United States Department of the Interior

BUREAU OF LAND MANAGEMENT
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In Reply Refer To:
7250 (CO-930)

DEC 2 4 2013

Ms. Linda Bassi
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

Dear Ms. Bassi:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its instream flow recommendation for the lower Dolores River, between the confluence with the San Miguel River and the confluence with West Creek near the town of Gateway. The importance of this stream reach has led to cooperation between the BLM and the Colorado Parks and Wildlife (CPW) to document the natural environment and implement cooperative studies to determine the flow rates needed to support the natural environment.

This portion of the river is known to provide habitat for flannelmouth sucker, bluehead sucker and roundtail chub, large-bodied native fish endemic to rivers and streams of the Colorado Plateau. The BLM and the CPW are signatories to a multi-state conservation agreement designed to protect and enhance habitat for these species, with the objective of preventing a listing of these species under the Endangered Species Act. This agreement is entitled "*Range-Wide Conservation Agreement and Strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*) and Flannelmouth Sucker (*Catostomus latipinnis*) 2006*" and is also known as the "Three Species Agreement." Establishment of instream flow protection for streams known to provide habitat for the species is identified as a priority conservation action under this agreement. In addition, the BLM has identified habitat for the three species as an "outstandingly remarkable value" as part of the BLM's evaluation of this river pursuant to the Wild and Scenic Rivers Act. Appropriation of an instream flow water right is a crucial component of protecting the habitat for these species that occurs on BLM lands.

Broadly-based stakeholder groups have also recommended to the BLM that water-dependent values be protected on this stream reach. An independently-formed stakeholder group, which analyzed streams in the Grand Junction Field Office planning area, recommended that the portion of the Dolores River in Mesa County be protected by a state-based instream flow water right. A broad-based stakeholder group convened by the BLM's Resource Advisory Council, which analyzed streams in Montrose County, recommended that 4.2 miles of this stream reach in Montrose County be determined as "suitable" for designation into the National Wild and Scenic Rivers System.

Protection of instream flows on this section of the Dolores River will also support a major partnership effort to restore riparian habitat along the river. The Dolores River Restoration Partnership has treated more than 415 acres of tamarisk, Siberian elm and weeds along this reach of the river. In addition to the BLM, the partnership includes the CPW, The Nature Conservancy, The Walton Foundation, the Tamarisk Coalition, Colorado Department of Transportation, Montrose County, Mesa County and multiple youth conservation corps. To date, the partnership has invested more than $2.2 million of state, federal, foundation, and non-government organization funds in restoring this reach of the river. The partnership predicts that an additional $575,000 will be expended within this reach in future years on follow-up treatments, monitoring, and long-term maintenance of treated lands. These future expenditures include a $100,000 grant from the Colorado Water Conservation Board (CWCB).

The BLM believes that instream flow protection for these values can be achieved while allowing water to be developed for current and future needs, including municipal, industrial and agricultural uses. The BLM is willing to meet with water users and stakeholders within the watershed to discuss any concerns they may have about the impact of the proposed appropriation on future water uses and development. The BLM is also willing to provide all of the supporting data to interested parties for their review. The BLM requests the CWCB proceed with its appropriation process at the regularly scheduled board meeting in January 2014, given that meetings to date with stakeholders in the Dolores River watershed have not revealed any significant reasons for a delay.

Enclosures to this letter provide specific information with regard to recommended flow rates, habitat analysis, biological characteristics, and water availability.

If you have any questions regarding this formal recommendation, please contact Roy Smith, BLM Water Rights Specialist, at (303) 239-3940.

Sincerely,

John Mehlhoff
Acting State Director

Enclosures

cc: Barbara Sharrow, Uncompahgre Field Office
Jedd Sondergard, Uncompahgre Field Office
Valori Armstrong, Southwest District
Katie Stevens, Grand Junction Field Office
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Enclosure 1 – Dolores River Instream Flow Recommendation

Biological Summary

Fisheries

Fishery surveys taken during 2007, 2009 and 2010 by the Colorado Parks and Wildlife (CPW) indicate that the stream environment supports bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis)*, roundtail chub (*Gila robusta*) and speckled dace (*Rhinichthys osculus*). The surveys indicated that, depending upon the location with the reach, 76% to 89% of the fish captured were native species. All three species that are subject to the "Three Species Agreement" were present in all of the sampled locations, and all three species were represented by individuals of multiple age classes. Based upon the data currently available, this reach of the Dolores River appears to be one of the best populations of the three native fishes within the Dolores River watershed, and represents an intact and functional assemblage of native warm water fish. In addition, phenology of the two sucker species do not indicate any hybridization with non-native white suckers, which occurs within the other major river basin in western Colorado (Colorado, White and Yampa Rivers). Accordingly, the CPW manages this reach as a Category 204 Native Fish Conservation Stream.

Roundtail chub is recognized by the State of Colorado as a species of special concern. The roundtail chub, flannelmouth sucker and bluehead sucker are considered sensitive species by the Bureau of Land Management (BLM). Criteria that apply to the BLM sensitive species include the following: 1) species under status review by the U.S. Fish and Wildlife Service; or 2) species with numbers declining so rapidly that federal listing may become necessary; or 3) species with typically small and widely dispersed populations; or 4) species inhabiting ecological refugia or other specialized or unique habits. The three species meet the first two of the criteria listed above, qualifying them as "sensitive species."

The BLM, the CPW and others have developed the "Range-Wide Conservation Agreement and Strategy" described earlier to direct management for these species. These species are not currently federally listed under the Endangered Species Act. The range-wide plan provides direction and goals for research and management of projects. The success of management strategies will depend upon the voluntary implementation of these strategies by the signatories. Special attention will need to be given to habitat degradation and influence of non-native species interactions within the native range of these species. The intention of these plans is to increase populations and distribution of the identified species, thereby assisting in the long-term persistence of the species.

The success of such plans could potentially curtail the need for federal listing of these species under the Endangered Species Act (ESA). Specifically, when the U.S. Fish and Wildlife Service found the roundtail chub "warranted, but precluded" for listing under the ESA, it noted "Addressing the needs of candidate species before the regulatory requirements of the Endangered Species Act come into play often allows greater flexibility to stabilize or restore these species and their habitats."

Macroinvertebrates

The BLM collected macroinvertebrate surveys during July 2013. The BLM utilized a sampling protocol developed by the National Aquatic Monitoring Center (NAMC), designed to generate data sufficient to characterize the status and trend of aquatic macroinvertebrate assemblages, including quantifying the effects of human disturbances and/or restoration actions. The results of this survey will be available by January 2014. The BLM will provide these results to the Colorado Water Conservation Board, along with our analysis of health and status of the macroinvertebrate community.

Riparian Community

The Dolores River riparian community has been heavily impacted by invasion of non-native tamarisk. Depending upon the location, the tamarisk component of the riparian community can range from 10 to 80% of vegetation cover. However, there are still extensive occurrences of native species, including Rio Grande cottonwood, narrow-leaf cottonwood, box elder, coyote willow, skunkbrush and New Mexico privet. In many locations, tamarisk dominates the zone immediately adjacent to the river channel and native species dominate the first terrace that is slightly elevated above the river channel. Even with the tamarisk impact, the river banks are in stable condition and excessive erosion does not appear to be impacting the aquatic community.

As mentioned previously, the Dolores River Restoration Partnership is making a major investment in treating the invasive species along the river. The Partnership's objective is to increase the vigor and extent of native riparian species, including Rio Grande cottonwood, narrow-leaf cottonwood, box elder, coyote willow, New Mexico privet, skunkbrush, and an understory of native grasses and forbs For the river corridor to successfully transition back to a vegetation community dominated by native species, a supporting hydrologic regime will be required that provides periodic flooding and maintains groundwater levels within the root zone of the riparian community.

While the proposed instream flow water right doesn't protect the highest flood flows, the BLM and the CPW believe that the proposed seasonal variations in flow rates will provide good support for groundwater levels in near-stream alluvial deposits. This support is accomplished by protecting stream flow during the snowmelt runoff period, the flows that recharge near-stream alluvium deposits. In addition, by protecting base flows during seasonally dry periods, alluvial groundwater can be maintained during high temperature and high evapotranspiration periods. Maintenance of groundwater levels in near-stream alluvial deposits during both periods will sustain the health and vigor of the riparian community.

Enclosure 2 – Dolores River Instream Flow Recommendation

Flow Quantification Methodology

PHABSIM and R2CROSS Methodology

The Colorado Parks and Wildlife (CPW) and the Bureau of Land Management (BLM) evaluated all of the data collected to date and determined that best flow recommendation would be derived from a combination of methods. PHABSIM (Physical Habitat Simulation) is a widely accepted method for quantifying the suitable versus unsuitable hydraulic habitat attributes of selected species and life stages as a function of discharge. R2CROSS is best suited for identifying flows with specific hydraulic criteria across riffle type habitats. The State of Colorado has used R2CROSS extensively in the past to appropriate instream flow water rights. PHABSIM is widely used in North America to quantify instream flow requirements, and it has been utilized previously by the Colorado Water Conservation Board to quantify instream flow appropriations.

The CPW and the BLM determined that exclusive use of the standard R2CROSS method would not be appropriate for this reach of the Dolores River. Historically, R2CROSS has been used in small to medium-sized streams with a high percentage of riffle habitat. In contrast, the Dolores River has a wide channel (over 100 feet wide in most places), supports different types of fish species than are typically found in smaller streams in Colorado (warm/cool water species) and exhibits big river channel hydraulics that include extensive run, pool and glide habitat and very low gradient. In addition, only a very small percentage of the fish habitat in this reach is comprised of riffles. For these reasons, the CPW and the BLM decided to utilize PHABSIM results to develop flow recommendation for the snowmelt runoff months between March and August. This is the portion of the year when the three sensitive species are using run, pool, glide and riffle habitat to complete important parts of their life cycles, such as spawning and recruitment of young-of-the -year. A diversity of habitat availability is critical during this period for maintaining the biomass and age class structure of the three sensitive fish species.

The CPW and the BLM decided to use the R2CROSS methodology to develop flow recommendations during the base flow portions of the year from August through March. This is the period when there is substantial competition between individuals for physical habitat space, foraging areas and limited food supplies. During this period, it is critical for the three species to be able to move between habitat areas to make full use of the limited physical habitat. Riffles are the first location where low flows can limit passage between habitat types, so it as appropriate to develop flow recommendations that focus on the fish passage function.

To select an appropriate location for PHABSIM modeling, the CPW and the BLM staff conducted reconnaissance throughout the 34-mile reach to identify its typical habitat characteristics, including channel widths, substrate types, depths and velocities. The CPW and the BLM staff then selected an 1800-foot reach of stream, located approximately seven miles upstream from the town of Gateway, as a location that could represent the full variety of habitat types found within the 34-mile reach. The CPW and the BLM staff established and monumented seven transects that incorporate different mesohabitat types including riffles, runs, pools and

glides. These seven different cross-sections formed the basis for the PHABSIM/River Habitat Simulation (RHABSIM) study conducted by the CPW and the BLM.

The CPW and the BLM staff also ran data from the seven cross sections through the R2CROSS model. Since the seven cross sections include only one cross section of riffle habitat, the CPW and the BLM staff also collected data from four additional representative riffle cross sections at other locations on the river. The additional cross section data collection was designed to increase the reliability of the R2CROSS model in predicting hydraulic characteristics that would be experienced at various flow rates within the 34-mile reach.

The initial recommendations based on the PHABSIM and R2CROSS modeling are designed to address the unique biologic requirements of this stream reach without regard to water availability. In addition to the criteria developed using the PHABSIM Methodology and RHABSIM Software, the three standard instream flow hydraulic parameters used in R2CROSS (average depth, percent wetted perimeter and average velocity) were also used to calculate and inform the biologic instream flow recommendations.

Relationship Between Life History of The Three Fish Species and Use of PHABSIM and R2CROSS Methodologies

The decision by the CPW and the BLM to utilize both the PHABSIM and R2CROSS methodologies is directly related to the life history of flannelmouth sucker, bluehead sucker and roundtail chub. Specifically, snowmelt runoff flows are critically important during certain life stages of this fish, and maintenance of base flows is critically important for other life stages. A summary of the life history of these three species is as follows:

- Late winter - early spring (pre-peak snowmelt period), March - April: low elevation streams in western Colorado often surge in response to melt of low elevation snowmelt, spring storms and early ripening of the snowpack in higher terrain, and water begins warming in response to longer days and warmer air temperatures. Along with an increasing photo-period, these hydrologic cues signal native fish to navigate toward likely spawning sites. Flannelmouth suckers and bluehead suckers have been known to travel long distances toward habitual spawning areas. In addition, increased flows during this period also mobilize fine sediments that may have settled during localized late-summer or fall monsoon storms, improving conditions in cobbles for spawning.

- Peak snowmelt runoff: In the Lower Dolores River, peak runoff occurs anywhere from mid-April thru mid-June, and has multiple benefits for native species. First, peak flows clear riffles of sediment and often re-set bed sediments to provide optimal aeration for deposited eggs. Second, peak flows are critical for maintaining habitat diversity within the stream channel, critical for support of all life stages of native fish. Especially important for emerging fry are side-channel and backwater sites that become refugia for young fish. Third, peak flows are critical for redistributing sediments, creating new instream and near-stream habitat and invigorating riparian processes (recall prior note about the importance of alluvial groundwater). Ramping flows on the descending side of the hydrograph are important so that fish have time to move to habitats where they will

spend most of the next 8 months of their lives. Spawning for bluehead suckers and flannelmouth suckers may occur during pre-peak or post-peak periods of the hydrograph, and fry emergence and dispersal shortly thereafter (7-10 days) is aided by continuing high flows and subsequent drift to side-channel, low velocity sites. Roundtail chub generally spawn at higher water temperatures than the sucker species, but soon after peak snowmelt runoff to allow for proper growth prior to winter.

- Baseflow: July - February: Adequate baseflow conditions are critical for survival of native fish for a few reasons. First, as young-of-the-year fish mature during summer, they venture from refugia into the main channel where larger adult and juvenile fish also survive. They need enough wetted perimeter and available habitats to survive predation and competition from both native (roundtail) and non-native fish. Second, native suckers, particularly bluehead suckers, are primarily foraging fish that feed on algae and detritus within the main channel, and incidental to consumption of vegetation by these fish, is the consumption of a number of high-protein macroinvertebrates that also feed on or inhabit riverine plants. This primary production within the channel is highly dependent on riffles that have both good aeration and available sunlight. Growth during summer baseflow months is critical to provide fish the resiliency needed to survive the winter, when forage is scarce. Baseflow during winter months is necessary to provide enough habitat variety to overwinter both young-of-the-year, juvenile, and adult fish and to provide enough mobility so that fish can escape predation or find more advantageous habitats as seasonal conditions evolve.

It is important also to recognize that these native fish evolved within the Colorado Plateau, a region that is hydrologically diverse and variable. Optimal conditions for spawning, growth, and survival were typically unpredictable. Adaptations of these fishes to accommodate this variability include their relatively large body sizes and longevity, as well as their egg-dispersal mechanisms, which favored high volume and low 'investment' in terms of energy required to nurture and care for emerging fry. In essence, these adaptions mimic the hydrologic landscape from which they evolved. This instream flow proposal should maintain, on a minimum basis, the seasonal variations in conditions required for these native fish to persist in the Lower Dolores River.

Application of Habitat Suitability Criteria

Habitat suitability criteria (HSC) were developed from the 2003 Riverine Fish Flow Investigation Study Report (Federal Aid Project F-289-R6) written and performed by Richard Anderson, the CPW Aquatic Researcher, and Gregory Stewart, Department of Geosciences Oregon State University[1]. The basis for this study was a 1999 request from the Colorado Water Conservation Board for the CPW to provide biologically justified instream flow recommendations for the Yampa and Colorado Rivers based on habitat and flow requirements for non-endangered native fish. Anderson and Stewart used two-dimensional (2D) modeling to develop habitat suitability criteria for bluehead and flannelmouth suckers, two native species.

[1] See "Impacts of stream flow alterations on native fish abundance and native fish habitat and the use of native fish population data to support instream flow recommendations made using a 2D instream flow methodology."

Their methods and results are more fully described in Anderson and Stewart (2003) and Stewart and Anderson (2005) and (2006).

The bluehead and flannelmouth sucker habitat suitability criteria were used to develop specific hydraulic criteria that were incorporated into a PHABSIM/RHABSIM analysis. Stewart and Anderson determined that "Abundance of bluehead sucker was a reliable indicator for instream flows and habitat maintenance for the native fish assemblage. In the Colorado, Gunnison and Yampa Rivers bluehead sucker habitat peaked at flows of 600 to 1,200 cfs. This flow range also resulted in high habitat diversity and high native fish biomass." Their assumption that flows that maintained adequate bluehead sucker abundance (about 25% of fish over 15 cm) would also maintain adequate flannelmouth sucker and roundtail chub habitat was validated by this study.

The CPW and the BLM determined that the flannelmouth sucker and bluehead sucker would be the primary indicator species for the biologically based instream flow recommendation. The reason for considering the needs of both species is that they have somewhat different habitat preferences. Flannelmouth sucker have stronger preference for pool, glide and run habitats, while bluehead sucker abundance is directly related to availability and quality of riffle habitats. Roundtail chub primarily utilize habitats with slower velocities, typically found in pools. The CPW and the BLM determined that if sufficient flows were protected for flannelmouth sucker and bluehead sucker needs, there would also be sufficient water to maintain pool habitats relied upon by roundtail chub.

When developing recommendations for flow rates to support flannelmouth sucker and bluehead sucker, The CPW and the BLM personnel examined tables and graphs produced by the PHABSIM model that show amounts of "weighted usable area" (suitable habitat) available at various flow rates for each of the two species. The CPW and the BLM personnel then identified the most efficient flow rate for providing habitat protection. In this case, the most efficient flow rate is defined as the minimum flow rate that protects at least 90 percent of the habitat that is potentially available within the stream channel for both species. For example, if a PHABSIM modeling run showed that an equal amount of weighted usable area was available at either of two different flow rates, then lower flow rate was identified for protection because it is more efficient.

When identifying minimum flow rates, the CPW and the BLM personnel also considered the amount of time weighted usable area is available in the Dolores River channel, specifically the number of days within a calendar year. The CPW and the BLM considered this factor because much of the potential habitat in the Dolores River is typically available during a 2-month period during the peak of snowmelt runoff between April 15 and June 14. This peak snowmelt period comprises only 16.7% of the calendar year. There are certain life functions of the species that can only occur during this very short period, so protecting the high flow rates associated with snowmelt runoff is essential if the long-term viability of these conservation populations is to be ensured.

Application of R2CROSS Criteria

The primary objective of most cross section methodologies, including R2CROSS, is to maintain quality riffles. Riffles are the most vulnerable habitat to dewatering and riffles are important for

invertebrate productivity. As noted previously, riffles comprise only a very small portion of the total habitat area in this stream reach, so the importance of maintaining riffle habitats is magnified even further. The CPW and the BLM performed a reconnaissance to identify the various types of riffles within this stream reach, based upon width, substrate, and average water velocity. The two agencies then selected four representative riffles for further R2CROSS analysis.

The CPW and the BLM personnel applied the following R2CROSS criteria in evaluating the R2CROSS modeling runs:

- Maintain 70% of wetted perimeter, given that the channel width typically exceeds 60 feet. These criteria are taken from Nehring, R.B., 1979, "Evaluation of instream flow methods and determination of water quanity needs for streams in the State of Colorado."
- Maintain 1.3 feet per second average velocity and maintain 1.0 average depth, which creates at least marginally suitable habitat for flannelmouth sucker and bluehead sucker. These criteria are taken from the 2003 Riverine Fish Flow Investigation Study Report referenced earlier in this letter.

The R2CROSS model provides reliable predictive results for flows that are up to 250% of the flow measured during the data collection effort. It also provides reliable predictive results for flows down to 40% of the flow measured during the data collection effort. This range, from 40% to 250% of flows measured during the data collection, is referred to as the "confidence interval" for R2CROSS modeling. When the flow rate that meets the instream flow criteria fell outside of this confidence interval, data from that cross section were not used to develop instream flow recommendations. The results from cross sections with usable results (inside the confidence interval) were averaged to develop the recommended flow rates.

Enclosure 3 - Dolores River Instream Flow Recommendation

Biological Flow Recommendations

Overview of Recommended Flow Rates

The recommended flow values were determined using the best professional judgment of Colorado Parks and Wildlife (CPW) and the Bureau of Land Management (BLM) biologists and hydrologists. The CPW and the BLM professionals reviewed and evaluated the results of the Physical Habitat Simulation (PHABSIM) Methodology and Habitat Simulation (RHABSIM) software PHABSIM/RHABSIM analysis. They also reviewed the R2CROSS analysis, using the criteria set forth in the previous section of this letter. These initial flow recommendations were based on the physical and biological data collected to date and were adjusted to accommodate the CPW and BLM initial analysis of water availability, as described in the following sections of this letter.

The PHABSIM/RHABSIM data analysis shows that the maximum amount of usable habitat for bluehead suckers is produced at a flow of 1200 cfs and for flannelmouth suckers at a flow of 875 cfs. The CPW and the BLM staff determined that a flow rate of 900 cfs would adequately protect the flannelmouth sucker habitat while protecting more than 90% of the usable habitat for bluehead sucker. The CPW and the BLM staff also noted that this usable habitat is typically available for only two months of the year. Accordingly, the initial biological recommendation for the snowmelt period between March 15 and August 14 is 900 cfs.

The R2CROSS analysis indicated that a fall/winter flow rate of approximately 100 cfs was necessary to meet two out of the three of the critical hydraulic criteria in the cross section selected by the CPW and the BLM. This flow rate is an average of the R2CROSS results collected in five different riffles. The CPW and the BLM personnel also determined that a flow of 100 cfs would also protect other habitat types, such as pools and glides, during the base flow period. According, the initial biological recommendation for the base flow period between August 15 and March 14 is 100 cfs.

Consideration of Water Availability

After developing initial flow recommendations based exclusively upon maintenance of usable habitat and hydraulic characteristics, The CPW and the BLM reviewed the initial recommendations in light of water available during various times of the year. The CPW and the BLM consideration of water availability was based upon an initial water availability analysis conducted jointly by the Colorado Water Conservation Board (CWCB), the CPW and the BLM staff. The initial water availability analysis is described in a separate enclosure. Consideration of water availability is very important for this recommendation because the amount of time (number of days in a calendar year) that habitat is available for the critical life functions of fish directly affects the health and viability of those populations.

After considering water availability, the original flow recommendations were modified as follows:

Time Period	% of 365-day year	Recommended Flow Rate	% of Weighted Usable Area Protected		Number of R2Cross Criteria Met
			Bluehead Sucker	Flannel-mouth Sucker	
April 15 to June 14 (61 days)	16.7%	900 cfs	94%	100%	3 of 3
June 15 to July 14 (30 days)	8.2 %	400 cfs	59%	66%	3 of 3
July 15 to August 14 (31 days)	8.5 %	200 cfs	30%	38%	3 of 3
August 15 to March 14 (212 days)	58%	100 cfs	8%	12%	2 of 3
March 15 to April 14 (31 days)	8.5%	200 cfs	30%	38%	3 of 3

The initial water availability analysis demonstrated that 900 cfs is available at least 50% of the time between April 15 and June 14, so no water availability adjustment was required during that time period. The biological flow recommendation of 900 cfs was reduced to 400 cfs for the June 15 through July 14 time period because of water availability concerns. The biological flow recommendation of 900 cfs flow was further reduced to 200 cfs during the July 15 to August 14 period because of water availability concerns. The recommendation for the June 15-July 14 and July 15-August 14 time periods are designed to maintain as much as possible bluehead sucker and flannelmouth sucker habitat during a period of the year when flows are rapidly declining. The descending limb of the hydrograph occurs at the warmest time of the year when the species are most active, and when the species are attempting to put on weight to survive limited food availability during winter.

The biological flow recommendation of 900 cfs was also reduced to 200 cfs for the March 15 to April 14 period because of water availability concerns. Protection of higher flows associated with the beginning of snowmelt runoff is warranted during this period because it is the beginning of the portion of the year when the sensitive fishes complete critical parts of their life cycles, including the commencement of spawning activities in early spring.

The R2CROSS Method suggests that fall/winter flows should be maintained at 100 cfs, which meets two of the three of the identified critical hydraulic criteria. The flow rate of 100 cfs was not reduced to address water availability concerns, because the initial water availability analysis performed jointly by the CWCB, the CPW, and the BLM suggested that 100 cfs is available at least 50% of the time during the time period between August 15 and March 14.

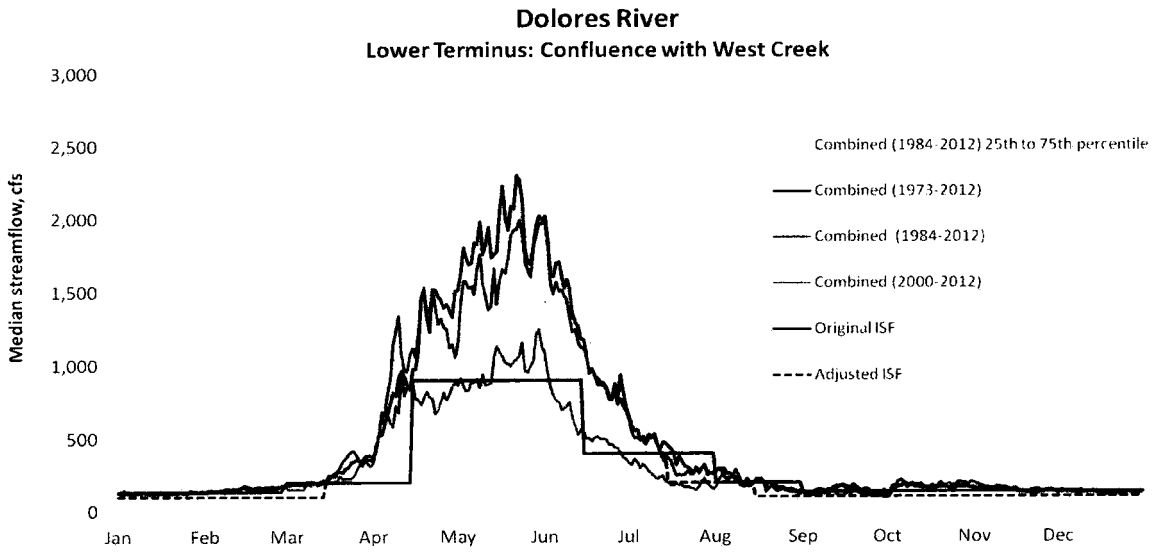
Enclosure 4 - Dolores River Instream Flow Recommendation

Water Availability

The Bureau of Land Management (BLM) and the Colorado Parks and Wildlife (CPW) staff cooperated with the Colorado Water Conservation Board (CWCB) staff to conduct an initial evaluation of the stream hydrology to determine if water was physically available for the instream flow recommendation. The hydrograph below was derived from data collected by the U.S Geological Survey (USGS) stream gage for the San Miguel River at Uravan, CO (#09177000), which has a drainage area of 1,500 square miles and from the USGS stream gage for the Dolores River at Bedrock, CO, which has a drainage area of 2,025 square miles. The period of record for the San Miguel River at Uravan gage was 1954 to 2004, and the period of record for the Dolores River at Bedrock gage is 1917 to 2013. The analysis focused on an overlapping period of record between 1973 and 2012, or 40 years.

The BLM and the CPW staff determined that combining the mean monthly flow from these two gages would provide a conservative estimate of water availability. The reason the estimate is conservative is that there is some limited tributary inflow to the Dolores River from Mesa Creek, Roc Creek and Blue Creek below these two gages. In addition, the estimate is believed to be accurate because there are no known diversions between the two gages and the upper terminus of the proposed instream flow reach at the confluence of the Dolores River and San Miguel River. Water availability for the lowest six miles of the proposed instream flow reach may have to be slightly adjusted for a handful of irrigation diversions that divert water upstream from Gateway. The initial water availability analysis may also have to be adjusted for channel losses or gains that occur through the 34-mile reach.

The cooperative analysis also examined subsets of the 40-year data set. In 1984, the Dolores Project on the Dolores River came on line and substantially altered the hydrology of the river. In 2000, two major events occurred. First, additional water delivery service areas were brought on line under the Dolores Project, increasing demand for project water. Second, a period of extended drought began. In the Dolores River watershed that feeds the Dolores Project, 11 of 13 years between 2000 and 2012 were below average water yield years. In the San Miguel River basin, 10 of 13 years between 2000 and 2012 were below average water yield years. The hydrograph below displays the results of the cooperative analysis.



The initial analysis of water availability revealed that proposed instream flow rates are conservative, when viewed from the perspective of water availability:

- The proposed flow rates are available at least 50% of the time, when viewed from the perspective of median flows over a wide range hydrologic conditions between 1984 and 2012, since the Dolores Project has been constructed.
- The proposed flow rates leave a substantial volume of water available in the river for future development, when viewed from the perspective of median flows. During the peak snowmelt period from April 15 to June 15, it is preliminarily estimated that the proposed flow rates would leave more than 66,000 acre feet annually available for development. During the baseflow period from August 15 through March 14, it preliminarily estimated that the proposed flow rates would leave approximately 23,000 acre feet available for development. It is important to note that these figures were derived using median hydrology and that more or less water could be available in high runoff or drought years.
- Even when viewed through the perspective of the recent drought period from 2000-2012, the proposed flow rates are generally aligned with water availability. There are certain short periods during drought years, such as late April and early June, when there would not be sufficient flow available to meet the recommended flow rates. However, the BLM and CPW believe that the opportunity to protect flow during the critical April 15 to June 14 period during average and above average years is important to long-term health and viability of this population of the three sensitive species.
- During drought years, it is likely that the proposed junior instream flow water right would not be in priority during the entire April 15 to June 14 period. Accordingly, the instream flow water right would not prevent diversions by established, senior water uses during drought periods. In addition, the instream flow water right would be junior to a large number of existing conditional water rights that have not yet been developed.

- If the period from 2000 through 2012 is viewed as a representative drought period, the proposed flow rates still allow for future water development by new junior water rights that could be established after an instream flow right is decreed. During the base flow period from August 15 through March 14, an average of 16,000 acre feet of water would still be available for future development during this representative drought period.

COLORADO PARKS & WILDLIFE

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30 December 2013

Ms. Linda Bassi
Colorado Water Conservation Board
Stream and Lake Protection Section
1313 Sherman Street, Room 723
Denver, Colorado 80203

Re: Colorado Parks and Wildlife Instream Flow Recommendations for the Dolores River – Montrose and Mesa Counties

Dear Linda:

The purpose of this letter is to formally transmit Colorado Parks and Wildlife's (CPW) instream flow (ISF) recommendations for the Dolores River (Water Division 4). This ISF recommendation is a joint recommendation from CPW and the Bureau of Land Management (BLM). CPW and BLM have collaborated on this effort from the start – jointly collecting stream habitat data, cross section data, natural environment data and then a coordinated review of the data, habitat modeling, and recommendation formulation. This effort started in 2010 and continued during the following three field seasons.

CPW is recommending ISFs for the reach of the Dolores River from its confluence with the San Miguel River near Uravan, Colorado to the confluence with West Creek near the town of Gateway, Colorado. This segment of the Dolores River is approximately 34 miles long and starts in Montrose County and ends in Mesa County. The lower terminus is approximately 7 miles from the Utah-Colorado border. Upstream of the upper terminus, there are existing decreed ISF water rights on the upper Dolores River (a 1975 ISF water right for 78 cfs) and on the Sam Miguel River (a 2011 ISF water right for flows ranging from 80 cfs to 325 cfs); within the reach that is the subject of this ISF recommendation there are several small tributary streams with ISF water rights in place (Mesa Creek and Rock Creek).

This segment of the Dolores River is important to CPW for a number of reasons, most importantly it is known to provide habitat for three native fish species of concern (both in Colorado and throughout the six state region) - flannelmouth sucker, bluehead sucker, and roundtail chub; these large-bodied fish are

endemic to rivers and streams of the Colorado Plateau. More importantly, these three species of fish are the subject of a range-wide conservation agreement and strategy that is signed by all six states' fish and wildlife management agencies, several Native American tribes, and federal agencies including the BLM and Bureau of Reclamation. This agreement is commonly referred to as the "Three Species Agreement" but is more accurately entitled "Range-Wide Conservation Agreement and Strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) 2006"; both CPW and the BLM's Colorado State Office are signatories to this agreement. In essence, the Three Species Agreement is an agreement amongst state, federal and tribal entities who collectively agreed to take affirmative management steps toward protecting populations of, and habitats for, these fish species throughout their historic range. The overall goal of this agreement is to prevent listing of these fish species under the Endangered Species Act. In Colorado, one of the most critical and effective tools for the protection of fish habitat is the CWCB's ISF Water Right Program. It is for this reason that CPW is requesting that the CWCB consider the Dolores River segment as described above for inclusion in its ISF Protection Program.

CPW, and its predecessor agencies (the Colorado Division of Wildlife and the Colorado Division of Parks and Outdoor Recreation) have long been partners with the CWCB for the protection of ISFs in Colorado. Since its passage in 1973, CPW has been one of the primary sources for ISF recommendations; since the late 1980s, BLM has also provided the CWCB with many ISF recommendations. Over the course of those years, CPW and BLM have worked closely on dozens of ISF projects – the most recent being the San Miguel River ISF appropriations upstream of this Dolores River Segment. CPW's legislative and strategic mission and the stated purpose of the ISF Program in its legislative declaration are complementary to one another in many ways – CPW is directed by the following language:

- "… that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors … and that, to carry out such a program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities" (See §33-1-101 (1) C.R.S.)
- "[h]ealthy aquatic environments are essential to maintain healthy and viable fisheries, and critical for self-sustaining populations… by protecting and enhancing the quality and quantity of aquatic habitats." (CPW Strategic Plan)

And CWCB's ISF Program is guided by this simple statement:

- "Further recognizing the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (See §37-92-102 (3) C.R.S.).

CPW reads these statements together as an affirmation that the CWCB's ISF Program is a critical habitat and species protection program that assists CPW in accomplishing its mission. In a similar way, one of CWCB's primary purposes is to foster the development and use of the state's water resources. In the case of

the Dolores River and in the context provided by the Three Species Agreement, CPW is of the belief that securing ISF protection for the Dolores River fishery is critical to the state's commitment to taking affirmative steps to prevent an ESA listing. We also believe from lessons learned elsewhere in the Colorado River basin, that the prevention of an ESA listing is critical to the future of water use and development in the state.

Natural Environment

This 34 mile reach of the Dolores River has the following physical characteristics:

- A very gentle gradient that averages about 0.2%.
- Mostly pool and run habitat types, riffle habitat is very limited.
- The dominant substrate type is sand and mud; some small cobble in isolated areas.
- Due to the general lack of significant tributary infow, the width and depth of the active channel is relatively uniform throughout the 34 mile reach.
- The riparian zone consists of a mixture of native and non-native trees, shrubs, and plants. There is a significant Tamarisk component to the riparian canapy.

CPW personnel has sampled the Dolores River quite intensively over the last decade with sampling events in 2007, 2009, and 2010. The river supports populations of bluehead sucker (*Catostomus discobolus*), flannelmouth sucker *Catostomus latipinnis*, roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*). These samples indicated that, depending upon the location with the reach, 76% to 89% of the fish captured were native species. All three of "Three Species Agreement" species were present in all locations. Further, the samples indicate that all three species were represented by individuals of multiple age classes. According to CPW biologists, this reach of the Dolores River appears to be one of the best populations of the three native fishes within the Dolores River watershed, and represents an intact and functional assemblage of native warm water fish. In addition, genetic testing of the two sucker species do not indicate any hybridization with non-native white suckers, which is known to occur in other major western Colorado rivers. CPW manages this reach as a Category 204 – Native Fish Conservation Stream.

The roundtail chub is classified as a "species of special concern" by CPW. BLM lists all three species as "sensitive species". The "Three Species Agreement" and Colorado's Species Conservation Plan (DRAFT) are designed to outline management measures to prevent a federal listing under the Endangered Species Act. Protection of the Dolores River native fishery with an ISF water right will go a long way toward Colorado's overall action to protect these species. As stated above, since the Dolores River does not have large numbers of non-natives (particularly predators and non-native suckers), this river reach presents a rather unique opportunity for Colorado to protect a healthy reproducing

assemblage of these native fish. Further, the occupied habitat in the Dolores River is dominated by public lands (BLM) thus providing some land use protection for the habitat. There have been recent efforts to list the roundtail chub throughout its range and these efforts have not succeeded due to state and federal land management agency efforts to conserve existing populations.

Below is a table which shows the habitat requirements and life stage periodicity for the three primary Dolores River fish species.

	SPAWN	FRY-EMERGENCE	YOUNG OF YEAR - JUVENILE	ADULT
Roundtail Chub	Need relatively clean cobbles/ interstitial space for eggs to settle; can be runs and glides; temps 14.4 - 18.3 C Season: After Peak Runoff	Structure/ complexity to avoid immediate predation Season: Late Summer	Quiet shallow channel margins, backwaters Season: Fall, Winter, and Spring	Deeper water/ slow-velocity eddies with access to good flow/ runs. In-channel structure. Carniverous, opportunistic feeder Season: All Year
Flannelmouth Sucker	Spawn over gravel, eggs adhere or fall into interstitial spaces. Needs clean substrate and flowing water to aerate eggs. Season: March - July	Near-shore, slow velocity habitats with cover Season: Late Summer	Utilizes wider variety of habitat types; deep runs, riffles and pools Season: Fall, Winter, and Spring	Utilizes multiple habitat types; feeds in riffles and deep runs on detritus, algae, invertebrates; have been known to move long distances (documented to ~150 miles) Season: All Year
Bluehead Sucker	Shallow areas with clean cobbles and interstitial space for egg incubation; 15.6 - (18-21) C Season: April - May	Near-shore, slow velocity habitats and trending toward deeper water and higher velocity with age Season: After Peak Runoff	Extends habitat used into faster moving water; begins feeding exclusively in riffles and deep runs Season: Fall, Winter, and Spring	Swifter velocity, higher-gradient riffles and runs. Opportunistic feeders of detritus, algae, and macro-invertebrates Season: All Year

More specifically to the lower Dolores River and the subject of ISFs, the following represents how these native species react to different stream flow conditions, air and water temperatures, etc. Also included in the following are geomorphic and fluvial processes associated with different stream flow conditions with an emphasis on how these factors affect habitat conditions for fish.

- Late winter - early spring (pre-peak snowmelt period), March - April: low elevation streams in western Colorado often surge in response to melt of

low elevation snowmelt, spring storms, and early ripening of the snowpack in higher terrain, and water begins warming in response to longer days and warmer air temperatures. Along with an increasing photo-period, these hydrologic cues signal native fish to navigate toward likely spawning sites. Flannelmouth suckers and bluehead suckers have been known to travel long distances toward habitual spawning areas. In addition, increased flows during this period also mobilize fine sediments that may have settled during localized late-summer or fall monsoon storms, improving conditions in cobbles for spawning.

- Peak snowmelt runoff: In the Lower Dolores River, peak runoff occurs anywhere from mid-April thru mid-June, and has multiple benefits for native species. First, peak flows clear riffles of sediment and often re-set bed sediments to provide optimal aeration for deposited eggs. Second, peak flows are critical for maintaining habitat diversity within the stream channel, critical for support of all life stages of native fish. Especially important for emerging fry are side-channel and backwater sites that become refugia for young fish. Third, peak flows are critical for redistributing sediments, creating new instream and near-stream habitat, and invigorating riparian processes (recall prior note about the importance of alluvial groundwater). Ramping flows on the descending side of the hydrograph are important so that fish have time to move to habitats where they will spend most of the next 8 months of their lives. Spawning for bluehead suckers and flannelmouth suckers may occur during pre-peak or post-peak periods of the hydrograph, and fry emergence and dispersal shortly thereafter (7-10 days) is aided by continuing high flows and subsequent drift to side-channel, low velocity sites. Roundtail chub generally spawn at higher water temperatures than the sucker species, but soon after peak snowmelt runoff to allow for proper growth prior to winter.

- Baseflow: July - February: Adequate baseflow conditions are critical for survival of native fish for a few reasons. First, as young-of-year fish mature during summer, they venture from refugia into the main channel where larger adult and juvenile fish also survive. They need enough wetted perimeter and available habitats to survive predation and competition from both native (roundtail) and non-native fish. Second, native suckers, particularly bluehead suckers, are primarily foraging fish that feed on algae and detritus within the main channel, and incidental to consumption of vegetation by these fish is the consumption of a number of high-protein macroinvertebrates that also feed on or inhabit riverine plants. This primary production within the channel is highly dependent on riffles that have both good aeration and available sunlight. Growth during summer baseflow months is critical to provide fish the resiliency needed to survive the winter, when forage is scarce. Baseflow during winter months is necessary to provide enough habitat variety to overwinter both

young-of-year, juvenile, and adult fish, and to provide enough mobility so that fish can escape predation or find more advantageous habitats as seasonal conditions evolve.

In summary, CPW is of the opinion that an important natural environment exists in the Dolores River; for the reasons described above, we believe that the Dolores River fishery is one of statewide interest and significance. We further believe that this natural environment can be preserved to a reasonable degree with the appropriation of an ISF water right in the amounts discussed below.

ISF Quantification

Methodologies – PHABSIM and R2CROSS

The recommending agencies for the Dolores River (CPW and BLM) utilized their collective professional judgement and past experiences with large river ISF recommendations and evaluated all of the data collected to date and determined that as was the case with the 2011 San Miguel ISF effort, the best flow recommendation would be derived from a combination of methods. PHABSIM (Physical Habitat Simulation) is a widely accepted method for quantifying the suitable versus unsuitable hydraulic habitat attributes of selected species and life stages as a function of discharge. R2CROSS is best suited for identifying flows with specific hydraulic criteria in a riffle habitat type. CWCB has used the R2CROSS method extensively in the past to appropriate ISF water rights. PHABSIM is a method that has been widely used and accepted to quantify ISF requirements. CWCB has previously used PHABSIM data to appropriate ISF water rights. In addition, CWCB has on numerous occasions, accepted ISF recommendations quantified with a combination of both R2CROSS and PHABSIM.

CPW and BLM determined that exclusive use of the standard R2CROSS method would not be appropriate for this reach of the Dolores River. Historically, R2CROSS has been used in small to medium-sized streams with a high percentage of riffle habitat. In contrast, the Dolores River has a wide channel (over 100 feet wide in most places), supports different types of fish species than are typically found in smaller streams in Colorado (warm/cool water species vs. cold water species such as salmonids). Further, the Dolores exhibits big river channel hydraulics with extensive run, pool, and glide habitats as well as a very low gradient. In addition, as noted above, the Dolores has a very small percentage of the total fish habitat as riffles. For these reasons, CPW and BLM decided to utilize PHABSIM to develop flow recommendation for the snowmelt runoff months between March and August. This is the portion of the year when the three sensitive species are using run, pool, glide, and riffle habitat to

complete important parts of their life cycles, such as spawning and recruitment of young of the year. Maintaining a diversity of habitat availability is critical during the higher stream flow period for the maintenance of population biomass and age class structure.

CPW and BLM decided to use the R2CROSS methodology to develop flow recommendations during the base flow portions of the year from August through March. This is the period when there is substantial competition between individuals for physical habitat space, foraging areas, and limited food supplies. During this period, it is critical for the three species to be able to move between habitat areas to make full use of the limited physical habitat. Riffles are the first location where low flows can limit passage between habitat types, so it as appropriate to develop flow recommendations that focus on the fish passage function of riffles and hydraulic controls.

To select an appropriate location for PHABSIM modeling, CPW and BLM staff conducted reconnaissance throughout the 34-mile reach to identify the typical habitat characteristics for the reach paying attention to factors such as channel width, substrate, depths, and velocities. The CPW and BLM staff then selected an 1800-foot reach of stream, located approximately seven miles upstream from the town of Gateway, as a location that could represent the full variety of habitat types found within the 34-mile reach. The CPW and BLM staff utilized standard PHABSIM field methods to establish and monument seven transects that incorporate the full variety of habitat types found in the Dolores River ISF segment. The transects were selected to describe the overall variety of riffles, runs, pools and glides. These seven cross-sections formed the basis for the data set that was input for the PHABSIM modeling programs.

BLM and CPW staff also ran the seven PHABSIM cross sections through the R2CROSS model. Since there was only one PHABSIM cross section placed in a riffle, in early 2013 CPW and BLM staff collected data from four additional representative riffle cross sections from other locations within the ISF segment. This additional cross section data was collected to increase the reliability of the R2CROSS modeling for the base flow period. We were of the opinion that since a large portion of the ISF recommendation hydrograph was going to be relying on R2CROSS modeling, the R2CROSS data set should be as robust as possible.

The initial recommendations based on the PHABSIM and R2CROSS modeling are designed to address the unique biologic requirements of this stream reach without regard to water availability. CPW and BLM utilized the same criteria as was used in the San Miguel ISF quantification when evaluating the PHABSIM output. The three standard hydraulic parameters (average depth, percent wetted perimeter and average velocity) were modified slightly and applied to the R2CROSS output to calculate the initial biologic ISF recommendations not constrained by water availability considerations.

PHABSIM Habitat Suitability Criteria (HSC)

PHABSIM HSC for the Dolores River ISF segment were developed from the 2003 Riverine Fish Flow Investigation Study Report (Federal Aid Project F-289-R6) written and performed by Richard Anderson, CPW Aquatic Researcher, and Gregory Stewart, Department of Geosciences, Oregon State University[1]. The basis for this study was a 1999 request from the CWCB for CPW to provide biologically justified ISF recommendations for the Yampa and Colorado Rivers based on habitat and flow requirements for non-endangered native fish. Anderson and Stewart used two–dimensional (2D) modeling to develop HSC for bluehead and flannelmouth suckers. Their methods and results are more fully described in Anderson and Stewart (2003) and Stewart and Anderson (2005) and (2006).

Stewart and Anderson determined that "Abundance of bluehead sucker was a reliable indicator for instream flows and habitat maintenance for the native fish assemblage. In the Colorado, Gunnison and Yampa Rivers bluehead sucker habitat peaked at flows of 600 to 1,200 cfs. This flow range also resulted in high habitat diversity and high native fish biomass." Their assumption that flows that maintained adequate bluehead sucker abundance (about 25% of fish over 15 cm) would also maintain adequate flannelmouth sucker and roundtail chub habitat was validated by this study. The bluehead and flannelmouth sucker habitat suitability criteria were used to develop specific hydraulic criteria that were incorporated into the PHABSIM analysis for the Dolores River.

As was the case on the San Miguel, CPW and BLM determined that the flannelmouth sucker and bluehead sucker would be the primary indicator species for the biologically based ISF recommendation. The reason for the focus on these two species is that they have somewhat different habitat preferences. Flannelmouth sucker have stronger preference for pool, glide, and run habitats, while bluehead sucker abundance is directly related to availability and quality of riffle habitats. Roundtail chub primarily utilize habitats with the slower velocities that are typically found in pool habitat. CPW and BLM agreed upon an approach to protect sufficient flows for flannelmouth suckers and bluehead suckers and then assume that there will be sufficient water to maintain roundtail chub habitat in the pools.

When developing ISF recommendations to support flannelmouth sucker and bluehead sucker, BLM and CPW personnel examined tables and graphs produced by the PHABSIM model that show the relationship between "weighted usable area" (suitable habitat) and flow rates for each of the two species within the PHABSIM site. We then identified the most efficient flow rate for providing

[1] See "Impacts of stream flow alterations on native fish abundance and native fish habitat and the use of native fish population data to support instream flow recommendations made using a 2D instream flow methodology."

habitat protection. In this case, the most efficient flow rate is defined as the minimum flow rate that protects at least 90 percent of the habitat that is potentially available within the stream channel for both species. For example, if a PHABSIM modeling run showed that an equal amount of weighted usable area was available at either of two different flow rates, then lower flow rate was identified for protection because it is more efficient.

When identifying minimum flow rates, BLM and CPW personnel also considered the amount of time weighted usable area is available in the Dolores River channel, specifically the number of days within a calendar year. The team considered this factor because much of the potential habitat in the Dolores River is typically available during a 2-month period during the peak of snowmelt runoff; this typically occurs between April 15 and June 14. This 60 day period is only 16.7% of a calendar year. There are certain life functions of the species that can only occur during this very short period, so protecting the high flow rates associated with snowmelt runoff is essential for the long-term viability of these fish populations.

Use of Standard and Modified R2CROSS Hydraulic Criteria

The primary objective of most cross section methodologies, including R2CROSS, is to maintain quality riffles. Riffles are the most vulnerable habitat to dewatering and riffles are important for invertebrate productivity. For many species, riffles play an important role in spawning and incubation. Riffles comprise only a very small portion of the total habitat area in this stream reach, so the importance of maintaining riffle habitats cannot be dismissed. In early 2013, the two agencies conducted a survey of the various types of riffles within the Dolores River ISF reach, paying particular attention to width, dominate substrate types, slope, and water velocity. The team then selected four representative riffles for individual analysis using R2CROSS.

BLM and CPW personnel applied/modified the standard R2CROSS criteria in the following manner:

- For the percent wetted perimeter criterion, we used the standard identified in the CDOW research publication, Nehring, R.B., 1979, “Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado.” Due to the top width of the Dolores River (it always exceeds 60 feet), the Nehring publication suggests maintaining 70% of wetted perimeter.
- The average velocity and average depth criteria were modified from Nehring to values suggested by the 2003 Riverine Fish Flow Investigation Study Report referenced earlier in this letter. Anderson and Stewart recommended an average velocity of 1.3 feet per second and an average depth of 1.0 foot, These criteria were suggested to maintain marginally suitable habitat for flannelmouth sucker and bluehead sucker.

These standard and modified criteria were applied to the R2CROSS computer runs that were performed on all the riffle cross sections collected by the agencies.

The R2CROSS model utilizes the Manning's Equation and it provides reliable predictive results for flows that are between 40% and 250% of the flow measured during the data collection effort. This range of accuracy is referred to as the "confidence interval" for R2CROSS modeling. When the flow rate that meets the ISF criteria falls outside of this confidence interval, data from that cross section is not used to develop an ISF recommendations. The results from cross sections with usable results (inside the confidence interval) are averaged to develop the recommended flow rates.

Dolores River Instream Flow Recommendations

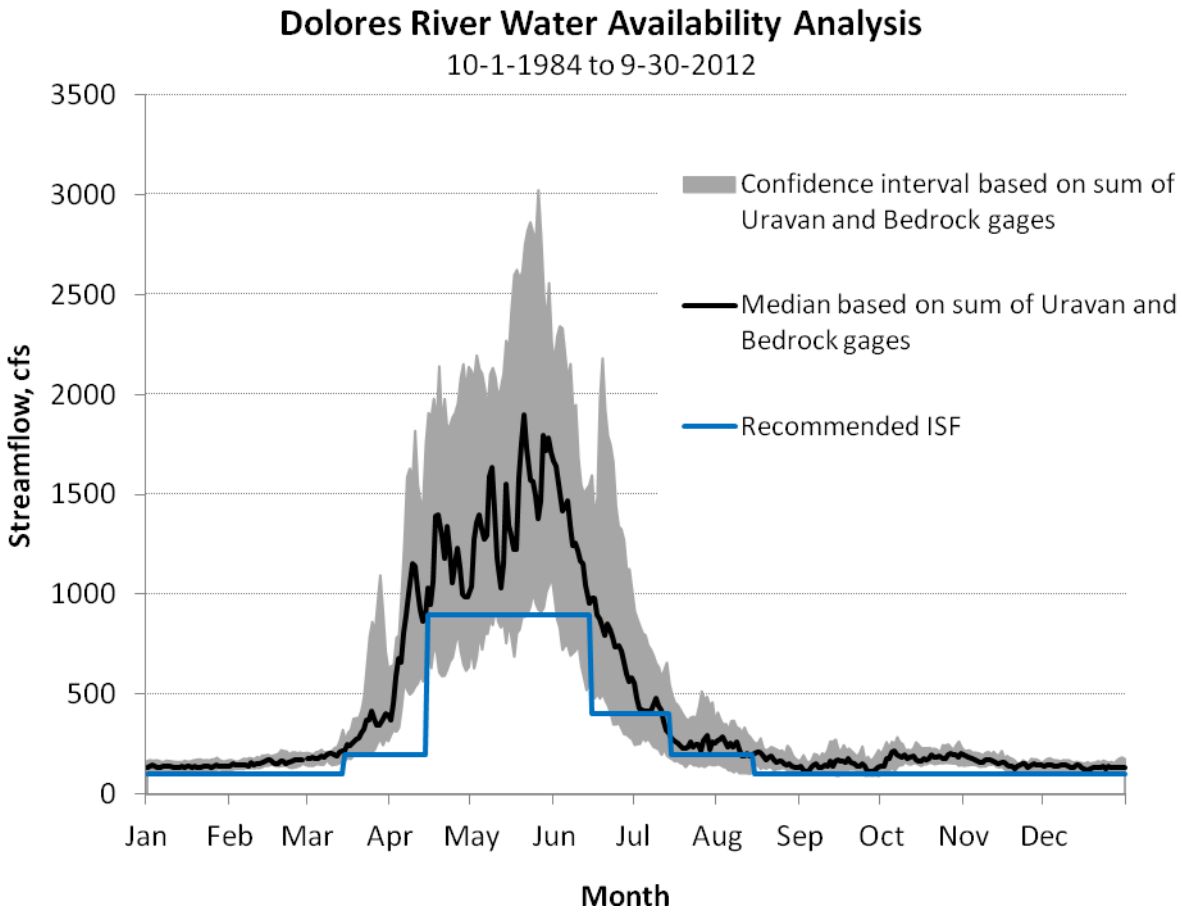
Utilizing the approach and applying the criteria described above and our collective professional judgment, CPW and BLM professionals (biologists and hydrologists) developed the following ISF recommendations. As discussed above, both the PHABSIM incremental methodology and the R2CROSS standard setting methodology were employed in this effort.
The PHABSIM output files (tables and graphs) show that the maximum amount of usable habitat for bluehead suckers is produced at a flow of 1200 cfs and for flannelmouth suckers at a flow of 875 cfs. BLM and CPW determined that a flow rate of 900 cfs would adequately protect the flannelmouth sucker habitat while protecting more than 90% of the usable habitat for bluehead sucker. As stated above. this usable habitat is typically available for only two months of the year. Accordingly, the initial biological recommendation for the summer/high flow/snowmelt period (typically from March 15 and August 14) from the PHABSIM method is 900 cfs.

As stated above, the R2CROSS method was selected to develop ISF recommendations for the fall/winter time period (typically between August 15 and March 14). The R2CROSS analysis for the five riffle cross sections yielded a flow recommendation of approximately 100 cfs to meet two out of the three of the hydraulic criteria. This flow rate is an average of the "in range" R2CROSS flow recommendations collected at the five riffles. BLM and CPW personnel are also of the opinion that a flow of 100 cfs would also protect other habitat types, such as pools and glides, during the base flow period. Accordingly, the initial biological recommendation for the base flow period between August 15 and March 14 is 100 cfs.

Initial Water Availability Analyses

The initial biologic ISF recommendations are next compared to some preliminary hydrologic analyses. Typically the recommending agencies perform some simple

water availability analyses to fine tune or revise the initial flow recommendations to match hydrologic reality. CPW compared our flow recommendations to a hydrograph produced by the combination of two USGS stream gages on the Dolores River and the San Miguel River near the confluence of these two rivers. This confluence also corresponds with the upper terminus of this ISF recommendation. The result of this rather simple hydrologic exercise is displayed in the graph below.



This graph clearly shows that the 900 cfs PHABSIM summer high flow ISF recommendation is only available between mid-April and mid-June. During the

rest of the of the critical summer time period (when spawning, incubation and growth are occurring in the fish populations), the agencies determined that the ISF recommendation needs to be as high as can be supported by the water available. Therefore, CPW and BLM modified the summer ISF recommendation down to 400 cfs (mid-June through mid-July) and to 200 cfs (mid-March through mid-April and mid-July through mid-August) thus creating "shoulders" on the ISF hydrograph. The graph also clearly shows that the 100 cfs R2CROSS generated winter base flow recommendation is available for the entire winter from mid-August through mid-March – no revision or modification of the initial ISF recommendation for this time period was necessary.

CWCB Water Availability Analyses

During the latter part of 2013, CWCB staff conducted several more sensitive and sophisticated hydrologic analyses utilizing the CDSS models, StateMOD models, and other hydrologic techniques to more precisely determine physical and legal water availability for the ISF appropriation. Some Dolores River basin stakeholders requested some specific examinations of water availability. CPW, BLM and CWCB staff have met and reviewed all of the results of the hydrologic work and no additional revisions appear to be necessary at this time.

Summary and Conlusions

As a result of nearly three years of data collection and analysis, CPW and BLM have developed what we believe to be an ISF proposal that is both reasonable and protective of the Dolores River's natural environment. We are of the opinion that a natural environment exists and that that environment can be preserved to a reasonable degree with the flows recommended by the agencies. The flow recommendations are as follows (modified by initial water availability analyses):

- 900 cfs is necessary to preserve the natural environment from April 15 through June 14;
- 400 cfs* is necessary to preserve the natural environment from June 15 through July 15;
- 200 cfs* is necessary to preserve the natural environment from July 16 through August 14;
- 100 cfs is necessary to preserve the natural environment from August 15 through March 15; and
- 200 cfs* is necessary to preserve the natural environment from March 16 through April 14.

  (* = flow recommendation modified due ot water availability considerations)

If you have any questions about the information contained herein, please call me at 303-291-7260. Thank you for the opportunity to submit these important flow recommendations; CPW will be represented at the January, 2014 CWCB meeting to address any questions or comments generated by the Board or public.

Sincerely,

Jay W. Skinner

Jay W. Skinner
Instream Flow Program Coordinator
Colorado Parks and Wildlife

CC: Chad Bishop, CPW Asst. Director – Wildlife & Natural Resources Branch
Alex Davis, CPW Water Resources Section Manager
Regional Staff

Fish Sampling Report

Paul Jones
Aquatic Biologist
Southwest Region

Water: Dolores River
Reaches: Big Gypsum, Mesa Creek to Roc Creek (RM 114.3-RM117.5), River Mile 124 to River Mile 126, Blue Creek to Salt Creek (RM 127.8-RM 130.6)
Dates: 6/14/2010 - 6/16/2010
Gear: 14 ft. electrofishing raft with booms and Smith Root 2.5 GPP
Drainage: Dolores
Water Codes: 39760

OBJECTIVE
With the exception of the Big Gypsum reach, the Dolores River was sampled with single pass CPUE electrofishing to monitor native fish populations on four separate reaches. The reaches sampled were the Big Gypsum reach, Mesa Creek to Roc Creek reach, River Mile 124 to River Mile 126 reach, and the Blue Creek to Salt Creek Reach (Figure 1). .

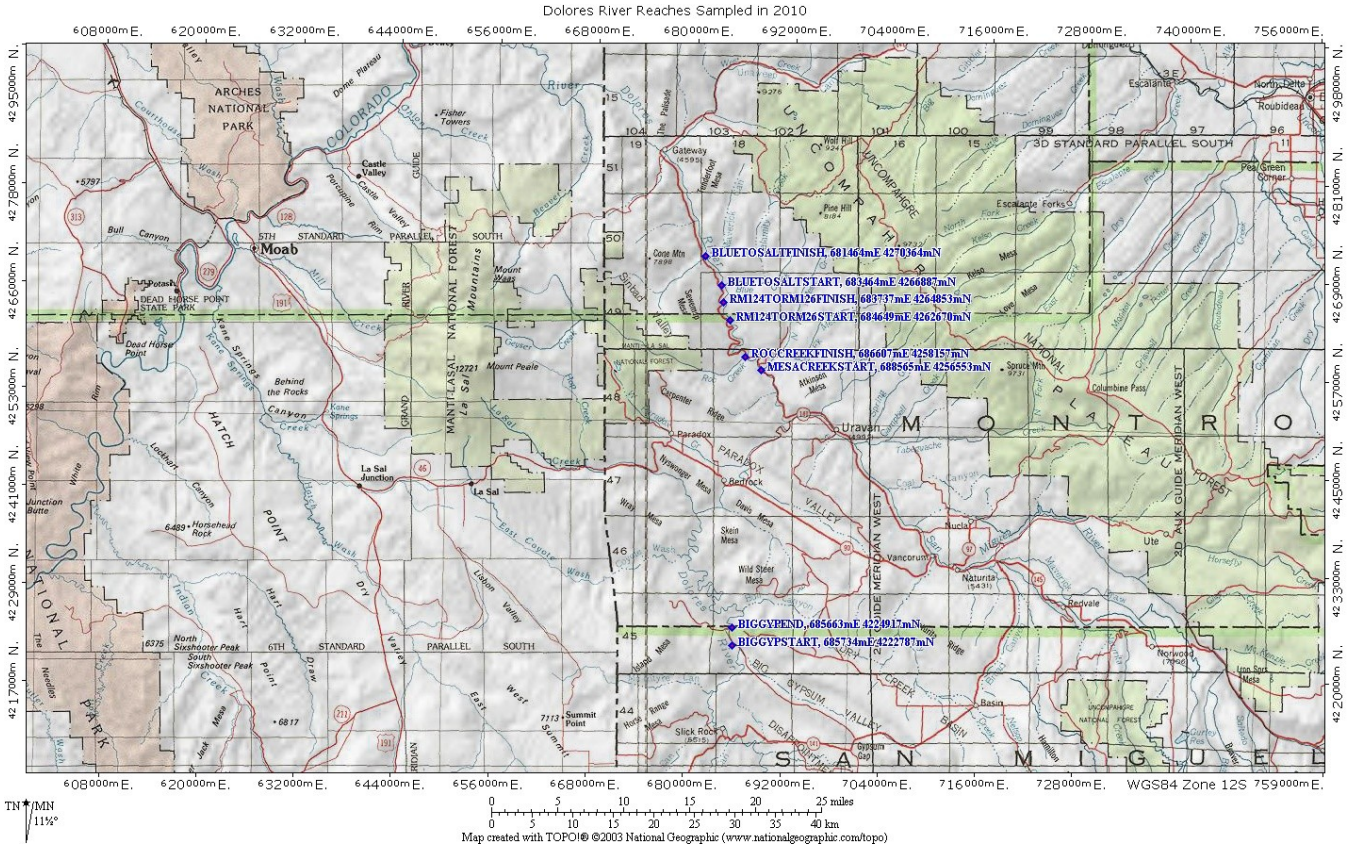


Figure 1. Dolores River Reaches Sampled in 2010

The first section that was sampled was the Big Gypsum reach on 6/14/2010. The reach runs from the Gypsum Valley Recreation Site/Boat Launch just downstream of river mile 61 to the San Miguel County Road 20R (Gyp Road) bridge at approximately river mile 63.5. This section was sampled with two pass CPUE electrofishing to monitor native fish populations Total pooled sampling distance was 5 miles (Figure 2).

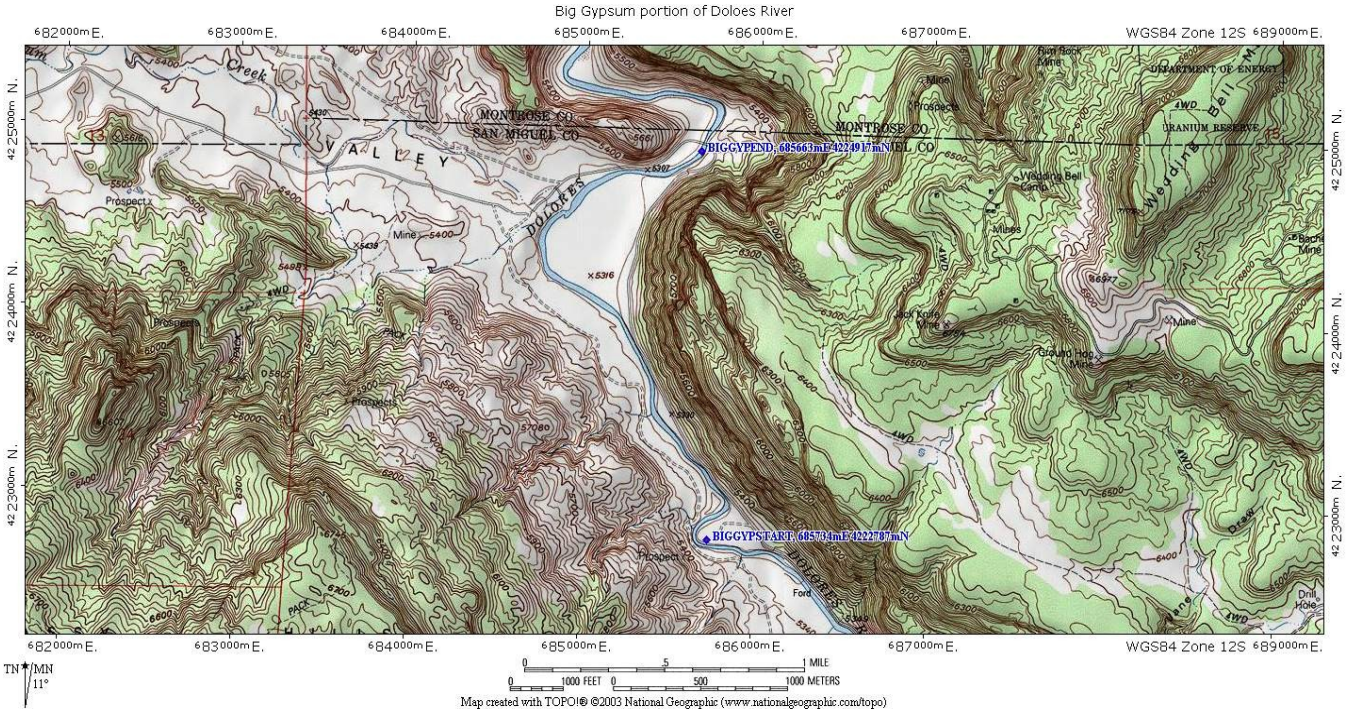


Figure 2. Big Gypsum Reach of the Dolores River Sampled in 2010

The Mesa Creek to Roc Creek sections of the Dolores River was sampled on June Fifteenth with single pass CPUE from the mouth of Mesa Creek to the mouth of Roc Creek (Figure 3). Total pooled sampling distance was 3.2 miles.

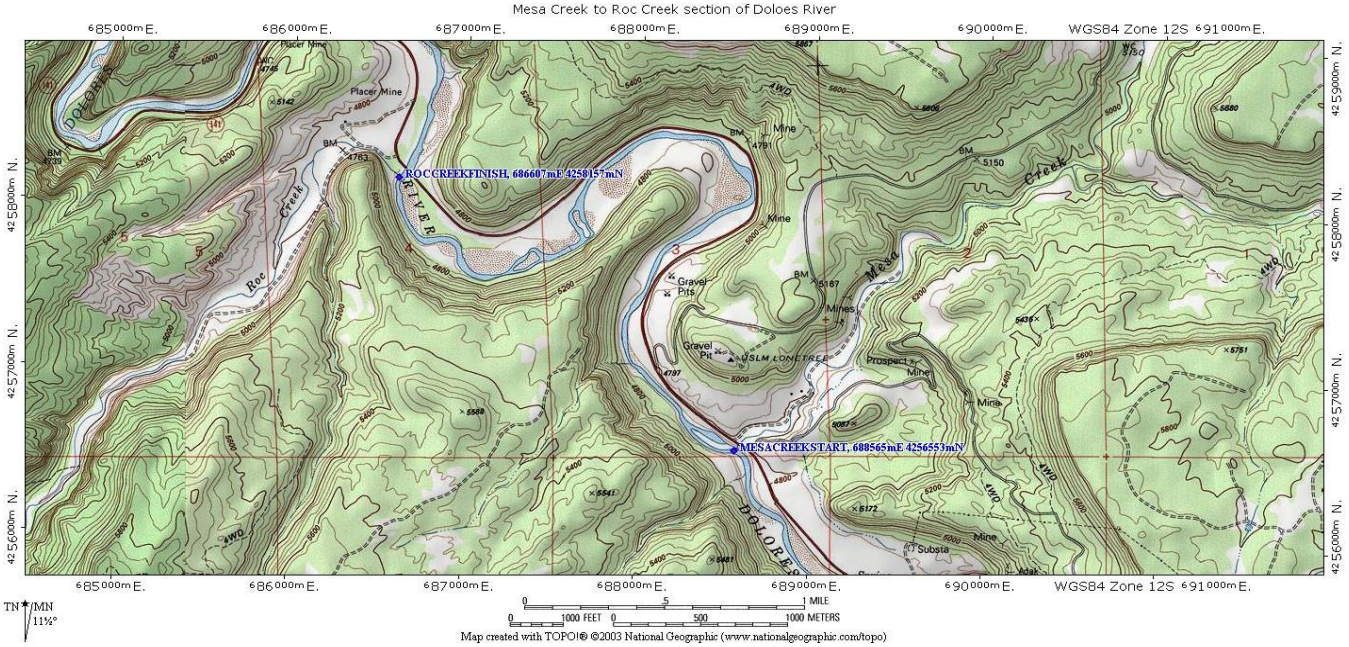


Figure 3. Mesa Creek to Roc Creek section of the Dolores River

The next reach of Dolores River that was sampled ran from the top of the island at RM 124 to the bottom of the island at RM 126 (Figure 4), and was sampled on the Sixteenth of June. Total pooled sampling distance was 2 miles.

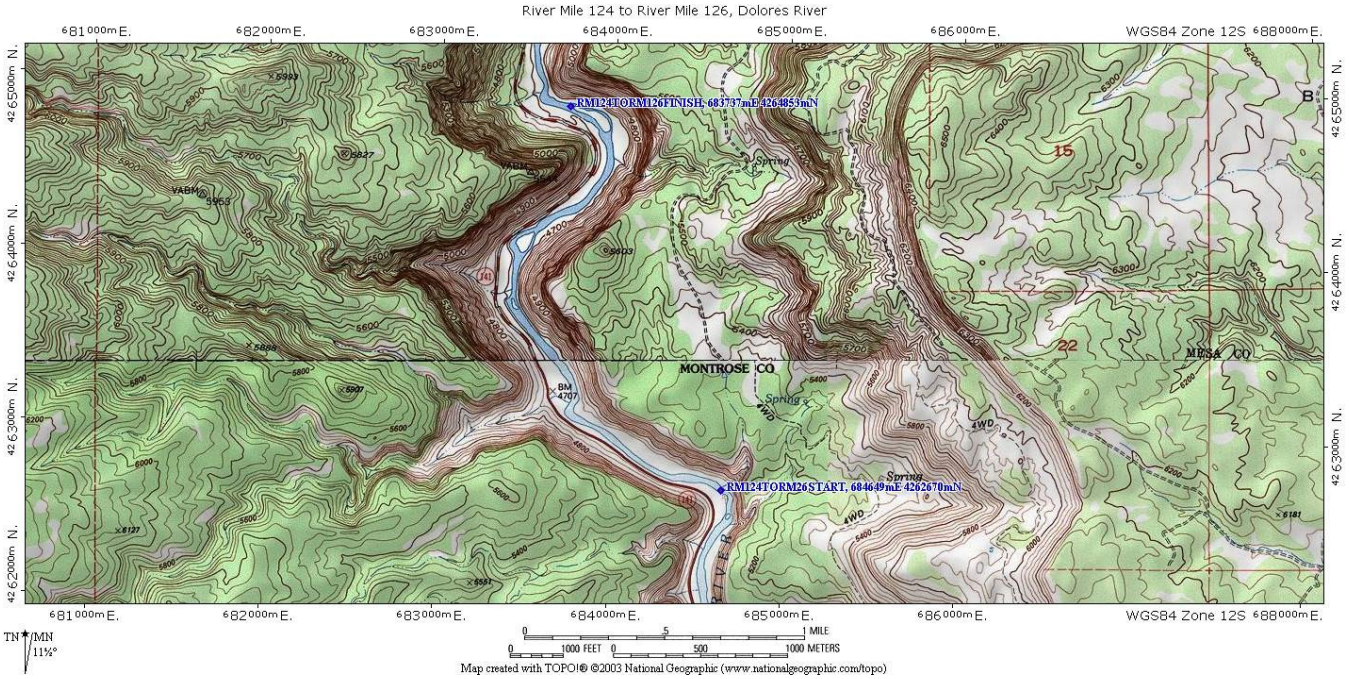


Figure 4. Dolores River from RM 124 to RM 126

The final reach of the Dolores River was sampled on the afternoon of June Sixteen, and it ran from the mouth of Blue Creek to the top of the rapids at the mouth of Salt Creek (Figure 5). Total pooled sampling distance was 2.8 miles.

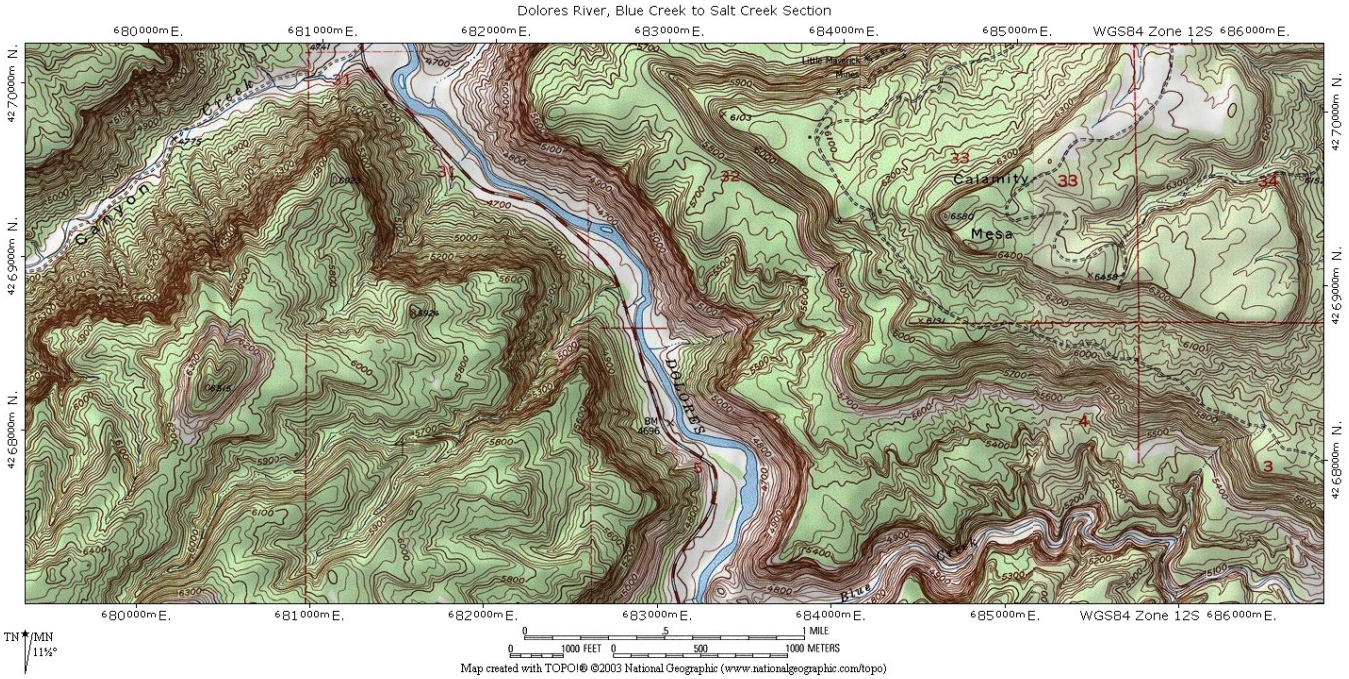


Figure 5. Dolores River from Blue Creek to Salt Creek

RESULTS

B IG GYPSUM REACH:

The results of the survey for the Big Gypsum reach are summarized in Table 1 and length frequency histograms for the three species are presented in Figure 5. Eighty five percent of the fish sampled were native species and flannelmouth suckers, bluehead suckers, and roundtail chub had a catch rate of 10.8 fish per mile. Only one

bluehead sucker was caught, but both flannel mouth suckers and round tail chubs showed several distinct age classes. Of some concern however is the presence of smallmouth bass and green sunfish. Two distinct size classes of smallmouth bass were captured, confirming that these fish are now breeding in the Dolores River below McPhee Dam.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	3	4	0.6	6.6	4.0-8.1
Bluehead Suckers	1	1	0.2	3.3	3.3
Roundtail Chub	50	62	10	6.1	2.9-10.9
Speckled Dace	4	5	0.8	3.2	1.9-4.0
Common Carp	1	1	0.2	2.6	2.6
Redside Shiner	2	2	0.4	2.9	2.8-3.0
Channel Catfish	3	4	0.6	7.5	6.5-8.8
Black Bullhead	3	4	0.6	6.6	4.0-8.1
Smallmouth Bass	2	2	0.4	8	6.1-9.8
Green Sunfish	1	1	0.2	6.5	6.5

Table 1. Summary of fish sampled in the Big Gypsum section of the Dolores River in 2010.

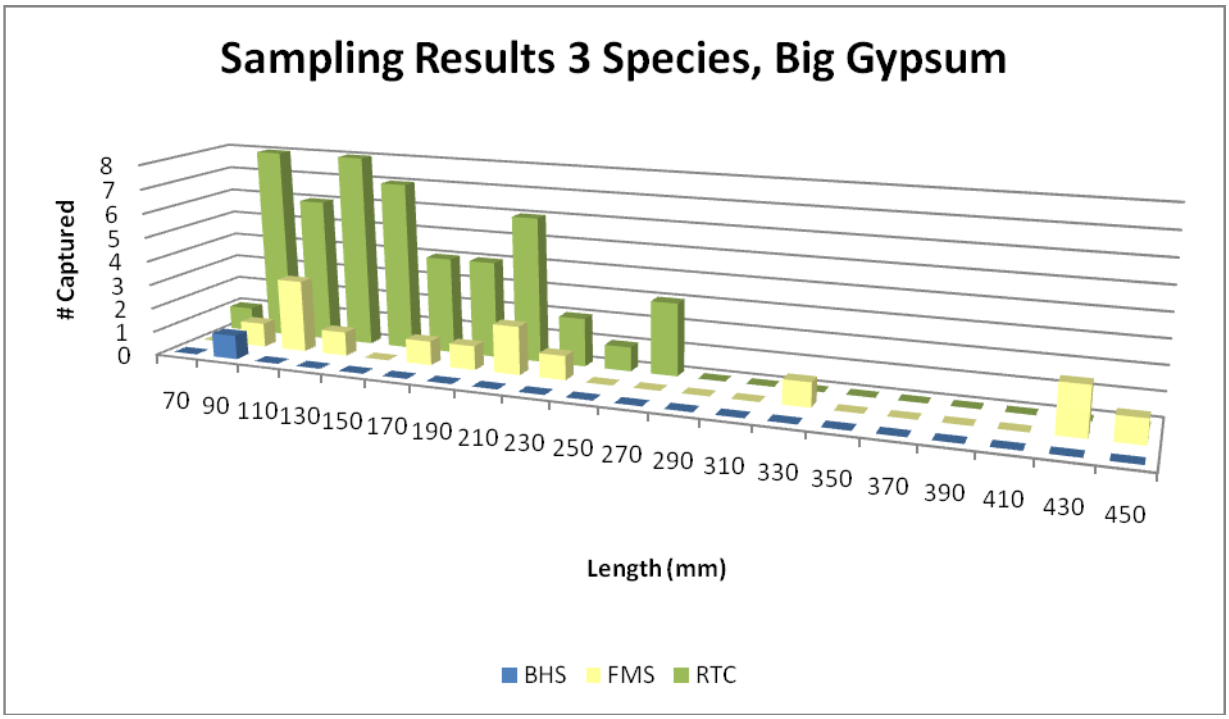


Figure 5. Length frequency histogram the three species captured in the Big Gypsum section of the Dolores River in 2010.

MESA TO ROC CREEK REACH:

The results of the Mesa Creek to Roc Creek survey are summarized in Table 2 and length frequency histograms for the three species are presented in Figures 6. Ninety three percent of the fish sampled were native species and the three species had a combined catch rate of 20.3 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. While two channel catfish were captured, no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	30	40	9.4	16.6	6.5-21.7
Bluehead Suckers	27	36	8.4	12.8	10.4-15.2
Roundtail Chub	8	11	2.5	6.2	4.1-9.8
Speckled Dace	5	7	1.6	3.3	2.8-3.9
Common Carp	2	3	.6	18.6	15.7-21.5
Channel Catfish	2	3	.6	17.3	14.4-20.3
Sand Shiner	1	1	.3	2.6	2.6

Table 2. Summary of fish sampled in the Dolores River from Mesa Creek to Roc Creek in 2010.

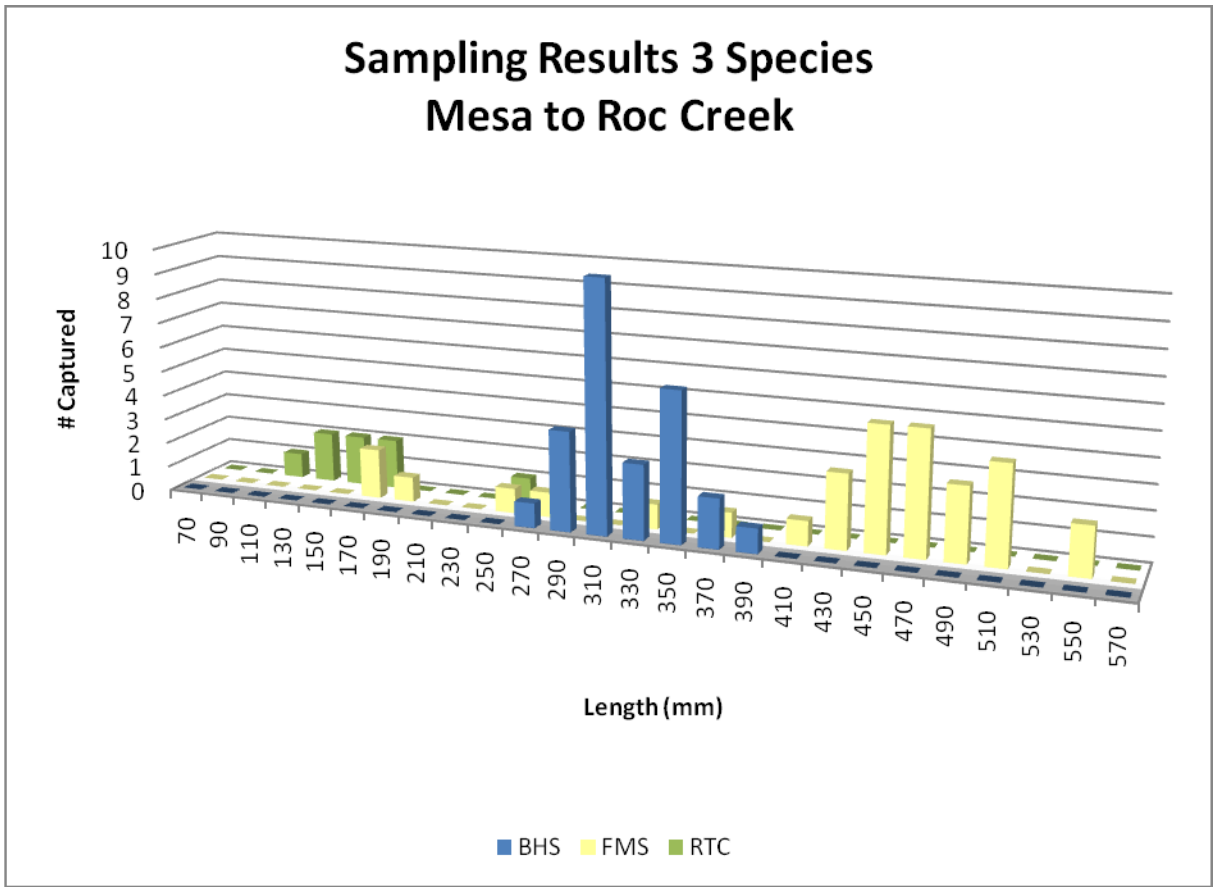


Figure 6. Length frequency histogram histogram the three species captured in the Mesa Creek to Roc Creek section of the Dolores River in 2010.

RIVER MILE 124 TO RIVER MILE 126 REACH:
The results of the survey are summarized in Table 3 and length frequency histograms for the three species are presented in Figures 7. Just over 80% of the fish sampled were native species of which 55% were three species. Bluehead suckers, flannelmouth suckers and roundtail chubs had a combined catch rate of 28 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. Only one channel catfish was captured, and no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	17	17	8.5	11.6	4.6-18
Bluehead Suckers	19	19	9.5	10.0	4.1-15.8
Roundtail Chub	20	20	10.0	5.2	3.1-7.4
Speckled Dace	26	25	13	3.3	2.2-4.0
Redside Shiner	1	1	0.5	2.6	2.6
Common Carp	4	4	2.0	21.8	20.6-22.8
Fathead Minnow	1	1	0.5	2.5	2.5
Red Shiner	10	10	5.0	3.0	2.6-3.3
Sand Shiner	3	3	1.5	2.6	2.4-2.8
Channel Catfish	1	1	0.5	11.7	11.7

Table 3. Summary of fish sampled in the Dolores River from RM 124 to RM 126 in 2010.

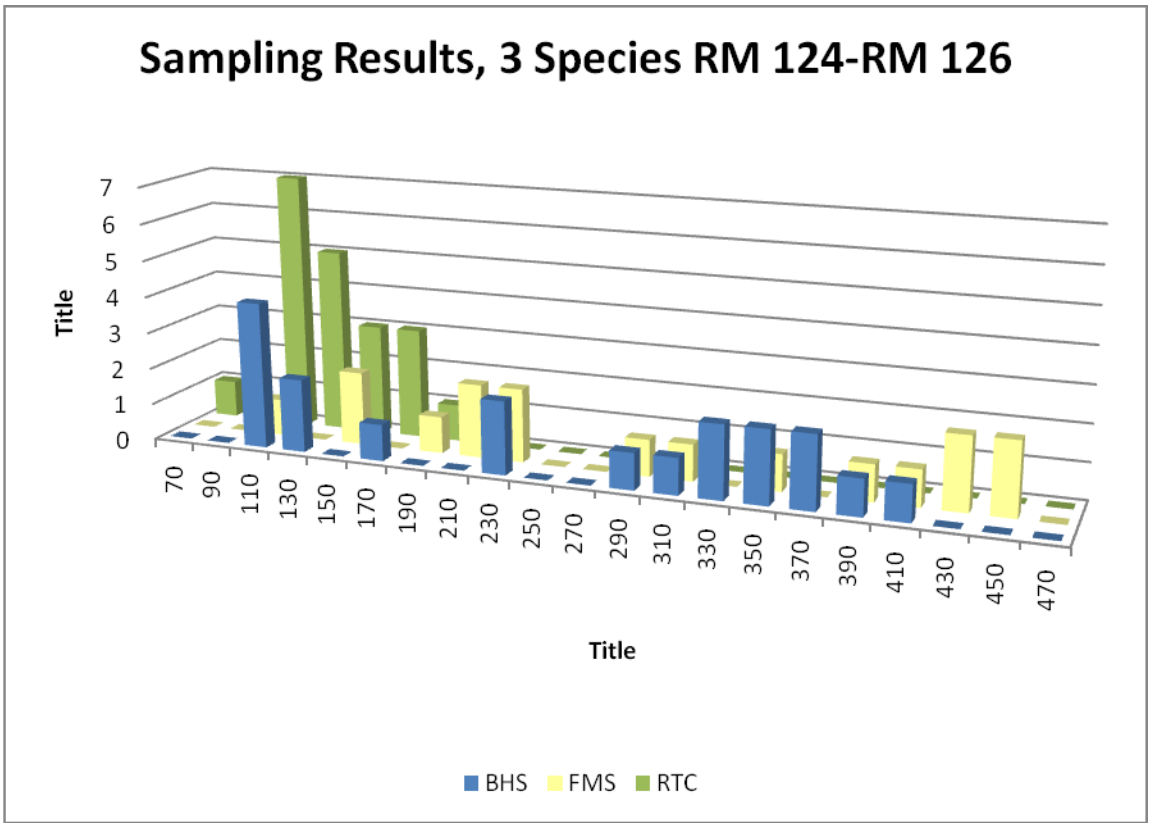


Figure 7. Length frequency histogram for the three species captured in the Dolores River from RM 124 to RM 126 in 2010.

BLUE CREEK TO SALT CREEK REACH:

The results for the final reach of the Dolores River sampled in 2010 are summarized in Table 4 and length frequency histograms for the three species are presented in Figure 8. Seventy six percent of the fish sampled were native species of which 58% were three species. Bluehead suckers, flannelmouth suckers and roundtail chubs had a combined catch rate of 13.2 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. Only two channel catfish was captured, and no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	22	44	7.9	16.9	3.8-22.2
Bluehead Suckers	6	12	2.1	14.0	11.7-17.9
Roundtail Chub	9	18	3.2	6.3	4.5-7.5
Speckled Dace	1	2	0.4	2.8	2.8
Common Carp	4	8	1.4	18.7	17.3-20.1
Red Shiner	3	6	1.1	3.1	2.8-3.5
Sand Shiner	1	2	0.4	2.6	2.6
Channel Catfish	2	4	0.7	16.5	10.9-22.0

Table 4. Summary of fish sampled in the Dolores River from Blue Creek to Salt Creek in 2010.

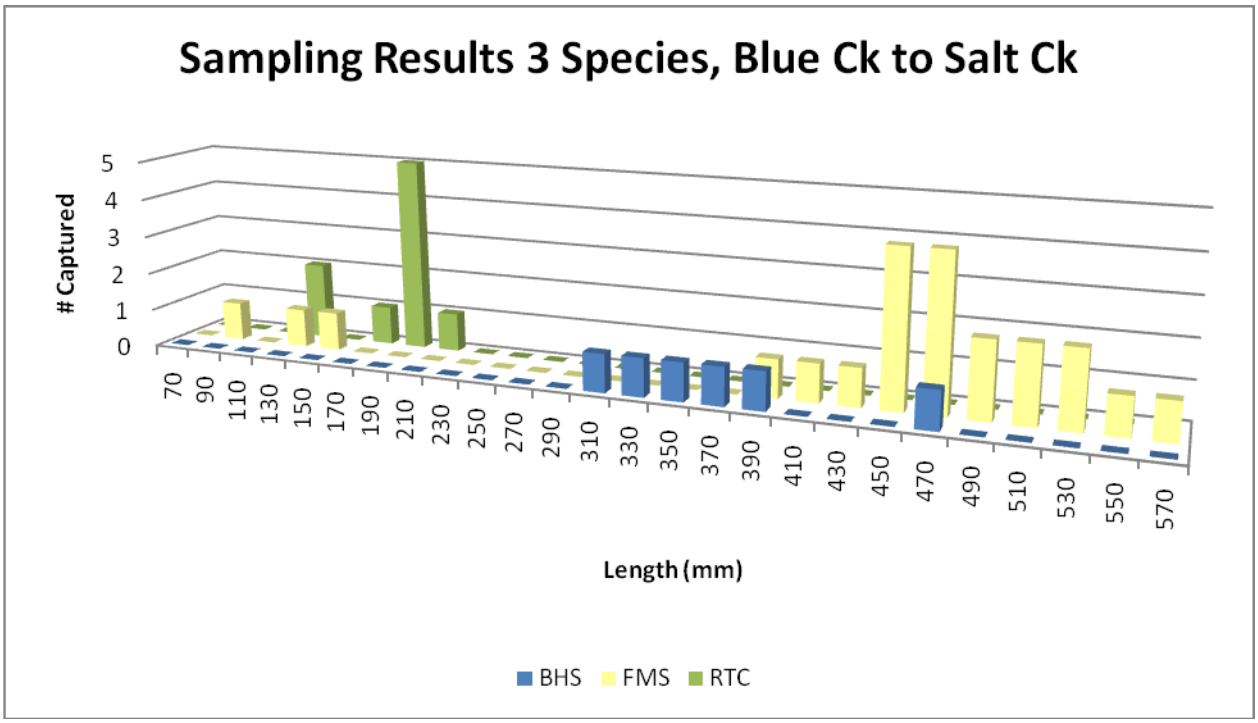


Figure 8. Length frequency histogram the three species captured in the Dolores River from Blue Creek to Salt Creek in 2010.

CONCLUSIONS

Above the confluence with the San Miguel River, the Dolores River contains a remnant population of native fish and should be managed as degraded water. The Dolores River above the confluence with the San Miguel River no longer has a natural peak flow hydrograph. Flows leaving the reservoir are significantly lower than those that enter the reservoir, impacting base flows in river below McPhee throughout the year (Figure 8). The hydrograph for the Dolores River above the confluence with the San Miguel no longer functions as it did historically. As a result, the decreased instream flows found in the Big Gypsum reach in late summer not only degrade the quality and quantity of native fish habitat but provide conditions more favorable to non-native fish like channel catfish and smallmouth bass. Two distinct age classes of smallmouth bass that were sampled in the Big Gypsum reach indicate that species is now reproducing in this portion of the river. The lower Dolores River below the confluence with the San Miguel still has a diverse native fish community and should continue to be managed as a native fish conservation water. The San Miguel now has a more natural hydrograph than the Dolores (Figures 9), and has a higher discharge than the Dolores above the confluence, even though it drains a much smaller watershed. Below the confluence of the San Miguel and Dolores Rivers the hydrograph is smaller than it was historically, but is much more natural. Native fish populations are healthy and contain multiple age classes.

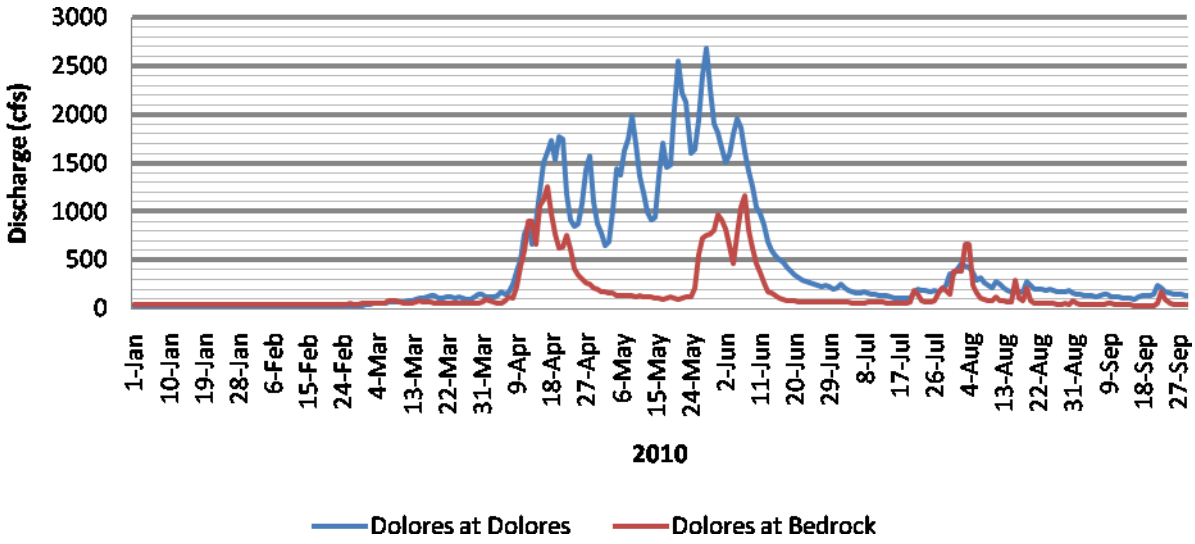


Figure 8 Discharge for the Dolores River above the confluence with the San Miguel River, 2010

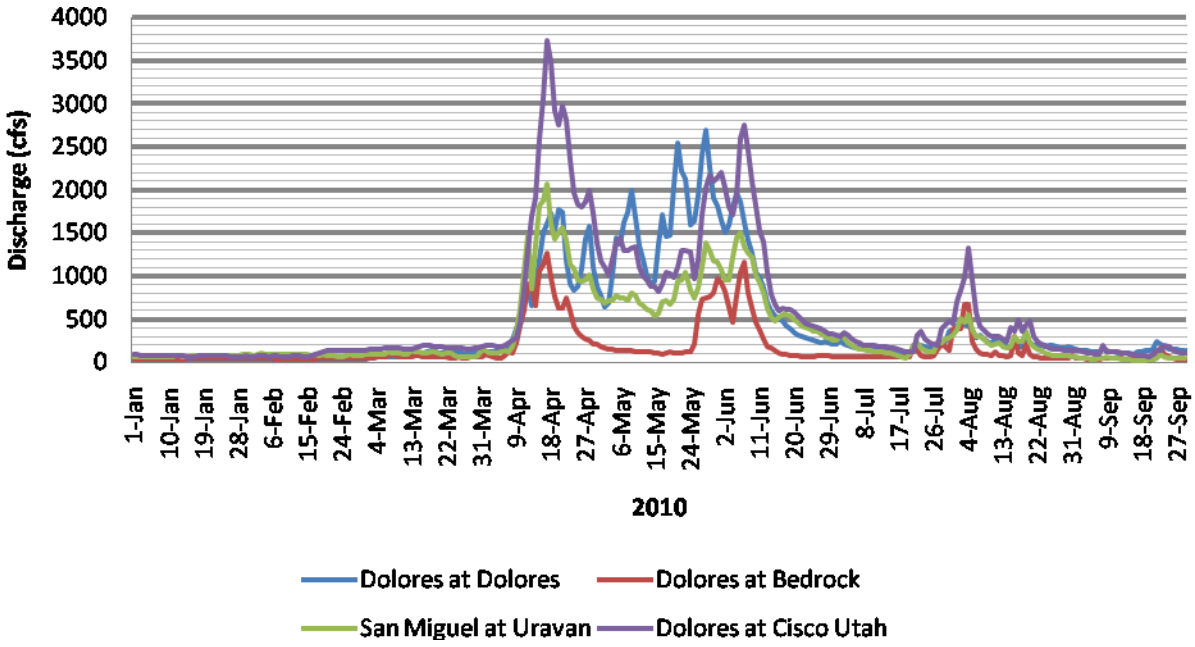


Figure 9 Discharge for the Dolores River and the San Miguel River, 2010

Flannelmouth suckers were distributed throughout the Dolores River in all reaches sampled in 2010 (Figure 10). However, higher numbers and larger age classes of fish were found downstream of the confluence with the San Miguel River as compared with the reach above the confluence. Smaller age classes of flannelmouth suckers were more concentrated in the Big Gypsum and reach between River Mile 124 and River Mile 126. Older Age classes were more common in the Blue Creek to Salt Creek reach and the Mesa Creek to Roc Creek reach.

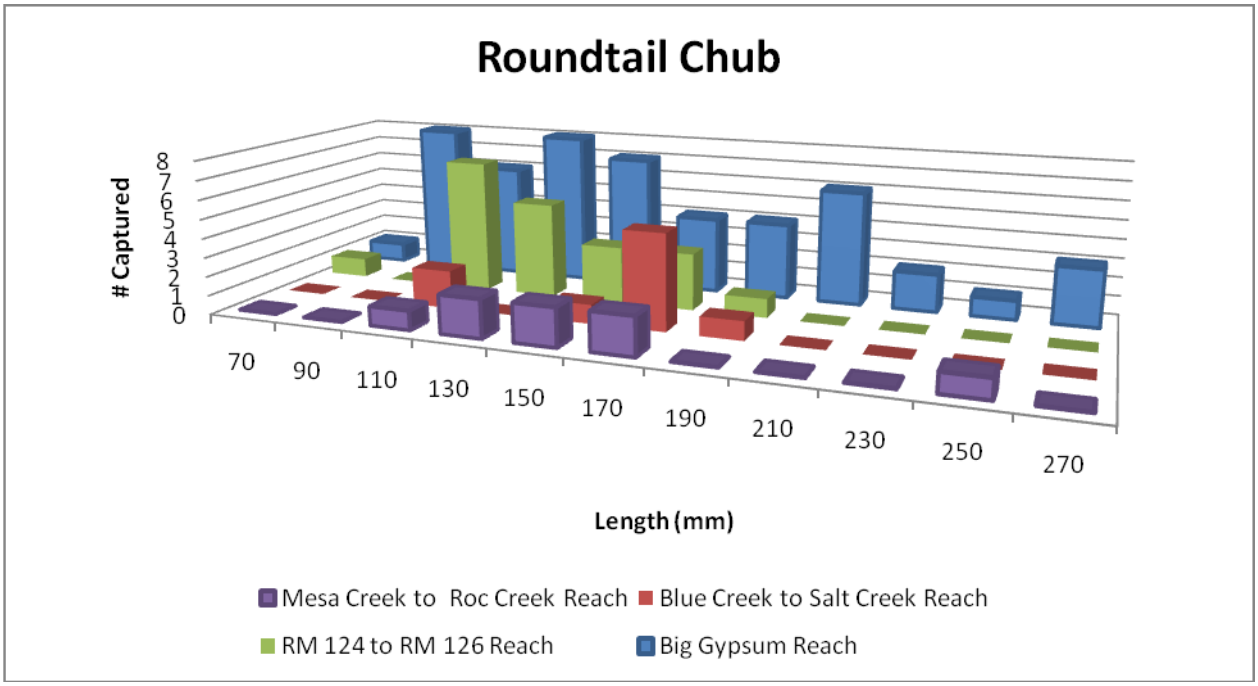


Figure 12 Roundtail Chub Pooled Length Frequency Distributions Dolores River, 2010

Some interesting trends appear from the figures above. First, roundtail chub are the most common member of the three species found in the degraded reach of the river, and was more common in that stretch than downstream. The Mesa Creek to Roc Creek section appears to hold the more and larger suckers of both species than the other reaches sampled, but at the same time it holds the least number of chubs. The Blue Creek to Salt Creek reach holds significantly fewer bluehead suckers and round tail chubs than the other two downstream reaches, but a high number of older age class flannelmouth suckers. A detailed habitat assessment of these reaches may help sort out these differences and should be conducted in the near future.

Non native fish that pose a threat to native species, such as smallmouth bass, green sunfish and channel catfish are greatly reduced in numbers or absent altogether below the confluence with the San Miguel. Their numbers continue to decline the further downstream one samples. Management efforts should be taken to prevent any further introductions of nonnative fish and to minimize the spread of channel catfish and smallmouth bass in the Dolores River. Efforts should be taken to enhance the flow regime in the lower Dolores including spring peak flows and especially base flows. Tributaries that could be used by native fish seasonally for spawning should also be evaluated for instream flow protection.

MANAGEMENT RECCOMENDATION SUMMARY

1. Management: Continue to manage the reaches below the confluence as a category 204 (Native Fish Conservation Stream), and the reaches above the confluence as category 800 Degraded Waters as well as trying to restore it to a category 204 Native Fish Conservation Stream.
2. Stocking: No supplemental stocking necessary at this time.
3. Regulations: Maintain current regulation that removes bag and possession limit on channel catfish and other non-native warmwater fish.
4. Habitat Improvement: Work to conserve native fish habitat by enhancing existing peak and base flows with water from McPhee. Improve native fish habitat by pursuing water leasing and/or purchasing opportunities from upstream senior water right holders to supplement late summer base flows.
5. Access/ Facilities: None needed.
6. Information and Education: Work with local water users and watershed coalition to educate stakeholders on the importance of these native fish populations to the whole Dolores River basin.

Fish Sampling Report

Paul Jones
Aquatic Biologist
Southwest Region

Water: Dolores River
Reaches: Mesa Creek to Roc Creek (RM 114.3-RM117.5), River Mile 124 to River Mile 126, Blue Creek to Salt Creek (RM 127.8-RM 130.6)
Dates: 6/15/2010 - 6/16/2010
Gear: 14 ft. electrofishing raft with booms and Smith Root 2.5 GPP
Drainage: Dolores
Water Codes: 39760

OBJECTIVE

The Dolores River was sampled with single pass CPUE electrofishing to monitor native fish populations on three separate reaches. The reaches sampled were the Mesa Creek to Roc Creek reach, River Mile 124 to River Mile 126 reach, and the Blue Creek to Salt Creek Reach (Figure 1). .

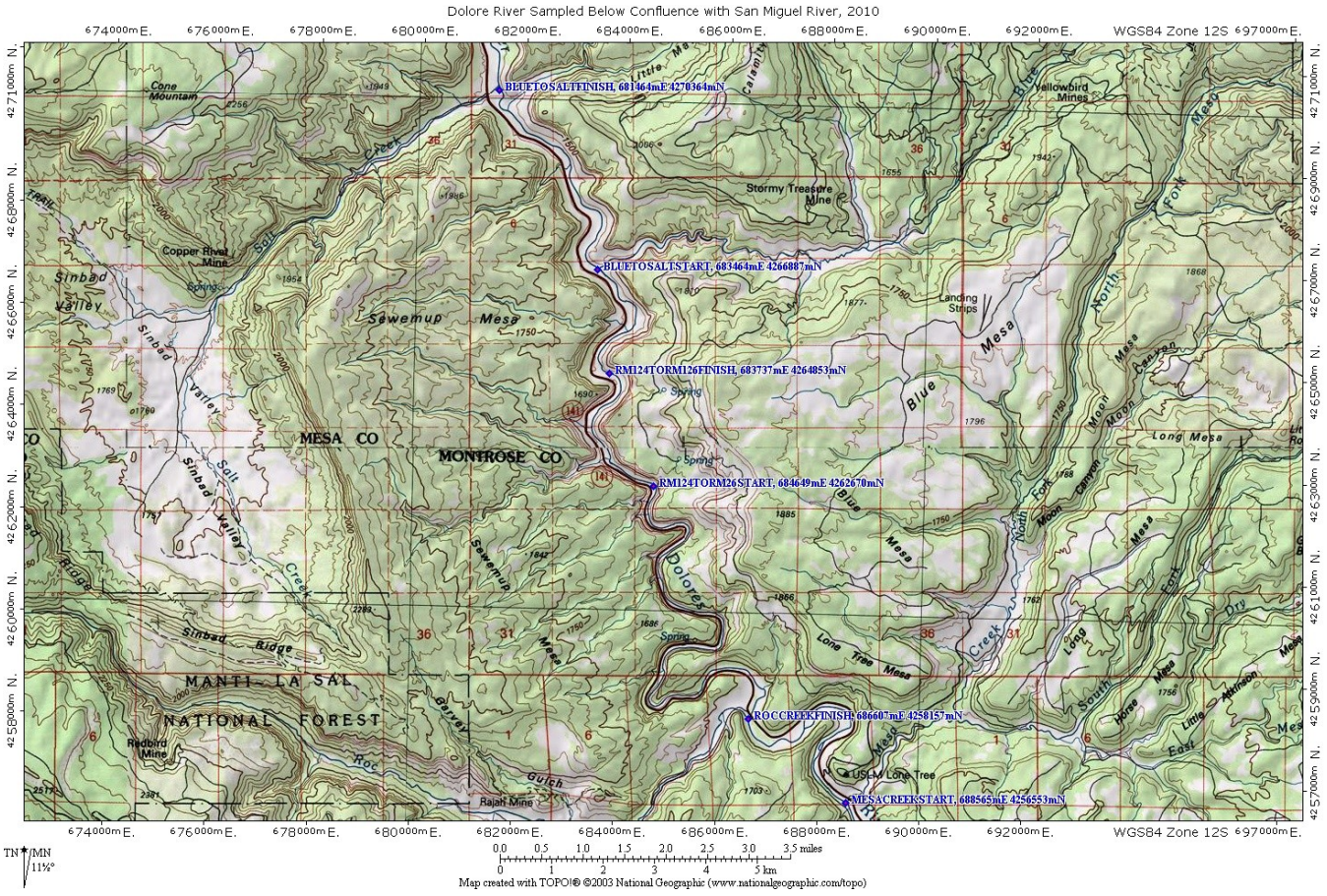


Figure 1. Dolores River Reaches Sampled in 2010

The Mesa Creek to Roc Creek sections of the Dolores River was sampled on June 15th with single pass CPUE from the mouth of Mesa Creek to the mouth of Roc Creek (Figure 2). Total pooled sampling distance was 3.2 miles.

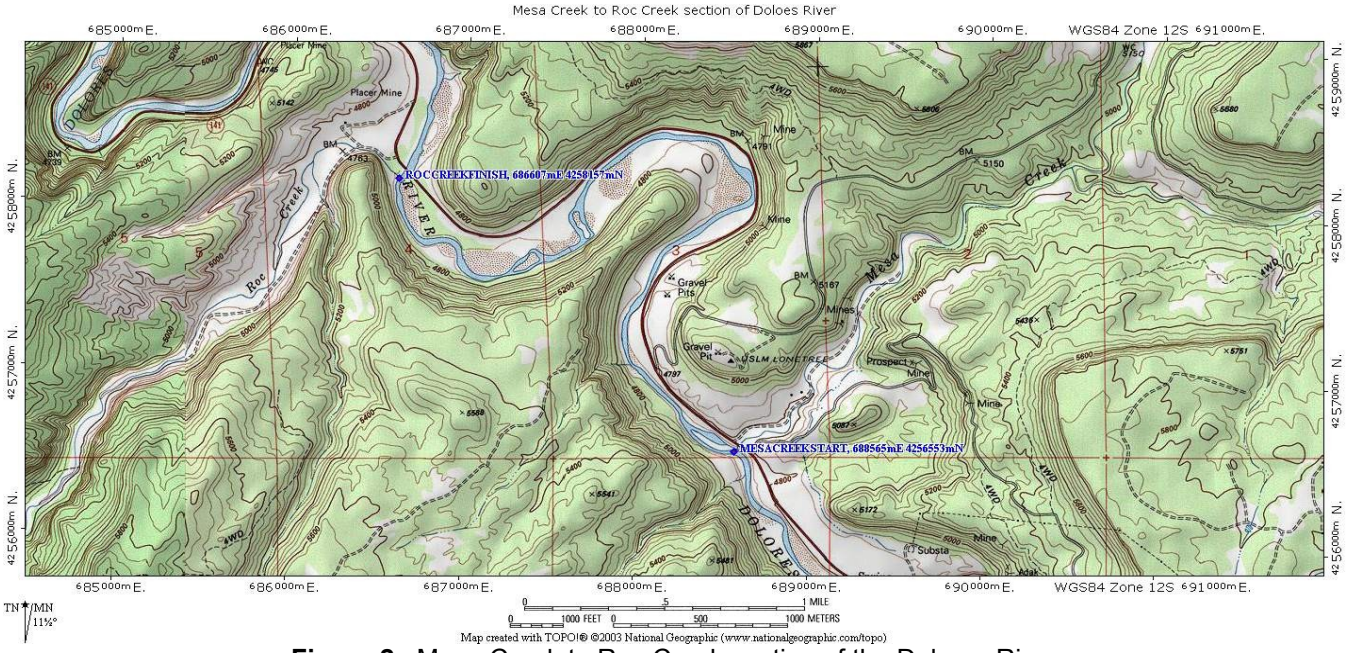


Figure 2. Mesa Creek to Roc Creek section of the Dolores River

The next reach of Dolores River that was sampled ran from the top of the island at RM 124 to the bottom of the island at RM 126 (Figure 3), and was sampled on the 16th of June. Total pooled sampling distance was 2 miles.

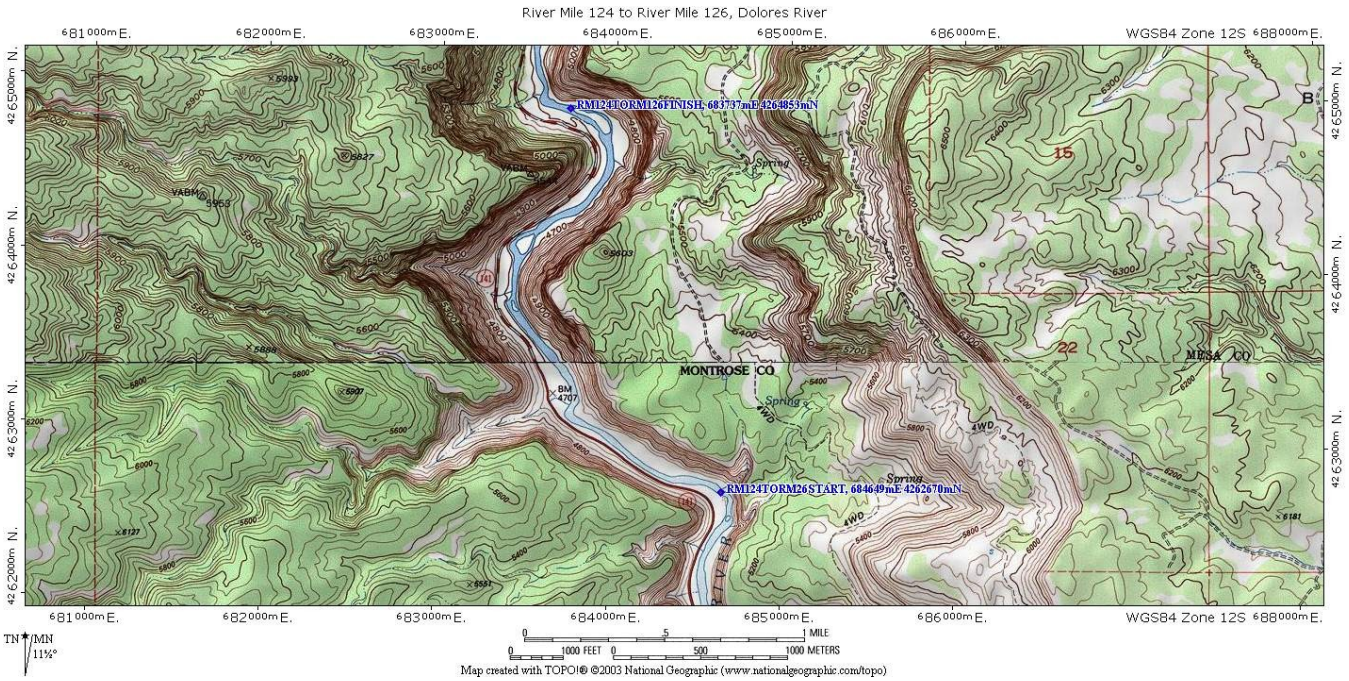


Figure 3. Dolores River from RM 124 to RM 126

The final reach of the Dolores River was sampled on the afternoon of June Sixteen, and it ran from the mouth of Blue Creek to the top of the rapids at the mouth of Salt Creek (Figure 4). Total pooled sampling distance was 2.8 miles.

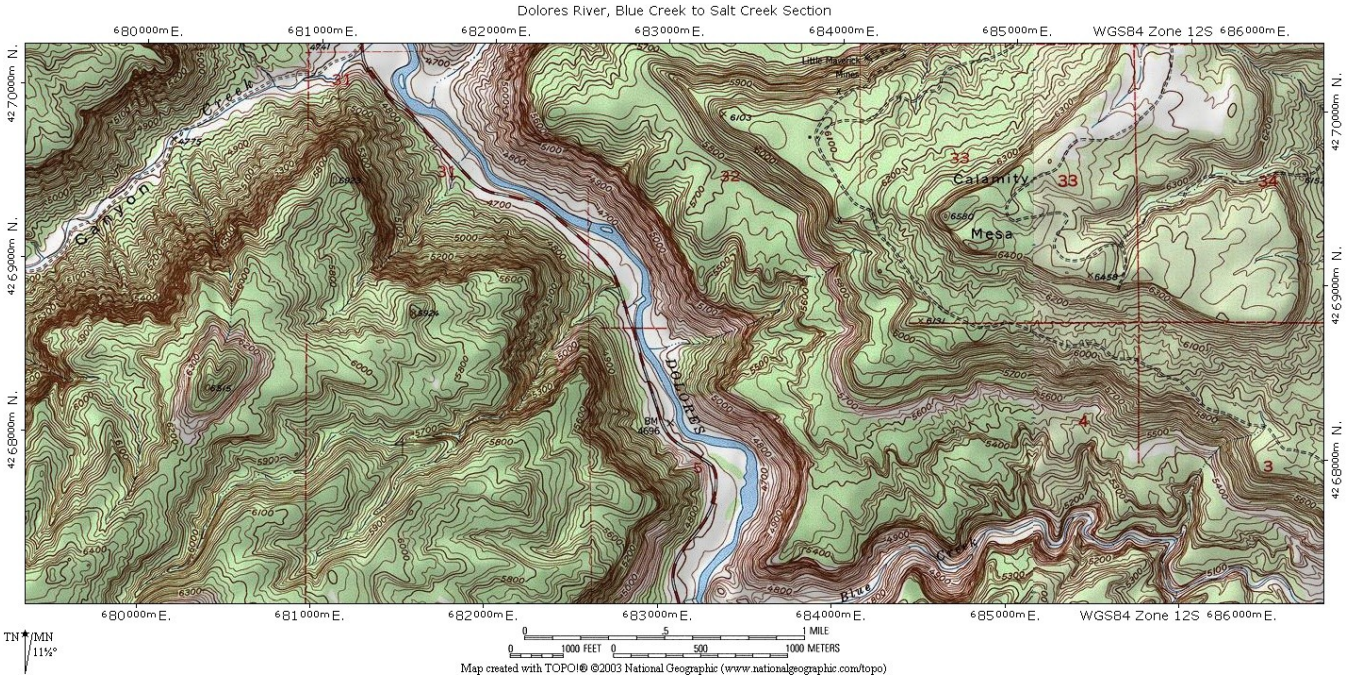


Figure 4. Dolores River from Blue Creek to Salt Creek

RESULTS

MESA TO ROC CREEK REACH:

The results of the Mesa Creek to Roc Creek survey are summarized in Table 1 and length frequency histogram for the three species are presented in Figure 5. The Level II report is located in Appendix A. Ninety three percent of the fish sampled were native species, with 87 percent being three species, which had a combined catch rate of 20.3 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. While two channel catfish were captured, no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	30	40	9.4	16.6	6.5-21.7
Bluehead Suckers	27	36	8.4	12.8	10.4-15.2
Roundtail Chub	8	11	2.5	6.2	4.1-9.8
Speckled Dace	5	7	1.6	3.3	2.8-3.9
Common Carp	2	3	.6	18.6	15.7-21.5
Channel Catfish	2	3	.6	17.3	14.4-20.3
Sand Shiner	1	1	.3	2.6	2.6

Table 2. Summary of fish sampled in the Dolores River from Mesa Creek to Roc Creek in 2010.

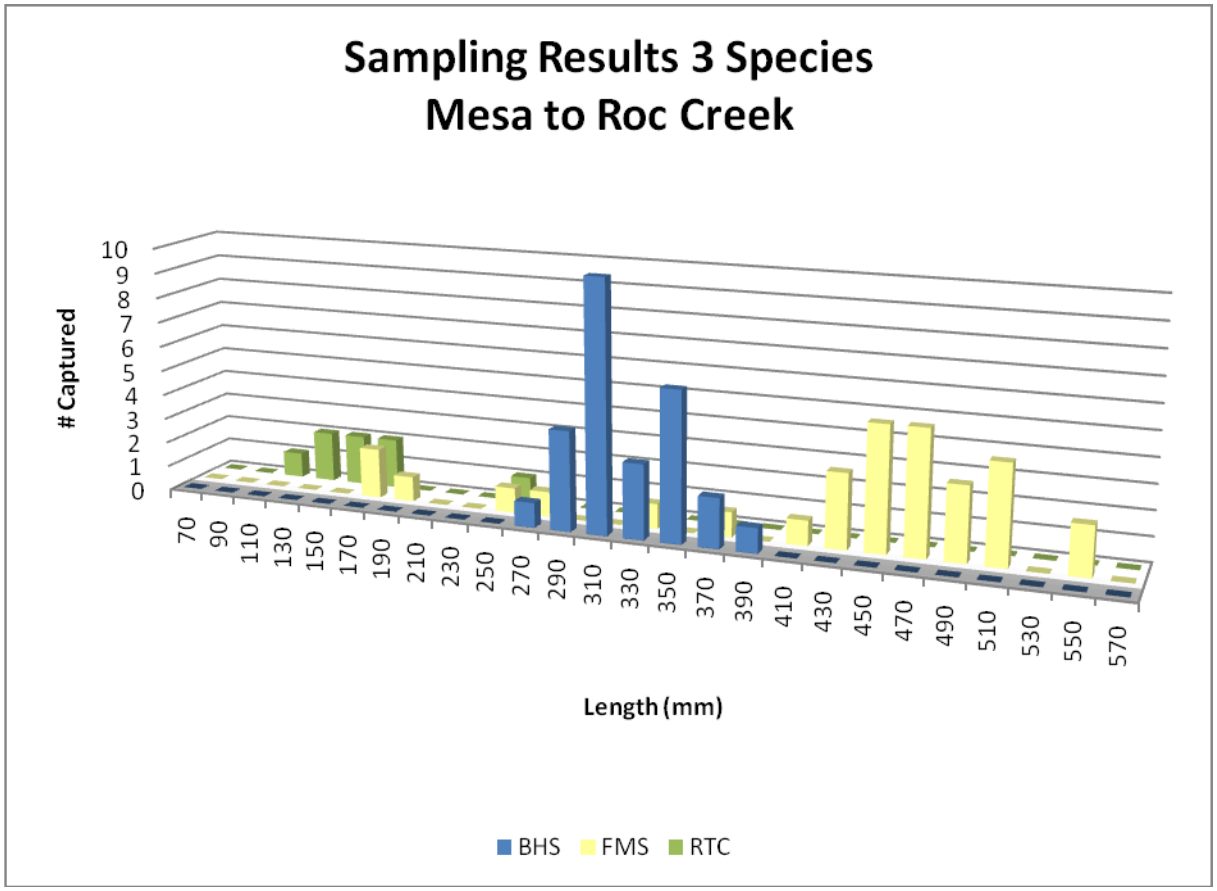


Figure 5. Length frequency histogram of Three Species captured in the Mesa Creek to Roc Creek section of the Dolores River in 2010.

RIVER MILE 124 TO RIVER MILE 126 REACH:
The results of the survey are summarized in Table 2 and length frequency histogram for the three species is presented in Figure 6. Appendix B contains the Level II report. Just over 80% of the fish sampled were native species of which 55% were three species. Bluehead suckers, flannelmouth suckers and roundtail chubs had a combined catch rate of 28 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. Only one channel catfish was captured, and no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	17	17	8.5	11.6	4.6-18
Bluehead Suckers	19	19	9.5	10.0	4.1-15.8
Roundtail Chub	20	20	10.0	5.2	3.1-7.4
Speckled Dace	26	25	13	3.3	2.2-4.0
Redside Shiner	1	1	0.5	2.6	2.6
Common Carp	4	4	2.0	21.8	20.6-22.8
Fathead Minnow	1	1	0.5	2.5	2.5
Red Shiner	10	10	5.0	3.0	2.6-3.3
Sand Shiner	3	3	1.5	2.6	2.4-2.8
Channel Catfish	1	1	0.5	11.7	11.7

Table 2. Summary of fish sampled in the Dolores River from RM 124 to RM 126 in 2010.

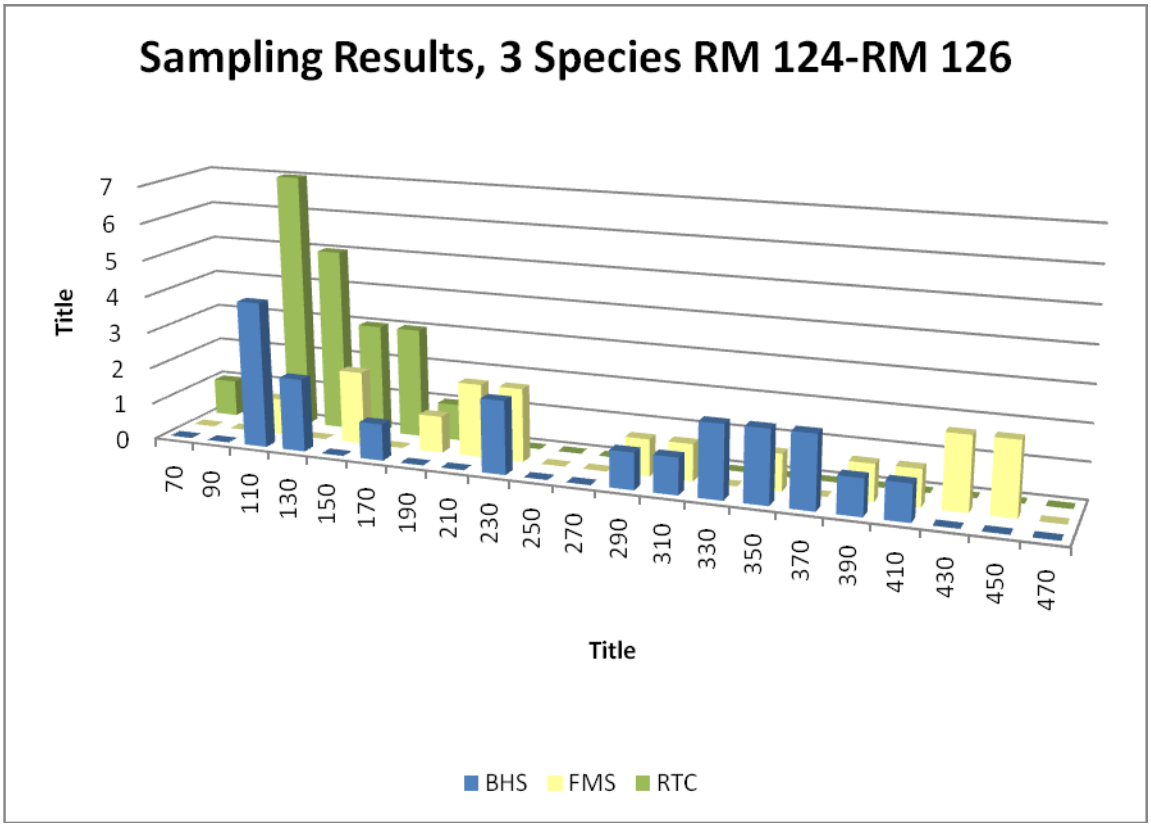


Figure 6. Length frequency histogram of Three Species captured in the RM 124-RM 126 section of the Dolores River in 2010.

BLUE CREEK TO SALT CREEK REACH:
The results for the final reach of the Dolores River sampled in 2010 are summarized in Table 3 and the length frequency histogram for the three species is presented in Figure 7. The Level II report can be found in Appendix C. Seventy six percent of the fish sampled were native species of which 58% were three species. Bluehead suckers, flannelmouth suckers and roundtail chubs had a combined catch rate of 13.2 fish per mile. Bluehead suckers, flannel mouth suckers and round tail chubs showed several distinct age classes. Only two channel catfish was captured, and no smallmouth bass or sunfish were captured during the survey.

Species	# Caught	% Catch	# Caught Per Mile	Mean Length (in.)	Length Range (in.)
Flannelmouth Suckers	22	44	7.9	16.9	3.8-22.2
Bluehead Suckers	6	12	2.1	14.0	11.7-17.9
Roundtail Chub	9	18	3.2	6.3	4.5-7.5
Speckled Dace	1	2	0.4	2.8	2.8
Common Carp	4	8	1.4	18.7	17.3-20.1
Red Shiner	3	6	1.1	3.1	2.8-3.5
Sand Shiner	1	2	0.4	2.6	2.6
Channel Catfish	2	4	0.7	16.5	10.9-22.0

Table 3. Summary of fish sampled in the Dolores River from Blue Creek to Salt Creek in 2010.

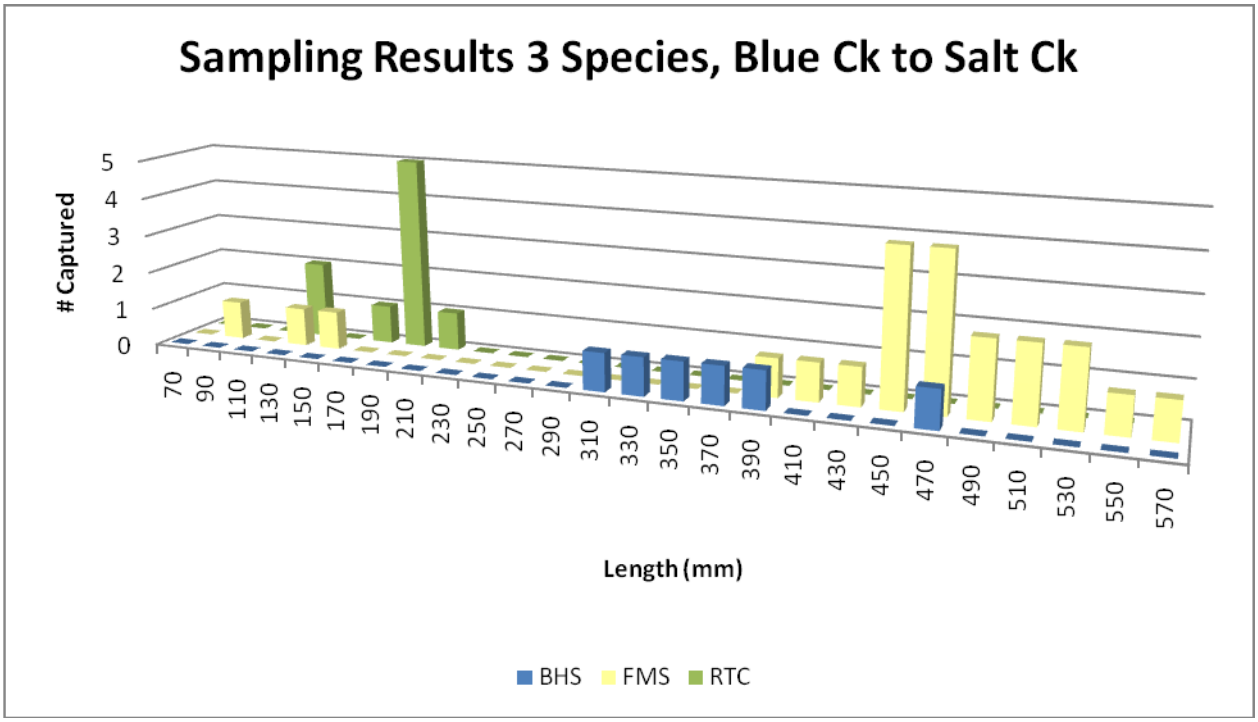


Figure 7. Length frequency histogram of Three Species captured in the Blue Creek to Salt Creek section of the Dolores River in 2010.

CONCLUSIONS

Flows in the Dolores River below the confluence with the San Miguel River have a more natural hydrograph than those above the confluence, which have been impacted by McPhee Reservoir (Figure 8). Flows begin to return to a more natural hydrograph after the San Miguel joins the Dolores River. Native fish populations also begin to

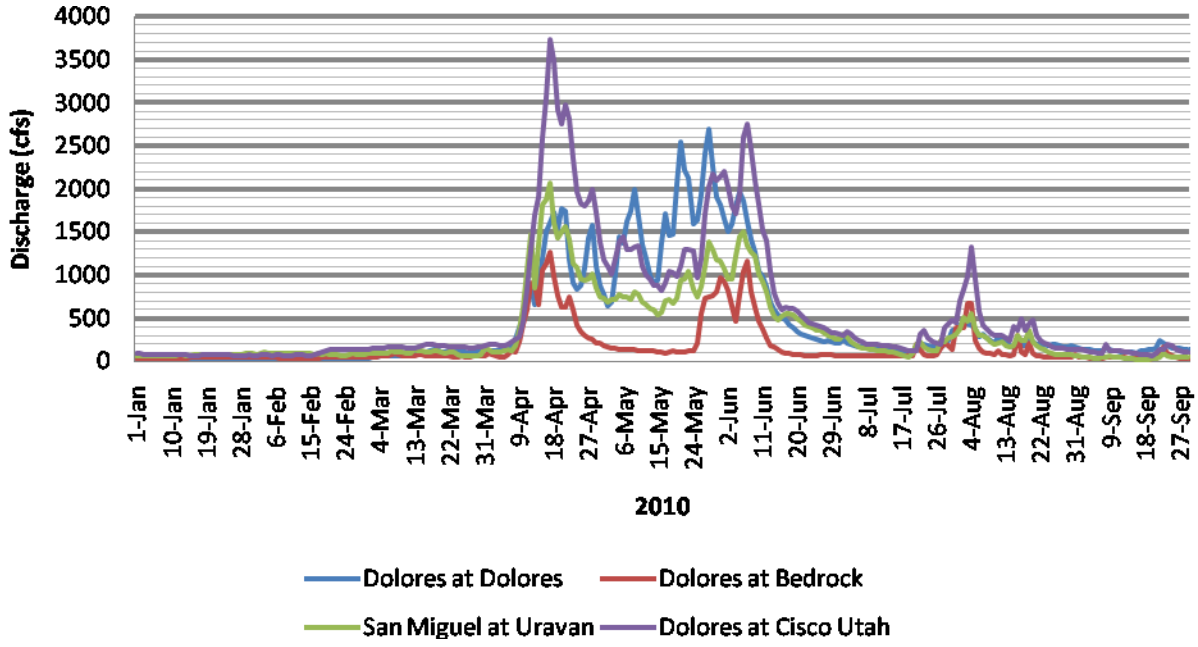


Figure 8. Discharge for the Dolores River and the San Miguel River, 2010

rebound below the confluence as well. Bluehead suckers were found in all three reaches sampled below the confluence (Figure 9). While numbers and the distribution of age classes declined as we sampled downstream, they were present in all three reaches.

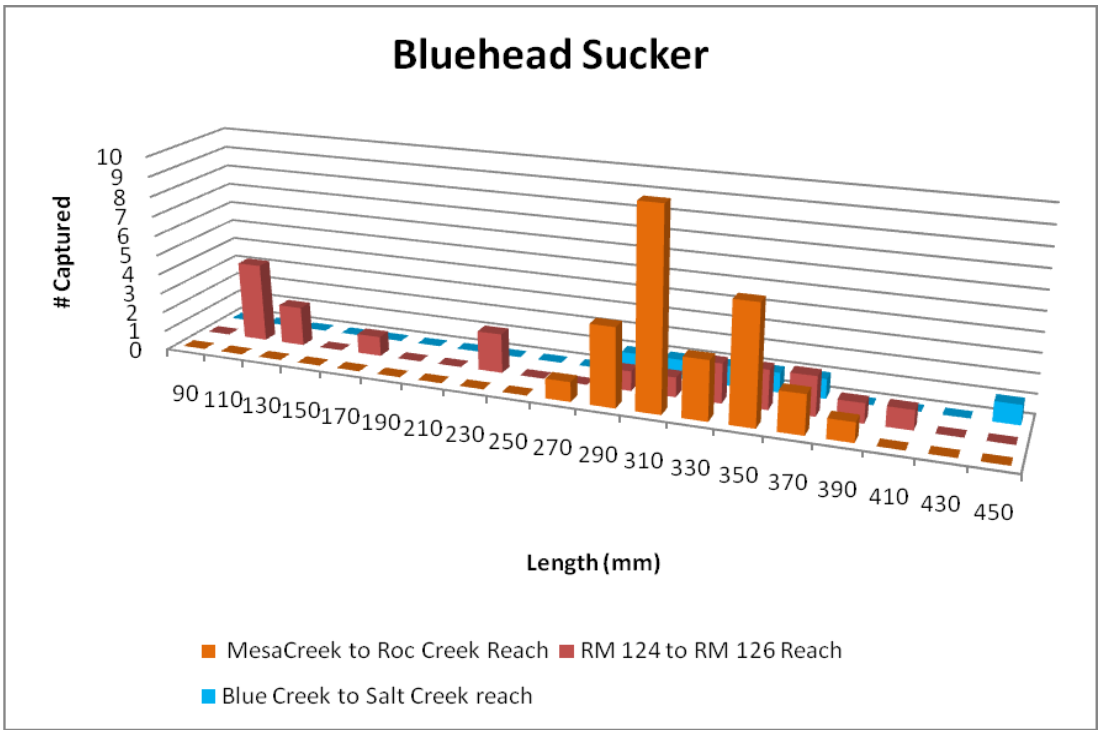


Figure 9. Bluehead Sucker Length Frequency in the Lower Dolores Below the San Miguel River

Flannelmouth Suckers were distributed throughout the Dolores River in all reaches sampled in 2010 (Figure 10). Smaller age classes of flannelmouth suckers were more concentrated in the reach between River Mile 124 and River Mile 126 than the other reaches. Older Age classes were more common in the Blue Creek to Salt Creek reach and the Mesa Creek to Roc Creek reaches.

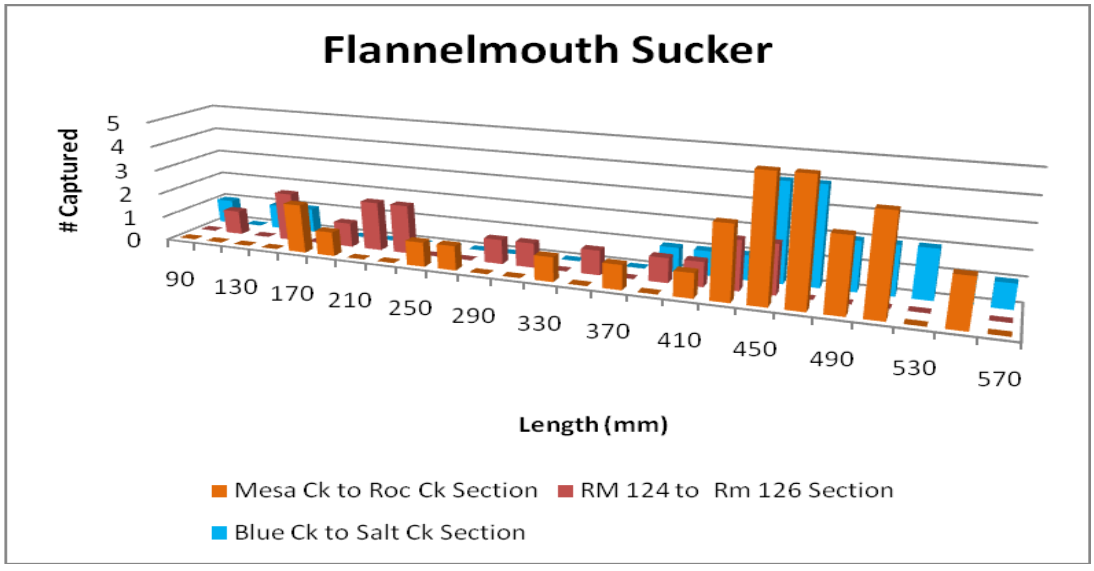


Figure 10. Flannelmouth Sucker Length Frequency in the Lower Dolores Below the San Miguel River

Roundtail chub were found in all three reaches and were of similar size in all three reaches(Figure 10). They were most numerous in the between River Miles 124 and 126. The Mesa Creek reach had the fewest number of roundtail chubs of the reaches sampled.

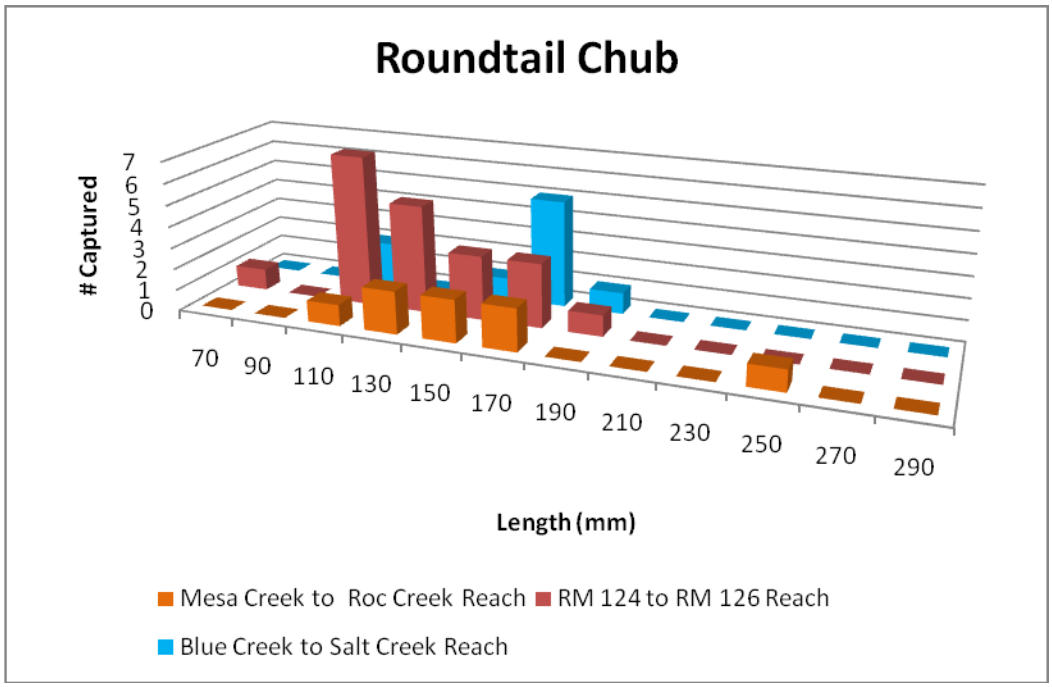


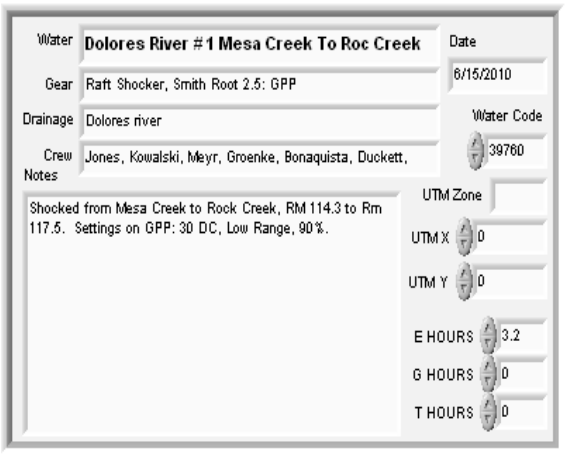
Figure 10. Roundtail Chub Length Frequency in the Lower Dolores Below the San Miguel River

Some interesting trends appear from the figures above. The Mesa Creek to Roc Creek section appears to hold the more and larger suckers of both species than the other reaches sampled, but at the same time it holds the least number of chubs. The Blue Creek to Salt Creek reach holds significantly fewer bluehead suckers and roundtail chubs than the other two downstream reaches, but a high number of older age class flannelmouth suckers. A detailed habitat assessment of these reaches may help sort out these differences and should be conducted in the near future.

Non native fish that pose a threat to native species, such as smallmouth bass, green sunfish and channel catfish are greatly reduced in numbers or absent altogether below the confluence with the San Miguel. Their numbers continue to decline the further downstream one samples. Management efforts should be taken to prevent any further introductions of nonnative fish and to minimize the spread of channel catfish and smallmouth bass in the Dolores River. Efforts should be taken to enhance the flow regime in the lower Dolores including spring peak flows and especially base flows. Tributaries that could be used by native fish seasonally for spawning should also be evaluated for instream flow protection.

MANAGEMENT RECCOMENDATION SUMMARY

1. Management: Continue to manage the reaches below the confluence as a category 204 (Native Fish Conservation Stream.
2. Stocking: No supplemental stocking necessary at this time.
3. Regulations: Maintain current regulation that removes bag and possession limit on channel catfish and other non-native warmwater fish.
4. Habitat Improvement: Work to conserve native fish habitat by enhancing existing peak and base flows with water from McPhee. Improve native fish habitat by pursuing water leasing and/or purchasing opportunities from upstream senior water right holders to supplement late summer base flows.
5. Access/ Facilities: None needed.
6. Information and Education: Work with local water users and watershed coalition to educate stakeholders on the importance of these native fish populations to the whole Dolores River basin.



LEVEL 2 - LAKE SURVEY

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Mean Ln (in)	Ln Range (in)	Mean Wt (lbs)	Wt Range (lbs)	E CPUE	G CPUE	T CPUE	PSD
BHS	27	36	12.8	10.4-15.2	0.00	0.0-0.0	8.4	NaN	NaN	100
CCF	2	3	17.3	14.4-20.3	0.00	0.0-0.0	0.6	NaN	NaN	50
CPP	2	3	18.6	15.7-21.5	0.00	0.0-0.0	0.6	NaN	NaN	50
FMS	30	40	16.6	6.5-21.7	0.00	0.0-0.0	9.4	NaN	NaN	100
RTC	8	11	6.2	4.1-9.8	0.00	0.0-0.0	2.5	NaN	NaN	100
SAH	1	1	2.6	2.6-2.6	0.00	0.0-0.0	0.3	NaN	NaN	100
SPD	5	7	3.3	2.8-3.9	0.00	0.0-0.0	1.6	NaN	NaN	100

LENGTH FREQUENCY RECORD (cm)

	Species	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	33-36	36-39	39-42	42-45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81-84	84-87	87-90	90-93	93-96	>96
1	BHS									1	3	13	7	3																				
2	CCF													1					1															
3	CPP														1					1														
4	FMS						1	2		1	1	1		1	1	5	8	4	3	2														
5	RTC				1	2	4			1																								
6	SAH			1																														
7	SPD			3	2																													
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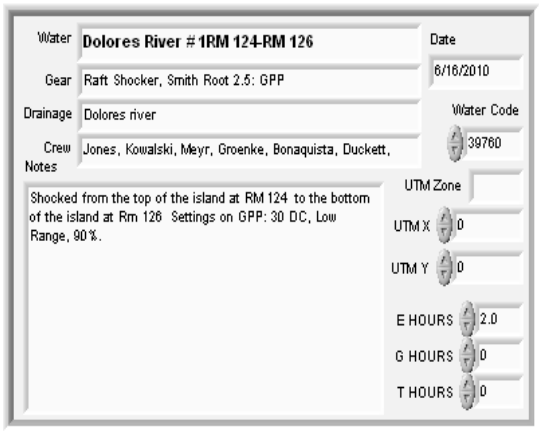
Water: Dolores River # 1 Mesa Creek To Roc Creek
Date: 6/15/2010
Gear: Raft Shocker, Smith Root 2.5: GPP
Drainage: Dolores river
Water Code: 39760
UTM Zone:
UTM X: 0 m
UTM Y: 0 m
E Hours = 3.2
G Hours = 0
T Hours = 0
Crew: Jones, Kowalski, Meyr, Groenke, Bonaquista, Duckett, Delpocalo
Notes: Shocked from Mesa Creek to Rock Creek, RM 114.3 to Rm 117.5. Settings on GPP: 30 DC, Low Range, 90%.

Species	Count	Length (mm)	Weight (g)	Status	Mark	TagID
FMS	1	545	E1			
FMS	1	441	E1			
FMS	1	476	E1			
RTC	1	250	E1			
BHS	1	315	E1			
BHS	1	310	E1			
BHS	1	315	E1			
BHS	1	362	E1			
BHS	1	306	E1			

BHS	1	320	E1	
SPD	1	80	E1	
SPD	1	91	E1	
FMS	1	473	E1	
BHS	1	300	E1	
BHS	1	309	E1	RIPE MALE
BHS	1	310	E1	
SPD	1	72	E1	
RTC	1	155	E1	
FMS	1	495	E1	
FMS	1	504	E1	
FMS	1	411	E1	
FMS	1	430	E1	
CPP	1	545	E1	
BHS	1	320	E1	
FMS	1	465	E1	
CCF	1	365	E1	
RTC	1	170	E1	
FMS	1	165	E1	
RTC	1	105	E1	
FMS	1	455	E1	
FMS	1	427	E1	
SSH	1	66	E1	
FMS	1	463	E1	
BHS	1	358	E1	
FMS	1	512	E1	
CCF	1	515	E1	
FMS	1	520	E1	
FMS	1	486	E1	
FMS	1	550	E1	
BHS	1	387	E1	
FMS	1	422	E1	
BHS	1	265	E1	
FMS	1	280	E1	
RTC	1	167	E1	
RTC	1	135	E1	
SPD	1	81	E1	
CPP	1	400	E1	
FMS	1	465	E1	
FMS	1	451	E1	
BHS	1	286	E1	
BHS	1	326	E1	
BHS	1	356	E1	
FMS	1	321	E1	
FMS	1	186	E1	
FMS	1	448	E1	
BHS	1	281	E1	
FMS	1	180	E1	
FMS	1	512	E1	
FMS	1	496	E1	
FMS	1	456	E1	
FMS	1	367	E1	
BHS	1	318	E1	
RTC	1	122	E1	
SPD	1	98	E1	
BHS	1	329	E1	
BHS	1	354	E1	
BHS	1	353	E1	

BHS	1	304	E1
BHS	1	368	E1
BHS	1	351	E1
RTC	1	152	E1
FMS	1	255	E1
BHS	1	353	E1
BHS	1	330	E1
BHS	1	298	E1

Appendix B



LEVEL 2 - LAKE SURVEY

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Mean Ln (in)	Ln Range (in)	Mean Wt (lbs)	Wt Range (lbs)	E CPUE	G CPUE	T CPUE	PSD
BHS	19	19	10.0	4.1-15.8	0.00	0.0-0.0	9.5	NaN	NaN	100
CCF	1	1	11.7	11.7-11.7	0.00	0.0-0.0	0.5	NaN	NaN	NaN
CPP	4	4	21.8	20.6-22.8	0.00	0.0-0.0	2.0	NaN	NaN	100
FMS	17	17	11.6	4.6-18.0	0.00	0.0-0.0	8.5	NaN	NaN	100
FMW	1	1	2.5	2.5-2.5	0.00	0.0-0.0	0.5	NaN	NaN	100
RDS	10	10	3.0	2.6-3.3	0.00	0.0-0.0	5.0	NaN	NaN	100
RSS	1	1	2.6	2.6-2.6	0.00	0.0-0.0	0.5	NaN	NaN	100
RTC	20	20	5.2	3.1-7.4	0.00	0.0-0.0	10.0	NaN	NaN	100
SAH	3	3	2.6	2.4-2.8	0.00	0.0-0.0	1.5	NaN	NaN	100
SPD	26	25	3.3	2.2-4.0	0.00	0.0-0.0	13.0	NaN	NaN	100

LENGTH FREQUENCY RECORD (cm)

	Species	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	33-36	36-39	39-42	42-45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81-84	84-87	87-90	90-93	93-96	>96
1	BHS				4	2	1		2		1	2	3	2	2																			
2	CCF										1																							
3	CPP																		1	2	1													
4	FMS				1	1	1	2	3		1	1	1	1	1	3	1																	
5	FMW			1																														
6	RDS			10																														
7	RSS			1																														
8	RTC			1	6	7	5	1																										
9	SAH			3																														
10	SPD		2	19	5																													
11																																		
12																																		
13																																		
14																																		

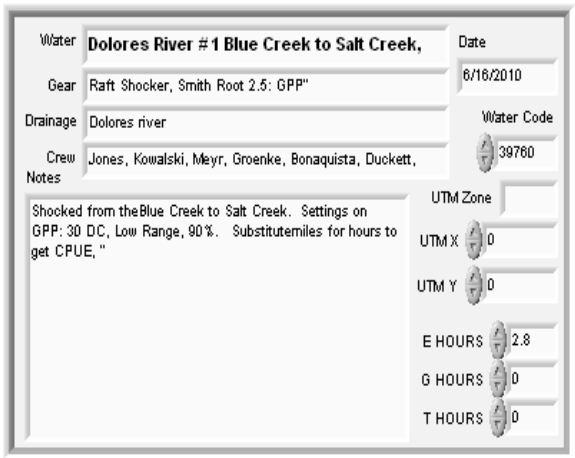
Water: Dolores River # 1RM 124-RM 126
Date: 6/16/2010
Gear: Raft Shocker, Smith Root 2.5: GPP
Drainage: Dolores river
Water Code: 39760
UTM Zone:
UTM X: 0 m
UTM Y: 0 m
E Hours = 2.0
G Hours = 0
T Hours = 0
Crew: Jones, Kowalski, Meyr, Groenke, Bonaquista, Duckett, Delpocalo, Jones and Jones
Notes: Shocked from the top of the island at RM 124 to the bottom of the island at Rm 126 Settings on GPP: 30 DC, Low Range, 90%.

Species	Count	Length (mm)	Weight (g)	Status	Mark	TagID
CPP	1	580	E2			
BHS	1	342	E2			
CPP	1	565	E2			
FMS	1	404	E2			
RTC	1	120	E2			
CPP	1	545	E2			
RTC	1	189	E2			
SPD	1	89	E2			

FMS	1	440	E2
BHS	1	394	E2
RSS	1	67	E2
FMS	1	117	E2
RTC	1	128	E2
SPD	1	83	E2
SAH	1	70	E2
RTC	1	163	E2
FMS	1	195	E2
FMS	1	216	E2
RTC	1	153	E2
RTC	1	158	E2
RTC	1	133	E2
RTC	1	130	E2
RTC	1	105	E2
RTC	1	147	E2
RTC	1	170	E2
BHS	1	233	E2
RTC	1	126	E2
RDS	1	76	E2
RTC	1	125	E2
RDS	1	79	E2
RDS	1	85	E2
SAH	1	70	E2
RTC	1	103	E2
RDS	1	71	E2
RDS	1	75	E2
RTC	1	116	E2
SPD	1	83	E2
SPD	1	78	E2
FMW	1	64	E2
FMS	1	145	E2
CPP	1	522	E2
BHS	1	363	E2
RDS	1	80	E2
FMS	1	387	E2
SPD	1	83	E2
RTC	1	102	E2
RTC	1	105	E2
RTC	1	78	E2
SPD	1	86	E2
RDS	1	71	E2
SPD	1	102	E2
SPD	1	100	E2
RDS	1	75	E2
SPD	1	73	E2
SPD	1	82	E2
SPD	1	75	E2
RDS	1	73	E2
FMS	1	430	E2
FMS	1	298	E2
FMS	1	456	E2
FMS	1	447	E2
BHS	1	117	E2
BHS	1	108	E2
BHS	1	132	E2
SPD	1	88	E2
SPD	1	85	E2

SPD	1	77	E2	
SPD	1	57	E2	
RTC	1	179	E2	
BHS	1	103	E2	
RTC	1	111	E2	
FMS	1	357	E2	
BHS	1	401	E2	CATARACTS
BHS	1	364	E2	
BHS	1	329	E2	
FMS	1	158	E2	
SPD	1	95	E2	
SPD	1	78	E2	
SPD	1	79	E2	
CCF	1	298	E2	
FMS	1	305	E2	
BHS	1	140	E2	
RDS	1	66	E2	
SPD	1	83	E2	
SPD	1	81	E2	
SAH	1	60	E2	
SPD	1	93	E2	
BHS	1	340	E2	
BHS	1	221	E2	
SPD	1	79	E2	
BHS	1	316	E2	
BHS	1	351	E2	
FMS	1	224	E2	
SPD	1	102	E2	
SPD	1	86	E2	
BHS	1	164	E2	
BHS	1	109	E2	
FMS	1	222	E2	
BHS	1	296	E2	
SPD	1	86	E2	
FMS	1	205	E2	
SPD	1	59	E2	

Appendix C



LEVEL 2 - LAKE SURVEY

SAVE PRINT PRINT DONE

SUMMARY INFORMATION

Species	# Caught	% Catch	Mean Ln (in)	Ln Range (in)	Mean Wt (lbs)	Wt Range (lbs)	E CPUE	G CPUE	T CPUE	PSD
BHS	6	12	14.0	11.7-17.9	0.00	0.0-0.0	2.1	NaN	NaN	100
CCF	2	4	16.5	10.9-22.0	0.00	0.0-0.0	0.7	NaN	NaN	100
CPP	4	8	18.7	17.3-20.1	0.00	0.0-0.0	1.4	NaN	NaN	100
FMS	22	44	16.9	3.8-22.2	0.00	0.0-0.0	7.9	NaN	NaN	100
LOC	2	4	10.7	10.4-11.0	0.00	0.0-0.0	0.7	NaN	NaN	100
RDS	3	6	3.1	2.8-3.5	0.00	0.0-0.0	1.1	NaN	NaN	100
RTC	9	18	6.3	4.5-7.5	0.00	0.0-0.0	3.2	NaN	NaN	100
SAH	1	2	2.6	2.6-2.6	0.00	0.0-0.0	0.4	NaN	NaN	100
SPD	1	2	2.8	2.8-2.8	0.00	0.0-0.0	0.4	NaN	NaN	100

LENGTH FREQUENCY RECORD (cm)

	Species	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	33-36	36-39	39-42	42-45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81-84	84-87	87-90	90-93	93-96	>96
1	BHS										1	1	2	1			1																	
2	CCF										1									1														
3	CPP															1	1	1	1															
4	FMS				1	2								1	1	3	6	2	4	2														
5	LOC									1	1																							
6	RDS			2	1																													
7	RTC				2		5	2																										
8	SAH			1																														
9	SPD			1																														
10																																		
11																																		
12																																		
13																																		
14																																		

Water: Dolores River # 1 Blue Creek to Salt Creek, RM 127.8-RM 130.6"
Date: 6/16/2010
Gear: Raft Shocker, Smith Root 2.5: GPP"
Drainage: Dolores river
Water Code: 39760
UTM Zone:
UTM X: 0 m
UTM Y: 0 m
E Hours = 2.8
G Hours = 0
T Hours = 0
Crew: Jones, Kowalski, Meyr, Groenke, Bonaquista, Duckett, Delpocalo, Jones and Jones"
Notes: Shocked from theBlue Creek to Salt Creek. Settings on GPP: 30 DC, Low Range, 90%. Substitutemiles for hours to get CPUE, "

Species	Count	Length (mm)	Weight (g)	Status	Mark	TagID
BHS	1	355	E3			
FMS	1	526	E3			
RTC	1	180	E3			
RTC	1	162	E3			

FMS	1	137	E3	
BHS	1	455	E3	SPENT FEMALE
CCF	1	278	E3	
BHS	1	296	E3	
RTC	1	178	E3	
RDS	1	70	E3	
RTC	1	115	E3	
FMS	1	96	E3	
SAH	1	66	E3	
FMS	1	483	E3	
FMS	1	481	E3	
BHS	1	371	E3	
RDS	1	90	E3	
FMS	1	462	E3	
BHS	1	315	E3	
FMS	1	143	E3	
RTC	1	116	E3	
FMS	1	412	E3	
LOC	1	265	E3	
CCF	1	560	E3	
FMS	1	446	E3	
FMS	1	441	E3	
FMS	1	555	E3	
FMS	1	510	E3	
FMS	1	465	E3	
FMS	1	526	E3	
FMS	1	515	E3	
FMS	1	565	E3	
LOC	1	280	E3	
RTC	1	190	E3	
FMS	1	385	E3	
RTC	1	172	E3	
FMS	1	461	E3	
FMS	1	465	E3	
FMS	1	460	E3	
BHS	1	334	E3	
CPP	1	510	E3	
CPP	1	440	E3	
FMS	1	433	E3	
FMS	1	450	E3	
CPP	1	450	E3	
CPP	1	500	E3	
RTC	1	176	E3	
RTC	1	150	E3	
SPD	1	70	E3	
RDS	1	76	E3	

Fish Sampling Report

Dan Kowalski
Aquatic Biologist
Southwest Region

Water: Dolores River Below San Miguel
Date: 7/15/2009
Gear: 14 ft. electrofishing raft with Smith Root 2.5GPP
Drainage: Dolores
Water Codes: 39760

OBJECTIVE

The Dolores River below the San Miguel was sampled with one pass CPUE electrofishing to monitor native fish populations. The station began at the San Miguel confluence and ended at the County Rd R13 bridge and was 4.9 miles long.

RESULTS

The results of the survey are summarized in Table 1 and length frequency histograms of the native fish are presented in Figures 1-3. Eighty-nine percent of the fish sampled were native species. This reach of the Dolores contains excellent populations of flannelmouth suckers, bluehead suckers, and roundtail chubs represented by multiple age classes including many large adults. This reach appears to support some the best populations of the three species in the Dolores River basin and has much more robust and healthy native fish populations than sites on the Dolores upstream of the San Miguel.

Species	# Caught	% Catch	Mean Length (in.)	Length Range (in.)	CPUE (fish/mile)
Bluehead Suckers	129	33	8.5	4.0-14.2	26.3
Flannelmouth Suckers	128	33	14.6	4.6-22.1	26.1
Roundtail Chubs	56	14	7.1	2.7-14.4	11.4
Speckled Dace	37	9	3.4	2.7-4.4	7.6
Channel Catfish	31	8	11.1	7.2-21.8	6.3
Common Carp	8	2	21.3	19.9-22.0	1.6
Red Shiner	2	1	3.0	2.9-3.1	0.4
Sand Shiner	1	0	2.8	2.8	0.2

Table 1. Summary of fish sampled in 2009 in the Dolores River below the San Miguel.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

The Dolores River below the San Miguel contains a good native fish community and should continue to managed as a category 100 native fish conservation water. Many of the habitat and flow problems associated with the river below McPhee (low base flows, altered peak flows, altered temperature regime, and reduced nutrient and sediment inputs) are improved by the influence of the San Miguel. The San Miguel River has a relatively natural spring peak hydrograph but base flows are impacted by irrigation withdrawals. However, unlike the trans-basin diversions associated with McPhee, irrigation return flows in the San Miguel basin come back to the river and reduce the impacts of base flow diversions. Efforts should be taken to protect the flow regime of this reach of river including spring peak flows and especially base flows. Major tributaries like Mesa Creek, Roc Creek, and Blue Creek that could be used seasonally for spawning should also be protected both for native fish habitat and the beneficial flows inputs to the main stem.

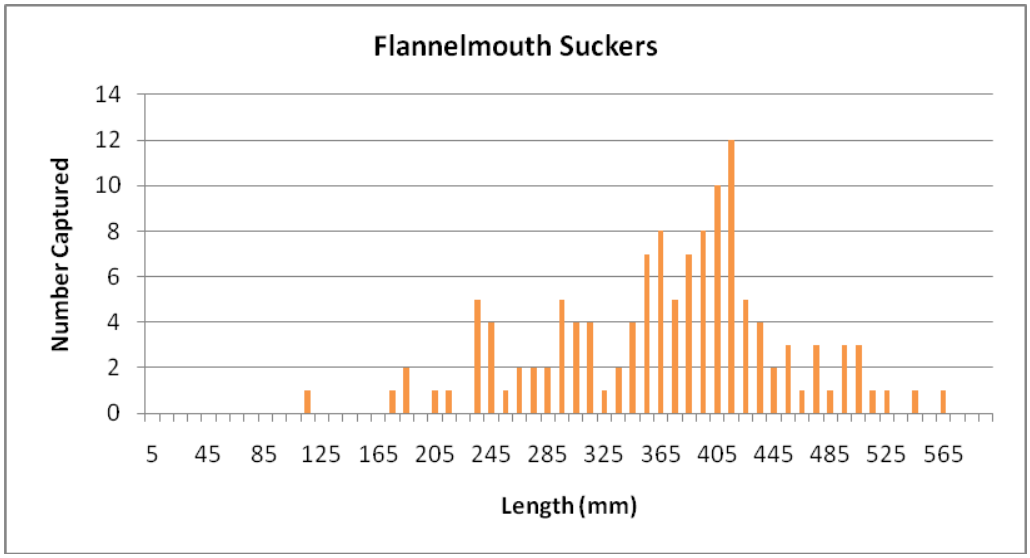


Figure 1. Length frequency histogram of flannelmouth suckers captured in the Dolores River in 2009.

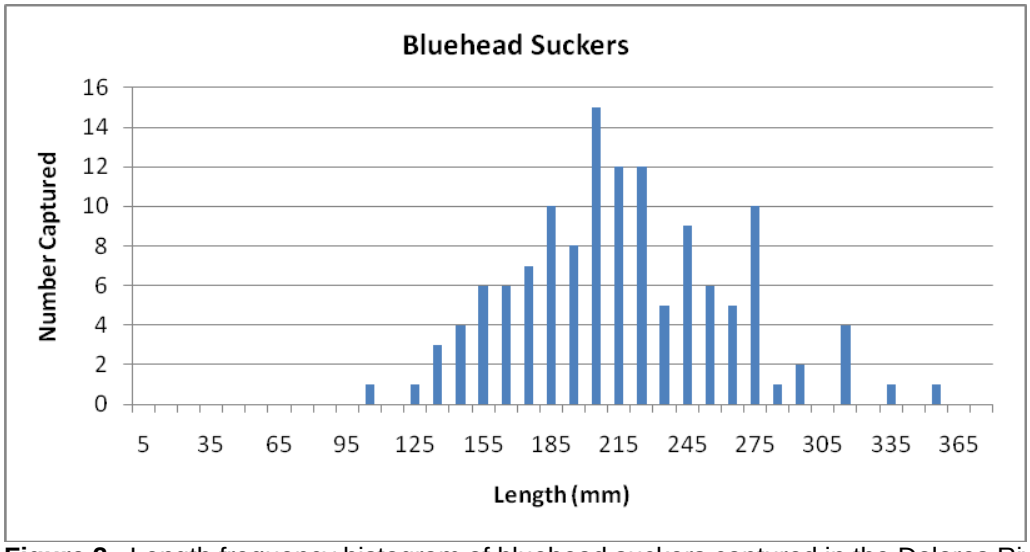


Figure 2. Length frequency histogram of bluehead suckers captured in the Dolores River in 2009.

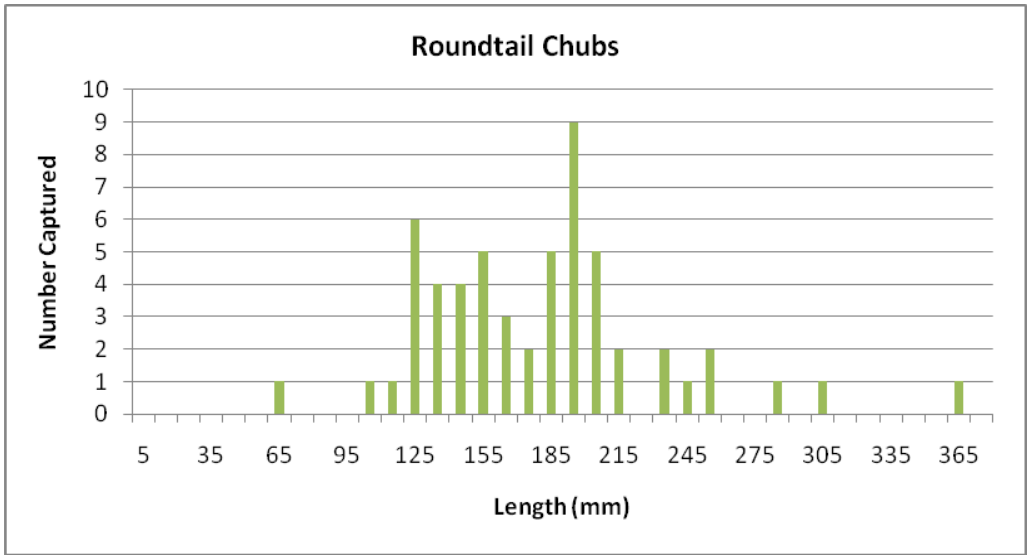


Figure 3. Length frequency histogram of roundtail chubs captured in the Dolores River in 2009.

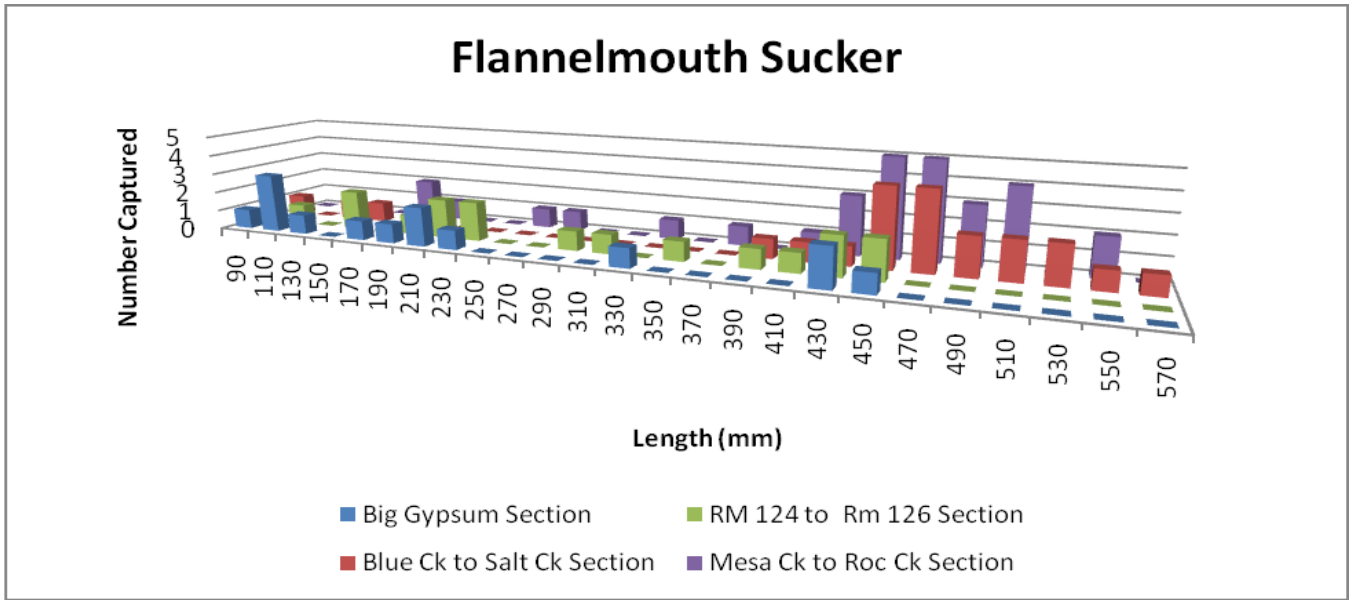


Figure 10 Flannelmouth Sucker Pooled Length Frequency Distributions Dolores River, 2010

Only one young bluehead sucker was captured in the Big Gypsum reach, while more and larger fish were increasingly common as we moved downstream (Figure 10). The only other portion of the river where we encountered smaller age classes of bluehead suckers was the reach between River Mile 124 and River Mile 126.

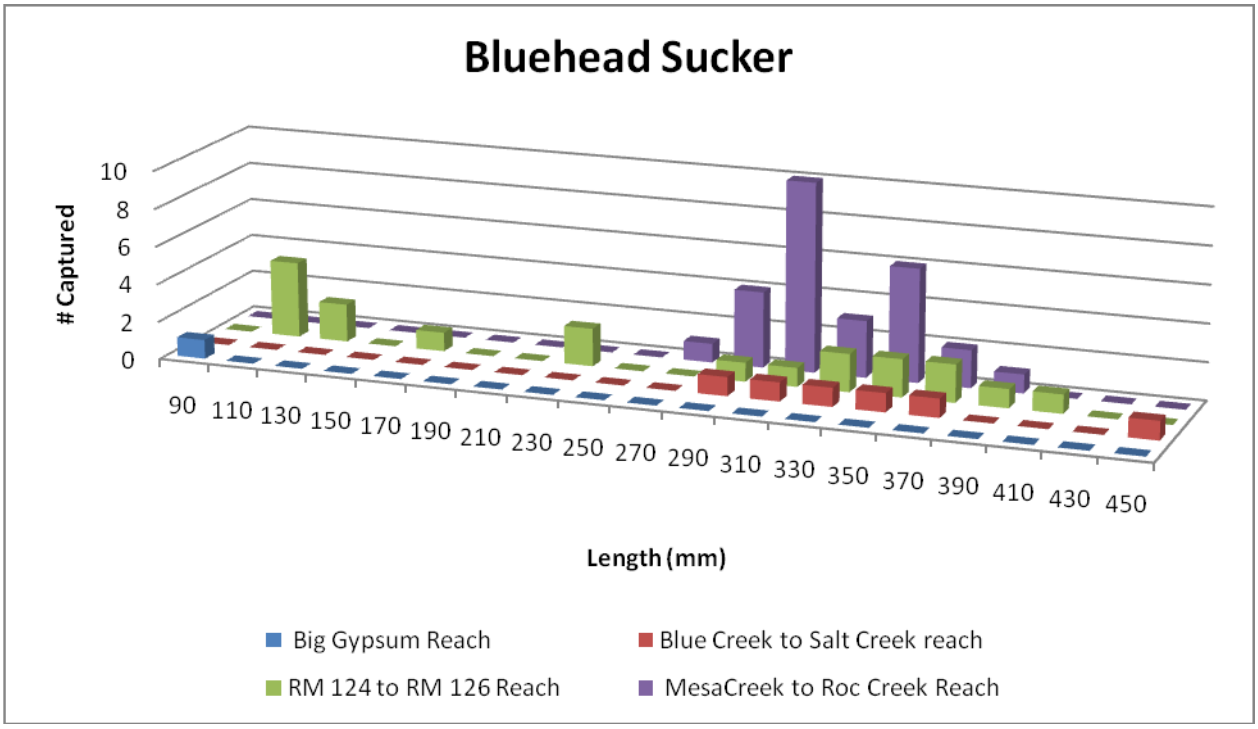


Figure 11 Bluehead Sucker Pooled Length Frequency Distributions Dolores River, 2010

Unlike flannelmouth and bluehead suckers, roundtail chub were much more common and more age classes were sampled in the Big Gypsum reach than in the reaches down stream (Figure 11). The reach between River Miles 124 and 126 had higher numbers of younger age classes than the other reaches below the confluence of the Dolores and San Miguel Rivers, and Mesa Creek had the fewest number of roundtail chubs of the reaches sampled.

Dolores River Instream Flow Project

R2Cross Data Summary – As Of April 10, 2013

X-Section Date and Number	Flow That Meets 2 of 3 Criteria	Flow That Meets 3 of 3 Criteria
2-27-13 #1	78.57 cfs	227.10 cfs
2-27-13 #2	Out of confidence interval	251.33 cfs
2-27-13 #3	92.35 cfs	153.37 cfs
2-27-13 #4	98.13 cfs	184.96 cfs
11-8-11 (riffle cross section in PHABSIM reach)	123.96	324.94 cfs
Averages	98.25 cfs	228.34 cfs

Preliminary Dolores River Recommendation From April 10, 2013 Conference Call

Note: March 15 to August 14 recommendations based upon PHABSIM results. August 15 to March 14 recommendations based R2Cross results.

900 cfs – April 15 to June 14
400 cfs – June 15 to July 14
200 cfs – July 15 to August 14
100 cfs – August 15 to March 14
200 cfs – March 15 to April 14

For Comparison: Instream Flow Water Rights on San Miguel River Appropriated by CWCB

325 cfs – April 15 to June 14
170 cfs – June 15 to July 31
115 cfs – August 1 to August 31
80 cfs – September 1 to February 29
115 cfs – March 1 to April 14

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Dolores River					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: Mile Marker 101			GPS Zone 12	681524	4269902
DATE: 2-27-13	OBSERVERS: R. Smith, D. Graf				4639 Rd.
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 31	TOWNSHIP: 50 (N)/S	RANGE: 18E/(W)	PM: NM
COUNTY: Mesa	WATERSHED: Dolores	WATER DIVISION: 4	DOW WATER CODE: 39760		
MAP(S):	USGS:				
	USFS:				

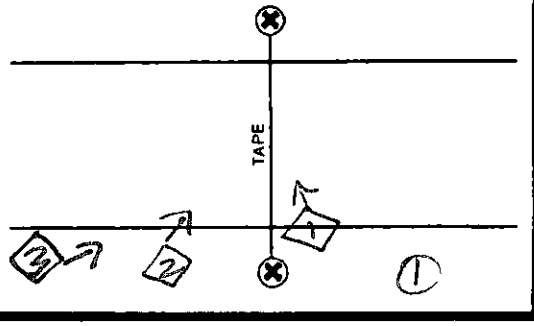
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES)/NO	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 4-6" cobbles to 2-foot boulders	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(X) Tape @ Stake LB	0.0	surveyed
(X) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	6.11 / 6.23
(2) WS Upstream	299.0	2.03
(3) WS Downstream	60.0'	7.09
SLOPE	5.06/359.0 = .014	

SKETCH



AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/(NO)

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River | CROSS-SECTION NO: 1 | DATE: 2-27-13 | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: _____ ft | TIME: 11:00 am

Features (Stake (S), Grassline (G), Waterline (W), Rock (R))	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical at 0.2	Area (ft²) at 0.5	Discharge (cfs)
LS	0.6		3.59								
	2.0		2.80								
G	4.0		4.21								
	5.0		4.66								
	6.0		5.43								
W	6.5	<7.0 6.8>	6.11	0.7				>0.83			
	8		7.45	1.30				1.60			
	10		7.84	1.70				1.54			
	12		6.89	0.80				2.48			
	14		7.93	1.70				2.69			
	16		7.88	1.60				3.50			
	18		8.90	2.70				3.39	2.94	3.83	
	20		8.73	2.50				2.59	1.60	3.57	
	22		8.53	2.40				1.90	1.51	2.29	
	24		8.22	2.00				2.80			
	26		8.40	2.10				3.91	3.26	4.56	
	28		8.25	2.00				3.02			
	30		8.02	1.80				∅			
	32		7.83	1.70				2.57			
	34		7.76	1.50				2.47			
	36		8.05	1.75				2.45			
	38		7.77	1.40				3.12			
	40		7.50	1.20				2.00			
	42		7.02	.6				2.62			
	44		7.16	1.0				1.82			
	46		7.61	1.3				1.55			
	48		7.11	.9				1.28			
	50		6.82	.5				0.01			
W	53		6.33								
	58.5		5.92								
	60.6		5.77								
	64		5.77								
	66.4		5.82								
	75.5		5.77								
	79		5.01								
G	83.5		4.23								
	88.0		3.97								
RS	98.5		2.66								
TOTALS											

End of Measurement | Time | Gage Reading ft | CALCULATIONS PERFORMED BY | CALCULATIONS CHECKED BY

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Dolores River
XS LOCATION:	Mile Marker 101
XS NUMBER:	1
DATE:	27-Feb-13
OBSERVERS:	R. Smith, D. Graf, N. Dieterich, E. Rumbold
1/4 SEC:	NW
SECTION:	31
TWP:	50
RANGE:	18
PM:	NM
COUNTY:	Mesa
WATERSHED:	Dolores
DIVISION:	4
DOW CODE:	39760
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

*** NOTE ***
Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod

CHANNEL PROFILE DATA

SLOPE: 0.014

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....…….....DATE.....

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 1

DATA POINTS= 39

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
LS	0.60	3.59			0.00		0.00	0.00	0.0%
	2.00	2.80			0.00		0.00	0.00	0.0%
1 G	4.00	4.21			0.00		0.00	0.00	0.0%
	5.00	4.66			0.00		0.00	0.00	0.0%
	6.00	5.43			0.00		0.00	0.00	0.0%
W	6.50	6.11	0.00	0.00	0.00		0.00	0.00	0.0%
	7.00	6.80	0.70	0.83	0.85	0.70	0.53	0.44	0.3%
	8.00	7.45	1.30	1.60	1.19	1.30	1.95	3.12	1.9%
	10.00	7.84	1.70	1.54	2.04	1.70	3.40	5.24	3.2%
	12.00	6.89	0.80	2.48	2.21	0.80	1.60	3.97	2.4%
	14.00	7.93	1.70	2.69	2.25	1.70	3.40	9.15	5.6%
	16.00	7.88	1.60	3.50	2.00	1.60	3.20	11.20	6.8%
	18.00	8.90	2.70	3.39	2.25	2.70	5.40	18.31	11.1%
	20.00	8.73	2.50	2.59	2.01	2.50	5.00	12.95	7.9%
	22.00	8.53	2.40	1.90	2.01	2.40	4.80	9.12	5.5%
	24.00	8.22	2.00	2.80	2.02	2.00	4.00	11.20	6.8%
	26.00	8.40	2.10	3.91	2.01	2.10	4.20	16.42	10.0%
	28.00	8.25	2.00	3.02	2.01	2.00	4.00	12.08	7.3%
	30.00	8.02	1.80	0.00	2.01	1.80	3.60	0.00	0.0%
	32.00	7.83	1.70	2.57	2.01	1.70	3.40	8.74	5.3%
	34.00	7.76	1.50	2.47	2.00	1.50	3.00	7.41	4.5%
	36.00	8.05	1.75	2.45	2.02	1.75	3.50	8.58	5.2%
	38.00	7.77	1.40	3.12	2.02	1.40	2.80	8.74	5.3%
	40.00	7.50	1.20	2.00	2.02	1.20	2.40	4.80	2.9%
	42.00	7.02	0.60	2.62	2.06	0.60	1.20	3.14	1.9%
	44.00	7.16	1.00	1.82	2.00	1.00	2.00	3.64	2.2%
	46.00	7.61	1.30	1.55	2.05	1.30	2.60	4.03	2.4%
	48.00	7.11	0.90	1.28	2.06	0.90	1.80	2.30	1.4%
	50.00	6.82	0.50	0.01	2.02	0.50	1.25	0.01	0.0%
W	53.00	6.23	0.00	0.00	3.06		0.00	0.00	0.0%
	58.50	5.92			0.00		0.00	0.00	0.0%
	60.60	5.77			0.00		0.00	0.00	0.0%
	64.00	5.77			0.00		0.00	0.00	0.0%
	66.40	5.82			0.00		0.00	0.00	0.0%
	75.50	5.77			0.00		0.00	0.00	0.0%
	79.00	5.01			0.00		0.00	0.00	0.0%
1 G	83.50	4.23			0.00		0.00	0.00	0.0%
	88.00	3.97			0.00		0.00	0.00	0.0%
RS	98.50	2.66			0.00		0.00	0.00	0.0%
TOTALS ----------					48.18	2.7 (Max.)	69.03	164.57	100.0%

Manning's n = 0.0937
Hydraulic Radius= 1.43250135

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	69.03	72.13	4.5%
5.92	69.03	84.58	22.5%
5.94	69.03	83.55	21.0%
5.96	69.03	82.51	19.5%
5.98	69.03	81.49	18.1%
6.00	69.03	80.47	16.6%
6.02	69.03	79.46	15.1%
6.04	69.03	78.46	13.7%
6.06	69.03	77.47	12.2%
6.08	69.03	76.48	10.8%
6.10	69.03	75.50	9.4%
6.12	69.03	74.53	8.0%
6.13	69.03	74.04	7.3%
6.14	69.03	73.56	6.6%
6.15	69.03	73.08	5.9%
6.16	69.03	72.60	5.2%
6.17	69.03	72.13	4.5%
6.18	69.03	71.65	3.8%
6.19	69.03	71.18	3.1%
6.20	69.03	70.71	2.4%
6.21	69.03	70.24	1.8%
6.22	69.03	69.77	1.1%
6.24	69.03	68.84	-0.3%
6.26	69.03	67.92	-1.6%
6.28	69.03	67.00	-2.9%
6.30	69.03	66.07	-4.3%
6.32	69.03	65.15	-5.6%
6.34	69.03	64.24	-6.9%
6.36	69.03	63.32	-8.3%
6.38	69.03	62.41	-9.6%
6.40	69.03	61.50	-10.9%
6.42	69.03	60.59	-12.2%

WATERLINE AT ZERO
AREA ERROR = 6.236

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 1

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	4.23	79.46	2.60	4.67	206.68	82.00	100.0%	2.52	718.22	3.47
	5.24	72.21	1.81	3.66	130.60	74.38	90.7%	1.76	356.66	2.73
	5.29	71.92	1.77	3.61	127.00	74.06	90.3%	1.71	341.38	2.69
	5.34	71.62	1.72	3.56	123.41	73.74	89.9%	1.67	326.39	2.64
	5.39	71.32	1.68	3.51	119.84	73.42	89.5%	1.63	311.68	2.60
	5.44	71.03	1.64	3.46	116.28	73.11	89.2%	1.59	297.26	2.56
	5.49	70.77	1.59	3.41	112.73	72.81	88.8%	1.55	283.08	2.51
	5.54	70.50	1.55	3.36	109.20	72.51	88.4%	1.51	269.19	2.47
	5.59	70.23	1.50	3.31	105.68	72.22	88.1%	1.46	255.59	2.42
	5.64	69.97	1.46	3.26	102.18	71.92	87.7%	1.42	242.28	2.37
	5.69	69.70	1.42	3.21	98.69	71.62	87.3%	1.38	229.28	2.32
	5.74	69.43	1.37	3.16	95.21	71.32	87.0%	1.33	216.57	2.27
	5.79	61.91	1.48	3.11	91.83	63.77	77.8%	1.44	219.70	2.39
	5.84	53.38	1.67	3.06	89.01	55.21	67.3%	1.61	229.62	2.58
	5.89	52.64	1.64	3.01	86.36	54.45	66.4%	1.59	220.37	2.55
	5.94	51.84	1.62	2.96	83.75	53.62	65.4%	1.56	211.51	2.53
	5.99	50.92	1.59	2.91	81.18	52.67	64.2%	1.54	203.21	2.50
	6.04	49.99	1.57	2.86	78.65	51.72	63.1%	1.52	195.15	2.48
	6.09	49.07	1.55	2.81	76.18	50.77	61.9%	1.50	187.32	2.46
	6.14	48.15	1.53	2.76	73.75	49.82	60.8%	1.48	179.72	2.44
	6.19	47.22	1.51	2.71	71.36	48.87	59.6%	1.46	172.34	2.41
WL	6.24	46.38	1.49	2.66	69.02	48.00	58.5%	1.44	165.00	2.39
	6.29	46.09	1.45	2.61	66.71	47.68	58.1%	1.40	156.59	2.35
	6.34	45.80	1.41	2.56	64.42	47.36	57.7%	1.36	148.38	2.30
	6.39	45.51	1.37	2.51	62.13	47.04	57.4%	1.32	140.35	2.26
	6.44	45.22	1.32	2.46	59.87	46.71	57.0%	1.28	132.52	2.21
	6.49	44.93	1.28	2.41	57.61	46.39	56.6%	1.24	124.88	2.17
	6.54	44.63	1.24	2.36	55.37	46.07	56.2%	1.20	117.44	2.12
	6.59	44.34	1.20	2.31	53.15	45.75	55.8%	1.16	110.20	2.07
	6.64	44.05	1.16	2.26	50.94	45.43	55.4%	1.12	103.15	2.02
	6.69	43.76	1.11	2.21	48.74	45.11	55.0%	1.08	96.30	1.98
	6.74	43.47	1.07	2.16	46.56	44.79	54.6%	1.04	89.65	1.93
	6.79	43.18	1.03	2.11	44.40	44.47	54.2%	1.00	83.21	1.87
	6.84	42.83	0.99	2.06	42.24	44.10	53.8%	0.96	77.02	1.82
	6.89	42.41	0.95	2.01	40.11	43.66	53.2%	0.92	71.13	1.77
	6.94	41.80	0.91	1.96	38.01	43.01	52.4%	0.88	65.67	1.73
	6.99	41.18	0.87	1.91	35.93	42.34	51.6%	0.85	60.43	1.68
	7.04	40.26	0.84	1.86	33.89	41.38	50.5%	0.82	55.67	1.64
	7.09	38.72	0.82	1.81	31.92	39.78	48.5%	0.80	51.70	1.62
	7.14	37.25	0.81	1.76	30.02	38.26	46.7%	0.78	47.91	1.60
	7.19	36.10	0.78	1.71	28.19	37.06	45.2%	0.76	44.07	1.56
	7.24	35.19	0.75	1.66	26.41	36.10	44.0%	0.73	40.22	1.52
	7.29	34.28	0.72	1.61	24.67	35.14	42.8%	0.70	36.56	1.48
	7.34	33.37	0.69	1.56	22.98	34.17	41.7%	0.67	33.09	1.44
	7.39	32.47	0.66	1.51	21.33	33.21	40.5%	0.64	29.80	1.40
	7.44	31.56	0.63	1.46	19.73	32.24	39.3%	0.61	26.69	1.35
	7.49	30.52	0.60	1.41	18.18	31.15	38.0%	0.58	23.82	1.31
	7.54	29.31	0.57	1.36	16.68	29.90	36.5%	0.56	21.21	1.27
	7.59	28.06	0.54	1.31	15.25	28.61	34.9%	0.53	18.81	1.23
	7.64	27.03	0.51	1.26	13.87	27.54	33.6%	0.50	16.48	1.19
	7.69	26.20	0.48	1.21	12.54	26.68	32.5%	0.47	14.23	1.13
	7.74	25.38	0.44	1.16	11.25	25.82	31.5%	0.44	12.14	1.08
	7.79	23.63	0.42	1.11	10.02	24.04	29.3%	0.42	10.48	1.05
	7.84	21.15	0.42	1.06	8.90	21.52	26.2%	0.41	9.27	1.04
	7.89	19.54	0.40	1.01	7.88	19.89	24.3%	0.40	7.97	1.01
	7.94	16.37	0.43	0.96	6.99	16.69	20.4%	0.42	7.33	1.05
	7.99	15.05	0.41	0.91	6.20	15.34	18.7%	0.40	6.36	1.03

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	164.57	cfs
CALCULATED FLOW (Qc)=	165.00	cfs
(Qm-Qc)/Qm * 100 =	-0.3	%
MEASURED WATERLINE (WLm)=	6.17	ft
CALCULATED WATERLINE (WLc)=	6.24	ft
(WLm-WLc)/WLm * 100 =	-1.1	%
MAX MEASURED DEPTH (Dm)=	2.70	ft
MAX CALCULATED DEPTH (Dc)=	2.66	ft
(Dm-Dc)/Dm * 100	1.3	%
MEAN VELOCITY=	2.39	ft/sec
MANNING'S N=	0.094	
SLOPE=	0.014	ft/ft
.4 * Qm =	65.8	cfs
2.5 * Qm=	411.4	cfs

RECOMMENDED INSTREAM FLOW:
==========

FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

RATIONALE FOR RECOMMENDATION:
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_____
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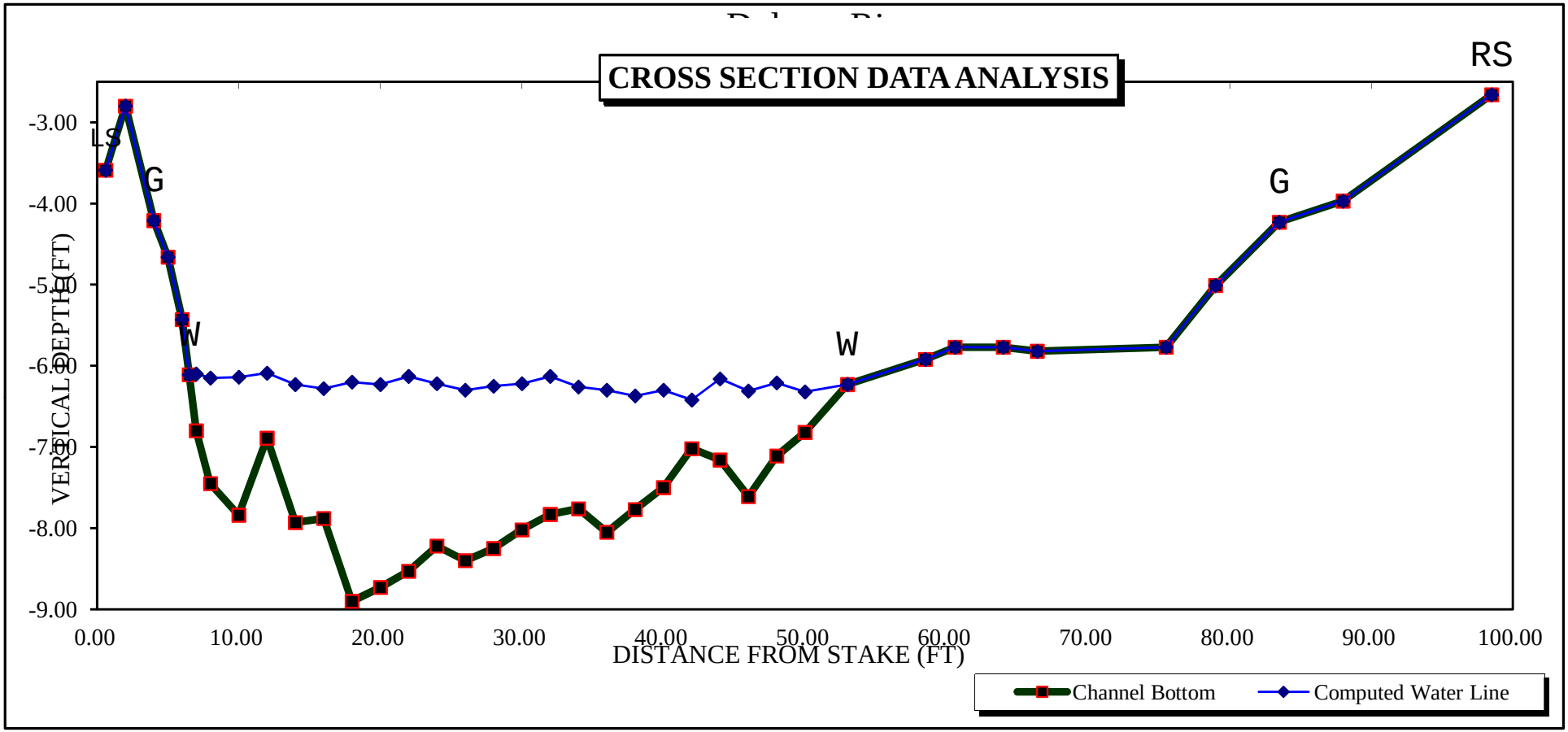
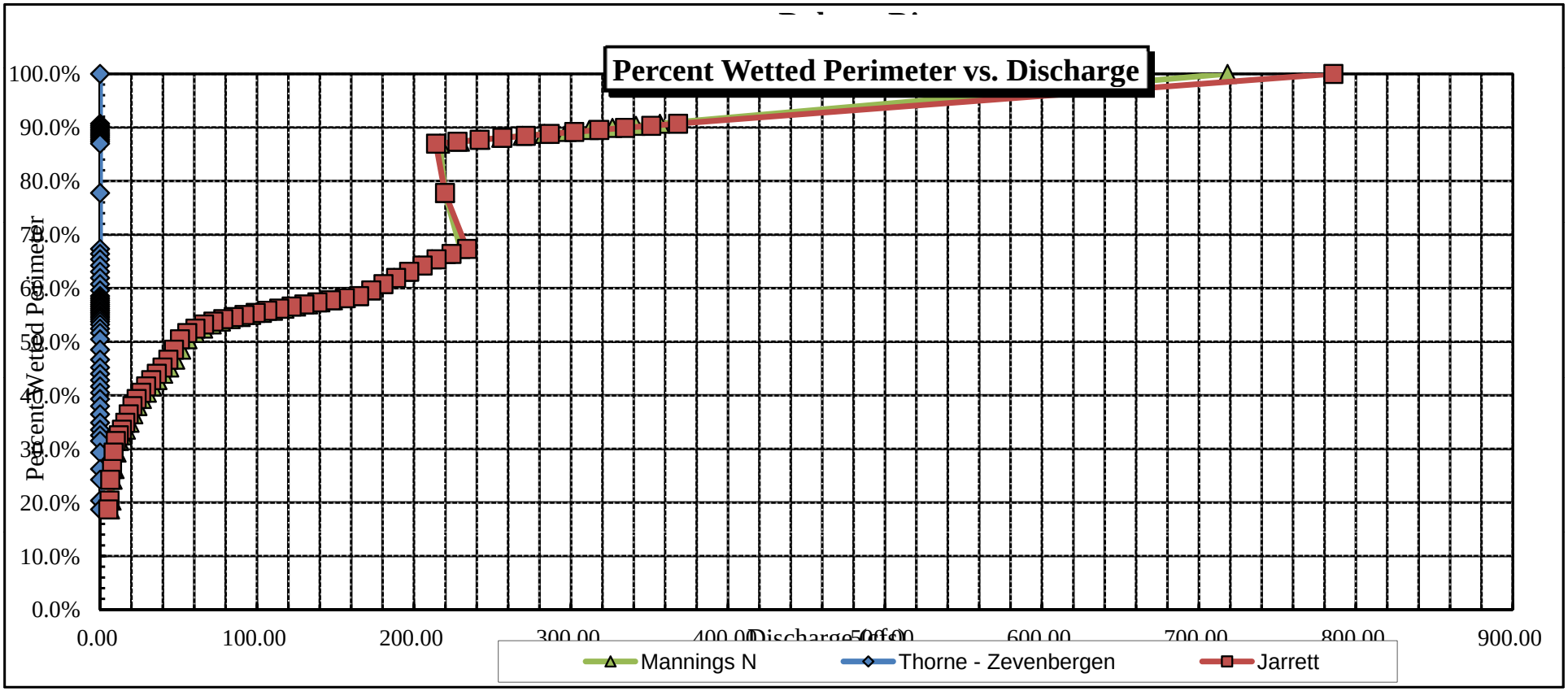
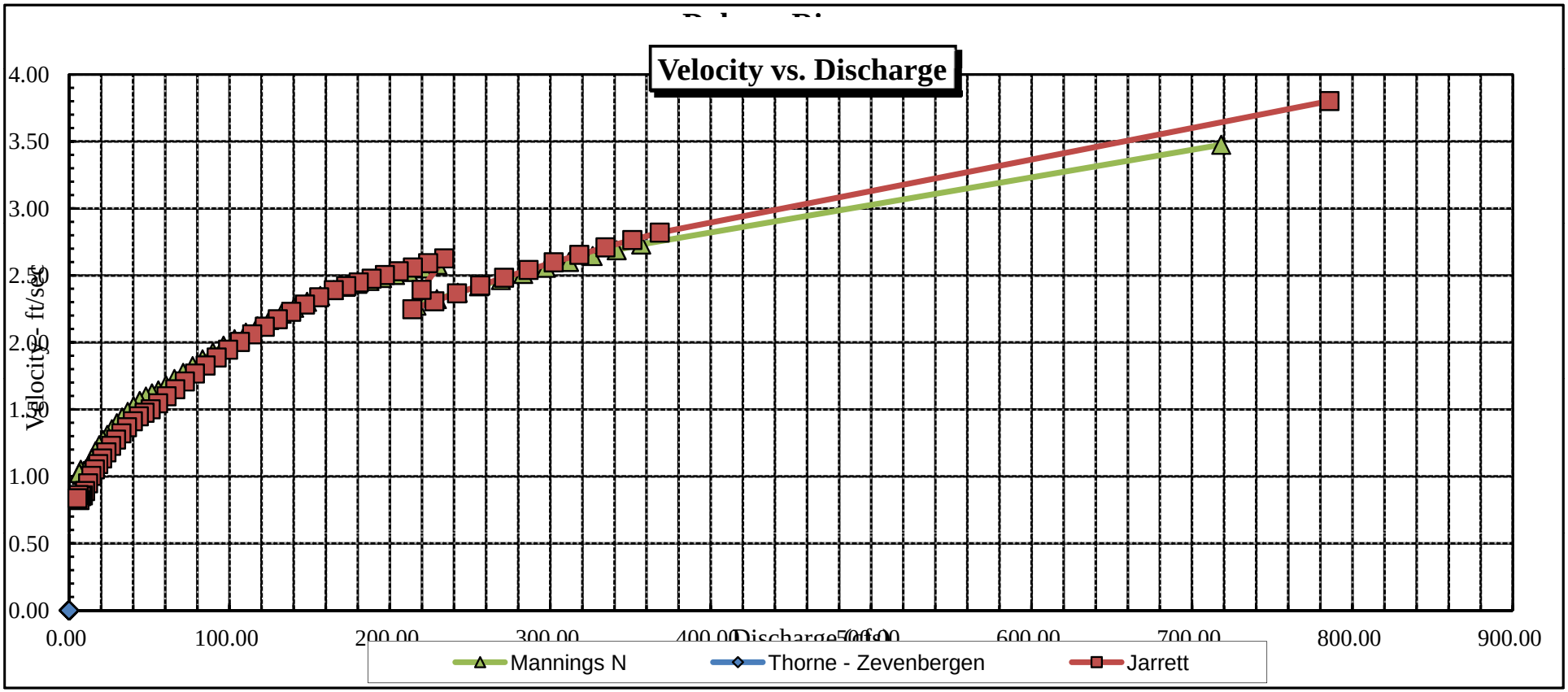
_____

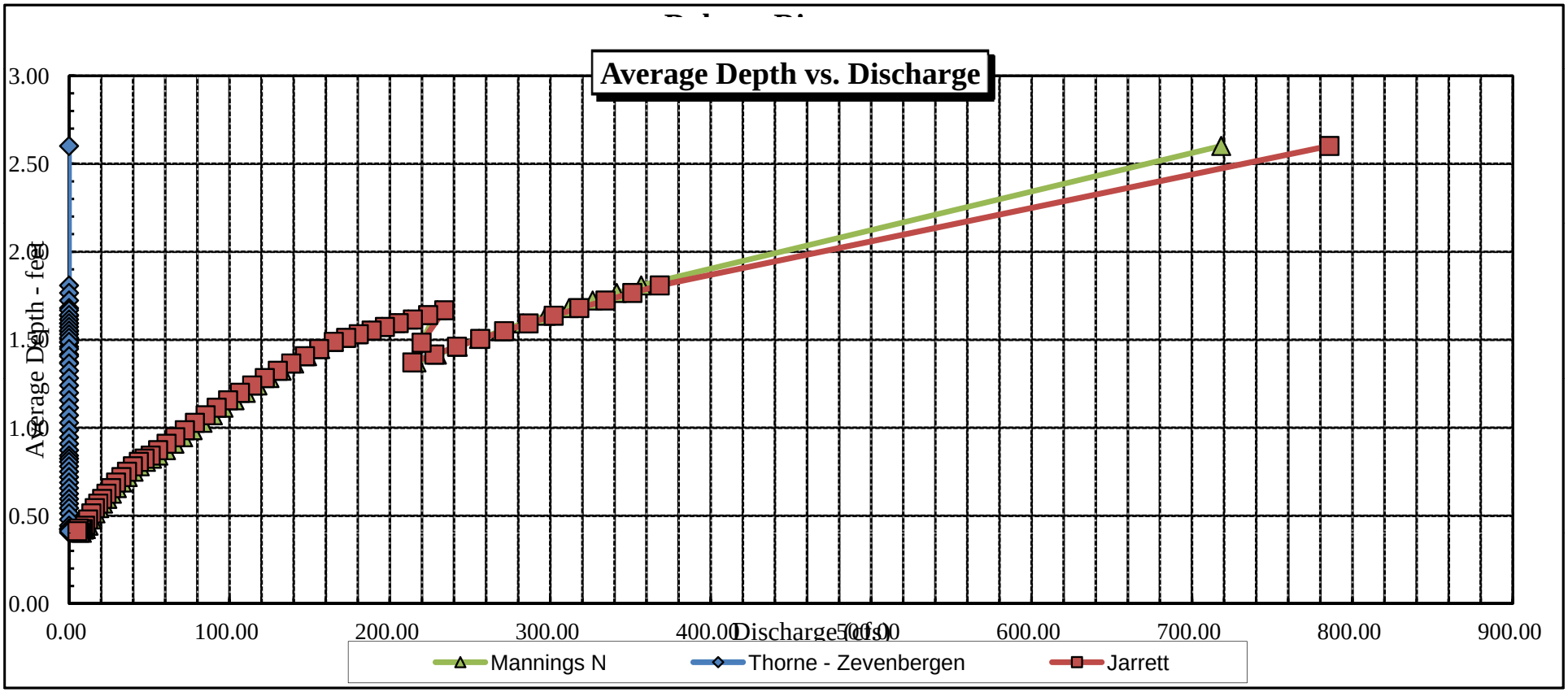
RECOMMENDATION BY: …….. AGENCY..…….. DATE:.....

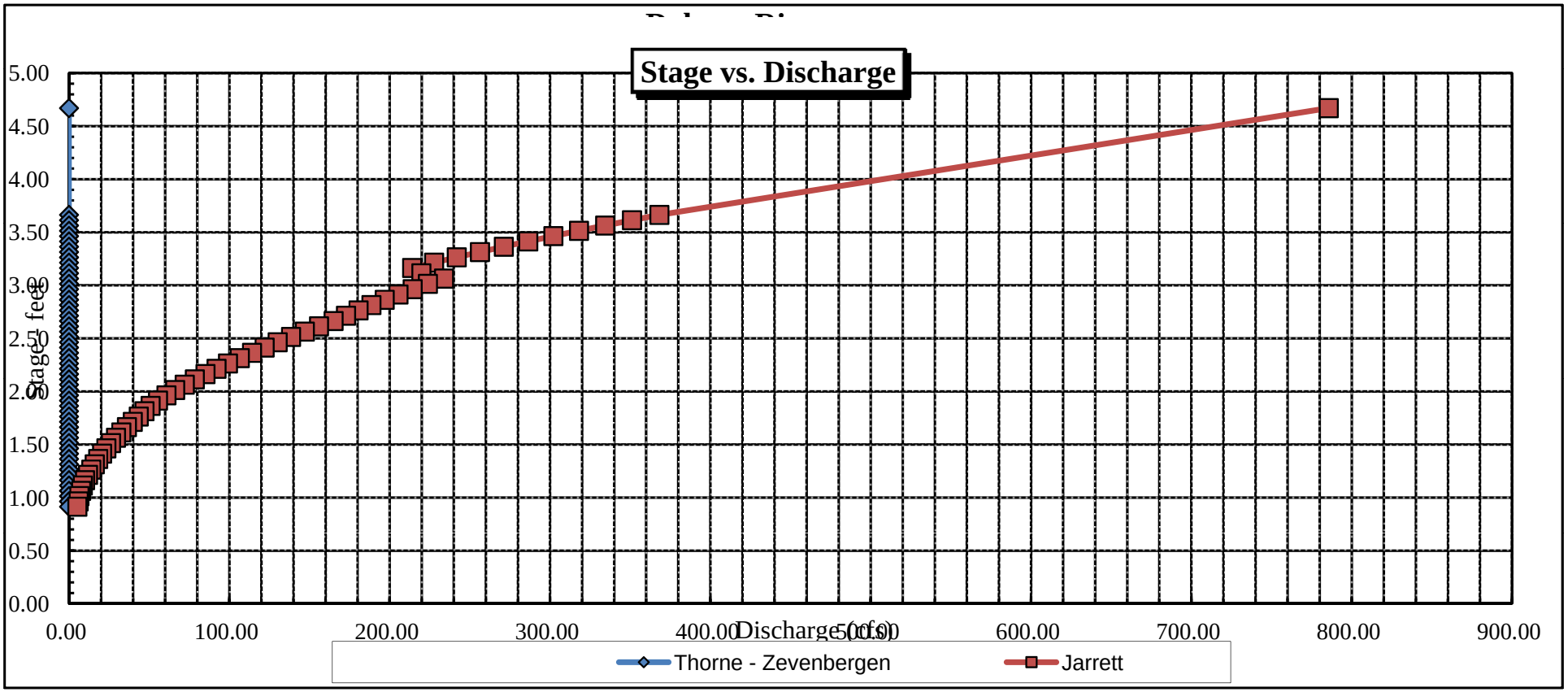
CWCB REVIEW BY: ..…….. DATE:.....


CROSS SECTION DATA ANALYSIS
RS
LS
G
W
W
G
-3.00
-4.00
-5.00
-6.00
-7.00
-8.00
-9.00
VERTICAL DEPTH (FT)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
Velocity - ft/sec
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
100.00
200.00
300.00
400.00
600.00
700.00
800.00
900.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Stage, feet
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
Discharge, (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Dolores River X-section #2						CROSS-SECTION NO.: #2
CROSS-SECTION LOCATION: Nad 1983 Zone 12S 0681592, 4216985						
DATE: 2/27/13	OBSERVERS: N. Dieterich (BLM), E. Rumbold (BLM), Cullin? (CPW)					
LEGAL DESCRIPTION	¼ SECTION: NW	SECTION: 31	TOWNSHIP: 50 (N)/S	RANGE: 18 E(W)	PM: NM	
COUNTY: Mesa	WATERSHED: Dolores	WATER DIVISION: 4	DOW WATER CODE: 39760			
MAP(S): USGS:						
USFS:						

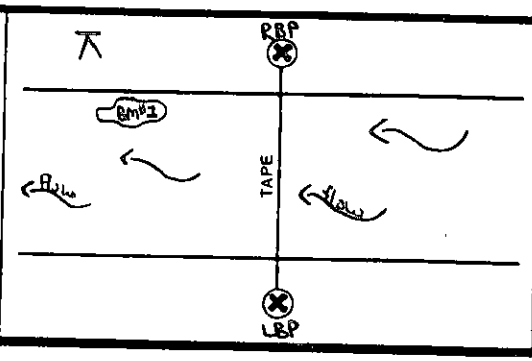
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES)/NO	METER TYPE: Marsh Mcbirney Flowmate			
METER NUMBER:	DATE RATED:	CALIB/SPIN. ____ sec	TAPE WEIGHT: ____ lbs/foot	TAPE TENSION: ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: gravel - sm. boulder	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	Surveyed
⊗ Tape @ Stake RB	0.0	Surveyed
① WS @ Tape LB/RB	0.0	6.33/7.15
② WS Upstream		
③ WS Downstream		
SLOPE	.014	

SKETCH



LEGEND:
Stake ⊗
Station ①
Photo ◇→
Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/(NO)

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL
Species? (Bluehead sucker?)																	

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

COMMENTS

Discharge (Q) calculated using area derived from depths measured w/ tape at wading and given velocity measurements were based off of these depths. In cells where wading was depths were not measured, depths calculated from the survey and were used. Velocities were caused to these cells from adjacent measurements to calculate discharge (Q). * Suffice from 30.5' to 72' w/ noticeable flow.

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River	CROSS-SECTION NO.:	DATE: 2/27/13	SHEET 1 OF 2
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT (RIGHT)	Gage Reading: _____ ft	TIME: 1130

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape (Inst) (ft)	Water Depth (ft) *profile depth	Depth of Observation (ft)	Revolutions Cleared profile elevation relative to BM=100	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Using profile & reading rod Area (ft^2) depths	Discharge (cfs)
BM#1 rock	BS=5.65	HI=105.65				100.0	20				
RBF (L)(S)	0	0	4.85		0.6d	100.8					
	22	22	5.94			99.71					
	27	5	6.59			99.06					
RWE (W)	30.3	3.3	7.15	*0		98.5		0		0	0
	30.5	0.2	7.15	0				0		0	0
	32.0	1.5	7.48	*0.23		98.17		0.05		~~0.52~~	~~0.026~~
	32.5	0.5	7.60	0.35				0.05			
	35.5	3	7.60	0.35				0.1		~~1.205~~	~~0.1205~~
	36.0	0.5	7.56	*0.31		98.09		0.1			
	39.5	3.5	7.15	0				0		0	0
bar	40.0	0.5	6.75	bar		98.9		bar			
bar	44.0	4	6.87	bar		98.78		bar			
bar	48.0		7.03	bar		98.62		bar			
	52.0		7.5	0.4		98.15		0.24		1	0.24
	56.0		7.58	0.5		98.07		0.26		1.32	0.3432
rock	60.0		6.92	rock		98.73		0			
	64.0		7.35	*0.1		98.3		0		0.4	0
	68.0		7.29	*0.04		98.36		0		0.16	0
	72.0		7.44	0.32		98.21		0		1.28	0
	76.0		7.62	0.3		98.03		0.29		1.2	0.348
	79.0	3	7.72	0.4				0.08		~~1.56~~	~~0.1248~~
	80.0	1	7.61	*0.36		98.04		0.08			
	82.0	2	7.95	0.7				0.64		1.4	0.896
	84.0	2	8.22	*0.97		97.43		1.4		~~2.44~~	~~3.416~~
	85.0	1	8.01	0.5				1.4			
Rock/eddy	88.0	3	7.91	0.4		97.74		0		1.2	0
	90.0	2	8.01	0.5				0.12		1	0.12
	92.0		8.61	1.2		97.04		2.03		2.4	4.872
	94.0		7.86	0.35				0.84		0.7	0.238
	96.0		8.31	0.8		97.34		0		1.6	0
	98.0		8.35	1.25				0.89		2.5	2.225
	100		8.1	1		97.55		2.74		2	5.48
	102		8.72	1.5				3.48		3	10.44
	104		8.82	1.6		96.83		1.8		3.2	5.76
	106		8.82	1.6				3.24		3.2	10.368
	108		8.83	1.5		96.82		2.59		3	7.77
	110		8.77	1.4				1.14		2.8	3.192
	112		8.77	1.4		96.88		2.83		2.8	7.924
	114		8.70	1				0.53		2	1.06
	116		8.3	0.55		97.35		1.41		1.1	1.551
	118		8.25	0.5				2.2		1	2.2
TOTALS:											

End of Measurement	Time:	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

DISCHARGE/CROSS SECTION NOTES

STREAM NAME:	CROSS-SECTION NO.:	DATE:	SHEET 2 OF 2

BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: _____ ft	TIME:

Features: Stake (S), Grassline (G), Waterline (W), Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft) (FS)	Water Depth (ft)	Depth of Observation (ft)	~~Revolutions~~ Channel profile relative to BM = 100'	Time (sec)	Velocity (ft/sec): At Point	Velocity (ft/sec): Mean in Vertical	Area (ft^2)	Discharge (cfs)
	120	2	8.16	0.6	0.6d	97.49	20	1.07		1.2	1.284
	122		7.89	0.5				3		1	3
	124		8.09	0.7		97.56		0.43		1.4	0.602
Rock/eddy	126		8.64	0.9				0		1.8	0
	128		8.59	0.85		97.06		0.29		1.7	0.493
	130		8.72	1.2				1.86		2.4	4.464
	132		8.82	1.3		96.83		2.05		2.6	5.33
Rock/eddy	134		8.01	0.1				0		0.2	0
	136		8.86	0.95		96.79		2.07		1.9	3.933
	138		8.38	1.3				1.21		2.6	3.146
	140		8.48	1.4		97.17		1.86		2.8	5.208
	142		8.18	1.1				1.61		2.2	3.542
	144		9.2	1.85		96.45		2.04		3.7	7.548
	146		9.25	1.9				3.38		3.8	12.844
Rock	148		9.39	0.95		96.26		2.37		1.9	4.503
Plunge pool	150		8.94	1.3				1.14		2.6	2.964
	152		9.24	1.6		96.41		2.83		3.2	9.056
	154		9.24	1.6				3.61		3.2	11.552
	156		8.85	1.5		96.8		3.77		3	11.31
	158		8.55	1.2				2.4		2.4	5.76
	160		8.28	0.5		97.37		1.12		1	1.12
	162		7.35	0				0		0	0
	162.3	0.3	7.35	0		98.3		0		0	0
LWE (W)	163	0.7	6.33			99.32					
LBF (G)	163.5	0.5	4.85			100.8					
S	165	1.5	4.45			101.2					
BM #1 check	5.64					100					
										Q =	166.4 cfs
TOTALS:											

End of Measurement	Time:	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Dolores River
XS LOCATION:	Mile Marker 101
XS NUMBER:	2
DATE:	27-Feb-12
OBSERVERS:	R. Smith, N. Dieterich, E. Rumbold, D. Graf
1/4 SEC:	NW
SECTION:	31
TWP:	50N
RANGE:	18W
PM:	NM
COUNTY:	Mesa
WATERSHED:	Dolores
DIVISION:	4
DOW CODE:	39760
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

*** NOTE ***
Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod

CHANNEL PROFILE DATA

SLOPE:	0.014

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 2

DATA POINTS= 67

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
1	RS & G	0.00	4.85			0.00		0.00	0.00	0.0%
		22.00	5.94			0.00		0.00	0.00	0.0%
		27.00	6.59			0.00		0.00	0.00	0.0%
	W	30.30	7.15	0.00	0.00	0.00		0.00	0.00	0.0%
		30.50	7.15	0.00	0.00	0.00		0.00	0.00	0.0%
		32.00	7.48	0.23	0.05	1.54	0.23	0.23	0.01	0.0%
		32.50	7.60	0.35	0.05	0.51	0.35	0.61	0.03	0.0%
		35.50	7.60	0.35	0.10	3.00	0.35	0.61	0.06	0.0%
		36.00	7.56	0.31	0.10	0.50	0.31	0.62	0.06	0.0%
		39.50	7.15	0.00	0.00	3.52		0.00	0.00	0.0%
		40.00	6.75	0.00	0.00	0.00		0.00	0.00	0.0%
		44.00	6.87	0.00	0.00	0.00		0.00	0.00	0.0%
		48.00	7.03	0.00	0.00	0.00		0.00	0.00	0.0%
		52.00	7.50	0.40	0.24	4.03	0.40	1.60	0.38	0.2%
		56.00	7.58	0.50	0.26	4.00	0.50	2.00	0.52	0.3%
		60.00	6.92	0.00	0.00	4.05		0.00	0.00	0.0%
		64.00	7.35	0.10	0.00	4.02	0.10	0.40	0.00	0.0%
		68.00	7.29	0.04	0.00	4.00	0.04	0.16	0.00	0.0%
		72.00	7.44	0.32	0.00	4.00	0.32	1.28	0.00	0.0%
		76.00	7.62	0.30	0.29	4.00	0.30	1.05	0.30	0.2%
		79.00	7.72	0.40	0.08	3.00	0.40	0.80	0.06	0.0%
		80.00	7.61	0.36	0.08	1.01	0.36	0.54	0.04	0.0%
		82.00	7.95	0.70	0.64	2.03	0.70	1.40	0.90	0.5%
		84.00	8.22	0.97	1.40	2.02	0.97	1.46	2.04	1.2%
		85.00	8.01	0.50	1.40	1.02	0.50	1.00	1.40	0.8%
		88.00	7.91	0.40	0.00	3.00	0.40	1.00	0.00	0.0%
		90.00	8.01	0.50	0.12	2.00	0.50	1.00	0.12	0.1%
		92.00	8.61	1.20	2.03	2.09	1.20	2.40	4.87	2.9%
		94.00	7.86	0.35	0.34	2.14	0.35	0.70	0.24	0.1%
		96.00	8.31	0.80	0.00	2.05	0.80	1.60	0.00	0.0%
		98.00	8.35	1.25	0.89	2.00	1.25	2.50	2.23	1.3%
		100.00	8.10	1.00	2.74	2.02	1.00	2.00	5.48	3.3%
		102.00	8.72	1.50	3.48	2.09	1.50	3.00	10.44	6.3%
		104.00	8.82	1.60	1.80	2.00	1.60	3.20	5.76	3.5%
		106.00	8.82	1.60	3.24	2.00	1.60	3.20	10.37	6.2%
		108.00	8.83	1.50	2.59	2.00	1.50	3.00	7.77	4.7%
		110.00	8.77	1.40	1.14	2.00	1.40	2.80	3.19	1.9%
		112.00	8.77	1.40	2.83	2.00	1.40	2.80	7.92	4.8%
		114.00	8.70	1.00	0.53	2.00	1.00	2.00	1.06	0.6%
		116.00	8.30	0.55	1.41	2.04	0.55	1.10	1.55	0.9%
		118.00	8.25	0.50	2.20	2.00	0.50	1.00	2.20	1.3%
		120.00	8.16	0.60	1.07	2.00	0.60	1.20	1.28	0.8%
		122.00	7.89	0.50	3.00	2.02	0.50	1.00	3.00	1.8%
		124.00	8.09	0.70	0.43	2.01	0.70	1.40	0.60	0.4%
		126.00	8.64	0.90	0.00	2.07	0.90	1.80	0.00	0.0%
		128.00	8.59	0.85	0.29	2.00	0.85	1.70	0.49	0.3%
		130.00	8.72	1.20	1.86	2.00	1.20	2.40	4.46	2.7%
		132.00	8.82	1.30	2.05	2.00	1.30	2.60	5.33	3.2%
		134.00	8.01	0.10	0.00	2.16	0.10	0.20	0.00	0.0%
		136.00	8.86	0.95	2.07	2.17	0.95	1.90	3.93	2.4%
		138.00	8.38	1.30	1.21	2.06	1.30	2.60	3.15	1.9%
		140.00	8.48	1.40	1.86	2.00	1.40	2.80	5.21	3.1%
		142.00	8.18	1.10	1.61	2.02	1.10	2.20	3.54	2.1%
		144.00	9.20	1.85	2.04	2.25	1.85	3.70	7.55	4.5%
		146.00	9.25	1.90	3.38	2.00	1.90	3.80	12.84	7.7%
		148.00	8.39	0.95	2.37	2.18	0.95	1.90	4.50	2.7%
		150.00	8.94	1.30	1.14	2.07	1.30	2.60	2.96	1.8%
		152.00	9.24	1.60	2.83	2.02	1.60	3.20	9.06	5.4%
		154.00	9.24	1.60	3.61	2.00	1.60	3.20	11.55	6.9%
		156.00	8.85	1.50	3.77	2.04	1.50	3.00	11.31	6.8%
		158.00	8.55	1.20	2.40	2.02	1.20	2.40	5.76	3.5%
		160.00	8.28	0.50	1.12	2.02	0.50	1.00	1.12	0.7%
		162.00	7.35	0.00	0.00	2.21		0.00	0.00	0.0%
		162.30	7.35	0.00	0.00	0.00		0.00	0.00	0.0%
	W	163.00	6.33	0.00	0.00	0.00		0.00	0.00	0.0%
1	G	163.50	4.85			0.00		0.00	0.00	0.0%
	LS	165.00	4.45			0.00		0.00	0.00	0.0%
	TOTALS ----------					125.03	1.9 (Max.)	93.66	166.67	100.0%

Manning's n = 0.0815
Hydraulic Radius= 0.74912877

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	93.66	107.72	15.0%
7.00	93.66	137.65	47.0%
7.02	93.66	135.17	44.3%
7.04	93.66	132.72	41.7%
7.06	93.66	130.27	39.1%
7.08	93.66	127.84	36.5%
7.10	93.66	125.42	33.9%
7.12	93.66	123.01	31.3%
7.14	93.66	120.62	28.8%
7.16	93.66	118.24	26.2%
7.18	93.66	115.87	23.7%
7.20	93.66	113.53	21.2%
7.21	93.66	112.36	20.0%
7.22	93.66	111.19	18.7%
7.23	93.66	110.03	17.5%
7.24	93.66	108.88	16.2%
7.25	93.66	107.72	15.0%
7.26	93.66	106.57	13.8%
7.27	93.66	105.43	12.6%
7.28	93.66	104.29	11.3%
7.29	93.66	103.15	10.1%
7.30	93.66	102.02	8.9%
7.32	93.66	99.80	6.6%
7.34	93.66	97.63	4.2%
7.36	93.66	95.51	2.0%
7.38	93.66	93.43	-0.2%
7.40	93.66	91.36	-2.5%
7.42	93.66	89.32	-4.6%
7.44	93.66	87.30	-6.8%
7.46	93.66	85.31	-8.9%
7.48	93.66	83.33	-11.0%
7.50	93.66	81.37	-13.1%

WATERLINE AT ZERO
AREA ERROR = 7.378

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 2

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	4.85	163.50	2.74	4.40	447.80	167.39	100.0%	2.68	1861.86	4.16
	6.38	137.60	1.60	2.87	220.74	140.34	83.8%	1.57	644.11	2.92
	6.43	137.18	1.56	2.82	213.87	139.90	83.6%	1.53	612.36	2.86
	6.48	136.76	1.51	2.77	207.02	139.45	83.3%	1.48	581.27	2.81
	6.53	136.34	1.47	2.72	200.20	139.00	83.0%	1.44	550.85	2.75
	6.58	135.92	1.42	2.67	193.39	138.55	82.8%	1.40	521.11	2.69
	6.63	135.57	1.38	2.62	186.60	138.17	82.5%	1.35	491.89	2.64
	6.68	135.24	1.33	2.57	179.83	137.81	82.3%	1.30	463.31	2.58
	6.73	134.92	1.28	2.52	173.08	137.45	82.1%	1.26	435.43	2.52
	6.78	133.63	1.24	2.47	166.35	136.12	81.3%	1.22	410.24	2.47
	6.83	131.57	1.21	2.42	159.72	134.02	80.1%	1.19	387.36	2.43
	6.88	129.58	1.18	2.37	153.20	131.97	78.8%	1.16	365.06	2.38
	6.93	127.82	1.15	2.32	146.76	130.17	77.8%	1.13	342.99	2.34
	6.98	125.41	1.12	2.27	140.43	127.70	76.3%	1.10	322.78	2.30
	7.03	123.00	1.09	2.22	134.22	125.24	74.8%	1.07	303.25	2.26
	7.08	121.38	1.06	2.17	128.11	123.55	73.8%	1.04	283.14	2.21
	7.13	119.79	1.02	2.12	122.08	121.91	72.8%	1.00	263.62	2.16
	7.18	117.84	0.99	2.07	116.14	119.91	71.6%	0.97	245.28	2.11
	7.23	115.96	0.95	2.02	110.29	117.98	70.5%	0.93	227.49	2.06
	7.28	114.08	0.92	1.97	104.54	116.06	69.3%	0.90	210.36	2.01
	7.33	108.69	0.91	1.92	98.95	110.63	66.1%	0.89	198.18	2.00
WL	7.38	103.90	0.90	1.87	93.66	105.79	63.2%	0.89	186.30	1.99
	7.43	101.07	0.88	1.82	88.53	102.94	61.5%	0.86	172.74	1.95
	7.48	98.42	0.85	1.77	83.55	100.26	59.9%	0.83	159.62	1.91
	7.53	94.69	0.83	1.72	78.71	96.51	57.7%	0.82	148.23	1.88
	7.58	89.96	0.82	1.67	74.09	91.75	54.8%	0.81	138.61	1.87
	7.63	84.91	0.82	1.62	69.73	86.69	51.8%	0.80	130.12	1.87
	7.68	82.56	0.79	1.57	65.54	84.31	50.4%	0.78	119.55	1.82
	7.73	80.50	0.76	1.52	61.47	82.23	49.1%	0.75	109.24	1.78
	7.78	80.09	0.72	1.47	57.46	81.81	48.9%	0.70	97.94	1.70
	7.83	79.69	0.67	1.42	53.46	81.40	48.6%	0.66	87.15	1.63
	7.88	79.17	0.63	1.37	49.49	80.85	48.3%	0.61	76.97	1.56
	7.93	76.88	0.59	1.32	45.57	78.53	46.9%	0.58	68.40	1.50
	7.98	72.71	0.58	1.27	41.83	74.32	44.4%	0.56	61.52	1.47
	8.03	69.15	0.55	1.22	38.29	70.72	42.2%	0.54	54.89	1.43
	8.08	66.80	0.52	1.17	34.90	68.30	40.8%	0.51	48.11	1.38
	8.13	64.38	0.49	1.12	31.61	65.81	39.3%	0.48	41.84	1.32
	8.18	61.53	0.46	1.07	28.46	62.87	37.6%	0.45	36.20	1.27
	8.23	57.88	0.44	1.02	25.48	59.12	35.3%	0.43	31.36	1.23
	8.28	54.23	0.42	0.97	22.67	55.39	33.1%	0.41	26.96	1.19
	8.33	50.10	0.40	0.92	20.06	51.18	30.6%	0.39	23.18	1.16
	8.38	46.86	0.38	0.87	17.65	47.86	28.6%	0.37	19.59	1.11
	8.43	43.55	0.35	0.82	15.39	44.46	26.6%	0.35	16.37	1.06
	8.48	40.11	0.33	0.77	13.30	40.91	24.4%	0.33	13.56	1.02
	8.53	37.94	0.30	0.72	11.35	38.65	23.1%	0.29	10.82	0.95
	8.58	35.85	0.27	0.67	9.50	36.47	21.8%	0.26	8.37	0.88
	8.63	31.80	0.25	0.62	7.80	32.33	19.3%	0.24	6.52	0.84
	8.68	28.90	0.22	0.57	6.30	29.35	17.5%	0.21	4.87	0.77
	8.73	25.73	0.19	0.52	4.92	26.11	15.6%	0.19	3.49	0.71
	8.78	19.08	0.20	0.47	3.76	19.41	11.6%	0.19	2.72	0.72
	8.83	11.05	0.27	0.42	2.95	11.31	6.8%	0.26	2.60	0.88
	8.88	9.58	0.26	0.37	2.45	9.80	5.9%	0.25	2.10	0.86
	8.93	8.93	0.22	0.32	1.99	9.12	5.4%	0.22	1.55	0.78
	8.98	8.16	0.19	0.27	1.56	8.32	5.0%	0.19	1.10	0.71
	9.03	7.36	0.16	0.22	1.17	7.48	4.5%	0.16	0.73	0.63
	9.08	6.55	0.13	0.17	0.82	6.65	4.0%	0.12	0.44	0.54
	9.13	5.75	0.09	0.12	0.52	5.81	3.5%	0.09	0.22	0.43

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 101
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	166.67	cfs
CALCULATED FLOW (Qc)=	186.30	cfs
(Qm-Qc)/Qm * 100 =	-11.8	%
MEASURED WATERLINE (WLm)=	7.25	ft
CALCULATED WATERLINE (WLc)=	7.38	ft
(WLm-WLc)/WLm * 100 =	-1.8	%
MAX MEASURED DEPTH (Dm)=	1.90	ft
MAX CALCULATED DEPTH (Dc)=	1.87	ft
(Dm-Dc)/Dm * 100	1.5	%
MEAN VELOCITY=	1.99	ft/sec
MANNING'S N=	0.081	
SLOPE=	0.014	ft/ft
.4 * Qm =	66.7	cfs
2.5 * Qm=	416.7	cfs

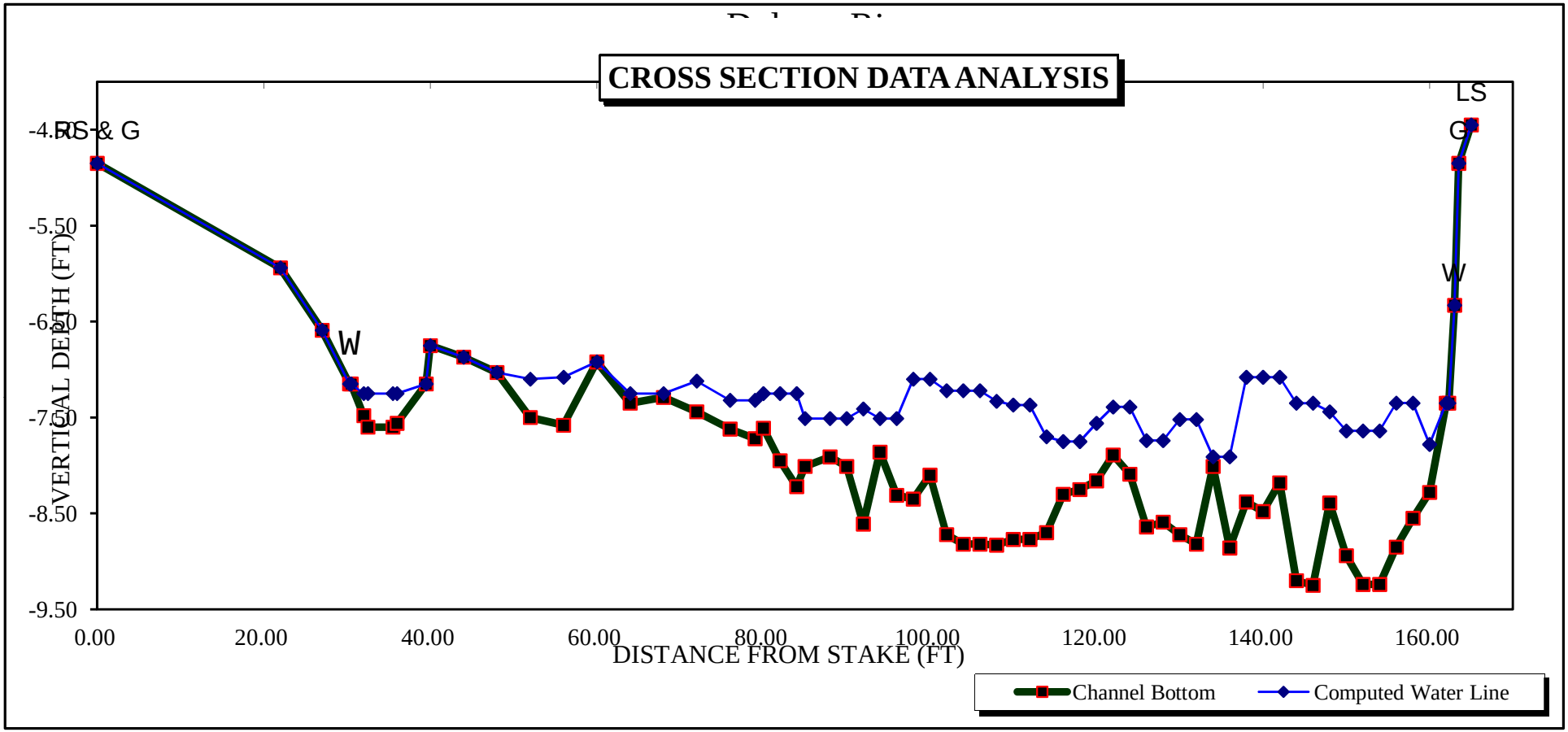
RECOMMENDED INSTREAM FLOW:
=============================

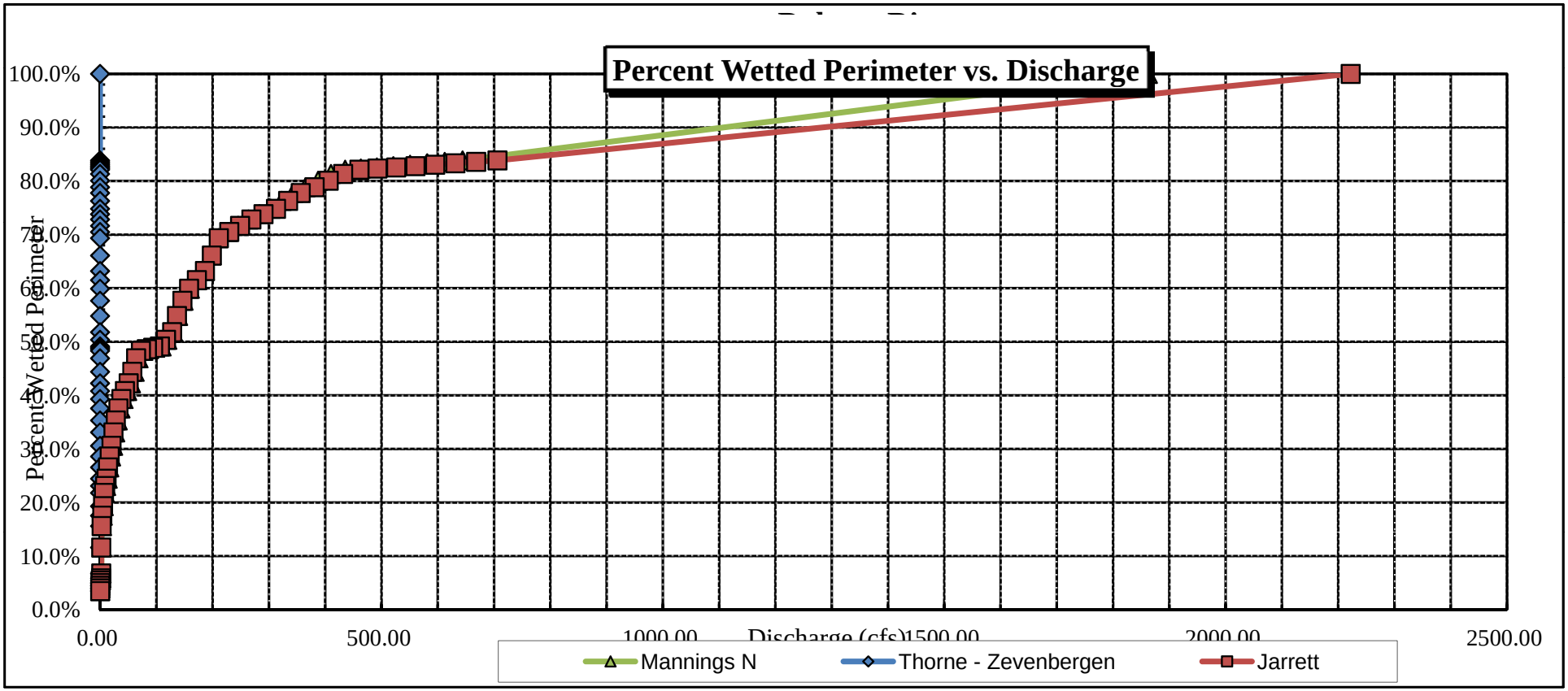
FLOW (CFS)	PERIOD
===========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

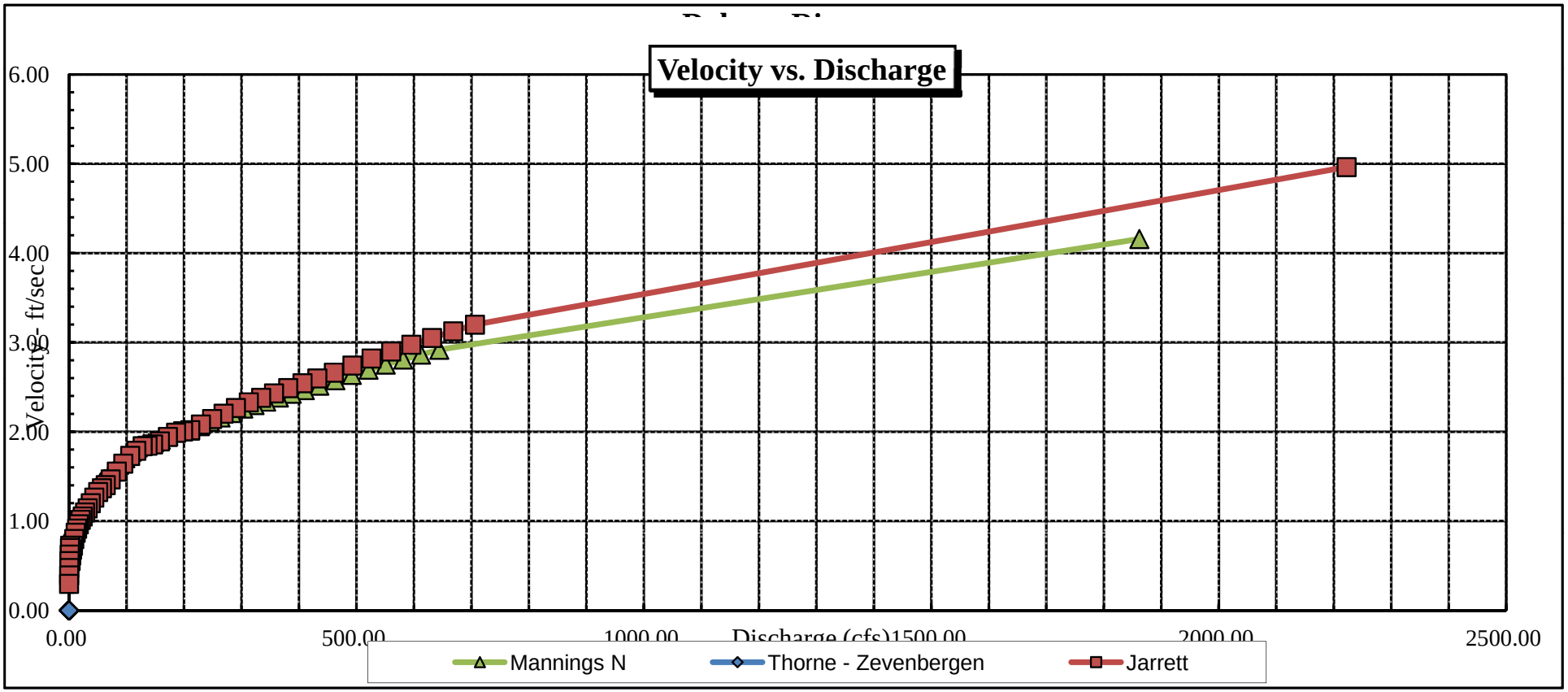
RATIONALE FOR RECOMMENDATION:
=============================

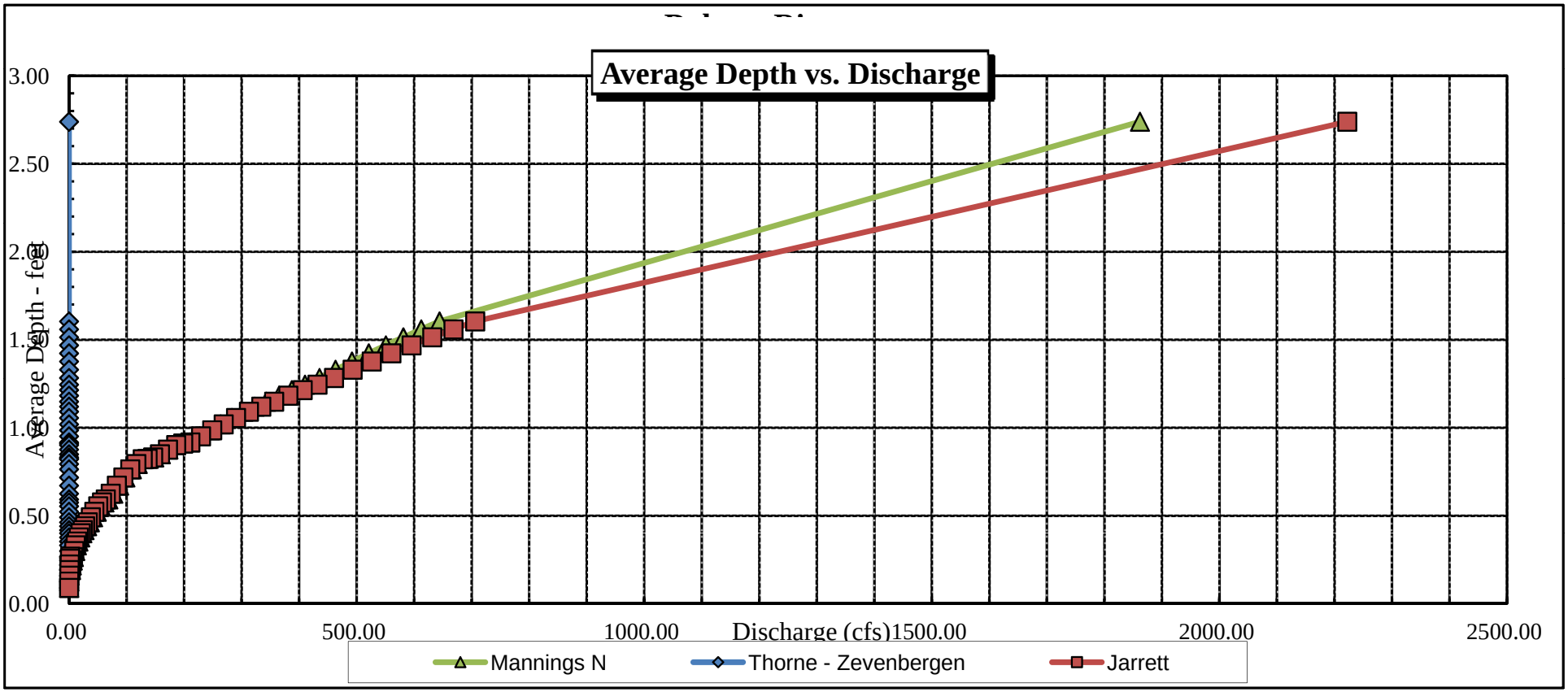
RECOMMENDATION BY: …………………...………..……............................... AGENCY...……………………......…….....…....…....... DATE:......…...…......……………

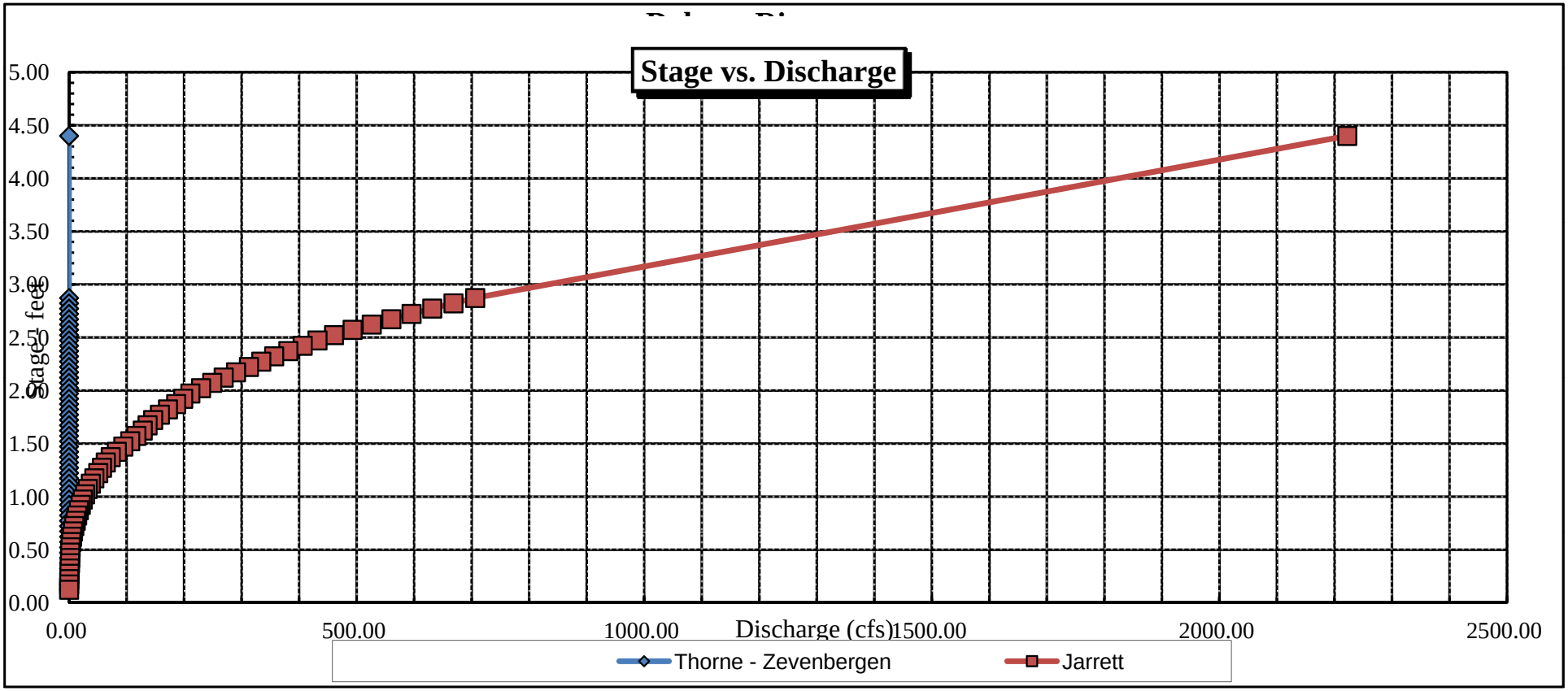
CWCB REVIEW BY: ...……………………….....………………………………………………..…............. DATE:.................…………….....


CROSS SECTION DATA ANALYSIS
RS & G
W
LS
G
W
-4.50
-5.50
-6.50
-7.50
-8.50
-9.50
VERTICAL DEPTH (FT)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
500.00
1000.00
Discharge (cfs)
1500.00
2000.00
2500.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Velocity - ft/sec
0.00
500.00
1000.00
Discharge (cfs)1500.00
2000.00
2500.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
500.00
1000.00
Discharge (cfs)
1500.00
2000.00
2500.00
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Stage, feet
0.00
500.00
1000.00
1500.00
2000.00
2500.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Dolores River					CROSS-SECTION NO.: 3
CROSS-SECTION LOCATION: Mile Marker 96 GPS Zone 12 683455 4263991					
DATE: 2-27-13	OBSERVERS: R. Smith, D. Graf, E. Rumbold, N. Dieterich				
LEGAL DESCRIPTION	¼ SECTION: SE	SECTION: 17	TOWNSHIP: 49 (N) S	RANGE: 18 E (W)	PM: NM
COUNTY: Mesa	WATERSHED: Dolores	WATER DIVISION: 4	DOW WATER CODE: 39760		
MAP(S):	USGS:				
	USFS:				

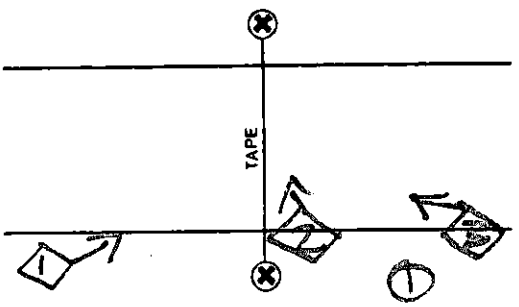
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES / NO)	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ____ sec	TAPE WEIGHT: surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 2" cobbles to 1-foot boulders	PHOTOGRAPHS TAKEN: (YES/NO)	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
(⊗) Tape @ Stake LB	0.0	surveyed
(⊗) Tape @ Stake RB	0.0	surveyed
(1) WS @ Tape LB/RB	0.0	8.90/8.94
(2) WS Upstream	39.0	8.61
(3) WS Downstream	132.5	10.42
SLOPE	1.81 / 171.5 = .0105	

SKETCH



LEGEND:
- Stake (⊗)
- Station (1)
- Photo (1)
- Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River	CROSS-SECTION NO.: 3	DATE: 2-27-13	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: ____ ft	TIME: 12:40 pm.

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Obser-vation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	1.0		4.98								
G	3.0		5.91								
	5.3		7.80								
W	9.0		8.90								
	10		9.15	.25				.43			
	12		9.36	.45				1.08			
	14		9.46	.60				1.81			
	16		9.39	.50				1.98			
	18		10.00	.90				1.91			
	20		10.26	1.5				1.37			
	22		10.29	1.55				2.83			
	24		10.07	1.2				2.36			
	26		10.45	1.6				2.28			
	28		10.53	1.75				1.89			
	30		10.37	1.5				2.29			
	32		10.25	1.3				2.25			
	34		10.38	1.5				2.07			
	36		10.28	1.25				2.2			
	38		9.99	1.1				1.42			
	40		9.84	1.0				1.75			
	42		9.80	0.9				1.92			
	44		9.78	0.9				0.43			
	46		9.95	0.9				2.19			
	48		9.85	0.9				0.83			
	50		9.60	0.75				2.17			
	52		9.88	0.85				1.08			
	54		9.72	0.75				1.75			
	56		9.57	0.75				1.26			
	58		9.24	0.5				0.41			
	60		9.05	0.1				0			
	62		8.94	0				0			
	64		9.19	0.3				1.16			
	66		9.20	0.3				1.28			
	68		9.14	0.1				0			
	70		8.97	0				0			
W	71		8.94	0							
	85		8.52								
	90		7.55								
	92		6.01								
G	93		5.73								
RS	96.6		4.72								
TOTALS:											

End of Measurement	Time	Gage Reading ft	CALCULATIONS PERFORMED BY	CALCULATIONS CHECKED BY

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Dolores River
XS LOCATION:	Mile Marker 96
XS NUMBER:	3
DATE:	27-Feb-13
OBSERVERS:	R. Smith, D. Graf, N. Dieterich, E. Rumbold
1/4 SEC:	SE
SECTION:	17
TWP:	49N
RANGE:	18W
PM:	New Mexico
COUNTY:	Mesa
WATERSHED:	Dolores
DIVISION:	4
DOW CODE:	39760
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

		*** NOTE ***
		Leave TAPE WT and TENSION
		at defaults for data collected
TAPE WT:	0.0106	with a survey level and rod
TENSION:	99999	

CHANNEL PROFILE DATA

SLOPE:	0.0105

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 96
XS NUMBER: 3

DATA POINTS= 41

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	LS	1.00	4.98			0.00		0.00	0.00	0.0%
1	G	3.00	5.91			0.00		0.00	0.00	0.0%
		5.30	7.80			0.00		0.00	0.00	0.0%
	W	9.00	8.90	0.00	0.00	0.00		0.00	0.00	0.0%
		10.00	9.15	0.25	0.43	1.03	0.25	0.38	0.16	0.2%
		12.00	9.36	0.45	1.08	2.01	0.45	0.90	0.97	1.0%
		14.00	9.46	0.60	1.81	2.00	0.60	1.20	2.17	2.3%
		16.00	9.39	0.50	1.98	2.00	0.50	1.00	1.98	2.1%
		18.00	10.00	0.90	1.91	2.09	0.90	1.80	3.44	3.7%
		20.00	10.26	1.50	1.37	2.02	1.50	3.00	4.11	4.4%
		22.00	10.29	1.55	2.83	2.00	1.55	3.10	8.77	9.4%
		24.00	10.07	1.20	2.36	2.01	1.20	2.40	5.66	6.1%
		26.00	10.45	1.60	2.28	2.04	1.60	3.20	7.30	7.8%
		28.00	10.53	1.75	1.89	2.00	1.75	3.50	6.62	7.1%
		30.00	10.37	1.50	2.29	2.01	1.50	3.00	6.87	7.4%
		32.00	10.25	1.30	2.25	2.00	1.30	2.60	5.85	6.3%
		34.00	10.38	1.50	2.07	2.00	1.50	3.00	6.21	6.7%
		36.00	10.28	1.25	2.20	2.00	1.25	2.50	5.50	5.9%
		38.00	9.99	1.10	1.42	2.02	1.10	2.20	3.12	3.3%
		40.00	9.84	1.00	1.75	2.01	1.00	2.00	3.50	3.7%
		42.00	9.80	0.90	1.92	2.00	0.90	1.80	3.46	3.7%
		44.00	9.78	0.90	0.43	2.00	0.90	1.80	0.77	0.8%
		46.00	9.95	0.90	2.19	2.01	0.90	1.80	3.94	4.2%
		48.00	9.85	0.90	0.83	2.00	0.90	1.80	1.49	1.6%
		50.00	9.60	0.75	2.17	2.02	0.75	1.50	3.26	3.5%
		52.00	9.88	0.85	1.08	2.02	0.85	1.70	1.84	2.0%
		54.00	9.72	0.75	1.75	2.01	0.75	1.50	2.63	2.8%
		56.00	9.57	0.75	1.26	2.01	0.75	1.50	1.89	2.0%
		58.00	9.24	0.50	0.41	2.03	0.50	1.00	0.41	0.4%
		60.00	9.05	0.10	0.00	2.01	0.10	0.20	0.00	0.0%
		62.00	8.94	0.00	0.00	2.00		0.00	0.00	0.0%
		64.00	9.19	0.30	1.16	2.02	0.30	0.60	0.70	0.7%
		66.00	9.20	0.30	1.28	2.00	0.30	0.60	0.77	0.8%
		68.00	9.14	0.10	0.00	2.00	0.10	0.20	0.00	0.0%
		70.00	8.97	0.00	0.00	2.01		0.00	0.00	0.0%
	W	71.00	8.94	0.00	0.00	0.00		0.00	0.00	0.0%
		85.00	8.52			0.00		0.00	0.00	0.0%
		90.00	7.55			0.00		0.00	0.00	0.0%
		92.00	6.01			0.00		0.00	0.00	0.0%
1	G	93.00	5.73			0.00		0.00	0.00	0.0%
	RS	96.60	4.72			0.00		0.00	0.00	0.0%
	TOTALS ----------					61.37	1.75 (Max.)	51.78	93.38	100.0%

Manning's n = 0.0754
Hydraulic Radius= 0.84370489

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 96
XS NUMBER: 3

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	51.78	48.56	-6.2%
8.71	51.78	65.03	25.6%
8.73	51.78	63.63	22.9%
8.75	51.78	62.24	20.2%
8.77	51.78	60.87	17.6%
8.79	51.78	59.51	14.9%
8.81	51.78	58.17	12.3%
8.83	51.78	56.84	9.8%
8.85	51.78	55.53	7.2%
8.87	51.78	54.23	4.7%
8.89	51.78	52.94	2.3%
8.91	51.78	51.67	-0.2%
8.92	51.78	51.04	-1.4%
8.93	51.78	50.41	-2.6%
8.94	51.78	49.79	-3.8%
8.95	51.78	49.17	-5.0%
8.96	51.78	48.56	-6.2%
8.97	51.78	47.96	-7.4%
8.98	51.78	47.36	-8.5%
8.99	51.78	46.76	-9.7%
9.00	51.78	46.17	-10.8%
9.01	51.78	45.58	-12.0%
9.03	51.78	44.42	-14.2%
9.05	51.78	43.28	-16.4%
9.07	51.78	42.15	-18.6%
9.09	51.78	41.04	-20.7%
9.11	51.78	39.94	-22.9%
9.13	51.78	38.85	-25.0%
9.15	51.78	37.78	-27.0%
9.17	51.78	36.72	-29.1%
9.19	51.78	35.70	-31.1%
9.21	51.78	34.71	-33.0%

WATERLINE AT ZERO
AREA ERROR = 8.903

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 96
XS NUMBER: 3

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	5.91	89.36	3.36	4.62	300.41	91.20	100.0%	3.29	1343.49	4.47
	7.90	82.53	1.55	2.63	127.97	83.11	91.1%	1.54	344.72	2.69
	7.95	82.10	1.51	2.58	123.86	82.67	90.6%	1.50	327.59	2.64
	8.00	81.68	1.47	2.53	119.76	82.23	90.2%	1.46	310.84	2.60
	8.05	81.25	1.42	2.48	115.69	81.79	89.7%	1.41	294.47	2.55
	8.10	80.83	1.38	2.43	111.64	81.36	89.2%	1.37	278.48	2.49
	8.15	80.40	1.34	2.38	107.61	80.92	88.7%	1.33	262.87	2.44
	8.20	79.97	1.30	2.33	103.60	80.48	88.2%	1.29	247.64	2.39
	8.25	79.55	1.25	2.28	99.61	80.04	87.8%	1.24	232.80	2.34
	8.30	79.12	1.21	2.23	95.64	79.60	87.3%	1.20	218.35	2.28
	8.35	78.70	1.17	2.18	91.70	79.17	86.8%	1.16	204.30	2.23
	8.40	78.27	1.12	2.13	87.77	78.73	86.3%	1.11	190.64	2.17
	8.45	77.85	1.08	2.08	83.87	78.29	85.8%	1.07	177.38	2.11
	8.50	77.42	1.03	2.03	79.99	77.85	85.4%	1.03	164.52	2.06
	8.55	76.05	1.00	1.98	76.15	76.48	83.9%	1.00	153.37	2.01
	8.60	74.22	0.98	1.93	72.39	74.63	81.8%	0.97	143.28	1.98
	8.65	72.38	0.95	1.88	68.72	72.79	79.8%	0.94	133.60	1.94
	8.70	70.55	0.92	1.83	65.15	70.95	77.8%	0.92	124.33	1.91
	8.75	68.71	0.90	1.78	61.67	69.10	75.8%	0.89	115.46	1.87
	8.80	66.88	0.87	1.73	58.28	67.26	73.8%	0.87	106.99	1.84
	8.85	65.04	0.85	1.68	54.98	65.42	71.7%	0.84	98.91	1.80
WL	8.90	63.21	0.82	1.63	51.77	63.57	69.7%	0.81	91.20	1.76
	8.95	60.99	0.80	1.58	48.66	61.35	67.3%	0.79	84.23	1.73
	9.00	58.54	0.78	1.53	45.68	58.88	64.6%	0.78	77.91	1.71
	9.05	56.46	0.76	1.48	42.81	56.80	62.3%	0.75	71.61	1.67
	9.10	54.75	0.73	1.43	40.03	55.07	60.4%	0.73	65.36	1.63
	9.15	52.73	0.71	1.38	37.33	53.03	58.2%	0.70	59.68	1.60
	9.20	47.88	0.73	1.33	34.79	48.18	52.8%	0.72	56.56	1.63
	9.25	46.93	0.69	1.28	32.42	47.23	51.8%	0.69	50.96	1.57
	9.30	46.16	0.65	1.23	30.09	46.44	50.9%	0.65	45.52	1.51
	9.35	45.38	0.61	1.18	27.80	45.66	50.1%	0.61	40.35	1.45
	9.40	43.72	0.58	1.13	25.57	43.99	48.2%	0.58	35.97	1.41
	9.45	40.82	0.57	1.08	23.45	41.08	45.0%	0.57	32.61	1.39
	9.50	40.03	0.54	1.03	21.44	40.28	44.2%	0.53	28.45	1.33
	9.55	39.57	0.49	0.98	19.45	39.80	43.6%	0.49	24.38	1.25
	9.60	38.81	0.45	0.93	17.49	39.03	42.8%	0.45	20.68	1.18
	9.65	37.22	0.42	0.88	15.59	37.43	41.0%	0.42	17.56	1.13
	9.70	35.63	0.39	0.83	13.77	35.82	39.3%	0.38	14.70	1.07
	9.75	34.07	0.35	0.78	12.02	34.25	37.6%	0.35	12.09	1.01
	9.80	30.08	0.35	0.73	10.39	30.24	33.2%	0.34	10.29	0.99
	9.85	25.90	0.35	0.68	9.00	26.04	28.6%	0.35	8.95	0.99
	9.90	22.95	0.34	0.63	7.78	23.08	25.3%	0.34	7.62	0.98
	9.95	20.64	0.32	0.58	6.70	20.75	22.8%	0.32	6.36	0.95
	10.00	19.88	0.29	0.53	5.68	19.98	21.9%	0.28	4.96	0.87
	10.05	19.15	0.25	0.48	4.71	19.25	21.1%	0.24	3.72	0.79
	10.10	17.94	0.21	0.43	3.78	18.03	19.8%	0.21	2.69	0.71
	10.15	16.50	0.18	0.38	2.92	16.57	18.2%	0.18	1.85	0.63
	10.20	15.05	0.14	0.33	2.13	15.11	16.6%	0.14	1.16	0.55
	10.25	13.50	0.10	0.28	1.41	13.54	14.8%	0.10	0.63	0.45
	10.30	8.60	0.10	0.23	0.86	8.62	9.5%	0.10	0.38	0.44
	10.35	5.73	0.09	0.18	0.51	5.75	6.3%	0.09	0.20	0.40
	10.40	3.83	0.07	0.13	0.28	3.84	4.2%	0.07	0.10	0.35
	10.45	2.87	0.04	0.08	0.11	2.88	3.2%	0.04	0.03	0.23
	10.50	1.00	0.01	0.03	0.01	1.00	1.1%	0.01	0.00	0.11

STREAM NAME: Dolores River
XS LOCATION: Mile Marker 96
XS NUMBER: 3

SUMMARY SHEET

MEASURED FLOW (Qm)=	93.38	cfs
CALCULATED FLOW (Qc)=	91.20	cfs
(Qm-Qc)/Qm * 100 =	2.3	%
MEASURED WATERLINE (WLm)=	8.96	ft
CALCULATED WATERLINE (WLc)=	8.90	ft
(WLm-WLc)/WLm * 100 =	0.6	%
MAX MEASURED DEPTH (Dm)=	1.75	ft
MAX CALCULATED DEPTH (Dc)=	1.63	ft
(Dm-Dc)/Dm * 100	7.0	%
MEAN VELOCITY=	1.76	ft/sec
MANNING'S N=	0.075	
SLOPE=	0.0105	ft/ft
.4 * Qm =	37.4	cfs
2.5 * Qm=	233.5	cfs

RECOMMENDED INSTREAM FLOW:
==========

FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

RATIONALE FOR RECOMMENDATION:
==========

_____
_____
_____
_____
_____
_____
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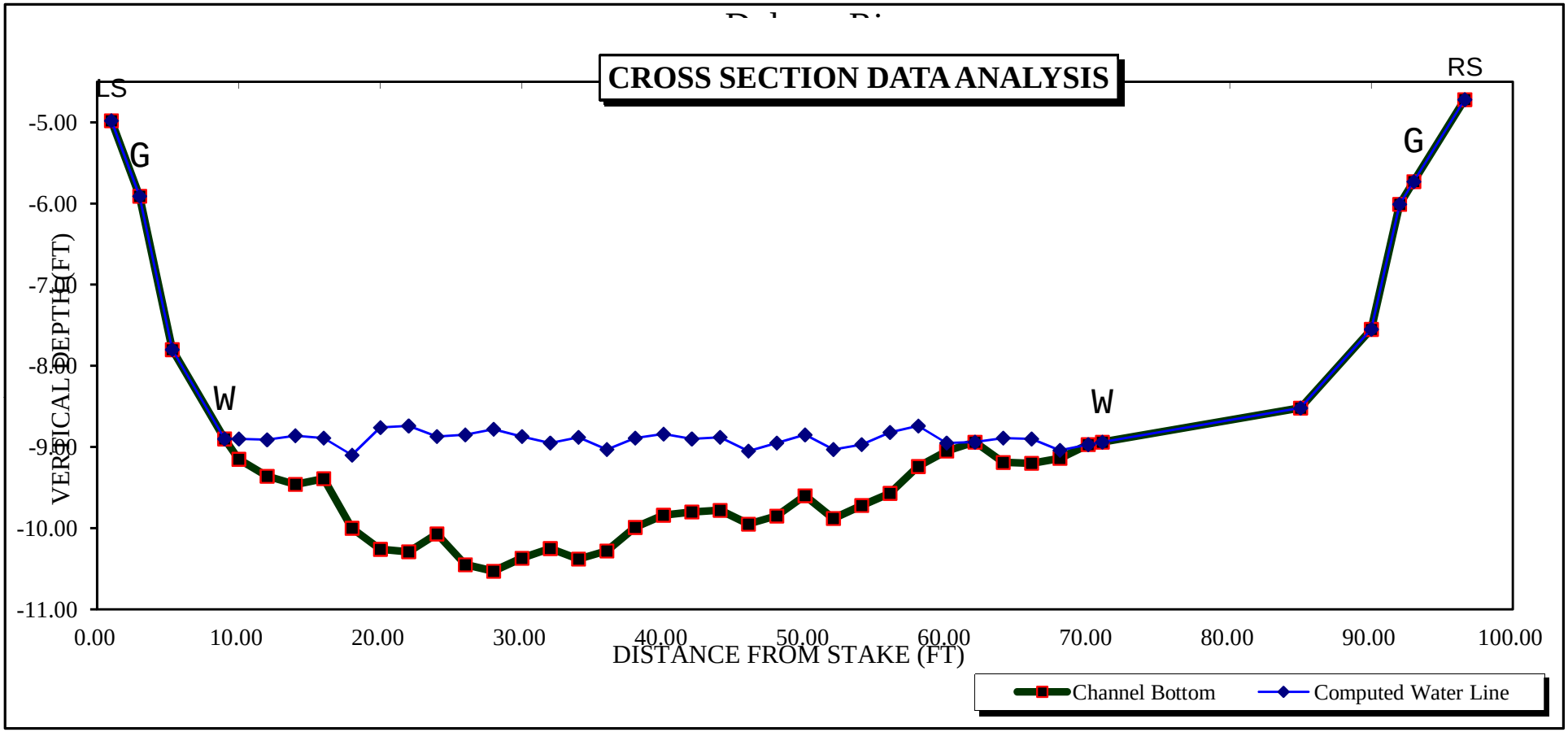
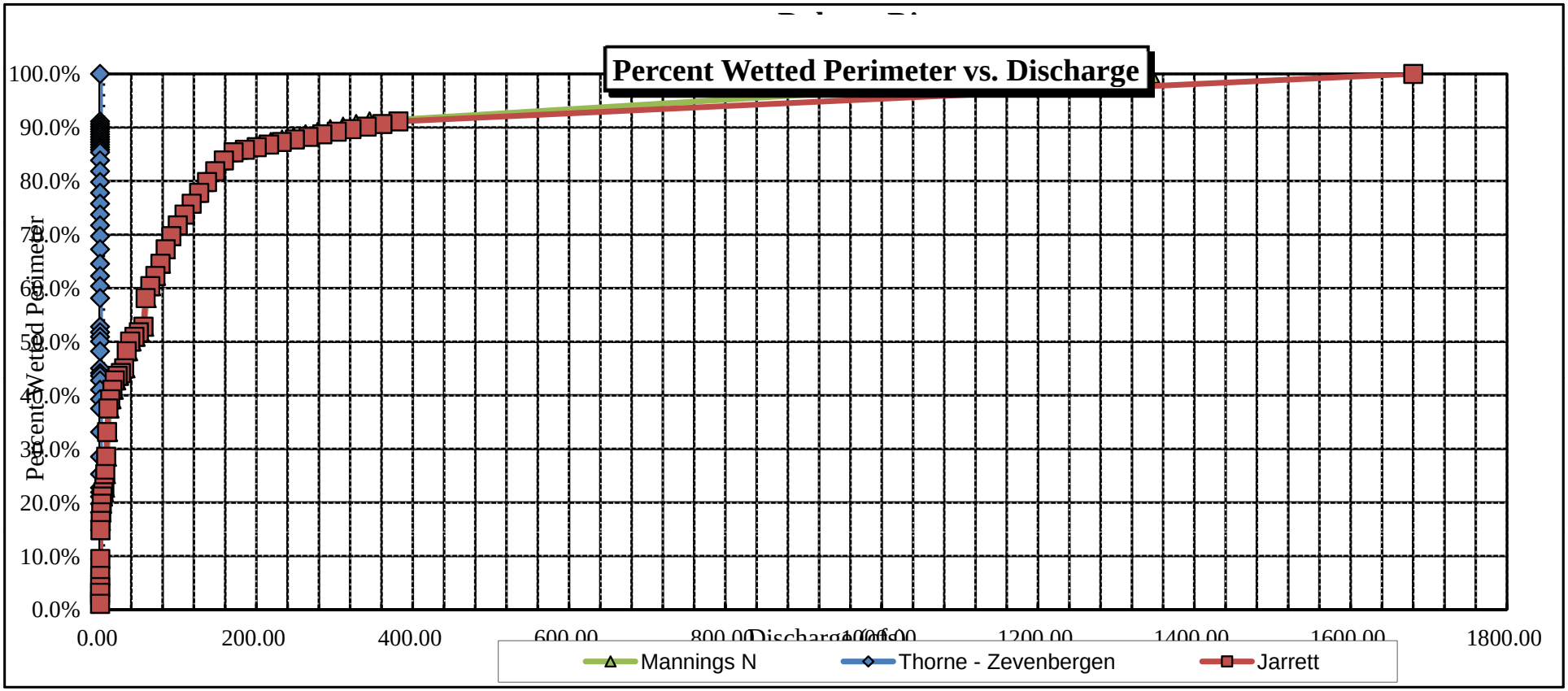
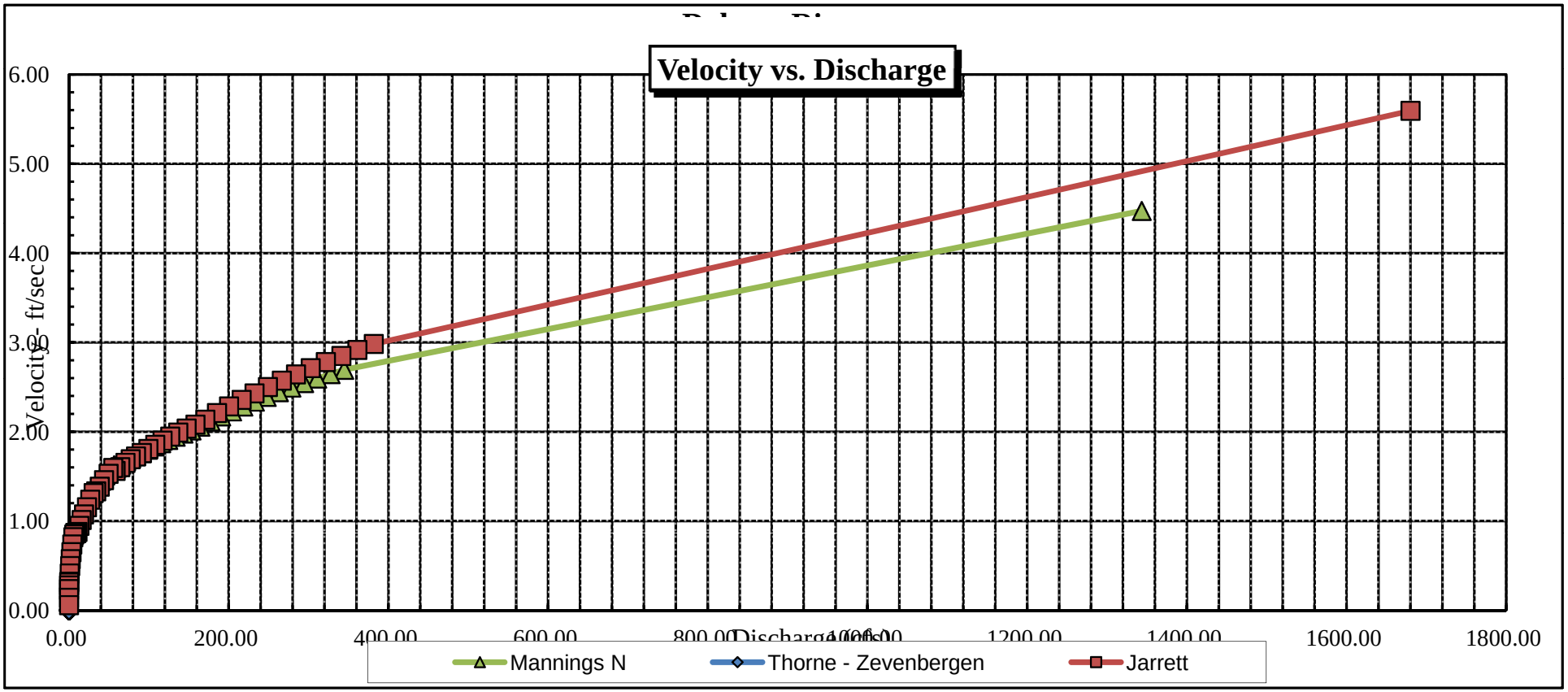
_____
_____
_____
_____
_____

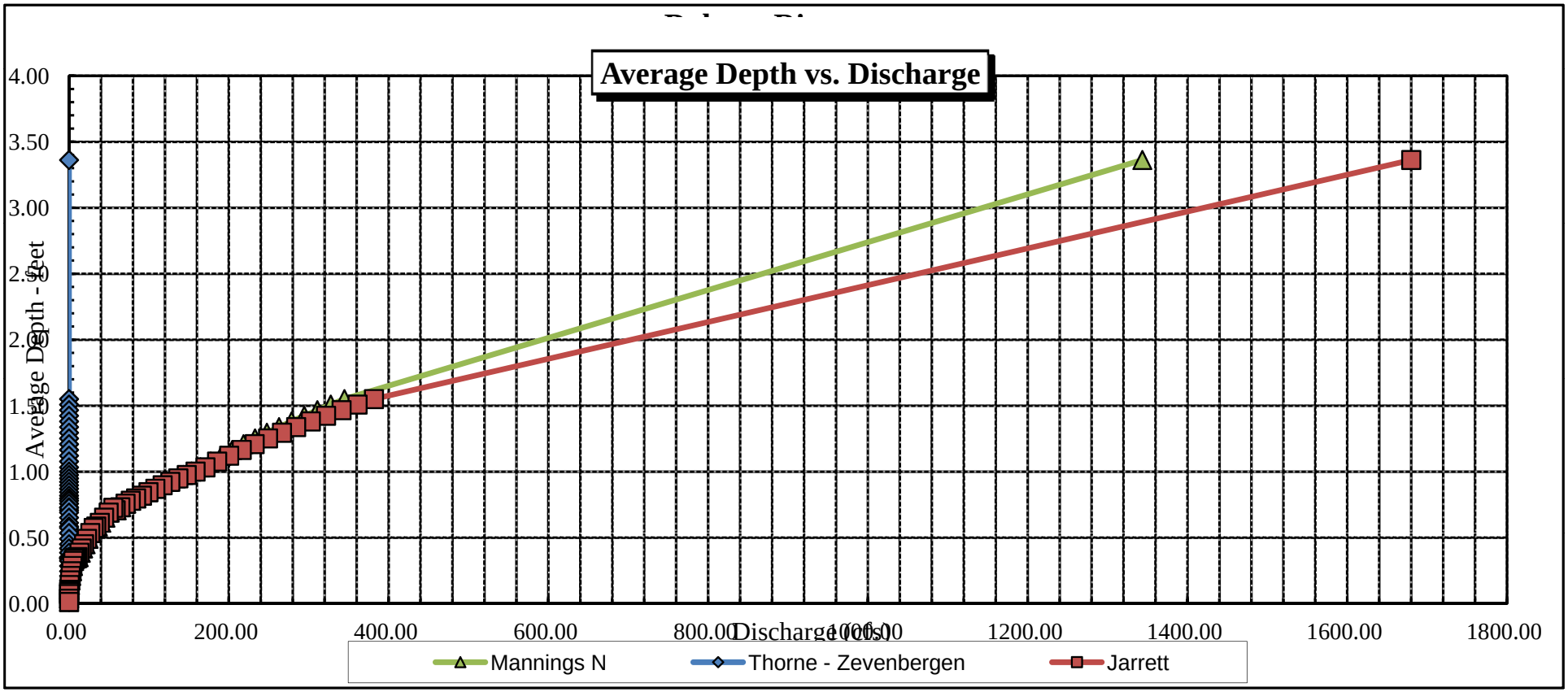
RECOMMENDATION BY: …….. AGENCY..…….. DATE:.....

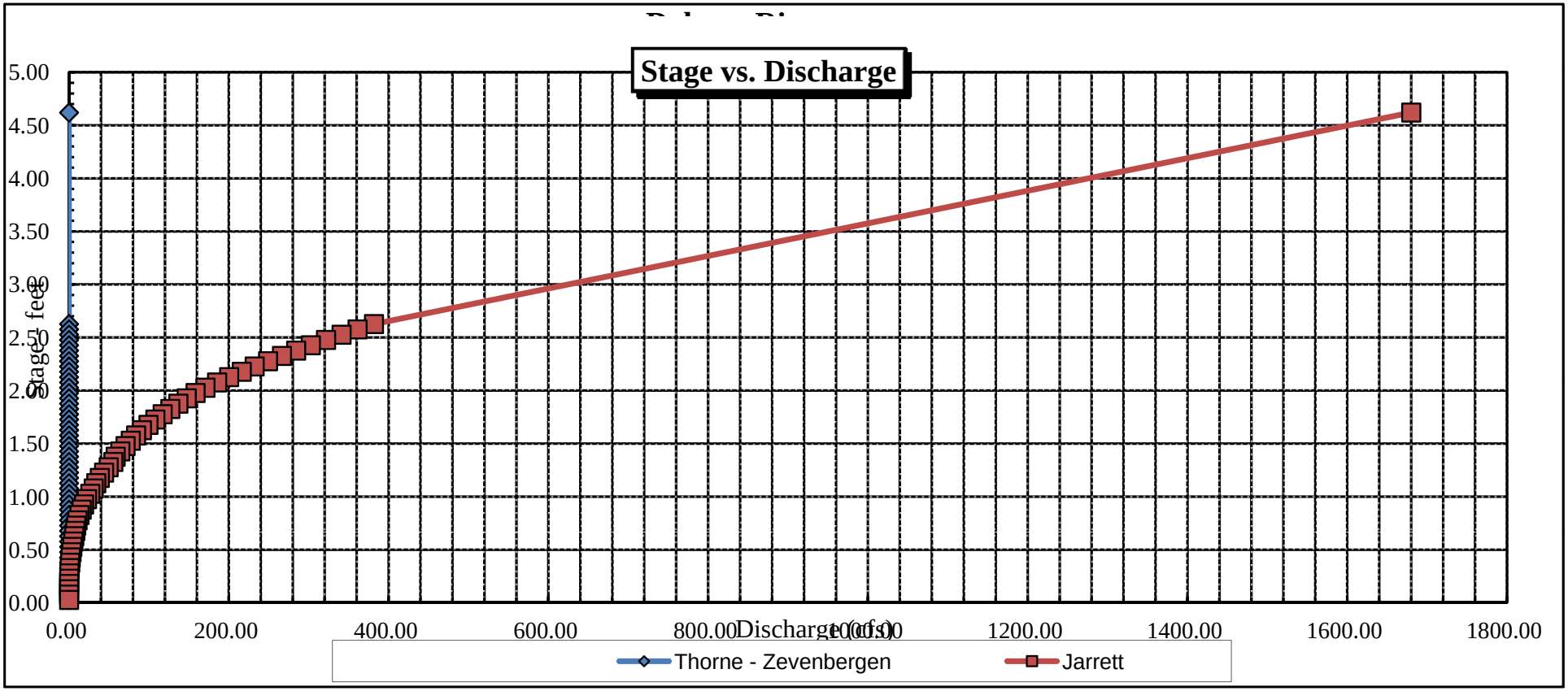
CWCB REVIEW BY: ..…….. DATE:.....


CROSS SECTION DATA ANALYSIS
LS
RS
G
G
W
W
-5.00
-6.00
-7.00
-8.00
-9.00
-10.00
-11.00
VERTICAL DEPTH (FT)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
1600.00
1800.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Velocity - ft/sec
0.00
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
1600.00
1800.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - Feet
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
1600.00
1800.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Stage, feet
0.00
200.00
400.00
600.00
800.00
1000.00
1200.00
1400.00
1600.00
1800.00
Discharge, (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Dolores River							CROSS-SECTION NO.: 4
CROSS-SECTION LOCATION: At Montrose - Mesa County Line							
GPS Zone 12 683745 4263265							
DATE: 2-27-13	OBSERVERS: R. Smith, D. Graf, E. Rumbold, N. Diederich						
LEGAL DESCRIPTION	¼ SECTION: NE	SECTION: 20	TOWNSHIP: 49 (N)S	RANGE: 18 E(W)	PM: NM		
COUNTY: Mesa	WATERSHED: Dolores		WATER DIVISION: 4		DOW WATER CODE: 39760		
MAP(S):	USGS:						
	USFS:						

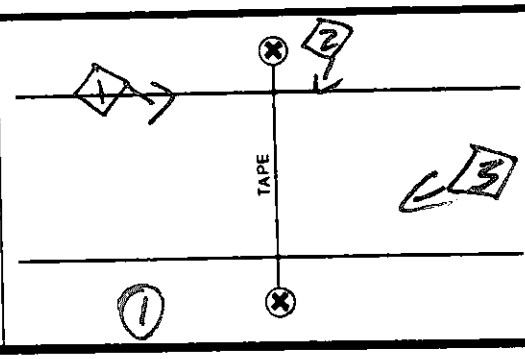
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION (YES)/NO	METER TYPE: M - M			
METER NUMBER:	DATE RATED:	CALIB/SPIN ____ sec	TAPE WEIGHT surveyed ____ lbs/foot	TAPE TENSION: surveyed ____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 2" cobbles to 2-foot boulders	PHOTOGRAPHS TAKEN: (YES)/NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0	5.36/5.55
② WS Upstream	152.0	3.10
③ WS Downstream	53.0	6.06
SLOPE	2.96/205.0 = .0144	

SKETCH



LEGEND:
- Stake ⊗
- Station ①
- Photo ◇
- Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/(NO)	DISTANCE ELECTROFISHED: ____ ft	FISH CAUGHT YES/NO	WATER CHEMISTRY SAMPLED: YES/(NO)

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River	CROSS-SECTION NO: 4	DATE: 2-27-13	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT	Gage Reading: ____ ft	TIME: 2:20 pm

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
LS	2		2.04								
	5		2.32								
G	9.5		3.68								
	12.5		4.59								
	13		4.98								
W	18		5.36	0				0			
	20		5.30	.15				0			
	23		5.41	.25				0			
	26		5.43	0				0			
	29		5.98	0.7				0.58			
	32		5.84	0.5				0.51			
	35		6.14	0.9				1.22			
	38		5.70	0.4				0.67			
	41		6.48	1.1				1.60			
	44		6.62	1.1				2.45			
	47		6.71	1.1				3.21			
	50		6.48	1.1				0.15			
	53		6.24	0.8				0.78			
	56		6.07	0.75				2.54			
	59		6.42	1.0				1.50			
	62		5.88	0.7				1.67			
	65		6.42	0.9				0.39			
	68		6.74	1.1				0.37			
	71		6.56	1.0				1.22			
	74		6.16	0.6				2.02			
	77		6.90	1.3				1.08			
	80		6.27	0.75				1.40			
	83		7.17	1.3				0.98			
	86		7.42	1.8				0.81			
	89		7.44	1.75				0.53			
	92		7.32	1.95				1.02			
	95		7.42	1.85				1.29			
	98		7.46	1.80				0.55			
	101		7.24	1.40				0.64			
	104		6.45	0.55				1.13			
	107		6.44	0.60				0.58			
	110		6.12	0.40				0.23			
W	113		5.55	0				0			
	117.5		4.25								
G	119.0		3.62								
	122.5		2.26								
RS	124.6		1.88								
TOTALS:											

End of Measurement	Time	Gage Reading ft	CALCULATIONS PERFORMED BY	CALCULATIONS CHECKED BY

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Dolores River
XS LOCATION:	Montrose-Mesa County Line
XS NUMBER:	4
DATE:	27-Feb-13
OBSERVERS:	R. Smith, N. Dieterich,
1/4 SEC:	NE
SECTION:	20
TWP:	49N
RANGE:	18W
PM:	New Mexico
COUNTY:	Montrose
WATERSHED:	Dolores
DIVISION:	4
DOW CODE:	39760
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

		*** NOTE ***
		Leave TAPE WT and TENSION
		at defaults for data collected
TAPE WT:	0.0106	with a survey level and rod
TENSION:	99999	

CHANNEL PROFILE DATA

SLOPE:	0.014

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: Dolores River
XS LOCATION: Montrose-Mesa County Line
XS NUMBER: 4

DATA POINTS= 42

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
LS	2.00	2.04			0.00		0.00	0.00	0.0%
	5.00	2.32			0.00		0.00	0.00	0.0%
1 G	9.50	3.68			0.00		0.00	0.00	0.0%
	12.50	4.59			0.00		0.00	0.00	0.0%
	13.00	4.98			0.00		0.00	0.00	0.0%
W	18.00	5.36	0.00	0.00	0.00		0.00	0.00	0.0%
	20.00	5.30	0.15	0.00	2.00	0.15	0.38	0.00	0.0%
	23.00	5.41	0.25	0.00	3.00	0.25	0.75	0.00	0.0%
	26.00	5.43	0.00	0.00	3.00		0.00	0.00	0.0%
	29.00	5.98	0.70	0.58	3.05	0.70	2.10	1.22	1.3%
	32.00	5.84	0.50	0.51	3.00	0.50	1.50	0.77	0.8%
	35.00	6.14	0.90	1.22	3.01	0.90	2.70	3.29	3.4%
	38.00	5.70	0.40	0.67	3.03	0.40	1.20	0.80	0.8%
	41.00	6.48	1.10	1.60	3.10	1.10	3.30	5.28	5.5%
	44.00	6.62	1.10	2.45	3.00	1.10	3.30	8.09	8.4%
	47.00	6.71	1.10	3.21	3.00	1.10	3.30	10.59	11.0%
	50.00	6.48	1.10	0.15	3.01	1.10	3.30	0.50	0.5%
	53.00	6.24	0.80	0.78	3.01	0.80	2.40	1.87	1.9%
	56.00	6.07	0.75	2.54	3.00	0.75	2.25	5.72	6.0%
	59.00	6.42	1.00	1.50	3.02	1.00	3.00	4.50	4.7%
	62.00	5.88	0.70	1.67	3.05	0.70	2.10	3.51	3.7%
	65.00	6.42	0.90	0.39	3.05	0.90	2.70	1.05	1.1%
	68.00	6.74	1.10	0.37	3.02	1.10	3.30	1.22	1.3%
	71.00	6.56	1.00	1.22	3.01	1.00	3.00	3.66	3.8%
	74.00	6.16	0.60	2.02	3.03	0.60	1.80	3.64	3.8%
	77.00	6.90	1.30	1.08	3.09	1.30	3.90	4.21	4.4%
	80.00	6.27	0.75	1.40	3.07	0.75	2.25	3.15	3.3%
	83.00	7.12	1.30	0.98	3.12	1.30	3.90	3.82	4.0%
	86.00	7.42	1.80	0.81	3.01	1.80	5.40	4.37	4.6%
	89.00	7.44	1.75	0.53	3.00	1.75	5.25	2.78	2.9%
	92.00	7.32	1.95	1.02	3.00	1.95	5.85	5.97	6.2%
	95.00	7.42	1.85	1.29	3.00	1.85	5.55	7.16	7.5%
	98.00	7.46	1.80	0.55	3.00	1.80	5.40	2.97	3.1%
	101.00	7.24	1.40	0.64	3.01	1.40	4.20	2.69	2.8%
	104.00	6.45	0.55	1.13	3.10	0.55	1.65	1.86	1.9%
	107.00	6.44	0.60	0.58	3.00	0.60	1.80	1.04	1.1%
	110.00	6.12	0.40	0.23	3.02	0.40	1.20	0.28	0.3%
W	113.00	5.55	0.00	0.00	3.05		0.00	0.00	0.0%
	117.50	4.25			0.00		0.00	0.00	0.0%
1 G	119.00	3.62			0.00		0.00	0.00	0.0%
	122.50	2.26			0.00		0.00	0.00	0.0%
RS	124.60	1.88			0.00		0.00	0.00	0.0%
TOTALS ----------					95.87	1.95 (Max.)	88.73	96.01	100.0%

Manning's n = 0.1543
Hydraulic Radius= 0.92546773

STREAM NAME: Dolores River
XS LOCATION: Montrose-Mesa County Line
XS NUMBER: 4

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	88.73	90.98	2.5%
5.24	88.73	114.04	28.5%
5.26	88.73	112.09	26.3%
5.28	88.73	110.15	24.1%
5.30	88.73	108.21	22.0%
5.32	88.73	106.30	19.8%
5.34	88.73	104.41	17.7%
5.36	88.73	102.55	15.6%
5.38	88.73	100.72	13.5%
5.40	88.73	98.90	11.5%
5.42	88.73	97.09	9.4%
5.44	88.73	95.34	7.5%
5.45	88.73	94.46	6.5%
5.46	88.73	93.59	5.5%
5.47	88.73	92.72	4.5%
5.48	88.73	91.85	3.5%
5.49	88.73	90.98	2.5%
5.50	88.73	90.11	1.6%
5.51	88.73	89.25	0.6%
5.52	88.73	88.38	-0.4%
5.53	88.73	87.51	-1.4%
5.54	88.73	86.65	-2.3%
5.56	88.73	84.92	-4.3%
5.58	88.73	83.20	-6.2%
5.60	88.73	81.48	-8.2%
5.62	88.73	79.77	-10.1%
5.64	88.73	78.06	-12.0%
5.66	88.73	76.35	-13.9%
5.68	88.73	74.65	-15.9%
5.70	88.73	72.95	-17.8%
5.72	88.73	71.26	-19.7%
5.74	88.73	69.58	-21.6%

WATERLINE AT ZERO
AREA ERROR = 5.516

STREAM NAME: Dolores River
XS LOCATION: Montrose-Mesa County Line
XS NUMBER: 4

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	3.68	109.36	2.54	3.78	277.23	110.81	100.0%	2.50	582.17	2.10
	4.52	104.32	1.80	2.94	187.82	105.50	95.2%	1.78	314.37	1.67
	4.57	103.98	1.76	2.89	182.62	105.15	94.9%	1.74	300.65	1.65
	4.62	103.70	1.71	2.84	177.42	104.84	94.6%	1.69	287.09	1.62
	4.67	103.46	1.66	2.79	172.25	104.58	94.4%	1.65	273.72	1.59
	4.72	103.23	1.62	2.74	167.08	104.32	94.1%	1.60	260.61	1.56
	4.77	102.99	1.57	2.69	161.92	104.06	93.9%	1.56	247.76	1.53
	4.82	102.75	1.53	2.64	156.78	103.80	93.7%	1.51	235.17	1.50
	4.87	102.51	1.48	2.59	151.65	103.53	93.4%	1.46	222.86	1.47
	4.92	102.28	1.43	2.54	146.53	103.27	93.2%	1.42	210.81	1.44
	4.97	102.04	1.39	2.49	141.42	103.01	93.0%	1.37	199.04	1.41
	5.02	101.37	1.34	2.44	136.33	102.33	92.4%	1.33	188.08	1.38
	5.07	100.54	1.31	2.39	131.28	101.49	91.6%	1.29	177.59	1.35
	5.12	99.71	1.27	2.34	126.28	100.65	90.8%	1.25	167.37	1.33
	5.17	98.88	1.23	2.29	121.31	99.81	90.1%	1.22	157.42	1.30
	5.22	98.05	1.19	2.24	116.39	98.97	89.3%	1.18	147.75	1.27
	5.27	97.22	1.15	2.19	111.51	98.13	88.6%	1.14	138.35	1.24
	5.32	95.42	1.12	2.14	106.67	96.32	86.9%	1.11	130.11	1.22
	5.37	91.84	1.11	2.09	102.00	92.73	83.7%	1.10	123.84	1.21
	5.42	89.56	1.09	2.04	97.45	90.45	81.6%	1.08	116.69	1.20
	5.47	87.09	1.07	1.99	93.07	87.97	79.4%	1.06	110.10	1.18
WL	5.52	86.65	1.02	1.94	88.72	87.51	79.0%	1.01	102.03	1.15
	5.57	86.17	0.98	1.89	84.40	87.03	78.5%	0.97	94.23	1.12
	5.62	85.64	0.94	1.84	80.11	86.48	78.0%	0.93	86.74	1.08
	5.67	85.10	0.89	1.79	75.84	85.94	77.6%	0.88	79.50	1.05
	5.72	84.40	0.85	1.74	71.60	85.22	76.9%	0.84	72.64	1.01
	5.77	83.33	0.81	1.69	67.41	84.13	75.9%	0.80	66.25	0.98
	5.82	82.26	0.77	1.64	63.27	83.04	74.9%	0.76	60.13	0.95
	5.87	80.37	0.74	1.59	59.19	81.14	73.2%	0.73	54.66	0.92
	5.92	77.33	0.71	1.54	55.25	78.07	70.5%	0.71	49.99	0.90
	5.97	74.14	0.69	1.49	51.46	74.84	67.5%	0.69	45.68	0.89
	6.02	71.91	0.66	1.44	47.81	72.58	65.5%	0.66	41.25	0.86
	6.07	70.06	0.63	1.39	44.27	70.70	63.8%	0.63	36.91	0.83
	6.12	67.00	0.61	1.34	40.84	67.62	61.0%	0.60	33.24	0.81
	6.17	64.02	0.59	1.29	37.56	64.61	58.3%	0.58	29.82	0.79
	6.22	60.91	0.57	1.24	34.44	61.47	55.5%	0.56	26.67	0.77
	6.27	57.94	0.54	1.19	31.47	58.47	52.8%	0.54	23.73	0.75
	6.32	54.71	0.52	1.14	28.65	55.19	49.8%	0.52	21.09	0.74
	6.37	51.45	0.51	1.09	26.00	51.89	46.8%	0.50	18.69	0.72
	6.42	48.19	0.49	1.04	23.51	48.58	43.8%	0.48	16.51	0.70
	6.47	42.58	0.50	0.99	21.23	42.94	38.7%	0.49	15.13	0.71
	6.52	39.46	0.49	0.94	19.18	39.78	35.9%	0.48	13.43	0.70
	6.57	36.03	0.48	0.89	17.29	36.32	32.8%	0.48	12.01	0.69
	6.62	32.20	0.48	0.84	15.58	32.46	29.3%	0.48	10.89	0.70
	6.67	27.82	0.51	0.79	14.08	28.05	25.3%	0.50	10.13	0.72
	6.72	23.67	0.54	0.74	12.80	23.86	21.5%	0.54	9.63	0.75
	6.77	22.23	0.52	0.69	11.66	22.40	20.2%	0.52	8.60	0.74
	6.82	21.42	0.49	0.64	10.57	21.57	19.5%	0.49	7.48	0.71
	6.87	20.62	0.46	0.59	9.52	20.74	18.7%	0.46	6.45	0.68
	6.92	19.95	0.43	0.54	8.51	20.05	18.1%	0.42	5.47	0.64
	6.97	19.58	0.38	0.49	7.52	19.67	17.7%	0.38	4.51	0.60
	7.02	19.22	0.34	0.44	6.55	19.29	17.4%	0.34	3.63	0.55
	7.07	18.85	0.30	0.39	5.60	18.91	17.1%	0.30	2.83	0.51
	7.12	18.49	0.25	0.34	4.66	18.53	16.7%	0.25	2.12	0.45
	7.17	17.82	0.21	0.29	3.75	17.86	16.1%	0.21	1.51	0.40
	7.22	17.13	0.17	0.24	2.88	17.16	15.5%	0.17	1.00	0.35
	7.27	16.19	0.13	0.19	2.04	16.21	14.6%	0.13	0.59	0.29

STREAM NAME: Dolores River
XS LOCATION: Montrose-Mesa County Line
XS NUMBER: 4

SUMMARY SHEET

MEASURED FLOW (Qm)=	96.01	cfs
CALCULATED FLOW (Qc)=	102.03	cfs
(Qm-Qc)/Qm * 100 =	-6.3	%
MEASURED WATERLINE (WLm)=	5.49	ft
CALCULATED WATERLINE (WLc)=	5.52	ft
(WLm-WLc)/WLm * 100 =	-0.5	%
MAX MEASURED DEPTH (Dm)=	1.95	ft
MAX CALCULATED DEPTH (Dc)=	1.94	ft
(Dm-Dc)/Dm * 100	0.3	%
MEAN VELOCITY=	1.15	ft/sec
MANNING'S N=	0.154	
SLOPE=	0.014	ft/ft
.4 * Qm =	38.4	cfs
2.5 * Qm=	240.0	cfs

RECOMMENDED INSTREAM FLOW:
==========

FLOW (CFS)	PERIOD
==========	========
_____	_____
_____	_____
_____	_____
_____	_____

RATIONALE FOR RECOMMENDATION:
==========

_____
_____
_____
_____
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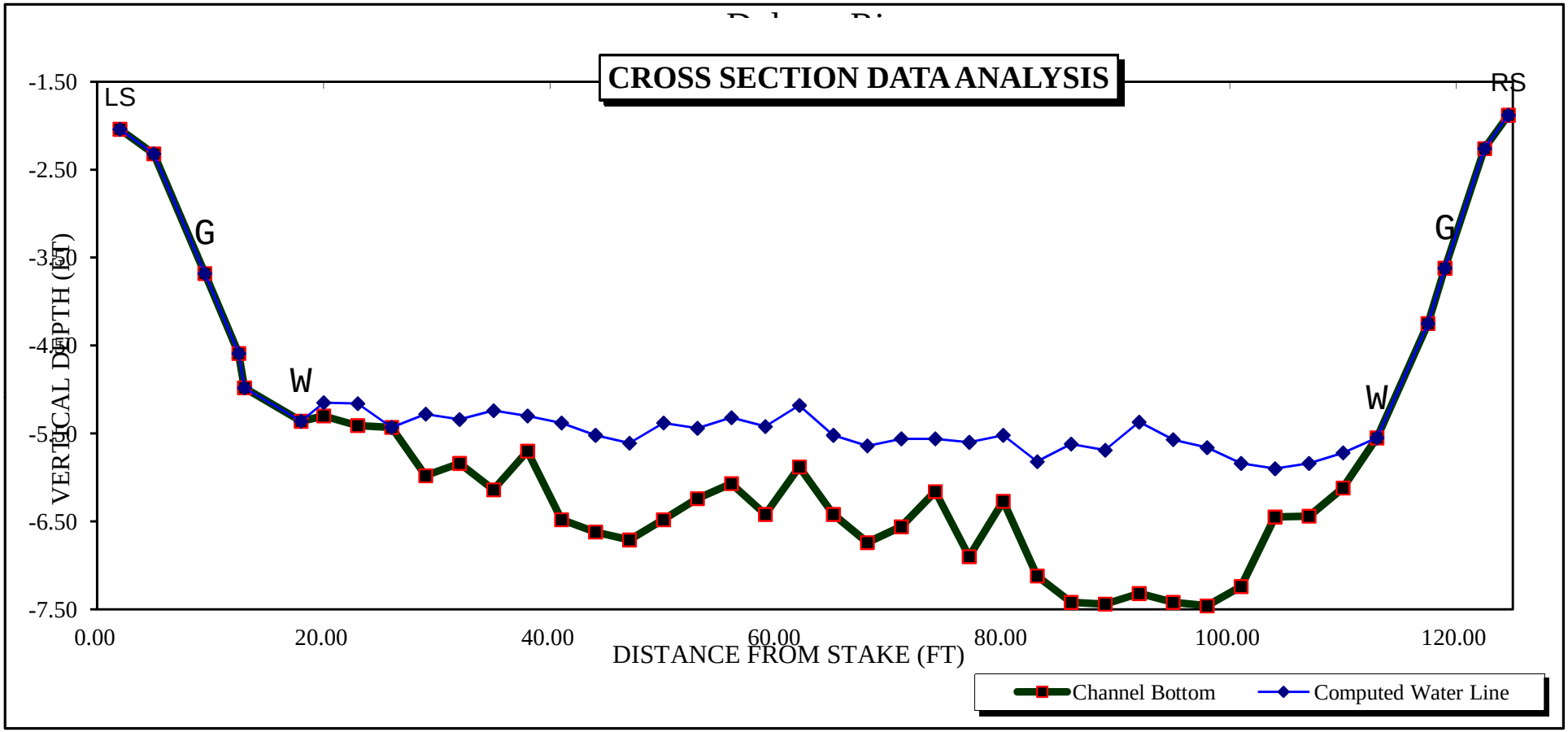
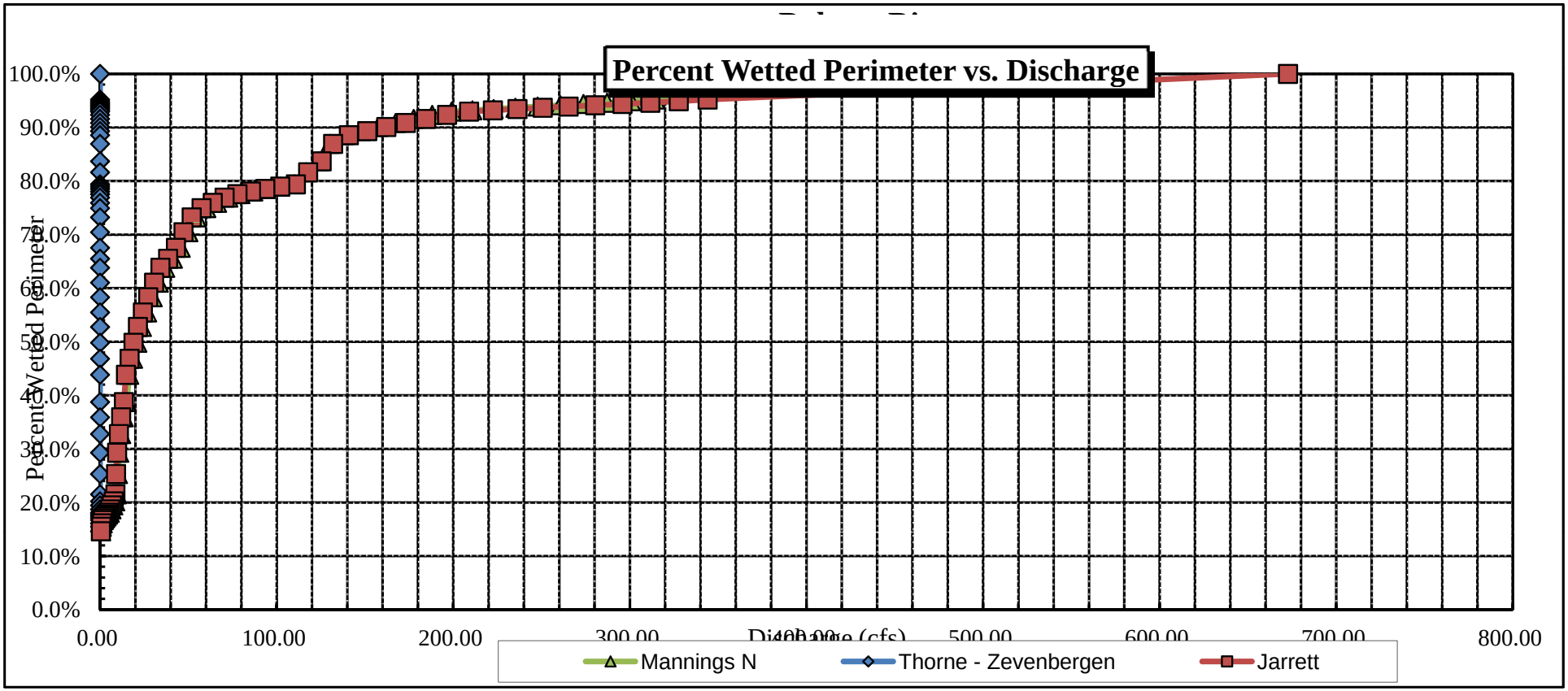
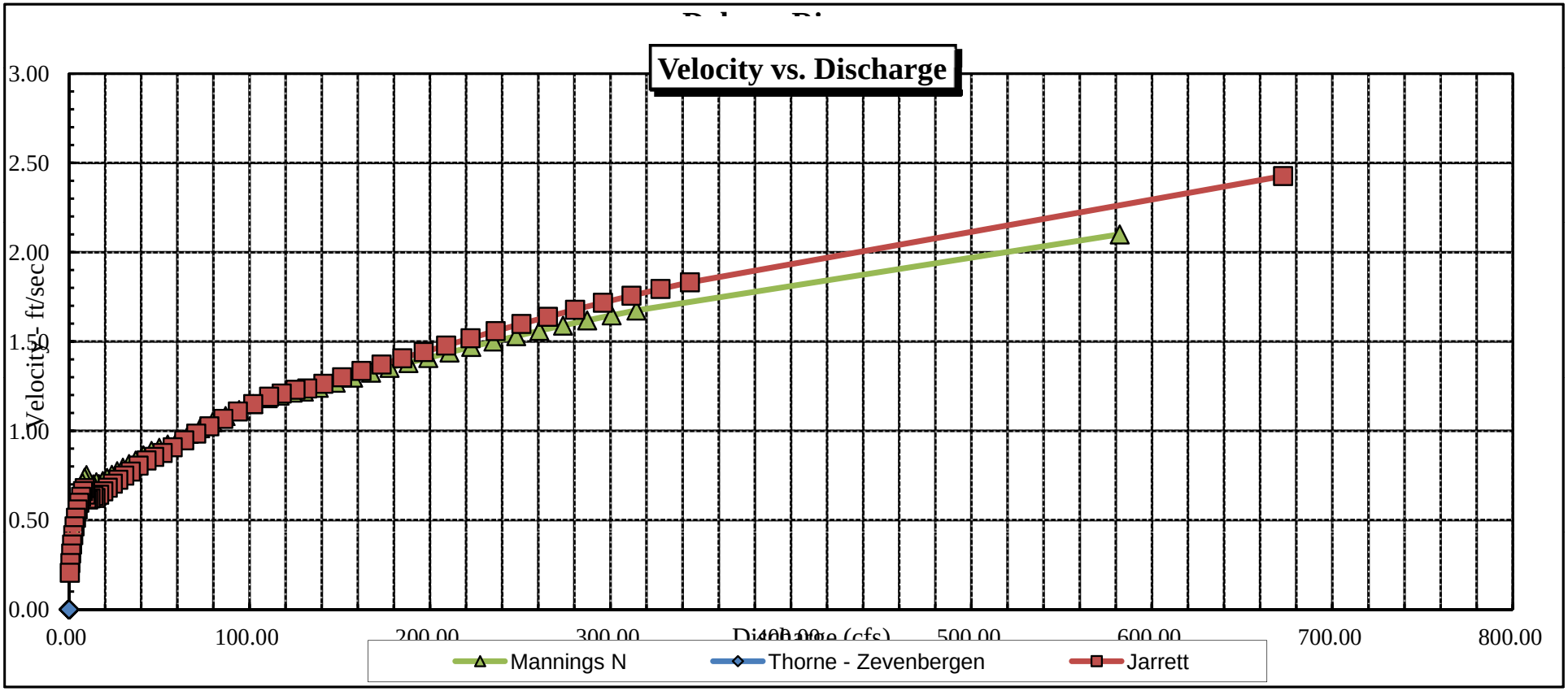
_____

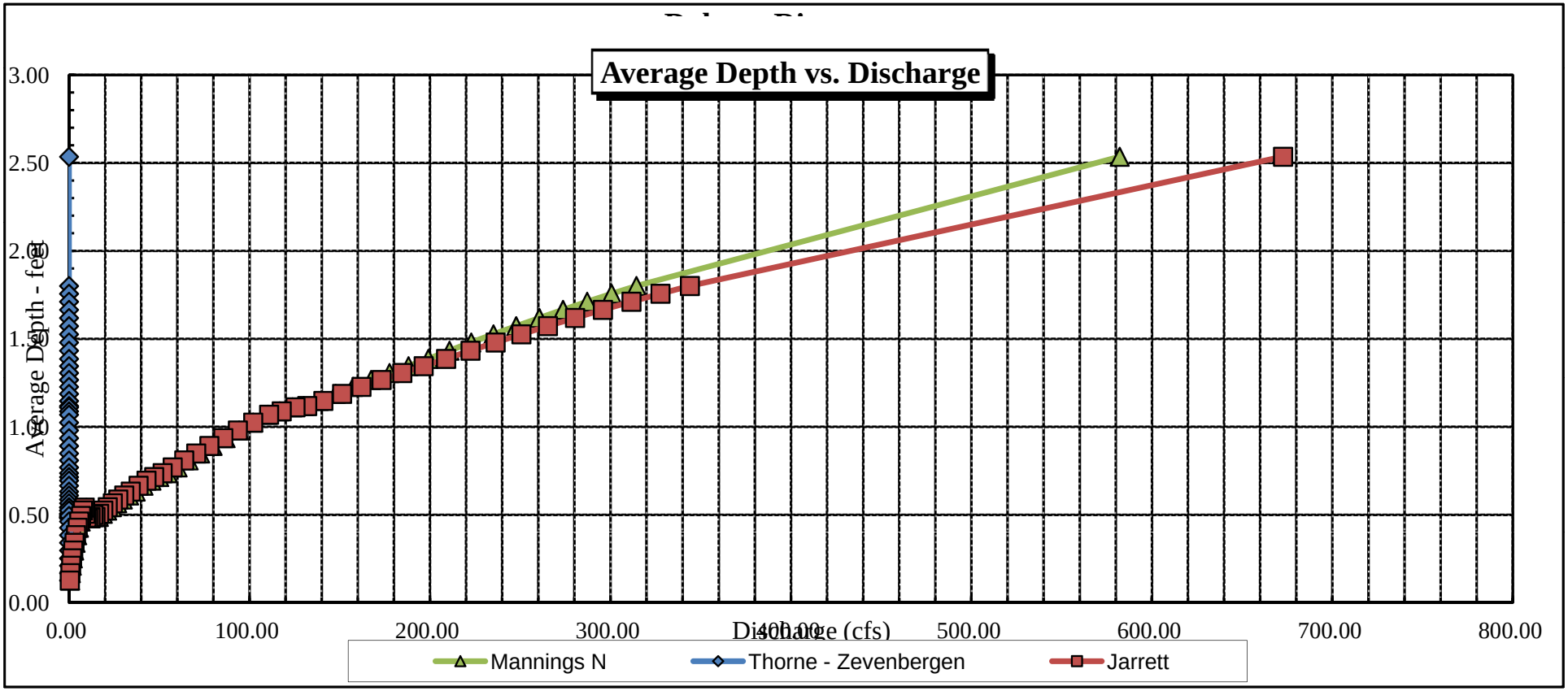
RECOMMENDATION BY: ..... AGENCY..... DATE:.....

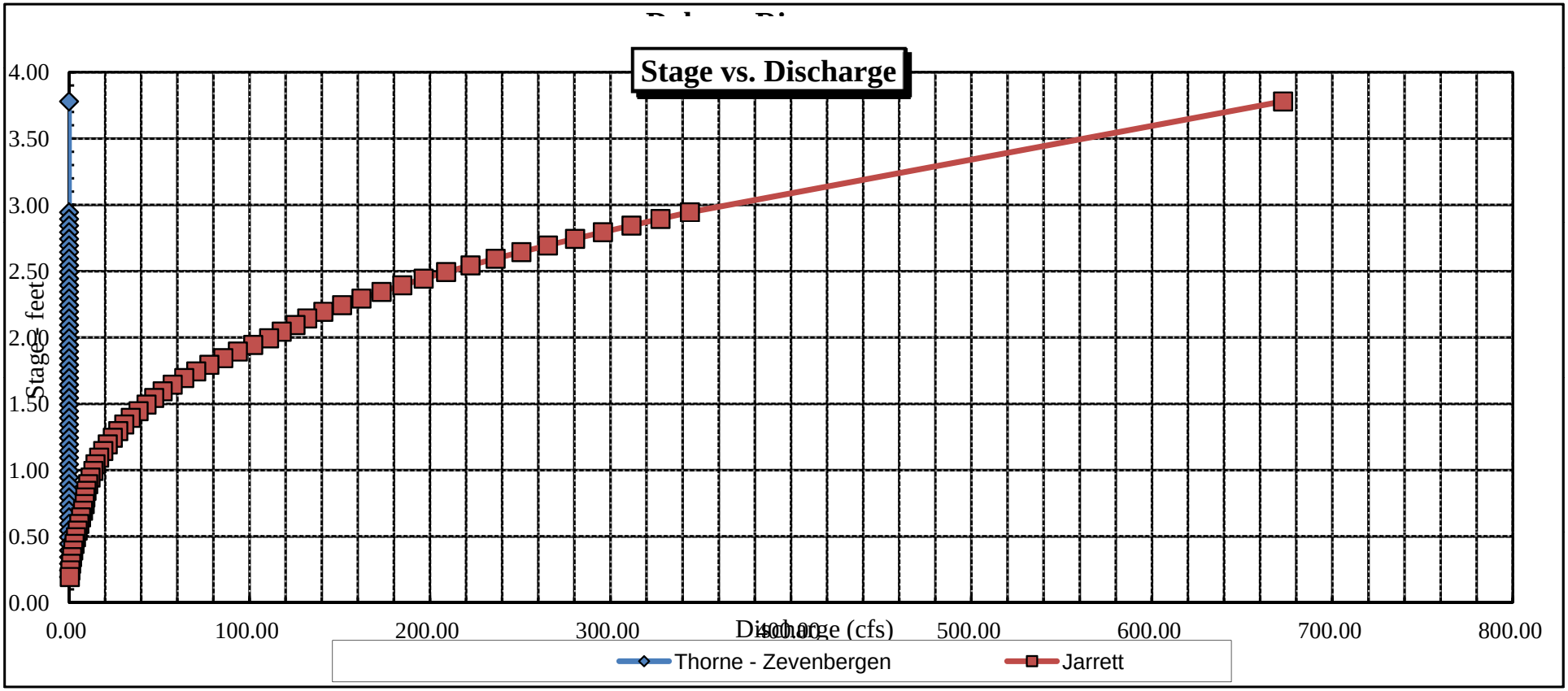
CWCB REVIEW BY: ..... DATE:.....


CROSS SECTION DATA ANALYSIS
LS
RS
G
W
W
G
-1.50
-2.50
-3.50
-4.50
-5.50
-6.50
-7.50
VERTICAL DEPTH (FT)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
100.00
200.00
300.00
500.00
600.00
700.00
800.00
Mannings N
Thorne - Zevenbergen
Jarrett


Velocity vs. Discharge
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
100.00
200.00
300.00
500.00
600.00
700.00
800.00
Mannings N
Thorne - Zevenbergen
Jarrett


Average Depth vs. Discharge
Average Depth - feet
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Stage vs. Discharge
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Stage - feet
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

COLORADO DIVISION OF WILDLIFE

LOCATION INFORMATION

STREAM NAME: Dolores River					CROSS-SECTION NO.: 1
CROSS-SECTION LOCATION: PHABSIM Reach - Cross Section 1 UTM = 4272581 m N 680671 m E					
DATE: 8-11-2011	OBSERVERS: R. Smith, B. Graf, M. Uppendahl				
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY: Mesa	WATERSHED: Dolores	WATER DIVISION: 4	DOW WATER CODE: 39760		
MAP(S): USGS:					
USFS:					

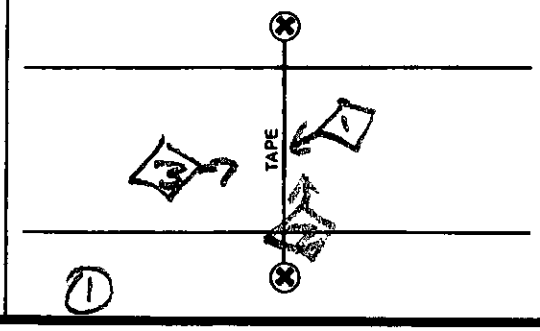
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: (YES) / NO	METER TYPE: M-M			
METER NUMBER:	DATE RATED:	CALIB/SPIN: _____ sec	TAPE WEIGHT: surveyed _____ lbs/foot	TAPE TENSION: surveyed _____ lbs
CHANNEL BED MATERIAL SIZE RANGE: 4" cobbles to 2-foot boulders	PHOTOGRAPHS TAKEN: (YES) / NO	NUMBER OF PHOTOGRAPHS: 3		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	Surveyed
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0	
② WS Upstream	see cross section documentation + PHABSIM notes	
③ WS Downstream		
SLOPE	0.05 ft	

SKETCH



LEGEND:
Stake ⊗
Station ①
Photo ◇→
Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO	DISTANCE ELECTROFISHED: _____ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

COMMENTS

This data was also used for PHABSIM Cross Section #1.

u/s Riffle

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River	CROSS-SECTION NO.: #1	DATE: 11/8/11	SHEET ___ OF ___
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) (LEFT / RIGHT)	Gage Reading: _____ ft	TIME:

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
TP	0.3		3.84								
BP	0.3		4.25								
	4.0		4.62								
	8.0		5.30								
	11.0		6.44								
	13.0		8.13								
	15.0		10.55								
SWL	18.5		10.85	0							
	23.0		10.85	0							
	29.0		10.85	0				0			
	32.0		11.25	.45				0.47			
	38.0		11.85	1.10				0.81			
	44.5		11.75	.90				0.52			
	50.5		11.65	.80				1.46			
	55.0		11.8	.90				0.70			
	61.0		12.0	1.20				2.00			
	64.0		11.95	.90				1.07			
	68.0		11.75	.60				.08			
	75.5		11.55	.70				.45			
	81.5		11.70	.90				.83			
	85.5		11.50	.75				1.27			
	88.5		11.55	.60				2.83			
	91.5		11.85	1.00				0.30			
	95.0		11.85	1.00				1.50			
	101.0		11.80	.80				2.28			
	104.0		11.90	.80				1.91			
	108.		11.90	1.00				2.27			
	111.		11.90	.80				2.98			
	113.5		11.95	.90				3.47			
	116		11.80	.80				1.26			
	119		11.95	1.00				1.30			
	122		12.05	1.00				2.62			
	124		12.45	1.50				2.23			
	126.5		12.80	1.90				3.28			
	128.5		12.95	1.80				2.89			
	129.5		13.20	2.25				2.53			
	131.7		13.25	2.30				2.94			
	134		13.20	2.20				3.66			
	136		12.90	2.10				1.98			
	138		12.75	1.75				3.73			
	140		12.05	1.40				3.31			
	142		12.00	0.90				3.76			
TOTALS:											

End of Measurement	Time:	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

U/S Riffle

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Dolores River	CROSS-SECTION NO.: #1	DATE: 11/8/11	SHEET 2 OF 2
BEGINNING OF MEASUREMENT	EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) (LEFT) RIGHT	Gage Reading: _____ ft	TIME:

Features: Stake (S), Grassline (G), Waterline (W), Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
	144.5		12.10	1.05				2.93			
	148.0		11.90	.70				.68			
	150		11.60	.55				.50			
SWL @	150		11.03	0				0			
	151.5		11.50	.30				.56			
SWL	151.6		11.03	0				0			
Bkset↑	153		10.45								
	155.5		8.71								
	157.		7.45								
	158		5.45								
	159		4.85								
BPin	160.9		4.56								
Top Pin	160.9		4.13								
TOTALS:											

End of Measurement	Time:	Gage Reading: _____ ft	CALCULATIONS PERFORMED BY:	CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	DOLORES RIVER - XS#1 - 11/08/11
XS LOCATION:	UPSTREAM RIFFLE
XS NUMBER:	01_110811
DATE:	11-Aug-11
OBSERVERS:	CPW & BLM
1/4 SEC:	0
SECTION:	0
TWP:	0
RANGE:	0
PM:	0
COUNTY:	MESA
WATERSHED:	DOLORES RIVER
DIVISION:	0
DOW CODE:	0
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

TAPE WT:	0.0106
TENSION:	99999

*** NOTE ***
Leave TAPE WT and TENSION at defaults for data collected with a survey level and rod

CHANNEL PROFILE DATA

SLOPE:	0.05

INPUT DATA CHECKED BY: .....DATE.....

ASSIGNED TO: ….....……..…….....DATE.....

STREAM NAME: DOLORES RIVER - XS#1 - 11/08/11
XS LOCATION: UPSTREAM RIFFLE
XS NUMBER: 01_110811

DATA POINTS= 54

VALUES COMPUTED FROM RAW FIELD DATA

	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
	TOP PIN	0.30	3.84			0.00		0.00	0.00	0.0%
1	BASE PIN	0.31	4.25			0.00		0.00	0.00	0.0%
		4.00	4.62			0.00		0.00	0.00	0.0%
		8.00	5.30			0.00		0.00	0.00	0.0%
		11.00	6.44			0.00		0.00	0.00	0.0%
		13.00	8.13			0.00		0.00	0.00	0.0%
		15.00	10.55			0.00		0.00	0.00	0.0%
	SWL	18.50	10.85	0.00	0.00	0.00		0.00	0.00	0.0%
		23.00	10.85	0.00	0.00	0.00		0.00	0.00	0.0%
		29.00	10.85	0.00	0.00	0.00		0.00	0.00	0.0%
		32.00	11.25	0.45	0.47	3.03	0.45	2.03	0.95	0.4%
		38.00	11.85	1.10	0.81	6.03	1.10	6.88	5.57	2.5%
		44.50	11.75	0.90	0.52	6.50	0.90	5.63	2.93	1.3%
		50.50	11.65	0.80	1.46	6.00	0.80	4.20	6.13	2.7%
		55.00	11.80	0.90	0.70	4.50	0.90	4.73	3.31	1.5%
		61.00	12.00	1.20	2.00	6.00	1.20	5.40	10.80	4.8%
		64.00	11.95	0.90	1.07	3.00	0.90	3.15	3.37	1.5%
		68.00	11.75	0.60	0.08	4.00	0.60	3.45	0.28	0.1%
		75.50	11.55	0.70	0.45	7.50	0.70	4.73	2.13	0.9%
		81.50	11.70	0.90	0.83	6.00	0.90	4.50	3.74	1.7%
		85.50	11.50	0.75	1.27	4.00	0.75	2.63	3.33	1.5%
		88.50	11.55	0.60	2.83	3.00	0.60	1.80	5.09	2.3%
		91.50	11.85	1.00	0.30	3.01	1.00	3.25	0.98	0.4%
		95.00	11.85	1.00	1.50	3.50	1.00	4.75	7.13	3.2%
		101.00	11.80	0.80	2.28	6.00	0.80	3.60	8.21	3.6%
		104.00	11.90	0.80	1.91	3.00	0.80	2.80	5.35	2.4%
		108.00	11.90	1.00	2.27	4.00	1.00	3.50	7.95	3.5%
		111.00	11.90	0.80	2.98	3.00	0.80	2.20	6.56	2.9%
		113.50	11.95	0.90	3.47	2.50	0.90	2.25	7.81	3.5%
		116.00	11.80	0.80	1.26	2.50	0.80	2.20	2.77	1.2%
		119.00	11.95	1.00	1.30	3.00	1.00	3.00	3.90	1.7%
		122.00	12.05	1.00	2.62	3.00	1.00	2.50	6.55	2.9%
		124.00	12.45	1.50	2.23	2.04	1.50	3.38	7.53	3.3%
		126.50	12.80	1.90	3.28	2.52	1.90	4.28	14.02	6.2%
		128.50	12.95	1.80	2.89	2.01	1.80	2.70	7.80	3.5%
		129.50	13.20	2.25	2.53	1.03	2.25	3.60	9.11	4.0%
		131.70	13.25	2.30	2.94	2.20	2.30	5.18	15.21	6.8%
		134.00	13.20	2.20	3.66	2.30	2.20	4.73	17.31	7.7%
		136.00	12.90	2.10	1.98	2.02	2.10	4.20	8.32	3.7%
		138.00	12.75	1.75	3.73	2.01	1.75	3.50	13.06	5.8%
		140.00	12.05	1.40	3.30	2.12	1.40	2.80	9.24	4.1%
		142.00	12.00	0.90	3.76	2.00	0.90	2.03	7.61	3.4%
		144.50	12.10	1.05	2.93	2.50	1.05	3.15	9.23	4.1%
		148.00	11.90	0.70	0.68	3.51	0.70	1.93	1.31	0.6%
		150.00	11.60	0.55	0.50	2.02	0.55	0.96	0.48	0.2%
		151.50	11.50	0.30	0.56	1.50	0.30	0.24	0.13	0.1%
	SWL	151.60	11.03	0.00	0.00	0.48		0.00	0.00	0.0%
		153.00	10.45			0.00		0.00	0.00	0.0%
		155.50	8.71			0.00		0.00	0.00	0.0%
		157.00	7.45			0.00		0.00	0.00	0.0%
		158.00	5.45			0.00		0.00	0.00	0.0%
		159.00	4.85			0.00		0.00	0.00	0.0%
1	BASE PIN	160.90	4.56			0.00		0.00	0.00	0.0%
	TOP PIN	160.91	4.13			0.00		0.00	0.00	0.0%
	TOTALS ----------					123.37	2.3 (Max.)	121.81	225.17	100.0%

Manning's n = 0.1782
Hydraulic Radius= 0.987338605

STREAM NAME: DOLORES RIVER - XS#1 - 11/08/11
XS LOCATION: UPSTREAM RIFFLE
XS NUMBER: 01_110811

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	121.81	120.33	-1.2%
10.69	121.81	152.91	25.5%
10.71	121.81	150.19	23.3%
10.73	121.81	147.49	21.1%
10.75	121.81	144.78	18.9%
10.77	121.81	142.09	16.6%
10.79	121.81	139.40	14.4%
10.81	121.81	136.71	12.2%
10.83	121.81	134.03	10.0%
10.85	121.81	131.36	7.8%
10.87	121.81	128.90	5.8%
10.89	121.81	126.45	3.8%
10.90	121.81	125.22	2.8%
10.91	121.81	124.00	1.8%
10.92	121.81	122.77	0.8%
10.93	121.81	121.55	-0.2%
10.94	121.81	120.33	-1.2%
10.95	121.81	119.11	-2.2%
10.96	121.81	117.89	-3.2%
10.97	121.81	116.67	-4.2%
10.98	121.81	115.45	-5.2%
10.99	121.81	114.23	-6.2%
11.01	121.81	111.80	-8.2%
11.03	121.81	109.37	-10.2%
11.05	121.81	106.95	-12.2%
11.07	121.81	104.53	-14.2%
11.09	121.81	102.11	-16.2%
11.11	121.81	99.70	-18.2%
11.13	121.81	97.29	-20.1%
11.15	121.81	94.88	-22.1%
11.17	121.81	92.47	-24.1%
11.19	121.81	90.07	-26.1%

WATERLINE AT ZERO
AREA ERROR = 10.928

STREAM NAME: DOLORES RIVER - XS#1 - 11/08/11
XS LOCATION: UPSTREAM RIFFLE
XS NUMBER: 01_110811 Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	4.56	157.50	6.60	8.69	1039.82	162.85	100.0%	6.39	6672.56	6.42
	9.93	139.26	1.85	3.32	258.25	140.62	86.3%	1.84	722.06	2.80
	9.98	139.15	1.81	3.27	251.29	140.47	86.3%	1.79	690.42	2.75
	10.03	139.04	1.76	3.22	244.33	140.31	86.2%	1.74	659.34	2.70
	10.08	138.92	1.71	3.17	237.39	140.16	86.1%	1.69	628.84	2.65
	10.13	138.81	1.66	3.12	230.44	140.01	86.0%	1.65	598.92	2.60
	10.18	138.70	1.61	3.07	223.50	139.86	85.9%	1.60	569.58	2.55
	10.23	138.59	1.56	3.02	216.57	139.70	85.8%	1.55	540.84	2.50
	10.28	138.47	1.51	2.97	209.65	139.55	85.7%	1.50	512.69	2.45
	10.33	138.36	1.47	2.92	202.73	139.40	85.6%	1.45	485.15	2.39
	10.38	138.25	1.42	2.87	195.81	139.25	85.5%	1.41	458.21	2.34
	10.43	138.13	1.37	2.82	188.90	139.09	85.4%	1.36	431.90	2.29
	10.48	137.99	1.32	2.77	182.00	138.92	85.3%	1.31	406.26	2.23
	10.53	137.83	1.27	2.72	175.10	138.72	85.2%	1.26	381.29	2.18
	10.58	137.37	1.22	2.67	168.22	138.24	84.9%	1.22	357.47	2.13
	10.63	136.66	1.18	2.62	161.37	137.52	84.4%	1.17	334.69	2.07
	10.68	135.96	1.14	2.57	154.55	136.80	84.0%	1.13	312.55	2.02
	10.73	135.25	1.09	2.52	147.77	136.09	83.6%	1.09	291.05	1.97
	10.78	134.55	1.05	2.47	141.03	135.37	83.1%	1.04	270.20	1.92
	10.83	133.85	1.00	2.42	134.32	134.66	82.7%	1.00	249.99	1.86
	10.88	122.76	1.04	2.37	127.93	123.56	75.9%	1.04	244.11	1.91
WL	10.93	122.26	1.00	2.32	121.81	123.05	75.6%	0.99	225.56	1.85
	10.98	121.77	0.95	2.27	115.71	122.54	75.2%	0.94	207.62	1.79
	11.03	121.27	0.90	2.22	109.63	122.03	74.9%	0.90	190.30	1.74
	11.08	120.88	0.86	2.17	103.58	121.60	74.7%	0.85	173.52	1.68
	11.13	120.50	0.81	2.12	97.54	121.17	74.4%	0.81	157.37	1.61
	11.18	120.11	0.76	2.07	91.53	120.74	74.1%	0.76	141.87	1.55
	11.23	119.72	0.71	2.02	85.53	120.31	73.9%	0.71	127.02	1.49
	11.28	119.27	0.67	1.97	79.56	119.81	73.6%	0.66	112.89	1.42
	11.33	118.76	0.62	1.92	73.61	119.26	73.2%	0.62	99.48	1.35
	11.38	118.25	0.57	1.87	67.68	118.70	72.9%	0.57	86.76	1.28
	11.43	117.74	0.52	1.82	61.78	118.15	72.5%	0.52	74.76	1.21
	11.48	117.23	0.48	1.77	55.91	117.60	72.2%	0.48	63.49	1.14
	11.53	114.09	0.44	1.72	50.09	114.44	70.3%	0.44	53.84	1.07
	11.58	108.08	0.41	1.67	44.53	108.42	66.6%	0.41	45.87	1.03
	11.63	101.69	0.39	1.62	39.29	102.01	62.6%	0.39	38.77	0.99
	11.68	92.98	0.37	1.57	34.40	93.30	57.3%	0.37	32.97	0.96
	11.73	83.93	0.36	1.52	29.99	84.24	51.7%	0.36	28.09	0.94
	11.78	76.57	0.34	1.47	25.98	76.86	47.2%	0.34	23.51	0.90
	11.83	64.31	0.35	1.42	22.40	64.60	39.7%	0.35	20.62	0.92
	11.88	50.08	0.39	1.37	19.62	50.35	30.9%	0.39	19.51	0.99
	11.93	36.06	0.48	1.32	17.47	36.32	22.3%	0.48	20.00	1.14
	11.98	28.81	0.55	1.27	15.86	29.07	17.8%	0.55	19.73	1.24
	12.03	22.62	0.64	1.22	14.58	22.87	14.0%	0.64	20.13	1.38
	12.08	18.72	0.72	1.17	13.56	18.96	11.6%	0.72	20.22	1.49
	12.13	17.39	0.73	1.12	12.67	17.62	10.8%	0.72	18.97	1.50
	12.18	17.00	0.70	1.07	11.81	17.21	10.6%	0.69	17.14	1.45
	12.23	16.60	0.66	1.02	10.97	16.80	10.3%	0.65	15.40	1.40
	12.28	16.21	0.63	0.97	10.15	16.40	10.1%	0.62	13.75	1.35
	12.33	15.82	0.59	0.92	9.35	15.99	9.8%	0.58	12.19	1.30
	12.38	15.42	0.56	0.87	8.57	15.58	9.6%	0.55	10.73	1.25
	12.43	15.03	0.52	0.82	7.81	15.18	9.3%	0.51	9.35	1.20
	12.48	14.58	0.48	0.77	7.07	14.71	9.0%	0.48	8.08	1.14
	12.53	14.08	0.45	0.72	6.35	14.20	8.7%	0.45	6.93	1.09
	12.58	13.58	0.42	0.67	5.66	13.69	8.4%	0.41	5.86	1.03
	12.63	13.08	0.38	0.62	4.99	13.18	8.1%	0.38	4.88	0.98
	12.68	12.58	0.35	0.57	4.35	12.67	7.8%	0.34	3.98	0.91

STREAM NAME:	DOLORES RIVER - XS#1 - 11/08/11
XS LOCATION:	UPSTREAM RIFFLE
XS NUMBER:	01_110811

SUMMARY SHEET

MEASURED FLOW (Qm)=	225.17	cfs
CALCULATED FLOW (Qc)=	225.56	cfs
(Qm-Qc)/Qm * 100 =	-0.2	%
MEASURED WATERLINE (WLm)=	10.94	ft
CALCULATED WATERLINE (WLc)=	10.93	ft
(WLm-WLc)/WLm * 100 =	0.1	%
MAX MEASURED DEPTH (Dm)=	2.30	ft
MAX CALCULATED DEPTH (Dc)=	2.32	ft
(Dm-Dc)/Dm * 100	-1.0	%
MEAN VELOCITY=	1.85	ft/sec
MANNING'S N=	0.178	
SLOPE=	0.05	ft/ft
.4 * Qm =	90.1	cfs
2.5 * Qm=	562.9	cfs

RECOMMENDED INSTREAM FLOW:
=============================

FLOW (CFS)	PERIOD
===========	========
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

RATIONALE FOR RECOMMENDATION:
=============================

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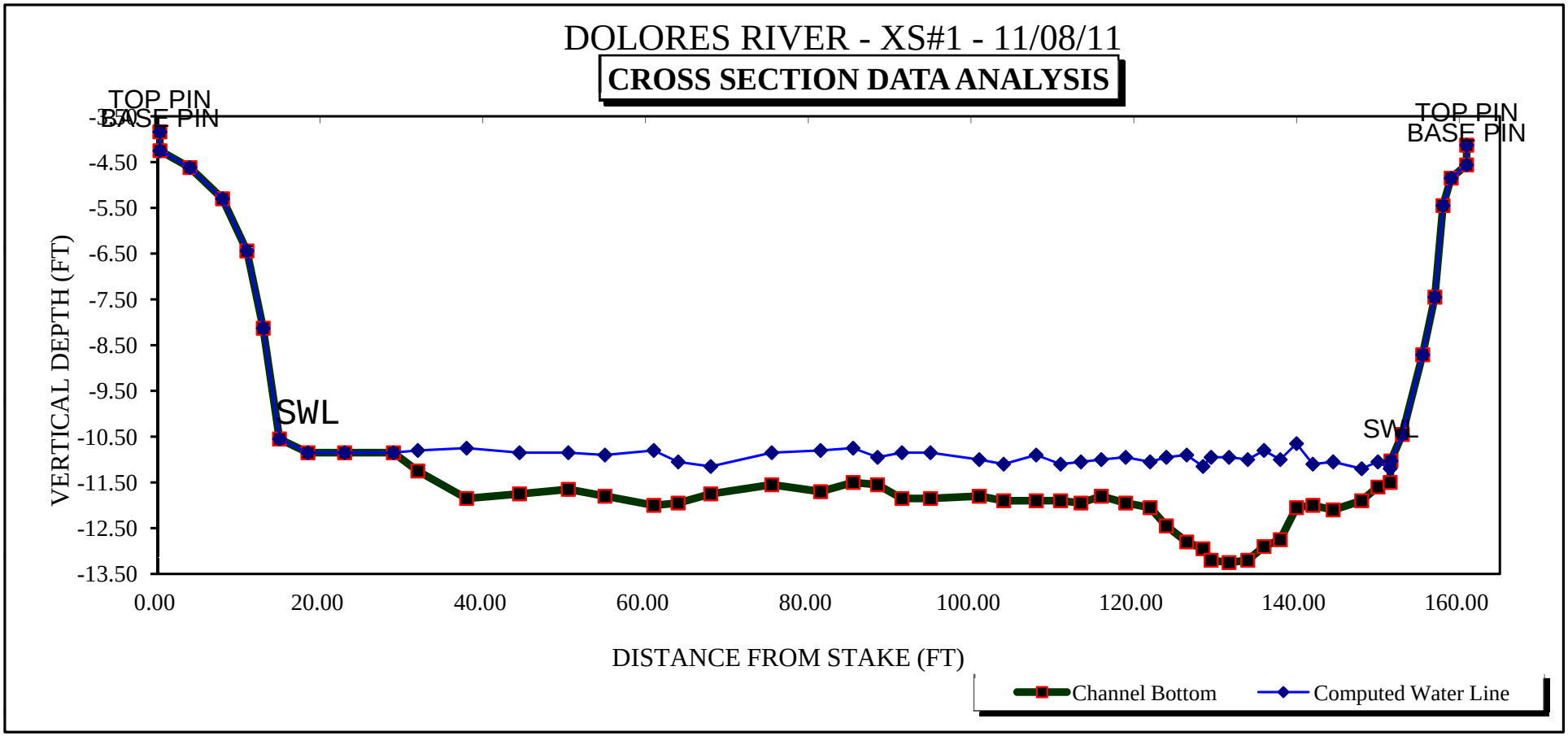
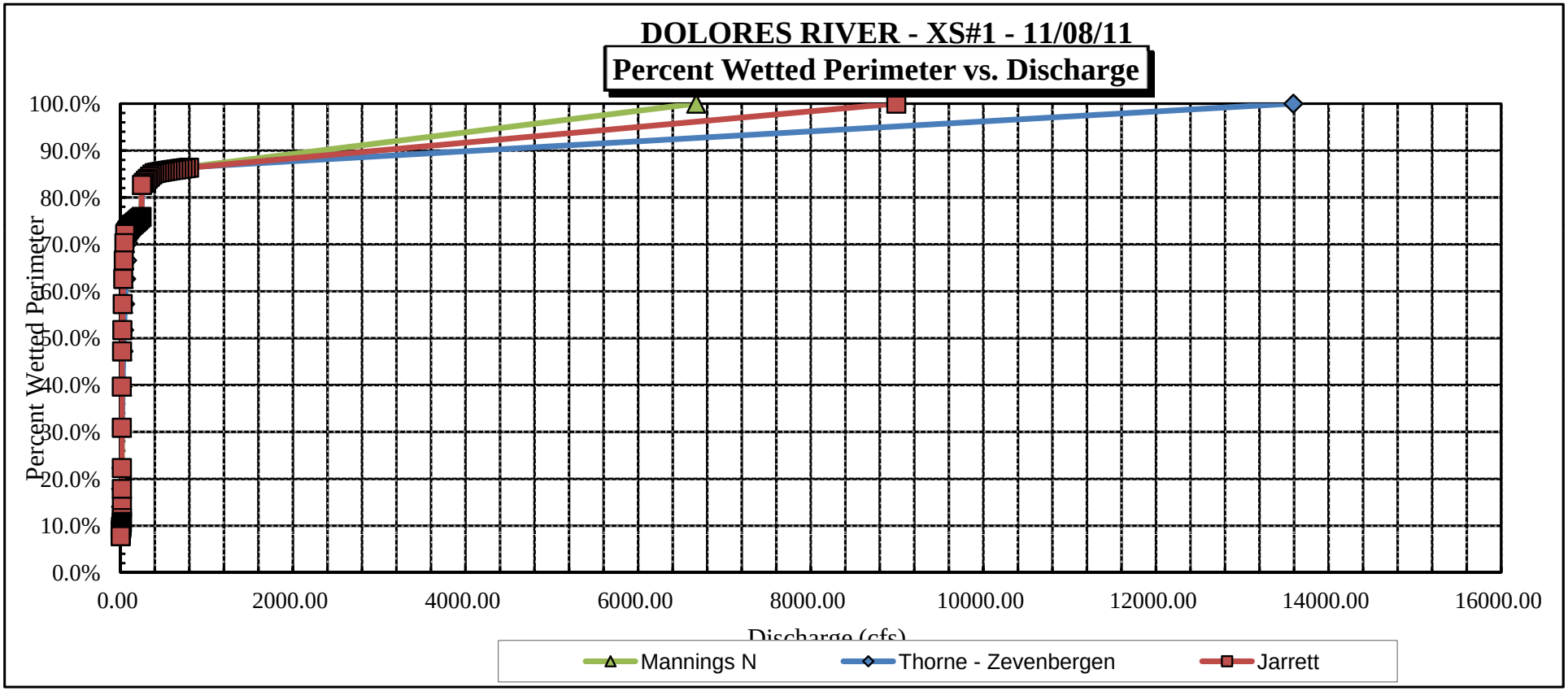
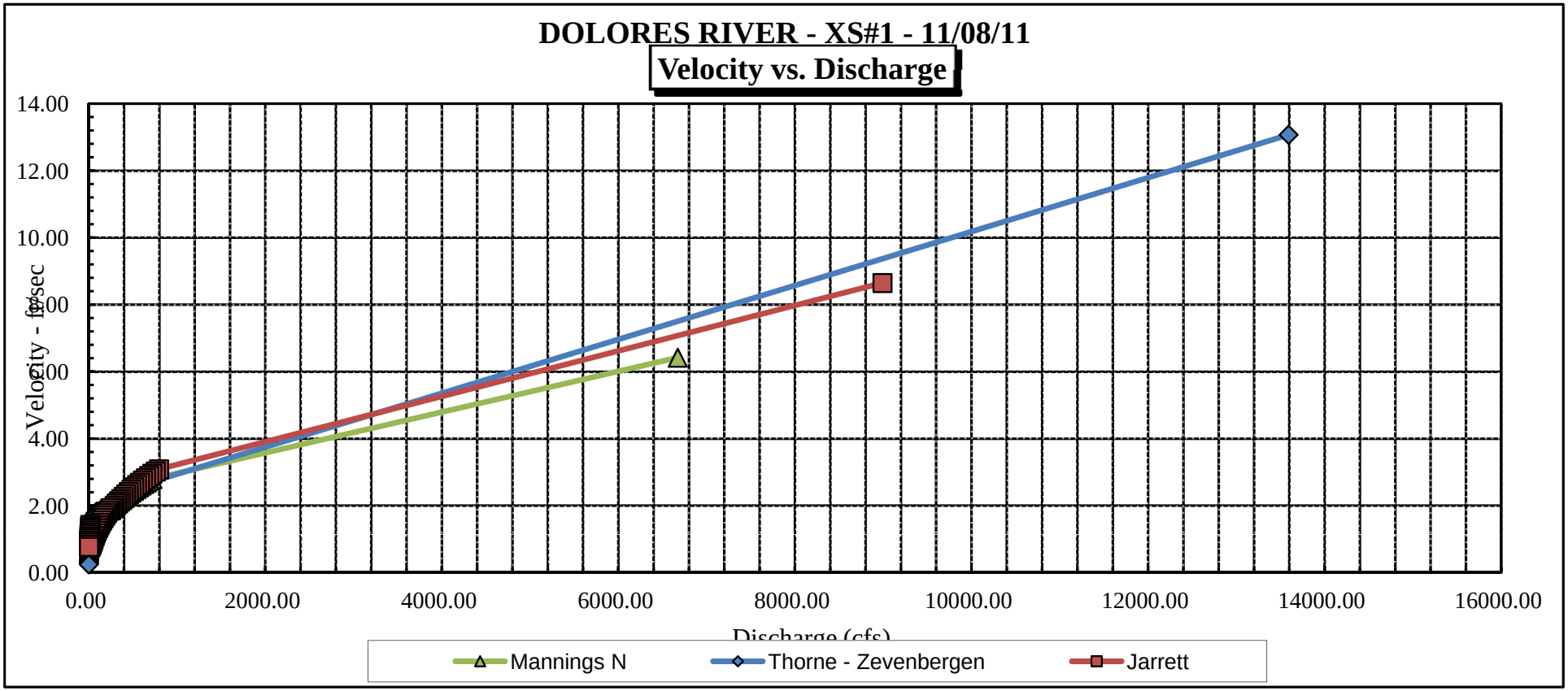
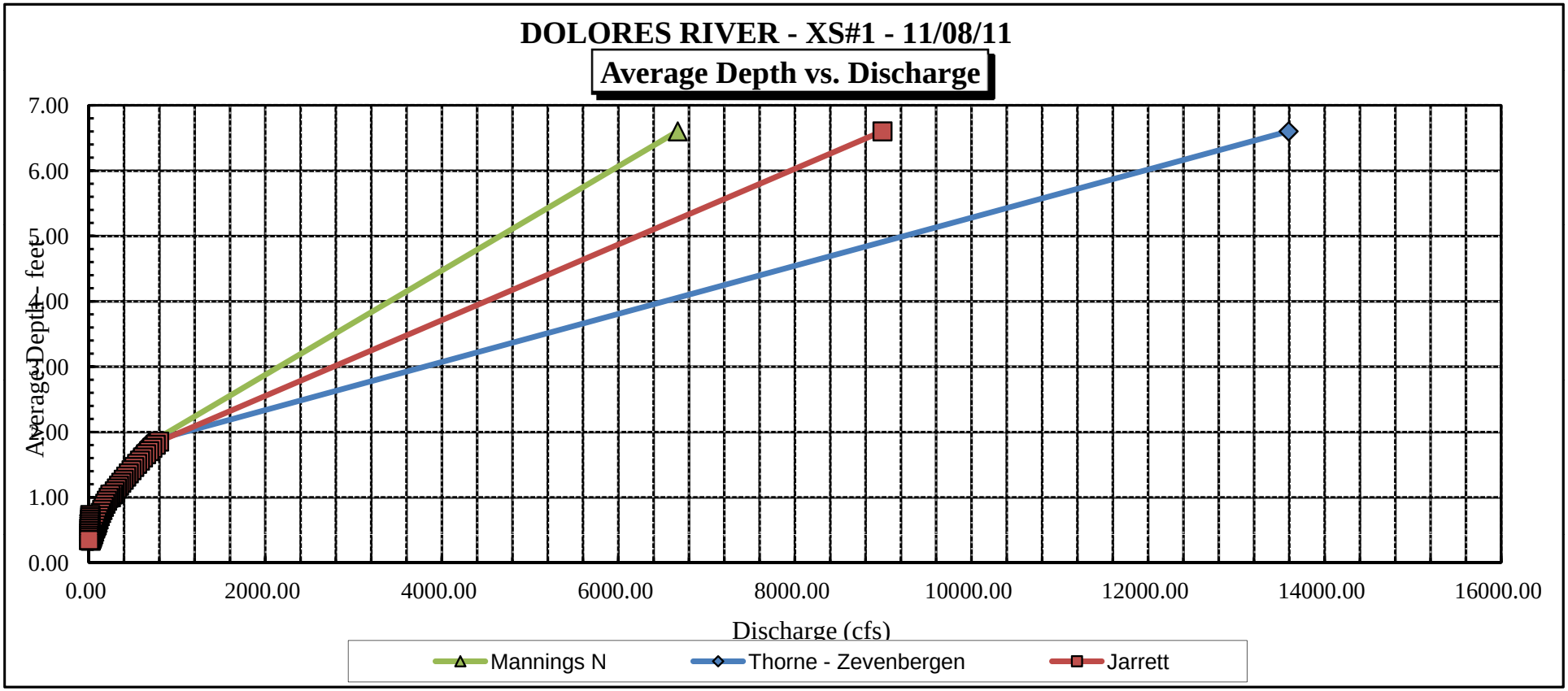
RECOMMENDATION BY: …………………...………..……............................... AGENCY..………………………......……...…...……...... DATE:......…...…......……………

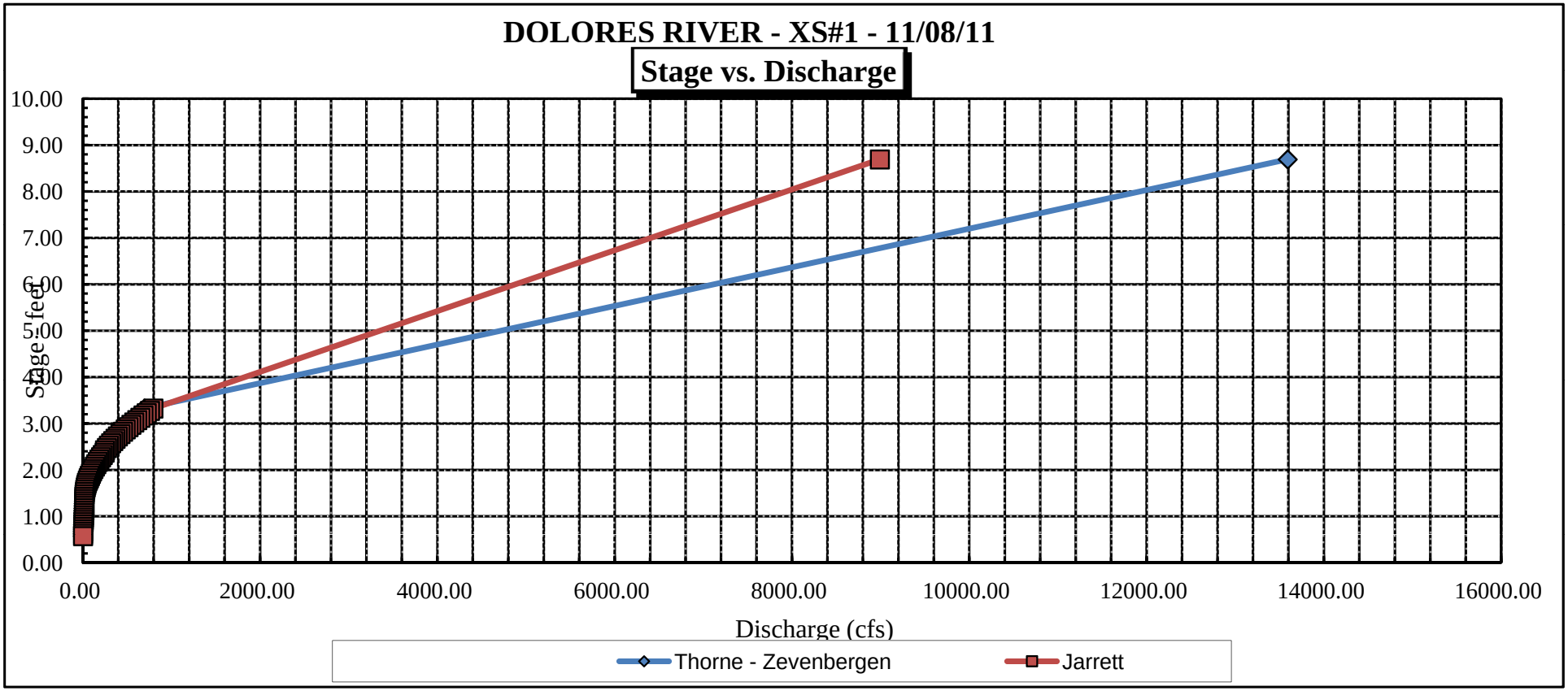
CWCB REVIEW BY: ..……………………………...……………………………………………………...…............. DATE:..................………………...…


DOLORES RIVER - XS#1 - 11/08/11
CROSS SECTION DATA ANALYSIS
TOP PIN
BASE PIN
SWL
TOP PIN
BASE PIN
SWL
-4.50
-5.50
-6.50
-7.50
-8.50
-9.50
-10.50
-11.50
-12.50
-13.50
VERTICAL DEPTH (FT)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


DOLORES RIVER - XS#1 - 11/08/11
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
16000.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


DOLORES RIVER - XS#1 - 11/08/11
Velocity vs. Discharge
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Velocity - ft/sec
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
16000.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett

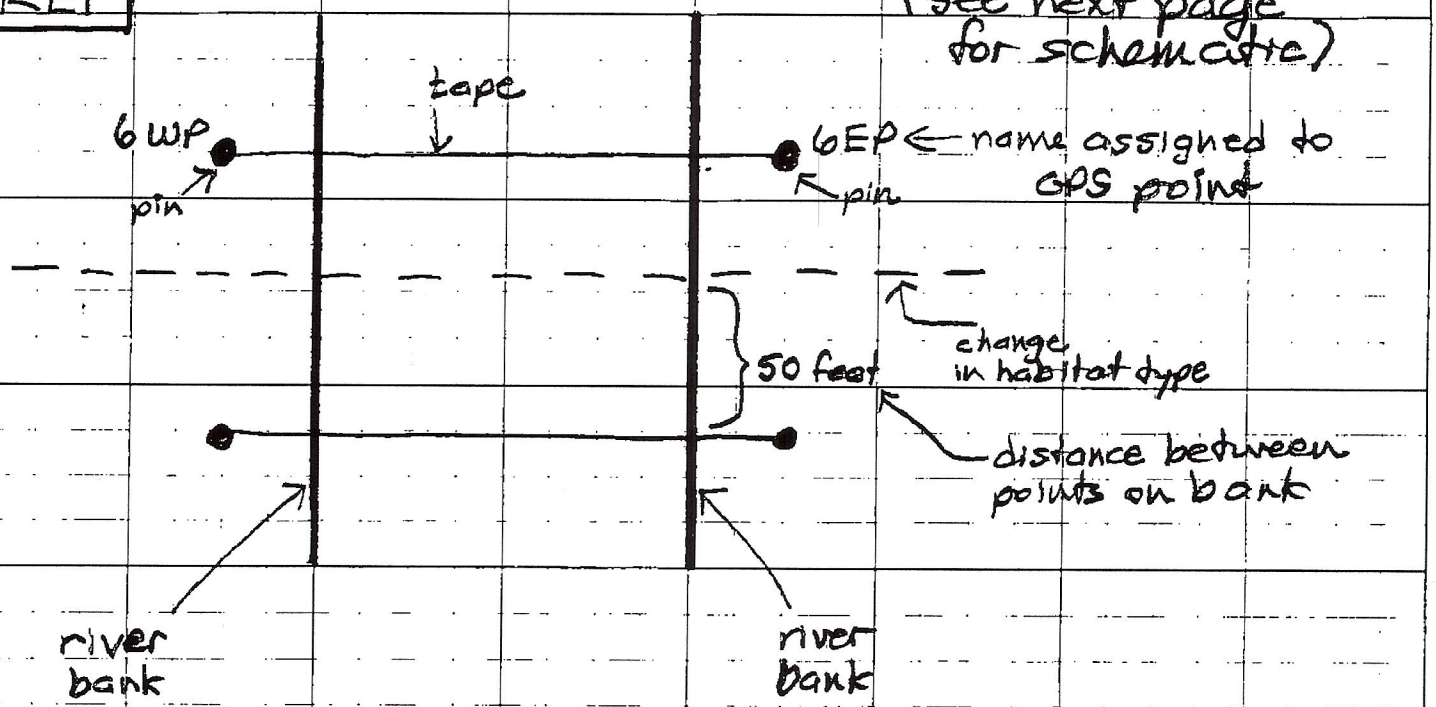

DOLORES RIVER - XS#1 - 11/08/11
Average Depth vs. Discharge
Average Depth - feet
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
16000.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett

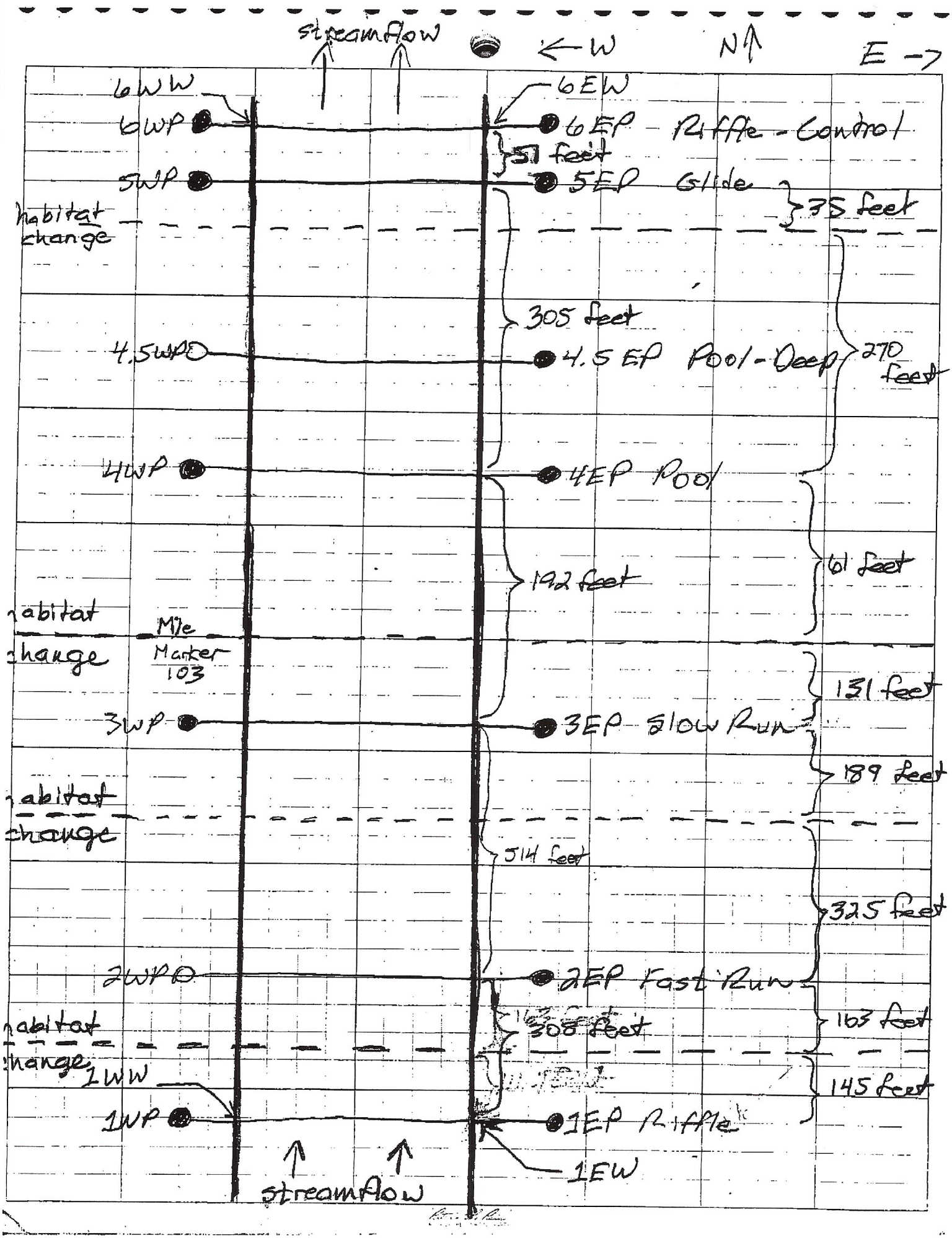

DOLORES RIVER - XS#1 - 11/08/11
Stage vs. Discharge
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Stage, feet
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
16000.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

Dolores River Instream Flow Modeling Reach Schematic

KEY

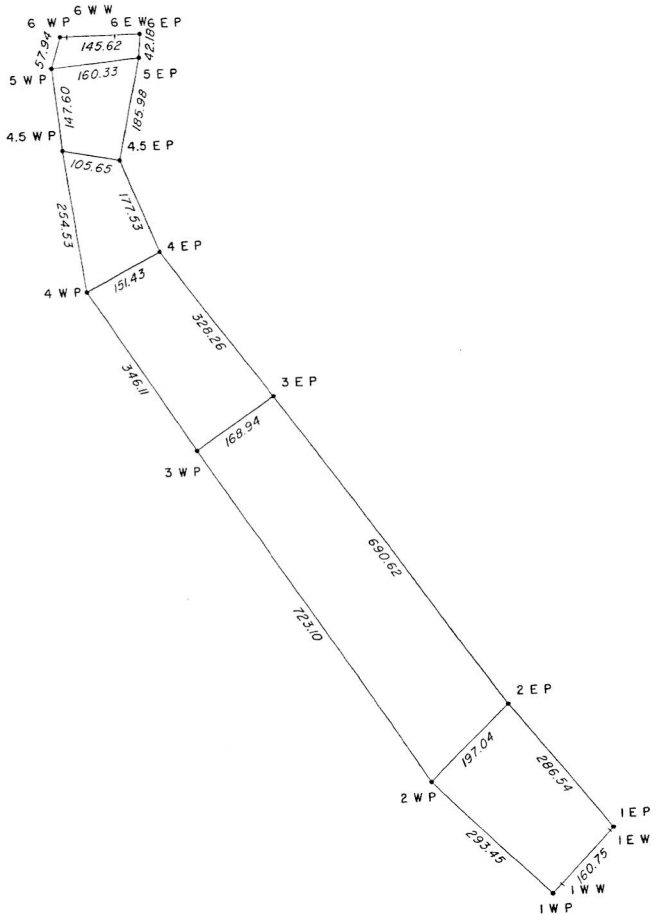
(see next page for schematic)

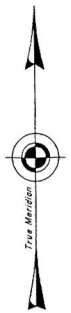


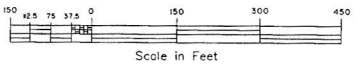

streamflow
W
N
E
6WW
6WP
6EW
6EP
Riffle - Control
51 feet
5WP
5EP
Glide
35 feet
habitat change
305 feet
4.5WPO
4.5 EP
Pool - Deep
270 feet
4WP
4EP
Pool
192 feet
61 feet
habitat change
Mile Marker 103
131 feet
3WP
3EP
Slow Run
189 feet
habitat change
314 feet
325 feet
2WPO
2EP
Fast Run
habitat change
308 feet
163 feet
1WW
145 feet
1WP
1EP
Riffle
1EW
streamflow

TOWNSHIP 50 NORTH, RANGE 19 WEST, OF THE NEW MEXICO PRINCIPAL MERIDIAN, COLORADO.

LOCATION DIAGRAM







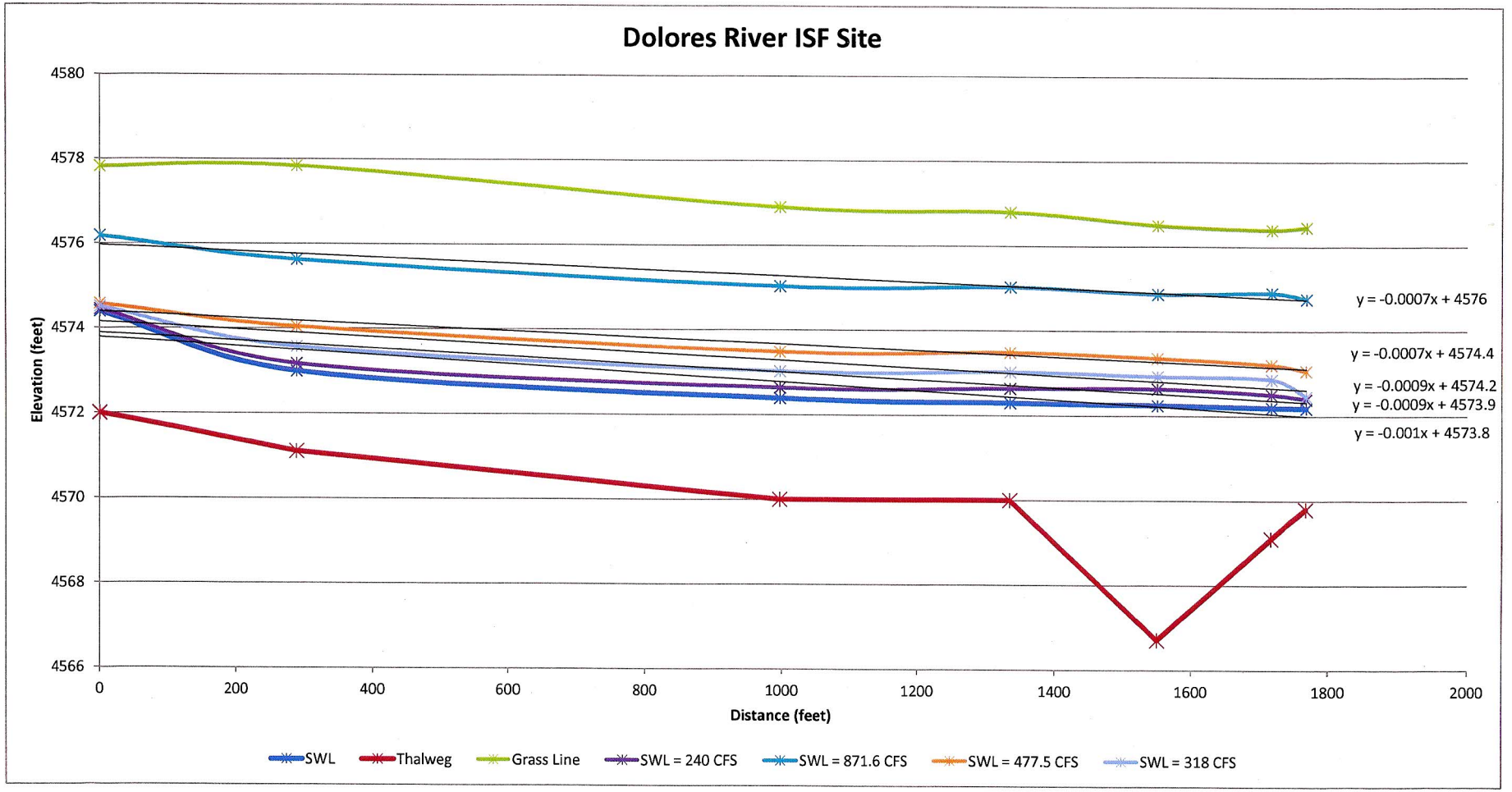
This location diagram depicts the location of the iron rebar set for the Delores River Model Project located south of Gateway, Colorado on Hwy. 141. The distances returned on this diagram are in feet and measure across and up the Delores River.

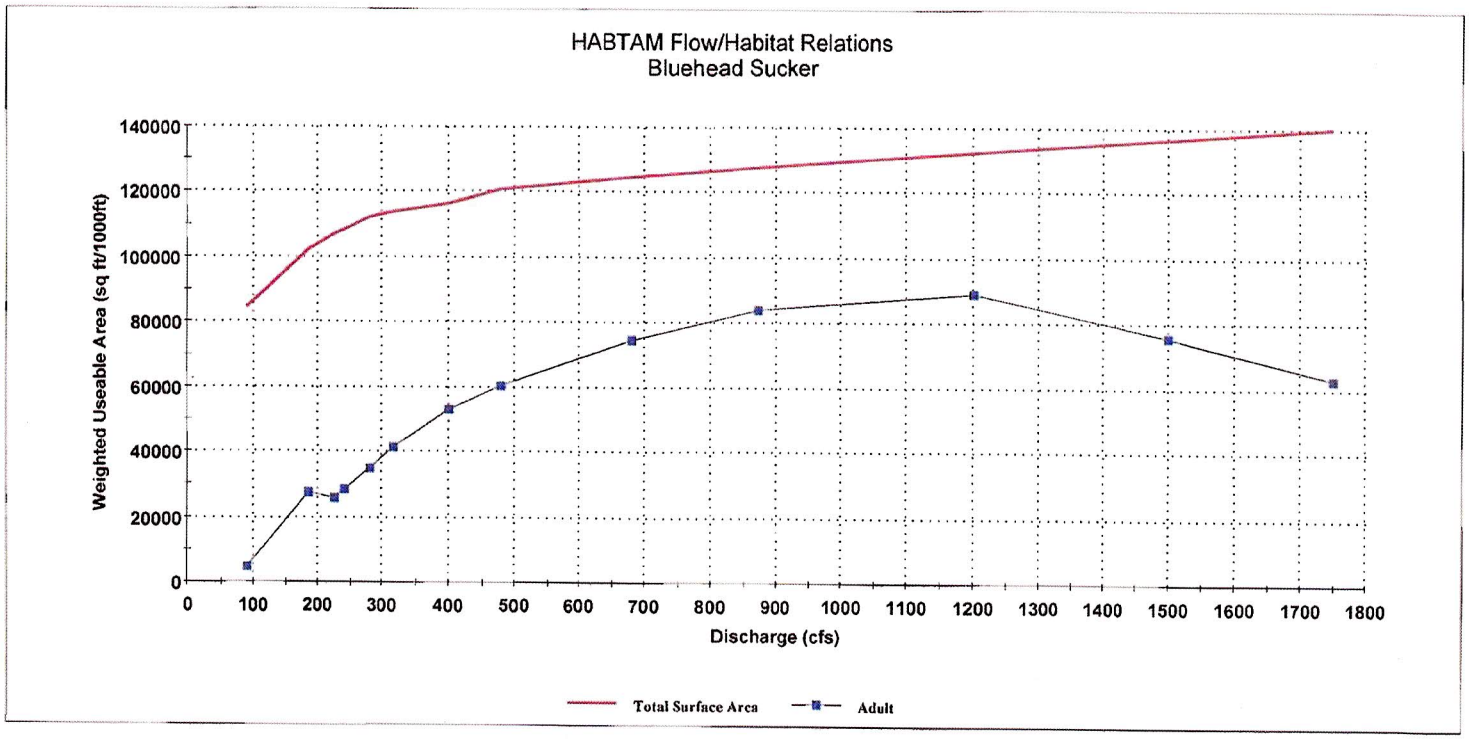
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

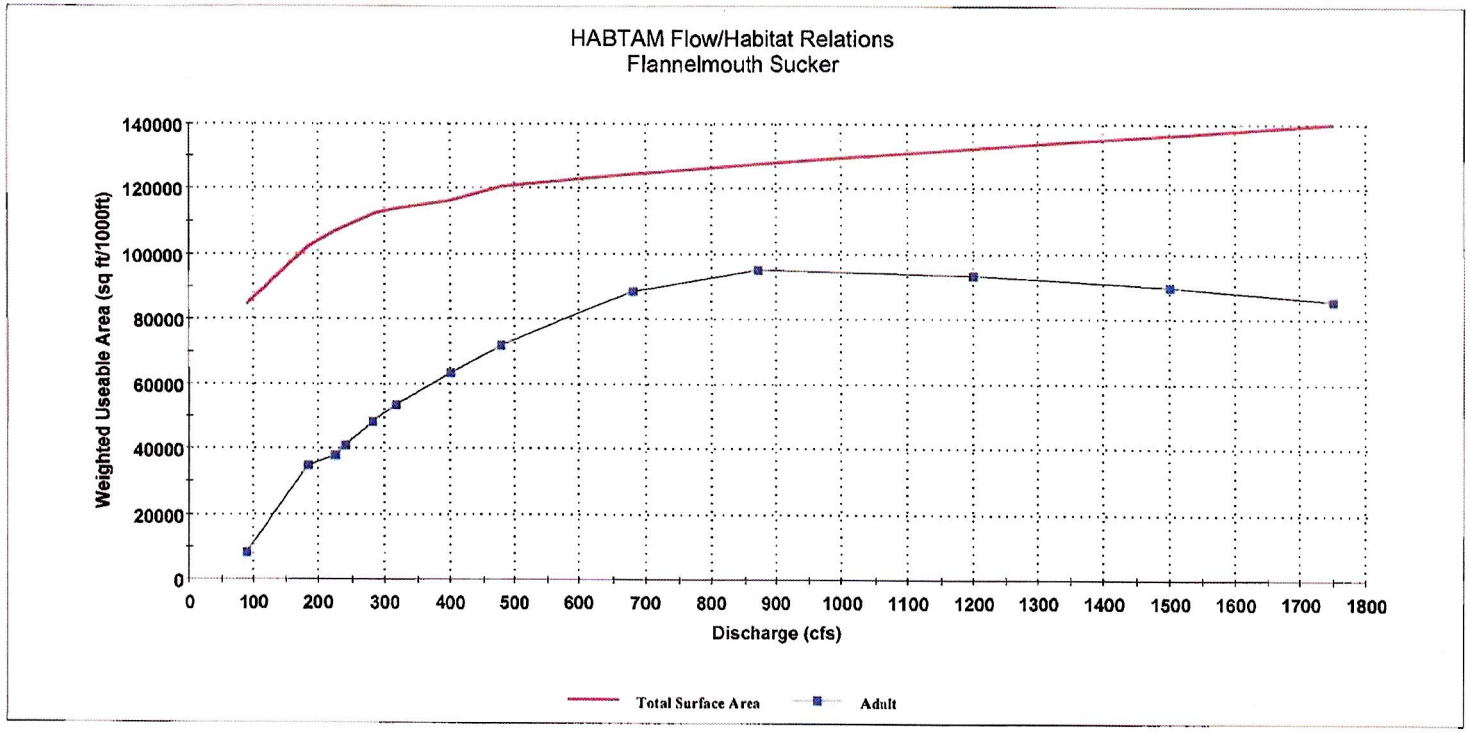
Denver, Colorado Nov. 9, 2011

R. M. Bruno

T. 50 N., R. 19 W., N. M. P.M.


Dolores River ISF Site
Elevation (feet)
4580
4578
4576
4574
4572
4570
4568
4566
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance (feet)
y = -0.0007x + 4576
y = -0.0007x + 4574.4
y = -0.0009x + 4574.2
y = -0.0009x + 4573.9
y = -0.001x + 4573.8
SWL
Thalweg
Grass Line
SWL = 240 CFS
SWL = 871.6 CFS
SWL = 477.5 CFS
SWL = 318 CFS


HABTAM Flow/Habitat Relations
Bluehead Sucker
Weighted Useable Area (sq ft/1000ft)
140000
120000
100000
80000
60000
40000
20000
0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Discharge (cfs)
Total Surface Area
Adult


HABTAM Flow/Habitat Relations
Flannelmouth Sucker
Weighted Useable Area (sq ft/1000ft)
140000
120000
100000
80000
60000
40000
20000
0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Discharge (cfs)
Total Surface Area
Adult

Dolores River Water Availability Technical Memo

Flow Modification

The proposed instream flow reach on the Dolores River receives water from the Dolores River, the San Miguel River, and a number of small tributaries. The Dolores and San Miguel Rivers each have historical municipal and irrigation water uses that alter the nature flow of the system (CWCB, 2005). There are also a number of reservoirs that affect flow conditions such as Gurley, Miramonte, Trout Lake, and Lake Hope on the San Miguel and Groundhog, McPhee, Summit, and Narraguinnep on the Dolores River. Many of these reservoirs are part of large water projects such as the Montezuma Valley Irrigation Company (MVIC), the Summit Reservoir System, and the Dolores Project (CWCB, 2012).

The Dolores Project, which includes McPhee Dam and nearly 200 miles of canals, tunnels, pipelines and laterals, significantly alters the flow regime in the proposed instream flow (ISF) reach. The Dolores Project was developed by the United States Bureau of Reclamation (USBR) and supplies an average annual volume of 90,900 acre-feet to Dove Creek, Towaoc, and the Montezuma Valley (USBR website). Many of these are transbasin diversions that export water from the Dolores River system to the San Juan River system. The majority of decreed water uses occur upstream from McPhee Reservoir. The exceptions are a fish pool, some senior downstream water rights, and flows necessary for the salinity control project in the Paradox Valley.

Construction of McPhee Dam started in 1980 and was completed in 1984 (Voggesser, 2001). Other portions of the project were completed later, such as the Great Cut Pumping Plant in 1987 and the McPhee Powerplant in 1993. The Dove Creek Canal and Towaoc Canal were completed in 1987 and 1993 respectively. The USBR declared the Dolores Project, “substantially complete” in 1995 with “final completion” in September 1998 after correcting minor design and construction deficiencies in laterals and canals (Voggesser, 2001). The full Dolores Project was online and in use by 1999 or 2000, with 2000 the typical date given (Ken Curtis – Dolores Water Conservancy District, personal communication). This history of changing use can be divided into three primary time frames:

1. Pre-McPhee which includes historical water depletions, prior to 1984
2. Post-McPhee, when McPhee Dam was complete but not necessarily the entire Dolores Project, 1984 to present
3. Post-Dolores Project when the entire Dolores Project was operational and utilized, 2000 to present.

Analysis Methods

The Dolores River and water development projects in the basin represent a complex system that has changed through time as different projects have been implemented. Given changes in historical use and available data, there are a number of time-frames and methods that can be used to analyze and determine water availability. Staff examined three principal means of evaluating water availability for

the proposed Dolores River instream flow. First, the gage data for the Dolores River near Bedrock and the San Miguel River near Uravan were combined to estimate flow entering the proposed reach from 1984 to 2012. This time frame represents post-McPhee conditions but not the full implementation of the Dolores Project. Second, the Colorado River Decision Support System (CDSS) Statemod model historical simulation was used to evaluate the historical use at the downstream terminus from 1984 to 2006. This time frame also represents post-McPhee conditions, but ends at the last year modeled by Statemod. Lastly, the Statemod model baseline simulation was used to evaluate the current management practices of the Dolores Project with historical hydrology from 1974 to 2006. These analyses and results are detailed below.

Gage Data

Several different gages have operated in the vicinity of the proposed instream flow reach, each with different periods of record. Relatively long term and continuous gage data is available for both the San Miguel River at Uravan (09177000) and the Dolores River near Bedrock (USGS 09171100) gages starting in 1973. The Uravan gage is located approximately 6.7 miles upstream from the proposed upper terminus at the confluence. The Bedrock gage is located approximately 3.5 miles upstream from the proposed upper terminus. A historical gage on the Dolores River at Gateway (09179500), located downstream from the proposed lower terminus, operated for less than twenty years in the 1930s to 1950s. Approximately 22 miles downstream from the lower terminus, the Dolores River at Cisco (0918000) gage has the longest continuous record operating from 1950 to present.

Gage Name	Gage ID	Start of record	End of record
Dolores River at Bedrock	09169500	10-1-1917 8-1-1971	9-30-1922 Present
Dolores River near Bedrock	09171100	8-1-1971	Present
San Miguel River at Uravan	0917700	8-1-1954 10-1-1973	9-30-1962 Present
Dolores River at Gateway	09179500	10-1-1936	9-30-1954
Dolores at Cisco	0918000	12-1-1950	Present

In order to estimate the flow that historically entered the proposed instream flow reach, gage data from the San Miguel at Uravan (09177000) and the Dolores River near Bedrock (USGS 09171100) were added together. Concurrent data at both gages is available from 10-1-1973 to the present, but only 10-1-1984 to 9-30-2012 was used in the analysis. 10-1-1984 is the date the USGS uses to analyze data for the post-McPhee period and 9-30-2012 represents the last complete water year with approved USGS data at the time of analysis.

Before adding the gages together, the data were analyzed to determine if the measured flows would meet on the same day at the confluence or if there would be a lag from one or the other gages. The field measurements for the Bedrock and Uravan gages were downloaded and a relationship between discharge and average velocity for each gage was developed. The distance between each gage and the

confluence of the two rivers was measured and travel times were calculated. The estimated travel times for both gages indicate that for all discharges measured, flow from the two different gages would reach the confluence on the same day. Therefore, it does not appear to be necessary to lag either gage before combining the datasets.

Once the gage data from 10-1-1984 to 9-30-2012 were added, a number of statistics were calculated. The median, or the flow that occurs at least 50% of the time, was calculated for each day. In addition, 95% confidence intervals for the median were calculated. Typically the Board considers water to be available if the proposed ISF flow rate is at or below the median value, but can consider ISF flow rates that are below the upper 95% confidence interval.

CDSS

Statemod is a modeling system developed by the CWCB for water supply planning purposes as part of the Colorado Decision Support System (CDSS). This model uses streamflow data, diversion records, water rights, reservoir contents, operating rules, return flow estimates, and consumptive use estimates among other datasets. The model simulates streamflow, native flow, and other information at specific locations in a basin for either monthly or daily time-steps. The model can be used to simulated different types of conditions including: 1) Historic simulations that use historic hydrology based on historic operations of reservoirs and diversion; and 2) baseline simulations that use historic hydrology, but current operating rules and practices. Typically, baseline simulations use diversion demand (the amount of water the crops actually need, limited by the water rights) rather than the diversion record.

The San Juan Statemod model contains the Dolores River and simulates flow from 1974 to 2006. This model was updated in 2010 as part of Colorado River Water Availability Study (CRWAS) and includes the operating procedures for the Dolores Project at that time. The San Juan model was modified to provide additional detail in the area near the proposed instream flow reach. Specifically, nodes representing the upstream and downstream instream flow termini were added; a node was added to explicitly model Casto (WDID630578); diversions on tributaries to the Dolores River instream flow reach were aggregated; and other diversions on the mainstem Dolores in the instream flow reach were aggregated. A number of other modifications and corrections were applied to improve simulations in this area. The modifications are summarized below.

- Created instream flow nodes to represent the upstream and downstream termini.
- Disaggregated the existing aggregate node (63_ADS_023) into four smaller aggregates that represent: structures physically and hydrologically located above the Uravan gage; structures on tributaries to the Dolores River within the proposed ISF reach; structures on the mainstem Dolores River within the proposed ISF reach; structures located downstream from the ISF reach.
- Removed Foster Miner Ditch (6300524) from model due to no diversion records and incorrectly assigned irrigated acreage.
- Disaggregated the existing aggregate node on West Creek (63_ADS_024) into five smaller aggregate structures.
- Created a new diversion node for Casto Ditch (WDID 630578) and assigned return flows to 63_ADS_Blw located below the lower terminus.

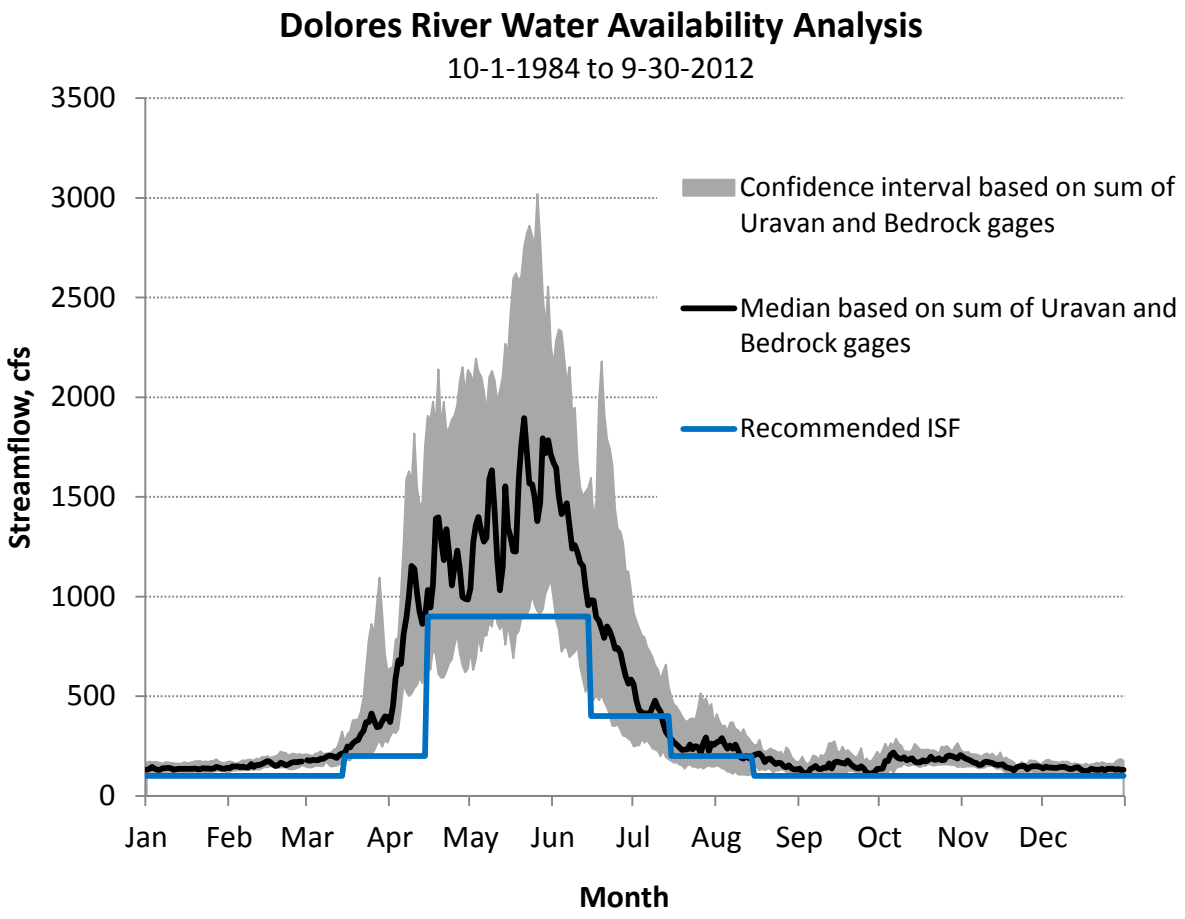
- Red Cross Ditch returns flows were assigned to 63_ADS_Blw located below the lower terminus.
- Set irrigation efficiencies for created Dolores River aggregate nodes and Casto to the efficiencies originally computed for the 63_ADS_023 aggregate.
- Set irrigation efficiencies for created West Creek aggregate nodes to the efficiencies originally computed for the 63_ADS_024 aggregate.
- Extended the gage record for the Dolores at Gateway using regression with the Dolores at Cisco gage.
- Revised daily pattern gage to use the Dolores at Cisco for the Dolores near Bedrock, Dolores at Gateway, and West Creek diversions.
- Revised the native flow calculation approach for West Creek from the neighboring gage approach to the gain approach (CDSS, 2010).
- Revised drainage basin area and precipitation values to better match values measured by StreamStats (Capesius and Stephens, 2009). Precipitation on West Creek was increased by 1 inch to improve calibration.
- Turned on use diversion comments when filling diversion records.

These modifications involved changes to the network and all necessary input files. New native flow calculations and daily historic and baseline simulations were performed. The simulated daily streamflow at the lower terminus was then used to determine the median and 95% confidence intervals for both the historical and baseline simulations.

Water Availability Results

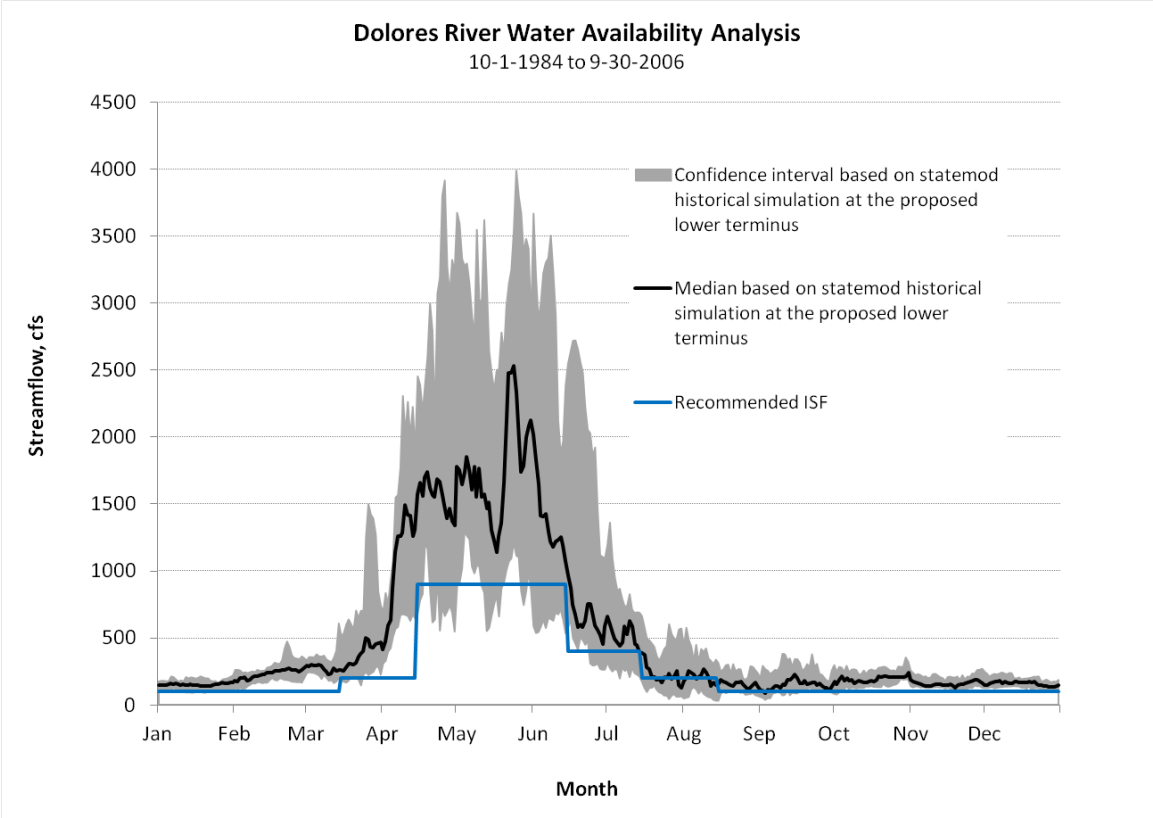
Historical Gage Analysis

The combined flow of the Dolores River at Bedrock and the San Miguel River at Uravan indicates that water has been available to meet the proposed ISF rate at the upper terminus from 10-1-1984 to 9-30-2012. The proposed ISF is below the median for 357 of 365 days. The proposed ISF is higher than the median for 3 days in July and 5 days in August. The ISF is below the upper 95% confidence interval for all days of the year.



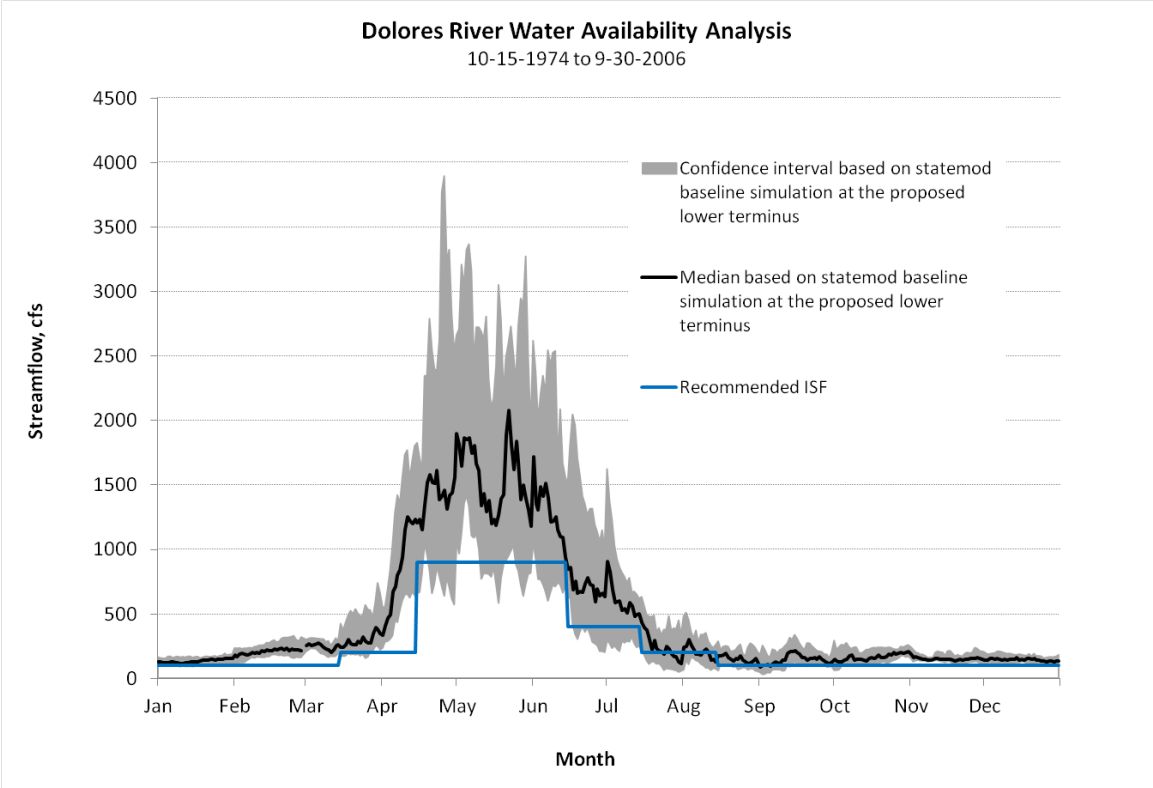
Historical Statemod Analysis

The historical Statemod results at the proposed lower terminus are similar to the historical gage analysis. These results are similar despite a change in the period of record (ending in 2006 not 2012) and a change in the location analyzed (upper versus lower terminus). The proposed ISF is below the median for 351 of 365 days. The proposed ISF is higher than the median for 8 days in July, 5 days in August, and 1 days in September. The ISF is below the upper 95% confidence interval for all days of the year.



Baseline Statemod Analysis

The baseline Statemod results at the proposed lower terminus are similar to the historical gage analysis. This occurs even though the analysis period for the baseline simulation is slightly longer. In this case analysis started on 10-15-1974 through 9-30-2006. The proposed ISF is below the median for 351 of 365 days. The proposed ISF is higher than the median for 6 days in July, 6 days in August, and 2 days in September. The ISF is below the upper 95% confidence interval for all days of the year.



Summary

Based on all three methods and time-frames of analysis, water is available to support the proposed instream flow rates for the Dolores River. The Statemod baseline simulation result is the most conservative estimate of streamflow because it simulates current operation of McPhee Dam including the completed Dolores Project. The final median hydrology used to evaluate water availability for the proposed instream flow on the Dolores River is based on the Statemod baseline results. This model was selected for the final hydrology because it represents the best available data and analysis method for the Dolores River.

Citations

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