° 51' 18.59"N) (Longitude 106° 38' 30.5"W)

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Grand & Eagle
Length: 23.7 miles
USGS Quad(s): Kremmling, Sheephorn Mountain, Radium, McCoy, State Bridge
Flow Recommendation: 500 cfs (September 16 – May 14)
600 cfs (May 15 – July 31)
750 cfs (August 1 –September 15)

Segment: Confluence with Piney River to Confluence with Cabin Creek

Upper Terminus: CONFLUENCE WITH PINEY RIVER
(Latitude 39° 51' 18.59"N) (Longitude 106° 38' 30.5"W)

Lower Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 39° 52' 28.61"N) (Longitude 106° 53' 35.85"W)

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Eagle
Length: 20.8 miles
USGS Quad(s): State Bridge, McCoy, Blue Hill, Burns North, Burns South
Flow Recommendation: 525 cfs (September 16 – May 14)
650 cfs (May 15 – July 31)
800 cfs (August 1 –September 15)

<u>Segment</u>: Confluence with Cabin Creek to Point Immediately Upstream of Confluence with Eagle River

Upper Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 39° 52’ 28.61”N) (Longitude 106° 53’ 35.85”W)

Lower Terminus: POINT IMMEDIATELY UPSTREAM OF CONFLUENCE WITH EAGLE RIVER
(Latitude 39° 38’ 48.33”N) (Longitude 107° 03’ 30.05”W)

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Eagle
Length: 25.0 miles
USGS Quad(s): Burns South, Sugarloaf Mountain, Dotsero
Flow Recommendation: 650 cfs (September 16 – May 14)
900 cfs (May 15 – June 15)
800 cfs (June 16 –September 15)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated instream flow file folder forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "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 CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Upper Colorado River Wild and Scenic Stakeholder Group (SG) recommended these three segments of the Colorado River to the CWCB for inclusion into the Instream Flow Program. These segments of the Colorado River are being considered for inclusion into the Instream Flow Program because there is a natural environment that can be preserved to a reasonable degree with an instream flow water right.

The Colorado River originates in Rocky Mountain National Park at an elevation of 11,200 feet and travels 282 miles before it exits Colorado at the Utah border at an elevation of 4,350 feet. The total length of the Upper Colorado River that is considered for this ISF appropriation is 69.5 miles long. The reach begins at the confluence with the Blue River, near the town of Kremmling, at an elevation of approximately 7,300 feet and ends at a point immediately upstream of the confluence of the Eagle River at an elevation of approximately 6,100 feet. Given the different biological and hydrological characteristics along the length of this Upper Colorado River reach, the SG has divided this reach into three segments 1) Blue River to Piney River Segment, 2) Piney River to Cabin Creek Segment, and 3) Cabin Creek to Eagle River Segment (lower termini immediately upstream of the confluence with the Eagle River). Portions of the Blue River to Piney River Segment are located in both Grand and Eagle counties, while the entire Piney River to Cabin Creek and Cabin Creek to Eagle River segments are located in Eagle County. The Blue River to Piney River Segment represents 23.7 river miles; the Piney River to Cabin Creek Segment represents 20.8 river miles and the Cabin Creek to Eagle River Segment represents 25.0 river miles.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence w/ Blue River	Confluence w/ Piney River	23.7	24%	76%

93% of the public lands are managed by the Bureau of Land Management (BLM) and the remaining 7% is part of the Radium State Wildlife Area (SWA).

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence w/ Piney River	Confluence w/ Cabin Creek	20.8	33%	67%

90% of the public lands are managed by the BLM and the remaining 10% is owned by the State Land Board (SLB).

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence w/ Cabin Creek	Point Immediately upstream of the Confluence w/ Eagle River	25.0	61%	39%

100% of the public lands are managed by the BLM.

Biological Data

Brown trout

Brown trout (*Salmo trutta*) are native to Europe and western Asia (Scott and Crossman 1973). This species was brought to Colorado and other Rocky Mountain states in the late 1880s (Belica 2007); the introduced fish were a mix of stocks from England, Scotland, and Germany (Behnke 2002). Brown trout are often the dominant trout species in lower elevation mountain streams (Belica 2007), but large streams characterized by variable habitat can allow rainbow trout to coexist with brown trout (Behnke 2002). Although they can tolerate sluggish flows, brown trout do not require slow water velocities (Scott and Crossman 1973). This species spawns in October and November, when water temperatures reach approximately 7°C (Scott and Crossman 1973; Behnke 2002). Like other trout species, brown trout bury their eggs in redds in shallow, gravel-bottomed streams (Scott and Crossman 1973; Behnke 2002). Brown trout typically reach adult lengths of 16 inches (Scott and Crossman 1973), but in smaller, relatively unproductive streams, they usually do not exceed 10 inches (Behnke 2002). Brown trout are carnivorous, but their diet changes in response to food availability. They consume large amounts of stream invertebrates, but they also eat frogs, fish, and rodents (Scott and Crossman 1973; Behnke 2002; Belica 2007). Brown trout begin to transition to a piscivorous diet at approximately 6 inches in length; at a length of 12 inches, brown trout are almost entirely piscivorous if sufficient prey fish are present (Scott and Crossman 1973; Belica 2007). Piscivorous brown trout tend to be larger and longer-lived than those that eat mostly invertebrates (Behnke 2002).

Rainbow trout

The native range of the rainbow trout (*Oncorhynchus mykiss*) is the eastern Pacific Ocean and streams west of the Rocky Mountains; this range stretches from Baja California north to the Kuskokwim River in Alaska (Scott and Crossman 1973). However, rainbow trout have been introduced worldwide and are common in Colorado (Bernstein and Montgomery 2008). Rainbow trout inhabit small to moderately large streams with gravel substrates and riffle-pool

morphology. They also inhabit lakes, but require streams for successful reproduction (Scott and Crossman 1973, Bernstein and Montgomery 2008). Rainbow trout spawn when water temperatures exceed 6-7°C, so timing is variable; in coastal areas, spawning occurs in January or February, but in colder regions, it occurs as late as June (Behnke 2002). Fertilized eggs are buried in redds, or nests excavated by the female (Scott and Crossman 1973; Bernstein and Montgomery 2008). Female rainbow trout reach sexual maturity between 2 and 6 years of age, and an average adult length for resident stream rainbow trout is 12-18 inches (Behnke 2002; Bernstein and Montgomery 2008). Rainbow trout mainly consume drifting invertebrates, but larger individuals will also eat small fish, eggs, and an occasional rodent (Scott and Crossman 1973; Bernstein and Montgomery 2008).

Mountain whitefish

The mountain whitefish (*Prosopium williamsoni*) is native to western North America; its range stretches from the Lahontan Basin in the south through British Columbia in the north (Scott and Crossman 1973). In Colorado, mountain whitefish are not native south of the Green River Drainage of the Colorado River Basin (Behnke 2002), but they have been successfully introduced outside of their natural range. Mountain whitefish prefer large rivers, and are most commonly associated with open channel habitat and deeper water (Behnke 2002), but they can also utilize pool habitats in smaller, turbid streams (Scott and Crossman 1973). Mountain whitefish can tolerate higher turbidity and temperatures than many other trout species (Behnke 2002). Mountain whitefish typically grow to a maximum length of 8-12 inches and reach sexual maturity between ages 3 and 6. Spawning occurs in winter and can extend into January or February in large systems where temperatures are more stable (Scott and Crossman 1973, Behnke 2002). Mountain whitefish are broadcast spawners that do not build nests (Scott and Crossman 1973). The diet of the mountain whitefish is predominantly benthic invertebrates (Scott and Crossman 1973), but the species is also opportunistic and will feed on fish eggs, fish, and invertebrates on the water's surface (Scott and Crossman 1973, Behnke 2002).

Flannelmouth sucker

Historically, the flannelmouth sucker (*Catostomus latipinnis*) was commonly found in most, if not all, medium to large, lower elevation rivers of the Upper Colorado River drainage (upstream of Glen Canyon Dam). Within the State of Colorado, flannelmouth sucker are present in the Colorado River and numerous tributaries including the Gunnison River up to the Aspinall Unit reservoirs (Bezzerides and Bestgen 2002), the Uncompahgre River (Sigler and Miller 1963) and the Dolores River. Flannelmouth suckers are typically found in slower, warmer rivers in plateau regions of the Colorado River drainage (Deacon and Mize 1997). They usually inhabit the mainstem of moderate to large rivers but are occasionally found in small streams. This species frequents pools and deep runs but can also be found in the mouths of tributaries, riffles, and backwaters. Flannelmouth sucker typically spawn in the Upper Colorado River basin between April and June (McAda 1977, McAda and Wydoski 1980, Snyder and Muth 1990, Tyus and Karp 1990).

Bluehead sucker

This bluehead sucker (*Catostomus discobolus*) is found in a large variety of river systems ranging from large rivers with discharges of several thousand cfs to small creeks with less 11 than a couple of cfs (Smith 1966). Adult bluehead suckers exhibit a strong preference for specific

habitat types (Holden and Stalnaker 1975). This species has been reported to typically be found in runs or riffles with rock or gravel substrate (Vanicek 1967, Holden and Stalnaker 1975, Carlson et al. 1979, Sublette et al. 1990). The bluehead sucker is known to feed on invertebrates, which have their highest densities in riffles. Although the species generally inhabits streams with cool temperatures, bluehead suckers have been found inhabiting small creeks with water temperatures as high as 82.4° F (Smith 1966).

Roundtail chub

Historically, roundtail chub (*Gila robusta*) were known to commonly occur in most medium to large tributaries of the Upper Colorado River Basin (Vanicek 1967, Holden and Stalnaker 1975, Joseph et al. 1977). Roundtail chub historically occurred in lower elevation (below 7,546 ft.) streams, including the Colorado, Dolores, Duchesne, Escalante, Green, Gunnison, Price, San Juan, San Rafael, White, and Yampa rivers (Bezzerides and Bestgen 2002). Roundtail chub are often found in stream reaches that have a complexity of pool and riffle habitats (Bezzerides and Bestgen 2002). Adults are found in eddies and pools adjacent to strong current and use instream boulders as cover (Sigler and Sigler 1996, Brouder et al., 2000). Roundtail chub begin spawning when water temperatures reach about 65°F (Vanicek and Kramer 1969, Joseph et al. 1977). In most Colorado River tributaries this increase in temperature coincides with a decrease in discharge after peak runoff (Bezzerides and Bestgen 2002).

Field Survey Data

The Upper Colorado River from Kremmling, Colorado downstream to Dotsero, Colorado is known to provide habitat for 14 fish species, with brown trout, rainbow trout, mountain whitefish and flannelmouth sucker being the key species of interest for the Physical Habitat Simulation (PHABSIM) modeling (MEC 2011) as selected by the Colorado Division of Wildlife (CDOW). The change in fish habitat in response to changes in flow was modeled for these species and some of their life stages at three locations in the Upper Colorado River: Pumphouse Site, Rancho del Rio Site, and Lyons Gulch Site. The Pumphouse and Rancho del Rio sites are located on the Colorado River between the Blue River and Piney River and the Lyons Gulch Site is located on the Colorado River between Cabin Creek and the Eagle River.

The nonnative brown trout and rainbow trout provide the majority of the recreational fishing opportunities in the Upper Colorado River reach from Kremmling downstream to Dotsero. At a site sampled in 2008 near Radium (Blue River to Piney Segment), brown trout and rainbow trout comprised 45% and 2% of the fish sampled, respectively. At a site sampled in 2008 from Cottonwood to Lyons Gulch (Cabin Creek to Eagle River Segment), brown trout and rainbow trout comprised 19% and <1% of the fish sampled. Brown trout reproduce naturally in the Colorado River and its tributaries, while the rainbow trout population has been supplemented by stocking since the onset of whirling disease greatly reduced their populations. Beginning in 2008 and continuing in 2009, a whirling disease resistant strain of rainbow trout was stocked throughout the Colorado River mainstem with the intent to increase survival and reproduction of these fish in the future.

Mountain whitefish, which are native in Colorado only to the Yampa River and White River drainages (Schisler 2010), comprised 8% and 12% of the fish sampled at the Radium and

Cottonwood to Lyons Gulch sites sampled in 2008, respectively. Speckled dace are native fish to the Colorado River drainage, and comprised 2% and 10% of the fish sampled at the Radium and Cottonwood to Lyons Gulch sites sampled in 2008, respectively. Flannelmouth suckers comprised <1% and 3% of the fish sampled at the Radium and Cottonwood to Lyons Gulch sites sampled in 2008, respectively. Similarly, the bluehead sucker comprised <1% of the fish sampled from both the Radium Site and from Cottonwood to Lyons Gulch.

Biological Flow Recommendation

These instream flow recommendations are the result of a review of the physical habitat – flow relationships, hydrological conditions, and a compromise among the SG entities on the recommended minimum instream flow necessary to preserve the natural environment to a reasonable degree. The instream flow recommendations consider the physical habitat – flow relationships, primarily for the adult trout life stage as presented in the MEC Instream Flow Report (2011) provided to the CWCB, although other native fish data were considered, in addition to water availability constraints. These flows are a component of the SG Plan to support the recreational fishing Outstandingly Remarkable Value identified by the Bureau of Land Management (BLM). The instream flow levels are within the range of flow from 500 cfs to 1,500 cfs that provide abundant habitat for most species and lifestages (MEC 2011).

Recommendations for minimum flows are based on PHABSIM relationships as reported by MEC (2011) and an evaluation of total weighted usable habitat and the relative quality of habitat available for all species and life stages modeled. Emphasis is placed on total habitat availability for the adult nonnative brown trout and rainbow trout, which provide the majority of the recreational value, although fry and juvenile trout life stages were also weighted more heavily than other species. Mountain whitefish and flannelmouth sucker were also considered in this evaluation. An effort was made to establish minimum instream flow recommendations that would provide adequate habitat for all life stages of these native species. The PHABSIM relationship between habitat and flow at specific sites for each species can be found in the attached SG recommendation.

Segment 1: Blue River to Piney River

The Blue River to Piney River Segment is represented by the MEC (2011) Pumphouse and Rancho del Rio sites, which are evaluated together given the similarity in habitat and fish composition. As discussed by MEC (2011), total habitat quantity is abundant for most species and lifestages between 500 and 1,500 cfs based on PHABSIM habitat versus flow relationships. This essentially means that the maximum habitat, or the peak of the habitat – flow relationship, for each species life stage occurs somewhere along this continuum of flow. The maximum flow within this range reduces the amount of habitat for the majority of species life stages, especially the brown trout juvenile and fry life stages that provide the foundation for a robust trout fishery. A minimum flow between 500 and 750 cfs balances an adequate amount of habitat for all species and lifestages.

A minimum flow of 500 cfs established during the winter period from September 16th to May 14th will maintain sufficient levels of habitat for all life stages of brown trout and rainbow trout at both the Pumphouse and Rancho del Rio sites. When placed in the context of water

availability, 500 cfs will provide sufficient levels of habitat during the base flow period that represents a bottleneck for adult trout in terms of metabolic constraints and survival. Based on the PHABSIM modeling, a minimum flow of 500 cfs will result in approximately 90% and 82% of the maximum total weighted usable habitat for adult brown trout and adult rainbow trout, respectively in the Blue River to Piney River Segment.

A minimum flow of 600 cfs during the spring/early summer period from May 15th to July 31st will provide less than the maximum amount of total weighted usable habitat. When the 600 cfs ISF level is placed in the context of both the brown trout and rainbow trout habitat – flow relationships, approximately 91% and 88% of the maximum total weighted usable area will be available to the trout fishery, respectively. An ISF of 600 cfs during the summer provides adequate habitat for juvenile brown trout, and juvenile rainbow trout. Based on the habitat – flow relationships for adult brown trout, the maximum total weighted usable area occurs at approximately 750 cfs at both the Pumphouse and Rancho del Rio sites. The SG recommendation also includes an ISF level that maximizes brown trout habitat for a six week period during late summer from August 1st to September 15th, which represents a key time of the year in terms of aquatic life stress.

The SG's recommended flows seek to balance the habitat among the three trout life stages – adult, fry and juvenile. Stream flows greater than a 750 cfs, which maximizes adult brown trout habitat, would also begin to decrease the amount of fry and juvenile habitat. Thus, it is important to consider the multiple trout life stages, because the recruitment of young fish into the adult population is important in maintaining a healthy fishery.

When the 600 cfs and 750 cfs levels are placed in the context of the optimum adult mountain whitefish habitat range, 500 cfs to 1,100 cfs, these flows will provide a sufficient amount of habitat for all of the life stages at the Pumphouse Site. Similarly, a 600 cfs and 750 cfs flow at the Rancho del Rio Site will provide a suitable amount of habitat for juveniles and fry, but less than the optimal range of habitat for adult mountain whitefish which occurs from approximately 1,500 cfs to 3,000 cfs. At the Rancho del Rio Site, the physical habitat available to adult mountain whitefish is considerably different than the habitat at the Pumphouse Site; however increasing an ISF level to achieve a greater amount of habitat for adult mountain whitefish at the Rancho del Rio Site would decrease the available habitat for other species and their life stages.

Flannelmouth sucker habitat was modeled at the Rancho del Rio Site, despite only comprising <1% of the fish sampled at the Radium Site, in 2008. This reach of the Colorado River is near the upstream extent of the flannelmouth sucker, as the current distribution is documented to extend upstream to near Glenwood Springs, CO (Bezzerides and Bestgen 2002). The amount of available habitat at flows between 500 and 750 cfs is sufficient to maintain the current population of flannelmouth suckers which is near the upstream extent of its distribution.

Segment 2: Piney River to Cabin Creek

The Piney River to Cabin Creek Segment represents a slight change in the hydrological conditions of the Colorado River given the additional inflows from the Piney River. Typically, the Piney River contributes about an additional 10% of flow above what is measured in the

Colorado River at the Kremmling gage, approximately 24 miles upstream. This additional flow is relatively constant on a seasonal basis and does not appreciably change the shape of the hydrograph. For example, the timing of spring runoff and the timing of the peak flows do not appreciably change in the Colorado River with the addition of Piney River flow. This is generally not the case with the proposed third ISF segment – Cabin Creek to Eagle River. Hydrological inputs from Cabin Creek and other tributaries downstream to the confluence with the Eagle River increase the flows in the Colorado River by approximately 25%. The additional flows in the most downstream segment also change the timing of runoff, such that runoff occurs slightly earlier in the calendar year. The change in hydrological and hydraulic conditions in the Colorado River from State Bridge downstream to Dotsero was one of the primary reasons for creating two ISF segments in this reach. The Piney River to Cabin Creek Segment also represents a transition zone for the recreational fishing ORV. The Bureau of Land Management (BLM) recognizes that the recreational fishing ORV extends downstream to Red Dirt Creek, near McCoy, approximately 7 miles downstream of the confluence with the Piney River.

To evaluate the biological instream flow needs, this segment was represented by the Rancho del Rio River2D site (MEC 2011). The Rancho Del Rio site is approximately 4 miles upstream of the confluence with the Piney River. Given the Rancho Del Rio information was considered in the development of the instream flow for the Blue River to Piney River Segment, the SG believes that the upstream ISF values provided a starting point for the Piney River to Cabin Creek ISF Segment but should be increased given the additional flow contributions to the river.

A minimum flow of 525 cfs during the winter period from September 16th to May 14th will maintain sufficient levels of available habitat for all life stages of brown trout and rainbow trout at the Rancho del Rio Site. Based on the PHABSIM modeling, a minimum flow of 525 cfs will result in approximately 87% and 78% of the maximum total weighted usable habitat for adult brown trout and adult rainbow trout, respectively in the Piney River to Cabin Creek Segment.

A minimum flow of 650 cfs during the summer period from May 15th to July 31st will provide approximately 88% of the maximum amount of habitat available to brown trout at the Rancho Del Rio Site. A flow of 650 cfs in this reach will also provide 86% of the maximum amount of habitat available to rainbow trout at the Rancho Del Rio Site. A minimum flow of 800 cfs during the late summer period from August 1st to September 15th will provide approximately 91% of the maximum amount of habitat available to brown trout at the Rancho Del Rio Site. A flow of 800 cfs will also provide 94% of the maximum amount of habitat available to rainbow trout at the Rancho Del Rio Site.

When the recommended ISF levels for the Piney River to Cabin Creek Segment are placed in the context of the Rancho Del Rio Site mountain whitefish habitat-flow relationships, a suitable amount of habitat will be available for juveniles and fry, but less than the optimal range will be available for the adult mountain whitefish. Similarly, for the flannelmouth sucker, flows between 525 cfs and 800 cfs will be sufficient to maintain the current population of flannelmouth suckers which is near the upstream extent of its distribution.

Segment 3: Cabin Creek to Point Immediately Upstream of Eagle River

The Cabin Creek to Eagle River Segment is represented by the Lyon's Gulch PHABSIM modeling site (MEC 2011). As discussed by MEC (2011), total habitat quantity is abundant for most species and lifestages between 500 and 1,500 cfs based on PHABSIM habitat versus flow relationships for this segment.

A minimum flow of 650 cfs during the winter period, September 16th to May 14th, will provide adequate amounts of habitat for all species and life stages during this base flow period. A 650 cfs flow during the winter period will provide approximately 89% and 94%, of the maximum total weighted usable habitat for adult brown trout and adult rainbow trout, respectively. A 650 cfs flow will also provide an adequate amount of habitat for fry and juvenile of each trout species. Again the adult brown trout and adult rainbow trout life stages were the primary species and life stage considered for this lower segment, although the mountain whitefish, speckled dace, and sucker species, including the flannelmouth sucker, were also considered. These other species comprised a larger component of the fish assemblage as compared to the upstream reach (CDOW 2010). However, as discussed above, the winter period is the most critical period for adult trout in terms of metabolic constraints and survival; thus, a 650 cfs flow should be protective of the adult trout during the winter period.

A minimum flow of 900 cfs established during the spring runoff and early summer period, May 15th to June 15th, will provide approximately 99% of the maximum total weighted usable habitat for both the adult brown trout and adult rainbow trout at the Lyon's Gulch Site. This flow level also provides an abundant amount of habitat for the adult mountain whitefish and adult flannelmouth sucker.

A minimum flow of 800 cfs during the mid to late summer period will provide approximately 97% and 98% of the maximum total weighted usable habitat, for adult brown trout and adult rainbow trout, respectively . This flow level balances the trout life stages during the summer months, a time when growth and development occurs for the younger life stages and adults.

Hydrologic Data and Analysis

During the development of the alternative management plan, the SG relied upon two hydrological data sets to establish flow-based resource guides. The SG evaluated both historical and future simulated flow conditions at three points of reference along the Upper Colorado River, from Kremmling downstream to Dotsero. The Kremmling gage (09058000) provided the upstream reference point for the Blue River to Piney River Segment, the Kremmling gage plus the Piney gage (09059500) provided a reference point for the Piney River to Cabin Creek Segment, and lastly – the Dotsero gage (0907050) minus the Eagle gage (09070000) provided a downstream reference point for the Cabin Creek to Eagle River Segment. The period of record from April 1st 1983 to March 31st 2006, 24 years, was selected to characterize the historical flow conditions for all three points of reference along the Upper Colorado River.

Using each data set (historic and future), the geometric mean value and the upper and lower 95% confidence intervals were calculated for each day of the year. These figures characterize the

central tendency of flows on a daily basis for the entire period of record without the distorting effects of rare high magnitude flood events.

Although staff typically only uses historic flow conditions to determine whether water is available for an instream flow recommendation, staff understands that the future simulated flows were utilized by the SG in the development of a consensus recommendation. Since all of the recommended flow amounts fall below the historic geometric mean or within the 95% confidence intervals at all three reference points, CWCB staff considers water to be available for appropriation. (See figures 1-3 below).

The SG also evaluated simulated flows to characterize possible future flow scenarios at all three points of reference along the Upper Colorado River. Briefly, future water demands of the East Slope, Grand and Eagle counties were imposed on the undepleted flows of the Upper Colorado River to construct a future hydrological scenario. The undepleted flows used in the model represented the period of record from April 1st 1947 to March 31st 1991, 44 years.

The SG also identified dry year conditions as occurring 25% of the time over the period of record for the Kremmling gage, based on the cumulative annual flow that passes the gage. This evaluation resulted in 6 years being characterized as dry year conditions for the historical period (e.g. 1992, 1994, 2001 through 2004), and 11 years for the simulated future flows. As such, these dry year conditions provide a reference for low flow levels in the Upper Colorado River at the Kremmling gage.

This subset of dry year conditions was also evaluated using the geometric mean. These hydrographs are noticeably different from the entire period of record hydrographs in that peak flows do not occur until late summer given the absence of snowpack driven runoff that is typically observed in early June. It is also apparent that modeled future dry conditions may be very similar to historical dry periods based on the similar shape of the hydrographs. During the historical winter base flow conditions, the lower 95% confidence interval ranged from approximately 300 cfs to 450 cfs, and the modeled future flows show a similar range.

It should be mentioned that the use of the future simulated flows discussed above resulted in some recommended flows which are significantly below the historic geometric mean and the lower 95% confidence interval, and in some cases the recommendations are below the 25 percentile value of daily flows. This is atypical of most ISF recommendations, which normally fall within the 95% geometric mean confidence bands. However, the Management Plan provides for voluntary measures to provide additional flows during these dry periods, which is not generally part of a typical ISF recommendation.

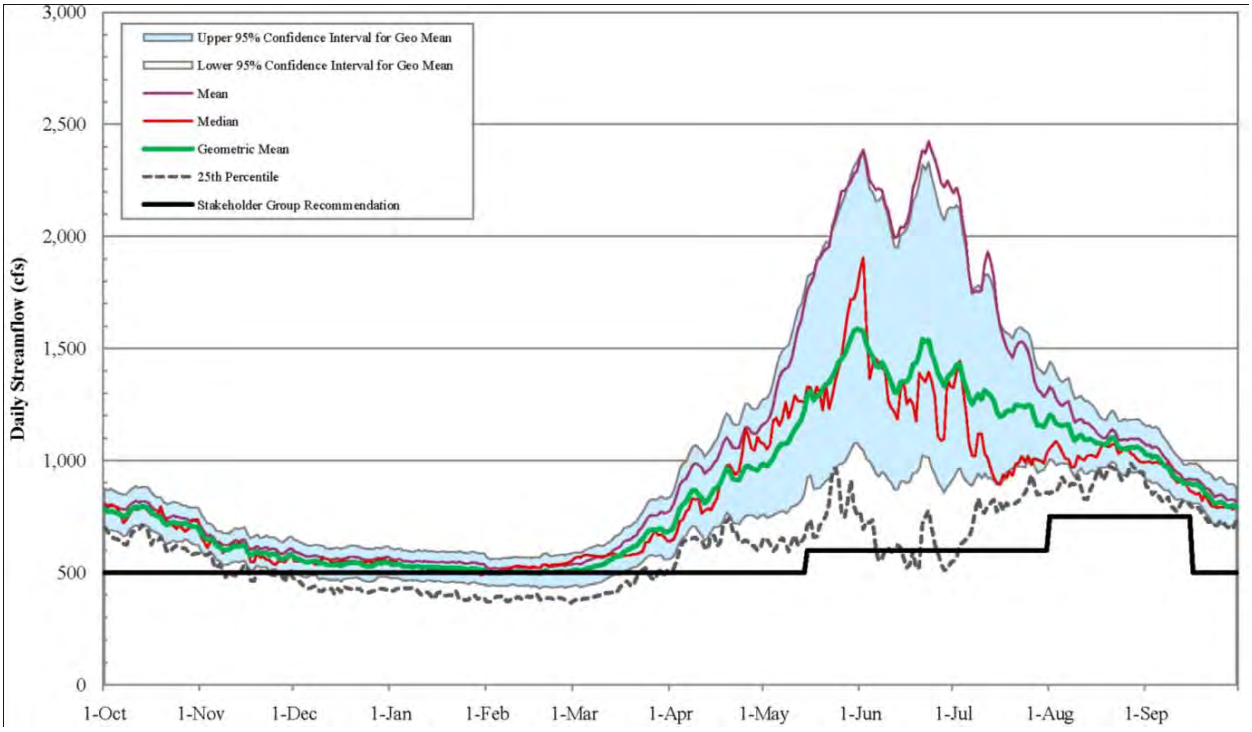


Figure 1 - Blue River to Piney River ISF summary; hydrograph based on the Kremmling gage (09058000).

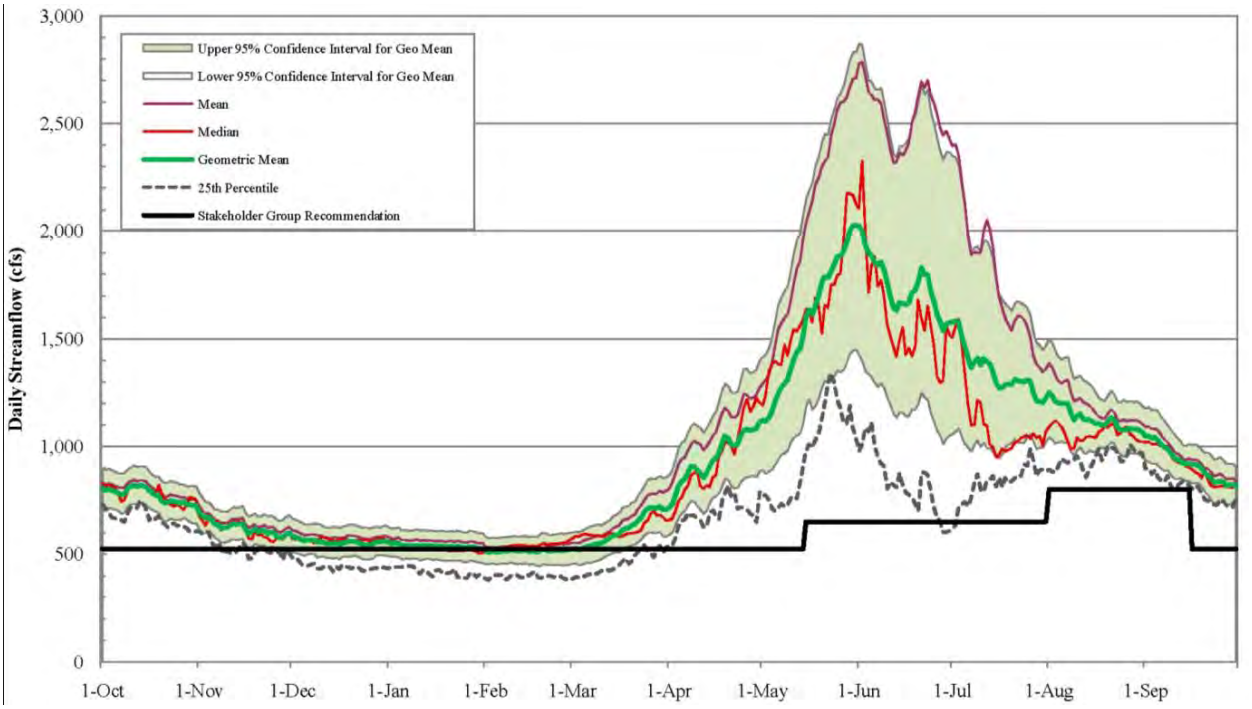


Figure 2 - Piney River to Cabin Creek ISF summary; hydrograph based on the Kremmling gage (09058000) plus the Piney River gage (09059500).

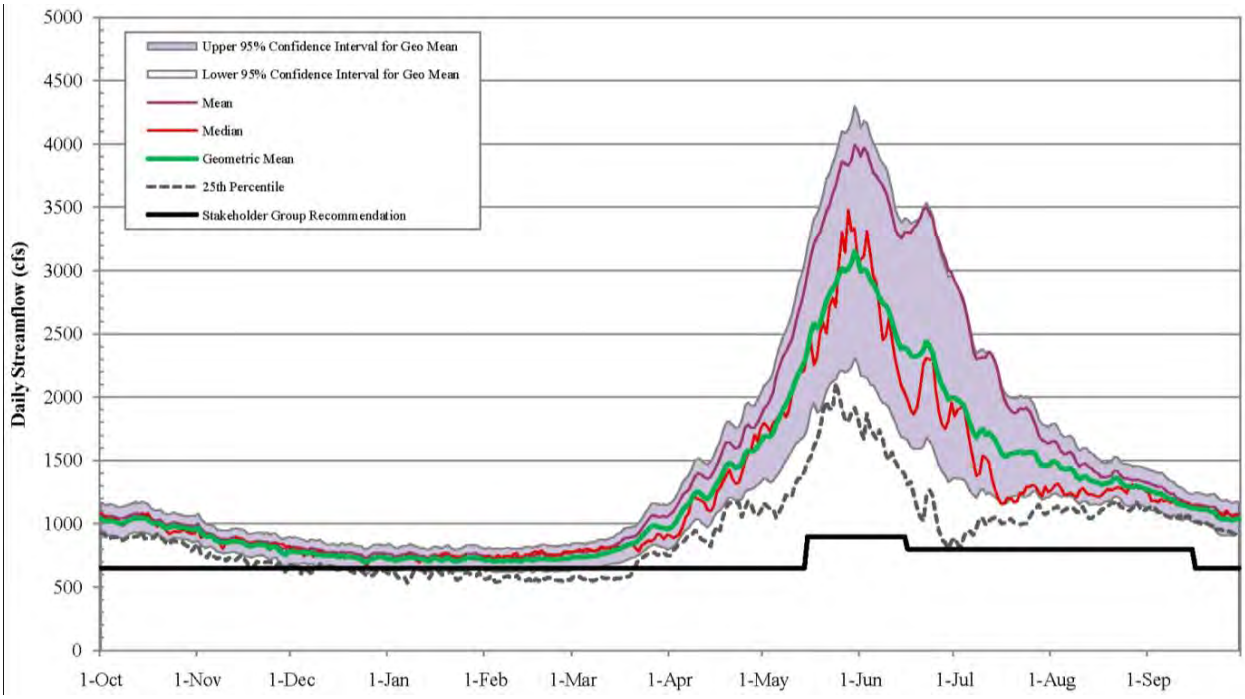


Figure 3 - Cabin Creek to Eagle River ISF summary; hydrograph based on the Dotsero gage (09070500) minus the Eagle River gage (09070000).

CWCB Staff's Instream Flow Recommendation

Staff recommends the Board form its intent to appropriate on the following stream reaches:

Segment: Confluence with Blue River to Confluence with Piney River

Upper Terminus: CONFLUENCE WITH BLUE RIVER
(Latitude 40° 02' 33.25"N) (Longitude 106° 23' 53.24"W)
UTM North: 4433418.29 UTM East: 380728.87
PLSS: NW NE S19 T1N R80W 6th PM
360' South of the North Section Line, 2100' West of the East Section Line

Lower Terminus: CONFLUENCE WITH PINEY RIVER
(Latitude 39° 51' 18.59"N) (Longitude 106° 38' 30.5"W)
UTM North: 44129714.89 UTM East: 359556.85
PLSS: NW NW S25 T2S R83W 6th PM
1307' South of the North Section Line, 1226 East of the West Section Line

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Grand & Eagle
Length: 23.7 miles
USGS Quad(s): Kremmling, Sheephorn Mountain, Radium, McCoy, State Bridge
Flow Recommendation: 500 cfs (September 16 – May 14)
600 cfs (May 15 – July 31)
750 cfs (August 1 –September 15)

Segment: Confluence with Piney River to Confluence with Cabin Creek

Upper Terminus: CONFLUENCE WITH PINEY RIVER
(Latitude 39° 51' 18.59"N) (Longitude 106° 38' 30.5"W)
UTM North: 44129714.89 UTM East: 359556.85
PLSS: NW NW S25 T2S R83W 6th PM
1307' South of the North Section Line, 1226 East of the West Section Line

Lower Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 39° 52' 28.61"N) (Longitude 106° 53' 35.85"W)
UTM North: 4415556.15 UTM East: 338088.78
PLSS: SE SE S15 T2S R85W 6th PM
444' North of the South Section Line, 737' West of the East Section Line

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Eagle
Length: 20.8 miles
USGS Quad(s): State Bridge, McCoy, Blue Hill, Burns North, Burns South
Flow Recommendation: 525 cfs (September 16 – May 14)
650 cfs (May 15 – July 31)
800 cfs (August 1 –September 15)

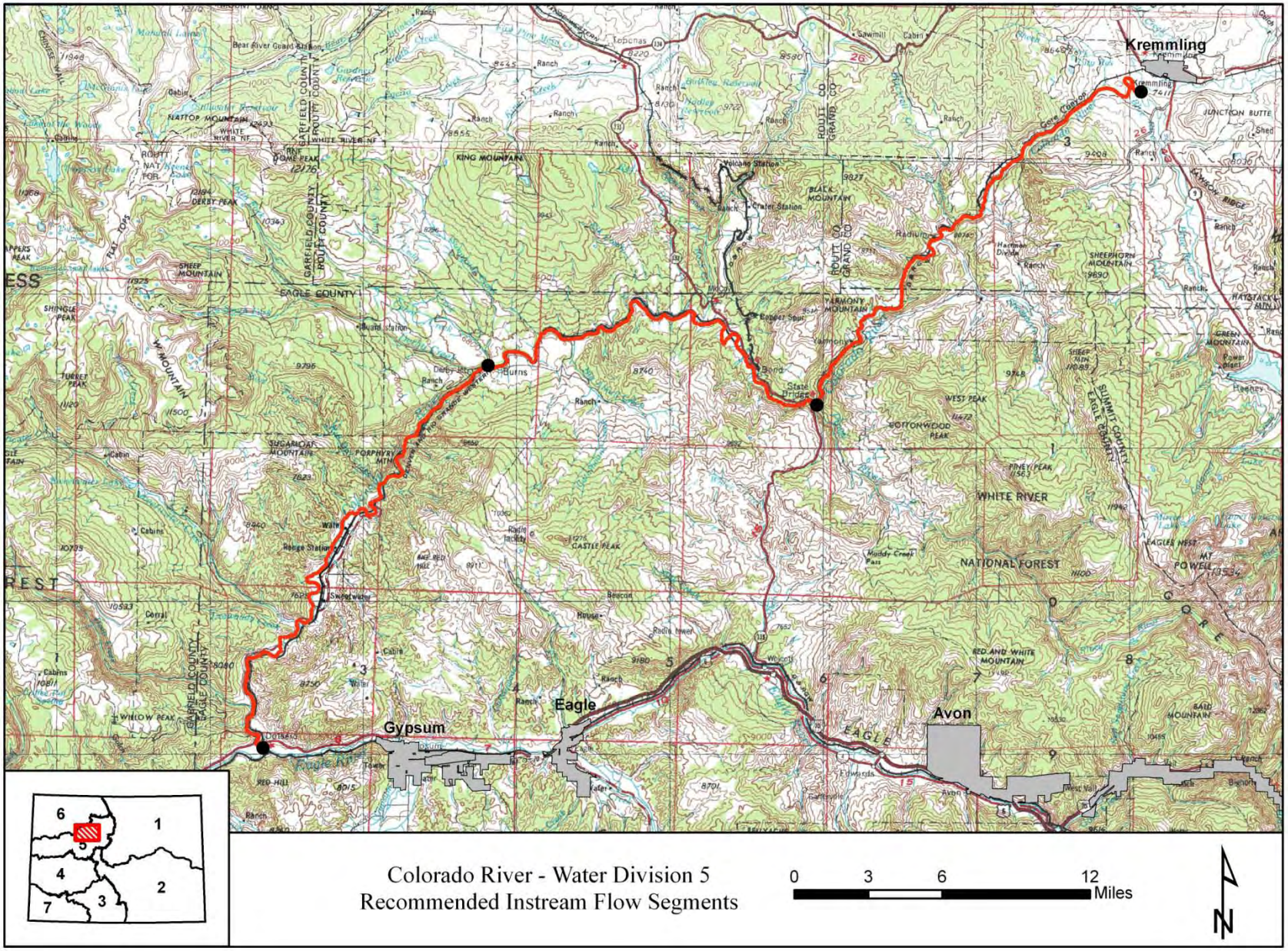
Segment: Confluence with Cabin Creek to Point Immediately Upstream of Confluence with Eagle River

Upper Terminus: CONFLUENCE WITH CABIN CREEK
(Latitude 39° 52' 28.61"N) (Longitude 106° 53' 35.85"W)
UTM North: 4415556.15 UTM East: 338088.78
PLSS: SE SE S15 T2S R85W 6th PM
444' North of the South Section Line, 737' West of the East Section Line

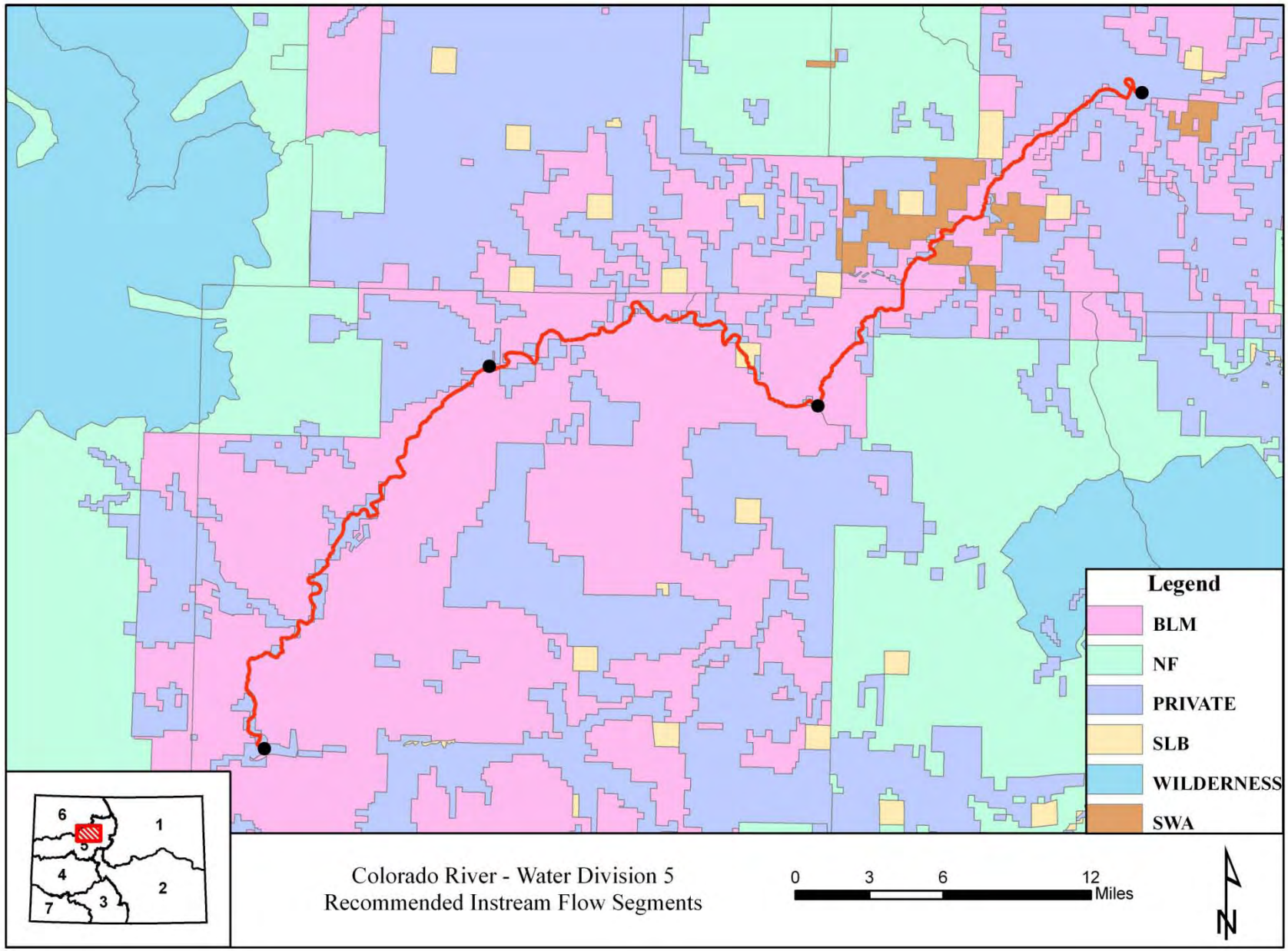
Lower Terminus: POINT IMMEDIATELY UPSTREAM OF CONFLUENCE WITH EAGLE RIVER
(Latitude 39° 38' 48.33"N) (Longitude 107° 03' 30.05"W)
UTM North: 4390576.79 UTM East: 323390.88
PLSS: SW NE S5 T5S R86W 6th PM
2319' South of the North Section Line, 2186 West of the East Section Line

Watershed: Colorado headwaters (HUC#: 14010001**)**
Counties: Eagle
Length: 25.0 miles
USGS Quad(s): Burns South, Sugarloaf Mountain, Dotsero
Flow Recommendation: 650 cfs (September 16 – May 14)
900 cfs (May 15 – June 15)
800 cfs (June 16 –September 15)

Vicinity Map



Land Use Map


Legend
BLM
NF
PRIVATE
SLB
WILDERNESS
SWA
6
1
5
4
2
7
3
Colorado River - Water Division 5
Recommended Instream Flow Segments
0
3
6
12
Miles
N