Comprehensive Agreement No.1

Fifth Annual Report

FY18

(July 1, 2017 – June 30, 2018)

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Prepared by:

CITY OF PRESCOTT
ARIZONA

PRESCOTT VALLEY

SRP®

October 2018

Comprehensive Agreement #1
Prescott/Prescott Valley/SRP
Monitoring/Modeling Committee
FY18 Annual Report
(July 1, 2017 – June 30, 2018)

Introduction

The fifth annual report documents the progress of the Monitoring and Modeling Committees (Committees) established by Comprehensive Agreement #1 (CA#1). Since late 2012, the Committees have worked to implement the Data Collection and Monitoring Plan (DCMP) for the purposes of developing an improved numerical groundwater flow model of the Big Chino Sub-basin as described in the exhibits attached to CA#1. These efforts include the installation of monitoring equipment required to generate the data sets necessary for an improved groundwater flow model, to establish long-term hydrologic records, and to provide information for future adaptive management approaches in the basin. This report contains: project background, Fiscal Year 2018 (FY18) accomplishments, financial summaries, and the ongoing monitoring and modeling efforts required to fully execute the CA#1 objectives.

Background

At a joint meeting on September 19, 2012, the Councils for the City of Prescott and the Town of Prescott Valley unanimously approved a comprehensive water monitoring and groundwater modeling agreement with Salt River Project and the Salt River Valley Water Users' Association (SRP) regarding the City's Big Chino Water Ranch Project. The CA#1 agreement was authorized by SRP's Board on September 10, 2012.

CA#1 evolved over two years of discussions among Prescott, Prescott Valley and SRP ("the Parties") to implement a plan consistent with the February 11, 2010, Agreement in Principle (AIP) among the same Parties. The AIP resolved longstanding differences pertaining to water rights in the Big Chino sub-basin, set forth a framework for future agreements, and ended litigation regarding plans to pump groundwater from the Big Chino Sub-basin as authorized by Arizona state law.

CA#1 set forth a program for enhanced water monitoring and modeling of groundwater flows in the Big Chino, confirmed rights to water arising from within the Prescott Active Management Area, and achieved a mutual agreement by all Parties not to challenge

those rights. CA#1 is a long-term commitment to construct, implement, and maintain the monitoring and modeling program, with the Parties sharing in the long-term cost.

The goals of the DCMP are to:

- Improve the understanding of the hydrologic relationship between groundwater and surface water in the Upper Verde River area.
- Act as an early warning system for the Upper Verde Springs.
- Collect data that may be used to distinguish groundwater pumping from the Big Chino Water Ranch from the impacts of groundwater pumping by others, and natural system variability.
- Develop the ability to relate regional groundwater and surface water observations to future groundwater model calibration and verification.
- Determine if additional data are needed.
- Provide data for development of a numerical groundwater flow model.

Summary of Annual Accomplishments

Meetings

- Monthly meetings of the Monitoring and Modeling Committees
- Supplemental meetings to discuss technical issues with Technical Consultants and/or Golder Associates, Inc. (8/11/17, 8/25/17, 1/3/18, 1/23/18, 3/4/18, 3/21/18, 6/26/18).
- Multi-agency meeting (10/11/2017)
- Presentation and Field Visit, CA#1 Committee Members and Technical Consultants to review well data and site visit to five wells or well sites (3/4/18).

Executed Documents or Coordinated Activities

- Collected and analyzed crop survey data in the Big Chino sub-basin – by United States Geological Survey (USGS) through a joint funding agreement with Arizona Department of Water Resources (ADWR) (6/14/ 2017)
- Executed Phase 2 Scope of Work to for professional services to design and provide construct oversight on new long-term monitoring wells for the Big Chino Sub-basin as described in the DCMP. Contract No. 2016-296A1 with Southwest Groundwater Consultants (approved on 7/25/2017)
- Development of contract amendment with USGS for continuation of real-time well monitoring at two (2) well sites, continuation of gravity (aquifer storage) monitoring at 28 sites, and continuation of flow monitoring and reporting at the Williamson Valley stream gage.

- Contract # 2018-114 with Yellow Jacket Drilling to drill seven (7) new monitoring wells as defined in the Data Collection and Monitoring Plan and complete aquifer testing at three (3) of those new wells.
- Memo request (3/15/2018) to ADWR to equip, monitor and report water levels at the seven (7) new wells and four (4) existing wells.
- Draft Supplemental Reports on Alternative Existing Well Investigations (1/9/2018) Southwest Groundwater Consultants]
- Contract 2017-143A1 (9/12/2017) Modification 1 to Joint Funding Agreement – Cooperative Match Increase - USGS
- Draft Technical Memo No. 1 – Data Compilation, Golder Associates, Inc. September 28, 2017

Funding Contributions

- All parties made monetary contributions for the Monitoring and Modeling Plan for FY17 per CA#1
- USGS increased funding support as match under contracts # 2017-143A1 in the amount of $54,902

Public Information

- City of Prescott website – continual updates
- City of Prescott Council Voting and Study Sessions
- SRP launched website *http://watershedconnection.com* that includes an overview about the CA#1 Monitoring and Modeling program.
- SRP presentation to ADWR staff (3/24/2018)

Status Reports Completed

- Big Chino Sub-basin Water Monitoring Project, July 1, 2017 – June 30, 2018 Annual Report. See Appendix I

Accounting/Budget

In accordance with CA#1, the Parties fund the project with annual contributions to an account managed by the City of Prescott as the fiduciary. The budget for the period of this annual report (FY18) is shown in **Table 1** as Year 4. It is important to note that the Communities and SRP do not have the same fiscal calendars. This project operates on a July 1st to June 30th timeframe. Further, SRP adjusted their contributions to increase their contributions in the early years of the project but their overall project contributions total was unchanged.

A detail of expenditures for FY18 only is shown in **Table 2**. Since the CA#1 commenced, the monitoring project account balance and expenditures as of June 30, 2018 are $1,290,112.28 and $2,706,771.70, respectively. Similarly, the modeling project account balance and expenditure as of June 30, 2018 are $860,390.96 and $397,200.91, respectively. The overall project funds have encumbrances with ongoing contracts, but those encumbrances are not reflected in the values shown in **Table 2**. In February 2017, the Parties entered into a contract (City Contract No. 2017-246) with Golder Associates Inc., for the completion of a groundwater flow model. Toward the end of the FY17, the Parties were completing contract negotiations with Southwest Groundwater Consultants, Inc. (SGC) for monitor well drilling oversight. The SGC contract (City Contract No. 2016-296A1) was approved by City Council on July 25, 2017 (FY18). The accumulations of funds in these accounts anticipate the large project cost for the modeling contract and for drilling several monitoring wells.

Table 1 – Contributions by CA #1 Parties in FY18

	Year 5 (FY18)		Year 4 (FY17)	
Entity	**Monitoring**	**Modeling**	**Monitoring**	**Modeling**
Prescott	$114,649	$108,298	$114,649	$85,751
Prescott Valley	$97,271	$91,883	$97,271	$72,754
SRP	$105,960	$100,091	$105,960	$79,253

Table 2 – Contract Expenditures in FY18

	Monitoring		
Contractor Name, Number	**Description**	**Amount**	**Payment Date(s)**
SRP, Contract No. 2014-001, 001A1, 001A2	New Stream Gages (Flowtography and weather equipment)	$65,938.72	12/4/17, 4/5/18, 4/30/18,
SRP, Contract No. 2014-001	Existing Stream Gages	$2,491.65	12/4/17, 4/5/18, 4/30/18, 6/30/18
SRP, Contract No. 2014-001	Existing Well Monitoring	$949.84	4/5/18,4/30/18
USGS, 2014-160, 160A1	Geophysics	$68,206.25	9/28/18,1/10/18, 4/30/18
USGS, Contract No. 2017-143	Geochemistry	$53,403.75	9/6/17, 1/10/18, 4/30/18
Southwest Groundwater Consultants, Contract No. 2016-296, 296A1	Well Drilling Oversight	$226,024.34	10/20/17, 12/4/17, 1/29/18, 3/23/18, 4/3/18, 4/30/18, 6/30/18
Yellow Jacket Drilling, LLC, Contract No. 2018-114	Monitor Well Drilling	$981,504.68	3/15/18, 3/22/18, 5/7/18, 5/24/18,6/30/18
	Monitoring Total	$1,398,519.23	

	Modeling		
	Description	**Amount**	**Payment Date(s)**
Golder Associates, Contract No. 2017-246	Modeling Contract	$326,776.39	8/18/17, 9/20/17, 10/31/17, 12/4/17, 2/21/18, 3/15/18, 4/20/18, 4/24/18, 6/4/18, 6/30/18
	Modeling Total	$326,776.39	
	Combined Total	**$1,725,295.62**	

Monitoring Project - Equipment

The CA#1 Parties and their specialized technical consultants worked with ADWR, USGS, Yavapai County Flood Control District and others to complete an inventory of the existing and historic hydrologic monitoring efforts in the Big Chino Sub-basin. This inventory and the data requirements for developing a detailed groundwater model pointed out data gaps and created a need for new equipment installations at certain locations in the sub-basin. Although not all data collection to date is reflected in this annual report, new equipment installed during the fiscal year will be identified in this section and existing equipment will be shown in table format, by type, in Appendix II.

Groundwater Level Monitoring

- See **Appendix III, Maps 1 and 2** for ongoing water level monitoring.
- During FY18, several new well sites were added to the network as follows:
  - Four (4) existing wells at three sites (Glidden, HR-2, Patton/Johnson)
  - Seven (7) new wells drilled at sites identified in the Data Collection and Monitoring Plan.
- On 6/7/2016, the Parties executed a scope of work with Southwest Groundwater Consultants to complete a groundwater well assessment (City Contract No. 2016-296). The groundwater well assessment included office and field review of 17 wells. The results of that review identified four existing wells to be added to the monitoring plan. Work under this contract was completed in FY18 with the detailed description of the four existing wells identified in the well assessment and installation of monitoring equipment. **See Appendix III, Map 3.**

- On July 25, 2017, the Parties executed Phase 2 Scope of Work (Contract 2016-296A1) with Southwest Groundwater Consultants to design seven (7) new monitoring wells, develop bid documents for drilling contract and provide drilling oversight, aquifer testing and data analysis.
- On November 2, 2017, the Parties executed a contract with Yellow Jacket Drilling (Contract # 2018-114) to drill seven (7) new monitoring wells as defined in the Data Collection and Monitoring Plan and complete aquifer testing at three (3) of those new wells. Well drilling began on January 22, 2018. Drilling and aquifer tests were complete by the end of June, 2018.

Drilling well MW-4d (March 4, 2018)

New Monitor Well Locations and Description

Well Name	ADWR 55 #	Land Owner	Cadastral	Depth (ft bgs)	Perf Interval (ft bgs)	Water Level (ft bgs)
MW-4b1	228266	USDA Forest Service	B(18-01)28BCD	460	340-460	320
MW-4b2	228265	USDA Forest Service	B(18-01)19 ADC	520	420-520	400
MW-4b3	228262	Arizona State Land Department	B(18-01)31 CCD	480	380-480	360
MW-4d	228264 (c) 228472	Arizona State Land Department	B(17-02)11ABD	450	280-340 (LCS); 330-450 (PVC)	310
MW-4e	228263	Arizona State Land Department	B(17-02)12CBD	340	240-340	225
MW-4g	921236	Southwest Land & Cattle LLC (dba K Larson)	B(18-03)26BDD	1400	1000-1400	142
BMW-2	921256	Kieckhefer, J.I.	B(18-04)01ACA	2000	1600-2000	180

Existing Wells Added to Monitoring Network Locations and Description

Well Name	ADWR 55 #	Land Owner	Cadastral	Depth (ft bgs)	Perf Interval (ft bgs)	Water Level (ft bgs)
Glidden	631886	USDA Forest Service	B(18-01) 27ABD	230	150-219	192.4
HR-2	527679	Civitan Foundation	B(17-02) W02DCC1	500	Not cased	328.3
MW-4f.1 (Patton)	803378	Southwest Land and Cattle Co.	B(18-01) 26BDD	92	25 to 60 and 80 to 90	15.5 to 18.3
MW-4f.2 (Johnson)	609259	Southwest Land and Cattle Co.	B(18-01) 26BDB1 B18003026BDB	320	37 to 320	119.4 to 141.8

Stream flow Monitoring

- See **Appendix III, Maps 4-6**

The flow monitoring network is essentially complete. No sites were added in FY18. Site maintenance and data collection continued along with developing a plan for determining flow rates at the upper Walnut Creek site (at Williamson Valley Road bridge crossing). Stage-flow relationships at this location are subject to frequent changes due to vegetation growth and/or erosion/aggradation of the channel. A complete description of the FY18 data collection efforts is included in Appendix I.

Weather Monitoring

- No additional sites were added to the weather monitoring network shown in **Appendix III, Map 7.** The network continued to collect a variety of weather data that will be used to help define the water budget for the Big Chino Sub-basin.
- FY18 precipitation graphs for all weather station sites can be found on **Map 7a**

Aquifer Storage Monitoring and Geophysical Surveys

During FY18, the USGS monitored stream flow at the Williamson Valley stream flow gaging station, collected isotope data at stream sampling sites, collected isotope and noble gas data at 6 wells, collected groundwater data at 25-30 sites, conducted geophysical surveys in Areas 2 and 3 (west of Hwy 89 and Paulden), and interpreted data in preparation for the release of the final reports.

- USGS geochemical studies in the Big Chino include monitoring of stable isotopes in stream base flow at the stream flow gaging station at the Verde River near Paulden and at Williamson Valley Wash, and sampling of groundwater from wells and springs for stable isotopes and noble gases. The Verde River near Paulden was also sampled in June 2018 for a suite of geochemical analytes. The purpose of the stable isotope stream flow monitoring is to develop a long-term data set that can be used to help determine variations in sources of baseflow to the Verde River. In addition, selected wells are sampled with the long-term goal of developing geochemical signatures of groundwater throughout the Big Chino hydrogeologic system. Six wells (including 5 new observation wells) and two springs (from the north and south side along the stretch of the Verde River downstream of Granite Creek confluence where there is a rapid increase in discharge) were sampled for the comprehensive geochemical suite during FY18. One blank and one replicate were collected along with the groundwater samples. **See Appendix III, Map 8** showing the Geochemical sampling sites.
- One round of aquifer-storage monitoring (repeat microgravity) was completed at 32 stations in September-October 2017. Monitoring will resume in October

2018 and continue through 2020. Results from 2010 through 2017 were summarized in a USGS Scientific Investigations Report, due out in fall 2018. **See Appendix III, Map 9** showing the gravity site locations.

- Depth to water was also observed at gravity stations that are co-located at wells. Depths to water is observed by USGS at 16 wells coincident with gravity observations and entered into the GWSI database. Continuous depth to water was also recorded at 5 of the 12 USGS monitored wells. Depths to water are also available from ADWR at 5 continuously monitored wells, 2 Index wells not measured by USGS, and at 10 other Index wells that are also monitored by USGS. No depth to water data were collected at 6 gravity stations because there is no co-located well or the well is inaccessible for measurements. One well, B-18-02 28ABA (North Paulden), was added to the USGS Climate Response Network and real-time data are available on the web. (https://groundwaterwatch.usgs.gov/Net/OGWNetwork.asp?ncd=crn)
- Aquifer storage and groundwater levels have declined throughout the monitored parts of the sub-basin from 2010-2017, except for a few wells in the northernmost part of the Big Chino Water Ranch and to the north of the Water Ranch. Storage declines were greatest in the Water Ranch area and the Paulden area. No significant recharge events occurred during the 2010-2017 period, including flows during January and February 2017 that caused no change in water-level trends in nearby wells. Precipitation was average to below average during this period. Base flows in the Verde River near Paulden (USGS station 09503700) and Williamson Valley Wash near Paulden (USGS station 09502800) were consistently below the long-term average for the 2010-2017 period.

Geophysical surveys using the Controlled-Source Audio-Magnetotelluric method (CSAMT) and Transient Electromagnetics (TEM) were completed in areas 1, 2, and 3. A total of about 69.6 miles (112 kilometers) of survey lines have been completed for the project. Completed surveys include a longitudinal profile parallel to Big Chino Wash, several perpendicular profiles including profiles across the Big Chino fault, individual soundings at potential drilling locations, and soundings near the Verde River headwater springs. Subsurface electrical models of the CSAMT data have been completed and interpreted. Draft of two USGS series reports summarizing the CSAMT surveys as well as the gravity and groundwater-monitoring efforts were completed and are currently making their way through the USGS review process. **See Appendix III, Map 10** showing the Geophysical profiles.

Crop Surveys and Estimated Crop Water Use

The USGS, in contract with ADWR, conducted crop surveys in the Big Chino Sub-basin in June 2017. The results are shown in **Table 3**, and depicted in **Appendix III, Maps 11-1 to 11-5**.

Approximately 45% of the irrigable lands that were surveyed were being irrigated in 2017 (1,741 acres cropped in June survey). The USGS estimated that the total water withdrawal for crops on these lands was 3,458 acre-feet during summer 2017. This represents a total withdrawal of just under 2.0 acre-feet per cropped acre. The USGS methodology for calculating crop consumptive use and irrigation efficiency should be examined and local climatic data collected at the station on the Big Chino Water Ranch should be incorporated in consumptive use estimates before these values are used in a groundwater model.

Table 3– 2016 Crop Survey – Acres Irrigated June 2017

	Map Area					
Crop	**Upper Big Chino**	**Paulden**	**Williamson Valley**	**Walnut Creek**	**Turkey Canyon**	**Total**
ALFALFA	237			156		393
GRASS	57		108	389	62	616
OATS	237	62				299
PASTURE				393		393
SOD		31				31
VEGETABLE		10				10
Total Crop Acres	**530**	**103**	**108**	**938**	**62**	**1741**
No Crop Evident	**1347**	**373**	**142**	**245**	**38**	**2145**

Monitoring Project - Analytical Results and Data Collected

The results of the data collection and data interpretation efforts are provided in separate reports or databases produced and managed by the responsible agency. One of the duties of the CA#1 Monitoring Committee is to coordinate and monitor these data collection and reporting efforts so that the results are useful for the groundwater modeling and monitoring purposes outlined in CA#1. An explanation of how these efforts are reported or recorded is provided below.

Groundwater Monitoring

Groundwater level monitoring efforts are being completed both under contract with the CA#1 program (e.g. aquifer storage monitoring and continuous water level monitoring under the USGS contract) and through traditional water level monitoring efforts conducted by the Arizona Department of Water Resources.

- Efforts by the USGS

The USGS will produce a data report for the CA#1 program on the aquifer storage monitoring results (gravity data combined with water level data) around January 2018, near the end of the contract period. Data that is collected in the interim is provided to the CA#1 Committee in regular presentations by the USGS and housed in electronic format by the USGS.

- Efforts by ADWR

ADWR collects annual water level data at over 80 index wells in the Big Chino Sub-basin (including 9 automated telemetry sites) and attempts to conduct water level "sweeps" of a larger number of wells approximately every five (5) years. ADWR conducted a water level sweep of the Big Chino Sub-basin in the spring of 2017. During the sweep, ADWR visited 142 wells, obtained water levels at 119 wells, of which 78 were at index well sites. Information from that sweep has been included in the Groundwater Site Index (GWSI) database (www.azwater.gov) and is being summarized by ADRW for a future water level change map.

Stream flow Monitoring

Stream flow monitoring efforts in the Big Chino Sub-basin are conducted by SRP Field Services Division and by the USGS under contracts with the CA#1 program. The USGS also maintains another stream gage outside of the CA#1 Contract. Additional flow stage data is collected by YCFCD for flood control purposes.

- Efforts by SRP

SRP Measurement Services collects stream flow data and other information at thirteen (13) locations in the Big Chino Sub-basin under contract with the CA#1 program. The following bullets summarize the observations during 2018.

- There were 22 days during the monitoring period that marked the start of a surface water flow event at a water monitoring location in the Big Chino Sub-basin
- All 22 days were during the monsoon season, July 1, 2017 – September 30, 2017
- Upper Big Chino Wash had eleven (11) separate flow events, the most at any location during the monitoring period, and Lower Big Chino Wash had two (2) flow events, the least of any location
- Flow volumes are generally low during the monsoon, with the highest flow events at Big Chino Wash below Partridge Creek on 8/5/2017, and at Lower Williamson Valley Wash on 7/17/2017 and 7/27/2017. Those three events combined produced an estimated 647 AF
- The least amount of surface water flow was observed at Pine Creek during the 2018 reporting period
- An estimated 473 AF was observed at Lower Williamson Valley Wash during the 2018 reporting period accounting for 46% of the flow observed in the Sub-basin

The full report for FY18 documenting the results of the flow monitoring program is attached as **Appendix I**. The annual hydrographs are located in **Appendix III, Maps 5 and 6**.

- Efforts by USGS

The USGS operates two stream gages in the Big Chino Sub-basin. The Williamson Valley Wash near Paulden gage is funded through the CA#1 program and the Verde River near Paulden gage is funded through a separate program with SRP, the U.S. Forest Service and the USGS. Stream flow records for these sites are maintained by the USGS in their on-line database: http://waterdata.usgs.gov/az/nwis/rt

- Efforts by Yavapai County Flood Control District

YCFCD collects flow stage data at four (4) locations in the Big Chino Sub-basin; Ashfork Draw at I-40, Partridge Creek at I-40, Big Chino Wash at Highway 89, and Walnut Creek at Walnut Creek Bridge. The CA#1 Committee and SRP Field Services evaluated these sites for their usefulness in converting flood stage data into stream flow records. Of the listed sites only the Walnut Creek Bridge stage data will be used for calculating stream flow.

Modeling Project

The Big Chino Groundwater Modeling Project is an intensive 3-year effort to develop a detailed computerized groundwater model of the Big Chino Sub-basin. After initiating the contract with Golder Associates, Inc. (Golder) in March, 2017, the modeling project continued forward into its first full year. In FY 18 several additional meetings were held with the CA #1 Committee, TCs and Golder to discuss modeling issues and technical data. The Golder Team marked several accomplishments in FY18 with the CA #1 Committee and Technical Consultants (TC) providing coordinated reviews and comments:

- July-September, 2017 – Data Compilation: Golder completed a draft interim report (Technical Memo #1) on data compilation that resulted in additional comments from the Committee and TCs. Significant additional effort was expended on this element of the project to ensure that the typical, historical and most up-to-date data-set are considered in the modeling effort.
- October, 2017-January, 2018 – Model Domain: Golder's proposed model domain (i.e. study area) was discussed with Committee, TC's and Multi-agency Stakeholders. Additional analysis was provided to support the proposed study area and was accepted as the correct approach by the various stakeholders.
- January – May, 2018 – Cross Sections: Based on data collection and analysis, Golder proposed adding two (2) additional geologic cross sections beyond the six (6) that were originally proposed and budgeted in the contract. The Committee and TCs accepted the proposal since the additional work remained within the contract allowance. Cross sections were constructed and reviewed by the TCs with comments provided to Golder.
- February-June, 2018 – Well Drilling and Aquifer Tests: Data from the drilling program was summarized and draft data transferred to Golder for incorporation into the model.

To view a copy of the approved Scope of Work, see the City's website at http://www.prescott-az.gov/services/water/chino.php.

Conclusions

The FY18 project year reached a significant milestone with the completion of the well drilling program anticipated in the Data Collection and Monitoring Plan through execution of contracts with Southwest Groundwater Consultants and Yellow Jacket Drilling. In addition to this effort, significant work continued on the groundwater model under Golder, while the USGS, ADWR, SRP and YCFCD continued data collection efforts under various contracts and agreements.

The surface water, gravity and weather station networks are deemed complete and data collection is on-going; however, if an opportunity arises to fill a data gap or improve the network in a certain area, then the Parties will discuss that effort and the associated expenditure(s). The crop survey work in the sub-basin will continue per the joint funding agreement between the USGS and ADWR.

Expectations for FY18 include 1) analysis from the USGS based on their geophysics and geochemical field work to assist the modeling effort; 2) the data analysis resulting from the 7 new monitor wells; 3) initial results of the USGS geochemistry work; and 4) continued development of the geologic framework and conceptual models in moving forward with Golder's work plan and 5) evaluation of the original DCMP and discussions with TCs and Golder to determine if data gaps exist and how to best resolve those issues.

The project's financial condition remains strong and cost savings measures continue to be assessed and taken when possible. Communications among the Parties, with their specialized technical representative, and with the agencies will continue as the need arises.

APPENDIX I

Big Chino Sub-basin Water Monitoring Project, July 1, 2017 – June 30, 2018 Annual Report

Big Chino Sub-basin Water Monitoring Project

July 1, 2017 – June 30, 2018 Annual Report

Prepared by SRP Water Measurement Staff

9/1/18

Prepared for CA1 Monitoring Committee

CONTENTS

INTRODUCTION

This report has been developed for the CA1 Monitoring Committee as part of the Big Chino Sub-basin Water Monitoring Project (City Contract No. 2014-001, A1, and A2) in collaboration with the City of Prescott, Town of Prescott Valley, and Salt River Project (SRP).

A summary of flow events recorded during the 2018 monitoring period (July 1, 2017 to June 30, 2018) is contained within this report.

SEASONAL FLOW SUMMARY

For this report, the 2018 annual reporting period refers to July 2017 through June 2018.

Surface water flow was observed at each SRP Flowtography® site during the 2018 annual reporting period. SRP Flowtography® sites, excluding the Upper Walnut Creek sites are ephemeral in nature. The flow event start date, magnitude of the flow, and the locations where surface water flow was observed are shown in Table 1 and Figure 1.

Facts about the flow observed in the sub-basin during the reporting period:

- There were 22 days during the monitoring period that marked the start of a surface water flow event at a water monitoring location in the Big Chino Sub-basin
- All 22 days were during the monsoon season, July 1, 2017 – September 30, 2017
- Upper Big Chino Wash had eleven (11) separate flow events, the most at any location during the monitoring period, and Lower Big Chino Wash had two (2) flow events, the least of any location
- Flow volumes are generally low during the monsoon, with the highest flow events at Big Chino Wash below Partridge Creek on 8/5/2017, and at Lower Williamson Valley Wash on 7/17/2017 and 7/27/2017. Those three events combined produced an estimated 647 AF
- The least amount of surface water flow was observed at Pine Creek during the 2018 reporting period
- An estimated 473 AF was observed at Lower Williamson Valley Wash during the 2018 reporting period accounting for 46% of the flow observed in the Sub-basin

TABLE 1. BIG CHINO SUB-BASIN JULY 2017 – JUNE 2018 FLOW EVENT SUMMARIES INCLUDING TOTAL ACRE-FEET (IN AF)

Start Date[1]	Upper Big Chino Wash (UBCW)	Big Chino Wash below Partridge Creek (BCWPC)[2]	Partridge Creek[3]	Pine Creek (PC)	Upper Walnut Creek at Forest Service (UWCFS)[4]	Upper Walnut Creek at Bridge (UWCB) (yes/no to visible flow increase)	Lower Walnut Creek at Charney Property (LWCCP)	Williamson Valley Wash at XU Ranch (WVWXU)	Lower Williamson Valley Wash (LWVW)	Lower Big Chino Wash (LBCW)
7/11/2017	1									
7/12/2017	42	42	< 1	2						
7/13/2017							5			
7/16/2017	6	< 1			Yes, flow increased	Yes, flow increased				
7/17/2017		< 1	< 1	5			70		229	84
7/19/2017				< 1						
7/21/2017	< 1									
7/22/2017				< 1			12			
7/24/2017				2						
7/25/2017										5
7/27/2017	< 1								217	
7/28/2017	2	4	2					15		
7/29/2017				< 1					26	
7/30/2017	< 1									
8/2/2017	< 1	< 1	< 1							
8/3/2017								10		
8/4/2017		5	5						< 1	
8/5/2017		201	201							
8/12/2017	< 1			11			8		< 1	
8/13/2017								14		
9/5/2017	< 1									
9/9/2017	1	4	3							
Totals	**52**	**257**	**212**	**21**			**95**	**39**	**473**	**89**

[1] Flow events may start just prior to date indicated or continue into the following day

[2] UBCW flows may be included in these numbers as the BCWPC gage is located 1.2 miles downstream of UBCW

[3] These flows were derived by subtracting the UBCW contribution from the flows at BCWPC. These are estimated flows, as there is no monitoring equipment located directly on the Partridge Creek channel itself

[4] Surface water flow is observed throughout the year at UWCFS. The flume and t-post event gage were removed from the channel on 6/8/2017. A t-post event gage was reinstalled at the site on 3/23/2018.

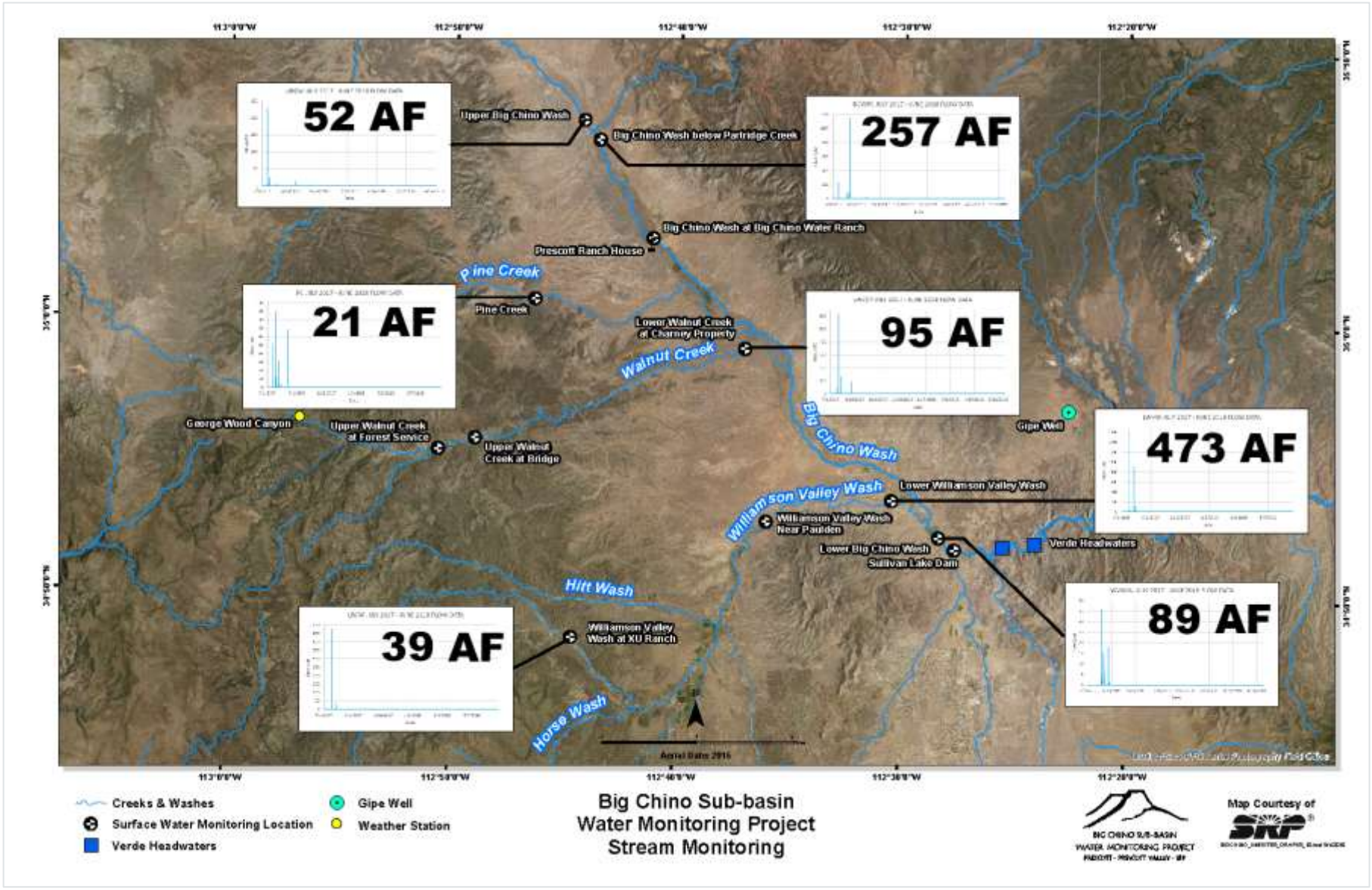


FIGURE 1. BIG CHINO SUB-BASIN MAP

LOCATION SUMMARIES

UPPER BIG CHINO WASH (UBCW)

Fifteen (15) events with measurable ephemeral flow were recorded at UBCW during the 2018 annual monitoring period. UBCW responded to monsoon related precipitation events only and the accumulated flows observed were small. Peak discharge for the year was 224 cubic feet per second (cfs) observed on 7/12/2017. The 7/12/2017 event was one of the longest lasting events observed at the site for the year with a duration of 18 hours, resulting in an estimated total flow volume of 42 AF or 81% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 52 AF. UBCW flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 2 and Figures 2-4.

TABLE 2. UBCW JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[5]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/11/2017	6:15 pm	11.5	0.800	9	1
7/12/2017	2:00 pm	18	3.336	224	42
7/16/2017	2:45 pm	5.5	0.593	5	< 1
7/16/2017	9:45 pm	18	1.216	25	5
7/17/2017	4:00 pm	3	0.150	< 1	0
7/20/2017	0:15 am	7	0.150	< 1	0
7/21/2017	11:00 pm	19	0.250	< 1	< 1
7/27/2017	5:15 pm	2.75	0.100	< 1	< 1
7/28/2017	4:45 pm	5.25	0.250	6	< 1
7/28/2017	10:15 pm	19	0.650	6	2
7/30/2017	2:45 am	13.75	0.250	< 1	< 1
8/2/2017	2:30 pm	5	0.250	< 1	< 1
8/10/2017	5:00 pm	4	0.100	no measureable flow resulted	no measureable flow resulted
8/12/2017	4:45 pm	7	0.200	< 1	< 1
9/5/2017	4:30 pm	5.5	0.250	< 1	< 1
9/9/2017	7:00 am	16.75	0.900	12	1
		161 (total hours)	**3.336**	**224**	**52 (total AF)**

The UBCW was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced the upstream and downstream pressure transducers
- Replaced the downstream pressure transducer cable
- Replaced the primary and backup batteries
- Diagnosed and repaired SRP Flowtography® equipment

[5] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

- Updated SRP Flowtography® equipment firmware

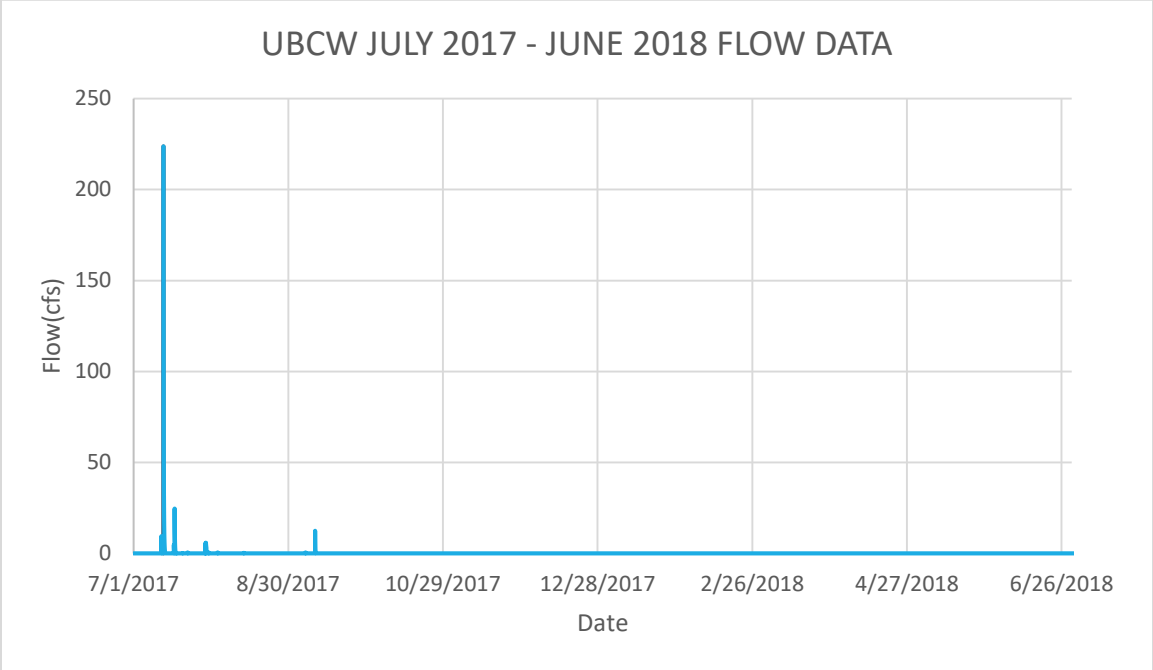


FIGURE 2. UBCW JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

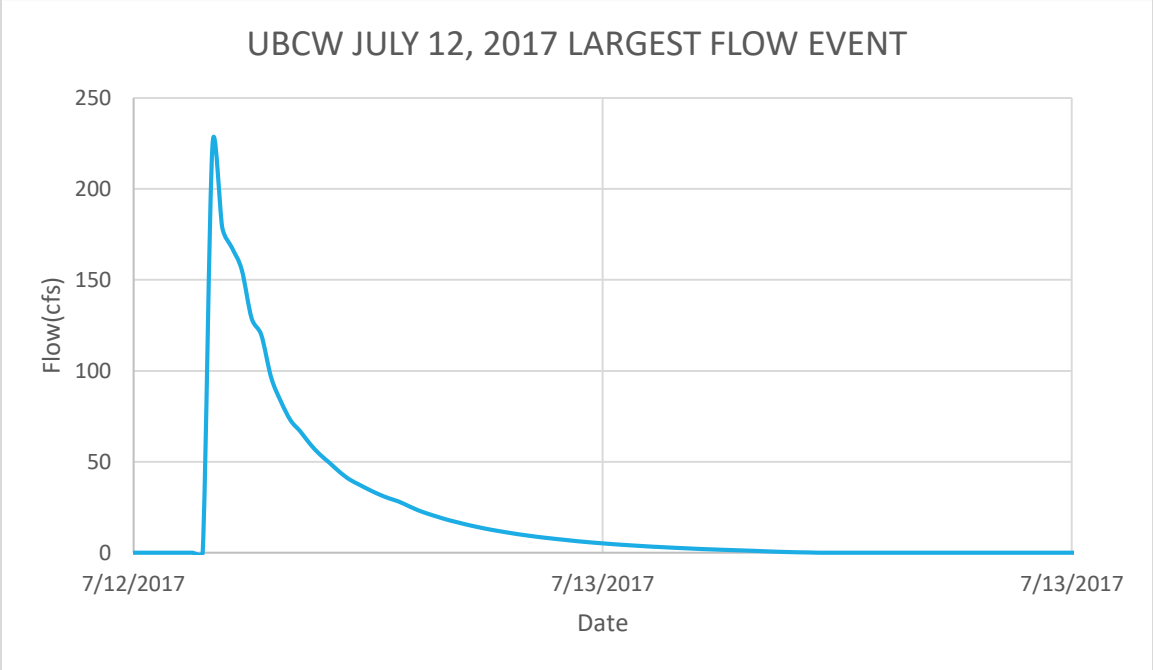


FIGURE 3. UBCW JULY 12, 2017 FLOW EVENT

UBCW at the start of the 2018 reporting period:

Greenup at the UBCW site after monsoon events:

Peak of 7/12/2017 flow event:

Snowfall at UBCW (no snow accumulation observed):

UBCW at the end of the 2018 reporting period:

FIGURE 4. UBCW IMAGE DATA

BIG CHINO WASH BELOW PARTRIDGE CREEK (BCWPC)

Eight (8) events with measurable ephemeral flow were recorded at BCWPC during the 2018 annual monitoring period. UBCW responded to monsoon related precipitation events only and most of the accumulated flows observed were small. Peak discharge for the year was 1138 cfs observed on 8/5/2017. The 7/12/2017 event was the longest lasting event observed at the site for the year with a duration of 15.25 hours, resulting in an estimated total flow volume of 42.11 AF or 16% of the annual volume at the site. The 8/5/2017 event resulted in the largest estimated volume at 201 AF or 78% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 257 AF. BCWPC flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 3 and Figures 5-7.

TABLE 3. BCWPC JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[6]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/12/2017	2:15 pm	15.25	3.80	228	42
7/16/2017	2:45 pm	3.25	0.85	3	< 1
7/17/2017	4:00 pm	4.00	0.60	< 1	< 1
7/18/2017	3:15 pm	3.75	0.40	no measureable flow resulted	no measureable flow resulted
7/19/2017	1:45 pm	1.25	0.20	no measureable flow resulted	no measureable flow resulted
7/21/2017	2:00 pm	1.25	0.20	no measureable flow resulted	no measureable flow resulted
7/28/2017	4:45 pm	0.75	0.10	no measureable flow resulted	no measureable flow resulted
7/28/2017	11:00 pm	4.00	2.50	44	4
8/2/2017	2:30 pm	2.50	0.90	4	< 1
8/4/2017	00:45 am	4.50	2.75	96	5
8/5/2017	1:00 am	13.00	7.10	1138	201
8/12/2017	6:00 pm	2.00	0.35	no measureable flow resulted	no measureable flow resulted
9/9/2017	12:00 pm	8.00	1.65	26	4
		63.5 (total hours)	**3.80**	**1138**	**257 (total AF)**

The BCWPC was visited a total of five (5) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Installed two (2) new whip style event gages

[6] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

- Replaced three (3) pressure transducers, two (2) SRP Flowtography® cameras, one (1) cellular modem, and two (2) batteries
- Resurveyed the stream channel after all 2018 reporting period flow events occurred
- Addition of temporary high water survey stakes (seen in Figure 7 below) to assist in event analytics in the event the gage is damaged
- Updated SRP Flowtography® equipment firmware

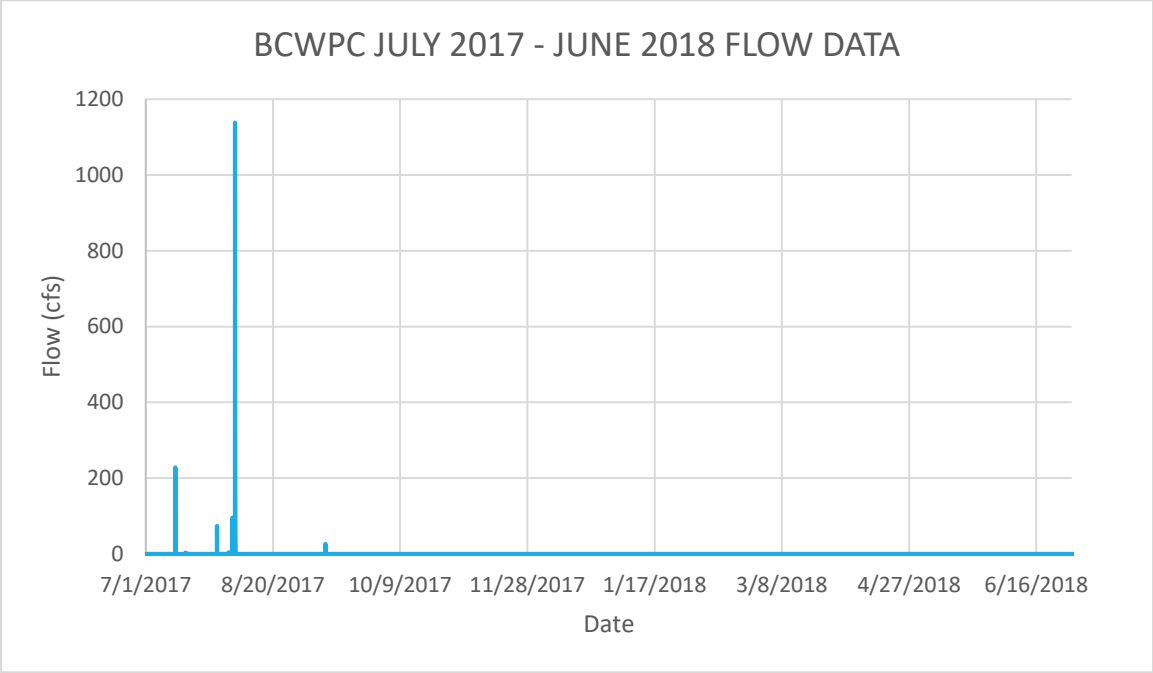


FIGURE 5. BCWPC JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

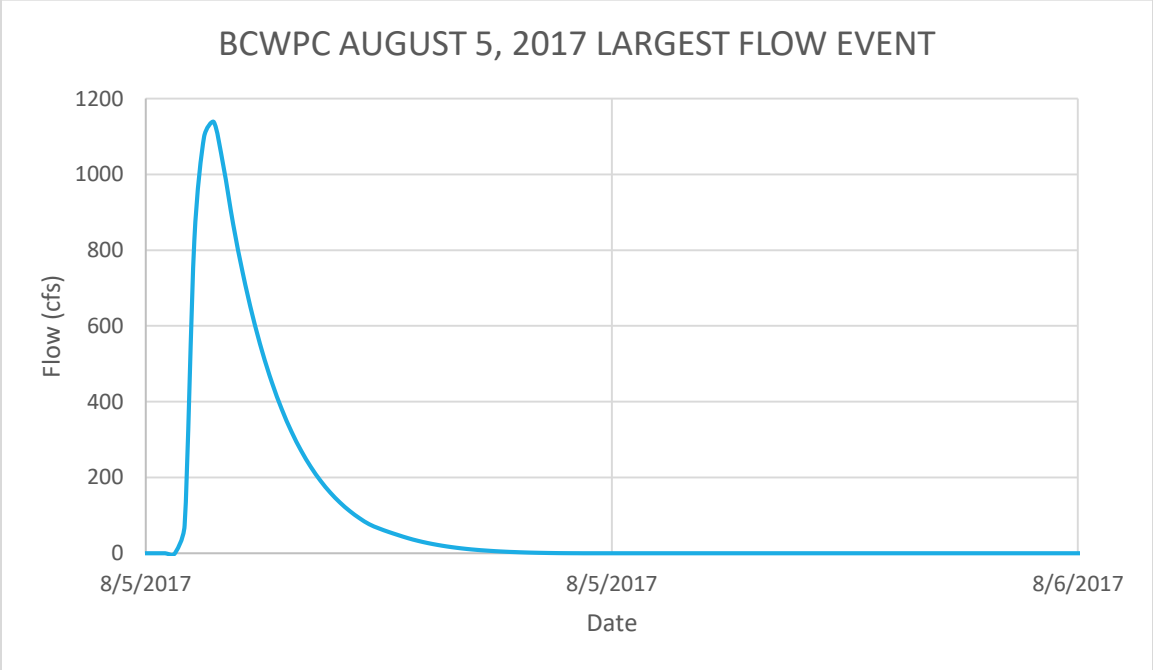


FIGURE 6. BCWPC AUGUST FLOW EVENT

BCWPC at the start of the 2018 reporting period:

Greenup at the BCWPC site after monsoon events:

Start of flow event on 7/12/2017:

Peak of flow event on 7/12/2017:

Flow event on 8/5/2017 before peak:

Peak of flow event on 8/5/2017:

BCWPC at the end of the 2018 reporting period:

FIGURE 7. BCWPC IMAGE DATA

BIG CHINO WASH AT BIG CHINO WATER RANCH (BCWR)

At BCWR, rainfall was observed on fifty-seven (57) days. Snowfall was visible on two (2) days, and snow accumulation was visible for two (2) days. None of the observed events resulted in water pooling at the surface. BCWR site images from the July 2017 – June 2018 reporting period can be seen in Figure 8 below.

The BCWR location was visited a total of four (4) times during the 2018 annual reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced one (1) battery
- Updated SRP Flowtography® equipment firmware

BCWR at the start of the 2018 reporting period:

Greenup after 2017 monsoon rain events:

Snow accumulation on 2/32/2018:

Snowfall on 2/23/2018:

BCWR at the end of the 2018 reporting period:

FIGURE 8. BCWR IMAGE DATA

PINE CREEK (PC)

Seven (7) events with measurable ephemeral flow were recorded at PC during the 2018 annual monitoring period. PC responded to monsoon related precipitation events only and all of the accumulated flows observed were small. Peak discharge for the year was 89 cfs observed 7/17/2017. The 8/12/2017 event was the longest lasting event observed at the site for the year with a duration of 12.25 hours, resulting in the largest volume single flow event with a total estimated volume of 11 AF or 52% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 21 AF. PC flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 4 and Figures 9-11.

TABLE 4. PC JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[7]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/12/2017	12:50 pm	4.50	< 1	51	2
7/17/2017	4:05 pm	8.00	1.25	89	5
7/19/2017	1:35 pm	3.25	< 1	12	< 1
7/22/2017	4:35 pm	3.25	< 1	2	< 1
7/24/2017	5:05 pm	4.25	< 1	32	2
7/29/2017	2:00 am	3.5	< 1	5	< 1
8/12/2017	11:45 am	12.25	1	69	11
		39 (total hours)	**1.25**	**89**	**21 (total AF)**

The PC was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced two (2) batteries, and two (2) pressure transducers
- Diagnosed and repaired SRP Flowtography® equipment
- Updated SRP Flowtography® equipment firmware

[7] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

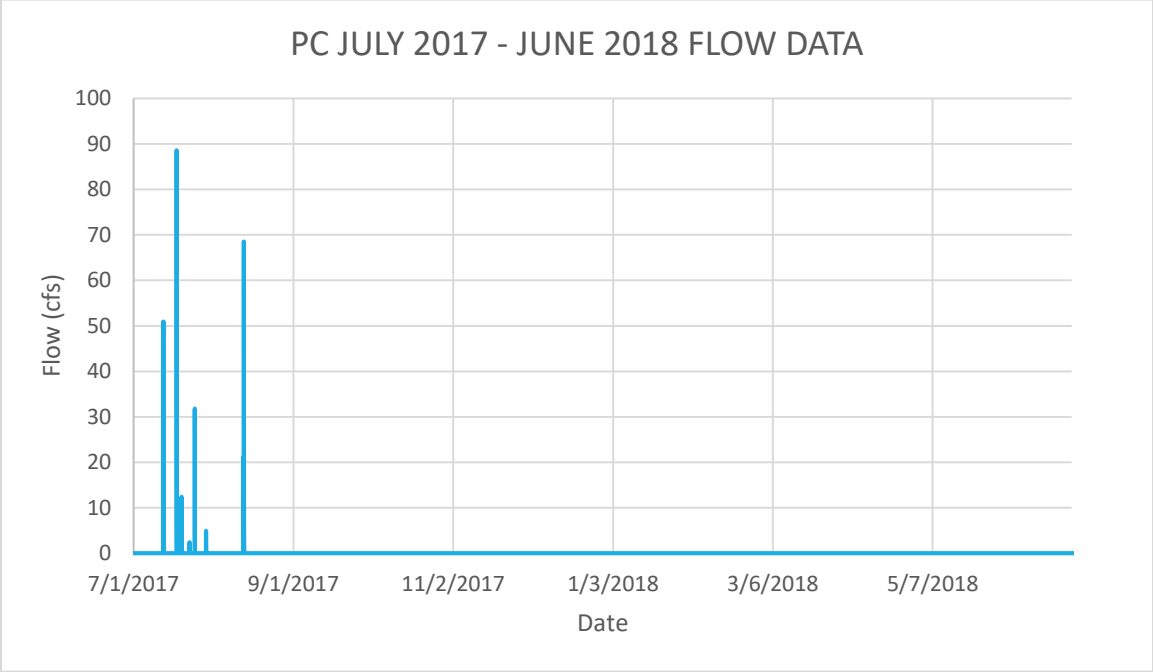


FIGURE 9. PC JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

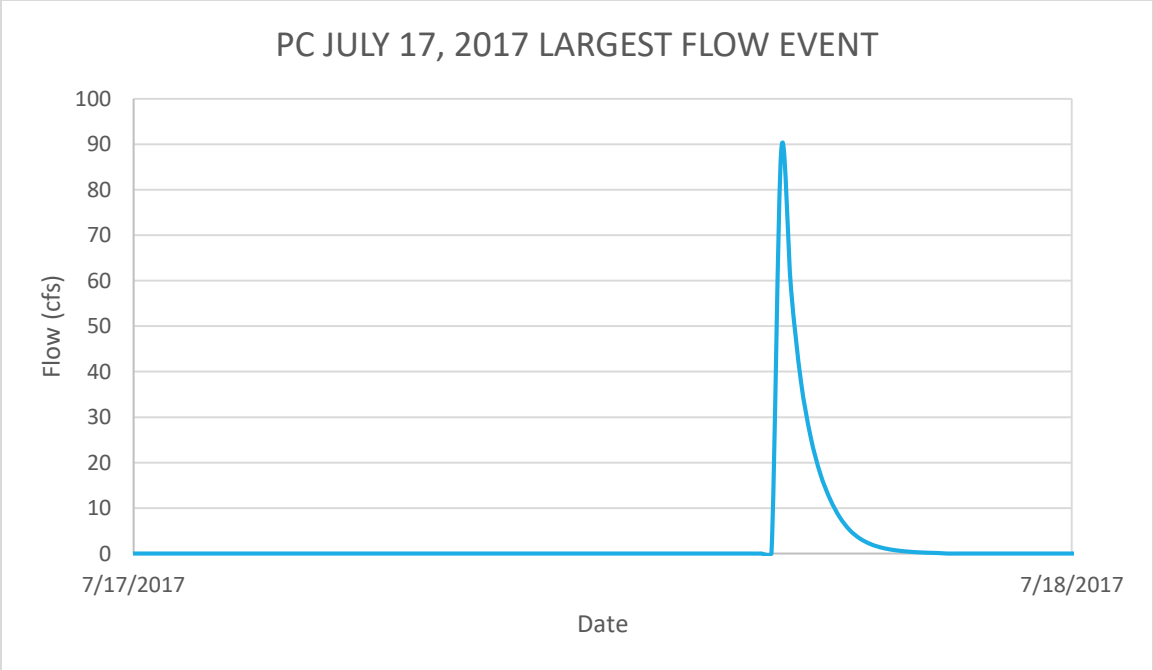


FIGURE 10. PC JULY 17, 2017 FLOW EVENT

PC at the start of the 2018 reporting period:

Greenup at the PC site after monsoon events:

Start of flow event on 8/12/2017:

Peak of flow event on 8/12/2017:

PC at the end of the 2018 reporting period:

FIGURE 11. PC IMAGE DATA

GEORGE WOOD CANYON (GWC)

The GWC weather station collected precipitation, barometric pressure, air temperature, wind direction, peak gust, relative humidity, wind speed, and SRP Snowtography® images of snow depth during the 2018 annual reporting period.

Four (4) snow accumulation events were recorded during the 2018 reporting period. During all observed events, snow depth never surpassed 0.1 feet (see Table 5).

Some items of interest recorded at the weather station are (see Figures 12-20):

- 11.73" of precipitation, exclusing seasonal snow water equivalent, was observed during the 2018 reporting period
- Wind speed ranged from a minimum of 0 mph on 1/9/2018 to a maximum of 17.7 mph on 12/7/2017, with the highest average wind speeds in the spring and the lowest in the fall
- The predominant wind direction was WNW with higher velocity winds tending from the NNE
- Air temperature ranged from a maximum of 94.4°F in July 2017 to a minimum of 10.3°F in February 2018
- The peak average relative humidity was 49.78% in July 2017

TABLE 5. GWC JULY 2017 – JUNE 2018 SNOW ACCUMULATION EVENTS

Start Date	End Date[8]	Snow Visible	Peak Snow Depth
1/9/2018	1/10/2018	<1 day (light dusting)	<0.1 feet
2/19/2018	2/20/2018	1 day	<0.1 feet
2/23/2018	2/24/2018	1 day	<0.1 feet
3/18/2018	3/18/2018	<1 day (light dusting)	<0.1 feet
Totals		**<4 days**	**<0.1 feet**

The GWC was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following servicing was made at the site:

- Replaced two (2) SRP Snowtography® batteries and one (1) weather station battery
- Replaced the weather station solar panel
- Replaced cellular modem for SRP Snowtography® assembly
- Updated SRP Snowtography® equipment firmware

[8] Some small patches of snow in shaded areas may still be present in image data after this date.

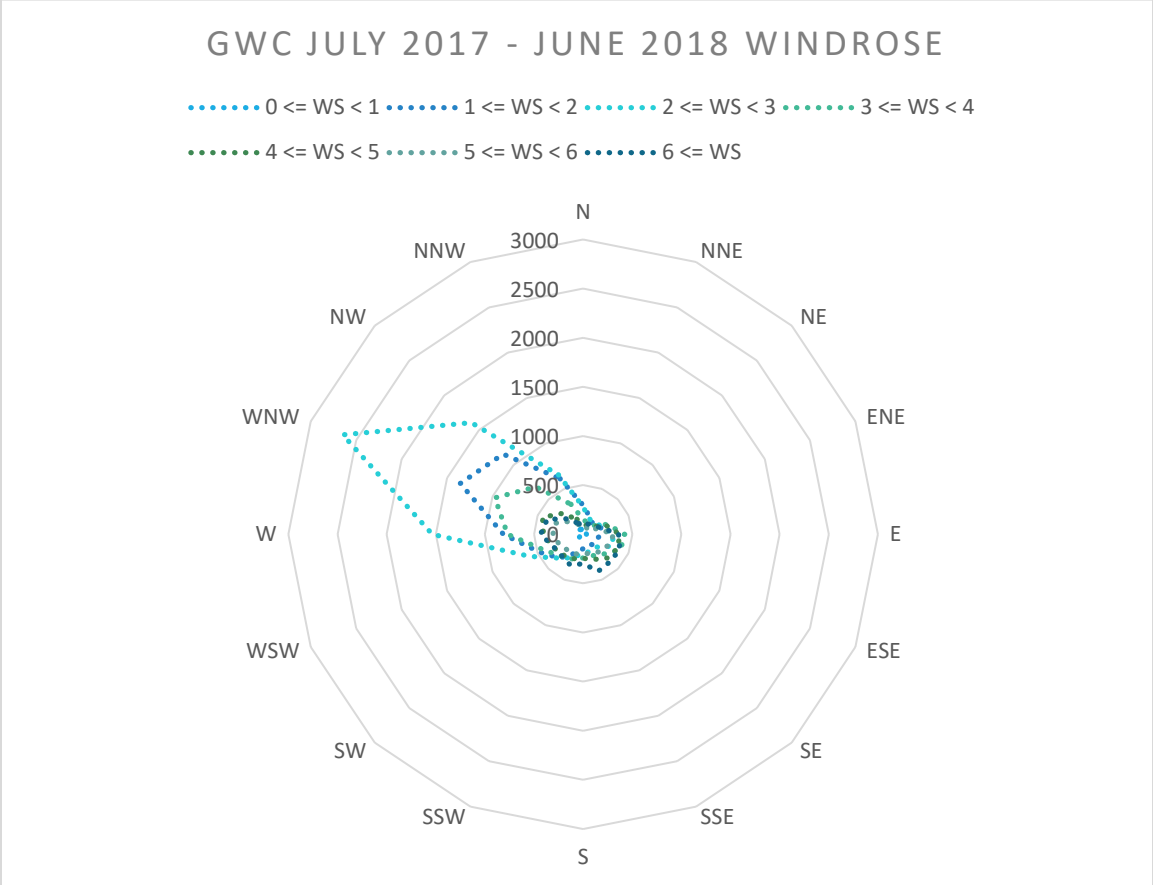


FIGURE 12. GWC JULY 2017 – JUNE 2018 WIND ROSE

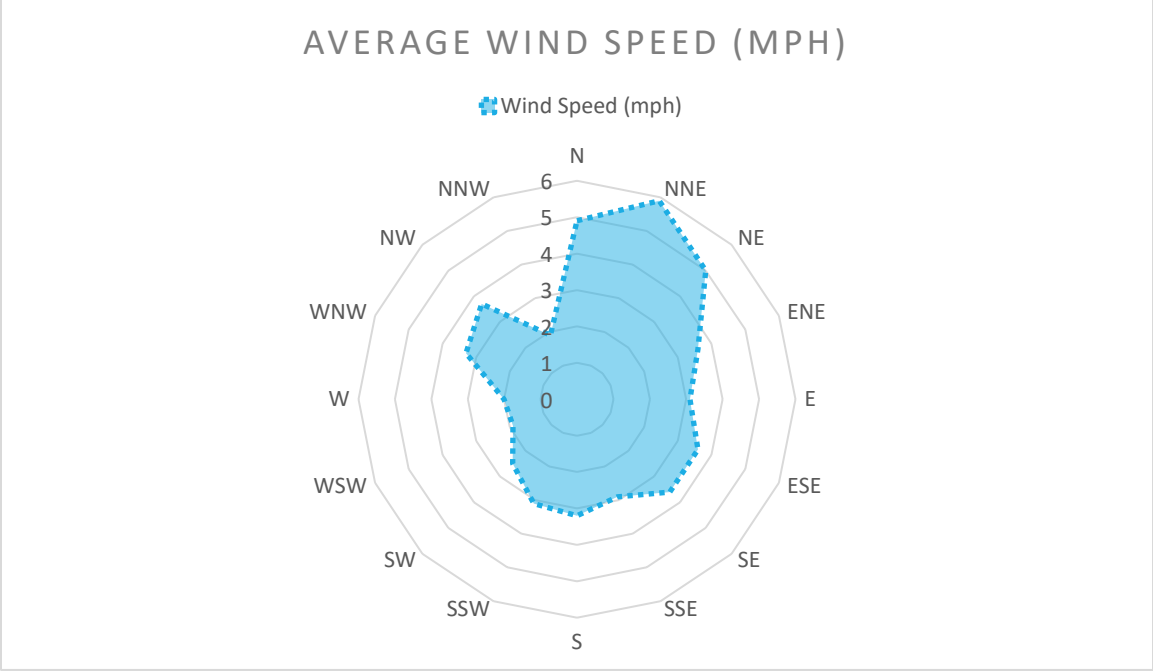


FIGURE 13. GWC JULY 2017 – JUNE 2018 AVERAGE WIND SPEED

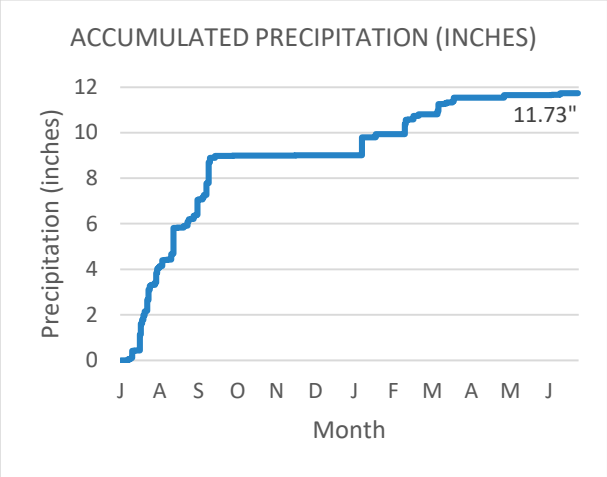


FIGURE 14. GWC JULY 2017 – JUNE 2018 ACCUMULATED PRECIPITATION

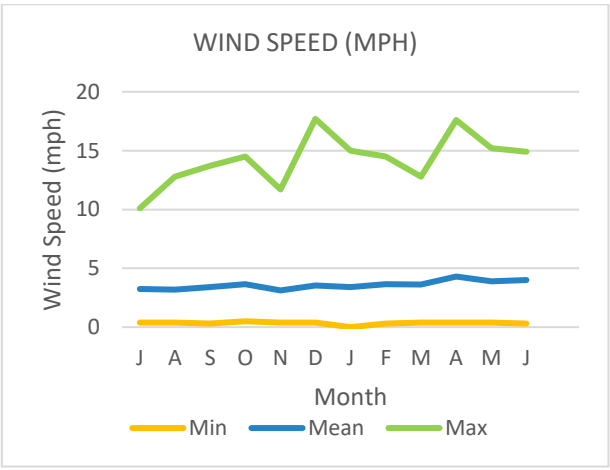


FIGURE 15. GWC JULY 2017 – JUNE 2018 AVERAGE WIND SPEED

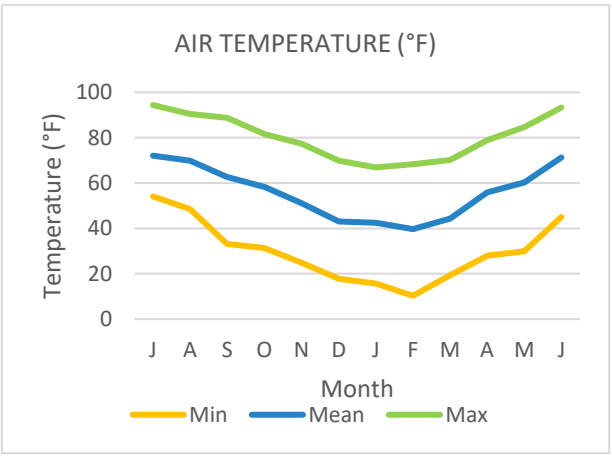


FIGURE 16. GWC JULY 2017 – JUNE 2018 AIR TEMPERATURE

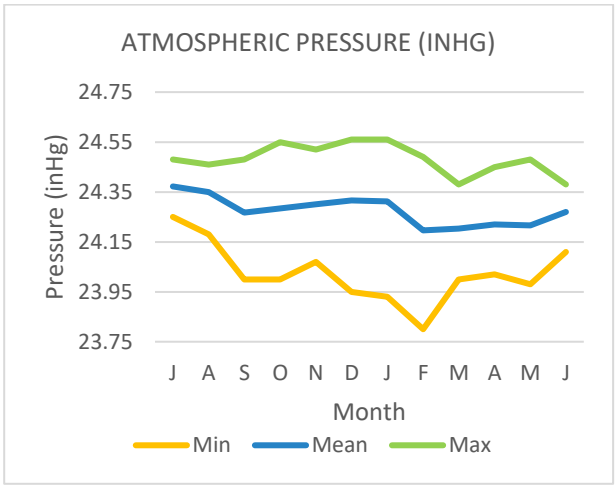


FIGURE 17. GWC JULY 2017 – JUNE 2018 ATMOSPHERIC PRESSURE

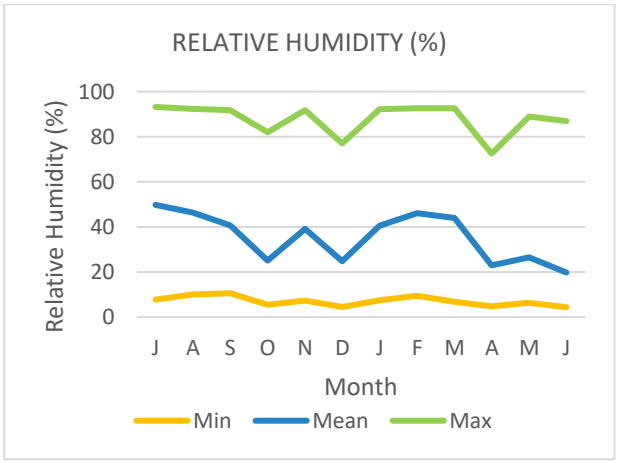


FIGURE 18. GWC JULY 2017 – JUNE 2018 RELATIVE HUMIDITY

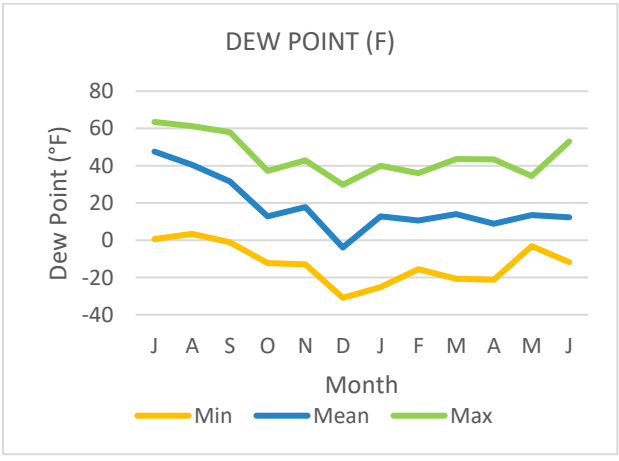


FIGURE 19. GWC JULY 2017 – JUNE 2018 DEW POINT

GWC at the beginning of the 2018 reporting period:

GWC at the end of the 2018 reporting period:

Snow accumulation event on 2/19/2018:

Snow accumulation event on 2/23/2018:

FIGURE 20. GWC IMAGE DATA

UPPER WALNUT CREEK AT FOREST SERVICE (UWCFS)

The flume was permanently removed after being damaged on December 22, 2016. Following the removal of the flume, there are no estimates of flow for this site, other than visual wet/dry conditions. UWCFS site images are shown in Figure 21 below.

The UWCFS was visited a total of six (6) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced (2) batteries
- Updated SRP Flowtography® equipment firmware
- Removed flume, concrete blocks, and all associated parts completely (had been set on the side of the channel) and replaced the t-post event gage

UWCFS at the start of the 2018 reporting period:

Greenup at the UWCFS site after monsoon events:

Rainfall on 7/16/2017:

Visible flow increase after 7/16/2017 rainfall:

UWCFS at the end of the 2018 reporting period:

FIGURE 21. UWCFS IMAGE DATA

UPPER WALNUT CREEK AT BRIDGE (UWCB)

Surface water flow appears to be visible at UWCB at the start of the 2018 annual monitoring period (see Figure 22), but tree and shrub growth block a clear view of the channel. Flow appears to continue at the site until approximately 2/20/2018. The view of the channel is obstructed by maturing plant and vegetation growth for much of the reporting period.

The UWCB was visited a total of five (5) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced (2) batteries
- Updated SRP Flowtography® equipment firmware

UWCB at the start of the 2018 reporting period:

Visible flow increase on 7/16/2017:

UWCB After snowfall event on 2/23/2018:

FIGURE 22. UWCB IMAGE DATA

LOWER WALNUT CREEK AT CHARNEY PROPERTY (LWCCP)

Four (4) events with measurable ephemeral flow were recorded at LWCCP during the 2018 annual monitoring period. LWCCP responded to monsoon related precipitation events only and no event lasted more than 5 hours. Peak discharge for the year was 612.29 cfs observed 7/17/2017, which was also the longest lasting flow event of the year with a duration of 4.75 hours, resulting in the largest accumulated flow event at the site with a total estimated volume of 69.89 AF or 73% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 95.73 AF. LWCCP flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 6 and Figures 23-25.

TABLE 6. LWCCP JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[9]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/13/2017	3:45 pm	2.75	< 1	46	5
7/17/2017	5:30 pm	4.75	2.52	612	70
7/22/2017	5:00 pm	3.50	1.00	131	12
8/12/2017	5:45 pm	4.25	< 1	92	8
		15.25 (total hours)	**2.52**	**612**	**95 (total AF)**

The LWCCP was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- (2) Pressure transducers replaced and the housings cleaned of debris and buildup
- Replaced (2) batteries
- Updated SRP Flowtography® equipment firmware

[9] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

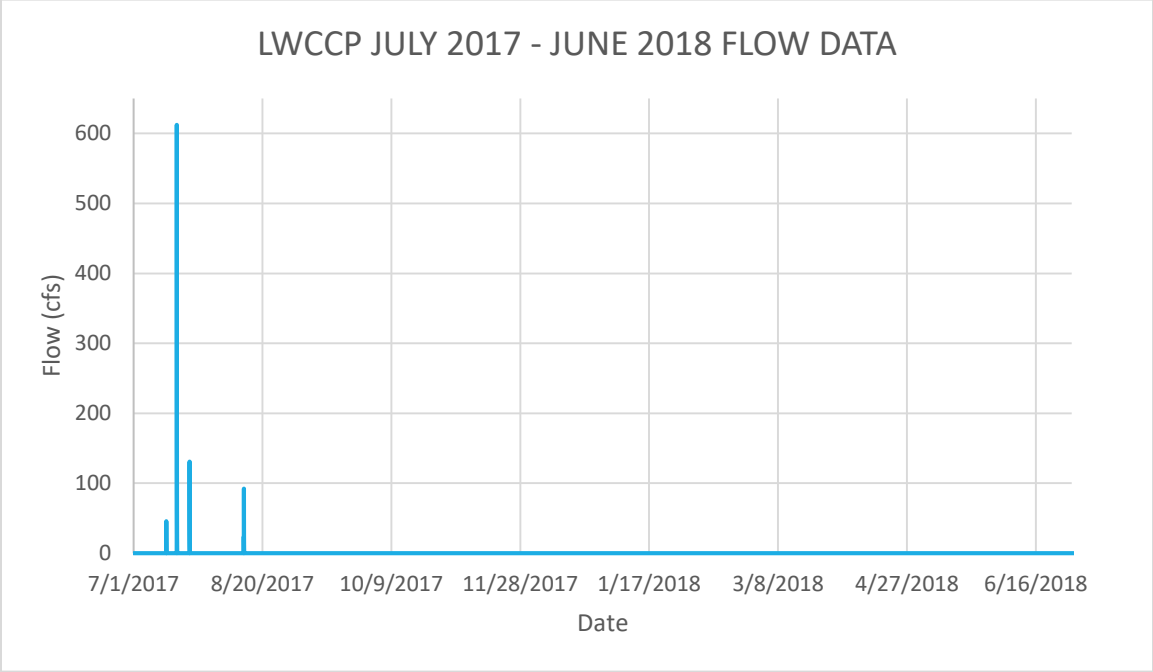


FIGURE 23. LWCCP JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

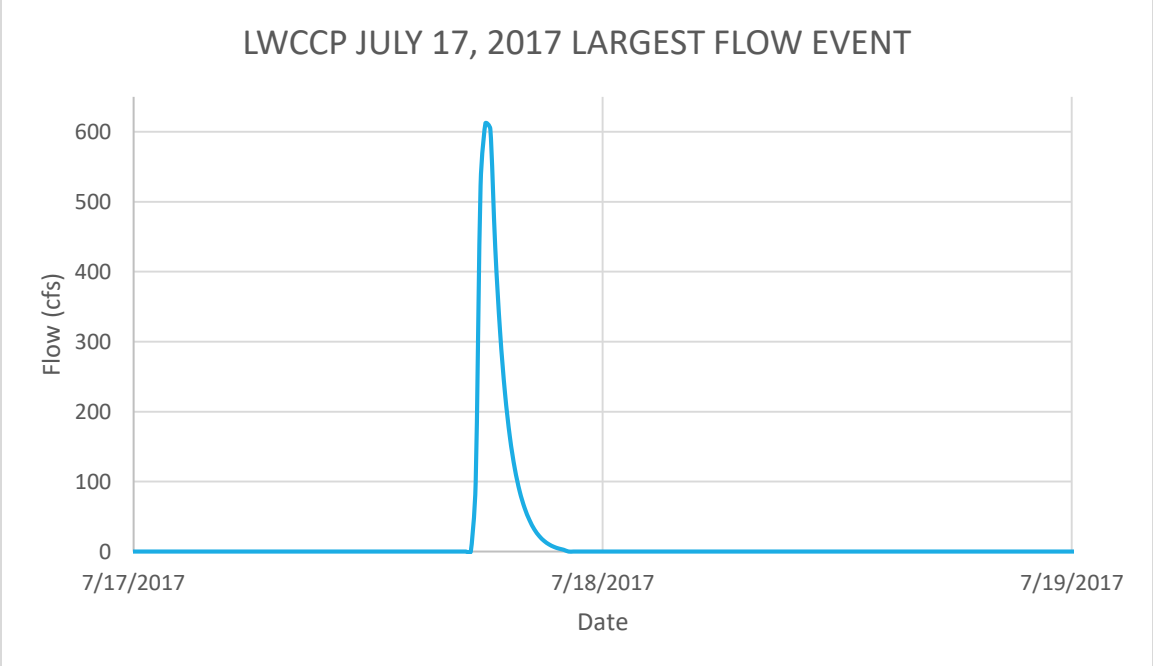


FIGURE 24. LWCCP JULY 17, 2017 FLOW EVENT

LWCCP at the start of the 2018 reporting period:

Greenup at the LWCCP site after monsoon events:

Before the flow event on 7/17/2017:

Peak of flow event on 7/17/2017:

LWCCP at the end of the 2018 reporting period:

FIGURE 25. LWCCP IMAGE DATA

WILLIAMSON VALLEY WASH AT XU RANCH (WVWXU)

Three (3) events with measurable ephemeral flow were recorded at WVWXU during the 2018 annual monitoring period. WVWXU responded to monsoon related precipitation events only. Peak discharge for the year was 35.20 cfs observed on 7/28/2017, which was also the longest lasting accumulated flow event of the year with a duration of 94.75 hours, resulting in the largest single flow event with a total estimated volume of 14.65 AF or 38% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 38.62 AF. WVWXU flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 7 and Figures 26-28.

TABLE 7. WVWXU JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[10]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/24/2017	11:30 am	29	< 1	no measureable flow resulted	no measureable flow resulted
7/28/2017	6:30 pm	94.75	1.00	35	15
8/3/2017	11:45 pm	64.25	< 1	15	10
8/13/2017	1:00 am	65.25	< 1	18	14
		235.25 (total hours)	**1.00**	**35**	**39 (total AF)**

The WVWXU was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- (2) Pressure transducers replaced and the housings cleaned of debris and buildup
- Replaced (2) batteries
- Updated SRP Flowtography® equipment firmware

[10] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

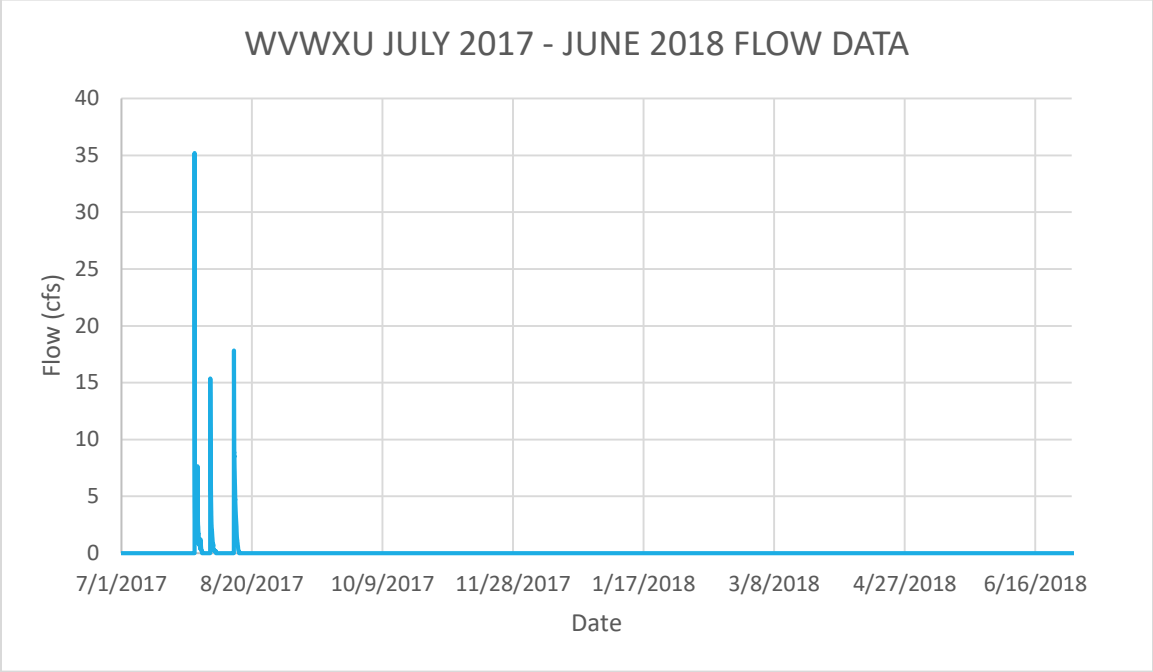


FIGURE 26. WVWXU JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

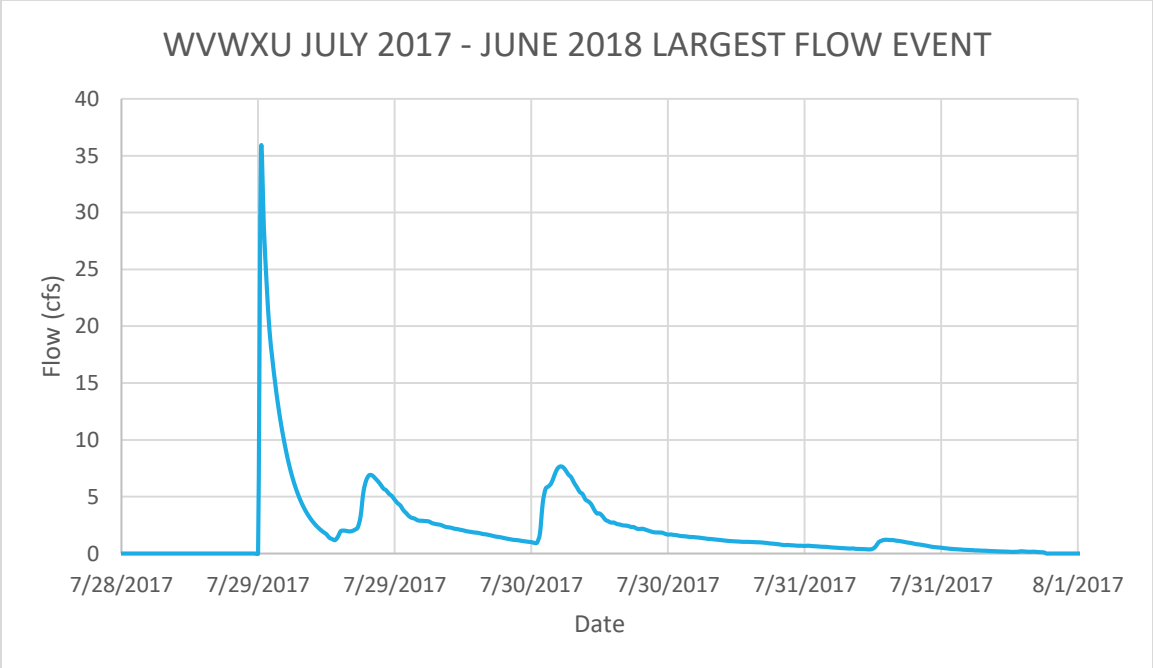


FIGURE 27. WVWXU JULY 208, 2017 FLOW EVENT

WVWXU at the start of the 2018 reporting period:

Greenup at the WVWXU site after monsoon events:

Start of flow event on 7/28/2017:

Flow event continued on 7/29/2017:

WVWXU at the end of the 2018 reporting period:

FIGURE 28. WVWXU IMAGE DATA

LOWER WILLIAMSON VALLEY WASH (LWVW)

Five (5) events with measurable ephemeral flow were recorded at LWVW during the 2018 annual monitoring period. LWVW responded to monsoon related precipitation events only. Peak discharge for the year was 1644.47 cfs observed on 7/17/2017, which was also the longest lasting accumulated flow event of the year with a duration of 22.75 hours, resulting in the largest single flow event with a total estimated volume of 229.36 AF or 49% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 472.54 AF. LWVW flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 8 and Figures 29-31.

TABLE 8. LWVW JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[11]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/17/2017	4:45 pm	22.75	2.43	1644	229
7/27/2017	4:30 pm	17	1.75	917	217
7/29/2017	7:45 pm	12.25	< 1	120	26
8/4/2017	1:15 pm	0.75	< 1	7	< 1
8/12/2017	6:00 pm	0.75	< 1	7	< 1
		53.5 (total hours)	**2.43**	**1644**	**473 (total AF)**

The LWVW was visited a total of five (5) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced the upstream event gage and transducer (due to damage from large flow event on 7/17/2017)
- Replaced (2) batteries
- Updated SRP Flowtography® equipment firmware

[11] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

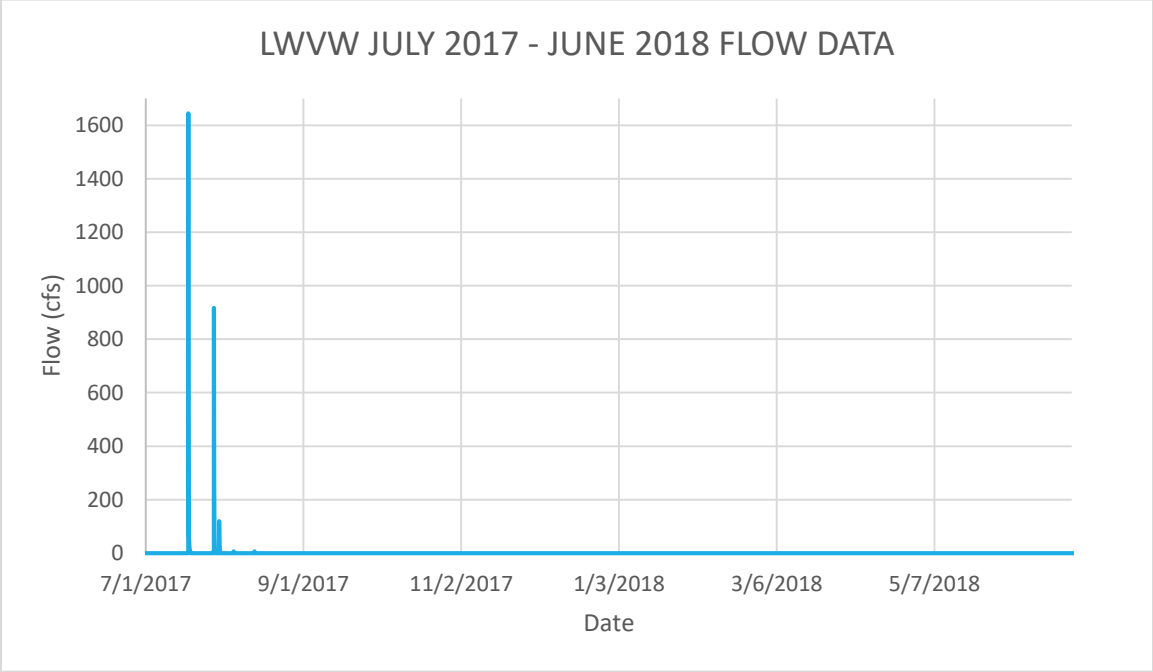


FIGURE 29. LWVW JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

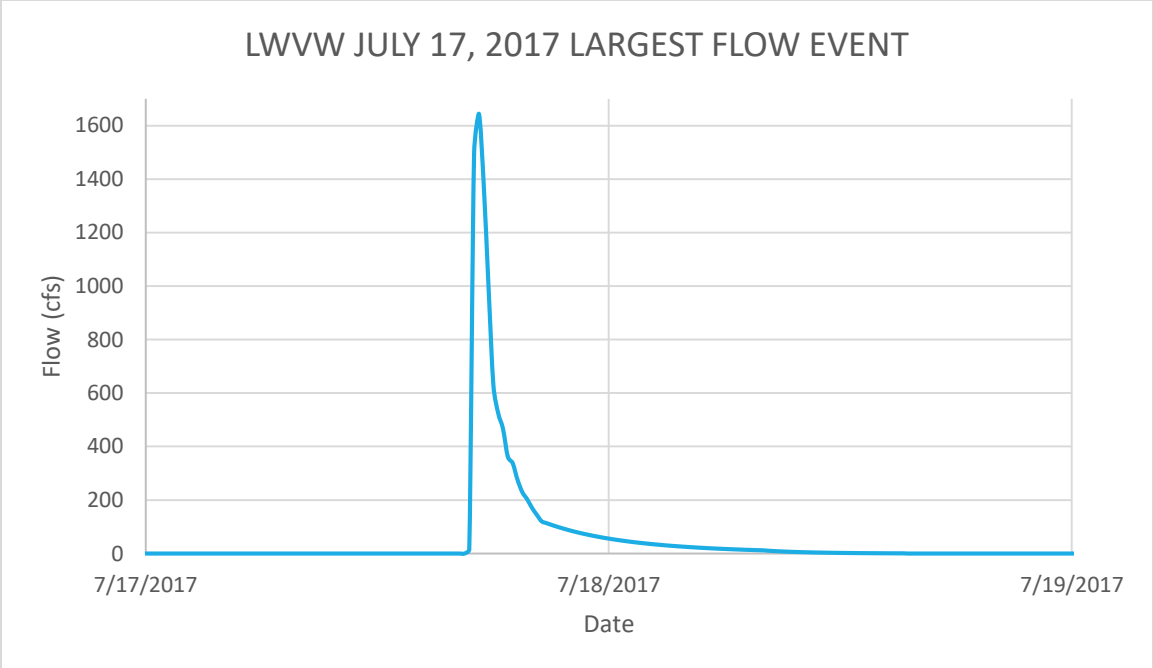


FIGURE 30. LWVW JULY 17, 2017 FLOW EVENT

LWVW at the start of the 2018 reporting period:

Greenup at the LWVW site after monsoon events:

Start of flow event on 7/17/2017:

Peak of flow event on 7/17/2017:

LWVW at the end of the 2018 reporting period:

FIGURE 31. LWVW IMAGE DATA

LOWER BIG CHINO WASH (LBCW)

Two (2) events with measurable ephemeral flow were recorded at LBCW during the 2018 annual monitoring period. LBCW responded only to monsoon related precipitation events only. Peak discharge for the year was 476.99 cfs observed on 7/17/2017, which was also the longest lasting accumulated flow event of the year with a duration of 12.5 hours, resulting in the largest single flow event with a total estimated volume of 83.72 AF or 95% of the annual volume at the site. The total estimated volume recorded at the site for the 2018 reporting period was 88.55 AF. LBCW flow events, durations, and total estimated volumes for the 2018 reporting period are outlined in Table 9 and Figures 32-35.

TABLE 9. LBCW JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[12]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/17/2017	5:15 pm	12.5	4.90	477	84
7/25/2017	5:15 pm	11.75	1.79	34	5
7/27/2017	11:00 pm	11.5	< 1	no measureable flow resulted	no measureable flow resulted
		35.75 (total hours)	**4.90**	**477**	**89 (total AF)**

The LBCW was visited a total of four (4) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced (2) batteries
- Installed whip style event gages and brackets on the upstream and downstream gages
- Updated SRP Flowtography® equipment firmware

It is important to note that LBCW is 2.5 miles southeast of LWVW, and aproximately 3.7 river miles downstream of the LWVW site due to a series of meandering bends. The channel behaved as it has in the past several years, where larger accumulated flows are observed at LWVW than LBCW. See Figure 32 below for an aerial image of the sites.

[12] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

FIGURE 32. AERIAL IMAGE OF WILLIAMSON VALLEY WASH CONFLUENCE WITH BIG CHINO WASH BETWEEN LWVW AND LBCW

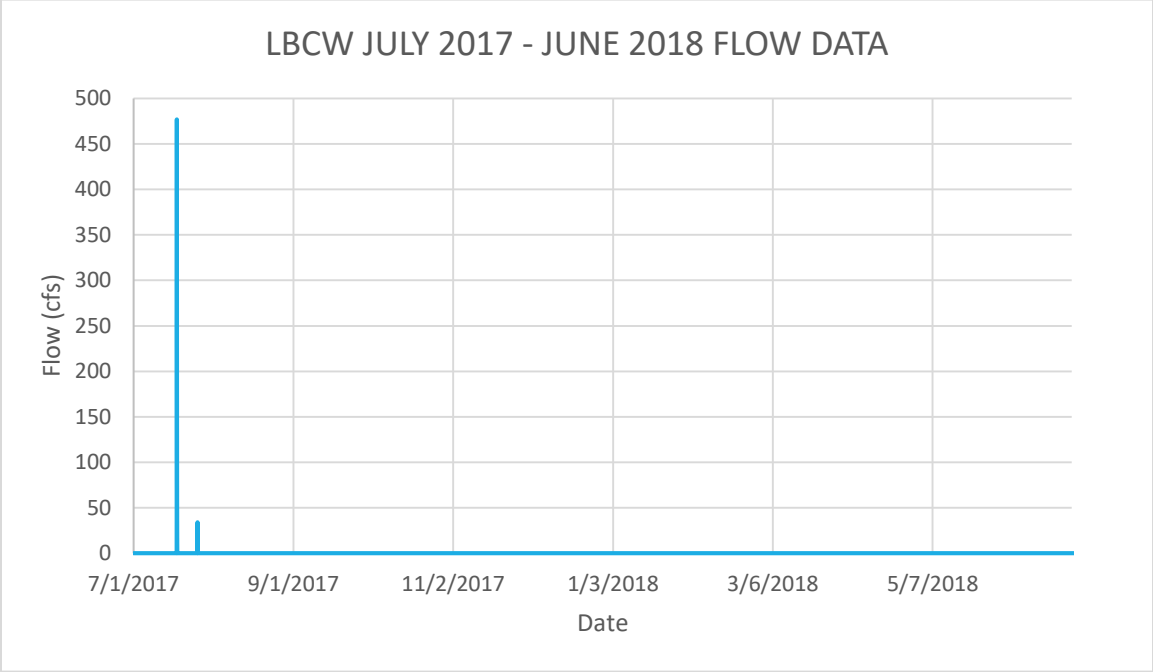


FIGURE 33. LBCW JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

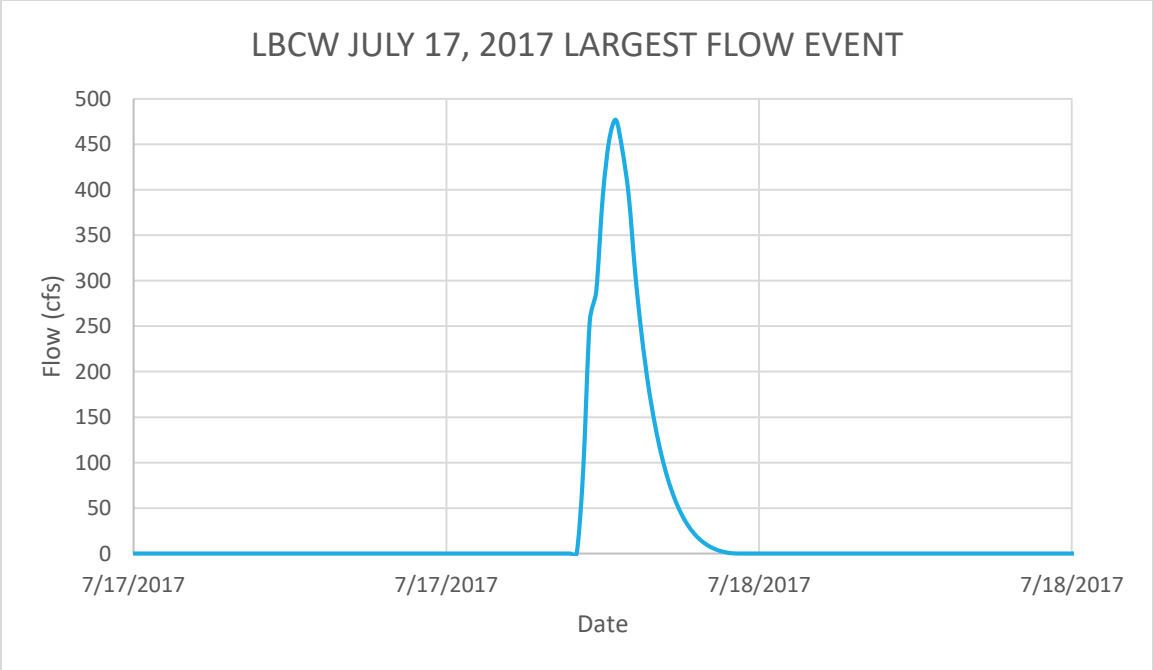


FIGURE 34. LBCW JULY 17, 2017 FLOW EVENT

LBCW at the start of the 2018 reporting period:

Greenup at the LBCW site after monsoon events:

Start of precipitation on 7/17/2017:

Peak of flow event on 7/17/2017:

LBCW at the end of the 2018 reporting period:

FIGURE 35. LBCW IMAGE DATA

SULLIVAN DAM (SD)

One (1) event was observed at SD during the 2018 annual monitoring period. SD responded only to monsoon related precipitation events. Standing surface was visible behind the dam starting on 8/6/2016 up to the start of the 2018 reporting period. Stage represents the water depth of water spilling over the SD structure crest. There is no stage to discharge relation for the site, therefore no flow data is assumed. SD events, durations, and peak stages for the 2018 reporting period are outlined in Table 10 and Figures 36-38.

TABLE 10. SD JULY 2017 – JUNE 2018 FLOW EVENTS

Start Date	Start Time[13]	Duration (hours)	Peak Stage (feet)	Peak Discharge (cfs)	Total Volume (AF)
7/17/2017	18:00	27.0	0.42	n/a	n/a
		27.0 (total hours)	**0.42**		

The SD was visited a total of six (6) times during the 2018 reporting period. In addition to routine maintenance and data collection, the following adjustments were made at the site:

- Replaced (2) batteries
- Trimmed the sunshade on the primary SRP Flowtography® camera
- Updated SRP Flowtography® equipment firmware

[13] Start times are approximate and actual start time are within ±15 minutes of the noted time. Events may also continue into the next day(s).

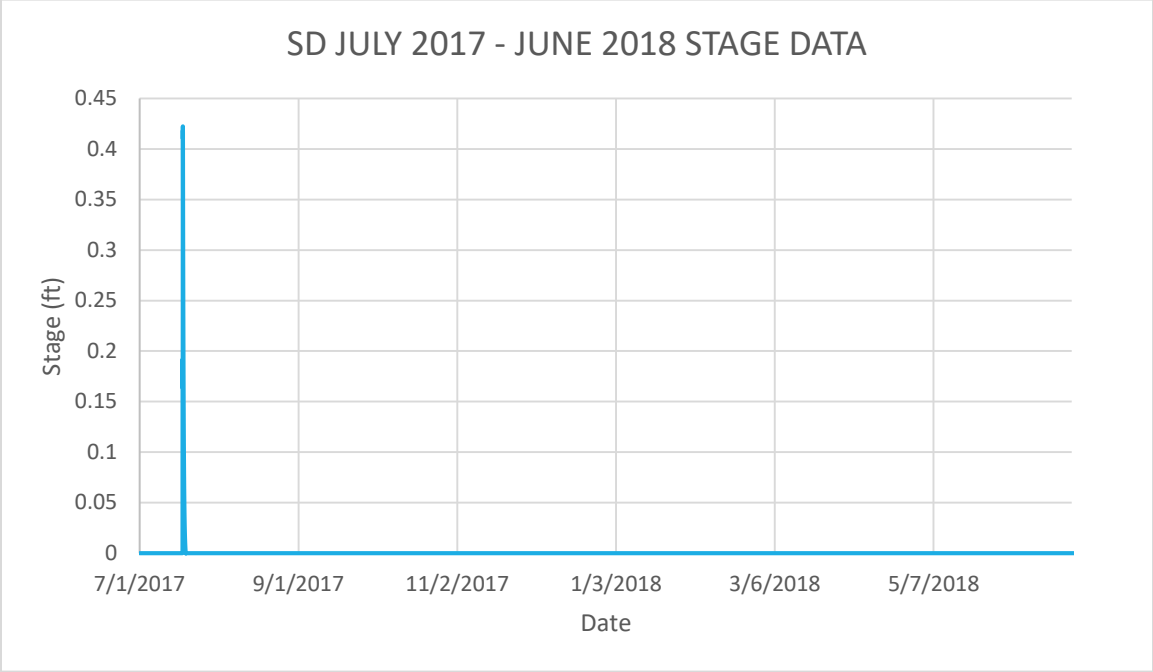


FIGURE 36. SD JULY 2017 – JUNE 2018 ANNUAL EVENTS

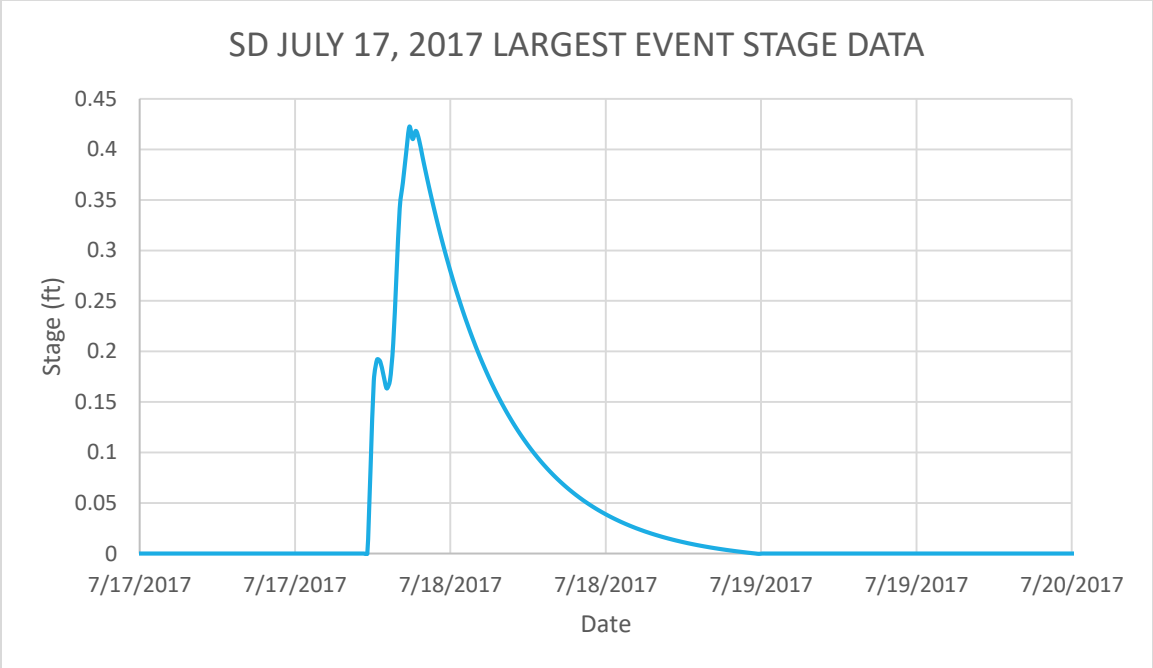


FIGURE 37. SD JULY 2017 – JUNE 2018 STAGE DATA

R

SD at the start of the 2018 reporting period:

Greenup at SD after monsoon events:

Start of flow event on 7/17/2017:

Continued flow event on 7/18/2017:

SD at the end of the 2018 reporting period:

FIGURE 38. SD IMAGE DATA

VERDE HEADWATERS AT CAMPBELL RANCH (VHCR)

The VHCR site experienced three (3) flow events during the 2018 annual monitoring period (for this site and report, a flow event was defined as exceeding a flow rate of over 20 cfs). No events exceeded the flume flow design limit of 100 cfs. The USGS stream gage, Verde River near Paulden, AZ, experienced flow events on the same days as the VHCR site (see Table 11 and Figures 39-42 below).

TABLE 11. VHCR AND VERDE RIVER NEAR PAULDEN, AZ USGS JULY 2017 – JUNE 2018 PEAK FLOW EVENT DATA

Date	VHCR	USGS Verde River near Paulden, AZ
7/18/2017	37.98 cfs	31.5 cfs
8/2/2017	55.76 cfs	38.6 cfs
8/12/2017	17.67 cfs	101 cfs
8/13/2017	20.78 cfs	77.8 cfs

The VHCR was visited a total of four (4) times during the 2018 reporting period. All site visits were for routine maintenance and data collection.

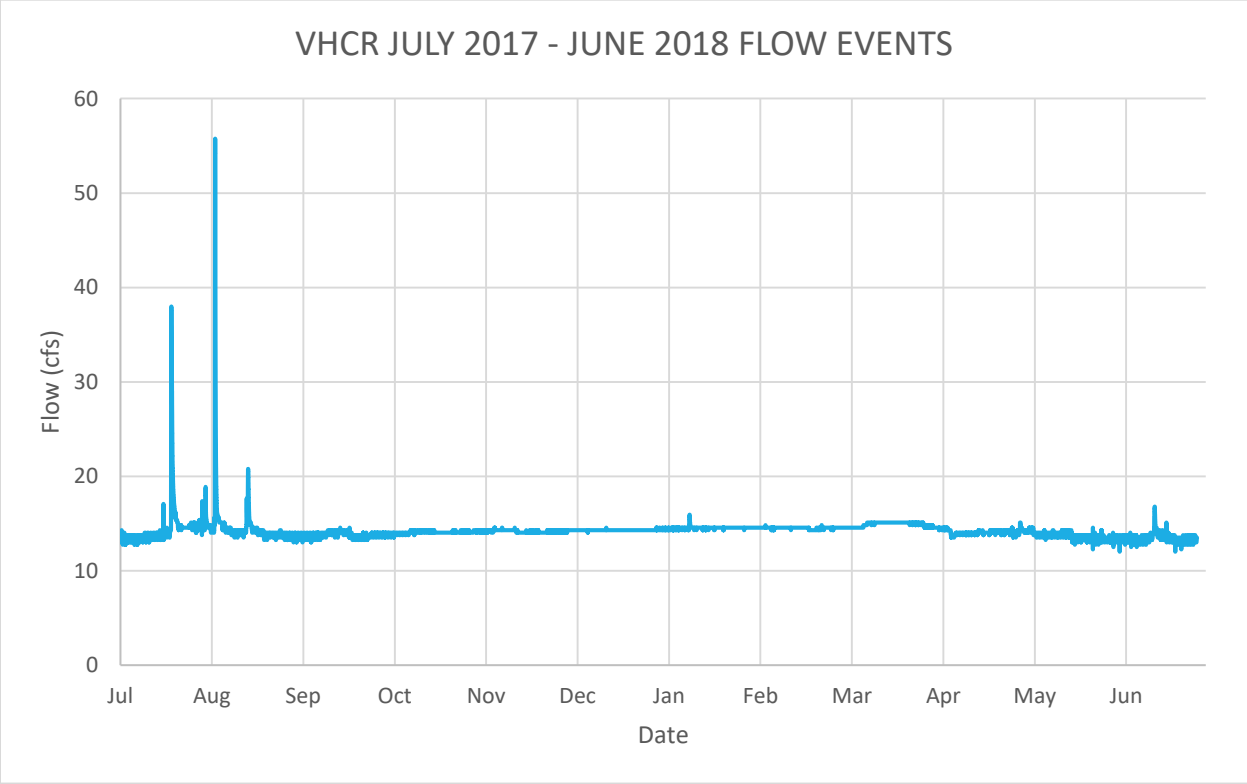


FIGURE 39. VHCR JULY 2017 – JUNE 2018 ANNUAL FLOW EVENTS

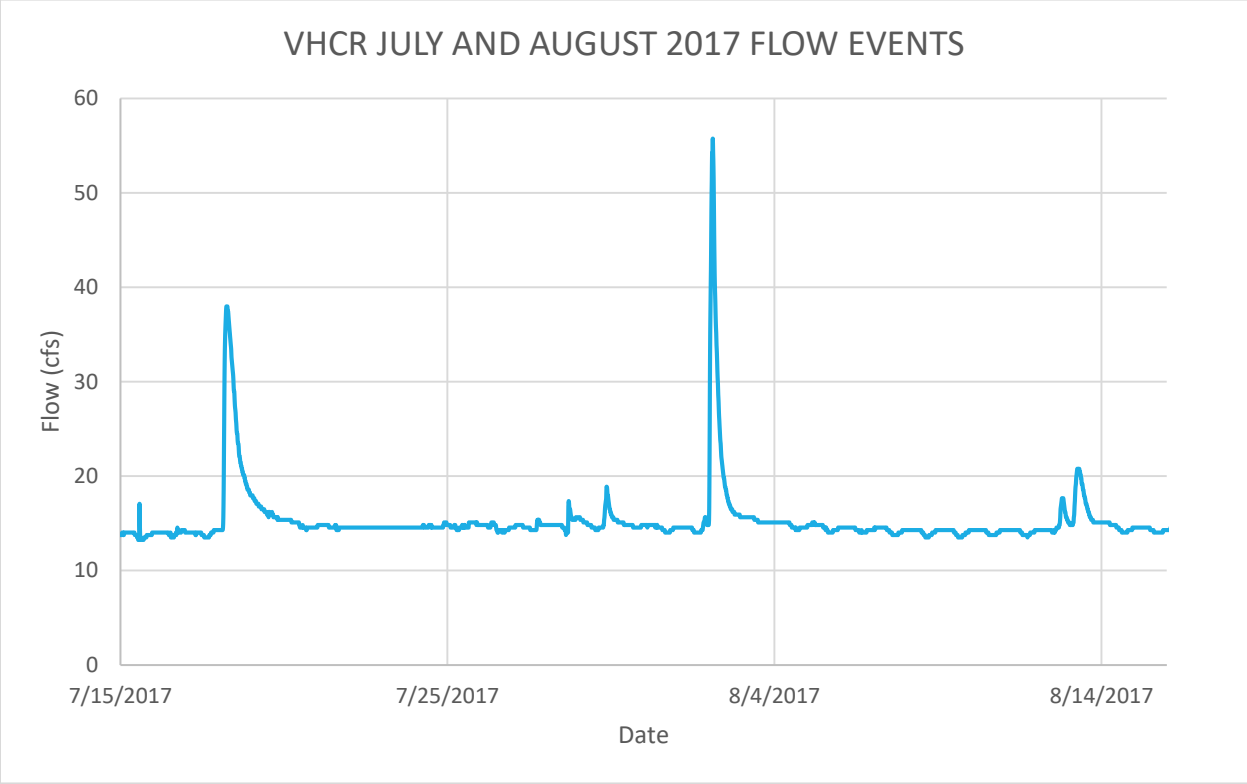


FIGURE 40. VHCR JULY AND AUGUST 2017 FLOW EVENTS

VHCR flow event on 8/2/2017:

FIGURE 41. VHCR SITE IMAGE

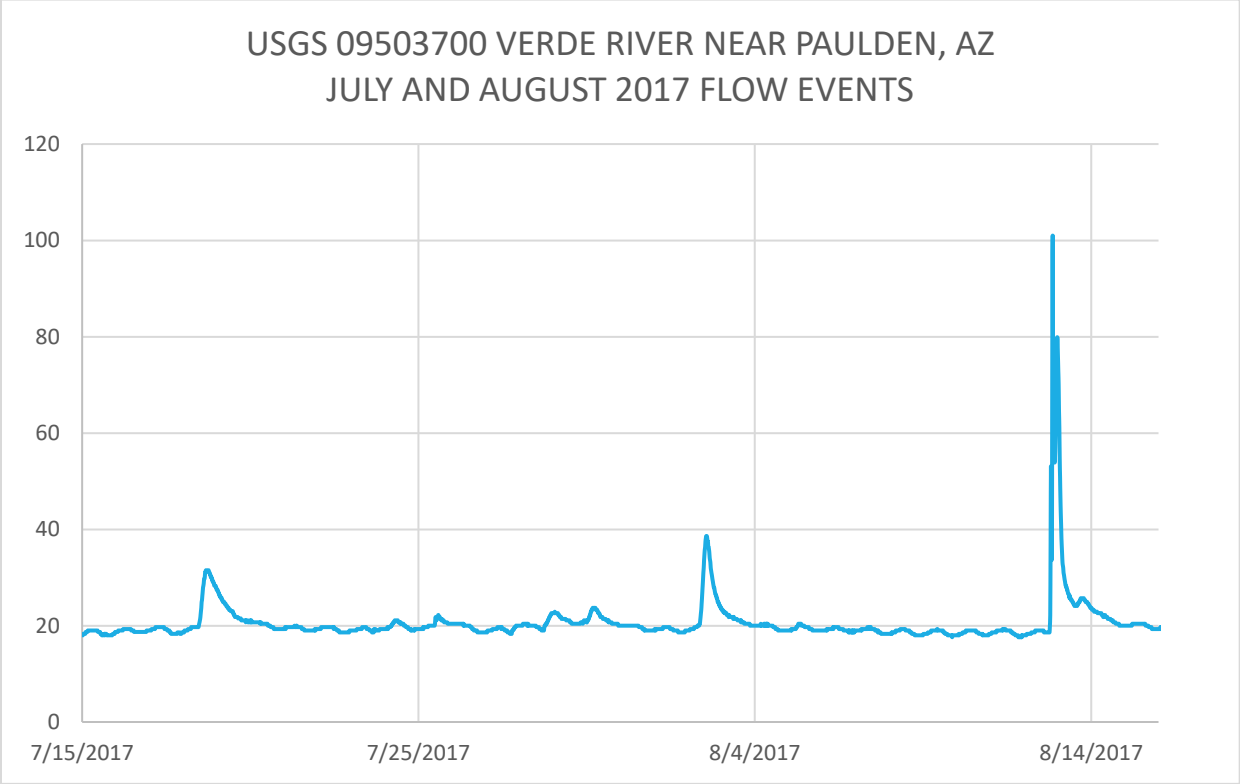


FIGURE 42. USGS VERDE RIVER NEAR PAULDEN, AZ JULY AND AUGUST 2017 FLOW EVENTS

GIPE WELL (GW)

The GW location records the distance from land to water (stage in feet below land surface). Between July 2017 through June 2018, the overall distance from land to water increased 1.02 feet (see figure 43 below).

The GW site was visited a total of four (4) times during the 2018 reporting period. All site visits were for routine maintenance and data collection.

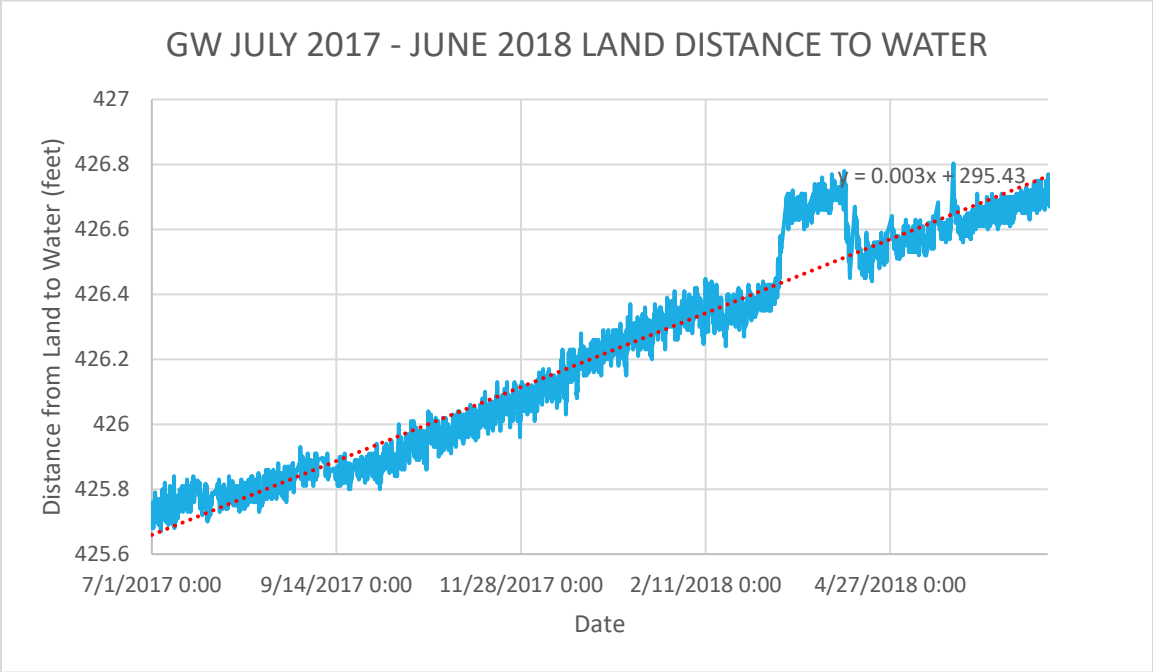


FIGURE 43. GW JULY 2017 – JUNE 2018 LAND DISTANCE TO WATER

FIGURE 44. GW SITE IMAGE FOR REFERENCE

SUMMARY

All sites within the Big Chino sub-basin experienced flow at various times during the annual 2018 reporting period, but only during the July through September 2017 monsoon season.

Over a third of AF produced was from the Williamson Valley Wash, accounting for an estimated 473 acre-feet (AF) or 38% of observed AF in the sub-basin. The site with the fewest observable flow events was Lower Big Chino Wash, with two (2) observed events for an estimated total of 89 AF.

The largest flow event for an estimated total of 229 AF occurred at Lower Williamson Valley Wash starting on July 17, 2017, and the smallest flow event at Upper Big Chino Wash starting on September 5, 2017 for a total of 0.02 AF.

Almost 12 inches of rain was recorded at the George Wood Canyon site during the 2018 annual reporting period, with approximately 77% of the precipitation occurring during the 2017 monsoon season. The remaining 23% of recorded precipitation resulted in no observable flow at any site within the sub-basin. All winter precipitation events resulted in less than 0.1 feet of observable snow accumulation, with the snow accumulation lasting no longer than one day. Winds generally come from the WNW, with higher speed winds tending from the NNE direction.

Water was stored behind Sullivan Dam at the beginning of the 2018 annual reporting period from 2017 winter precipitation and runoff events. Water behind the dam did not dry up completely until April 25, 2018 and remains dry for the rest of the reporting period. Although water pooled behind the dam for much of the reporting period, water only spilled over the dam for brief periods of time over twelve (12) days.

The Gipe Well distance from land to water increased approximately one (1) foot, with a constant downward trend of the water level.

SRP WM continues to maintain the sites and process pressure transducer and SRP Flowtography® images collected at the monitoring locations. While stage values are typically more accurate during flow events, discharge values are based on estimated ratings derived from cross sectional profiles and impacted by changes in the channel cross sections. Additional direct current meter measurements of discharge are needed to improve estimates of future discharge values. The data presented within this report are provisional in nature, and is reflective of the best available data at the time this report was written.

APPENDIX II

Summary of Existing Data Collection Equipment

Established Monitoring Efforts

Groundwater Level Monitoring

Monitoring Wells Previously Established Under CA#1

Name	Cadastral Location	Completion Date	Comments
WMW-1	B-20-04 19CBA	1956	Data collection by either ADWR or USGS
WMW-2	B-20-04 33CBD2	2006	Data collection by either ADWR or USGS
WMW-3	B-19-04 10CCB2	2006	Data collection by either ADWR or USGS
BMW-3	B-18-04 01ACA2	2007	Data collection by ADWR
BMW-1	B-18-04 11ACC	2003	Data collection by ADWR
BCMW-1	B-18-04 25AAA2	2006	Data collection by ADWR
Gipe Well	B-18-01 17AAA	2008	Installed by SRP with cooperative funding from the Drake Mine
PZ3	B-17-02S 04DBC3	1989	Data collection by either ADWR or USGS

Stream flow Monitoring

Stream flow Monitoring Sites Funded By/Established Under CA#1

Name	Completion Date	Comments
Verde Headwaters at Campbell Ranch	4/2005	
Williamson Valley Wash Near Paulden, AZ	1965-1985 2002-Current	USGS Gage 09502800
Big Chino Wash below Partridge Creek	6/26/2014	
Lower Big Chino Wash	5/21/2014	
Lower Walnut Creek at Charney Property	6/10/2014	
Lower Williamson Valley Wash	5/22/2014	
Pine Creek	5/19/2014	
Upper Big Chino Wash	1/16/2014	
Upper Walnut Creek at Forest Service	10/1/2014	Displaced and removed
Williamson Valley Wash at XU Ranch	6/12/2014	
Upper Walnut Creek at Bridge	6/26/2014	Camera only
Upper Walnut Creek at Bridge	6/05/2015	Yavapai County Flood Control District radar stage gage
Big Chino Wash at Prescott Ranch	8/26/2015	Camera only, basin conditions
Sullivan Dam	5/25/2016	stage gage/transducer installed 10/12/2017

Climate Monitoring

Publicly Accessible Repositories for Climate Data

Agency Name	Data Portal
YCFCD	http://weather.ycflood.com/
USGS	http://waterdata.usgs.gov/az/nwis/rt
NWS-HADS (Camp Wood – CPWA3, Ashfork – ASFA3)	http://www.nws.noaa.gov/oh/hads/
Historic Climatic Data	http://www.wrcc.dri.edu/summary/climsmaz.html

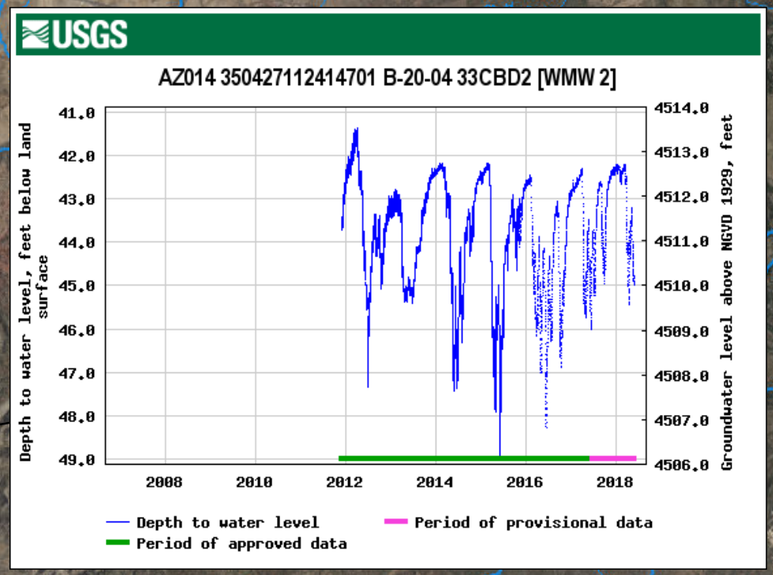
Existing Weather Stations in the Big Chino Sub-basin[1]

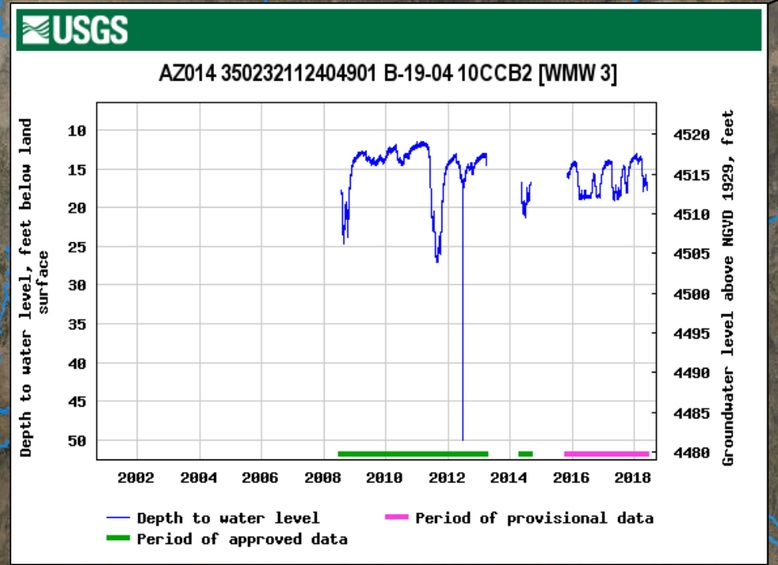
Station Name	Responsible Agency	Data Collected
Granite Basin	YCFCD	Precipitation
Walnut Creek	YCFCD	Precipitation/Stage
Big Chino Wash @ SR 89	YCFCD	Precipitation/Stage
CYFD @ Outer Loop Rd	YCFCD	Precipitation
Hyde Mountain	YCFCD	Precipitation
Williamson Valley FD	YCFCD	Precipitation
Seligman Airport	YCFCD	Precipitation/Weather
Ash Fork Draw @ I-40	YCFCD	Precipitation/Stage
Partridge Creek @ I-40	YCFCD	Precipitation/Stage
Crookton	YCFCD	Precipitation
Big Chino Water Ranch[1]	YCFCD	Precipitation/Weather
Williamson Valley Wash near Paulden, AZ	USGS	Precipitation/Stage/Flow
Verde River @ Perkinsville	USGS	Precipitation/Stage/Flow
Camp Wood nr Bagdad CPWA3	National Weather Service	Precipitation
Ashfork 12 NW ASFA3	National Weather Service	Precipitation

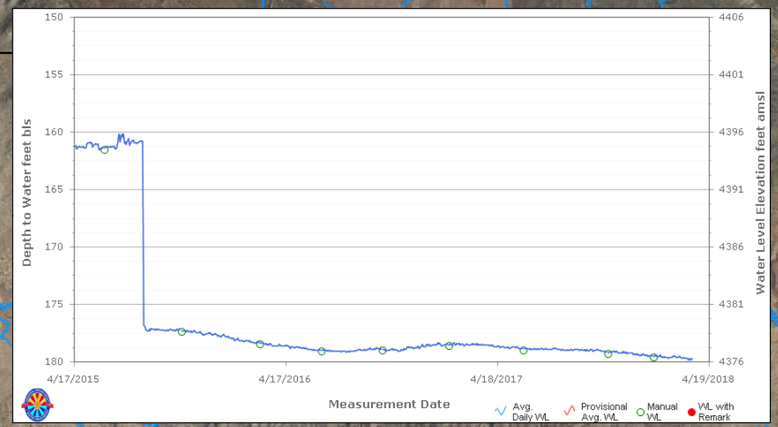
[1] Not all Weather Stations are included on Maps 7 and 7a.

APPENDIX III

Maps







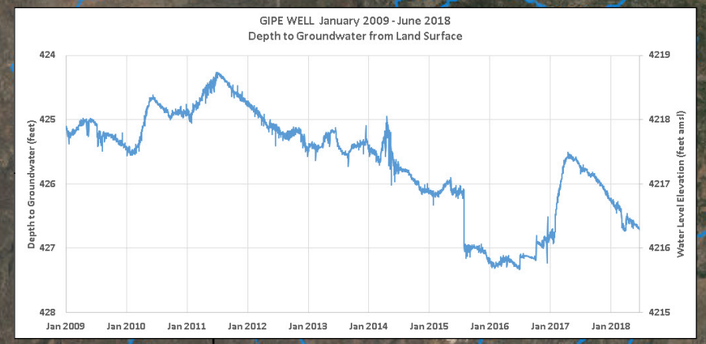
Existing Monitor Well

Map 1
Big Chino Water Ranch/Gipe Well
Northern Existing Monitor Wells

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIG_CHINO_MONWELL_18NORTH.mxd
9/27/2018



Johnson Creek
Pine Creek
Walnut Creek
Big Chino Wash
Williamson Valley Wash
Hitt Wash
WMW-3
BMW-3
BMW-1
BCMW-1
PZ3
MW-4D
Gipe Well
MW-4B2
MW-4B1
113°0'0"W
112°50'0"W
112°40'0"W
112°30'0"W
112°20'0"W
112°10'0"W
35°10'0"N
35°0'0"N
34°50'0"N
N
0
4
8
Miles
Aerial Date: 2013
SRP GIS

Existing Monitor Well
Gipe Well

Map 2
Big Chino Water Ranch/Gipe Well
Southern Existing Monitor Wells

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIG_CHINO_MONWELL_18SOUTH.mxd 9/27/2018

112°40'0"W 112°30'0"W 112°20'0"W

35°0'0"N

34°50'0"N

Pine Creek
Big Chino Wash
Walnut Creek
BMW-2
Johnson
MW-4g
Patton
SRP GIS
Area Detail
Johnson
Patton
MW-4g
Big Chino Wash
Hell Canyon
Rattlesnake Wash
Grindstone Wash
M C Canyon
Bear Canyon
MW-4b2
MW-4b1
Glidden
Verde River
MW-4b3
HR2
MW-4d
MW-4e
Verde River
Granite Creek
Hitt Wash
N
0 2 4 Miles
Aerial Date: 2013
SRP GIS

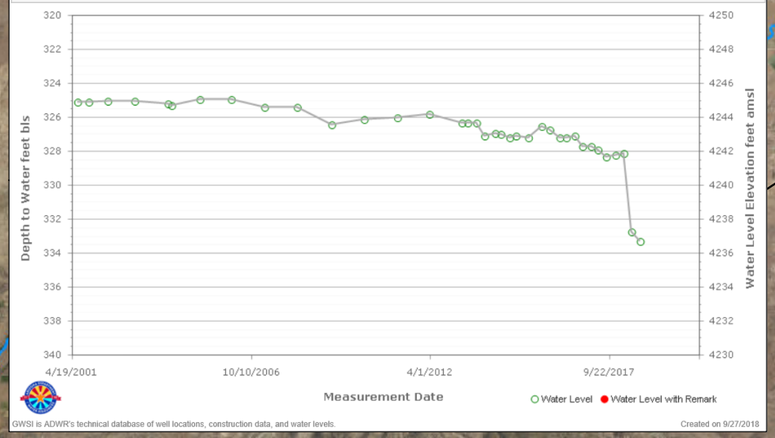
Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
B-18-03 26BDD	345500112324501	803378	34° 55' 2.0"	112° 32' 56.0"	4405	UNUSED	609	6	1/1/1953	2/4/1992	15.7	4389.3

GWSI is ADWR's technical database of well locations, construction data, and water levels. Created on 9/27/2018

Arizona GroundWater Monitoring Site Hydrograph

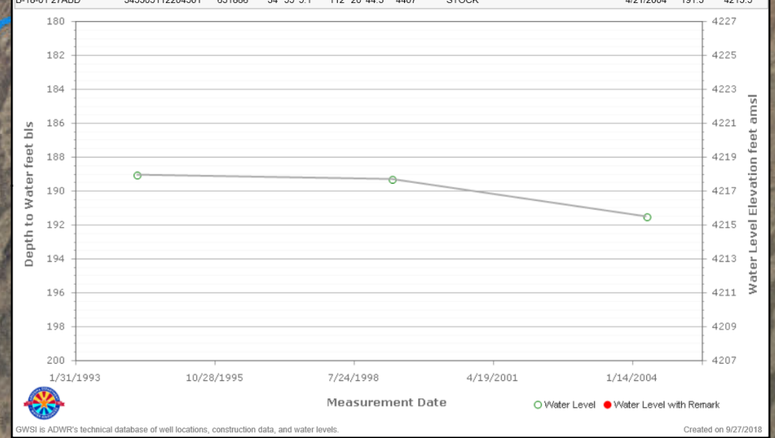
Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
B-17-02W02DCC1	345256112261901	527679	34° 52' 56.3"	112° 26' 19.5"	4570	UNUSED	500	10.75	7/13/1990	8/22/2018	333.3	4236.7



GWSI is ADWR's technical database of well locations, construction data, and water levels. Created on 9/27/2018

Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
B-18-01 27ABD	345505112204501	631886	34° 55' 5.1"	112° 20' 44.3"	4407	STOCK				4/21/2004	191.5	4215.5



GWSI is ADWR's technical database of well locations, construction data, and water levels. Created on 9/27/2018

Existing Well
New Well Drilled

Map 3
Big Chino Sub-basin Water Monitoring Project
Wells Added to Monitoring Network

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_POTENTIALMONWELL_18.mxd
9/27/2018

Surface Monitoring Location
USGS Gauge
Verde Headwaters
Creeks & Washes

Map 4
Big Chino Sub-basin - Surface Water Monitoring
(existing flowtography, camera only sites and Verde Headwaters)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

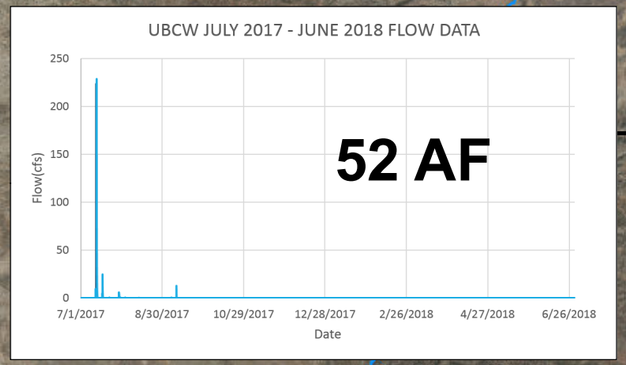
BIGCHINO_EPHEMERAL_18.mxd 9/27/2018

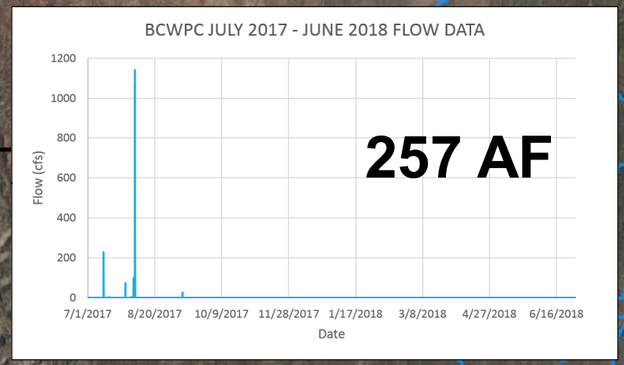
113°0'0"W 112°50'0"W 112°40'0"W 112°30'0"W 112°20'0"W

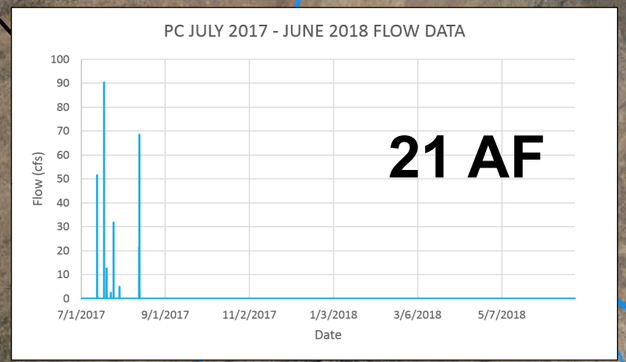
35°10'0"N

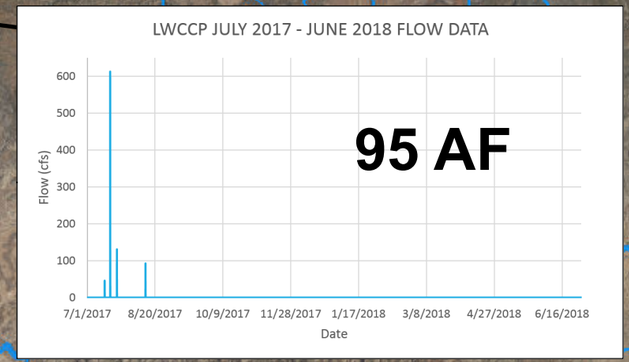
35°0'0"N

34°50'0"N









Upper Big Chino Wash

Big Chino Wash below Partridge Creek

Big Chino Wash at Big Chino Water Ranch

Big Chino Wash

Pine Creek

Pine Creek

Lower Walnut Creek at Charney Property

Walnut Creek

Upper Walnut Creek at Bridge

Upper Walnut Creek at Forest Service

Hitt Wash

Williamson Valley Wash at XU Ranch

Horse Wash

N

0 4 8 Miles

Aerial Date: 2013

SRP GIS

113°0'0"W 112°50'0"W 112°40'0"W 112°30'0"W 112°20'0"W

Creeks & Washes

Surface Water Monitoring Location

Verde Headwaters

Map 5
Big Chino Sub-basin - Surface Water Monitoring Northern Hydrographs

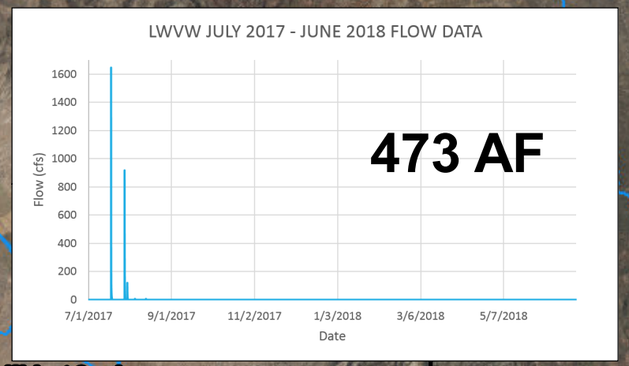
BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

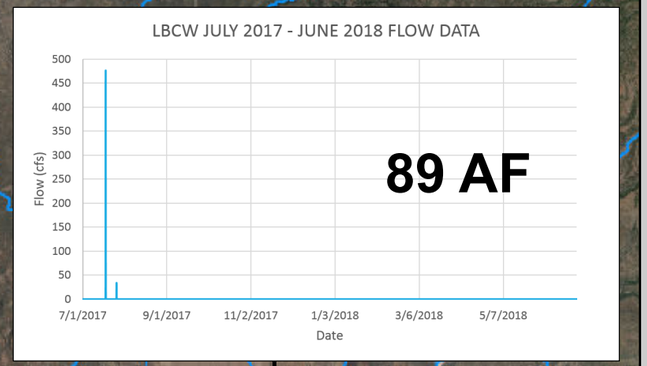
Map Courtesy of SRP®

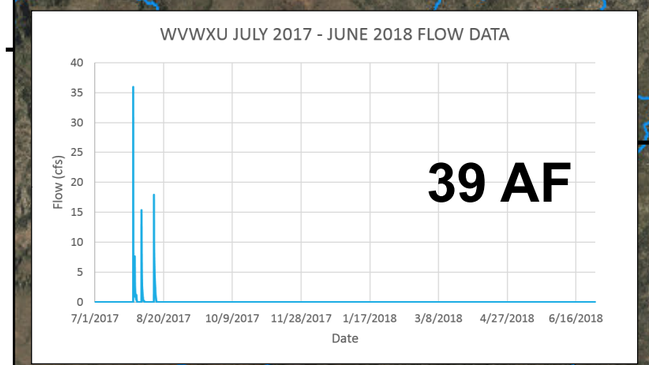
BIGCHINO_WMSITES_18NORTH.mxd
9/27/2018

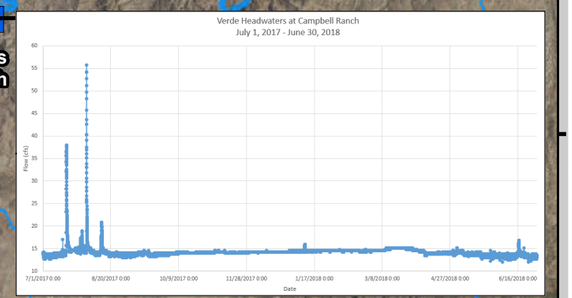
113°0'0"W
112°50'0"W
112°40'0"W
112°30'0"W
112°20'0"W
35°10'0"N
35°0'0"N
34°50'0"N

Upper Big Chino Wash
Big Chino Wash below Partridge Creek
Big Chino Wash at Big Chino Water Ranch
Pine Creek
Pine Creek
Lower Walnut Creek at Charney Property
Walnut Creek
Upper Walnut Creek at Bridge
Upper Walnut Creek at Forest Service
Big Chino Wash
Lower Williamson Valley Wash
Williamson Valley Wash
Lower Big Chino Wash
Sullivan Dam
Verde Headwaters at Campbell Ranch
Hitt Wash
Williamson Valley Wash at XU Ranch
Horse Wash









N
0
4
8
Miles
Aerial Date: 2013
SRP GIS

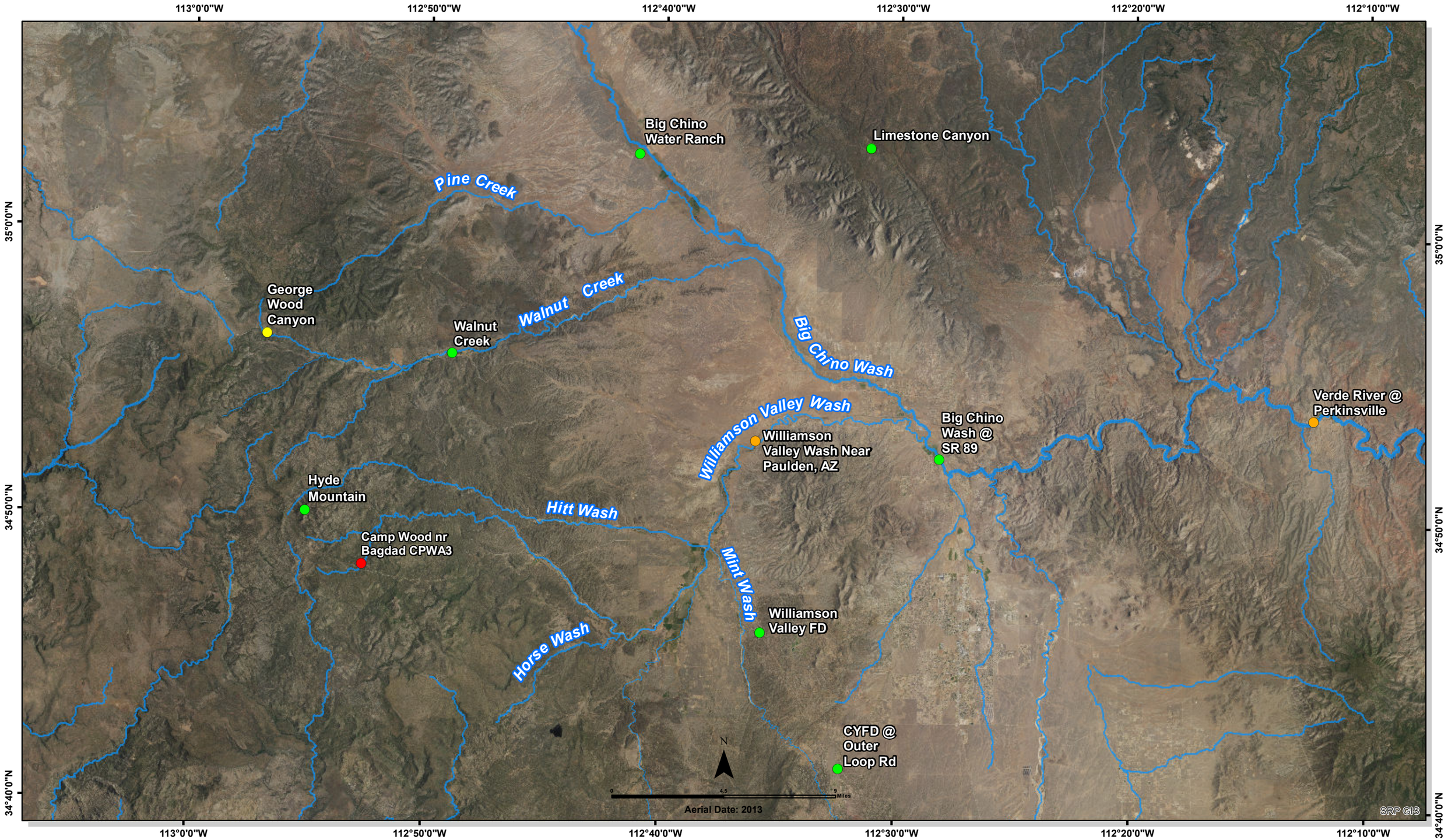
Creeks & Washes
Surface Water Monitoring Location
Verde Headwaters

Map 6
Big Chino Sub-basin - Surface Water Monitoring
Southern Hydrographs

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_WMSITES_18SOUTH.mxd
9/27/2018



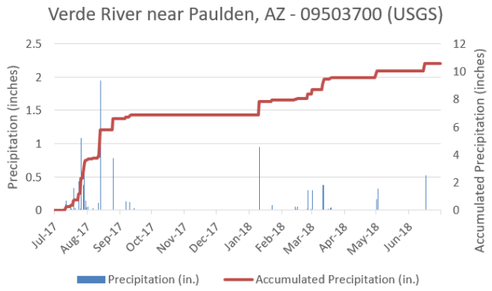
- Yavapai County Flood Control District Weather Station
- National Weather Service Hydrometeorological Automated Data System Station
- USGS Weather Station
- SRP Weather Station

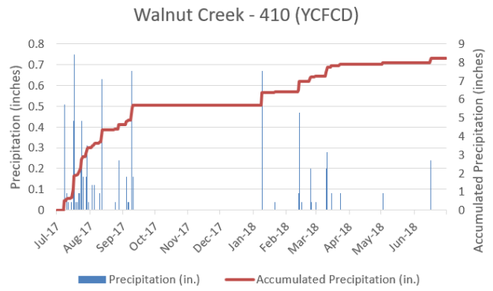
Map 7
Big Chino Area
Weather Stations

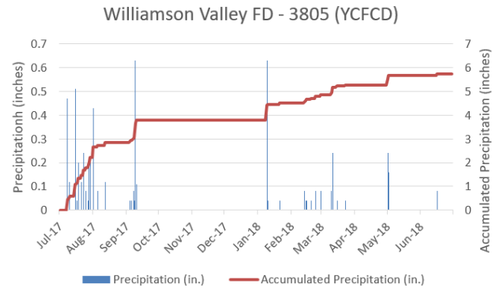
BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

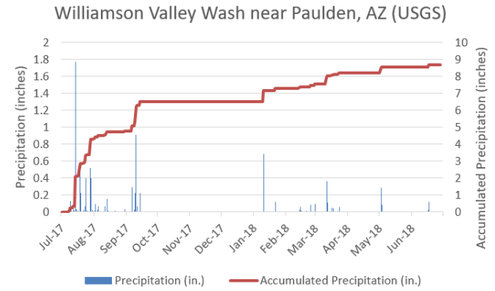
Map Courtesy of SRP®

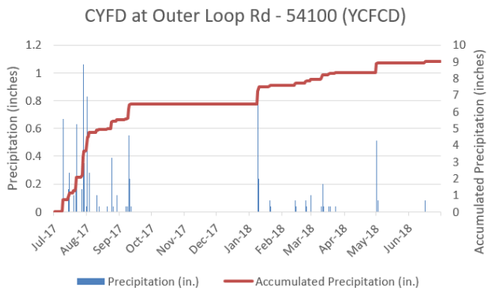
BIG_CHINO_WEATHER_STATIONS_18.mxd
9/27/2018

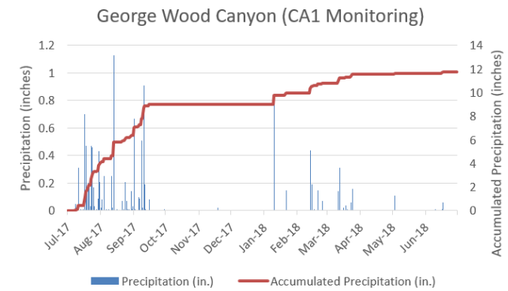


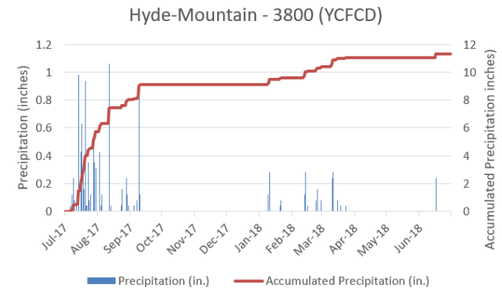


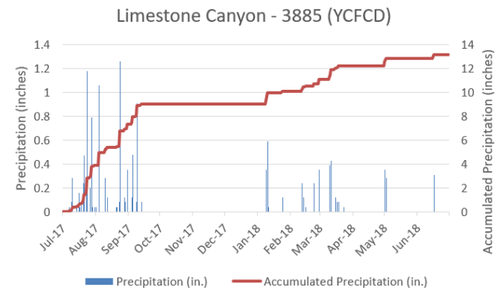


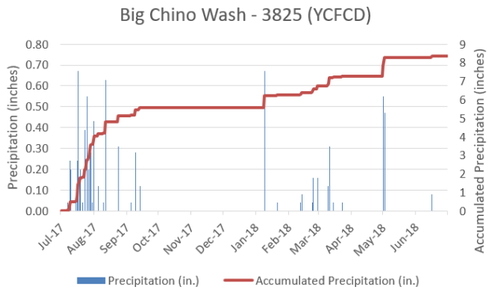


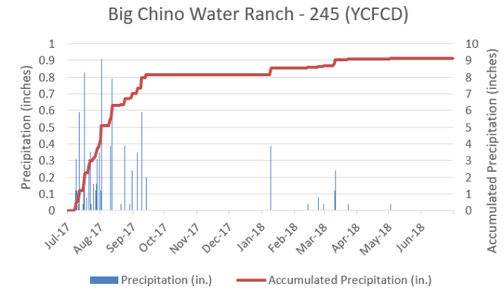


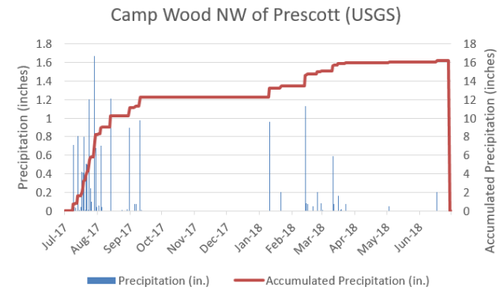


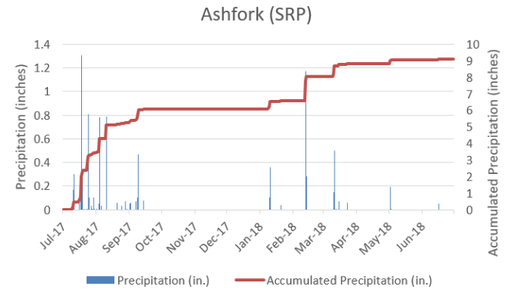










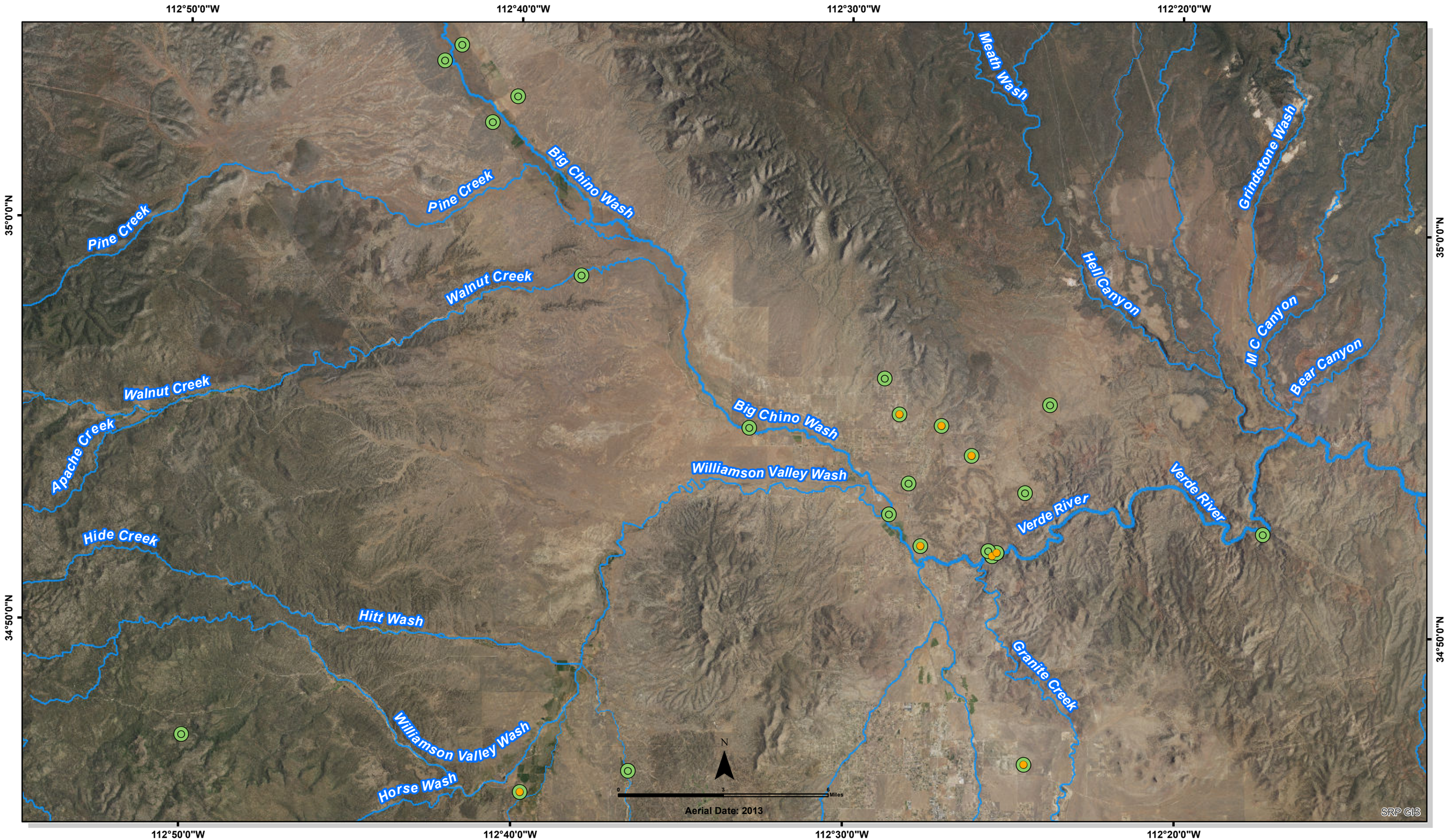


Map 7a
Big Chino Area
Weather Station Data

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIG_CHINO_WEATHER_DATA18.mxd 9/27/2018



Active Sample Sites

Samples Collected in FY18

Map 8
Big Chino Sub-basin Water Monitoring Project
Geochemical Data Collection – Active Sites

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_GEOCHEM_A_18.mxd 9/27/2018

113°0'0"W 112°50'0"W 112°40'0"W 112°30'0"W 112°20'0"W

35°0'0"N

34°50'0"N

Pine Creek

Walnut Creek

Big Chino Wash

Williamson Valley Wash

Hitt Wash

N

0 3 6 Miles

Aerial Date: 2013

SRP GIS

USGS Gravity Sites

- Active Data Collection
- Potential

Map 9
Big Chino Sub-basin Water Monitoring Project
USGS Gravity Sites

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_GRAVITY_18.mxd 9/27/2018

112°50'0"W 112°40'0"W 112°30'0"W 112°20'0"W

35°0'0"N

34°50'0"N

Pine Creek

Walnut Creek

Big Chino Wash

Williamson Valley Wash

Hitt Wash

N

0 3 6 Miles

Aerial Date: 2013

SRP GIS

USGS Gravity Sites

- FY15 Profiles - Field Work Completed
- FY16 Profiles - Field Work Completed
- FY17 Profiles - Field Work Completed

Geophysical Profiles

- Phase 1
- Phase 2
- Phase 3
- King Spring

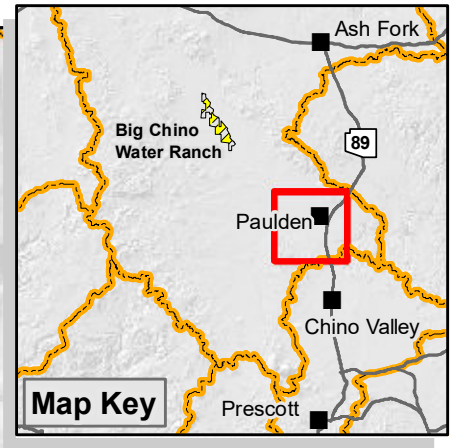
Map 10
Big Chino Sub-basin Water Monitoring Project
USGS Geophysical Profiles

BIG CHINO SUB-BASIN
WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_GEOPHYSICAL_18.mxd 9/27/2018

Map 11-1: Big Chino Crop Survey June 2017 at Paulden



112°30'0"W

34°50'0"N

Big Chino Wash

Williamson Valley Wash

89

Verde River

BIG CHINO

LITTLE CHINO

0 1 2 Miles

N

112°30'0"W

34°50'0"N

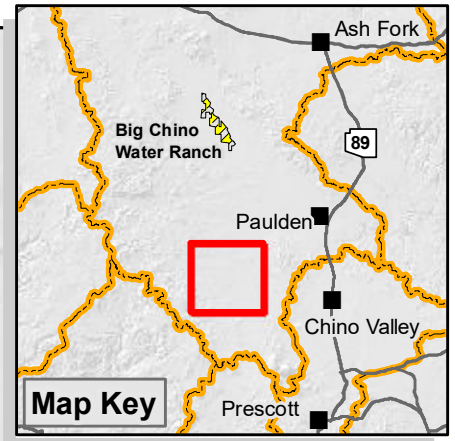
Alfalfa
Grass
Oats
Pasture
Sod
Vegetable
No Crop Evident (Abandoned/Fallow)
Groundwater Sub-basin (ADWR)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_CROPSURVEY_17.mxd 8/16/2018

Map 11-2: Big Chino Crop Survey June 2017 at Williamson Valley



112°40'0"W

34°50'0"N

Hitt Wash

Williamson Valley Wash

Mint Wash

Horse Wash

Strickland Wash

0 1 2 Miles

N

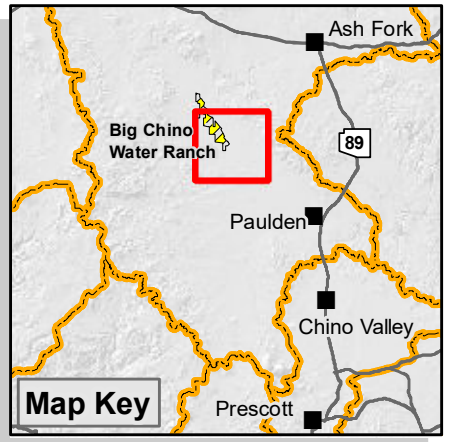
Alfalfa
Grass
Oats
Pasture
Sod
Vegetable
No Crop Evident (Abandoned/Fallow)
Groundwater Sub-basin (ADWR)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP

BIGCHINO_CROPSURVEY_17.mxd 8/16/2018

Map 11-3: Big Chino Crop Survey June 2017 at Upper Big Chino



112°40'0"W

35°0'0"N

Big Chino Wash

Pine Creek

Walnut Creek

0 1 2 Miles

N

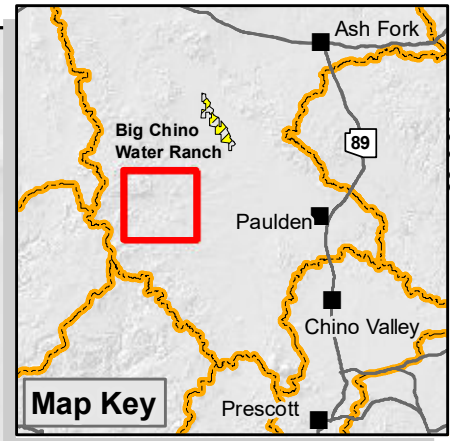
Alfalfa
Grass
Oats
Pasture
Sod
Vegetable
No Crop Evident (Abandoned/Fallow)
Groundwater Sub-basin (ADWR)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP®

BIGCHINO_CROPSURVEY_17.mxd 8/16/2018

Map 11-4: Big Chino Crop Survey June 2017 at Walnut Creek



112°50'0"W

35°0'0"N

Pine Creek

Walnut Creek

Apache Creek

Hide Creek

0 1 2 Miles

N

112°50'0"W

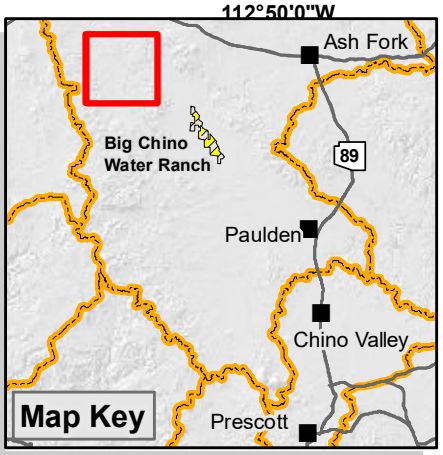
Alfalfa
Grass
Oats
Pasture
Sod
Vegetable
No Crop Evident (Abandoned/Fallow)
Groundwater Sub-basin (ADWR)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP

BIGCHINO_CROPSURVEY_17.mxd 8/16/2018

Map 11-5: Big Chino Crop Survey June 2017 at Turkey Canyon



112°50'0"W

35°10'0"N

Big Chino Wash

Turkey Canyon

Big Chino Wash

0 1 2 Miles

N

Alfalfa
Grass
Oats
Pasture
Sod
Vegetable
No Crop Evident (Abandoned/Fallow)
Groundwater Sub-basin (ADWR)

BIG CHINO SUB-BASIN WATER MONITORING PROJECT
PRESCOTT - PRESCOTT VALLEY - SRP

Map Courtesy of SRP

BIGCHINO_CROPSURVEY_17.mxd 8/16/2018