IN THE SUPERIOR COURT OF THE STATE OF ARIZONA
IN AND FOR THE COUNTY OF MARICOPA

IN RE THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE GILA RIVER SYSTEM AND SOURCE	W-1 (Salt) W-2 (Verde) W-3 (Upper Gila) W-4 (San Pedro) (Consolidated) Contested Case No. W1-11-3342 **Order Quantifying Federal Reserved Water Rights for the Aravaipa Canyon Wilderness Area**

This matter came before the Court to quantify the United States' federal reserved water rights in the Aravaipa Canyon Wilderness Area ("ACWA"). Pursuant to the Arizona Wilderness Act of 1984, Congress set aside approximately 6,670 acres of public lands in Graham and Pinal Counties, Arizona to create the ACWA that includes a portion of the perennial reach of Aravaipa Creek and the land located approximately 0.5 to 1.5 miles on either side of the stream. Pub. L. No. 98-1485, §§ 201 and 202, 98 Stat. 1491. [SRP, FOF 2, 6] Six years later, Congress enacted the Arizona Desert Wilderness Act of 1990 to incorporate into the ACWA an additional 12,711 acres of public land in Pinal and Graham Counties, Arizona. Pub. L. No. 101-628, §101(a)(39), 104 Stat. 4469, 4472. In the 1990 legislation, Congress specifically reserved "a quantity of water sufficient to fulfill the purposes of this title." *Id.* § 101(g)(1).

The Bureau of Land Management (BLM), an agency of the United States Interior Department, has the responsibility to manage the ACWA and appropriately balance the demands on the ACWA. [SRP FOF 5] It establishes the level of appropriate public access to the ACWA for camping, hiking, and recreation, admitting approximately 4,000 visitors annually. [071515:17 (Moore)] It sets the number of cattle allowed to graze and access the springs in the ACWA. [07272015: 22-23 (Sergent)] It implements measures to eliminate exotic fish populations, such as constructing a barrier in the streambed. [Reinthal Report at 10, Exh. 42; 07222015:162-163 (Reinthal); U.S. FOF 82; Carothers Report at 9, Exh. US 41] As part of its management function to maintain the ACWA, the BLM also filed claims for water rights under both federal and state law. This decision determines the quantity of the United States' federal reserved water rights in the ACWA.

A. Aravaipa Creek

Aravaipa Creek has its headwaters in Graham County, Arizona. As shown on *figure 1,* it flows from north to south through Klondyke. Once north of Klondyke, Aravaipa Creek continues west. [Arizona Water Atlas, Vol. 3, Section 3.1. Exh. 685] Aravaipa Creek enters the ACWA along the eastern border and continues flowing west where it exits the western border of the ACWA. Aravaipa Creek

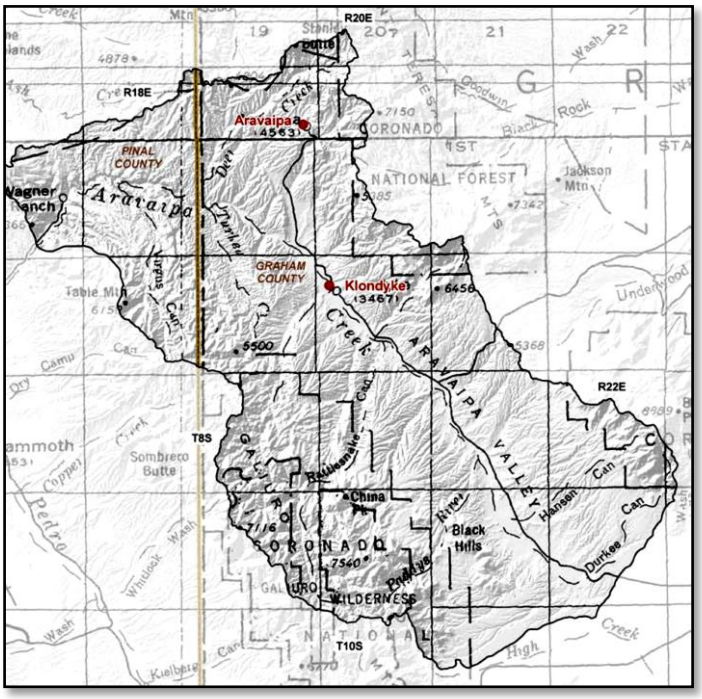

Figure 1. Map of Aravaipa Creek from the headwaters to the ACWA.
Source: Figure 3.1-1 Arizona Water Atlas, Vol. 3, Section 3.1.

then flows southwest until it joins the San Pedro River. The reach of the Aravaipa Creek within the ACWA flows perennially. Aravaipa Creek serves water users both upstream and downstream of the ACWA. [Burtell Report at 13, Exh. 40 (referring to the San Pedro River HSR); 072015:66 (Bonar); 072215:182-183 (Reinthal)]

The flow in Aravaipa Creek is characterized by generally low flows throughout the year, interrupted by relatively short duration higher flows due to upstream rainstorm activity. [Mussetter Report at 12, Exh. 44] Flow duration curves produced by the United States and Salt River Project Agricultural Improvement and Power District and Salt River Valley Water Users' Association ("SRP"), which are based on mean daily flow rates, demonstrate that the flow measured at either the USGS gage or using more recent data at the gage on or near the eastern boundary of the ACWA, typically does not exceed 20 cubic feet per second (cfs). [Appendix 1 to Swanson Report, Exh. 37; 072015:153-154 (Mussetter)] The annual flow duration curve prepared by SRP is reproduced as *figure 2*. Floods typically occur in January, February, August and October due to a "bimodal pattern of winter cyclonic rains, spring drought, summer monsoon, and autumn drought." [Reinthal Report at 15, Exh. 44; 070315:75 (Swanson)] The

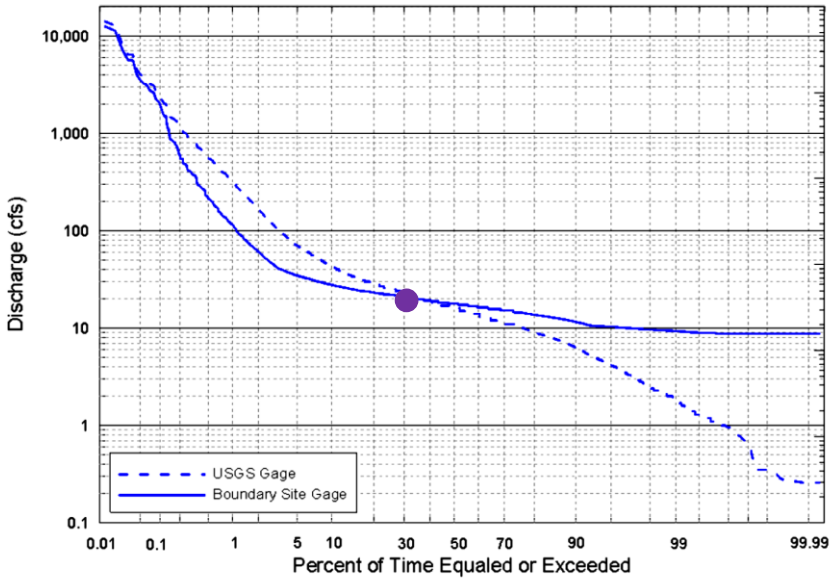

Figure 2. The annual flow duration chart presented by SRP shows the amount of discharge at the eastern boundary of the ACWA for 1967-2012 (excluding 2004-2005) as a function of that percent of time the flow rate is exceeded in Aravaipa Creek. The large dot added to the figure highlights that the streamflow equals or exceeds 20 cfs only about 30% of the year based on this data.
Source: Mussetter Report, Exh. 44, p. 13, fig. 8. Also admitted as Exh. 90.

floods contribute a substantial amount of the water that flows through the ACWA. Approximately 66% of the total volume of the water in Aravaipa Creek occurs on about 10% of the days. [Swanson Report at 4-5, Exh 606] This combination of relatively low flows and seasonal flooding creates a highly variable flow. [072218:91 (Patten); 071515:107 (Fogg); 072918:82-84 (Carothers)] All of the parties agree that the pattern of flow as well as the amount of flow must be taken into account in the determination of the quantity of the federal reserved water rights to Aravaipa Creek.

B. Procedural Background

On March 28, 1991, BLM filed its initial Statement of Claimant No. 39-68704 ("SOC") to claim federal reserved water rights to 15,000.8 acre feet of instream flow in Aravaipa Creek water, "all water from sources not inventoried" and unspecified quantities for a list of stockponds. The Arizona Department of Water Resources (ADWR) investigated the original claims for water rights in the Final Hydrographic Survey Report for the San Pedro River Watershed (1991) ("San Pedro HSR"). The BLM subsequently amended its SOC on October 6, 1994 and February 24, 1995.

On August 17, 2009, the Special Master initiated this contested case to adjudicate the United States' claims for federal reserved water rights in the ACWA. On November 2, 2011, the Special Master issued a decision on seven issues as a matter of law. Two months later, on January 10, 2012, the BLM amended its SOC to claim federal reserved water rights for 24,799.03 acre feet of water annually.[1] It claimed 24,600 acre feet for instream flow in Aravaipa Creek, 182.94 acre feet of water from 14 springs and 16.09 acre feet from 13 stockponds. In February 2014, ADWR submitted its Report Concerning Federal Reserved

[1] A final amended SOC was filed on October 6, 2014 to correct the estimated flow from floods with return periods of 2, 10, 25, 50 and 100 years.

Water Rights Claim for Aravaipa Canyon Wilderness Area ("ADWR Report") that analyzed the methodology the United States used to quantify its claimed federal reserved water rights for the ACWA.

A thirteen day evidentiary hearing was subsequently held to resolve the following issues:

1. Did Congress intend to reserve all unappropriated waters within the Aravaipa Canyon Wilderness Area?
2. If unappropriated water was available on August 28, 1984, what is the precise quantity of unappropriated water required to fulfill the minimal need of, and satisfy, the primary purpose of the Arizona Wilderness Act of 1984?
3. If unappropriated water was available on November 28, 1990, what is the precise quantity of unappropriated water required to fulfill the minimal need of, and satisfy, the primary purposes of the Arizona Desert Wilderness Act of 1990?

[Joint Pretrial Statement, May 20, 2015, p. 5]

C. Standard for Quantification of Federal Reserved Water Rights

No party disputes the directive established in *United States v. New Mexico*, 438 U.S. 696, 699 (1978), which set federal reserved water rights for a national forest: such water rights only extend to the minimal amount necessary to accomplish the purpose of the reservation. [SRP COL 13] In the adjudication of federal reserved water rights, the Arizona Supreme Court observed, "non-Indian reserved rights are narrowly quantified to meet the original, primary purpose of the reservation." *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source*, 201 Ariz. 307, 312 ¶14 (2001) ("*Gila V"*). The issue that must

be resolved in this proceeding is the precise quantity of water that constitutes the minimal amount necessary to preserve the ACWA as the wilderness area envisioned by Congress.[2]

The San Carlos Apache Tribe and SRP contend that a federal reserved water right should attach to all unappropriated water flowing into and available to the ACWA. The quantification of water rights must be consistent with the minimalist approach and the Court's admonition that "federal reserved water rights will frequently require a gallon-for-gallon reduction in the amount of water available for water-needy state and private appropriators." *United States v. New Mexico*, 438 U.S. at 705. The Court recognizes that state and private users appropriate water both upstream and downstream of the ACWA.

To provide a level of certainty to the multiple users of water in the Aravaipa subwatershed, the United States' federal reserved water rights should be precisely quantified using an objective, measurable standard. A literal adoption of a descriptive quantification of "all" water rather than a numerical quantification that can be objectively and physically measured would not be consistent with the approach taken in *Cappaert v. United States*, 426 U.S. 128 (1976), a case which determined federal reserved water rights in a national monument. The *Cappaert* court relied on a specific physical measurement to quantify the amount of water subject to federal reserved water rights. Advocating a contrary interpretation, SRP contends that the *Cappaert* decision supports a conclusion that a precise quantification is not required. [SRP Post Hearing brief, p. 6 lines 20-23] It bases its argument on the fact that the *Cappaert* Court did not define the federal reserved water right in terms of gallons or acre feet of water. Instead, the Court quantified the water rights in terms of a specific distance between the surface level of a contained pool in a limestone cavern and a brass marker permanently set into the rock.

[2] A determination of the minimal amount of water required by the ACWA does not preclude BLM from pursuing additional water supplies to obtain the amount it determines to be optimal.

The Court's use of distance as a proxy for volume demonstrates for purposes of this case that an objective, measurable standard should be used to quantify federal reserved water rights for non-Indian reservations when reasonably available and necessary due to competing water uses.

The United States, like SRP, contends that the Congressional intent to preserve the ACWA requires that its federal reserved water rights must encompass all of the natural flow through the ACWA. [U.S. Closing Statement, filed Feb. 5, 2016, p. 2.] It, however, employed a different approach to proving its claim for federal reserved water rights. The United States claimed specific quantities of monthly base flow and annual unimpounded flood flow intended to be a statistical representation of the total quantity and pattern of flow. [U.S. FOF 18, 22; 071315:103-104 (Swanson)] As the claimant, the United States has the burden of proof to establish the minimally necessary amount of water. *Arizona v. California*, 460 U.S. 605, 620 (1983). If the United States shows that a quantity of water contributes to the primary purposes of the reservation, but does not prove that a lesser amount would frustrate their accomplishment, then the United States has not met its burden. *Avondale Irrigation Dist. v. N. Idaho Properties, Inc*., 99 Idaho 30, 41, 577 P.2d 9, 20 (1978).

D. Quantity of Water Required in Aravaipa Creek

Quantification of a federal reserved water right requires a clearly defined, specific need for the water.[3] In *Cappaert*, the Court provided the following description as it approached the task of quantifying the federal reserved water rights:

[3] In his November 2, 2011 order, the Special Master found six broad purposes for the 1984 designation of the ACWA. Water is generally necessary to satisfy the purposes of the ACWA. [U.S. COL 17]

> When the water is at the lowest levels, a large portion of a rock shelf in Devil's Hole is above water. However, when the water level is at 3.0 feet below the marker or higher, most of the rock shelf is below water, enabling algae to grow on it. This in turn enables the desert fish (Cyprinodon diabolis, commonly known as Devil's Hole pupfish), referred to in President Truman's Proclamation, to spawn in the spring. As the rock shelf becomes exposed, the spawning area is decreased, reducing the ability of the fish to spawn in sufficient quantities to prevent extinction.

426 U.S. 128, 133–34. A broader description of the specific needs than that used in *Cappaert* must be formulated in this case because the ACWA encompasses an entire wildness area and not a small pool. The description, however, cannot be so broad that it prevents a practical consideration of the individual components of the ACWA relevant to quantifying the minimally necessary water supply.

Streamflow in Aravaipa Creek supports the riparian and fish habitats by providing water for plants along the Aravaipa channel, phreatophytes and various native fish populations. [(071515:39-41 (Fogg); 073015:50-51 (Carothers); SRP FOF 62; US FOF 52] Flood flow flushes downstream and over the fish barrier the exotic fish populations not indigenous to the area that threaten native populations, removes vegetation that is either invasive or otherwise prevents the germination or growth of new vegetation, provides water to support seedlings during the initial stage of growth, scours the streambed, and eliminates debris remaining from camping, hiking and other recreational activities.[4] [071515:23 (Moore); 072015:11-12, 22 (Bonar); 072215:153,158, 170 (Reinthal); 072915:131-132 (Carothers)]

The two very different types of water uses, water to maintain the ecosystem and water as a physical force to disrupt the ACWA, can be satisfied by a general flow pattern of long periods

[4] The United States has acknowledged that recreation is not a primary purpose of the ACWA. [U.S. COL 19] The Court agrees. Accordingly, no further consideration will be given to water uses related to recreational activities permitted in the ACWA.

of relatively stable low flows interrupted by high flows. Dr. Mussetter, who holds a masters and a Ph.D. in hydrology engineering, defined the necessary discharge regimes as follows:

> The discharge regimes that are responsible for the *wilderness character* of Aravaipa Creek within the ACWA can be separated into two categories: sustained flows and flood (or disturbance regime) flows. The sustained flows considered in the above analysis are an important factor in determining the character of Aravaipa Creek within the ACWA because they support instream and riparian habitat, and they also provide the energy to transport a small portion of the total sediment load through the reach. The geomorphic character of arid region streams such as Aravaipa Creek, however, tend to be driven by periodic floods that transport large quantities of sediment, scour riparian vegetation, erode banks, scour the channel bed, and deposit flood debris in the channel and overbanks.

Robert Mussetter, Hydrologic and Geomorphic Characteristics of Aravaipa Creek within the Aravaipa Wilderness Area – Implications for Instream Flow Water Rights. p.12, admitted as Exh. 44.

The United States quantified the first component of its claim by asserting a need for 9,444 acre feet of base flow. [U.S. FOF #19] Technically, base flow results from the natural release of water from river bank storage and adjoining riparian aquifers. Base flow does not include streamflow directly related to precipitation events, e.g., winter storms event and summer monsoon rains. [072115:175 (Patten); SRP FOF 69; Carothers's Report at 4, Exh. 41; United States FOF #31] Thus, an appropriate methodology that distinguishes between base flow and the storm flow components must be used to determine base flow. [ADWR Report at 3-2, Exh. 38] The methodology implemented by the United States to claim 9,444 acre feet relies upon the sum of the monthly median streamflow derived from streamflow data that includes base flow and flood flow. The issues in this case do not require a determination of whether the values submitted by the United States constitute base flow as opposed to a rate/volume of streamflow that combines base flow and stormflow, so no determination will be made that the first component of the United States' claim constitutes base flow. For purposes of this decision, the

term "sustained flow" will be used to identify the first component of the United States' claim. Flood flows constitute the second component of the United States' claim for federal reserved water rights.

1. Sustained Streamflow

All of the scientific experts agreed that the sustained flow in the ACWA is an essential constituent of the minimal water needs of the ACWA because it preserves the native fish and riparian communities. [071515:92 (Fogg); U.S. FOF 50, 51] Sustained flow is necessary to support the healthy population of seven native fish species found in the ACWA. [072015:29 (Bonar); SPR FOF 129; US FOF 57] Five species populate "shallow, riffle areas where the habitat is characterized by tranquil flow over pebbles/gravel substrate . . . or low or moderate gradients and flow" [072215:140 (Reinthal)] Two species require a habitat of deeper pools. [*Id.*] Dr. Peter Reinthal, a fisheries biologist who has a Ph.D. in zoology and is a professor at the University of Arizona, opined that that historical sustained flow regime must be maintained to preserve the amount and quality of fish habitat. [Reinthal Report at 14, Exh. 618; 072215:170 (Reinthal)] Dr. Scott Bonar, who has a Ph.D. in fisheries, serves as the United Leader of the United States Geological Survey's Arizona Cooperative Fish and Wildlife Research Unit at the University of Arizona and is employed as a professor at the University of Arizona, stressed the importance of maintaining low flows during the dry season because they are "key to the reproductive success of numerous native species, as most larval fish require 1) areas with low water velocities and fine sediments, 2) areas with warm temperatures relative to the rest of the channel in which to grow, 3) areas where algal growth provides them with food resources and coverage, and 4) cover from terrestrial and aquatic predators." [Reinthal Report at 3, Exh. 618; SRP FOF 118,119] Sustained flow also benefits the riparian habitat by maintaining the

alluvial aquifer that supports riparian plants in the floodplain area of the river, as well as plants farther from the river such as the woody riparian species with relatively deep roots that can tap into this groundwater source. [072215:30 (Patten)]

Steve Swanson, a hydrologist with the Bureau of Land Management, based the United States' claim for 9,444 acre feet of water annually on 28 years (1932-1940, 1942, 1967-1984) of streamflow data obtained from the gage maintained by the United States Geological Survey (USGS) located approximately six miles downstream of the western border of the ACWA (the "USGS gage"). [[071315:84-85 (Swanson); Burtell Report at 11, Exh. 40; US FOF 20] The ADWR Report confirmed that the USGS gage is the only gage with an adequate period of record for analyzing characteristics of the natural flow regime of Aravaipa Creek prior to the establishment of the ACWA in 1984. [ADWR Report at 3-10, Exh. 38; see also Mussetter Report at 5, Exh. 44] In terms of accuracy, 95% of the data from the USGS gage is within ten percent of the actual value. [071315:84 (Swanson)]

Using the USGS data, Mr. Swanson made three calculations. First, he ascertained the mean of the daily flow measurements for each day. Second, he ranked the daily means for each day of the month to find the median daily rate of flow for each month. The median of a data set is the midpoint of the rank-ordered set of values meaning that one half of the data points are less than the median and one half of the data points exceed the median. [ADWR Report at 3-8, Exh. 38; US FOF 136] Third, Mr. Swanson converted the median daily rate calculated for each month into the equivalent volume in acre feet per day and multiplied that amount by the number of days in each month to determine the median monthly flow.[5] [071315:85-87 (Swanson)] Table 1 sets forth the results of these calculations. [Swanson Report at 4, Exh. FMC 606]:

[5] For example, Mr. Swanson determined that the median of the mean daily rates of streamflow for January was 16 cfs. Multiply this number by 1.98 to obtain 31.68 acre feet per day. Multiply again by 31 to obtain 982.08 acre feet per month.

Month	Rate of the Median of the Mean Daily Flow (cfs)	Volume of Median Monthly Flow (acre-feet/month)
January	16	982
February	18	998
March	18	1,105
April	13	772
May	10	614
June	6	356
July	10	614
August	14	859
September	12	713
October	11	675
November	12	713
December	17	1,043
Total		**9,444**

Table 1. United States' claim for sustained flow through the ACWA presented by month.
Source: Amended Statement of Claimant No. 39-68704, Attachment B.

The use of statistical methodology to quantify the highly variable sustained flow is appropriate in this case. [ADWR Report at 3-7, Exh. 38] No party contests Mr. Swanson's computations of the median monthly streamflow at the USGS gage. Analyzing the same data, ADWR found very similar (and in many months identical) median monthly stream flows using the same data. [ADWR Report, Table 3-3, Exh. 38] The choice of the median to quantify sustained flow, rather the mean, is consistent with the bifurcated approach taken by the United States to quantify its federal reserved water rights because the median is not as sensitive as the mean to outlier data i.e., the rate of flood flows. Mr. Swanson explained that the primary effect of using the median is that it "cuts off all of the influences of the high events," [071315:92 (Swanson)] Dr. Mussetter and ADWR also concurred that the use of median monthly flows based on daily mean flows is an appropriate method to quantify the rate of flow.

The parties dispute the appropriate site at which to measure the sustained flow and the methodology to be used to quantify that sustained flow at that site. Although the USGS gage

provides the most accurate historical streamflow data for the period prior to 1984 at its site on Aravaipa Creek, it alone does not provide sufficient data upon which to quantify sustainable flow for the ACWA. The flow measurements recorded by the USGS gage are affected by water diversions occurring between the western boundary of the ACWA and the USGS gage, evapotranspiration of vegetation along the reach between the ACWA and the USGS, a larger flood drainage area and the gradient of the alluvial water table. [07152015:84 (Fogg); Fogg Report at 6, Exh. 640; Masseter Report at 9, Exh. 44]

The Nature Conservancy maintains a gage near the eastern (upstream) boundary, and the BLM installed a gage at the eastern boundary of the ACWA that measures flow in Aravaipa Creek. [Fogg Report at 14, Exh. FMC 640; 072015:126 (Mussetter)] The BLM also maintains a gage at the western boundary of the ACWA. These gages have not generated a historical record comparable to the USGS gage. Nevertheless data from these gages can be used in conjunction with the USGS gage data to ascertain valid sustained flow rates for the ACWA. James Fogg, a hydrologist who holds a master of science in Watershed Science, proposed:

> The 30+/- instantaneous discharge measurements available for each month near the upstream wilderness boundary also provide an opportunity to correlate measured upstream flows with flows measured at the USGS gage for the same or following day (based on travel time between the upstream boundary and the USGS gage site). It is most desirable to develop such correlations by month, since the relationship between flows measured at the two sites changes throughout the year. . . . By careful selection of measurement pairs (i.e., at the upstream site and the USGS gage) to eliminate flashy short-term monsoon events, it should be possible to define monthly correlations between the two sites that can be applied to any period of the long-term USGS record to estimate corresponding median monthly flows near the upstream wilderness boundary. Monthly correlations also will enable calculation of other percentiles of interest for defining monthly flow-duration characteristics near the upstream wilderness boundary.

Aravaipa Canyon Resource Assessment in support of Federal Reserved Water Rights, LowClouds Hydrology, Inc. (2011). [Fogg Report at 12, Exh. FMC 640]

Dr. Mussetter utilized the eastern boundary gage maintained by The Nature Conservancy and the USGS gage to develop a correlation between the two sites. [072015:34, 128-131 (Mussetter)] He concluded that the eastern gage provides the appropriate measurement site because the eastern gage provides a thorough, long term record of measurements and it is at the upstream boundary of the wilderness area. [072015:98-99 (Mussetter] Richard Burtell, a registered geologist with a master in science in Hydrology, relied on measurements taken at The Nature Conservancy gage in conjunction with other flow measurements to determine the sustained flow rate in the ACWA. [Burtell Expert Report, Exh. 203, p. 17] Mr. Burtell also opined that the eastern boundary of the ACWA provides the appropriate site to establish flow rates because enforcement actions would not need to account for diversions between the western boundary of the ACWA and the USGS gage. [072715:81-83 (Burtell)]

Also endorsing the approach of using ACWA boundary data to correct the BLM monthly flow data by correlation of flows at the two sites, ADWR applied simple linear regression analysis to data collected from the USGS and ACWA west boundary gages to determine the median monthly flow rates for the period ending in 1984. [ADWR Report at 3-10, Exh. 38] In addition, ADWR studied flow measurements from the eastern and western gages maintained by the BLM to determine if separate quantification is required at both the upstream and downstream boundaries of the ACWA. It concluded that statistically significant differences did not exist between the measurements from the gages for ten months out of twelve months and concluded that "a single quantification of natural flow regime adequately characterizes [the] ACWA." [ADWR Report 3-13, Exh. 38] Based upon the expert opinions presented concerning the appropriate measurement site and the fact that the ACWA and the reach of Aravaipa Creek between the eastern and western gages is under the control and

management of the United States, the appropriate point to measure the United States' federal reserved rights is at the eastern boundary of the ACWA.

Each of the experts who have considered the United States' claim for sustained flow measured at the eastern boundary submitted monthly median flow rates as shown in Table 2. [ADWR Report at 3-13, Exh. 38; SRP FOF 307]

Month	Median Rate of the Mean Daily Flow – USGS (cfs) U.S.	Median Rate of the Mean Daily Flow-West (cfs) ADWR	Median Rate of the Mean Daily Flow – East (cfs) SRP	Median Rate of the Mean Daily Flow – East (cfs) FM
January	16	16.6	20	13
February	18	19.9	20	12
March	18	20.2	21	14
April	13	15.2	18	12
May	10	12.6	16	12
June	6	7.6	13	10
July	10	11.4	17	13
August	14	14.8	19	13
September	12	15.9	17	14
October	11	13.6	17	12
November	12	14.7	18	13
December	17	16.6	20	15

Table 2. The flow rates calculated by the United States and ADWR follow the same general pattern of more than a 60% change in flow rates from the highest flow rates in February and March to the lowest flow rates in June and July. The rates calculated by SRP generally follow the same flow pattern reported by the United States and ADWR except that the summer flow rates decline by approximately 38% from the winter flow rates. The flow regime computed by FM creates a more linear flow pattern than the other three data sets.

The values submitted by Dr. Mussetter give the highest monthly median values. Dr. Mussetter used the historical record for the USGS gage from 1967 – 2012 after concluding that no systemic differences in the flow regime for the periods before and after 1984. [072015:132-133, 155 (Mussetter)] Mr. Burtell testified that Dr. Mussetter's chosen period of record omits dry years prior to 1985 and includes post-1984 years with very high flows. [072715:92

(Burtell)] While ADWR concurred that less than a 1% difference exists between the mean annual volumes before and after 1984, it did find significantly increased annual minimum stream flow and decreased annual maximum flows. [ADWR Report at 3-12, Exh. 38] Based on this evidence and statistical analysis, quantification of sustained stream flow must be based on the data for the time period preceding the federal reservation of water rights.

Mr. Burtell presents the least varied monthly median flow rates due to computed higher summer flows and lower winter flows. Mr. Burtell reached his conclusions after including data synthesized from an analysis of data from a gage on the San Carlos River. [072815:127 (Burtell); SRP FOF 350] The standard error range associated with the synthesized data point ranges from 21% to 24%. [072815:128 (Burtell); SRP FOF 331] In contrast, ADWR used only the data from the USGS gage and the ACWA boundary gages. Accordingly, the Court finds that the methodology and data to be the most reliable and relevant to determine the federal reserved water rights for sustained flow is the median monthly rates provided by ADWR which shall be used to quantify the sustained flow.

Along with its submission of the monthly mean flows, ADWR provided additional statistical data for the purpose of better defining the sustained flows to which the United States will have federal reserved water rights. As explained above, the median of the stream flow represents only the midpoint of the data set. The actual flow in Aravaipa Creek for one-half of the days in any given month over time is expected to be less than the median streamflow. Thus, the administration of the federal reserved water rights based on the Monthly Streamflow requires additional information to better define the appropriate distribution of flow rates. Table 3 provides the flow rates at the 25^{th} percentile and the 75^{th} percentile computed by ADWR that demonstrates the skew in the data and improves the accuracy of the distribution of the 1984 sustained flow rates in Aravaipa Creek. The Court finds that the United States is entitled to a

federal reserved water right within the ACWA with a priority date of August 28, 1984 for a sustained flow in Aravaipa Creek that has a distribution of flow rates consistent with the following:

Month	25th Percentile (cfs)	Monthly Streamflow (cfs)	75th Percentile (cfs)
January	12.0	16.6	23.5
February	14.6	19.9	26.1
March	16.0	20.2	30.1
April	11.2	15.2	21.5
May	8.8	12.6	17.9
June	5.4	7.6	13.2
July	6.0	11.4	21.1
August	9.2	14.8	25.0
September	11.5	15.9	23.5
October	10.5	13.6	18.8
November	11.6	14.7	21.8
December	12.7	16.6	21.3

Table 3. Distribution of flow rates determined by ADWR.

2. Stormflow

The United States also asserts a claim for federal reserved water rights to the flood waters in the ACWA. It submitted data for five categories of floods shown in Table 4. Floods are described by their instantaneous peak flows, which is the highest rate of flow measured during a flood before the rate of flood water begins to recede, shown as "Estimated Flow" in Table 4. [072715: 84 (Burtell); Freeport FOF 162] By analyzing the peak flows in a given area, the probability of occurrence[6] for each flow rate can be calculated and then reported as the "Flood Flow Return Period."

[6] The return period of a flood is defined by the probability that the flood will occur during a year. The return period of a flood is the denominator of the fraction equal to the probability that such a flood will occur. Thus, a flood with a two year return period has a (1/2 = 0.5) or 50% probability of occurring each year, and a 100 year flood has a (1/100 = 0.01) or 1% probability of occurring in each year.

Flood Flow Return Period	Estimated Flow (cfs) US
2 Year	4,540
10 Year	14,600
25 Year	26,300
50 Year	37,000
100 Year	50,700

Table 4. Estimated flood flows and related probabilities of occurrence submitted by the **Source**. United States in its Statement of Claimant, as amended.

The ADWR Report addressed the peak discharges claimed by the United States and concluded that they significantly exceeded ADWR's computations based on the same pre-1985 data from the USGS site. [ADWR Report at 3-17, Exh. 38] For example, ADWR's computed estimated flows at 3,560 cfs and 11,000 cfs for 2 and 10-year return periods, respectively. [ADWR Report, Table 3-2, Exh. 38] Mr. Burtell and Dr. Mussetter also disagreed with the United States' estimated peak flood flows for the ACWA. According to Mr. Burtell, the drainage area at the eastern boundary of the ACWA is 411 square miles, it increases to 503 miles at the western boundary of the ACWA and it encompasses approximately 537 square miles at the USGS gage site. [Burtell Report at 11, Exh. 40] Greater drainage areas contribute to higher flood flows. Mr. Burtell estimated the flood flows at the eastern boundary to be 24% lower than those measured at the USGS gage and estimated the flood levels to be about 10% lower at the western gage. [Burtell Report at 11; Exh. 40]

Dr. Mussetter also testified that the USGS gage is not the appropriate site to measure flood flow in the ACWA citing to differences in drainage areas. He determined that the flood peak discharges at the eastern ACWA boundary should typically be in the range of 87% to 90%

of the corresponding peak discharges at the downstream USGS gage. [Mussetter Report at 16, Exh. 44] Table 5 lists the flood frequencies computed by Dr. Mussetter and Mr. Burtell.

Flood Flow Return Period	**Estimated Peak Flow USGS Gage Mussetter (cfs)**	**Estimated Peak Flow East ACWA Boundary Mussetter (cfs)**	**Estimated Peak Flow East ACWA Boundary Burtell (cfs)**
2 years	3,900	3,400	2,890
5 years	8,100	7,200	6,130
10 years	12,100	10,700	9,220
50 years	24,700	22,100	18,800
100 years	32,000	28,800	24,300

Table 5. Instantaneous peak flows for five categories of floods calculated by Dr. Mussetter and Mr. Burtell.

Notwithstanding the presentation of flood flow frequencies in the United States' claim, Mr. Swanson concluded that "identifying a specific quantified flood regime (e.g. magnitude, duration, frequency) suitable for maintaining the wilderness ecosystem is not practical for the water right claim." [Swanson Report at 6, Exh. FMC 606] As a surrogate for a specified flood regime, the United States claimed 15,156 acre-feet of unimpounded flood flow per year, the difference between the 9,444 acre-feet of claimed annual base flow and 24,269 acre feet, the mean annual total flow recorded at the USGS gage downstream of the ACWA. [071315: 88 (Swanson); U.S. FOF 19, 21]

The mean annual volume is not an appropriate measurement for quantifying federal reserved water rights given the stochastic nature of the storm system in the ACWA. It does not satisfy the mandate to precisely quantifying federal reserved water rights where the water rights in question are highly variable flows. Moreover, the mean annual volume does not account for the skew in the data because in many years the storm systems will not deliver 24,269 acre feet

of water. The claimed amount will be met or exceeded, on average, only about 34% of the time. [ADWR Report at 3-17, Exh. 38] Conceivably the expected frequent shortfalls could result in unwarranted enforcement actions.

Assuming the claim for 24,269 acre feet is meant as an average that implicitly defines a range of acceptable annual amounts, an accurate distribution of flood flows cannot be determined from a single parameter. The same mean can result from a relatively stable streamflow and from streamflow that with extreme high and low flows. Alternatively, if the proposed annual mean volume is a shorthand approach to claim all flood flow, then the number does not qualify as a precise quantification of federal reserved water rights. A more complex and comprehensive approach must be used to define the water rights.

Finally, quantifying federal reserved water rights based solely on the annual mean volume does not directly protect the other elements of the flood regime that the parties have identified as important, which are the magnitude, duration, frequency, timing and rate of change of the floods. The ACWA requires floods from the winter cyclonic storms that tend to produce floods of larger duration and the summer monsoon rains that tend to produce floods of greater magnitude but with very rapid recession rates and lower volumes. [SPR POF 65, 66, 91; 072115: 55, 170-71 (Fogg); Mussetter Report at 23, Exh. 44] The ecosystem requires the maintenance of the floods' flow patterns, which when graphed are known as hydrographs. A hydrograph relates the rate of discharge to time. The experts refer to the flow patterns in Aravaipa Creek as "flashy hydrology" because in some cases a flood can appear and recede within a matter of hours. [Mussetter Report at 33, Exh. 44; FM SOF 183-186; 071315:79-80 (Swanson)] Thus, as in the case of sustained flow, the amount of federal reserved water rights to flood flow must be more specifically examined and quantified based on the minimal water needs of the ACWA.

Flooding provides the hydraulic force and energy necessary for a dynamic ecosystem. Mr. Fogg testified that floods are important to the maintenance of the wilderness area because they scour, transport, and deposit sediment. Although Mr. Fogg proposed that hydraulic analysis and modeling be conducted to quantify the flows sufficient to initiate the needed sediment transport in the ACWA, no such work was undertaken. [071515:105 (Fogg); 2011 Fogg Report at 9-10, Exh. 640; Freeport FOF 194]

Flooding also changes or disrupts the ACWA by disturbing soil and vegetation and displacing exotic fish populations. (072115:24 (Mussetter); SRP FOF 34] The evidence presented by the United States primarily focused on the impact of flooding on two aspects of the ecosystem: vegetation and fish. The United States has the burden to prove the minimal amount of floodwater necessary to maintain these aspects of the ecosystem.

The riparian area of Aravaipa Canyon includes a diversity of plant species which are stratified with respect to Aravaipa Creek by: (1) rooting depth, with plants having shallower root systems such as watercress, rushes and grasses occurring nearer to the stream; and, (2) tolerance to floods. [071515: 41-42 (Fogg); 07215:167 (Patten); U.S. FOF 91, 93; SRP FOF 60] Trees such as the cottonwood and willows grow farther away from the stream and benefit the riparian habitat by providing shade for the stream and bird habitat. [071515:55-56 (Fogg); FM FOF 194]

The cottonwood and willow require floods to provide fresh sediment along the banks of the stream necessary for seed establishment and growth. [*Id*; U.S. FOF 93, 95] Successful seed germination and seedling growth, known as recruitment, depends upon the continued availability of water to the roots (in short, the seedling will die if its root growth cannot keep up with the receding water table). [071515: 54-57 (Fogg); U.S. FOF 100-101; SPR FOF 93] According to Mr. Fogg and Dr. Duncan Patten, who holds a Ph.D. in plant ecology and is a professor emeritus at Arizona State University, cottonwood and willow tree recruitment occurs

from February to mid-April. [072218:76-78 (Patten); 071515:78-81 (Fogg); FM FOF 199]. Winter flooding in February, March and April benefits recruitment, but high summer storms can uproot and destroy new seedlings. [072115:173 (Patten)] Dr. Patten testified that the recession flow rate from the winter floods influences the ability of the seedlings to survive because of the need for the new seedlings to have a source of water. [072215:98 (Patten)] He had not, however, done the analysis known as a stage flow graph that would relate growth to the needed recession flow pattern in the ACWA. [072215:99-100 (Patten)] Mr. Fogg indicated that seedlings required a recession flow rate following a flood peak in the zone of 50 to 300 cfs over a period of time for successful recruitment. [071515:78-79 (Fogg)]

In addition to promoting growth of new vegetation, the evidence shows that large floods benefit the ACWA by destroying vegetation. Dr. Patten testified that floods benefit the riparian area by scouring the vegetation (including large plants and trees) thereby creating an ecosystem consisting of multiple age classes of plants and a diversity of plants. [SRP FOF 81-85; 07221:7-10 (Patten)] He further stated that a large flood such as the flood of 2006 created the kind of scouring that promotes the creation of a multiple class, multiple canopy type system. Dr. Patten concluded that such a large flood creates the right conditions for the reestablishment of a healthy riparian area. [SRP FOF 88; 07221:17-18 (Patten)]

Large floods also adversely affect the salt cedars (tamarisks), a non-native tree found in the ACWA. Salt cedars have displaced native plants and, in particular, the cottonwood, willows and sycamores. [Exh. 598 (Fogg); U.S. FOF 104] Salt cedars increase the salinity of the soil to such an extent that other plants can no longer survive. [071515:70-71 (Fogg); U.S. FOF 106; SRP FOF 104-106] Large floods ameliorate the impact of the salt cedar by removing the salty soil and transporting the remaining salt farther down into the remaining soil. *Id.*

With respect to fish, floods serve two main purposes. Floods benefit fish populations by washing nutrients into the stream and by removing sediment from fish habitats, the cobble and riffle areas and pools. [072015:18 (Bonar)] Flood flows also contribute to a reduction in exotic fish populations that threaten the native fish populations in Aravaipa. [102715:156 (Carothers); 072015:72: (Bonar); (Reinthal Report at 10, Exh. 42; U.S. FOF 60)] Dr. Reinthal primarily viewed flooding as a means to eliminate undesired exotic fish populations. He testified that exotic fish populations declined following the flood that occurred in 2006. Dr. Reinthal testified that he hoped that one more 100-year flood, a flood for which there is a 0.01 probability of occurrence in any given year, would eliminate a species of exotic fish known as the red shiner.

The experts adopted two different approaches in their respective analyses of the needs of the ACWA for flood waters. The scientific experts retained by the United States and SRP took the position that no additional anthropomorphic changes could be permitted to decrease the flood waters because either: (1) a small change in the water supply could produce disproportionate impacts to the ecosystem that cannot be currently described; or (2) the ecosystem is sufficiently complex that any change in the current water supply could cause damage that cannot now be anticipated. Dr. Mussetter summarized his testimony with the conclusion that a decree that prevents any further surface water diversion upstream from the ACWA is the best method to protect the ACWA. [072115:61 (Mussetter)] Similarly Dr. Patten testified that the most ecologically sound recommendation of hydrology to maintain these plant communities is to maintain or allow natural hydrological events to continue to take place into and through the canyon. [072215:29 (Patten); SPR FOF 109]

The issue here, however, is not the quantification of water for optimal environmental conditions; instead it is the quantification of the minimal amount of water necessary to

accomplish the purposes of the ACWA. *See Avondale Irrigation Dist. v. N. Idaho Properties, Inc.,* 99 Idaho 30, 41, 577 P.2d 9, 20 (1978) ("the court must find the necessary minimum flow so that the marginal excess may be available for use and appropriation"). Dr. Stephen Carothers, a terrestrial and aquatic ecologist, and ADWR directly considered whether any portion of the flood flow was surplus to the minimal amount necessary for the maintenance of the ACWA. Dr. Carothers opined that flood water could be diverted under a defined set of protocols without undermining the ecosystem. [Carothers Report, at 1, Exh. US 41] Similarly, ADWR rejected the assumption that no water in excess of the amount needed by ACWA flows through Aravaipa Creek. It stated:

> It is a generalized overstatement to suggest that *any* human-induced alteration to the natural flow regime would result in tangible negative effects. Prescribed instream flow regimes have been developed across diverse ecological conditions allowing *some amount* of human-induced alteration to certain aspects of natural flow regimes (e.g. flood flows during specific times of year, etc.) which still providing protection to critical aspects of natural flow regimes (citations omitted).

[ADWR Report, at 3-21, Exh. 38]

Dr. Carothers undertook the analysis to quantify flood flows required for the maintenance of the ACWA and the amount of surplus floodwater. He concluded that flood water in excess of the minimum amount needed by ACWA flows through the Aravaipa Creek and recommended permitting extractions of unappropriated water as follows:

A. When the discharge measured at the east boundary of the ACWA exceeds 3,500 cfs, up to 350 cfs may be extracted. Once natural discharge falls below 3,500 cfs, extractions must cease unless B., below, is satisfied.

B. When the natural discharge measured at the east boundary of the ACWA is less than 3,500 cfs, and the flow has exceeded 20 cfs and has been steady or

> descending for at least 48 hours, up to 350 cfs may be extracted if natural discharge exceeds 700 cfs. If the natural discharge is 700 cfs or below, extractions must be limited to 50% of the difference between the discharge rate and 20 cfs (i.e., 0.5 x (current discharge – 20 cfs).

[FM Closing Statement, p. 65]

Dr. Carother's proposed calculation of surplus water set forth above affects a very limited number of floods. The data presented by Dr. Mussetter, reported in *figure 3,* shows that out of 61 flood events with peak discharge in excess of 500 cfs occurring during the 25-year time period investigated by Dr. Mussetter, only three winter storms and six summer monsoons had peak flows of 3,500 cfs or greater. Thus, Dr. Carothers' quantification of excess flow will only apply to about 15% of the floods assuming that the 25-year period chosen by Dr. Mussetter is representative of current and future conditions in the ACWA.

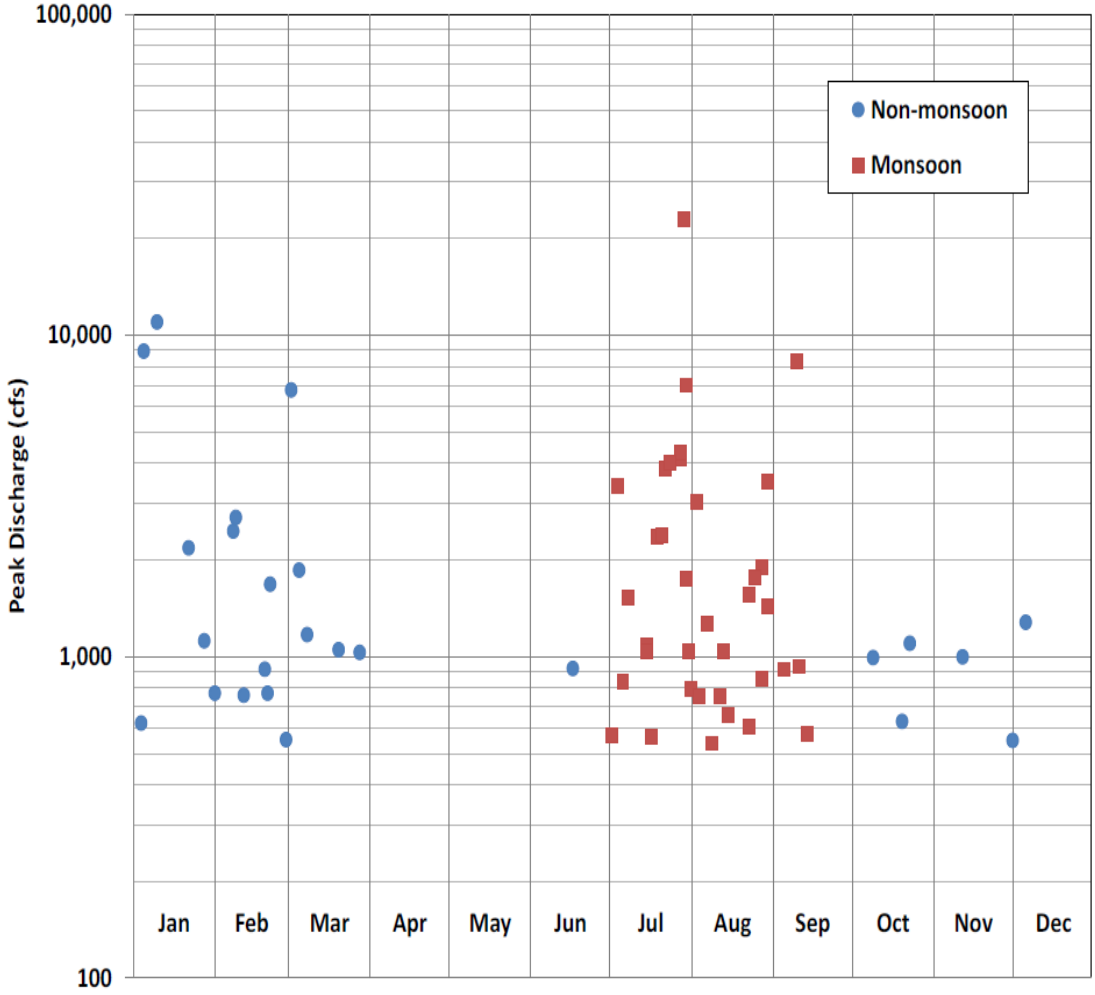

Figure 3. Peak discharges greater than 500 cfs recorded at the USGS gage for the 25 year period of October 1, 1988 through March 15, 2013.
Source: Expert Report of Dr. Robert A. Muessetter, dated October 31, 2013 [Exh. SPR97]

Dr. Carother's recommended extraction protocols do not affect the duration, frequency or timing of floods, key characteristics of the ACWA hydrograph which all of the experts opined should be preserved. They do affect the two remaining characteristics of the flow pattern: the magnitude of floods and the rate of change of flooding as the flood flows decline. The magnitude of flood flows affects the streambed and the surrounding vegetation.

Mr. Fogg testified regarding the types of floods needed to shape the geomorphology of the stream. He stated that "you have to have floods bigger than ten-year floods to do this

ripping and tearing. And to have these really geomorphically affected floods, you need big flood events. You need floods like the 2006 flood that tore out so much stuff, because those are the one that are able to kind of reset the system and get everything going again." [071515:74 (Fogg]) Mr. Fogg estimated that the 2006 flood had an instantaneous peak discharge of approximately 28,000 cfs making it a flood having between a 50 and a 100-year return period. [071515:75 (Fogg)] Mr. Fogg does not testify as to the peak flow rate that would cause the minimally needed amount of destruction other than to indicate that a flood having a 10-year return period, which would have generated peak flow of less than one half the rate of the 2006 storm, would not suffice. Assuming that only flows of approximately 28,000 cfs or greater will generate the necessary disturbance to the riverbed and surrounding vegetation, Dr. Carother's proposed extractions would minimally affect these relatively rare floods. The extraction of water at the rate of 350 cfs from a flood discharging at 28,000 cfs would reduce the rate of discharge by approximately 1.3%. The choice to use a fixed rate of extraction from large floods creates an increasingly smaller impact as the floods increase in size, thereby substantially preserving the destructive force of the very large floods.

Dr. Carother's quantified destructive flow needed by the ACWA on an assessment prepared in 2000 for the U.S. Fish and Wildlife Service of Aravaipa Canyon geohydrology that "considered destructive flooding (significant changes in bed form, locations of riffles and rapids, loss of overbank vegetation) to occur when daily discharges were greater than 800 cfs." [Carother's Report at 21, Exh. U.S. 41] Dr. Carothers determined that "in the interest of conservatism," extractions could not be allowed until flows exceeded 1,000–3,500 cfs. *Id.* Relying upon either Mr. Fogg's testimony or the authority included in Dr. Carother's report, extracting the flood water in accordance with Dr. Carother's proposal would not deprive the ACWA of minimally needed flood water.

Mr. Fogg's primary concern with the regime proposed by Dr. Carothers concerned the flooding needed for recruitment of willow and cottonwood trees. He opined that if flood water is extracted "on a regular basis as a standard procedure, you are going to impact the ecology of this canyon." As shown in *figure 3*, there has only been one flood with a peak flow in excess of 3,500 cfs during the February to April time period that Mr. Fogg and Dr. Patten specified as important to the recruitment of trees in the riparian ecosystem. The prohibition of diversion unless flood flow exceeds 3,500 cfs addresses Mr. Fogg's concern that regular extractions could occur.

Dr. Carothers also refined his proposal to state that once the flood entered the recession phase, extraction would be halted for 48 hours (the "Recession Period") and then resumed under tighter restrictions. Once the flow dropped to less than 700 cfs, the extraction rate would be reduced to less than one-half of the flow rate. Dr. Carothers testified that he adopted this rule to protect the descending limb of flood events protocol in order to facilitate root establishment during the cottonwood and willow recruitment. [072915:116-118 and 102715:145-146 (Carothers); FM FOF 214] Dr. Patten did address this key issue in his testimony that if water were diverted in accordance with the guidelines developed by Dr. Carothers, the loss would cause some changes to the ACWA but it probably would not cause the ACWA to lose its character as a well-functioning and diverse riparian ecosystem. [072215:74-75, 102 (Patten)]

The maintenance of fish habitat also factored into the development of Dr. Carother's flood extraction regime. As discussed above, he determined that a flow of 3,500 cfs would provide sufficient sediment transport within the stream for fish habitat. He also opined that according to the literature he reviewed, flood flows of at least two orders of magnitude greater than base flow are necessary to control the exotic fish population. [072915:138-141

(Carothers)] Assuming a base flow of 20 cfs, the preservation of rising flows until the flood water reached the rate of 3,500 cfs preserves the flooding recommended by the literature, i.e., 2000 cfs.

Based on the evidence presented, the actual rate of flow necessary to control or eradicate the exotic fish population is unclear. An examination of population data for fish in ACWA demonstrates that exotic fish populations decline following flooding, but the population rebounds in succeeding years. [Reinthal Report at 26, Exh. US 42] Thus, flooding seems to have only limited temporal impact. Dr. Reinthal opined that the complete removal of the red shiner from the ACWA relying only on large floods is not a realistic scenario. [10281590:90-92 (Reinthal); Freeport FOF 2310] Notably, the green sunfish (another exotic fish) was finally eradicated not by flooding but by physical removal. [10281590:46 (Reinthal)] Thus, the United States has not shown that a small reduction in large floods will eliminate the required fish habitat or enable the proliferation of exotic fish populations to the exclusion of the desired populations.

To test his hypothesis that the set of rules governing diversions of flood flow would not create a different hydrograph for a flood event, Dr. Carothers devised a model that he used to calculate the hydrographs for 80 to 100 different extraction scenarios. [Carother's Report at Exh. U.S. 41] The final set of recommendations are incorporated into hydrographs shown in *figure 4* that compares the natural hydrograph of the period July 1, 2006 – August 12, 2006 to a hydrograph for the same time period adjusted in accordance with Dr. Carother's extraction protocols. Only very minor differences between the two hydrographs can be detected showing that Dr. Carother's approach to identifying surplus water generally maintains the existing hydrograph.

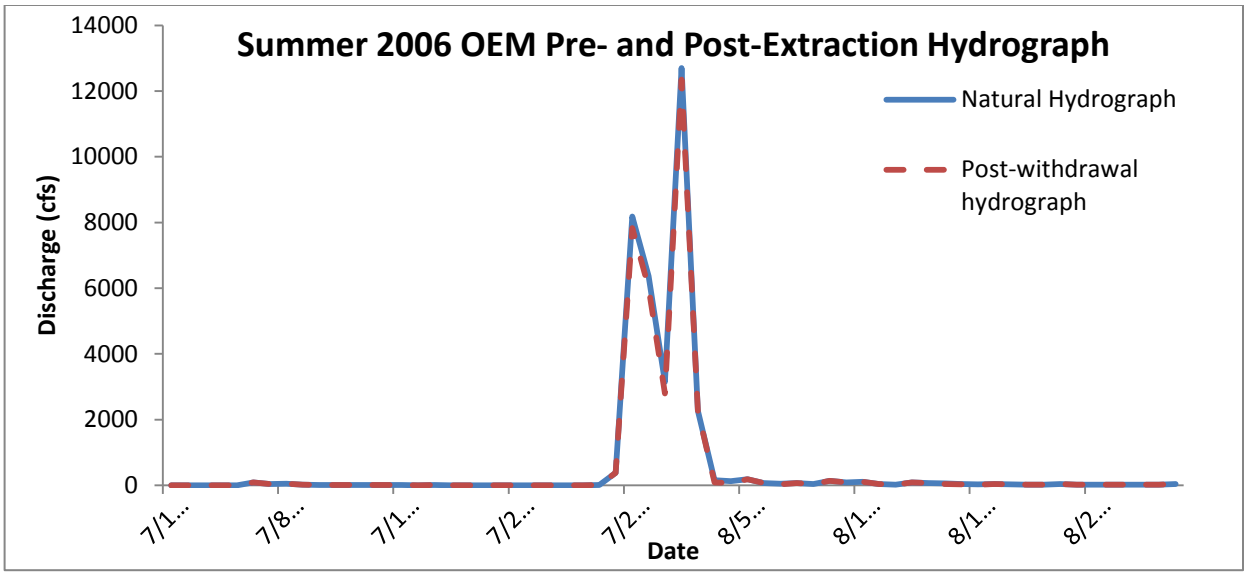

Figure 4. Hydrograph of a flood event based on daily data compared to hydrograph from daily data adjusted by Dr. Carother's proposed extraction rules.
Source: Carother's Report at 22.

The United States challenges the model on a number of grounds. It argues that the model has not been published in a scientific journal and subject to peer review. Publication, however, does not always correlate with reliability and innovative theories may not be published despite solid methodology. *Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993) The United States contends that the model does not make predictions regarding ecological impacts. The United States assessment is correct. The model was created to answer only one question: Does the resulting hydrograph substantially match the existing hydrograph? As demonstrated by *figure 4* above, the conclusion is affirmative. Figure 4 provides evidence that the pattern of flow in ACWA will be maintained under the proposed recommendations. The United States proposal, in contrast, seeks to define its federal reserved water rights for flood flow at a single number because it did not believe it could, as a practical matter, expressly take into account the components of the pattern of flood flow in the ACWA: timing, frequency, duration, magnitude or rate of change. Given the importance that the experts have attributed to

the maintenance of the natural hydrograph, the evidence supports the more nuanced approach taken by Dr. Carother to set the water needs of the ACWA.

Although Dr. Carothers' proposed regime deals with diversions of floodwater when the rate of flow exceeds 3500 cfs, it does not provide any guidance for smaller floods, which based on Dr. Mussetter's data constitute the majority of the floods in the ACWA. Thus, this Court adopts ADWR's approach, which is to quantify flood flow by describing a distribution of the stochastic flood values. The ADWR Report provided the pre-1985 median value of 16,437 acre feet annually measured at the BLM West gage as well as the annual flow values at the 25th percentile and the 75th percentile. This statistical information defines the distribution and skew for purposes of quantifying the federal reserved water right. ADWR did not include statistical values for annual flood flow at the eastern boundary of the ACWA in its report, having concluded that measurements from the two gages are not statistically different. Thus, the statistical values computed by ADWR shall be used to quantify the federal reserved water rights for flood flow.

4. Springs.

The BLM claims federal reserved water rights for fourteen springs and all other naturally occurring water within the ACWA. [FOF US 264] Springs and seeps provide water for wildlife [Tr. 2 July 14, 2015, at 23:1-2 (Wells)] William Wells, a hydrologist for the BLM, testified that the field information about the springs was limited to one or two recent measurements of three springs. (Wells Tr. At 7) This amount of data does not suffice to describe a natural flow regime; rather it simply provides limited information about the amount of flow at a particular point in time. The BLM does not have measurements from different years or different seasons for any of the 14 springs. This level of data does not meet the standard established by the United States Supreme Court and adopted by the Arizona Supreme Court to quantify federal

reserved water rights for a non-Indian reservation where there are competing water demands. Under similar circumstances, the Supreme Court of Colorado rejected claims for federal reserved water rights for instream flows in national forests because "[t]he United States has shown sparse evidence to support its claims that instream flows serve the national forest purposes of watershed and timber protection." *U.S. v. City and County of Denver, by and through Bd. of Cmmrs*., 656 P.2d 1, 22 (1982). The evidence offered by the United States in support of its claims for the 14 springs is insufficient to quantify a federal reserved water right.

5. Conclusion

Based upon the evidence and testimony presented, the Court finds that the United States has not demonstrated that the purposes of the ACWA's reservation would be entirely defeated without a federal reserved water right to the entire natural flow of Aravaipa Creek. Instead, the Court finds that the United States' federal reserved rights are limited as follows.

A. The United States is entitled to federal reserved water rights for sustained instream monthly flow in Aravaipa Creek measured at the eastern boundary of the ACWA as follows:

Month	**25th Percentile (cfs)**	**Monthly Streamflow (cfs)**	**75th Percentile (cfs)**
January	12.0	16.6	23.5
February	14.6	19.9	26.1
March	16.0	20.2	30.1
April	11.2	15.2	21.5
May	8.8	12.6	17.9
June	5.4	7.6	13.2
July	6.0	11.4	21.1
August	9.2	14.8	25.0
September	11.5	15.9	23.5
October	10.5	13.6	18.8
November	11.6	14.7	21.8
December	12.7	16.6	21.3

B. The United States is entitled to federal reserved water rights to be measured at the eastern boundary of the ACWA in accordance with distribution defined by a median of 16,437, a 25th percentile of 13,393 and a 75th percentile of 30,569 acre feet annually. These amounts are inclusive, and not in addition to, the monthly sustained instream flow amounts.

C. Notwithstanding B above, for flood events in which the discharge measured at the eastern boundary exceeds 3,500 cfs, the United States does not have a federal reserved water right to that amount of flood flow that is subject to diversion under the following circumstances:

1. When the discharge measured at the eastern boundary of the ACWA exceeds 3,500 cfs from a flood event, streamflow may be diverted at a rate of up to 350 cfs until such time as the discharge rate declines to 3,500 cfs.

2. When the discharge measured at the eastern boundary of the ACWA drops below 3500 cfs, and the flow has been (and remains) steady or descending for at least 48 hours: (a) up to 350 cfs may be diverted if the natural discharge exceeds 700 cfs; and (b) up to 50% of the difference between the discharge rate and 20 cfs may be diverted when the discharge falls below 700 cfs. *Example: If the discharge is 680 cfs, then 330 cfs may be diverted:* $\frac{680-20}{2} = 330$. If at any point the flow increases, then all diversions shall cease until the flow has again been steady or descending for at least 48 hours.

D. The Court makes no finding regarding whether the water subject to diversion has been previously appropriated. Instead, the Court merely identifies those amounts of water not subject to a federal reserved water right. The Court also makes no finding

as to whether the allowed diversions will ever be feasible, economically or otherwise.

E. The beneficial use for all federal reserved water rights quantified in this decision will be instream flow. Reserved water will not be diverted from Aravaipa Creek. There shall be no impoundments of flow in Aravaipa Creek in the ACWA nor interference with natural surface water occurring along the reach of the stream channel in the ACWA. The right to use is restricted to place of use and for purpose of use.

Dated December 17, 2018.

Mark H. Brain
Judge of the Maricopa County Superior Court