Monitoring Report 2018

Prepared in accordance with the

Upper Colorado River Wild & Scenic Stakeholders

Management Plan

FINAL

June 21, 2019

TABLE OF CONTENTS

List of Figures

List of Tables

Abbreviations and Acronyms

303(d)	Colorado's Section 303(d) list of impaired waters per Regulation 93
AF	Acre-Feet
BLM	U.S. Bureau of Land Management
CDPHE	Colorado Department of Public Health and Environment
CWCB	Colorado Water Conservation Board
CPW	Colorado Parks and Wildlife
CPUE	Catch Per Unit Effort
CROS	Coordinated Reservoir Operations
CFS	Cubic Feet per Second
DM	Daily Maximum
HUP	Historic User's Pool
MWAT	Maximum Weekly Average Temperature
M&E	Monitoring and Evaluation list per Colorado's Regulation 93
MMI	Multi-Metric Index
ORV(s)	Outstandingly Remarkable Value(s)
SG	Upper Colorado River Wild and Scenic Stakeholder Group
SG Plan	Upper Colorado River Wild and Scenic Stakeholder Group Management Plan January, 2012
TIV	Tolerance Indicator Value
TFE	Total Fishing Effort
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
W&S	Wild and Scenic

EXECUTIVE SUMMARY

The Upper Colorado River Wild and Scenic Stakeholder Group (SG) monitors and protects Outstandingly Remarkable Values (ORVs) on segments of the Colorado River from Kremmling, Colorado to about 2 miles east of Glenwood Springs. The Upper Colorado River Wild and Scenic Stakeholder Group Management Plan (SG Plan) provides the framework for the SG to operate and protect ORVs through long-term protection measures, cooperative measures, and monitoring of ORV Indicators and Resource Guides. The purpose of the SG Plan is to "balance permanent protection of the ORVs, certainty for the stakeholders, water project yield, and flexibility for water users." The SG Plan is currently in year four of a five year provisional period, during which time the SG will evaluate and revise the provisional ORV Indicators and Resource Guides, if necessary.

The purpose of this report is to provide a summary of cooperative measures and monitoring activities conducted by the SG during W&S water year 2018, from April 1, 2018 to March 31, 2019. These monitoring activities support evaluation of the provisional ORV Indicators and review of Resource Guides for recreational floatboating and recreational fishing. Monitoring also includes assessment of the W&S Year Type which is currently part of the Resource Guide for recreational floatboating. The Year Type in W&S segments 4-6 is classified as Dry typical and the Year Type in W&S segment 7 is classified as Driest 25%.

During 2018, the Cooperative Measures Committee monitored streamflow and temperature in the W&S Segments and participated in Historic User's Pool (HUP) calls. E-mails summarizing activities on the Colorado River including forecasted flows, current stream temperature, and current flow gage data were circulated to the Cooperative Measures Committee and Executive Committee on a weekly basis throughout the summer. In support of the Recreational Floatboating ORV, flows were adequate to accommodate the annual Gore Canyon Festival in August.

The SG group continued efforts to monitor the provisional ORV Indicators in 2018. Based on available data, the provisional fishing ORV Indictors for quality fish and biomass were met at the State Bridge location in 2018, as summarized in Table 1, below. However, three provisional fishing ORV Indicators were not met at the Catamount site: quality trout was 21 fish over 14" per

acre, and the provisional ORV Indicator is 24; biomass was 56 pounds per acre, while the provisional ORV Indicator is 90 pounds per acre. Species diversity, which is assessed based on aggregated data from both locations, was not met; species diversity was ten, and the provisional ORV Indicator is 14. The provisional ORV Indicator for boating is a narrative and was not evaluated.[1]

Table 1. Summary of provisional ORV Indicators in 2018.

ORV Indicator	Measure/Metric	2018 Status
Recreational Floatboating	Narrative	Not evaluated
Recreational Fishing	Quality Trout	Not met at Catamount
	Biomass	Not met at Catamount
	Species Diversity	Not met at State Bridge & Catamount
	TFE / CPUE	No criteria

The SG also continued to monitor the provisional ORV Resource Guides in 2018. During the Provisional Period, the Resource Guides will be used as a source of information among others to inform SG discussions under the Plan and are not intended to be used as test for Plan success. Most Resource Guides were within range as summarized by Table 2. Flows were within range for both usable floatboating days and seasonal flows for fishing. The provisional flushing flow of 2,000 cfs for 3 days did not occur in 2018; however, this metric is based on the occurrence of this flow rate on average every other year. Daily Max (DM) temperature observations attained the standards at all sites, but Maximum Weekly Average (MWAT) temperature standard potential exceedances occurred in the lower W&S SG segments downstream from State Bridge at the Catamount, Red Dirt, and No Name monitoring sites during the months of July and August. The frequency and magnitude of these potential exceedances increased in the downstream direction, with the highest number occurring at the No Name site. A complete analysis per Colorado Department of Public Health and Environment's (CDPHE) 2018 Section 303(d) listing

[1] Note: the "one-size-fits-all" approach to establishing provisional ORV Indicators is being re-evaluated during the Provisional Period in order to better reflect the variability in Quality Trout and Biomass that is now known to exist across W&S Segments 5 and 6.

methodology and Policy Statement 06-1 has not been conducted to determine if any of the potential exceedances would be excluded due to high air temperature, low flow, or shoulder season excursions.

Table 2. Summary of provisional ORV Resource Guides in 2018.

ORV Resource Guides	Measure/Metric	2018 Status
Recreational Floatboating	Useable Days	Within range for all Opportunities
Recreational Fishing	Seasonal flows	Within the seasonal range of flow
Recreational Fishing	Flushing flows	Flows below provisional flushing flow
Water Quality	CDPHE Standards	Macroinvertebrates listed on M&E list[2]
Temperature	DM	No exceedances of the temperature threshold recorded
	MWAT	Potential exceedances of the temperature threshold at Catamount, No Name, Red Dirt

In addition, the SG conducted additional monitoring related to the W&S segments to support SG decisions, including recreational fishing and floatboating use data collected by RRC Associates (RRC), macroinvertebrate and substrate collections by Timberline Aquatics, and initiated a flushing flow study to be completed in 2019.

[2] CDPHE includes macroinvertebrates on Monitoring and Evaluation List from Gore Canyon to Derby Creek, which includes W&S Segments 4, 5, and the top portion of Segment 6.

INTRODUCTION

The 2012 Upper Colorado River Wild and Scenic Stakeholder Management Plan (SG Plan, or Plan) was adopted by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) as a Wild and Scenic (W&S) management alternative to protect the Outstandingly Remarkable Values (ORVs) identified in the Eligibility Reports for BLM Segments 4 through 7 (USFS Segments 1 through 2) on over 80 miles of the upper Colorado River (See Appendix A: Project Area Map). The purpose of the SG Plan is to "balance permanent protection of the ORVs, certainty for the Upper Colorado River Wild & Scenic Stakeholders (SG or "stakeholders"), water project yield, and flexibility for water users." Key elements of the SG Plan include provisions for protection of the ORVs and a plan for monitoring the ORV Indicators and Resource Guides to assist in implementation of the Plan.

Protection of the ORVs

The SG Plan is intended to protect all ORVs identified in the Wild & Scenic Eligibility Reports for W&S Segments 4 through 7, while focusing on the primary streamflow-influenced recreational fishing ORVs in Segments 4 through 6, and recreational floatboating ORVs in Segments 4 through 7.

Long-Term Protection Measures include appropriation of Colorado Water Conservation Board (CWCB) instream flows, continued delivery of water to downstream demands, continued delivery to downstream senior water rights, and ongoing existing deliveries to the endangered fish species under the Upper Colorado River Endangered Fish Recovery Program[3]. The SG Plan contains provisions for addressing any material change in circumstances that undermines the value of these long-term protection measures.

Cooperative Measures are voluntary strategies that are used by the SG to maintain or enhance the ORVs. Opportunities for cooperative measures are considered annually and are based on hydrologic conditions, consideration of the ORV Indicators and Resource Guides and availability

[3] Garrison, M., and V. Lee, 2017. *2017 COLORADO RIVER RECOVERY PROGRAM FY 2017 ANNUAL REPORT*

of voluntary cooperative measures that do not impair the ability of water providers to meet their water supply commitments using prudent operational constraints.

Monitoring Plan

The SG Plan aims to protect all ORVs while focusing on recreational fishing… and recreational floatboating... The SG Plan uses two distinct tools – "ORV Indicators"… and "Resources Guides"... (SG Plan, p.3) Failure to meet criteria related to the provisional or final ORV Indicators (SG Plan, Section IV) may be cause for elevation and potential termination of the SG Plan. ORV Indicators, which describe conditions that characterize the ORVs, are monitored to gauge whether the ORVs are being protected under the SG Plan. Provisional ORV Indicators were developed for recreational floatboating and recreational fishing.

Resource Guides include resource conditions that may influence the ORVs, and include flows, water quality and temperature. The Resource Guides are used as a source of information to inform SG discussions under the SG Plan. Resource Guides are not intended to be used as a test for SG Plan success nor for use by permitting agencies or other entities as criteria for evaluating a project's effects on the ORVs.

The Monitoring Plan included in the SG Plan has an initial 3-to-5 year provisional period during which the SG will monitor, evaluate, and revise the provisional ORV Indicators and Resource Guides, if necessary. The provisional period was triggered when BLM and USFS signed their Records of Decision (RODs) in June 2015. Consequently, the 2018 water year was the fourth year of the SG's provisional period.

PURPOSE

The purpose of this report is to provide a summary of cooperative measures and monitoring activities conducted by the SG in 2018. Monitoring activities include evaluation of the provisional ORV Indicators and Resource Guides, evaluation of additional data collected by the SG, and review of information collected by other entities that is pertinent to the ORVs. Based on the SG Plan, the 2018 monitoring year begins on April 1, 2018 and ends March 31, 2019.

HYDROLOGY

The SG monitors streamflow on the Colorado River to: 1) gain a general understanding of the hydrology impacting the W&S segments; 2) identify opportunities for data collection, such as conducting additional visitor surveys during low flows; 3) identify potential issues that could be addressed by cooperative measures; and 4) evaluate Floatboating and Fishing Resource Guides associated with year-type and seasons.

Data for three streamflow gages were available in the W&S segments in 2018 (Table 3). The SG Plan uses the U.S. Geological Survey (USGS) Kremmling and Dotsero gages to monitor flows in the W&S segments. In addition, the SG spearheaded the installation of a new USGS gage in October of 2016 at the Catamount Bridge in W&S Segment 6. This gage is currently operational for 8 months each year, from March 15th through November 15th and is used to monitor streamflow, water temperature and air temperature, however, data from the Catamount gage has not yet been included in the SG Plan at this time. Figure 1, **Error! Reference source not found.**, and Figure 3 display the historic median daily streamflow and the average daily streamflow from all gages during the 2018 W&S Water Year.

All three hydrographs and all subsequent analyses use USGS data that was available as of 4/12/2019, this includes both approved and provisional data; the Kremmling gage data is provisional from 10/1/2018 to 3/31/2019, the Dotsero gage is provisional from 2/4/2019 to 3/31/2019, and the Catamount gage is provisional from 10/5/2019 to 3/31/2018 (gage not operated from 11/15/2018 to 3/14/2019). Values for ice affected days were filled using the average of the values on either side of the ice affected period.

Table 3. USGS gages operated in W&S segments in 2018.

Number	Gage Name	Parameters	W&S Segment
09058000	Colorado River near Kremmling	Streamflow & Temperature	4
09060799	Colorado River at Catamount	Streamflow & Temperature	6
09070500	Colorado River near Dotsero	Streamflow	7

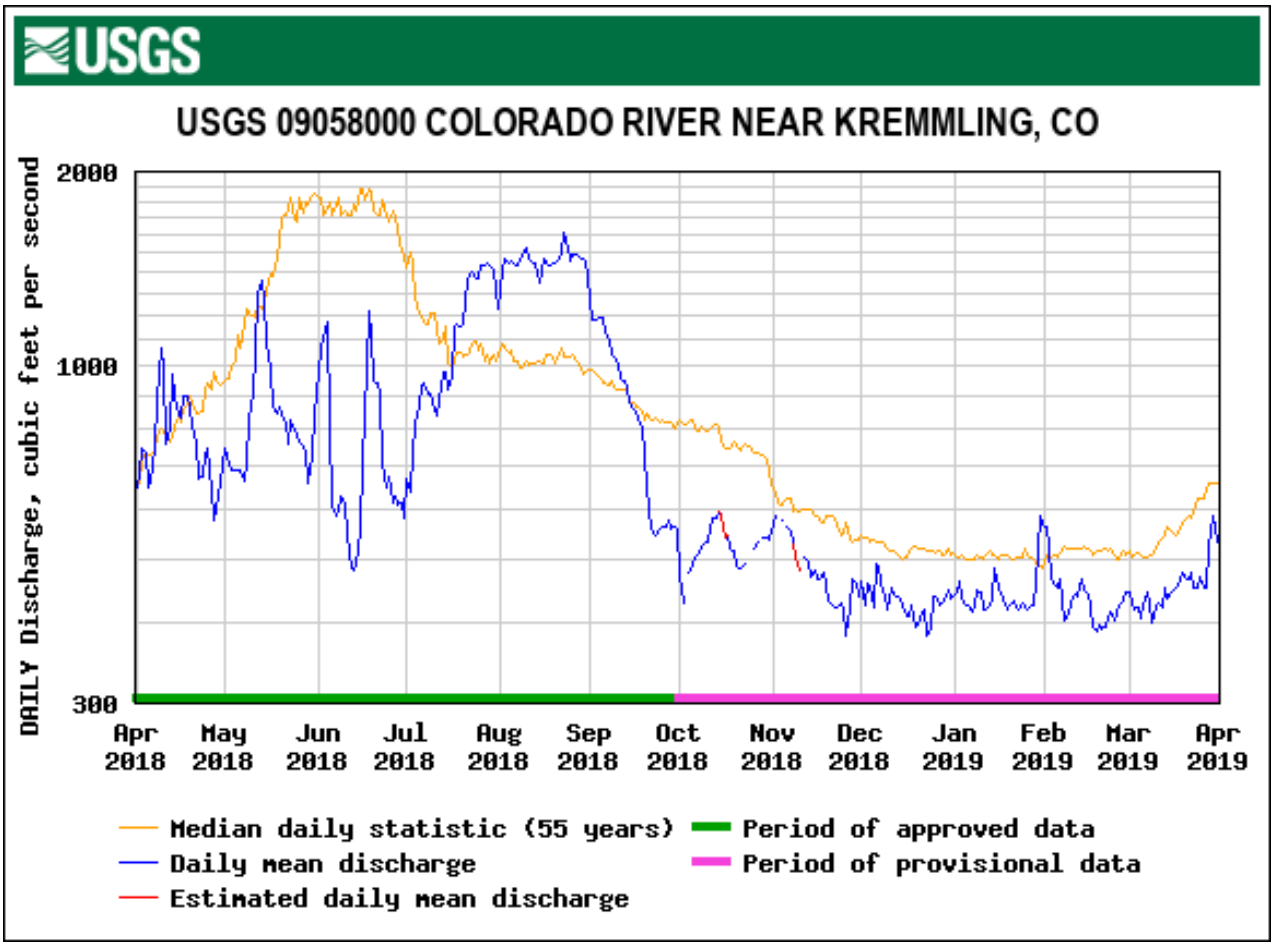


Figure 1. Daily streamflow in 2018 at the Colorado River near Kremmling, CO gage (USGS 09058000).

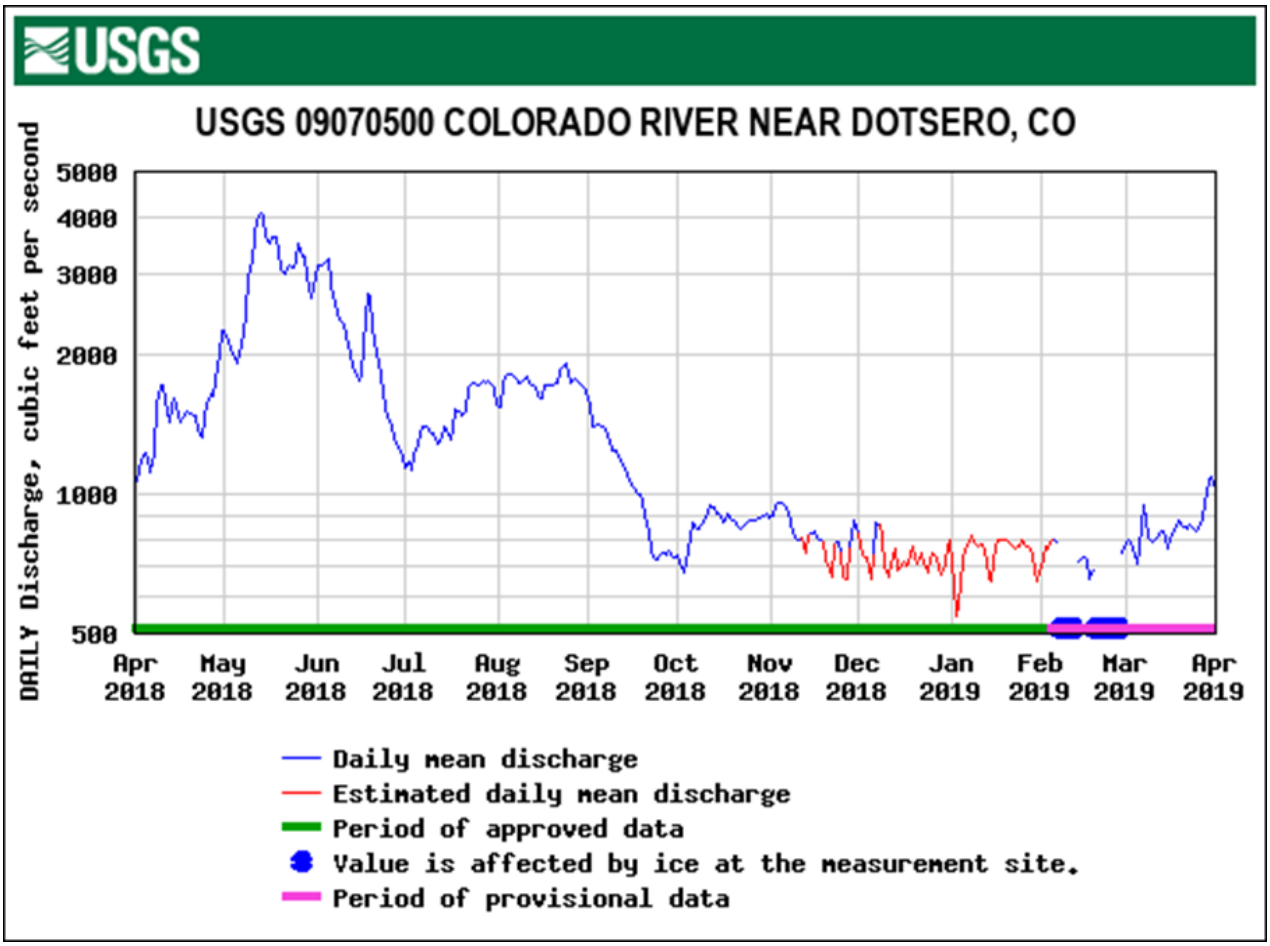


Figure 2. Daily streamflow in 2018 at the Colorado River near Dotsero, CO gage (USGS 09070500).

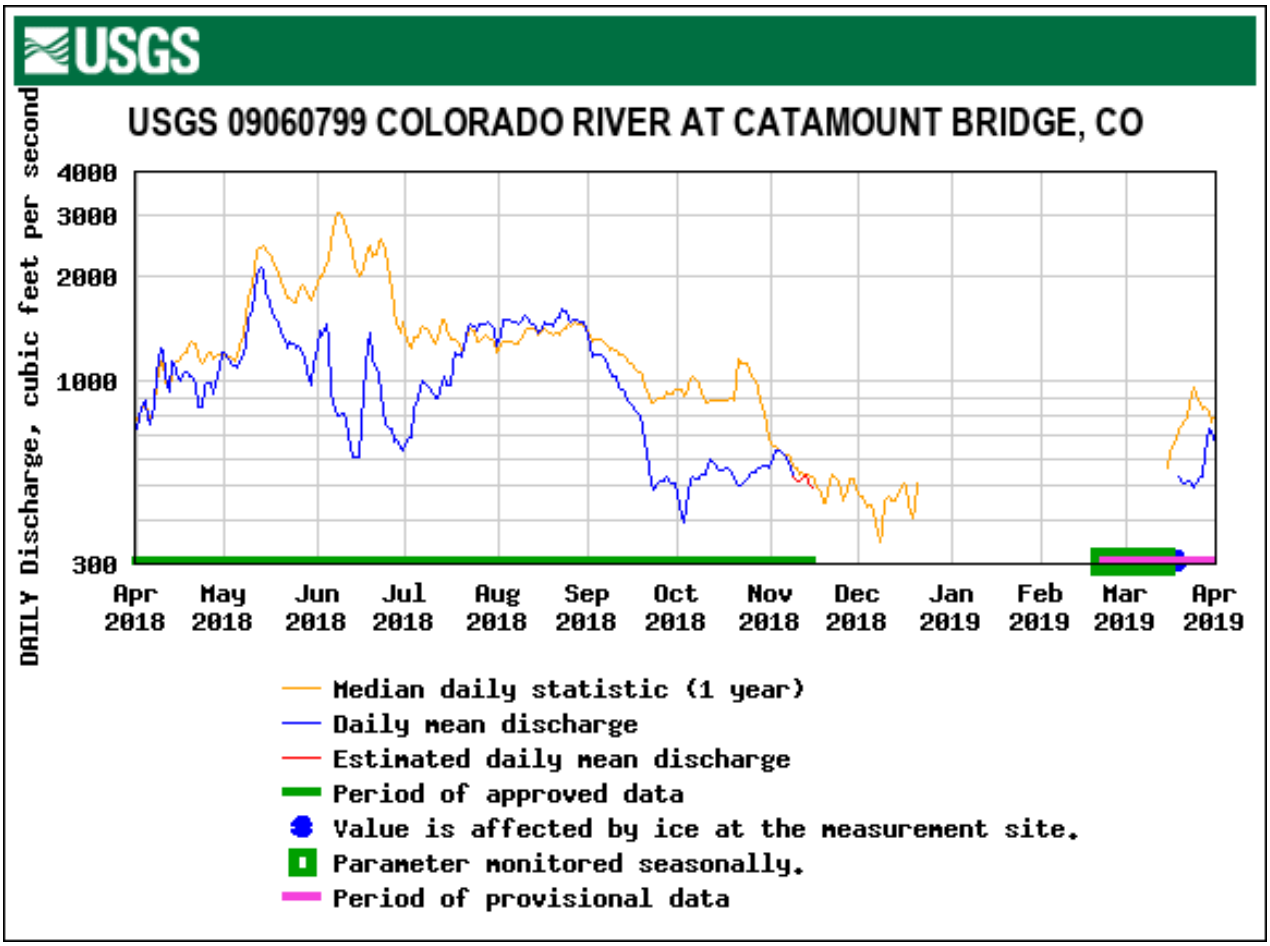


Figure 3. Daily streamflow in 2018 at the Colorado River at Catamount Bridge, CO gage (USGS 09060799).

Coordinated Reservoir Operations

During the 2018 season, Coordinated Reservoir Operations (CROS) did not occur due to low flows and low forecasted reservoir volumes. When CROS is operated, it increases the peak flows in the 15-Mile Reach of the Colorado River to improve fish habitat for species protected under the Endangered Species Act. CROS creates higher peak flows in all the W&S segments when releases from participating upstream CROS reservoirs pass through W&S segments.

Year Type Determination

The SG Plan calls for evaluating annual flow volumes and categorizing flow volumes by "Year Type" (Table 4). The actual Year Type is based on total annual flow volumes measured at the Kremmling and Dotsero gages from April 1st through March 31st. In addition, the SG evaluates the

predicted Year Type based on the Colorado River Basin Forecast Center April 1 Water Supply Forecast (Table 5). The April 1 prediction references Table 5 in the SG Plan to predict the Year Type, which is based on undepleted forecasted flows. The April 1 prediction in 2018 estimated that the undepleted flows would be 690,000 acre-feet (AF) for Kremmling and 1,020,000 AF at Dotsero (**Error! Reference source not found.**). Based on these volumes the predicted flows at b oth Kremmling and Dotsero were "Dry Typical."

In 2018, the total actual annual flow volume at the Kremmling gage was 515,400 AF and the total volume at the Dotsero gage was 948,963 AF (red font indicates values include provisional data as discussed in the Hydrology Section, see Table 6). Consequently, these segments are ranked in the "Dry Typical" and "Driest 25%" categories, respectively. It is worth noting that 4 of 7 years since 2012 have been classified as "Wettest 25%" or "Wet Typical." This is partly due to the Year Type classification, which is based on Denver Water's PACSM model, which includes water projects that have not yet been constructed in its simulations.

Table 4. SG Plan Year Type classification for W&S Segments 4-6 and Segment 7. This table is based on data from Denver Water's PACSM future modeled hydrology for 1947-1991 .

Year Type	Segment 4-6 Kremmling Gage (AF)	Segment 7 Dotsero Gage (AF)
Wettest 25%	>769,500	>1,519,500
Wet Typical	525,000 - 769,500	1,234,000 - 1,519,500
Dry Typical	454,500 - 525,500	1,029,500 - 1,234,000
Driest 25%	<454,000	<1,029,500

Table 5. April 1 Forecast predicted Year Type classification.

Year Type	Segment 4-6 Kremmling Gage (AF)	Segment 7 Dotsero Gage (AF)
Wettest 25%	>1,007,000	>1,757,500
Wet Typical	812,500 - 1,007,000	1,362,500 - 1,757,500
Dry Typical	607,000 - 812,500	1,007,000 - 1,362,500
Driest 25%	<607,000	<1,007,000

Table 6. Summary of April 1 flow predictions, actual flow volumes, and actual Year Type from 2012 through 2018 for all W&S segments.

Year	Segment 4-6 Kremmling Gage			Segment 7 Dotsero Gage		
	April 1 Prediction	Actual AF	Actual Type	April 1 Prediction	Actual AF	Actual Type
2012	Driest 25%	409,208	Driest 25%	Driest 25%	733,824	Driest 25%
2013	Driest 25%	514,954	Dry Typical	Driest 25%	1,107,878	Dry Typical
2014	Wettest 25%	1,207,257	Wettest 25%	Wettest	2,170,195	Wettest
2015	Dry Typical	1,074,067	Wettest 25%	Dry Typical	1,744,893	Wettest
2016	Wet Typical	855,910	Wettest 25%	Dry Typical	1,565,583	Wettest
2017	Wet Typical	790,942	Wettest 25%	Wet Typical	1,439,400	Wet Typical
2018	Dry Typical	510,400	Dry Typical	Dry Typical	948,963	Driest 25%

Red font indicates values that include provisional data as discussed in the Hydrology Section. Values in this table may not match a given year's Annual Monitoring Report because these values have been updated based on the final approved USGS data.

2018 COOPERATIVE MEASURES

During 2018, the Cooperative Measures Committee discussed opportunities for cooperative measures that focused on flows and temperatures in the Colorado River. Representatives from the W&S Cooperative Measures Committee participated in State of the River/Historic User Pool (HUP) weekly calls between May and October to provide input to some of the operations being discussed on the Colorado River. Weekly e-mails were sent to the Cooperative Measures Committee, and at times to the full W&S Stakeholder Group summarizing information from the HUP calls as well as streamflow and stream temperature graphs. The group discussed concerns expressed about the river and planned a response. In early June, water providers were asked to consider operational changes due to high temperatures and low flows in the middle and lower Colorado River. At that time, Northern Water, Denver Water, and the Colorado River Water Conservation District were able to temporarily modify their project operations to increase flows

in the Colorado River in an attempt to prevent further increases in temperature in the river. This collaborative opportunity was successful because of timing, but not all requests for changes can be accommodated, as the flexibility for changes is not always available. The Cooperative Measures Committee also worked on an interactive summary of Tier 1 Long-Term Protection Measures and Tier 2 Cooperative Measures as defined in the SG Plan.

GORE CANYON FESTIVAL

Late summer flow conditions on the Upper Colorado River are primarily influenced by upstream reservoir operations and downstream calls. The Cooperative Measures Committee participated in the weekly HUP calls to determine reservoir operations and flow predictions for the Gore Canyon Festival this year. The flows were adequate for a successful festival this year.

2018 MONITORING RESULTS

The Monitoring Committee assembled or collected information necessary to evaluate the provisional ORV Indicators and Resource Guides. During 2018, the SG conducted the following activities:

- Determined recreational floatboating usable days and recreational seasonal flows by SG Plan Year Type.
- Assessed fish biosurvey data collected by Colorado Parks and Wildlife (CPW).
- Evaluated temperature at five sites based on USGS and BLM temperature gages and an additional two sites based on W&S temperature data loggers.
- Conducted visitor surveys and continued development of the visitor survey database and analysis with RRC Associates.
- Collected macroinvertebrate and substrate data at five locations.

RECREATIONAL FLOATBOATING

ORV Indicators for Recreational Floatboating

The SG Plan has a provisional ORV Indicator for recreational floatboating, which applies to the Upper Colorado River from the top of Gore Canyon to No Name in Glenwood Canyon. The current ORV Indicator is the following narrative standard:

> "Protect the existing range and quality of the outstanding floatboating opportunities. This narrative standard does not imply mirroring any specific hydrology."

The intent of the SG is to develop and incorporate objective criteria into the final ORV Indicators for recreational floatboating. The Ad-Hoc Floatboating Committee continued to work towards this goal based in part on recreational survey work conducted by RRC Associates. This work is summarized in the Additional Monitoring section.

Resource Guides for Recreational Floatboating

Resource Guides for recreational floatboating are based on assessing the number of usable days at different flow rates depending on the Year Type determined by W&S segment.

W&S Segment 4-6

Floatboating Resource Guides for W&S Segments 4-6 are shown in Table 7. In 2018, there were 136 total usable days in these segments during the floatboating season (April 1 to September 30), which was within the range of usable days for a Dry-typical Year-Type based on the provisional Resource Guide. The breakdown of usable days was 93 days in the "Green Opportunities" category (lower than the median), 43 usable days in the "Blue Opportunities" category (higher than the maximum), and 0 days in the "Black Opportunities" category (within the range) (Table 1). Provisional Resource Guides for the number of usable days in these segments were within or exceeded the range in 2018. Figure 4 illustrates mean daily streamflow and the provisional range of floatboating opportunities in these segments during the 2018 floatboating season.

Table 7. Floatboating provisional Resource Guide for number of usable days in Segments 4-6 - minimum (median) maximum.

Year Type	Total Usable Days	Green Opportunities (700-1,300 cfs)	Blue Opportunities (1,300-4,000 cfs)	Black Opportunities (4,000-7,000 cfs)
Wettest 25%	115 (161) 180	38 (74) 121	39 (72) 79	4 (22) 28
Wet Typical	120 (153) 169	68 (108) 119	19 (57) 79	0 (0) 5
Dry Typical	74 (115) 141	69 (106) 127	0 (14) 33	0 (0) 0
Driest 25%	62 (80) 96	53 (73) 87	0 (1) 25	0 (0) 0

Table 8. Summary of usable days in W&S Segments 4-6 from 2012 through 2018.

Year	Year Type	Total Usable Days	Green Opportunities (700-1,300 cfs)	Blue Opportunities (1,300-4,000 cfs)	Black Opportunities (4,000-7,000 cfs)
2012	Driest 25%	103	103	0	0
2013	Dry Typical	89	83	6	0
2014	Wettest 25%	180	50	106	24
2015	Wettest 25%	179	95	58	26
2016	Wettest 25%	170	101	57	12
2017	Wettest 25%	179	70	106	3*
2018	Dry Typical	136	93	43	0

* Indicates that this number of usable days was below the provisional Resource Guide range.

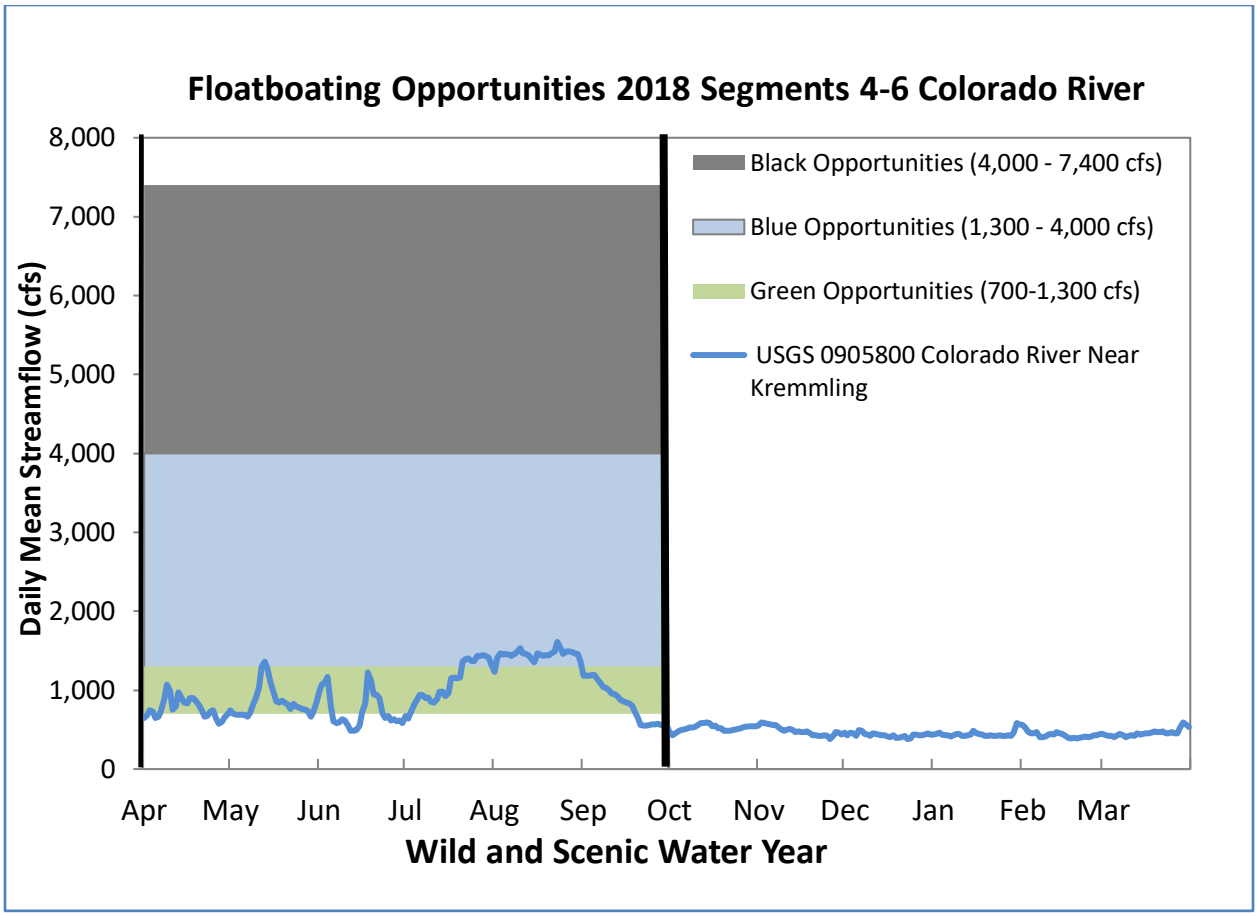


Figure 4. Hydrograph from the Colorado River near Kremmling, CO gage (USGS 0905800) demonstrating the floatboating opportunities in 2018 in W&S Segments 4-6.

W&S Segment 7

The provisional Resource Guides for W&S Segment 7 are shown in Table 9. In 2018, there were 156 total usable days in this segment during the floatboating season (April 1 to September 30), which was within the range of usable days for a Driest 25% year-type in the provisional Resource Guide. The breakdown included 93 usable days in the "Green Opportunities" category (lower than the median), 63 usable days in the "Blue Opportunities" category (higher than the median), and 0 usable days in the "Black Opportunities" category (within the range) (Table 1). Figure 5 illustrates mean daily streamflow and the provisional range of floatboating opportunities in this segment during the 2018 floatboating season.

Table 9. Floatboating provisional Resource Guide for number of usable days in Segment 7 - minimum (median) maximum.

Year Type	Total Usable Days	Green Opportunities (1,200/1250 - 1,800 cfs)	Blue Opportunities (1,800-5,500 cfs)	Black Opportunities (5,500-8,600 cfs)
Wettest 25%	120 (156) 169	33 (57) 83	49 (68) 77	21 (29) 42
Wet Typical	126 (164) 172	44 (68) 102	39 (75) 110	1 (13) 33
Dry Typical	138 (161) 178	75 (86) 121	40 (61) 91	0 (2) 11
Driest 25%	136 (159) 177	88 (126) 137	10 (32) 63	0 (0) 6

Table 10. Summary of usable days in W&S Segment 7 from 2012 through 2018.

Year	Year Type	Total Usable Days	Green Opportunities (1,200/1250 - 1,800 cfs)	Blue Opportunities (1,800-5,500 cfs)	Black Opportunities (5,500-8,600 cfs)
2012	Driest 25%	136	131	5*	0
2013	Dry Typical	152	94	57	1
2014	Wettest 25%	158	34	96	28
2015	Wettest 25%	159	69	79	11*
2016	Wettest 25%	165	86	54	25
2017	Wet Typical	179	64	97	18
2018	Driest 25%	156	93	63	0

* Indicates that this number of days was below the provisional Resource Guide range.

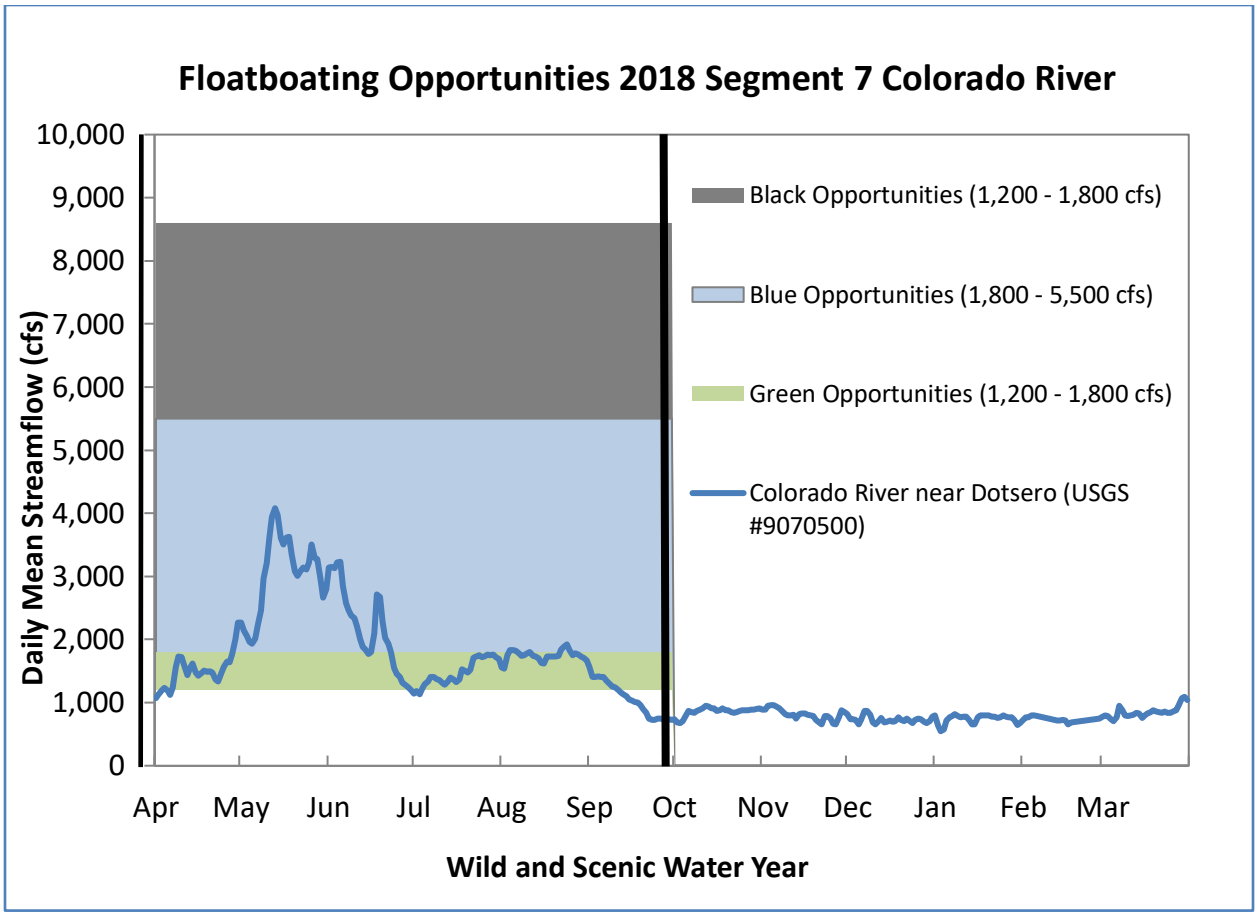


Figure 5. Hydrograph from the Colorado River near Dotsero, CO gage (USGS 09070500) demonstrating the floatboating opportunities in 2018 in W&S Segment7.

RECREATIONAL FISHING

ORV Indicators for Recreational Fishing

The SG Plan identifies provisional ORV Indicators for Recreational Fishing (Table 11, below) which apply to the Upper Colorado River from Gore Canyon to Red Dirt Creek, within W&S Segments 4, 5 and 6. These provisional Fishing ORV Indicators enable the SG to monitor the characteristics that help define the Recreational Fishing ORV in W&S Segments 4, 5 and 6. This includes both the *fishery* and the *fishing experience* (SG Plan page 14). The SG monitors these provisional ORV Indicators based on the results of annual fish population surveys (biosurveys) conducted by CPW, as well as intercept surveys performed by RRC, Associates. Starting in 2010, CPW began conducting extensive biosurveys across W&S Segments 5 and 6. As previously discussed, and

based on CPW biosurveys, the "one-size-fits-all" approach to establishing provisional ORV Indicators for Quality Trout and Biomass is being re-evaluated during the Provisional Period in order to better reflect the variability that is now known to exist in the fishery across W&S Segments 5 and 6. Once the SG Plan becomes final, a "Data Review Committee" will be established (including members of the SG and CPW) to analyze annual biosurveys data in the context of Final ORV Indicators.

The provisional Fishing ORV Indicators address trout abundance (i.e., "quality trout"), biomass, and fish species diversity. Refer to Table 11, below, for specific metrics. A Quality Trout is recognized as a trout over 14 inches, and the minimum target abundance is 24 Quality Trout per acre. The minimum target for Trout Biomass has been defined as 90 pounds of trout per acre. The SG monitors these provisional ORV Indicators through CPW's fish population surveys (biosurveys) which they use to evaluate fish abundance, biomass, and presence/absence of species. CPW's biosurveys are regularly conducted along four established two-mile reaches within W&S Segments 5 and 6 at Radium, State Bridge, Catamount, and Lyons Gulch. (See appendix B for a map of CPW biosurvey sites. (Note: it is not possible to perform biosurveys in W&S Segment 4 – Gore Canyon.)[4] CPW's biosurveys are conducted annually between April 15 and May 15 on two of the four reaches, alternating years at each reach with a few exceptions (noted in Table 12). The data is analyzed and reported by CPW to the W&S Stakeholders.

The results of CPW's biosurveys and RRC intercept data from 2010 to 2018 are summarized below and are also included in Table 12. In 2018, biosurveys were conducted at State Bridge and Catamount. Between 2010 and 2015, data reported was for brown trout only; however, starting in 2016 trout estimates were recalculated by pooling data together for both brown trout and rainbow trout since the ORV and the provisional ORV Indicators do not distinguish between trout species. Starting with the 2016 Monitoring Report, pooled estimates are being reported for

[4] The Recreational Fishing ORV ends in W&S Segment 6 at the confluence with Red Dirt Creek, and the Lyons Gulch reach is located downstream of the segments targeted for the Recreational Fishing ORV so the Lyons Gulch biosurvey is not included in this summary.

Quality Trout and Biomass for the biosurvey reaches, meaning any comparisons made between the most recent monitoring reports and reports before 2016 must take this change into consideration.

Quality Trout Evaluation

In 2018, CPW estimated abundance for Quality Trout to be 40 trout over 14 inches per acre in the State Bridge reach and 21 trout over 14 inches per acre in the Catamount reach. Quality Trout abundance at State Bridge exceeded the minimum target by 67%, as defined by the provisional ORV Indicator. However, Quality Trout abundance at Catamount fell short of the provisional ORV Indicator by 12% or 3 fish per acre. Though the disparity is not statistically significant, Quality Trout abundance at Catamount is stable over time, but remains consistently lower than the provisional ORV Indicator target value.

Biomass Evaluation

In 2018, CPW estimated Trout Biomass to be 108 pounds per acre in the State Bridge reach and 56 pounds per acre in the Catamount reach. Trout Biomass at State Bridge exceeded the provisional ORV Indicator by 17%. Trout Biomass at Catamount was 38% lower than the provisional ORV Indicator, a discrepancy of 34 pounds per acre, and statistically significant. Catamount's Trout Biomass has been relatively stable over time, as well, and estimates to date consistently fall significantly short of the provisional ORV Indicator.

Species Diversity

Species Diversity is the total number of species detected during CPW's biosurveys. In 2018, CPW captured 10 different species of fish in both the State Bridge and Catamount reaches. This is four (4) fewer species than the SG's provisional ORV Indicator, a discrepancy of 29%. Table 13 lists all species caught by CPW in the W&S Segments from 2010 – 2018, and provides information about class and endemic status of these species with regard to CPW's fishery management objectives. Table 13 also indicates which species were detected in the 2018 biosurveys.

Total Fishing Effort (TFE) and Catch Per Unit Effort (CPUE)

The SG Plan does not specify values for TFE and CPUE, but indicates that values are to be determined in the provisional period. Results from the research have been analyzed and combined with data from previous years (2013-2015) to augment TFE and CPUE measures. RRC Associates continued to explore the data generated by angler intercept surveys and coordinated with the Fishing AHC and CPW to consider the relationships between biosurvey data and RRC's data. In addition, RRC continued to assist the SG in interpreting the available data on TFE and CPUE. This assistance will continue as the SG considers refining the ORV Indicators during the provisional period.

Table 11. Provisional ORV Indicators for recreational fishing in W&S Segments 4-6.

Type	Name	Current metric (if available)
Fishery	Quality Trout	24 fish over 14" per acre
Fishery	Biomass	90 pounds per acre
Fishery	Species Diversity (SD)	14 species of fish
Recreational Fishing	Total Fishing Effort (TFE)	TBD
Recreational Fishing	Catch Per Unit Effort (CPUE)	TBD

Table 12. Summary of CPW biosurvey and RRC intercept survey data collected in 2010 – 2018a. Shading indicates unmet provisional ORV Indicators.

Sampling Metric	ORV	2010	2011	2012	2013	2014[b]	2015	2016	2017	2018
Radium (Segment 5)										
Quality Trout (# > 14"/acre)	24	44	60	49	52	-	65	-	66	-
Biomass (lbs/acre)	90	121	143	155	164	-	145	-	173	-
Species Diversity (# present)	14	12	14	15	14	-	11	-	7	-
CPUE (annual average)	TBD	-	-	-	0.73	0.93	0.53	-	-	-
Number of samples		-	-	-	166	191	80	-	-	-
State Bridge (Segment 6)										
Quality Trout (# > 14"/acre)	24	-	-	-	52[c]	-	23	31	33	40
Biomass (lbs/acre)	90	-	-	-	172[c]	-	71	74	86	108
Species Diversity (# present)	14	-	-	-	11[c]	-	8	7	9	10
CPUE (annual average)	TBD	-	-	-	0.94	0.74	0.67	-	-	-
Number of samples		-	-	-	34	75	99	-	-	-
Catamount (Segment 6)										
Quality Trout (# > 14"/acre)	24	-	18	-	19	-	22	-	-	21
Biomass (lbs/acre)	90	-	57	-	57	-	50	-	-	56
Species Diversity (# present)	14	-	7	-	12	-	8	-	-	10
CPUE (annual average)	TBD	-	-	-	-	1.25	0.93	-	-	-
Number of samples	-	-	-	-	-	24	60	-	-	-
Two Bridges (Segment 6)										
CPUE (annual average)	TBD	-	-	-	-	-	0.56	-	-	-
Number of samples		-	-	-	-	-	47	-	-	-

[a] Data in this table in previous reports included only brown trout; all years shown in this table have been revised to include both brown and rainbow trout.
[b] High water prevented CPW from conducting biosurveys in the W&S Segments in 2014.
[c] CPW determined the biosurvey data collected at State Bridge in 2013 was imprecise. An additional biosurvey was performed in this survey reach in 2016.

Table 13. Fish species captured from 2010 – 2018 in the W&S Segments 5 & 6. Species captured in 2018 at State Bridge and Catamount are identified below. "Invasive" indicates undesirable non-native species.

Fish	Class	Endemic Status	2018
Colorado Cutthroat Trout	Coldwater fish	Native	
Rainbow Trout	Coldwater Sportfish	Introduced	X
Rainbow/Cutthroat Hybrid	Coldwater Sportfish	Hybrid - introduced	
Brown Trout	Coldwater Sportfish	Introduced	X
Brook Trout	Coldwater Sportfish	Introduced	
Kokanee Salmon	Coldwater Sportfish	Introduced	
Lake Trout	Coldwater Sportfish	Introduced	
Mountain Whitefish	Coldwater Sportfish	Introduced	X
Speckled Dace	Non-game	Native	
Mottled Sculpin	Non-game	Native	X
Bluehead Sucker	Non-game	Native	X
Flannelmouth Sucker	Non-game	Native	X
White Sucker	Non-game	Invasive	X
Longnose Sucker	Non-game	Invasive	X
White/Longnose hybrid	Non-game	Hybrid - invasive	
White/Flannelmouth hybrid	Non-game	Hybrid - invasive	X
White/Bluehead hybrid	Non-game	Hybrid - invasive	
Longnose/Bluehead	Non-game	Hybrid - invasive	X

Resource Guides for Recreational Fishing

Seasonal Flows

The provisional Resource Guides shown in Table 14 represent the seasonal ranges of flow for the Recreational Fishing ORV in W&S Segments 4, 5 and 6. Since the effective date of the SG Plan, the SG has agreed to use the mid-point value as a reference flow and compare it to the 5-year rolling average each season for purposes of discussion under the SG Plan.[5]

[5] During the provisional period, the 5-year rolling average will include data from the previous 4 years.

Table 14. Provisional Resource Guides for Recreational Fishing in W&S Segments 4-6.

Season	Number of Days	Months	Seasonal Fish Flow Range and midpoint, cfs
1	91	April, May, June	800-1,000 900 midpoint
2	92	July, August, September	600-1,000 800 midpoint
3	61	October, November, December	400-800 600 midpoint
4	121	January, February, March	400-600 500 midpoint

Calculations of the seasonal average flow and rolling 5-year average flows are based on daily mean discharge data from April 1, 2018 to March 31, 2019 at the Kremmling gage (USGS 09058000). These calculations included use of provisional data as discussed in the Hydrology section.

Figure 6 provides a comparison of 5-year average seasonal flows at the Kremmling gage to the W&S provisional Resource Guides between 2013 and 2018. In all but one case, the 5-year average streamflows exceed the mid-point value of the seasonal flow ranges for each season. The exception is the 2012 average flow of 434 cfs during Season 4, which falls within the target flow range, but below the midpoint of 500 cfs.

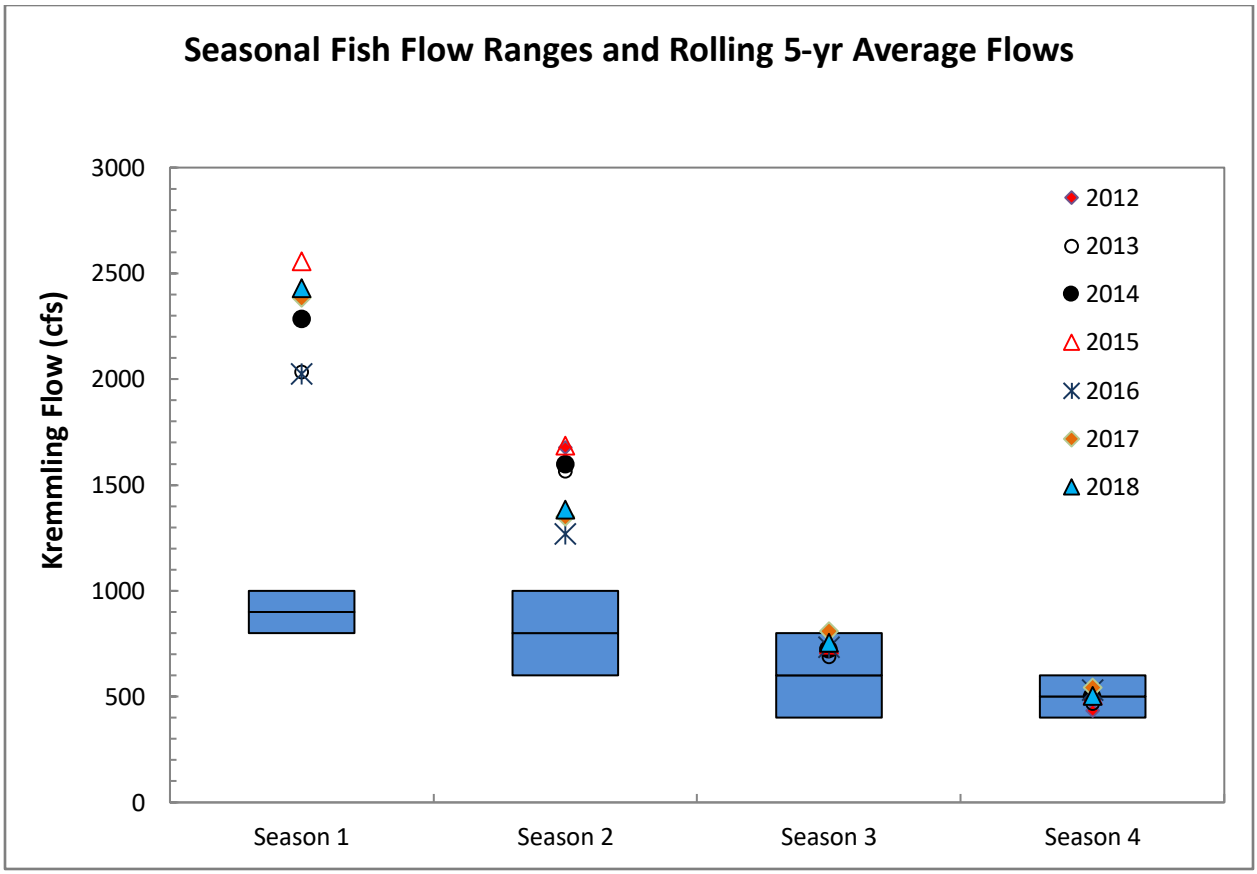


Figure 6. Five-year average streamflows for 2013-2018 compared to W&S provisional Resource Guides for Recreational fishing (blue boxes). This analysis includes provisional data as discussed in the Hydrology section.

Flushing Flows

In addition to Seasonal Fish Flows, the SG Plan includes "Flushing Flows" as a provisional Resource Guide for the Fishing ORV. During the provisional period, the SG has negotiated the following provisional Resource Guide for a periodic high flow: "A daily average flow of at least 2,000 cfs maintained for three consecutive days with a frequency of occurrence of once in two years on average." Table 15 summarizes "Flushing Flow" results from 2012 through 2018 based on the Colorado River near Kremmling, CO gage (USGS 09058000). Streamflow did not reach 2,000 cfs in 2018.

Table 15. Peak streamflow and flushing flow metrics based on the Colorado River near Kremmling gage (USGS 09058000).

Year	Year Type	Instantaneous Peak Streamflow, cfs	Maximum Daily Mean Streamflow, cfs	2,000 cfs for 3 consecutive days	Number of days above 2,000 cfs
2012	Driest 25%	1,280	1,150	No	0
2013	Dry	1,750	1,680	No	0
2014	Wettest 25%	7,830	7,670	Yes	99
2015	Wettest 25%	7,860	7,820	Yes	76
2016	Wettest 25%	4,830	4,770	Yes	58
2017	Wettest 25%	4,380	4,280	Yes	32
2018	Dry Typical	1,650	1,610	No	0

WATER QUALITY

The SG Plan adopted CDPHE's water quality standards as provisional Resource Guides for W&S Segments 4 - 7:

> "The [provisional] Resource Guides for water quality are the Colorado Department of Public Health and Environment (CDPHE) water quality standards for cold water aquatic life and recreation uses for the portion of the stream segment that CDPHE has designated COUCUC03 (Mainstem of the Colorado River from the outlet of Granby Reservoir to the confluence with the Roaring Fork River) that is within the Wild & Scenic Segments 4 through 7."

These standards are specified in CDPHE's Regulation #33 - Classifications and Numeric Standards for Upper Colorado River Basin and North Platte River.

Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List (Regulation #93 – 5 CCR 1002-93), effective March 2, 2018 lists W&S Segment COUCUC03_D (Gore Canyon to Derby Creek, W&S Segments 4, 5, and the top of 6) on the Monitoring & Evaluation list for macroinvertebrates and impaired for temperature, and Segment COUCUC03_E (Derby Creek to the confluence with the Roaring Fork River, W&S Segments 6 and 7) as impaired for temperature. A discussion of macroinvertebrates occurs in the "Additional Monitoring" section below. Appendix A shows the W&S Segments and Derby Creek.

Water Temperature

The provisional Resource Guide for water temperature is based on CDPHE's standard for Segment COUCUC03 [6] Mainstem of the Colorado River from the outlet of Lake Granby to the confluence with Roaring Fork River, which is classified as a Cold Stream Tier II. Regulations state that temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to resident aquatic life.[7]

Table 16 shows the currently adopted numeric temperature standards for the Upper Colorado River Basin. Attainment of chronic temperature standards is based on a Maximum Weekly Average Temperature (MWAT), which is defined as a seven day moving average. Attainment of the acute temperature standard is based on a Daily Maximum (DM), which is defined as the highest two-hour average water temperature in a given 24-hour period. Temperature data are evaluated against numerical standards for chronic (MWAT) and acute (DM) seasonal maxima.

Table 16. CDPHE numeric temperature standards for Cold Stream Tier II.

Temperature Tier	Tier Code	Species Expected	Applicable Months	Temperature Standard MWAT (°C)	Temperature Standard DM (°C)
Cold Stream Tier II	CS-II	All other cold-water species[8]	Apr1-Oct 31	18.3	23.9
			Nov 1-Mar 31	9.0	13.0

The Monitoring Committee has been collecting and reviewing water temperature data within the W&S segments since 2012. Prior to 2017, the Monitoring Committee collected water temperature readings at five locations using Onset Hobo TidbiT data collectors. The five TidbiT sites were not measured in 2017; however, previously collected data is archived in the Grand County Water Information Network (GCWIN) database https://www.gcwin.org/data.

In 2018 the Monitoring Committee compiled water temperature throughout Segments 4-7 from two W&S SG-administered sites, three real time temperature sites at USGS gage stations, and

[6] Colorado Department of Public Health and Environment, Water Quality Control Commission *5 CCR 1002-31*, September 30, 2017.
[7] Colorado Department of Public Health and Environment, Water Quality Control Commission *5 CCR 1002-33*, September 30, 2017.
[8] All other cold-water species includes brown trout and rainbow trout.

two BLM temperature sites (Table 17). One additional W&S SG station at Dotsero was unrecoverable at the end of field season. The data was analyzed utilizing the Microsoft Excel temperature macro version 4.5 developed by CDPHE.

Table 17. Temperature stations and responsible entities.

Temperature Station	Entity
Colorado River Near Kremmling (09058000)	USGS
COR-Pumphouse (not reported for 2018 due to data quality concerns)	BLM
COR-Radium	BLM
Colorado River at Catamount Bridge, CO (09060799)	USGS
Colorado River at State Bridge	W&S SG
Colorado River at Red Dirt	W&S SG
Colorado River at Dotsero (unrecoverable in 2018)	W&S SG
Colorado River Above Glenwood Springs, CO (09071750) aka "No Name"	USGS

The 2018 temperature data shows an expected downstream warming trend between Kremmling and Glenwood Springs (Figure 7, Figure 8). In general, during runoff and post-runoff conditions, little warming is observed between the mouth of Gore Canyon below Kremmling and Radium, with a recognizable increase from site to site downstream of Radium. The lower magnitude of heat gain from Gore Canyon to Radium likely relates to the rugged topography and confined nature of the river course in this region, which decreases potential solar gain during daytime periods. From Radium downstream, heat gain occurs more consistently from site to site until near Glenwood Springs.

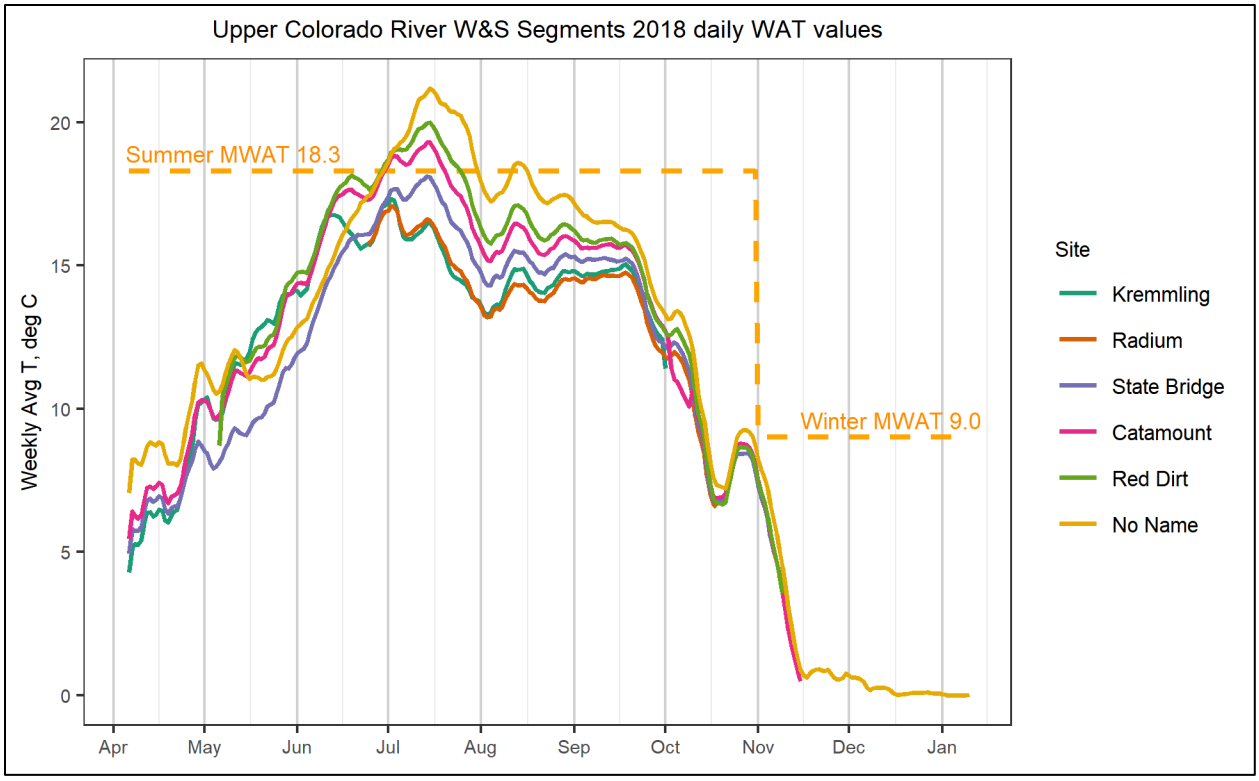


Figure 7. Weekly average temperatures (WAT) in 2018 and the applicable CDPHE summer and wintertime Maximum Weekly Average Temperature (MWAT) standards.

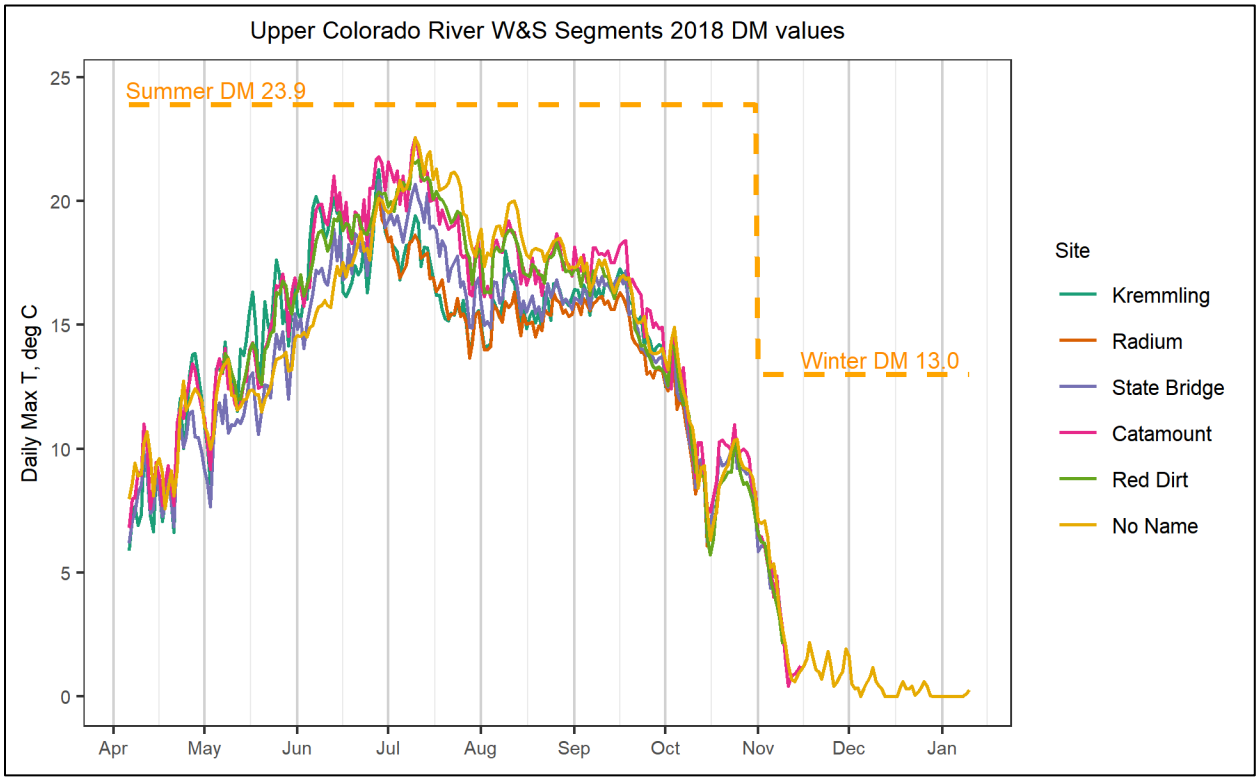


Figure 8. Measured daily (DM) temperatures in 2018 and applicable CDPHE summertime and wintertime standards.

Based on comparison to State standards[9], the Catamount, Red Dirt, and No Name monitoring sites showed potential exceedances of the Maximum Weekly Average (MWAT) temperature standard of 18.3°C (75°F) during the summer season. Potential exceedances occurred over a four-week period throughout the July, with increased length of potential exceedance time periods moving downstream from Catamount to Red Dirt and No Name. An official analysis as per WQCD's 2018 Section 303(d) listing methodology and Policy Statement 06-1, which tallies exceedances using only non-overlapping 7-day periods, and may exclude exceedances based on exceptions for air temperature, low flow, or shoulder-season excursions has not been conducted. Based on the available data, no MWAT temperature issues occurred during the shoulder season transition into the winter standard. Sites showed no potential summer or winter DM exceedances in 2018. MWAT potential exceedance summaries by site for 2013-2018 are shown in Table 18. In cases where "the temperature standard for a segment has been excluded but the excursion data has not yet been evaluated, the segment will be placed on the M&E List."[10]

[9] Colorado Department of Public Health and Environment, Water Quality Control Commission *5 CCR 1002-33*, September 30, 2017.

[10] Colorado Department of Public Health and Environment, Water Quality Control Commission, *Section 303(d) Listing Methodology 2018 Listing Cycle*, March 2017

Table 18. MWAT exceedances at W&S temperature sites from 2013 – 2018.

Site	W&S	2012	2013	2014	2015	2016	2017	2018
Kremmling	4		y				y	
Pumphouse	4/5		y					*
Radium	5		y					
State Bridge	5/6		y				nd	
Catamount [11]	6	nd	nd	nd	nd	nd	y	y
Red Dirt	6	nd	y		y	y	nd	y
Dotsero	6	y	y		*	y	nd	nd
No Name[12]	7	y	y	y	y	y	y	y

**Not reported due to data issues such as incomplete record or QAQC concerns.*
nd: No data collected or reported for this year at this location
y: yes an exceedance occurred

Water temperature conditions are driven by multiple factors, with air temperature and flow conditions contributing strongly to daily and seasonal patterns. Runoff peaked earlier than typical in 2018 at just over 2100 cfs on May 13 at the Catamount gage. Flows declined to 600 cfs by mid June but remained variable in June, occasionally returning to over 1000 cfs. The Shoshone Call came on June 30th, bringing additional water downstream from the Grand County region into Segments 4-7. The junior Cameo Call came on July 20th, and the senior call was placed on August 1st. The Cameo Call remained on for the duration of the irrigation season until October 10th. USGS air temperature data after the beginning of June at the Catamount Gauge remains provisional at this time and therefore is unreported here. Records at the Elliot Ridge SNOTEL site (Figure 9) show that warmest air temperatures for the summer season occurred on June 26th, holding steady through July 19th before declining slowly through August and September. We note that this SNOTEL site is at an elevation significantly higher than the river corridor. An additional notable warm spell occurred around August 12th.

[11] The Catamount temperature monitoring site was activated in 2016.
[12] The "No Name" temperature site is formally known as USGS Gage 09071750 "Colorado River above Glenwood Springs, CO".

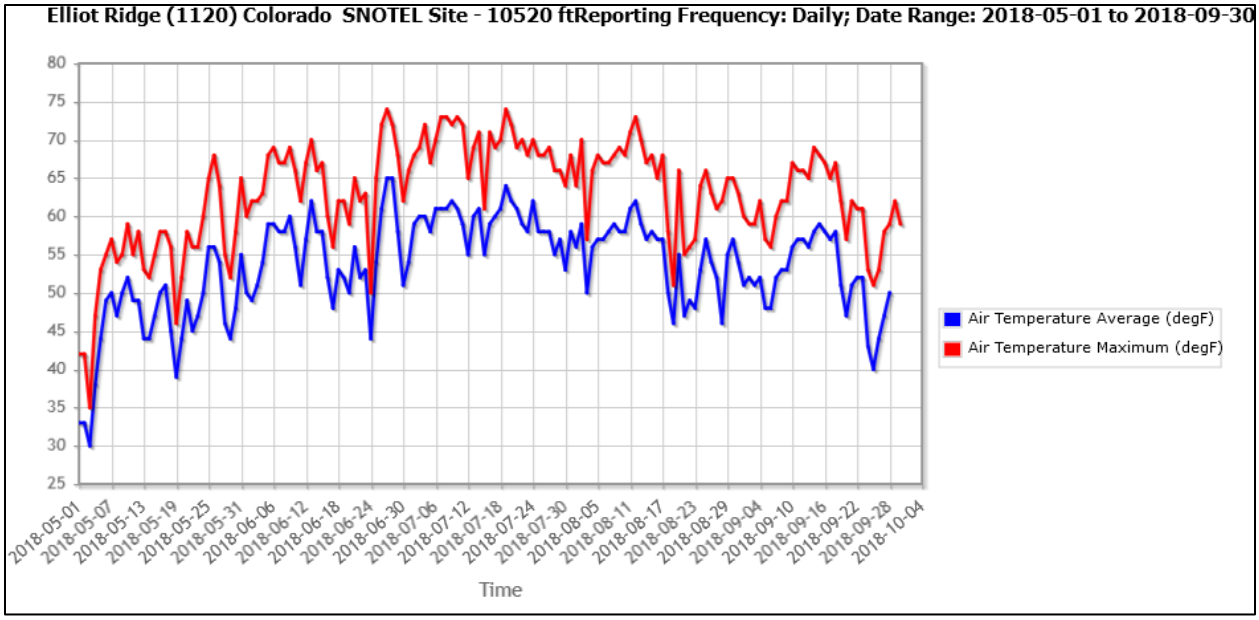


Figure 9. Daily average and maximum air temperatures at Elliot Ridge SNOTEL, site 1120.

ADDITIONAL MONITORING

Fishing and Floatboating User Surveys

In 2013, the W&S SG retained RRC Associated (RRC) to develop and conduct fishing and floatboating surveys (intercept surveys) at river access sites within the W&S segments, with the understanding that the data collected from these surveys would be used to inform management decisions. Following that initial developmental season, RRC completed intercept surveys between 2013 and 2015 (RRC, 2014; RRC, 2015; RRC, 2016) and again in 2018.[13] [14] [15] The decision to conduct surveys in 2018 was made in part because relatively dry conditions were anticipated in both Segments 5 and 6 (Dry Typical year-type) and Segment 7 (Driest year-type). Further, following considerable discussion of survey results as they apply to ORV Indicators for fishing and floatboating, there was a desire to augment the overall survey-based dataset with additional samples. The goals of RRC's 2018 research included:

a) To advance the pilot effort to establish baseline measures and methods that will be used to guide research and associated policy decisions in the future.

[13] RRC Associates, Inc., 2014, Upper Colorado River Wild & Scenic Stakeholder Group, 2013 Pilot Study - Final Results.
[14] RRC Associates, Inc., 2015, Upper Colorado River Wild & Scenic Stakeholder Group, 2014 Pilot Study - Final Results
[15] RRC Associates, Inc., 2016, Upper Colorado River Wild & Scenic Stakeholder Group, 2015 Pilot Study and 3 year provisional period summary

b) To continue to evaluate existing data including intercept survey results from 2013-2015, to add results from 2018 fieldwork.

c) To refine methods for warehousing and accessing data.

The SG is using the results of RRC's multi-year efforts to assist in refining the provisional ORV Indicators and Resource Guides in the SG Plan.

In 2018, RRC's work program focused on a series of tasks including: creating a new survey program designed to permit benchmarking of data over time, obtaining additional vehicle count information, evaluating commercial data from multiple years, combining those data with intercept results from previous years (2013-2015), and creating new methods for sharing data among stakeholders. RRC has continued to assist the SG by organizing data on the Tableau platform (http://rrcinteractive.squarespace.com/) and working to create tools for warehousing data now and into the future. In addition, select summary graphs are presented in Appendix D. The expectation is that summary graphs portraying the results of survey research will continue to be updated and presented in an Appendix to the Annual Monitoring Reports. The following are some key elements of the 2018 program.

Floatboating and Angling Survey Research in 2018

Intercept surveys were conducted by RRC during 2018. Designed to gather data in formats developed in 2013-2015, and closely following the guidance provided by the protocols document produced in 2017, the 2018 research program was based on surveying conducted on 15 "study days" over the 2018 summer season. The total number of surveys collected in 2018 numbered 951. These results have been presented in a series of graphs contained in Appendix D as well as via the Tableau Dashboard available at the website identified above. Briefly stated, some of the key findings from 2018 include the following:

For purposes of monitoring visitor use levels and satisfaction, the SG has elected to divide flows on the Upper Colorado River into year types based on total flow volumes in a given year, compared with long-term flow volumes recorded at stream gages. The categories are: driest (0 to 25 percentile), dry typical (26th to 50th percentile), wet typical (51st to 75th percentile), and wettest (76th to 100th percentile). The survey results from years 2015 to 2018 are reported by year with the year types identified.

- A key goal of the stakeholder group is to collect a sufficient number of surveys in each year type to enable a scientifically valid characterization of the visitor experience.

- 2018 was an unusual hydrologic year in that the volume of flow in Segments 5 and 6 registered as a "dry typical" year type, while the volume of flow in Segment 7 registered a “driest” year type. This finding should be noted as results from 2018 are evaluated.
- Significantly, the data from 2018 did not show an increase in respondents indicating that they do not intend to return to the segment where they were interviewed in spite of relatively drier conditions. However, respondents did indicate that they were affected by flow levels at higher percentages than had been identified in past surveys (when conditions were wetter). Further, respondents were relatively more likely to “characterize the water level today” as “too low” or “low-acceptable” compared to results from 2013 to 2015.
- In general, ratings of factors influencing visitor experience were similar to those obtained in past years, with the exception of more respondents indicating that water levels had reduced their experience.
- The intercept surveys track visitors in commercial parties compared to private parties. In 2018 the number of private parties increased, with more visitors originating from Colorado and more from the Colorado counties near the river (Eagle, Garfield, Grand and Summit).
- As noted above, a full set of breakdowns of survey responses, by year type, are presented in the Appendix.

User Group Surveys

RRC developed and conducted a web-based survey program that was fielded through cooperative efforts with American Whitewater and results were analyzed in 2018. This survey was proposed as a part of a continuing effort to evaluate “proof of concept” tools that might be used in the future to monitor river user experiences on an annual basis. This survey was designed to build on a web-based survey previously conducted in 2015 using the website Mountain Buzz as a means of distributing the survey. It was the first of several potential surveys designed to collect input from user groups. This type of survey can be repeated in future years to develop multi-year evaluations of the river experience by a diverse set of river users that can be used to support management decisions by the SG and land management agencies.

Wade Fishing Surveys—Special Angler Survey

In 2018, a special effort was made to collect surveys from wade anglers above the Pumphouse Recreation Area. This program continued the surveying that was initiated mid-summer 2017. The

purpose of this effort was to collect data from these individuals using survey questions comparable to those asked of anglers who floated the river during intercept surveys conducted from 2013-2015, and 2018. Signs were posted at the kiosk to encourage participation, and survey forms provided to allow exiting anglers to report their fishing results. The survey used an abbreviated set of questions to measure fish caught and hours fished by date; these are survey-based metrics that are being discussed for a potential angling ORV measure. Specifically, the form requested that anglers report their hours fished and fish caught (TFE and CPUE). Data from the surveys were analyzed and the survey responses were compared to results obtained from floating anglers as obtained downstream in Segments 5 and 6.

This self-reporting technique resulted in 103 completed surveys obtained between July 1 and October 15, 2017. Additionally, 146 surveys were completed between April 14 and October 8, 2018. Note, some additional survey log data was collected in late October/early November of 2017 that was not included in the analysis. In 2018, the calculated TFE was 4.4 hours fished per reported angler (up from 4.0 in 2017) and the CPUE was 1.9 (up from 1.4 in 2017). This is higher than results reported by floating anglers when surveys were conducted, 2013-2015.

Commercial Data

RRC tabulated 2017 commercial data as reported by outfitters to the Kremmling and Colorado River BLM officers, and USFS. Commercial outfitters typically report their river use daily to the agencies. Some of these reports are provided in digital form, other reports required data entry by RRC staff. These reports have been obtained since 2013 and RRC has aggregated the available data into a master file that permits commercial user groups, both floatboating and angling, to be analyzed by date, party size, craft type, and location of launch and takeout. The availability of commercial data has historically lagged each year, resulting in RRC obtaining 2016 data in 2017/2018, and 2017 data only becoming available in 2019. Collection of this data was interrupted by the U.S. government closure in early 2019, resulting in delays in obtaining files required to complete the 2017 commercial log collection.

Vehicle Counters Program

Five vehicle counters were placed at various sites in Segments 5 and 6 for the 2018 season. These units were monitored and downloaded periodically from May through October. The counters included four enhanced capacity MetroCount units, as well as a fifth unit which required frequent on-site readings to get detailed results. The 2018 vehicle count information was incorporated

into the master file and is available on a daily as well as hourly basis for the period during which counters were in place. The vehicle counters provide a source of information that can support additional analysis describing visitation patterns and relative volumes of visitors, year over year and by day of week.

In 2018, for the first time, the BLM Colorado Field Office purchased and placed vehicle counters downstream of State Bridge. The results from these counters have been integrated with data collected from the RRC annual effort. In 2019, it is expected that the BLM Kremmling Field Office will also be purchasing and placing vehicle counters in selected locations. In the future, it is anticipated that the role of the W&S SG (assisted by RRC) will change: RRC will assist in analyzing data from the multiple counters but will no longer be charged with placing and monitoring the units.

The results from these analyses are summarized in graphs presented in Appendix D. However, it should be recognized that the graphs provide an overview representation, further analysis is suggested in order to fully understand patterns of visitation.

Tabulation of Fee Envelope Data

RRC coordinated pickups of 2018 BLM private fee envelopes organized by collection site and gathered data from a sampling of approximately 4,000 envelopes. The envelope data provide a unique source of information portraying private river users, which are not represented by the commercial visitation log data. The records show home zip codes of fee payees, as well as date and activities at fee sites. The fee envelopes were collected by geographic location and this information was tabulated (Pumphouse, Radium, etc.). The resulting data will be consolidated into the master file, to be completed by March 2019. These include data summarizing geography of origin for visitors paying fees, as well as reported activities. It is anticipated that the fee envelope data collection effort will be terminated in 2019. The established data set is sufficient to provide a benchmark of fee envelope reporting, and the program could be reinitiated in the future if a particular question arises that requires this type of information.

River Ranger Data

Data collected by River Rangers at the Shoshone and Grizzly locations in Segment 7 were tabulated. These interviewers, who are supported by the USFS and participating outfitters, record observations of user patterns at the sites and the resulting graphs portray the number of people observed. Historic dates are aligned by 2018 day of week. The data have been shared with the

W&S SG on a cooperative basis and are compiled in Tableau format to permit various analyses. The data set represents fieldwork collected and reported daily and as such, it represents a valuable portrayal of Segment 7 user patterns. The 2018 findings are summarized in Appendix D along with results from previous years (2014-2017). The River Ranger data can be segmented and explored as requested by W&S SG members.

Displacement Survey

A "displacement survey" was initiated in fall 2018. Visitors who previously participated in the intercept survey process on the Upper Colorado River from 2013-2015 were contacted via email to complete a follow-up survey. The survey aimed to understand visitors' recreation patterns, likelihood to return, and whether they have been displaced to rivers other than the Upper Colorado River since being initially surveyed on-site. Displacement occurs when an individual finds that a recreation location no longer provides them with their desired experience and decides to visit other locations instead. The 2018 displacement survey sought to identify whether signs of displacement were occurring in users who had previously been to the Upper Colorado River and, if so, to identify some possible causes. Specifically, the survey asked respondents to rate the likelihood of their decision to return/not return to the Upper Colorado River. Additionally, the survey was used to evaluate experiential data and demographics from survey respondents. In other words, the goal of this survey program was to better understand return visits, or for those not returning, why? The survey was developed with input from a variety of stakeholders and was formally approved by the W&S SG.

- The source of the survey responses was an email list compiled from river users who responded to intercept surveys in 2013 to 2015. The survey used 1,300 email addresses compiled from visitors in 2013-2015. Approximately 300 emails were determined to be no longer valid, resulting in a list of about 1,000 survey invitations. The survey was completed by 97 respondents, with an additional 15 partial responses, a good return rate (10%+) for this type of survey, which was fielded three to five years after actual intercept surveys occurred.
- The survey found that 85% of those who have been on <u>any</u> river in the past 5 years have been back to the Upper Colorado.
- About 95% of respondents are likely to return (rated 3 out of 5 or higher) to the Upper Colorado. This is comparable to, but slightly more than, the percentages

obtained at the time of intercept interviews on the river. Of those not returning, about 3% reported they were on a "bucket list trip."

- The results suggest that few visitors are reporting that they won't return for reasons that could be considered experiential. This survey was developed as a "proof of concept" initiative to test the viability of this approach to monitoring and measuring displacement. Preliminary results are encouraging, it appears that this approach to post-visit surveying could provide a workable and cost-effective means of measuring individuals who report not coming back due to experiential factors, i.e. displacement.

Data Management and W&S SG Support

RRC conducted a number of other activities including warehousing and management of W&S SG data, sharing data in Tableau dashboard format, and analysis and visualization. RRC continued participation in W&S SG and Committee work as requested. RRC also expanded the Tableau Dashboard to make the results of floatboating and angling data readily available to W&S SG. The dashboard represents a work in progress, undergoing continuing refinement and improvement, but it now represents a viable tool for interested groups to obtain current data from the surveying program, 2013-2018. The Intercept Survey Research Protocols, developed in 2017 by RRC and the Floatboating AHC, were used to guide the survey research efforts and to ensure that methods are documented and can be replicated over time. RRC's contributions were intended to: advance the pilot effort to establish baseline measures and methods that will be used to guide research in the future, continue to evaluate existing data, refine methods for accessing that data, and to assist with the W&S SG's efforts to refine the provisional ORV Indicators and Resource Guides for recreational fishing and floatboating. Raw data and research results were shared and discussed with the SG and committees in a variety of settings.

Macroinvertebrates

Aquatic macroinvertebrate species vary in sensitivity to environmental perturbation as reflected in measurable changes in the production, diversity, and relative abundance of species in aquatic communities. Sampling, taxonomic identification and quantification, and calculation of indices that describe community structure are therefore widely used to assess aquatic ecosystem health (i.e., bioassessment). Monitoring macroinvertebrate communities by repeating comparable bioassessments over time can also reveal changes in the physical environment or water quality.

Further, differences among taxa in sensitivity to various disturbances create opportunities to calculate a variety of community metrics to help determine the nature of detected impacts.

Throughout 2018, macroinvertebrate bioassessment and monitoring was discussed by the Fishing Ad-Hoc and Monitoring Committees. The Fishing Ad-Hoc committee initiated an ongoing discussion of the goals and merits of long-term macroinvertebrate monitoring and how different bioassessment approaches might provide useful data to inform SG efforts to monitor and protect the Recreational Fishing ORV for Segments 4 through 6. The Monitoring Committee worked through a request for proposals process approved by the SG to identify a qualified contractor to conduct a 2018 bioassessment study at five established sites in the Colorado River from Pumphouse to downstream of Red Dirt Creek. The contract was awarded to Timberline Aquatics, Inc., which conducted field sampling and analysis beginning in October 2018.

CDHPE Standards and Bioassessment using Colorado's Multi-metric Index (MMI)

Because CDPHE water quality standards for cold water aquatic life are provisional Water Quality Resource Guides in the SG Plan, the 2018 Bioassessment study was conducted using an approach consistent with CDPHE's Aquatic Life Bioassessment methodology.[16] The CDPHE methodology relies on Colorado's multi-metric index (MMI). The MMI scores from test sites are compared against standard thresholds to determine how closely the macroinvertebrate community metrics at a test site resemble those measured at standard reference locations known to be minimally disturbed.

The MMI score itself is a composite of several community metrics, scaled to 100, that vary in their ability to detect specific stressors and is designed to be an indicator of the general health of the aquatic life in a stream. When the MMI indicates aquatic life impairment, the individual metrics, and other indices can be used to help identify the possible causes. The CDPHE bioassessment methodology allows for a range of sample collection methods, some of which are more robust and allow for the calculation of additional metrics or indices to more extensively explore the data.

In practice, the CDPHE Bioassessment methodology involves sampling and quantification of macroinvertebrate taxa from test sites. The Colorado Environmental Data Acquisition System tool is then used to calculate community metrics and three indices, including the MMI, Shannon

[16] Colorado Department of Public Health and Environment, Water Quality Control Commission, *Aquatic Life Use Attainment Methodology to Determine Use Attainment for Rivers and Streams. Policy Statement 10-1*, August 7, 2017.

Diversity Index (SDI), and Hilsenhoff Biotic Index (HBI). The indices are compared to established thresholds for attainment or impairment through a multistage decision tree flow. An MMI Score above the attainment threshold is considered sufficient evidence of a healthy aquatic life, and a score below the impairment threshold is considered sufficient evidence of aquatic life impairment. When an MMI score falls between the attainment and impairment thresholds, two auxiliary metrics, the SDI, and the HBI, are used to complete site assessments. Because degradation may be indicated by marked drop in MMI score between representative bioassessments at least 12 months apart, even if the later assessment is in attainment, a large drop from a previously high MMI score may be used to indicate impairment in some cases, subject to conditions defined in Colorado's 303(d) listing methodology.

Update to MMI Version 4

In August 2017, updates to the metric used and calculation of the MMI were approved and the Colorado MMI version 4 (v4) was implemented. Because the base metrics differ from the previous version of the MMI version 3 (v3), the values and thresholds for MMI v4 are not directly comparable to those from MMI v3, so for comparisons among years it is necessary to recalculate MMI v4 scores from previous bioassessment results. Alternatively, MMI v3 scores can be calculated in addition to v4 scores, for comparison with previous years with the caveat that MMI v3 and v4 are calculated from different metrics likely differ in their sensitivity to certain impacts.

Applicable Standard Thresholds

Upper Colorado Wild & Scenic Segments 4 through 6 are classified as "transition" or "biotype 1" streams. The current applicable MMI v4 attainment and impairment thresholds are 45 and 34, respectively. When MMI falls between these scores for a site, an SDI greater than 2.1 or an HBI less than 5.8 would indicate attainment of aquatic life standards. For sites that previously had representative MMI scores greater than 56, a new "representative" bioassessment conducted at least 12 months later that produced an MMI score more than 22 points lower might also indicate impairment.

2018 Bioassessment Study

During October of 2018 Timberline Aquatics, Inc. collected macroinvertebrate samples at five sites in the Upper Colorado Wild & Scenic segments from Pumphouse to below Red Dirt Creek (Table 19). All macroinvertebrates collected were identified, counted, and their CDPHE bioassessment metrics calculated using the MMI v4 method and subsampling process (Table 20).

All sites were in attainment based on MMI v4 scores and thresholds. The MMI v3 scores were also calculated to provide a common basis of comparison with results from previous years (

Table 21).

In 2018, all sites were in regulatory attainment with currently applicable aquatic life standards (MMI v4). In addition to the MMI and associated metrics, Timberline Aquatics Inc. reported a range of other metrics, including density, taxa richness, EPT (*Ephemeroptera, Plecoptera, Trichoptera*) taxa, Giant Stonefly (*Pteronarcys californica*) density, percent EPT taxa excluding *Baetidae*, and percent *Chironomidae*. Some metrics provided were possible because of the full count Hess sampling method employed for sample collection, and they provide additional indication of macroinvertebrate community health or impacts. See the full Bioassessment report from Timberline Aquatics for an explanation of these additional metrics.[17]

Comparisons between MMI v3 scores among years must be qualified. Differences both in timing and sampling methods may have affected some results, so differences in MMI v3 scores from year to year or from previous years to 2018 should not be considered strong indication of a trend in site conditions. Still, it is useful to note that the range of MMI v3 scores reported by Timberline for 2018 were overall similar in range to those from previous years. Comparing 2016 and 2018, the two years for which MMI v3 scores are available for all study sites, scores at Pumphouse and above Catamount were markedly higher in 2016 than 2018, whereas the score at State Bridge for 2018 was markedly higher than in 2016, when the site was not in attainment based on MMI v3 standard thresholds. The Monitoring Committee will evaluate the usefulness of other datasets to W&S, such as macroinvertebrate work performed by researchers at CSU and data collected by the BLM. [18, 19]

[17] Rees, D., and Musto, D., 2019. *Benthic Macroinvertebrate Biomonitoring and Pebble Count Study, Upper Colorado River, 2018*, Timberline Aquatics, Inc.
[18] Beeby, J., and B. Bledsoe., 2015. *Bed Material and Flushing Flow Analysis for the Colorado River in Eagle County*. Colorado State University, p 1-18
[19] Beeby, J., Bledsoe, B., and K. Hardie, 2014. *Colorado River in Eagle County Inventory and Assessment*. p 1-273

Table 19. Bioassessment monitoring sites.

W&S Segment	Station ID	Location	Latitude	Longitude	Elevation (m)
5	CR-PH	Colorado River at Pumphouse	39.98471	-106.514	2170
5	CR-Rad	Colorado River at Radium	39.94985	-106.558	2093
5	CR-SB	Colorado River at State Bridge	39.85783	-106.647	2060
6	CR-aC	Colorado River above Catamount	39.91239	-106.785	2046
6	CR-bRD	Colorado River below Red Dirt	39.70996	-107.047	1914

Table 20. Individual metrics and MMI v4 scores from benthic macroinvertebrate samples collected in the Colorado River Wild & Scenic study area during October 2018. All metric scores based on MMI v4 subsampling process.

Metric	Station ID				
	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD
EPT taxa	54.5	73.7	95.3	97.2	95.3
% Non-Insect individuals	93.9	85.5	95.1	88.9	92.1
% EPT individuals, no *Baetidae*	51.6	43.7	79.2	68.6	55.9
% *Coleoptera* individuals	6.7	14.1	30.1	14.7	21.6
% Intolerant Taxa	86.0	70.9	74.1	65.0	70.0
% Increasers, Mid-Elevation	98.5	98.7	98.3	97.4	98.7
Clinger taxa	53.2	87.7	97.0	100.0	100.0
Predator/Shredder taxa	57.1	50.0	57.1	57.1	64.3
MMI	**62.7**	**65.5**	**78.3**	**73.6**	**74.7**
	Auxiliary Metrics				
Diversity	2.83	3.45	3.62	3.33	3.46
HBI	3.45	3.92	2.86	3.59	3.88

Table 21. MMI (v3) scores from samples collected at five locations in the W&S segments from 2015 through 2018. The National Aquatic Monitoring Center (NAMC) protocol was used for sampling from 2015-2017. The 2018 sampling used the Colorado Department of Public Health and Environment (CDPHE) Hess Sampler Protocol. In 2016, the MMI score for the State Bridge site was below the attainment threshold.

	MMI Score				
Year	**CR-PH**	**CR-Rad**	**CR-SB**	**CR-aC**	**CR-bRD**
2015[20]	53.7	-	-	-	-
2016	73.9	55.2	46.1	76.2	70.8
2017[21]	60.1	-	-	-	-
2018	55.0	59.8	73.9	65.3	72.0

Substrate Monitoring

In 2018, the W&S SG contracted with Timberline Aquatics to characterize and assess substrate using a similar sampling protocol to one used in previous studies for Eagle River Watershed Council and W&S in the Upper Colorado River.[22, 23] This work was conducted in conjunction with the macroinvertebrate sampling during October of 2018 at the same macroinvertebrate sampling locations. The complete findings of this study can be found in the 2018 Benthic Macroinvertebrate Biomonitoring and Pebble Count Study.[24] Table 22 summarizes data collected by Timberline Aquatics in 2018. Percent embeddedness is a measure of the average depth of the largest substrate above and below the layer of fine material surrounding the rock. Tolerance Indicator Value (TIV) "reflects both the reduction in relative abundance of sediment-sensitive taxa and the increase in relative abundance of sediment-tolerant taxa".[25] Values for TIV range between 0 and 10, with higher values indicating more sediment-tolerant macroinvertebrate communities. CDPHE uses a measure of percent fines (based on a different methodology than conducted by the studies at these locations), the TIV score, and a review of the available watershed information to assess impairment. This assessment has not been performed by the W&S SG.

[20] This sample was collected following construction of the whitewater feature at Pumphouse.
[21] Due to high flows (>900 cfs), the 2017 Pumphouse sample collection was delayed to late October.

Table 22. Pebble count data collected in 2018.

Metric	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD
Total % Algae	20.00	12.07	19.66	12.07	46.55
% Fine (<2mm)	6.90	5.52	3.10	8.97	16.55
% Fine (<8mm)	15.52	11.03	11.03	14.48	35.17
% Coarse (>8mm)	84.48	88.97	88.97	85.52	64.83
% Embeddedness	14.97	20.52	20.46	19.41	25.50
TIV	4.02	4.73	4.52	4.69	4.60

Substrate studies were previously conducted at 4 of the 5 sites sampled in 2018. Beeby et al (2014) conducted sediment sampling in late November and early December in 2012 at Pumphouse, Radium, Above Catamount and a site called "Below Sweetwater" which is comparable to the site called below Red Dirt in this report and the Timberline report. The W&S SG contracted with Beeby and Bledsoe (2015) to resurvey the previous cross-sections and repeat the substrate work at the same locations in the fall of 2014 following a high peak flow of 7,830 cfs. The following tables report changes through time to a number of metrics; D_{50} (the particle size that 50% of the samples are equal to or smaller than) (Table 23); the percent of sediment finer than 2 mm (Table 24), percent algae (Table 25), and percent embeddedness (a measure of how much of the surface sediment is buried in sediment) (Table 26).**Error! Reference source not found.**

[22] Beeby, J., and B. Bledsoe., 2015. Bed Material and Flushing Flow Analysis for the Colorado River in Eagle County. Colorado State University, p 1-18.

[23] Beeby, J., Bledsoe, B., and K. Hardie, 2014. *Colorado River in Eagle County Inventory and Assessment*. p 1-273

[24] Rees, D., and Musto, D., 2019. *Benthic Macroinvertebrate Biomonitoring and Pebble Count Study, Upper Colorado River, 2018*, Timberline Aquatics, Inc.

[25] Colorado Water Quality Control Commission, *Guidance for Implementation of Colorado's Narrative Sediment Standard Regulation #31, Section 31.11(1)(a)(i), Policy 98-1,* November 10, 2014

Table 23. D_{50} sediment size in mm from samples collected at 5 locations in the W&S segments from 2012 through 2018. Measurements in 2012 and 2014 are based on the full grain size and have not been truncated by removing fines from the analysis.

Year	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD[26]
Winter 2012	110	67	NA	95	100
Summer 2013	126	67	NA	87	86
Winter 2014	*	*	NA	94	81
Fall 2018	128	64	77	90	90

*Streamflow in 2014 was too high to sample Pumphouse and Radium.

Table 24. Percent fines less than <2mm from samples collected at 5 locations in the W&S segments from 2012 through 2018. Values from 2018 have been rounded to whole numbers as reported in the previous studies

Year	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD
Winter 2012	12	28	NA	8	8
Summer 2013	1	11	NA	2	14
Winter 2014	*	*	NA	3	12
Fall 2018	7	6	3	9	17

*Streamflow in 2014 was too high to sample Pumphouse and Radium.

Table 25. Percent algae from samples collected at 5 locations in the W&S segments from 2012 through 2018.

Year	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD
Winter 2012	55	26	NA	65	26
Summer 2013	69	63	NA	75	22
Winter 2014	*	*	NA	37	35
Fall 2018	20	12	20	12	47

*Streamflow in 2014 was too high to sample Pumphouse and Radium.

[26] CR-bRD is the same location as the "Below Sweetwater" site referenced in the Bledsoe & Beeby reports referenced on page 41.

Table 26. Percent embeddedness from samples collected at 5 locations in the W&S segments from 2012 through 2018. Values from 2018 have been rounded to whole numbers as reported in the previous studies.

Year	CR-PH	CR-Rad	CR-SB	CR-aC	CR-bRD
Winter 2012	50	30	NA	32	52
Summer 2013	9	44	NA	37	42
Winter 2014	*	*	NA	19	38
Fall 2018	15	21	20	19	26

*Streamflow in 2014 was too high to sample Pumphouse and Radium.

2019 MONITORING PLAN

The SG approved its fiscal year 2019 Monitoring Plan which continues stream temperature monitoring at 3 locations, as well as recreational floatboating and fishing user surveys. In 2019 the SG approved conducting a flushing flow study in 2019, using in-river hydrophone monitoring techniques to understand the movement of sediment to maintain spawning habitat for fishing. The SG also approved funding for macro-invertebrate studies, though no specific plan or decision regarding macroinvertebrates is currently in place.

APPENDICES

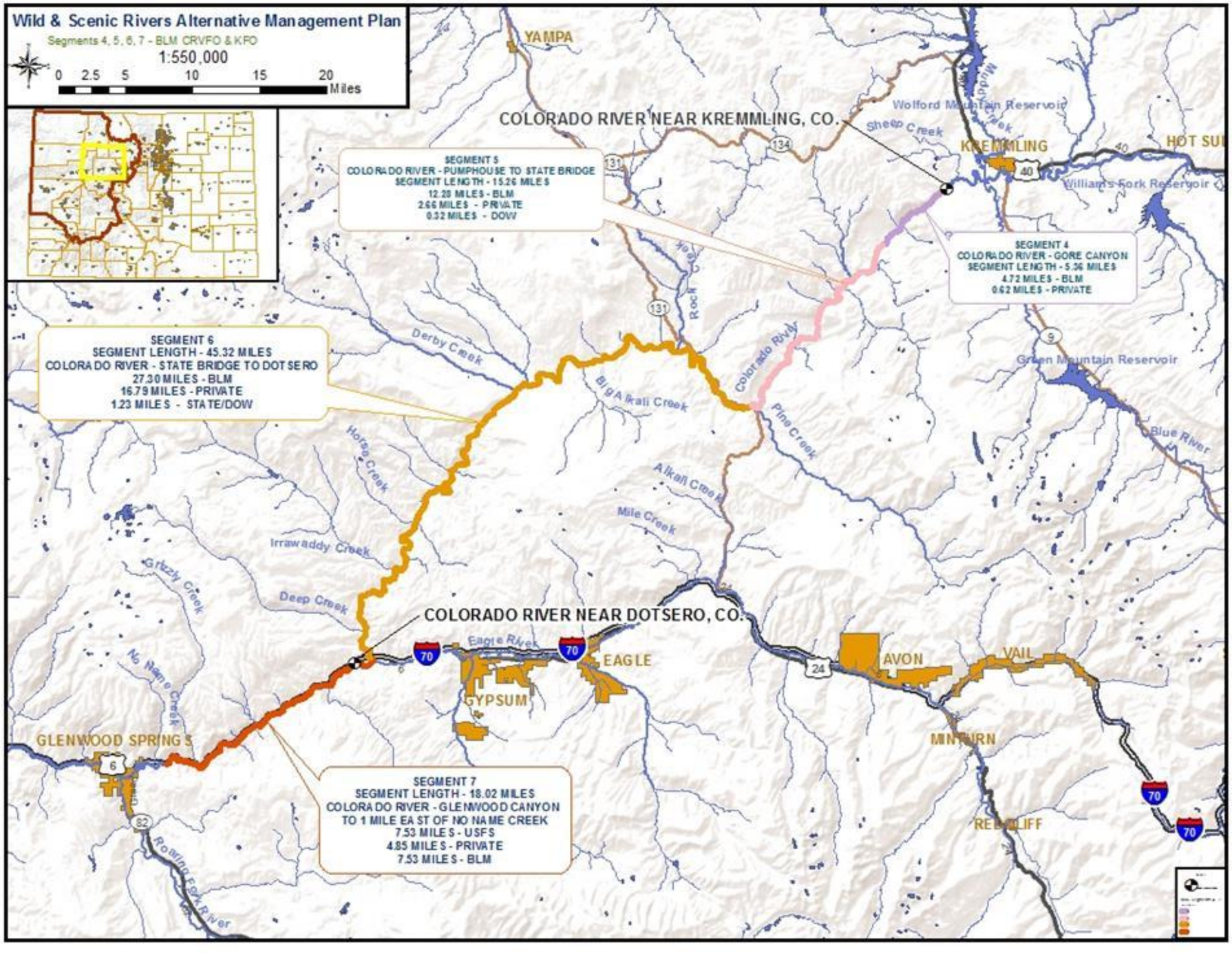
Appendix A: Project Area Map

Appendix B: CPW Biosurvey Sample Sites

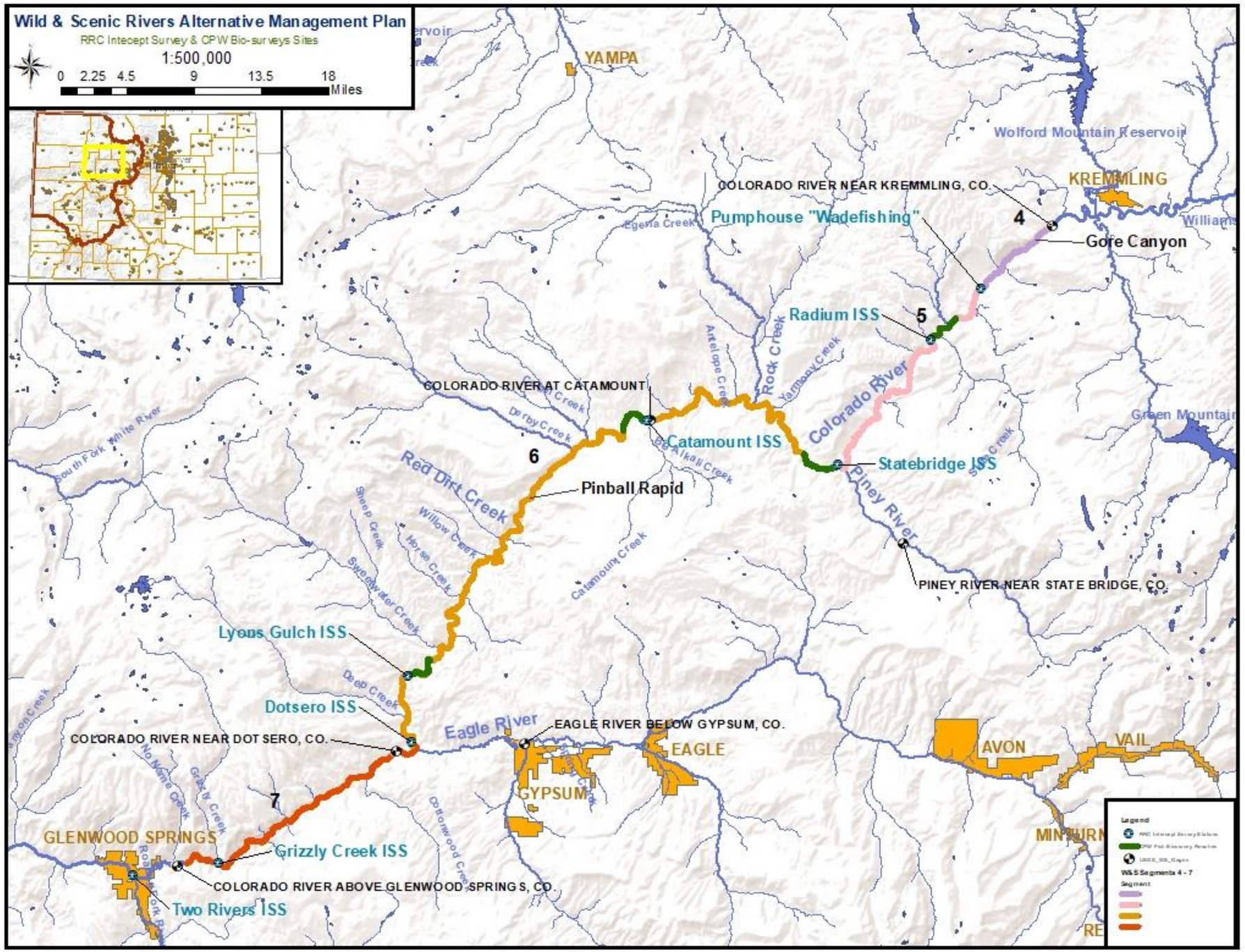
Appendix C: Monitoring by Other Entities

Appendix D: RRC Selected Summary Graphs

APPENDIX A: PROJECT AREA MAP



APPENDIX B: RRC & CPW BIOSURVEY SAMPLE SITES



APPENDIX C: MONITORING BY OTHER ENTITIES

U.S. Bureau of Land Management

The U.S. Bureau of Land Management (BLM) conducts various monitoring activities on the W&S segments. Currently, the BLM supports two water temperature monitoring locations, collects additional vehicle counter data at select locations, and has paid for operating and maintenance costs of the Catamount gage. In addition, the BLM conducts monitoring to support other non-flow related ORVs such as bald eagles, river otters, riparian vegetation, and noxious weeds.

Colorado Parks and Wildlife

In addition to their annual biosurveys, CPW is also conducting research on Giant Stonefly (*Pteronarcys californica*) and Mottled Sculpin *(Cottus bairdii)* sampling methods at the Pumphouse Recreation Site. The SG is monitoring progress on these efforts and may include results or parameters from these and/or other studies in future reports.

Grand County

In 2015, Grand County initiated macroinvertebrate monitoring at the Gore Canyon Whitewater Feature at Pump House (WWF) as required by special condition number 4 of the U.S. Army Corps of Engineers (USACE) Permit No. SPK-2013-00580, issued November 6, 2014.

Data collected through Grand County's program are analyzed using the Colorado Water Quality Control Division's Multi Metric Index (MMI) to assess compliance with Colorado's aquatic life standard. Additional standard metrics are computed to provide a complete assessment of the macroinvertebrate community. Sampling methods are consistent with these objectives.

Grand County's monitoring activities during 2017 represented the third year in five years of required monitoring under Grand County's Clean Water Act Section 404 permit for the Whitewater Park. Grand County will discontinue this effort after 2019.

Colorado Department of Public Health and Environment (CDPHE)

Colorado Department of Public Health and Environment's (CDPHE) Environmental Data Unit endeavors to collect scientifically sound water quality monitoring data on behalf of the Division's Clean Water Program. CDPHE maintains a system of statewide stream water quality monitoring sites for collecting chemical, physical and biological data. Each year sites are added in a specific focus basin to collect additional data in support of future basin wide rulemaking hearings conducted by the Water Quality Control Commission.

CDPHE's data and information is chiefly used in the development and revisions of standards and criteria or performing assessments that determine attainment of Colorado's water quality standards and criteria, including reporting the status of water quality across Colorado. The SG relies on CDPHE's monitoring and assessment efforts to evaluate the provisional Water Quality Resource Guide for W&S Segments 4-7.

APPENDIX D: RRC SELECTED SUMMARY GRAPHS

		2013 - Dry Typical	2014 - Wettest	2015 - Wettest	2018 - Dry Typical (Seg. 4-6)	2018 - Driest (Seg. 7)
Segment 5	Radium	465	445	125	137	
	State Bridge	402	537	342	119	
	Total	**867**	**982**	**467**	**256**	
Segment 6	Two Bridges			8	77	
	Catamount		9	15		
	Dotsero			57	123	
	Total		**9**	**80**	**200**	
Segment 7	Grizzly Creek	175	68	102		5
	Two Rivers		125	52		313
	Total	**175**	**193**	**154**		**318**
Grand Total		**1,042**	**1,184**	**701**	**456**	**318**

Source: RRC Associates

Figure 10. Number of 2019 Intercept Surveys by Site.

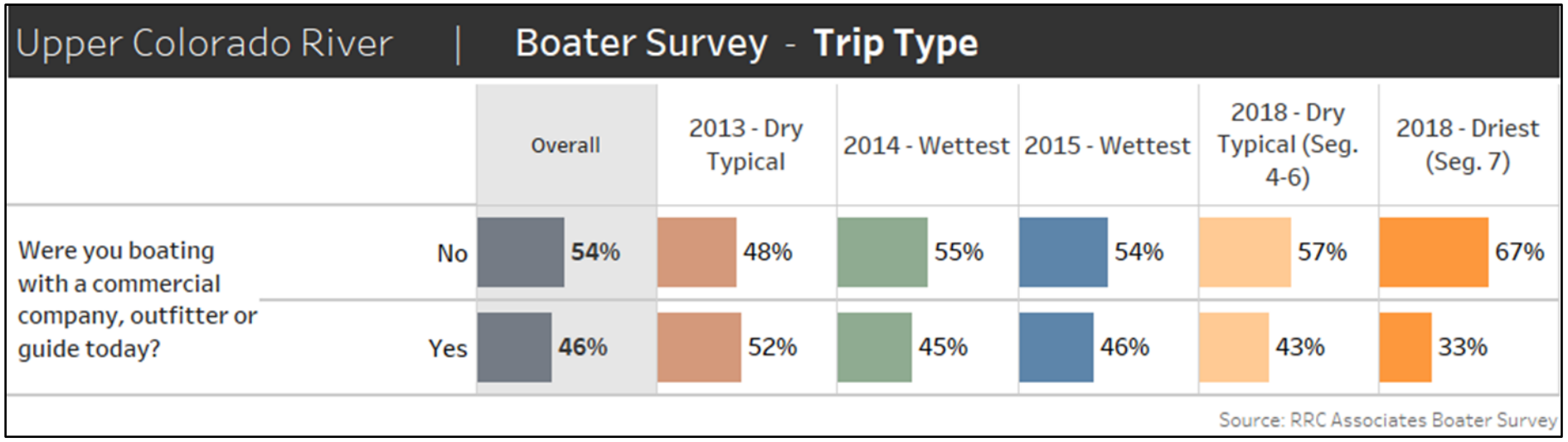


Figure 11. Boater Survey – Trip Type.

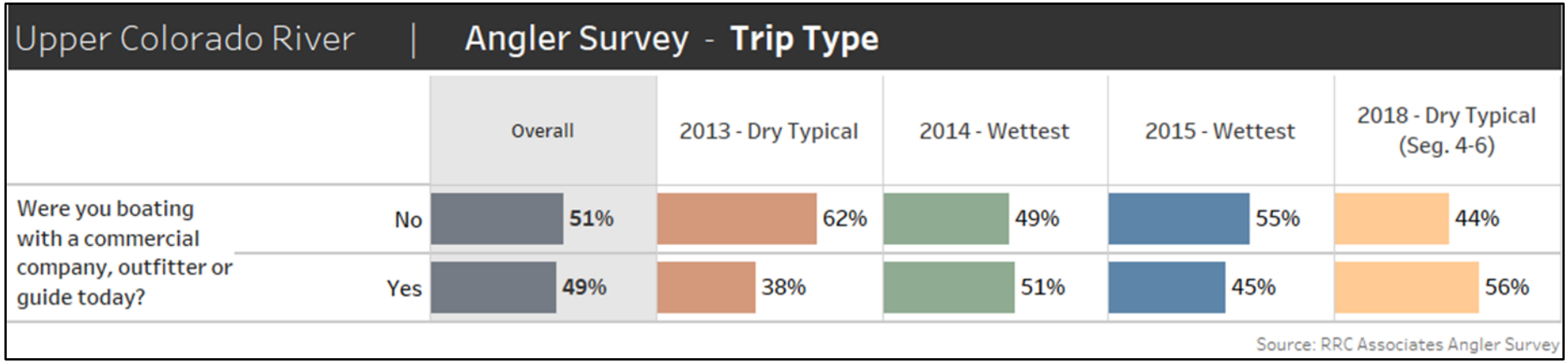


Figure 12. Angler Survey – Trip Type.

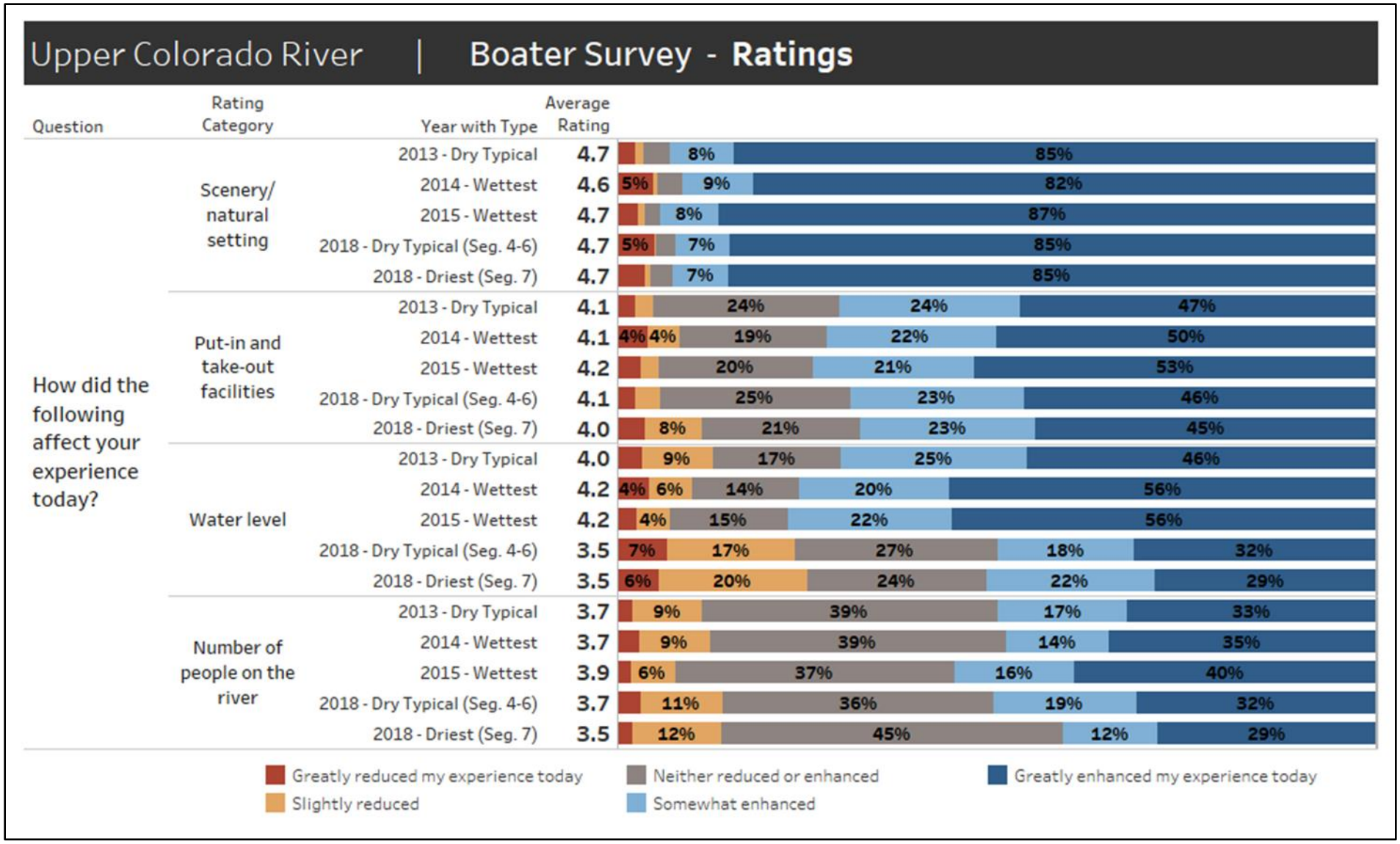


Figure 13. Boater Survey – Ratings Sorted by Average Importance (categories of primary interest only).

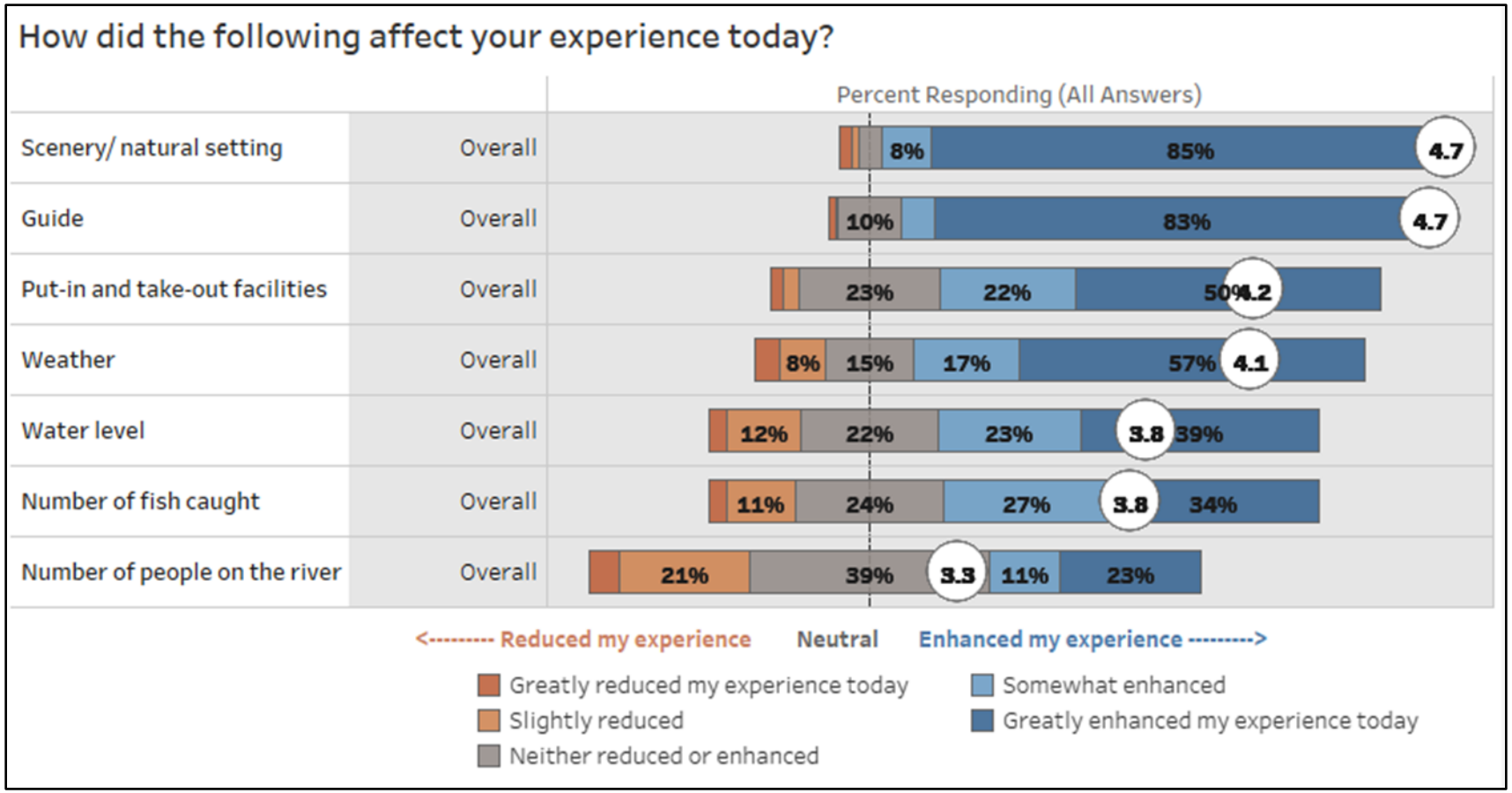


Figure 14. Angler Survey – Ratings.

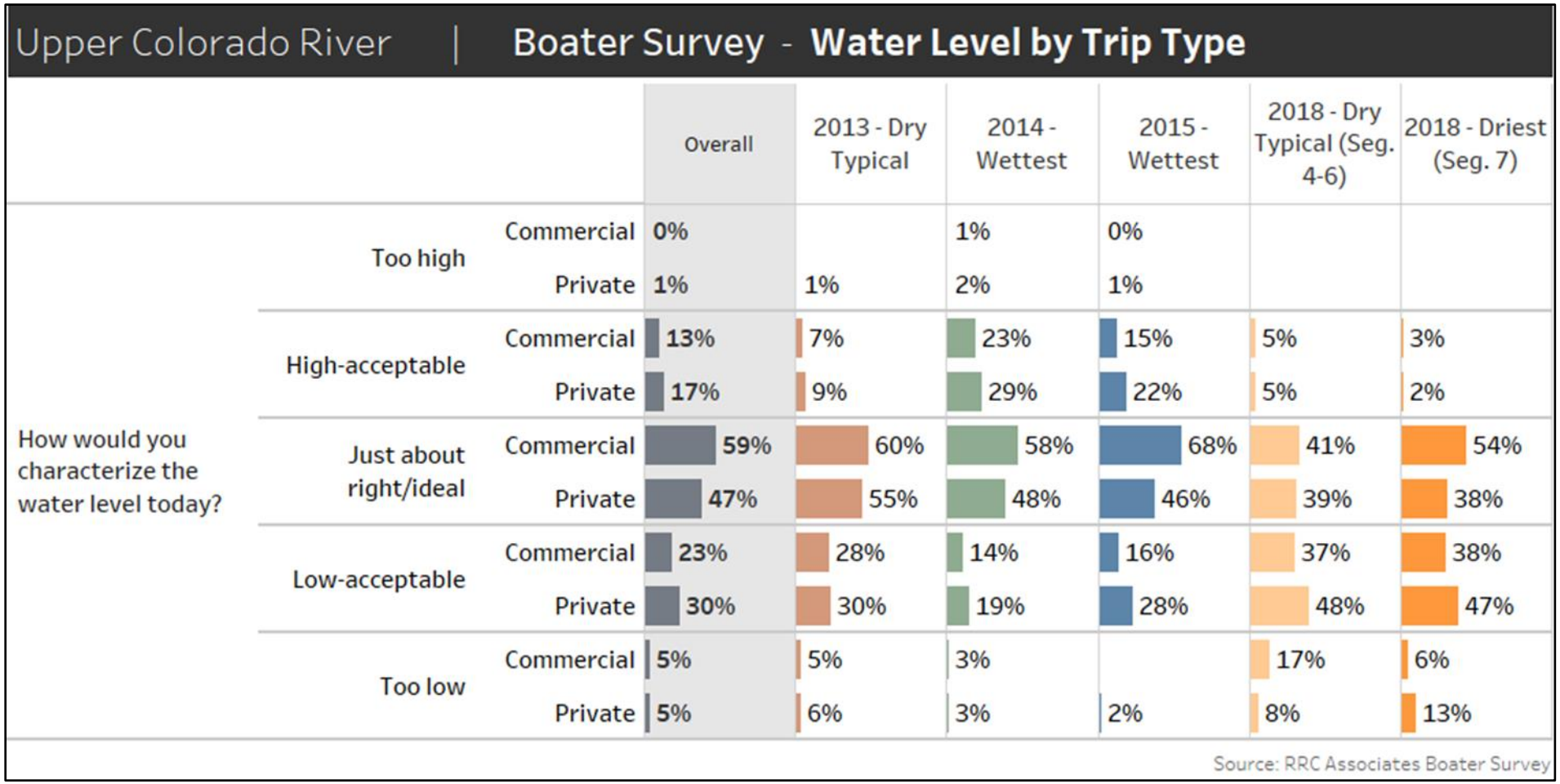


Figure 15. Boater Survey – Water Level Characterization by Trip Type and W&S Year Type.

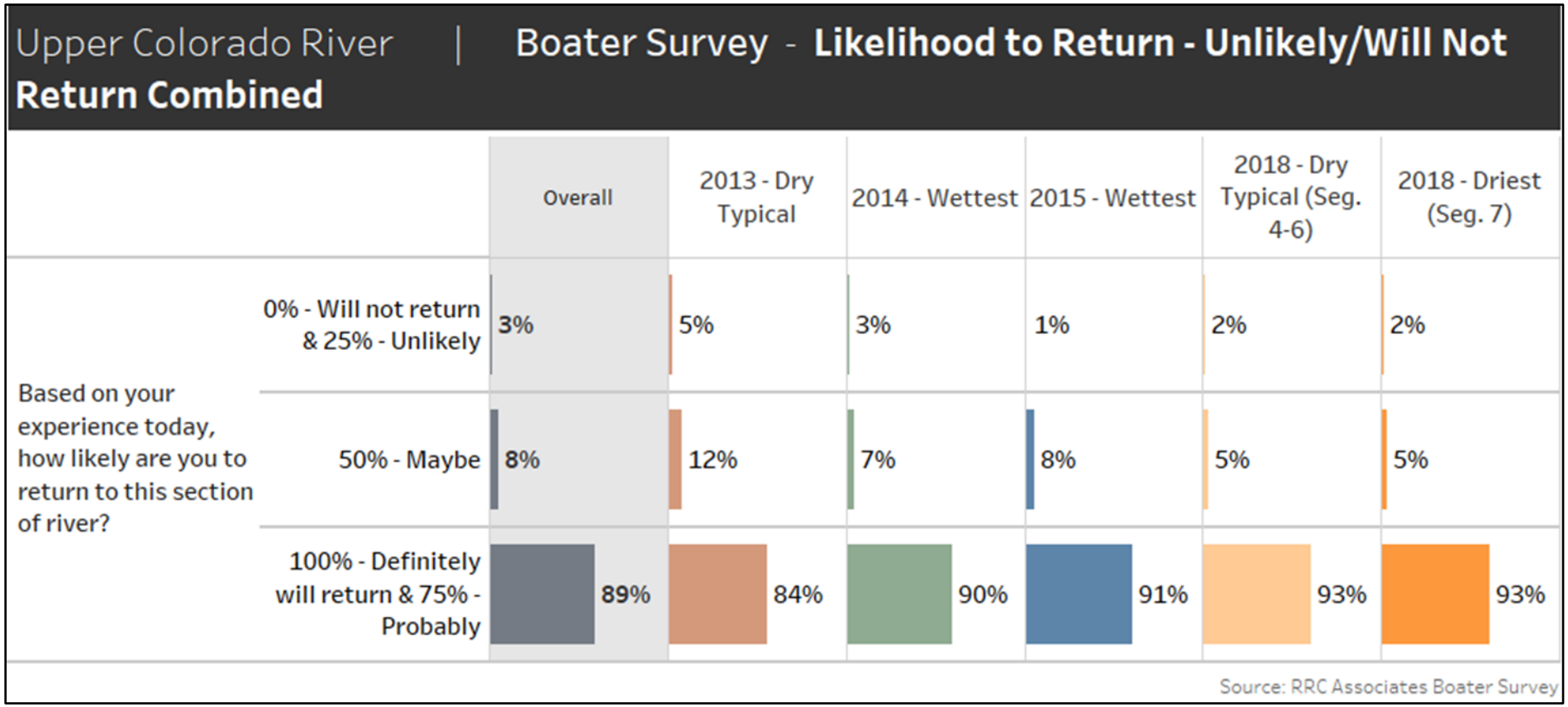


Figure 16. Boater Survey – Likelihood to Return.

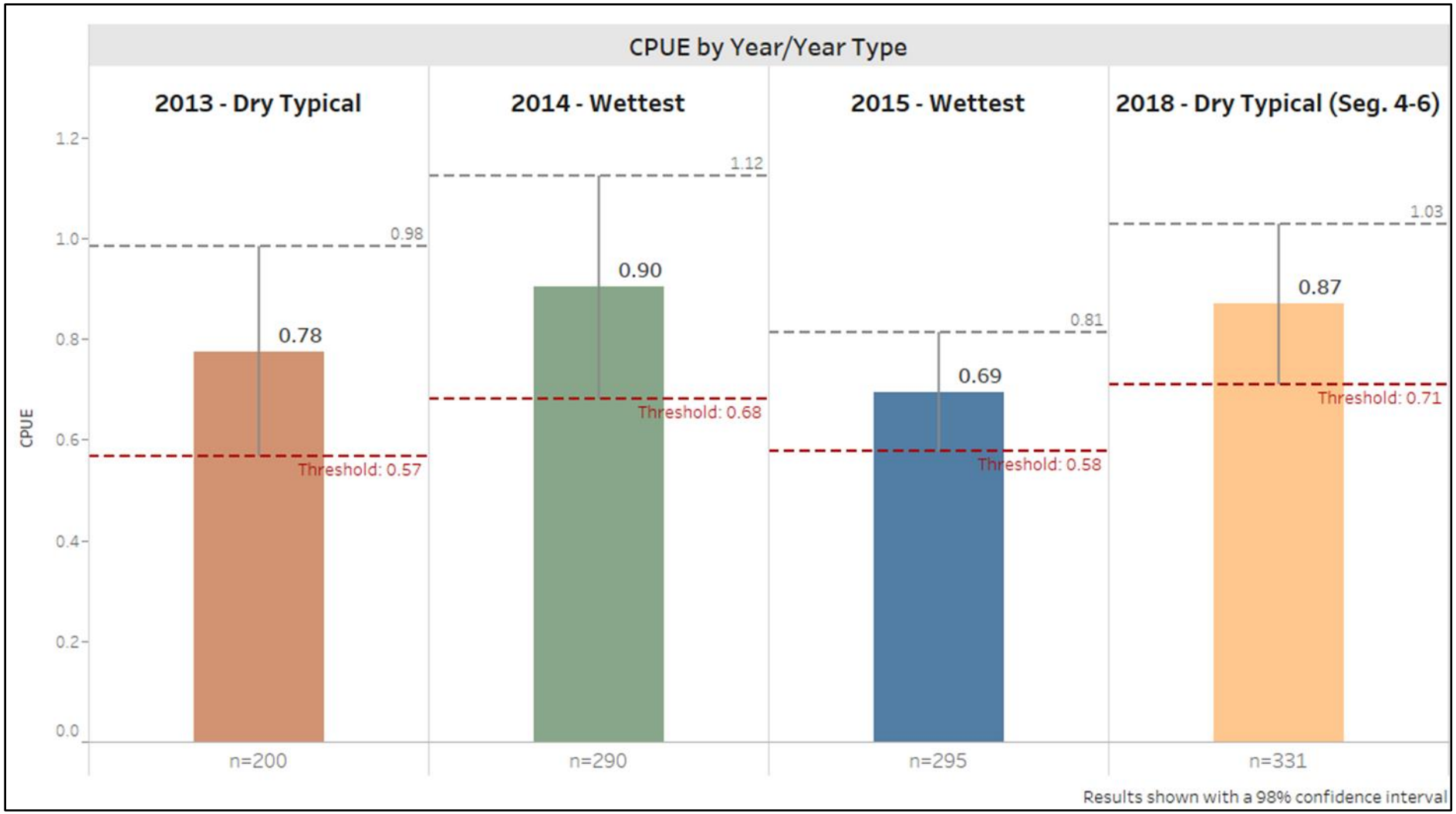


Figure 17. Anger Survey – CPUE by Year and W&S Year Type.

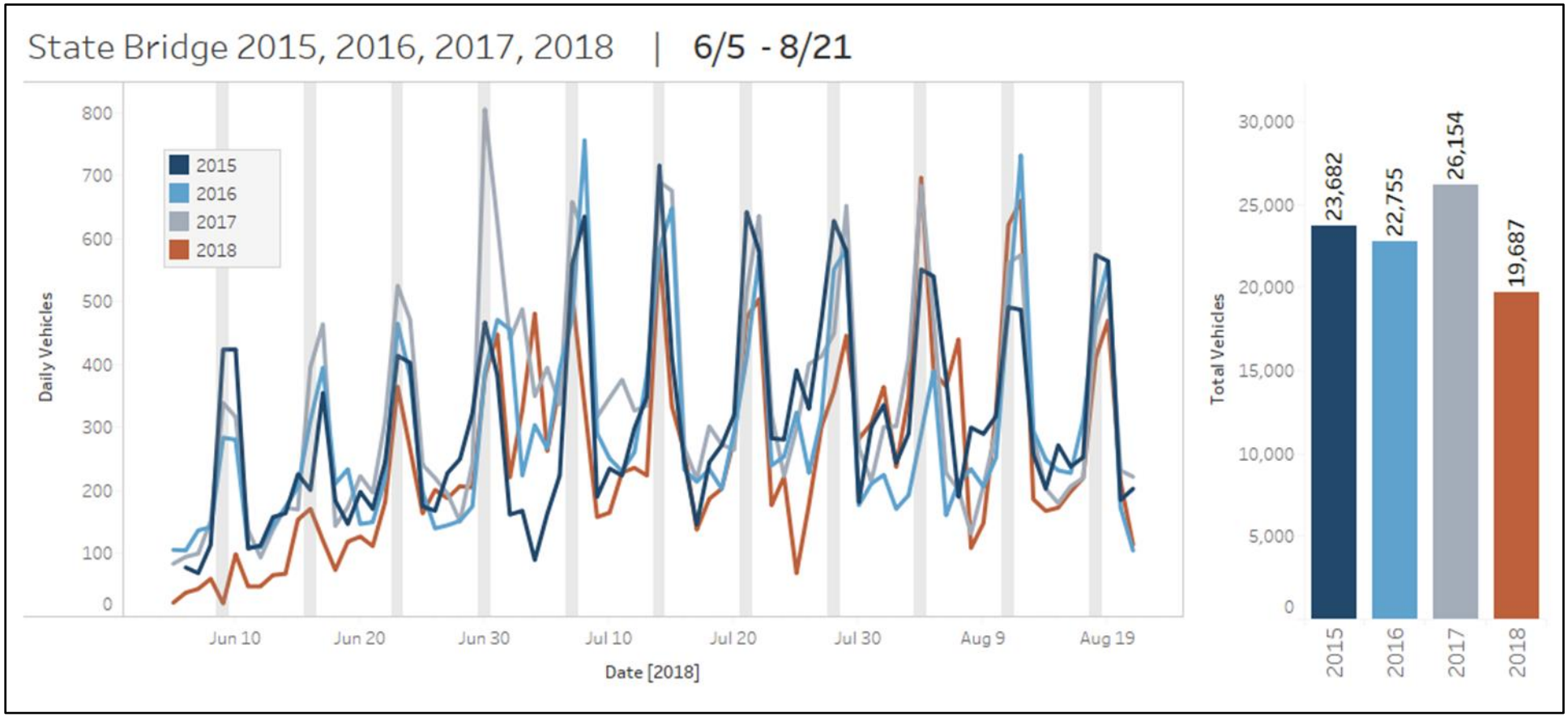


Figure 18. Vehicle Counter Data – State Bridge

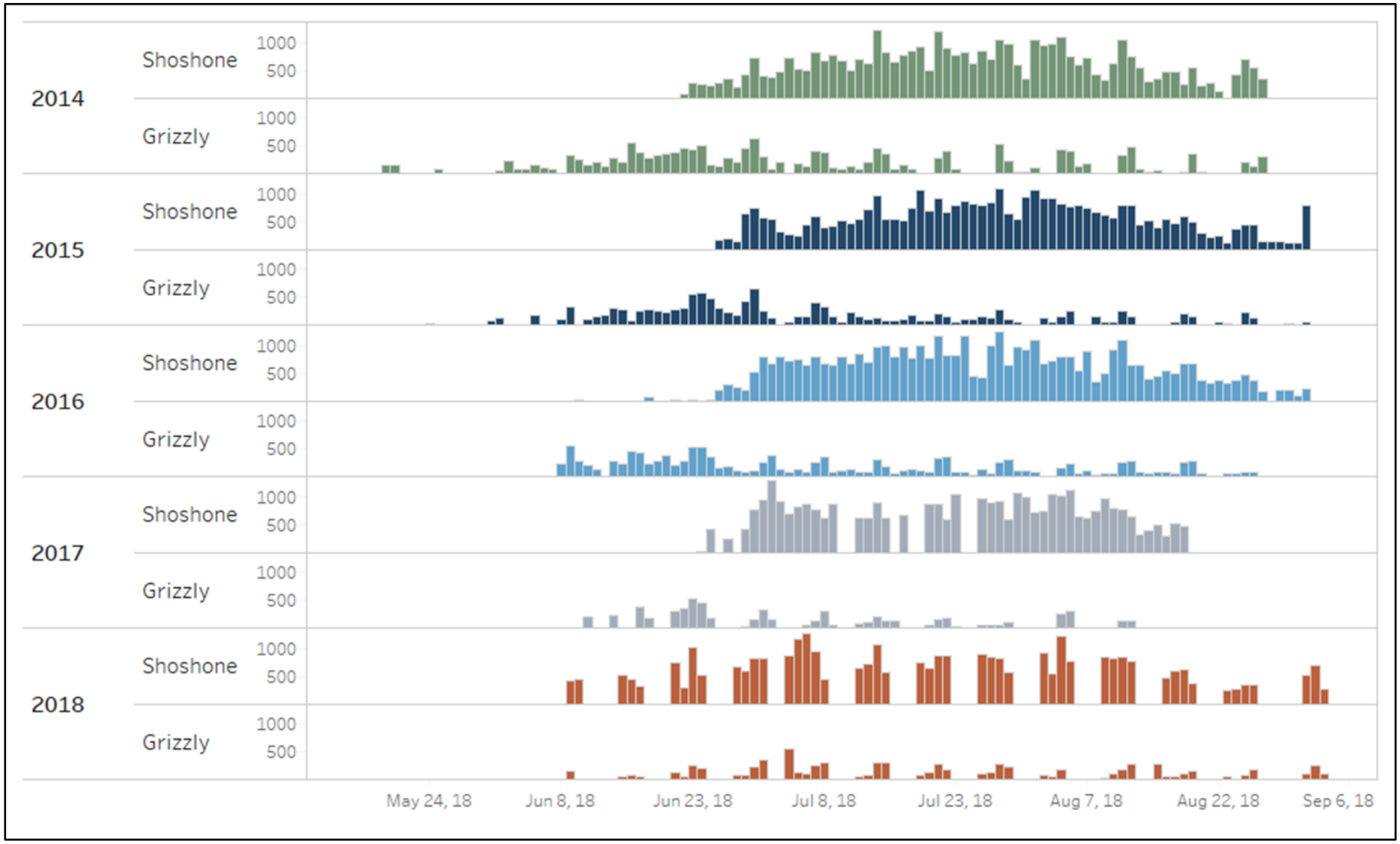


Figure 19. 2019 USFS Ranger Observation Data.